Does Competition among Schools Benefit Students? Evidence from Japan's School Zone Reform*

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Abstract

This study estimates the impact of school choice on student's academic performances by exploiting the reform of education system in Japan. Although Japanese public high schools have used to regulate school zones, this restriction was eliminated since 2003. To estimate the causal effects of the reform, we exploit the fact that the timing of this deregulation varies across prefectures. We found that the reform significantly increases university enrollment rates of students by approximately 1% on average. This positive effect has also been observed in competitive disadvantaged schools. The impact of the reform was primarily due to the competitive effect between schools.

Keywords: *school choice, school competition, reform of education system, staggered difference-in-difference estimation*

JEL code: H75, I21, I24, I28

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1 Introduction

Public education performance is an issue of great importance to society. However, achieving high-quality public education is not an easy task because of budget constraints and a shortage of capable and motivated teachers. There are various potential ways to improve the productivity of public education, such as providing incentives to teachers, reducing class size, and outsourcing management to the private sector, one of which is sometimes suggested as bringing competition into the educational arena by increasing school choices.

Supporters of school choice argue that freedom of choice has several advantages for students' academic performance (Friedman 1962; Hoxby, 2003). First, increasing the number of available school options improves allocation efficiency by allowing each student to attend a school that is better suited to their needs. Moreover, freedom of school choice promotes competition among schools for students, which is expected to improve school productivity through increased school investment and management effort. These benefits extend to students who do not exercise their choice, thus school choice is said to be a boon for all students ("*Tide that Lifts All Boats*"). Conversely, some are skeptical about school choice, fearing that school competition leads to stratification among schools, resulting in unequal educational opportunities for students. Whether school choice should be introduced into public education is a controversial issue, and there is no clear consensus on its impact on educational efficiency or the side effects of inequality.

The purpose of this study is to analyze the impact of school competition on students' academic performance by exploiting the educational reform of eliminating school zones in Japan. In Japan, the school zoning system (*Gakku-sei*) has long restricted public high schools, so that students can enroll in schools near their place of residence. However, this restriction was relaxed in 2002 with the amendment of the Law Concerning the Organization and Administration of Local Educational Administration (*Chiho Kyouiku Gyosei no Sosiki oyobi Unei ni kansuru Houritsu*), which allowed students to freely choose their high school, depending on the prefectural government's decision. Importantly, as the management of the school zone system in each prefecture was left to the discretion of the prefectural governments, whether and when school districts were eliminated in response to deregulation varied from prefecture to prefecture.

Figure 1 shows the year in which the school district system was eliminated in each prefecture in Japan, indicating a large and irregular variations among regions. By exploiting regional variations in the timing of deregulation, we estimate the causal effects of increased school competition on student performance. The analysis uses administrative data from the Basic School Survey of the Ministry of Education, Culture, Sports, Science and Technology (MEXT), which covers all schools in Japan.

[Figure 1 here]

Our main findings are as follows. First, we found that the elimination of school zones increases university enrollment rates by approximately 1% on average. Our analysis of the

dynamics of the effects of the reforms using the event study method revealed significant positive effects in cohorts that entered high school before the elimination of school zones. This suggests that the increased competition among schools owing to the elimination of school zones is an important factor in improving students' academic achievements.

Second, we did not find positive support for the argument that school choice reduces high school dropout rates by improving school-student mismatches. Our analysis did not show any long-term improvement in the dropout rate, although a decrease was observed in the years immediately following the reform.

Third, we found that school zone reforms increased university enrollment rates in public and private schools by approximate the same magnitude. Although private schools are not subject to school zone regulations, these results suggest that the expansion of public high school choices may have promoted competition not only between public schools but also between public and private schools.

Finally, free school choice did not increase the gap in academic performance between schools. Rather, the removal of the school zone increased university enrollment rates in schools with poor academic performance to the same extent as those with good performance.

Related Literature Numerous studies that examined the effect of school choice on students' academic performance by comparing students who attended different schools. Most of these studies found that attending preferred public schools has no significant effect on the test scores of students (Cullen et al., 2005, 2006, Deming, 2011, Deming et al., 2014), and enrolling in a so-called elite school has not been shown to have a significant effect on academic performance(e.g. Abdulkadiroğlu et al., 2014; Dobbie and Fryer Jr, 2013). [1] As for the effect of attending charter schools and private schools, the findings are mixed (e.g. Abdulkadiroğlu et al., 2011; Angrist et al., 2013), with some reporting significantly negative effects (Abdulkadiroğlu et al., 2018).

As our research interest lies in the effects of competition among schools owing to the expansion of school choices, we are more closely related to studies that analyze the effects of competition among schools. [2] Several empirical studies have tested the validity of the argument that competition among schools has desirable consequences for students' academic performance. Hoxby (2000) showed that greater educational choice, measured by the number of school districts in a city, results in higher student performance.[3] Card

[1] Beuermann and Jackson (2022) showed that attending a preferred school has no significant effect on short-term outcomes such as test scores, but does improve long-term outcomes such as years of education and income levels. Exploiting a public school choice lottery in Charlotte-Mecklenburg schools, Deming et al. (2014) also found that female students who went to the school of their choice significantly increased college enrollment, while there were no significant effects for male students.

[2] It should be noted that the impact of large-scale expansion of school choice is not limited to students who actually exercise their school choice but also have a spillover effect on students who remain in their original schools. Exploiting a large-scale two-stage experiment in which vouchers are randomly distributed to villages in India, Muralidharan and Sundararaman (2015) showed that the performance of students who went to private schools improves, but that of public school students who are left behind does not tend to deteriorate.

[3] However, Rothstein (2007) reported that Hoxby (2000)'s finding is not robust with respect to the

et al. (2010) also indicated that the competition between private and public schools in Ontario has a positive impact on student performance. Conversely, Gibbons et al. (2008) showed that freedom of choice and inter-school competition have no significant effect on student performance in primary education in England.

Studies have analyzed the impact of changes in the competitive environment among schools, owing to policy and institutional changes, such as large-scale voucher programs and deregulation of entry into charter schools. For instance, Hsieh and Urquiola (2006) found that the entry of private school through a national voucher program in Chile had no significant impact on students' academic achievement. In contrast, Sandström and Bergström (2005) showed that the competition between public schools and independent schools brought about by reforms in Sweden had a positive impact on performance of public school students. Figlio and Hart (2014) also showed that competitive pressure from private schools caused by Florida's voucher program had a positive impact on student test scores. Bagde et al. (2022) also showed that private school entry into public schools in rural India improves the performance of students who attend private schools but does not worsen the performance of students in public schools. Regarding the effect of an increase in charter schools in the U.S. on the academic achievement of traditional public school students, Gilraine et al. (2021) found a positive effect on local student performance, whereas Mumma (2022) found no significant effect. Gilraine et al. (2021) showed that the effect of charter school entry depends on the degree of horizontal differentiation from public schools, indicating that the entry of schools differentiated from public schools has little effect.

Our study differs from these studies as we analyzed the impact of increased school choice within existing public schools owing to the elimination of school zone regulations. In that sense, our study is closest to Lavy (2010, 2021) and Campos and Kearns (forthcoming), who analyze the impact of the free choice of public schools. Exploiting education policy reform in Tel Aviv, Lavy (2010, 2021) found that greater freedom of school choice significantly reduces the probability of dropout and has a positive impact on college credential attainment, matriculation exams scores, and long-term outcomes, such as college enrollment and income level in adulthood. Campos and Kearns (forthcoming) studied the Los Angeles Unified School District's (LAUSD) school choice program and found that expanding the number of schools available to students improved student achievement and college enrollment rates. They also found that this effect was largely owing to improved school efficiency through school competition, and that the effect was larger for lower-performing schools.

Finally, Akabayashi (2006) examined the effects of competition among schools owing to changes in the school zones, and found that school choice has a positive effect on the university enrollment rate. However, he used data prior to the elimination of school zones in 2002 and analyzed the effects of regional variation in the degree of school choice and

method of analysis.

time variation owing to system modifications in each region. [4]

The Japanese school zoning reforms analyzed in this study are national-level policies on a larger scale than Tel Aviv's school choice reforms. The advantage of using large-scale reforms implemented at the national level is that sufficient variation is available to test not only the average effect but also how the effect varies from school to school. Moreover, because there was almost no issue of segregation by race or religion when Japanese school zones were established, changes in school zones should not change the frequency of interactions between different groups, but simply capture changes in competition among schools. This is another advantage of using the changes in the Japanese school attendance zone.

The remainder of this paper is organized as follows. Section 2 discusses the possible hypotheses as to why the elimination of school zones affects school performance. Section 3 provides an overview of the Japanese education system and its evolution regarding high school attendance zones. Section 4 describes the sample data and explains identification strategies. Section 5 presents the main result. Section 6 discusses the mechanisms underlying the findings. Finally, Section 7 summarizes the study and concludes the paper.

2 How does the elimination of school zones can affect school performance?

In this section, we discuss the possible mechanisms by which the elimination of school zones can affect students' academic performance. Generally, it is argued that the expansion of school choice will affect school productivity primarily through two channels (e.g. Urquiola, 2016). [5] First, free school choice is expected to improve students academic performance by eliminating the school-student mismatches and changing the composition of students attending each school, affecting school productivity through changes in peer effects (*selection effect*). Having more classmates who are more capable or closer to one's abilities may have a positive impact on students; however not all schools will benefit from the reallocation of students through the elimination of school zones. As more able students are likely to attend better schools and less able students are likely to be left behind in worse schools, free school choices may result in the stratification of students' academic skills between schools. In such cases, the selection effect can negatively affect the performance of unpopular schools through negative peer effects.

Second, free school choice encourages schools to invest more effort in attracting students through increased competition (*competition effect*). As long as each school has

[4] Yoshida et al. (2009) analyzed the impact of a school choice program in the Adachi Ward, Tokyo. However, their study differs from ours in that they focused on junior high school students and analyzed locally implemented educational programs.

[5] Although most previous studies focused on competition between public and private schools, the same framework can also be applied to school zone reforms in our analysis, which are primarily concerned with school competition among public schools. Moreover, the reform of school zone regulations may also promote competition between public and private schools as it would undermine the advantages of private schools that were not subject to regulation.

an incentive to secure a certain size of student enrollment, faculty and staff will need to improve the content of the course, curriculum, and teaching methods and make the school more attractive to applicants when students are able to freely choose their school of choice. [6] Improved school efficiency through efforts to attract students to such schools can benefit all students, not just those who change the school they attend through school choice. However, it should be noted that school competition does not necessarily improve school efficiency. If competing schools are extremely attractive to students, the cost of retaining them may be excessively high. In such cases, competition among schools may reduce the incentives to improve productivity (McMillan, 2004). Additionally, if student-peer effects are more important to the productivity of the school than the effort of the school, free school choice may reduce room for improving productivity through school effort. In this case, school choice can reduce a school's incentive to increase productivity (Barseghyan et al., 2019).

Overall, whether competition among schools improves school productivity depends on the size and direction of the selection and competition effects, which depends on the situation in which each school is placed in competition. If the difference between schools is relatively small and competition encourages schools to make efforts without many schools dropping out, the efficiency of many schools is expected to improve. However, if competition leads to severe stratification among schools through student selection, the gap between schools may widen and the efficiency of lower-ranked schools may decline. As both predictions hold theoretically, they should be clarified empirically. [7]

3 Background

3.1 Educational Administration in Japan

In Japan, the central government, particularly the Ministry of Education, Culture, Sports, Science and Technology (MEXT), determines the general framework of education policy in a unified and centralized manner. There are no major differences in educational poli-

[6] However, it is somewhat questionable whether there is a strong incentive for teachers in public schools to improve their performance as public school teachers are employed by the municipality, not individual schools, they are unlikely to lose their jobs even if their schools are closed. However, even if financial incentives are not strong, there are several possible reasons why public school teachers may make an effort to attract more students. For instance, teachers in public schools may try to avoid dealing with fewer applicants and less-motivated students. Some teachers may simply want to avoid the stigma of the bad reputation of the school for which they work. For example, Rouse et al. (2013), in their study of accountability systems for schools, argues that pressure on schools can encourage teachers to put in more effort, even in the absence of financial incentives such as teacher job loss.

[7] In addition to the channels identified in previous studies, the elimination of school zones in Japan may also affect the academic outcomes of high schools through increased *competition among students* for admission. This is because Japanese high schools select students based on entrance examinations. If school choice makes admissions more competitive, it may have a positive effect on students' academic performance by making their studied more difficult for entrance exams. For instance, Bound et al. (2009) reported that students spend more time preparing for admission in response to the trend of American universities becoming more selective in recent years. However, if exam preparation can be viewed as signaling rather than the accumulation of human capital, increased competition for admission should not lead to an increase in students' academic performance (MacLeod and Urquiola, 2015).

cies or curricula among regions throughout the country, and disparities among schools are relatively small. To achieve "equal educational opportunity" and "maintenance and improvement of educational standards" nationwide, MEXT formulates the national standards for the curricula called Courses of Study (*Gakusyu sido yoryo*), which set minimum standards for the objectives and educational content of each subject, teacher licenses, classroom organization, and the number of teachers. The MEXT has significant financial authority and provides financial support to ensure that each school pursues national educational policy, as well as guidance, advice, and assistance for the implementation of proper education.

Although the central government plays an important role in Japan's education policy, local governments are also allowed some discretion in education policy because most of public schools are established by local governments (mainly prefectures). Particularly, the establishment and management of schools, the hiring, promotion, and transfer of teachers and staff; and the administration of entrance examinations are at the discretion of prefectural governments. The Board of Education (*kyouiku iinkai*) was established to execute these roles one in each prefecture and one in each municipality. [8] However, because school finances are under the jurisdiction of the local government, the ultimate authority for budget execution and the acquisition and disposal of educational property rests solely with the head of the local government. Therefore, measures that require large budgetary allocations, such as the assignment of schools or placement of additional teachers, or significant institutional changes, such as consolidation or elimination of school zones, is generally regulated by ordinances approved by the local assembly and governor.

3.2 Reform of school zone regulations

As high schools are not mandatory in Japan, even public schools require an examination for admission. Entrance examinations are typically based on tests in five subjects: Japanese, mathematics, English, social studies, and science. Generally, entrance exams for public high schools in the same prefecture are held on the same day; therefore students cannot take entrance exams for more than one public high school simultaneously. Japanese public high schools have long had regulations regarding commuting zones that only allow students to take exams at a high school that is somewhat close to the student's residence.[9]

However, private schools are not subject to school zone regulations and may enroll students even if they are located in a different school zone or prefecture other than their

[8] Generally, one board of education is established in each prefecture and municipality. It consists of five school board members and a secretariat. Boards of Education are not as politically or financially independent as school districts in the U.S., and appointments by the governor or mayors elect their leaders.

[9] Under the school zone system, a prefecture is generally divided into several school zones, and students can only apply to public high schools in the same zone as their residences. However, there were some exceptions such as vocational courses or special quotas to go to other areas that allowed students to attend public high schools far from their own address.

address. [10]

The concept of the school zone system was provided in the report of the U.S. Educational Mission to Japan submitted to the GHQ in 1946, immediately after the war, and was formally enacted in Article 54 of the Board of Education Law enacted in 1948. Specifically, it was stated that each prefecture must establish several school zones, and that the establishment of zones was under the authority of the prefectural boards of education. According to Ministry of Education, Culture, Sports, Science and Technology (1980) , the purpose of introducing school zoning regulations is was the standardization of school education and control of education by prefectures, as follows:

> *"the new system was intended to eliminate the differentials of the old system, to insure the standardization of upper secondary education, and insofar as possible to place the control of upper secondary schools in the hands of prefecture's authorities." (Ministry of Education, Culture, Sports, Science and Technology (1980),p.225)*

This rule was revised on June 2, 1956, into the Law Concerning Organization and Administration of Local Education Administration (*Chikyogyo ho*), and for a long time, the designation of school attendance zones had its legal basis in Article 50 of the law.

This school zone system survived for a long time and contributed to Japan's standardized education system. However, it had to be revised after the 1990s in response to the demand for the decentralization of government functions. Particularly, the following changes in social conditions led to a growing demand for the reform of the school-zoning system, which prevented free educational choices. First, the development of transportation has reduced the cost of attending schools outside traditional school zones. This makes attending schools located away from their places of residence a viable option for students. Second, restricting school attendance zones is regarded as an obstacle to equality of opportunity although it may reduce the widening gap between schools. Furthermore, with the rise of private schools, public schools have come under competitive pressure to improve their efficiency. School zone reform, which stimulated competition in public schools, was viewed as a way to improve the productivity of inefficient public schools.

In response to these discussions, in August 2001, Article 50 of the Law Concerning Organization and Administration of Local Education Administration (*Chikyogyo ho*) was deleted, and the revised law came into effect on January 11, 2002. Consequently, school attendance zones were eliminated in all prefectures. As a result, the decision to establish school zones was left to the discretion of each prefectural board of education. Since then, the liberalization of public high school selection has spread in earnest, with Tokyo and Wakayama prefectures pioneering the elimination of school zones from the high school

[10] As private high school entrance exams are often held on a different day than public high school entrance exams, and because private school exam dates often do not coincide with other private school exams, students may take both private and public school exams or multiple private school exams if they wish. Private schools generally charge higher tuition fees than public schools, but their diverse educational policies and content are attractive.

entrance selection process implemented in March 2003, and many prefectures eliminating school zones one after another.

3.3 Some case studies

There is little evidence of how the elimination of school zone regulations has changed students' and parents' school choices. However, some prefectures have published reports on the impact of the reforms on schools, parents, and students. Miyagi, Shiga, Osaka, and Oita prefectures have compared data on enrollment or applications before and after the elimination of the school zone. Here, we examine the various changes observed after the elimination of school zones in each of the four counties based on case reports for later discussion. [11]

The four prefectures have several important characteristics in common. For instance, the policy-making process in these prefectures consists of two steps. (1) the Board of Education consults an expert panel or other body in school zones; (2) the Board of Education drafts a specific amendment to the system, which is then discussed and passed by the assembly.

These prefectures also actively disclose information on their public schools. The elimination of school zone restrictions would allow students to apply to all public high schools in that prefecture, which would dramatically increase the amount of information junior high school students and their parents would need to make their high school choices. In response to this demand for information on schools, Boards of Education have generally made efforts to disclose information on public high schools in the prefecture, such as preparing high school catalogs. Each high school has also made efforts to attract applicants by holding school information sessions. For example, the Miyagi prefecture Board of Education and each high school actively provide information about high schools to junior high school students and their parents through guidebooks, websites, e-mail newsletters, and briefing sessions. The guidebook included information on each prefecture high school's traditions and culture, distinctive initiatives, curricula, club activities, post-graduate advancement and employment, commuting methods, and uniforms.

Importantly, information on the career paths of each school's graduates is of great interest to students and parents because there are no other appropriate indicators that reflect the academic performance of each school, and information on the university enrollment rate of graduates is almost always included in these guidebooks. [12]

There is some divergence among the four prefectures in terms of the extent to which school zone reform has increased the number of students attending schools that were outside their commuting zone before the reform and could not attend. The four prefectures also differ in the indicators used to measure changes in school choice; therefore

[11] We provide a more detailed description of the case studies in each prefecture in the Appendix.

[12] In Japan, the deviation score (*hensachi*), an indicator of the difficulty of each high school's entrance exam, is also widely used as a proxy for high school academic performance. However, these are indicators created by private preparatory schools and are rarely published in documents written by prefectural Boards of Education.

comparisons must be made with caution.

According to a report by Shiga Prefecture, in 2006, when the restrictions were lifted, 5.2% of students who went to a regular public high school went to schools that were previously inaccessible owing to school zone restrictions.[13] Miyagi Prefecture reported that the share of students going to public high schools within the same school zone as their graduating junior high school students decreased from 69.3% in 2009, before the reform, to 66.7% in 2010, after the reform. [14]

For Osaka and Oita, the share of students who went to high schools outside their school zones after the reform was not provided, but information on the areas of junior high schools for each public high school applicant graduate was available. In Osaka, 98.4% of applicants for regular courses in public high schools were students who graduated from junior high schools in the same school zone in 2013, before the elimination of school districts, but this percentage decreased to 93.4% and 92.3% in 2014 and 2015, after the elimination, respectively. Oita Prefecture reported that the share of applicants from outside the former school zone for regular courses in public high schools was approximately 1.5% for the two years before elimination (2.0% in 2006 and 1.3% in 2007), but it rose to 2.1% and 3.1%, respectively, in 2008 and 2009, when the school zone was eliminated.[15]

In summary, all four prefectures report that the elimination of school zone restrictions increased the number of students attending high schools that were outside their former school zones, but the magnitude of these increases is not very large and is usually only a few percent.

4 Data and Empirical Strategy

4.1 Data

We use school-level data from the School Basic Survey of the MEXT for the period from the school year 2003 to the school year 2019. The School Basic Survey is an administrative survey of all schools in Japan, and our available sample includes 84,007 observations over 17 years of data from 5,000-6,000 schools. Approximately 75% of the schools in the sample are public schools subject to school zone regulation. Most public schools were established and operated by local governments.

Data on whether and when the school zone system was reformed in each prefecture were collected from the prefecture's publications. When information from publications alone was insufficient, it was supplemented by contacting the prefectural office. We also

[13]Before the reform, Shiga Prefecture allowed students in some areas to attend schools outside the school zone as an adjusted commuting zone (*Chosei Tuugaku Kuikiuugaku Kuiki*); however the number of students who went to schools outside this previously possible school zone also increased from 12.1% to 15.1%.

[14]However, the remaining 30% of graduates included students who went on to private high schools, therefore it cannot necessarily be said that enrollment in public schools outside the school zone has risen.

[15]In both Osaka Prefecture and Oita Prefecture, some students were allowed to go outside their school zones by recommendation or other special means before the reform.

collected information not only when school zones were eliminated, but also when there were modifications to the school zone boundaries.[16]

We use the percentage of graduates who attend universities as a measure of each school's academic performance, As there is no uniform test taken by all high school students in Japan, we cannot use more direct academic indicators such as test scores in our analysis; however, given that Japan's university entrance examinations are primarily based on academic achievement tests, we believe that the university advancement rate is an appropriate proxy indicator of the academic performance of high school students.

Moreover, to consider whether school choice reduces student-school mismatch, we also use school dropout rates as an outcome measure of secondary interest. As the School Basic Survey does not ask about the number of dropouts directly, we estimate school-level dropout rates from changes in the number of students in the same generation one year later. [17] [18]

In Japan, the university enrollment rate has generally increased over the past 20 years, when school zones have been eliminated in many areas. Figure 2 depictsthe change in the mean and standard deviation of the university enrollment rate over the school years 2003-2019. This graph shows that the percentage of students who went to university increased from approximately 35% in 2003 to approximately 50% 15 years later. This feature is observed in public and private schools, and the scale of change is almost the same, but the university enrollment rates for private school graduates are consistently higher than those for public school graduates, by an average of approximately 10%. The graph also shows that the dispersion of university enrollment rates among schools expanded significantly during this period. However, trends in the dispersion of university enrollment rates differ between public and private schools. While the dispersion of the enrollment rate among public high schools increased significantly during this period, this trend was not observed in private high schools.[19]

[Figure 2 here]

Next, to determine whether there is any relationship between school zone reforms and increases in university enrollment rates, Figure 3 provides a comparison of the transition of university enrollment rates in schools in areas where school zones have been eliminated with those in areas where school zones have not yet been eliminated. School zone reforms were gradually implemented and spread throughout the prefectures from 2003 onward;

[16] See Table A.3 in Appendix for details.

[17] It should be noted that our estimated dropout rate is somewhat imprecise since the number of students in each grade may change for reasons other than dropout, such as transferring or staying in school. To mitigate the effects of these noises, dropout rates are assumed to be missing for schools for which dropout rates are difficult to estimate. See the Appendix for more details.

[18] In Appendix, we provide some descriptive statistics, including Table A.2 showing the average and standard deviation of each schools' characteristics as of 2003.

[19] Figure A.3 shows that the dropout rate has declined slightly over the past 15 years. The average estimated dropout rate was approximately 3.5% in 2003, but decreased to approximately 2.5% in 2019. The dropout rate was slightly higher for private schools, but there was little difference between the changes in dropout rates for public and private schools.

however, here we focused on the four school years in which many schools were affected: 2005, 2006, 2008, and 2014. We compare the university enrollment rates of schools in prefectures where school zones were eliminated each year with those in prefectures where school zones were not eliminated as of 2019. The graph shows an upward trend in university enrollment rates for all groups, and university enrollment rates in schools in areas with and without the reforms appeared to have generally remained parallel before the reforms were implemented. As for changes after the reforms were implemented, schools in areas where school districts were eliminated in 2005, 2006, and 2014 appeared to have a larger increase in university enrollment rates after school zone elimination than the comparison group, but this was not necessarily the case for the group eliminated in 2008.

[Figure 3 here]

4.2 Identification strategy

As discussed in Section 3, the elimination of restrictions on school zones was promoted at the national level, but the timing of implementation varied from prefecture to prefecture. Our identification strategy exploits this variation in policy implementation timing to estimate the causal effects of increased school competition.

We estimate the impact of the school zone reforms on students' performance using the following event-study model

$$Y_{ijt} = \alpha_i + \lambda_t + \sum_{s \neq -1} \beta_s \mathbb{1}\{t - T_j = s\} + \epsilon_{ijt} \tag{1}$$

where Y_{ijt} is the outcome of school i in prefecture j at school year t, T_j is the school year that prefecture j implements reform and eliminates school zone, α_i and λ_t are the school fixed effects and time fixed effects, and ϵ_{ijt} is an error term. The indicators $\mathbb{1}\{t - T_j = s\}$ mean years since reform and take one if the prefecture j eliminated school zones s years ago.[20] Standard errors are clustered at the prefecture level.

The coefficient of our main interest is β_s, which represents the cumulative impact of the reform on outcomes after $s \geq 0$ years of school zone elimination. The advantage of the event study formulation in Equation (1) is that it allows us to examine the dynamics of the effects of school zone reform, thereby gaining useful insights into the channel through which the elimination of school zones affects students' performances. Specifically, the effects on university enrollment rates up to two years after the elimination of school zones (i.e. β_0, β_1, and β_2) can be interpreted as reflecting the effect of increased school productivity owing to competition among schools (Figlio and Hart 2014). This is because graduates within two years of elimination do not freely choose their high school, so the estimates of these coefficients should not include selection effects.[21] Conversely, the effect on university enrollment rates after the third year of elimination (β_3 and beyond)

[20] For prefectures with school zones not eliminated before 2019, we set $T_j = \infty$. This means that $\mathbb{1}\{t - T_j = s\} = 0$ for any t and s for schools located in prefectures j.

[21] It is important to note that students who entered high school by free choice immediately after school

includes not only the competition effect but also the selection effects. Thus, comparing the coefficients in the event study model provides clues to understand the mechanism of the impact of the elimination of school zones.

To correctly identify the causal effect of school zone elimination using the Model (1), the parallel trends assumption that the potential outcomes of not eliminating school zones should run parallel for schools in all regions must hold. As the decision to the school zone reform is at the discretion of prefectural governments, the validity of this assumption becomes questionable if, for example, a prefecture that focuses more on high school education is more likely to implement school zone reform. However, as Figure 1 shows, there was no geographic regularity in the prefectures that have implemented school zone reform. In the Appendix, we provide the comparison of the areas with and without reformed school districts in terms of several important attributes such as the ratio of the young population to the number of schools per square mile, and find no significant differences. This result supports the validity of parallel trends. [22]

Recent studies highlighted that even if the parallel trend assumption holds, if there is heterogeneity in treatment effects, estimating the two-way fixed effects (TWFE) model as in Equation (1) simply by regression may lead to estimation problems such as negative weights and spurious identifications. [23] To avoid these problems, we use the estimators that are robust to the heterogeneity of treatment effects to estimate the coefficients in Equation (1). Several estimators that are robust to the heterogeneity of treatment effects have been proposed. Among these, we use the imputation method proposed by Borusyak et al. (2024), which has an efficiency advantage over others. [24]

5 Result

5.1 Main Result

University enrollment rates Panel (a) in Figure 4 provides the event study estimates of the impact of school zone elimination on the university enrollment rates of high school

zone reform took three years to graduate from high school. In addition, students already enrolled in high school at the time of the reform did not have free choice of schools, but may have benefited from the inter-school competition resulting from the elimination of school zones.

[22] The validity of this assumption is discussed in the Appendix in more detail. It also shows that there were notable changes in the timing of reforms with respect to income, education spending, or political factors related to local governments, which would make it difficult to identify the causal effects of school zone reforms.

[23] The problem is that a standard two-way fixed estimator (TWFE) is not always a convex combination of individual treatment effects when there is heterogeneity in treatment effects. This implies that it can be the case that the sign of the estimated coefficients does not coincide with the sign of the individual treatment effects, making interpretation of the TWFE estimates difficult. Moreover, heterogeneity in treatment effects creates contamination problems when estimating dynamic treatment effects in the event-study specification. An important consequence of this problem is that it is not reasonable to test the parallel trend using the coefficients of the pre-trend when there is heterogeneity in the treatment effects. (See Sun and Abraham, 2021)

[24] See the Appendix for the specific our estimation procedures. In the Appendix, we also show that there is no significant difference in the size of the estimated effect when using other estimators that are robust to heterogeneity of treatment effects.

graduates. There is no significant effect on university enrollment rates immediately after the reform, but the effect gradually increases as the years pass and the long-term impact on university enrollment is above 1%. Importantly, it is also significantly positive for graduates two years after elimination. This implies that school zone elimination increased the university enrollment rate for the generation that chose to enter high school during the period when school zoning restrictions remained in place, meaning that some of the effects of school zone elimination can not be explained by the selection effect.

Figure 4 also shows that there is no significant coefficient for the timing before the elimination of school zones. The lack of significant differences in the pre-trends between schools in areas where school zones were eliminated and schools in the control group that remained in school zones supports our identification strategy.

[Figure 4 here]

Next, we conducted the same analysis on a separate sample of public and private schools to examine how school competition affects students performance in private schools. The results are provided in panel (a) of Figure 5. The magnitude of the estimated dynamic effect is also similar for private and public schools, with both showing an increase in the university enrollment rate prior to three years after the elimination of school zones, which is somewhat surprising given that private schools are not subject to school zone regulations. These results suggest that the elimination of commuter zones has promoted overall competition among private and public schools in the prefecture.

[Figure 5 here]

Panel (a) of Figure A.7 in the Appendix shows that there is little gender difference in impact on the university enrollment rates. Reform of the school district system has increased college enrollment rates for both male and female students by approximately 1%, and the scale of the effect is almost identical.[25] [26]

Dropout rate Next, we examine the effect of eliminating school zones on dropout rates. Panel (b) of Figure 4 shows the estimated dynamic effects of removing school zone regulations on the dropout rates. The dropout rate decreased significantly in the two years immediately following the elimination of school districts. However, this effect seems temporary and there is no long-term effect of eliminating school zones on dropout rates. Thus, from this figure, it appears that school zone reform reduces the dropout rate of

[25] This finding contrasts with some previous studies that have found greater school choice benefits for female students (e.g. Deming et al., 2014).

[26] However, there is gender differences in the impact on career paths other than university, as shown in Figure A.13. While the reform of the school zone system has increased university enrollment rates regardless of the gender of students, it has decreased the percentage of male students who went on to work and the percentage of female students who went on to attend two-year junior colleges. Although it is impossible to make a definitive statement from these results, one simple interpretation is that the school zone reform may have led to more male students who had previously gone to work after high school and more female students who had gone to two-year junior colleges attending universities.

students immediately after the reform, but is not effective in reducing dropouts over the long term. [27]

Panel (b) of Figure 5 compares the impact of eliminating school zones on dropout rates between public and private schools. This shows that the short-term dropout rate decreased immediately after the reform was implemented in both public and private schools. However, for both groups, the effect of reduced dropout is temporary and not sustained in the long run. [28] Panel (d) of Figure A.7 shows a similar trend in dropout rates after eliminating school zones for both men and women, with a short-term decrease immediately after the elimination, but there is a slight gender difference in the magnitude of the effect. [29]

In contrast to the long-term improvement in university enrollment rates, there was only a temporary improvement in dropout rates immediately after the elimination of school zones. Therefore, the estimation results do not provide support for the argument that eliminating school zones improves dropout rates.

Robustness of our main results In the Appendix, we confirm the robustness of our main results that eliminating school zones significantly increases the university enrollment rates of high school graduates.

First, Figure A.8 shows that the magnitude of the estimated impact on the university enrollment rate does not change much even if we use Callaway and Sant'Anna (2021)'s estimator, which is another estimator that is robust to the heterogeneity of treatment effects. Therefore., our main results do not depend on the estimation method. [30]

Second, if each prefecture's choice of school zone reform was driven by changes in the demographic, economic, and political environment, then the observed post-reform increase in university enrollment rates may not necessarily be a causal effect of the reform, but may be owing to changes in these factors Contrary to this concern, Figure A.9 shows the controlling for time-varying factors in prefectures did not change our estimates in any important way.

Third, there may have been concerns that the control group is inappropriate. This is because the control group consists of schools in prefectures where school zones have not been eliminated, but some prefectures have modified their school-zone systems, although they have not eliminated them. To address this concern, we conducted an analysis that excluded schools in prefectures that were in the control group and whose school districts were modified in some way during the analysis period. Figure A.10 shows that the

[27] It should be noted that unlike the university enrollment rate, which is a result of graduates, the dropout rate is a result of current students. Therefore the impact immediately after the deregulation (less than three years after the following year) includes the impact on students enrolled through free school choice. Regarding the effect on the dropout rate, it is difficult to distinguish between selection and school competition effects.

[28] For private schools, the dropout rate appears to be rather increasing in the long run.

[29] Female students were more likely than male students to experience a decrease in dropout rates immediately after school zone elimination, although the effect was only short-term for females.

[30] However, the short-term improvement in the dropout rates shown in panel (b) of Figure 4 is not robust to the estimation method.

estimation results do not differ significantly using the restricted sample.

5.2 Does free choice widen achievement gaps between schools?

Our main finding is that on average, the elimination of school zones increases the university enrollment rate of high schools by approximately 1%. This finding supports the argument that free school choice through the school zone reform improves students' academic performance. However, because our estimates are only the average of the treatment effects on schools affected by deregulation, the treatment effects may vary widely from school to school. In particular, as skeptics of school choice are concerned, even if it improves students' academic performance on average, it may cause stratification and polarization among schools. If free school choice concentrates om the best students in good schools and the worst students in bad schools, then the choice will make it increasingly academically advantageous for students to attend schools with good reputations because of the effect of better peers. Conversely, the performance of students attending schools with poor reputations is likely to be worsened by free school choice, as better peer students are less likely to attend schools with poor reputations when they have the freedom to choose their schools.

To test the validity of this concern, we examine whether eliminating school zones had different effects on schools with good and poor performance. For this purpose, we divided the schools in our analysis into two groups: those whose graduate university enrollment rate as of 2003, before the elimination of school zones, was above the median (high-quality schools, HQS) and those whose graduate university enrollment rate was below the median among the prefectures (low-quality schools, LQS). We then we compare the treatment effects of eliminating the school zone in each group.

Figure 6 shows the results of an analysis in which the sample is divided according to university enrollment as of 2003. We show that the impact of the elimination of school zones does not change significantly depending on the academic performance of schools before elimination. An increase in university enrollment after the reform of school zone regulations are observed not only in high-quality schools but also in schools that originally had low academic performance. While the estimated effect for low-quality schools is less precise and not necessarily significant, there is no substantial difference in the magnitude of the effect between the two groups.

[Figure 6 here]

The finding that school choice also improves the academic performance of students who attend schools with poor reputations suggests that, at least for Japanese public high schools, the concern that school choice will lead to serious polarization is not that worrisome.[31] Rather, this result seems more consistent with the argument that school

[31] In the Appendix, we check the robustness of the estimation result (See Figure A.11.) In addition, we examine how the dispersion of university enrollment rates in schools within prefectures changes after the elimination of school zones. Figure A.12 shows that deregulation does not increase the dispersion of

choice can be viewed as a "tide that lifts all boats."

6 Discussion

The key findings of the analysis thus far are that (i) Free school choice increases the university enrollment rate of high school students. (ii) However, no long-term effects of free choice on student dropout rates is found. (iii) Positive effects on university enrollment rate are observed equally in the lower-performing schools.

Next, we discuss the potential mechanisms underlying these findings. Although our data are insufficient to elucidate the mechanisms by which deregulation affects outcomes, we aim to gain deeper insights into our findings by discussing whether some of the possible hypotheses are consistent with available evidence.

Competition effect As discussed in Section 3, one of the aims of school zone deregulation was to improve student achievement through competition among schools resulting from increased school choice. Importantly, the effect of increased school productivity owing to inter-school competition can benefit all students, not just those who exercise their school choice.

Our findings suggest that this competition effect at work can be considered the most important factor in the positive effects of school zone reform because of the significant positive impact on university enrollment rates for graduates less than three years after deregulation who chose high school within their school zones. Given that the change in university enrollment rates immediately after the elimination of school districts to two years after the elimination of school districts cannot be explained by selection effects, we believe that the school competition effect can explain a substantial portion of the estimated effect of eliminating school zones. Furthermore, school zone reform had a positive impact on the university enrollment rates of private school graduates, suggesting that the expansion of public school choices stimulated competition between public and private schools.

Although the available data do not allow us to examine the extent to which competitive pressures among schools have affected educational inputs, and curriculum, it should be emphasized that the university enrollment rate is an important indicator that many Japanese students and parents pay attention to when choosing a high school. Moreover, anecdotal evidence from the report of the Board of Education of Shiga Prefecture suggests that students and parents have a stronger interest in the published academic performance of high school graduates as a result of the freedom to choose their schools.[32] Thus, it seems natural to consider that the elimination of school zones has given schools and

university enrollment rates among schools in prefecture. Therefore, the prefecture-level analysis does not provide evidence of widening inequality among schools owing to increased school choice.

[32] While academically advanced students should be concerned not simply with the university enrollment rate, but also with how many of their graduates went on to prestigious universities among them, it seems safe to assume that the university enrollment rate indicator is important to the average students.

teachers more incentive to improve the publicly observed academic indicators of university enrollment. [33]

Selection effect We argue that the elimination of school zones may have improved students' academic performance primarily through competition among schools. Simultaneously, we believe that the elimination of school zones through changes in the composition of students in each high school (*selection effect*) may have played a limited role in improving student achievement for the following reasons.

First, as already discussed, there was a significant improvement in the university enrollment rate in the second year after eliminating the school zone. As it takes three years for students to graduate from high school, if there is a selection effect for students enrolled in the first year of school zone elimination, university enrollment rates should be shown three years after the elimination. However, there is no significant difference between the estimates of the effects two and three years after the reform, nor is the difference statistically significant. This result implies that selection effects are unlikely to be a major factor in the eliminating school zones.

Second, anecdotal evidence from the reports of the boards of education indicates that the share of students attending schools that could not be attended by regulation after the reform was not that large. If the pattern of students' school choice does not change significantly because of the reform, then the magnitude of the selection effect should not be large. [34]

The argument that most students may not have actually exercised the expanded school choice afforded by the elimination of school zones is consistent with the fact that there was no permanent improvement in dropout rates and with the finding that even low-quality schools showed improvements in university enrollment rates. If the elimination of school zones does not significantly change the composition of students in each school much, effect of eliminating school zones on mitigating mismatches will be limited, and it is unlikely that the concentration of poorly-performing students in schools with bad reputations will further exacerbate the performance of poorly performing schools through a negative peer effect. [35]

In summary, the elimination of school zones in Japanese public high schools did not

[33] It should be noted, however, the question remains as to whether the increase in the university enrollment rate really implies an improvement in academic performance. For example, faculty may have simply encouraged students who wanted to work or attend to junior college to attend to universities to improve the published measures of university enrollment. Ideally, we would like to examine whether competition among schools increases the value added by the schools to students' academic performance. However, owing to data limitations, it is not possible to measure the value added by the schools.

[34] The reason why students' choices have not changed that much may be because that public schools in Japan are homogeneous to some extent.

[35] In this regard, we examined whether the elimination of school zones would concentrate student popularity in schools with a good reputation if students were free to choose their schools by focusing on the impact of the elimination of school zones on the competition rate, which is defined as the ratio of applicants to the enrollment capacity at each school. As shown in Figure A.14, the elimination of school zones did not increase competition for high schools with high academic performance. These results suggest that the elimination of school zones did not significantly change students' high school application behaviors.

significantly change students' school choice patterns, however, providing students with more choice may have promoted competition among schools and improved their academic performance primarily through this competitive effect. [36]

7 Conclusion

This study examined how the elimination of restrictions on school zones affected student enrollment and dropout rates. For this purpose, we used the administrative data of Japanese high schools. We found that the elimination of school zones significantly increases university enrollment rates by approximately 1% on average. These improvements in the university enrollment rate are observed regardless of whether the school is public or private, and regardless of the school's performance prior to the institutional reform. These findings are consistent with the argument that school competition benefits all students across boards. Conversely, our analysis did not find any negative effects of school choice because the elimination of school districts led to greater school stratification and lower performance in less reputable schools.

Our interpretation of these findings is that the elimination of school zones promotes competition among schools and improves students' academic performance mainly through this competitive effect. However, perhaps the selection effect does not explain as much of our findings, as many students continued to attend schools near their residences even after school zone restrictions were eliminated.

Finally, we briefly discuss why the widening gap between schools, often pointed out as an important negative effect of school choice, was not observed after the elimination of school zones in Japanese high schools. One possible reason, as already noted, is that the actual school choices of students did not change as much because of school zone reform in the first place. If the attributes of peers at each high school do not change significantly, widening the gap between schools through the peer effect will not work significantly. Moreover, because there were not such large differences in the quality of education among Japanese public schools, it may be less likely that the results of competition would inhibit effort incentives in poorly performing schools, as McMillan (2004) highlighted.

Given these considerations, the expansion of choice among schools with relatively few differences in quality may be more likely to benefit all students who are relatively unaffected by the negative effects of choice. However, this is only a speculation, and further evidence is required to verify the validity of this argument.

[36] Another potential mechanism could be the intensification of high school entrance exams through free choice, as discussed in section 2, could have led to an increase in academic achievement as junior high school students learned to prepare for entrance examinations. It is also possible that the stratification of schools has reduced the dispersion of student performance within schools, thereby allowing education to be tailored to the level of students and possibly improving educational efficiency. However, since both these effects should become apparent three years after the reform, the effects are considered limited, as is the selection effect.

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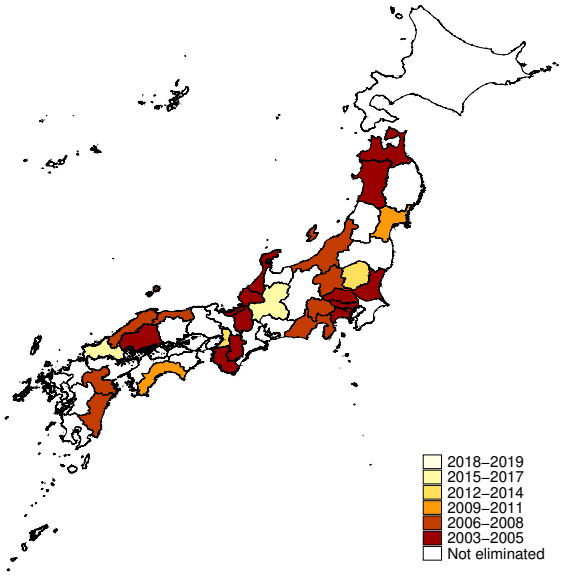


Figure 1: Timing of elimination of school zenes in each prefecture

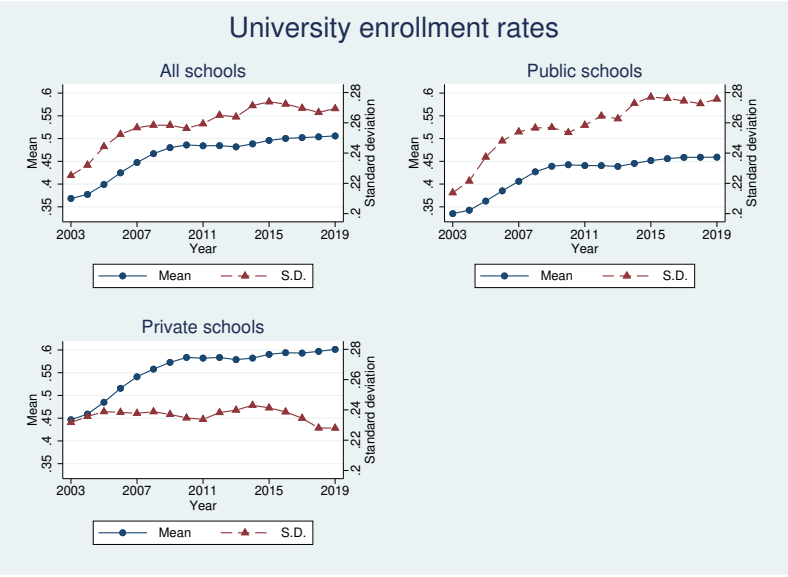


Figure 2: The change in university enrollment rates from 2003 to 2019

Note: This figure shows the transition in the mean and standard deviation of university enrollment rates from 2003 to 2019 for all schools, public schools, and private schools. Both statistics were calculated using weights based on the number of graduates. The solid line with dots shows the mean of the university enrollment rate, and the dashed line with triangles shows the standard deviation of the university enrollment rate.

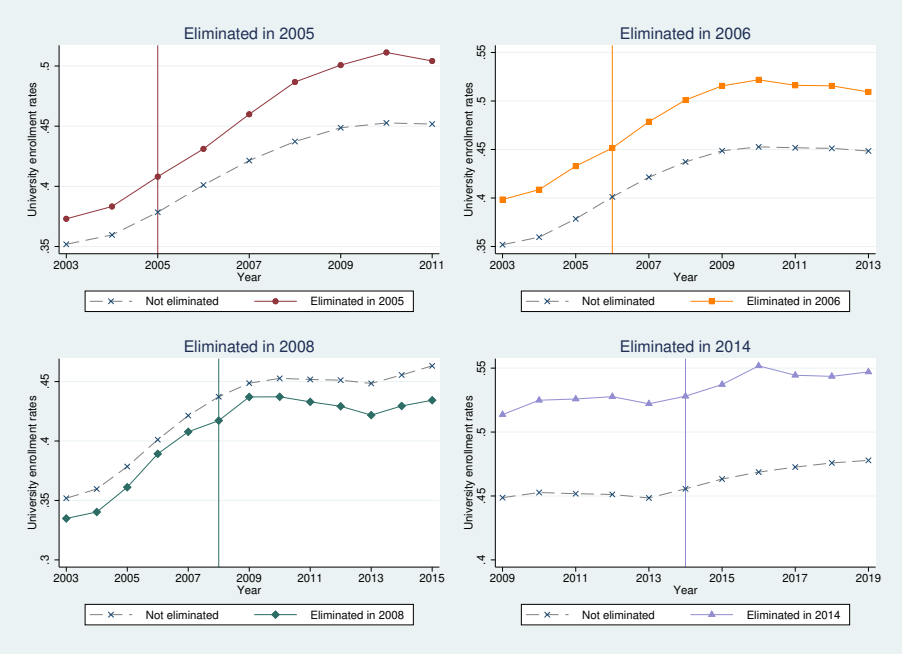
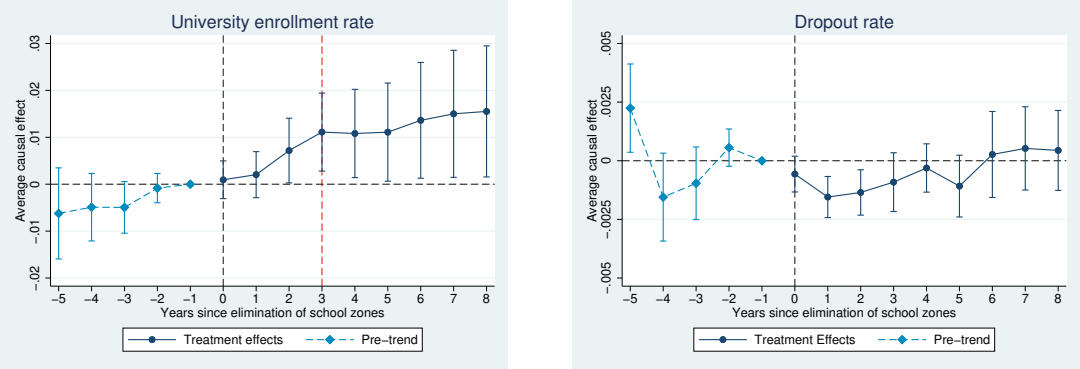


Figure 3: Comparison between treated schools and untreated schools

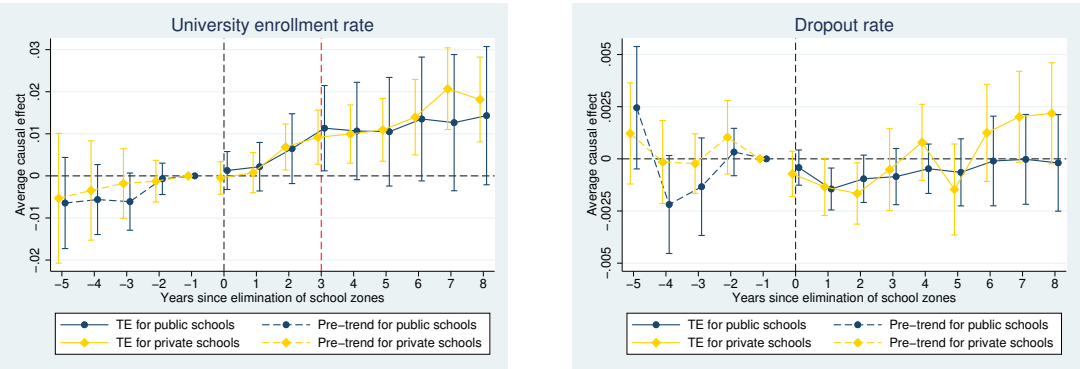
Note: This figure compares the university enrollment rates of high schools in prefectures where school zones were eliminated in 2005, 2006, 2008, and 2014 with those in prefectures where school zones were not eliminated by 2019 before and after the year of reform. The solid lines represent the average university enrollment rates for schools in prefectures where school districts have been eliminated and the dashed lines are the average university enrollment rates for schools in prefectures where school districts have not been eliminated. The averages were weighted according to the number of graduates. The vertical lines in each graph indicate that the school zones were eliminated in each school group. The group of schools whose zones were eliminated in 2005 corresponded to schools in Aomori, Akita, Kanagawa, and Ishikawa prefectures. The group eliminated in 2006 corresponded to schools in Ibaraki, Shiga, Nara, and Hiroshima prefectures, and the group eliminated in 2008 corresponded to schools in Shizuoka, Niigata, Shimane, Ohita, and Miyazaki prefectures. The schools in the areas where school zones were eliminated in 2014 were only schools in Osaka prefecture, but there were 259 schools in Osaka alone in 2014.



(a) University enrollment rates (b) Dropout rates

Figure 4: Average effect of school zone elimination

Note: These figures plot the event-study estimates and 95% confidence intervals where events are the elimination of school zones. The dependent variables are the university enrollment rate in Panel (a) and the dropout rate in Panel (b). The straight line shows the estimated treatment effect of the reform and the dashed line shows the estimated pre-trend. The vertical red dashed line in Panel (a) indicates three years after the elimination of the school zones. All regressions control for school and year fixed effects, and the observations are weighted by the number of graduates in Panel (a) and the number of students in Panel (b). Only untreated samples were used to estimate the pre-trends.



(a) University enrollment rates (b) Dropout rates

Figure 5: Comparison public and private schools

Note: These figures plot event-study estimates and 95% confidence intervals when the sample is analyzed separately for public and private schools. The dependent variables are the university enrollment rate in Panel (a) and the dropout rate in Panel (b). The straight line shows the estimated treatment effect of the reform and the dashed line shows the estimated pre-trend. The navy line shows the estimates for public schools, and the yellow line shows the estimates for private schools. The vertical red dashed lines in Panel (a) indicates three years after the elimination of the school zones. All regressions control for school and year fixed effects, and the observations are weighted by the number of graduates in Panel (a) and the number of students in Panel (b). Only untreated samples were used to estimate the pre-trends.

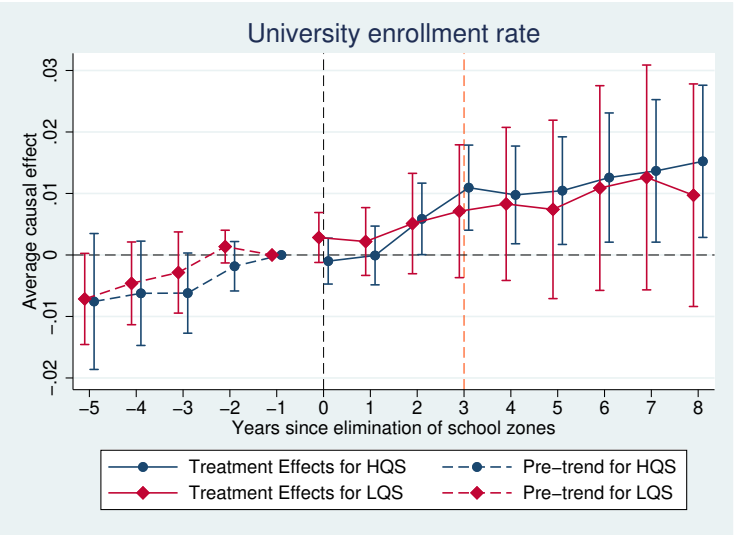


Figure 6: Comparison of impact on schools with good and poor performances

Note: These figures the plot event-study estimates and 95% confidence intervals when the sample is analyzed separately for high-quality and low-quality schools. High-quality schools(HQS) are those whose graduates' university enrollment rate as of 2003 was above the median, low-quality schools (LQS) are below the median among the prefectures. The dependent variables are the university enrollment rate. The straight line shows the estimated treatment effect of the reform and the dashed line shows the estimated pre-trend. The navy line shows the estimates for high-quality schools and the red line shows estimates for low-quality schools. The vertical red dashed line in Panel (a) indicates three years after the elimination of school zones. All regressions control for school and year fixed effects, and the observations are weighted by the number of graduates. Only untreated samples were used to estimate the pre-trends.

A Appendix

A.1 Case Studies

Based on reports from the prefectural boards of education, this section presents the history and impact of eliminating school attendance zones at the individual prefecture level. Specifically, we focus on four prefectures, Miyaghi, Shiga, Osaka and Oita, for which data on changes in students' school choice behavior after the elimination of school zone regulations are available.

Miyagi Prefecture School attendance zones were abolished in Miyagi Prefecture, starting with the FY2010 entrance examination. Before that, the prefecture had five school attendance zones for full-time regular courses in public high schools.[1]

On July 12, 2005, the Council for High School Entrance Examinations received consultations from the Superintendent of the Board of Education regarding the school attendance zones. In November 2006, the Council issued a report stating that current school attendance zones should be abolished to guarantee students the opportunity to freely select schools and revitalize schools by accepting various students from other zones. It also contributes to strengthening the disclosure and dissemination of school information in high schools.

In response to this report, the Prefectural Board of Education revised the " Regulations Concerning Prefectural High School Commuting Zones " and decided to eliminate school zones from the 2010 entrance examinations. To prepare for this reform, the Prefectural Board of Education improved the disclosure of school information. Specifically, the Board and schools actively provide information on high schools to junior high school students and their parents through guidebooks, websites, e-mail newsletters, and briefing sessions. The guidebook included information on each prefectural high school's traditions and culture, distinctive initiatives, curricula, club activities, post-graduate advancement and employment, commuting methods, and uniforms.

Miyagi Prefecture reported that the share of students attending public high schools within the same school zone as their graduating junior high school students decreased from 69.3% in 2009, before the reform, to 66.7% in 2010, when the school zone was eliminated. However, the remaining approximately 30% of graduates included students who went to private high schools, so it cannot necessarily be said that enrollment in public schools outside the school zone has risen.

Shiga Prefecture Shiga Prefecture eliminated school attendance zones from the 2006 entrance examination. Before the elimination, the school zones for full-time regular courses were divided into six districts (Otsu, Konan, Koka, Koto, Kohoku, and Kosai).

[1] With some exceptions, students from outside the school district were allowed to participate. Up to three percent of each high school's capacity was allowed to accept students from other zones. In addition, there were adjustment measures at certain girls' schools in some school zones in Sendai City.

Still, a special exception system allowed students to enter high schools outside the school zones. [2]

In June 2003, the Board of Education established an investigation committee of experts to consult on revisions of school attendance zones. On June 30, 2004, the investigation committee concluded that one prefecture-wide district was most desirable. The committee noted that as transportation convenience within the prefecture improved and the living areas of prefectural residents expanded, respect for individuality and independent choice in education became more important as high school education became more widespread. Subsequently, on November 24, 2004, the Board of Education submitted a proposal to the local assembly to amend the regulations regarding school attendance zones, which was approved. Consequently, school attendance zones were eliminated from the 2006 entrance examinations.

The year before the school zone elimination, the Board of Education established the following system for disclosing and providing information about high schools: (1) The Board of Education assisted all public high schools in enhancing their websites to provide detailed school information and updates. A portal site was established on the Board of Education's website. In addition, the Board of Education prepared and distributed a booklet detailing the characteristics of the high schools. (2) The Board of Education organised a school information session for junior high school students and their parents on the features and career paths of public high schools.

According to a report by Shiga Prefecture, in 2006, when the restrictions were lifted, 5.2% of students who attended a regular public high school went to schools that were previously inaccessible due to school zone restrictions.Before the reform, Shiga Prefecture allowed students in some areas to go to schools outside the school zone as an adjusted commuting zone *Chosei Tuugaku Kuiki*), but the number of students who went to schools outside this previously possible school zone also increased from 12.1% to 15.1%.

Osaka Prefecture Osaka Prefecture eliminated school attendance zones starting with the FY2014 entrance examination. Before its elimination, there were four separate school attendance zones for regular full-time courses.[3]

In Osaka Prefecture, the elimination of school attendance zones was promoted under the strong leadership of the governor and his political party (*Osaka Ishin*). In September 2011, *Osaka Ishin* submitted a draft of a basic education ordinance to the Osaka Prefectural Assembly, proposing in Article 43 that the school attendance area for prefectural high schools be expanded to cover the entire prefecture. The proposal was rejected at the time. However, in November of the same year, a new governor belonging to *Osaka Ishin* was elected. In January 2012, the governor instructed the Board of Education

[2]Among the three commuting areas of Otsu, Konan, and Koka, where the population is relatively concentrated within the prefecture, up to 20% or 24% of the capacity of a particular high school can be enrolled in other zones. In addition, for students graduating from junior high schools in the four municipalities, there was also an option to apply for and enter a specified high school in an adjacent commuting zone.

[3]Enrollment in regular courses in other school zones was not allowed, with some exceptions.

to eliminate all school attendance zones for prefectural high schools by 2014. Then, in February 2012, the governor submitted a draft ordinance for Osaka Prefectural Schools to the Osaka Prefectural Assembly, which stated, " The high school attendance area shall be reviewed and set to be the entire prefecture as of April 1, 2014. " The proposal was discussed and passed in March.

In preparation for eliminating school attendance zones, the Osaka Prefecture enhanced its system to provide junior high school students and their parents with information from public high schools. (1) School information sessions were held with the participation of all public high schools. (2) A wide-area prefectural version of the Guide to Public High Schools was created. (3) A portal site was created to search prefectural high school information.

Osaka Prefecture reported that the share of applicants to public high schools who came from public junior high schools in the school attendance area was 98.4% in 2013 before the reform, but decreased to 93.4% in 2014 and 92.3% in 2015 after the reform.

Oita Prefecture Oita Prefecture eliminated school attendance zones starting with the FY2008 entrance examination. Before its elimination, there were six school attendance zones for regular full-time courses.[4]

Oita Prefecture was proactive in reorganizing its high schools to meet diverse educational needs and the rapidly declining number of children. The High School Reform Plan Investigation Committee, composed of experts, compiled a December 15, 2004 report. In response to this report, the Board of Education formulated the " High School Reform Promotion Plan, " The plan stated the need for further studies to combine school attendance zones within the prefecture, extend the benefits of promoting school diversification and specialization, and increase the sense of competition among schools.

In April 2007, the Prefectural Assembly approved repealing the " Regulations Concerning the Establishment of School Zones for Prefectural High Schools. " In preparation for eliminating school zones from the FY2008 entrance examinations, the Board of Education also requested that each high school actively provide information to students and their parents on the initiatives and characteristics of their school and promote the creation of schools for students.

The average percentage rate of students who applied to high schools in other zones based on the number of applicants for full-time regular courses was 1.65% for two years before the elimination (2.0% in FY2006 and 1.3% in FY2007), but averaged 3.5% for six years from FY2008 to FY2013 after the elimination, an increase of approximately two percentage point.

A.2 Data

The School Basic Survey The School Basic Survey is a census survey of all schools in Japan conducted by the Ministry of Education, Culture, Sports, Science and Technology

[4]Before the elimination of the zone, specific quotas accepted students from outside the zone.

(MEXT) every May to obtain basic data for school education administration. The School Basic Survey consists of the School Survey (*Gakkou Chosa*) and the Survey of Graduates (*Sotugyo-go no Jokyo Chosa*). The School Survey asks for basic information on schools, such as the number of students enrolled, teachers, and applicants to the school as of May 1 in the survey year, while the Survey of Graduates collects information on the career paths of graduates in March of that year (or the previous the school year). For example, the 2010 School Basic Survey data includes information on students and faculty enrolled as of May 2010 and graduates who graduated in March 2010.

Prefecture data We collected data on area, youth population ratio (ratio of the population under 15 years of age), taxable income per capita, and public education expenditure per student for each prefecture from the Social Demographic Statistics System (*Syakai Zinko Tokei Taikei*) of the Ministry of Internal Affairs and Communications (MIC). Public education expenditures per student was calculated by dividing public expenditures on schooling by the number of full-time students.

The years of experience of governors in office are collected from the website of the National Governors' Association (*Zenkoku Chizi Kai*).[5] For the share of seats held by each party in prefectural assemblies, we used data from the Personnel Survey of Members and Heads of Local Public Organization Assemblies by Party Affiliation. (*Chiho Kokyo Dantai no Gikai no Giin oyobi Cho no Syozoku-touhabetu Zininn Sirabe to*) from the MIC. To calculate the seat shares of leftist parties, we define the Democratic Party of Japan, the People's Democratic Party, the Constitutional Democratic Party, the Social Democratic Party, and the Japanese Communist Party as leftist parties.

A.3 Definition of Variables

University enrollment rate The university enrollment rate was defined as the number of graduates who entered an university divided by the total number of graduates in the school. The number of university-enrolled students here does not include those who went on to two-year junior colleges (*tanki daigaku*), distance learning universities, or short-term courses (*Bekka*). The survey asked about the career paths of graduates who graduated in March of that year, so students who entered university one year after graduation (so-called "ronin" students who entered university after having been ronin) were not included.

Dropout rate Since the School Basic Survey does not include information on student dropouts, we estimated the dropout rate based on the change in the number of students from the previous year. Specifically, the estimated dropout rate is the percentage decrease in the total number of students in Grades 3 and 2 in the following year from those in Grades 1 and 2 in the previous year. However, the dropout rate estimated by this definition includes changes in the number of students due to student transfers and mid-course enrollment and may deviate from the actual dropout rate. To eliminate outliers

[5] URL: https://www.nga.gr.jp

so that estimation errors do not become a serious problem, observations that meet the following criteria are not used in the analysis of dropout rates as missing values: (i) School has fewer than 240 students, including those in Grade 1 and in Grade 2 (schools with approximately two or fewer classes per grade). (ii) School has no students in a particular grade (i.e., a school that is scheduled to close or a new high school that has been in operation for a short time) or has no students in Grade 1 or Grade 2 from the previous year. (iii) There was a significant increase in the number of students in the same age group (i.e., the number of students between the previous year's freshmen and the following year's sophomores or between the previous year's sophomores and the following year's third-year students) from the previous year (specifically, more than 40 students).

As mentioned above, the estimated dropout rate is simply calculated based on changes in the number of students; therefore, it may be negative if the number of students increases due to transfers or other reasons. Some schools receive many mid-course enrollments or offer courses that allow students, mainly international students and returnees, to transfer from the third grade, thus resulting in a large number of transfers. As these schools would result in large negative dropout rate estimates, we impose the condition that: (iii) These cases were excluded from the analysis.

Timing of reform The year in which each prefecture's school zone regulation was eliminated was determined by whether the school zone system was applied to the high school entrance examination held in March of that year. For example, the elimination of school zones in Tokyo in 2003 meant that students who took the high school entrance examination in March 2003 and entered high school in April 2003, as well as younger students, could freely choose their high school.

Other variables The number of students enrolled full-time and in the main course of study was counted, as indicated in the School Survey. We only used data from full-time students affected by school zones. Hence, students enrolled in night courses, special courses (*Bekka*), or majors(*Senkoka*) were excluded.

Onlly full-time teachers were included. Concurrent employees (*Kenmusya*) in the School Survey were counted as assistant teachers and were not included in the number of full-time teachers.

When classifying schools as public or private, the 15 national schools in Japan are included in the public school category.

The competition rate is the ratio of the number of applicants to the enrollment capacity. If a high school has more than one department, the number of applicants and capacity of each department are aggregated to calculate the number of applicants and capacity of each school.

The employment rate was calculated by dividing the number of graduates employed by the number of graduates in the graduate survey. The number of employed individuals included those who were self-employed or employed for a fixed period. The percentage

of graduates who went to two-year junior colleges was calculated by dividing the number of graduates who went to junior colleges by the number of graduates in the graduate survey. The percentage of graduates who went on to vocational schools was calculated by dividing the number of graduates who went on to vocational schools including special training preparatory schools, by the number of graduates.

School fixed effect In our difference-in-differences analysis, we control for school fixed effects. The identity of each school was determined by the school code provided in the School Survey; therefore, schools assigned the same code within each prefecture were considered the same school. School codes are provided so that schools are uniquely identified within each prefecture. However, there is a caution when using school codes to identify schools. MEXT assigns a new code to a school that changed its name or moved to a new address; thus, that school is treated as a different school. However, the number of schools in which these changes occurred was very few, and did not have a significant effect on the analysis.

A.4 Descriptive Statistics

Table A.1 shows the year when school zones were eliminated for all 47 prefectures. Since the elimination of school districts in Tokyo and Wakayama prefectures in 2003, about half of the prefectures eliminated school districts by 2019. FigureA.2 shows the transition of the number of prefectures where school zones were eliminated and the percentage of schools located in prefectures where school zones were eliminated. While the percentage of schools that are no longer affected by school district regulations has increased dramatically from approximately 5 % to levels exceeding 50 % between 2003 and 2019, approximately half of the schools in the region are still under school zones as of 2019.

Figure A.1 shows the changes in the number of schools during the study period. While the number of public schools decreased slightly, partly due to the declining birth rate, the number of private schools remained virtually unchanged. Consequently, the percentage of private schools increased slightly during this period.

Table A.2 shows descriptive statistics for all schools in 2003 when school districts had not yet been eliminated in most regions except Tokyo and Wakayama. The average number of students enrolled in a school is 775, with private schools having slightly more students. The average number of full-time teachers is about 50, and the number of students per full-time teacher is approximately 15. Public schools have slightly more teachers, less students and fewer the students per full-time teacher ratio than private schools. However, private schools had an average of 25 non-full-time assistant teachers, which is considerably higher than that for public schools. Therefore, if part-time teachers are included, private schools would have more teachers per student than public schools.

The average competition rate for private schools was 3.2, which was considerably higher than the public school average of 1.3, indicating that private schools were more competitive in entrance examinations. The percentage of students who graduated from

junior high schools in other prefectures averaged approximately 9.6% for private schools. In comparison, it was less than 1.0% for public schools.[6]

FigureA.3 shows the overall average dropout rate and the averages for public and private schools during the period analyzed. The change in the dropout rate during this period was not monotonous; a slight downward trend was observed. There was also little difference in trend between public and private schools.

Finally, FigureA.4 shows how the distribution of university enrollment rates for each school changed from 2003 to 2019. Figure 2 shows that the dispersion of university enrollment rates among schools expanded during this period. Figure A.4 also reports that the number of public schools with low university enrollment rates decreased significantly. In constrast, private schools, which originally had a flat distribution, saw an increase in the number of schools with high performance, resulting in the distribution becoming more skewed to the right. These changes have contributed to an increase in the dispersion of university enrollment rates among schools

A.5 On the Validity of our Empirical Approach

The validity of our research design critically depends on the assumption that schools in prefectures in which school zones have not been eliminated can be considered a reasonable control group for schools in areas where school zones have been eliminated. More specifically, we impose the parallel trend assumption that there would be no important difference in changes in outcome variables across schools in the absence of reforms.

While it is difficult to directly test this parallel trend assumption, we see here that there is little difference between prefectures where school zones were eliminated and those where there was no reform.[7] With regard to the endogeneity of the reform decision, some may worry that prefectures with lower academic performance or greater dispersion of performance across schools might be more likely to reform. However, this was not the case in the present study. Table A.3 shows no significant differences in the means and standard deviations of university enrollment rates between the prefectures that eliminated school zones and those that did not. In addition, prefectures with more schools are not more likely to eliminate school zones. Figure A.5 illustrates the relationship between the timing of eliminating school district regulations, the number of schools per area, and the dispersion in university enrollment rates among schools. No significant differences were found in the characteristics between the prefectures that eliminated school districts and those that did not. While these observations do not necessarily guarantee the validity of the parallel trend assumption, they provide support for the validity of our identification strategy.

Even if there were no a priori important differences between the treatment and control

[6]Since students cannot enter public schools in prefectures other than their place of residence, it is assumed that those from public middle schools in other prefectures have changed their place of residence.

[7]Following the convention, we also confirm in Section 5 that the coefficients of the dummy variable for the years prior to the reform are not significant; no pre-trend is observed.

groups, it would be difficult to identify the effects of the reform if the timing of reforming school zones was correlated with other important factors. For example, prefectures with large declines in youth populations tend to be more likely to eliminate school zones. In this case, the validity of the parallel trend assumption should be questioned. To address this concern, we conducted a series of auxiliary analyses using prefecture-level panel data. In paticular, we performed an event-study analysis similar to (1) with time-varying prefectural variables as the explained variables, to examine the relationship between these variables and the timing of school zone elimination in each prefecture.

Figure A.6 shows the changes in the ratio of the young population, per capita taxable income, per capita public education expenditures, governors' tenure in office, and share of seats held by leftist party members for the prefectures before and after the elimination of school districts.[8] None of the variables showed significant changes before or after the school zone reform. Therefore, no evidence that would lead us to suspect that changes in demographic, economic, or political circumstances were occurring behind the elimination of the school zones was found. We believe that these results also support the validity of the parallel trend assumption.

A.6 Imputation Method

We use the following imputation method to estimate the dynamics of the treatment effects of school zone reform: first, using only untreated observation, the individual school-fixed effects α_i and time-fixed effects λ_t in Equation (1) are estimated by OLS.

Next, to estimate the effect $s \geq 0$ years after the reform for each school i, i.e. β_s in Equation (1), the fixed effects estimated in the above procedure are used to predict the counterfactual in the absence of treatment for each treated observation. The estimated treatment effect s years after the reform for each school i is calculated from the difference between the actual outcome and the counterfactual predicted outcome, (i.e. $Y_{ijT_j+s} - \hat{\alpha}_i - \hat{\lambda}_{T_j+s}$). Finally, taking the average of the second-step estimated effects, we calculate the average treatment effect on the treated.

Borusyak et al. (2024) show that the imputation estimator is more efficient than other estimators robust to the heterogeneity of treatment effects proposed by Callaway and Sant'Anna (2021) and Sun and Abraham (2021) under the assumptions of the Gauss-Markov theorem, which includes homoskedasticity and no serial correlation of error terms.

Furthermore, to test the validity of the parallel trend assumption, we estimate the pre-trend coefficients by regression on the set of untreated observations only.

$$Y_{ijt} = \alpha_i + \lambda_t + \sum_{s<0}^{-2} \beta_s \mathbb{1}\{t - T_j = s\} + \epsilon_{ijt} \tag{A1}$$

Because the sample consists of only untreated observations, $T_j > t$ always holds. We

[8] This analysis was conducted using prefecture-level data, and the imputation method was used for estimation.

normalize the coefficient from one year before the treatment β_{-1} to zero.

We graphically present the treatment effect estimates and the estimated coefficients of the pre-trend. Note that unlike the usual TWFE estimation where the coefficients of the pre-trend and treatment effect are estimated simultaneously, in this analysis, the treatment effect estimation and pre-trend test are separated from each other and run separately. To emphasize this point, the estimates of treatment effects and coefficients of the pre-trend are shown as separate lines on the graph.

A.7 Robustness Check

In Section 5, we confirmed that eliminating school zones significantly increased the university enrollment rates of high school graduates. We provide additional analyses to verify the robustness of the main results.

Estimator by Callaway and Sant'Anna (2021) First, we test whether adopting another estimator robust to the heterogeneity of treatment effects would significantly change our main results. As an alternative estimator that is robust to heterogeneity in treatment effects, we use the estimator proposed by Callaway and Sant'Anna (2021).

Figure A.8 compares our estimates using the imputation method with estimates using Callaway and Sant'Anna (2021). The magnitude of the estimated impact on the university enrollment rate is roughly the same, indicating that our main results are robust regardless of the estimation method adopted. However, the estimator by Callaway and Sant'Anna (2021) is less efficient, and the standard errors of the estimates are larger.[9] Differences in their estimated impact on the dropout rate were also observed. None of the estimation results indicate that the elimination of school districts has a significant effect on the dropout rate of high school students in the long run. However, the short-term improvement in the dropout rates shown in Panel (b) of Figure 4 is not robust to the estimation method.

Control for time-varying characteristics of prefectures Second, we control for several factors that may simultaneously influence the academic performance of schools and the educational policy of the local governments. As Figure A.6 shows, there was no clear correlation between factors such as prefectural youth population ratios, education expenditures, and the timing of the elimination of school zones; we included these factors as covariates in our analysis to confirm the robustness of the main results.

[9] De Chaisemartin and d'Haultfœuille (2022) show that the key difference between the approaches of Borusyak et al. (2024) and Callaway and Sant'Anna (2021) lies in the difference in the baseline outcome. Callaway and Sant'Anna (2021) used the outcome immediately before treatment as the baseline. In contrast Borusyak et al. (2024) used the average of the outcome from the first period to the period immediately before treatment as the baseline. Borusyak et al. (2024) imposed parallel trends for each cohort and between pairs of consecutive periods. In contrast, Callaway and Sant'Anna (2021) only made the minimum necessary assumptions for parallel trends. Although their estimators are more robust to differences in prior group-specific trends, they are more vulnerable to anticipation effects.

Figure A.9 shows the estimated results after controlling for the ratio of the young population, log per capita taxable income, education expenditures per student, the percentage of seats held by leftist parties, and the governor's term of office. This shows that controlling for time-varying factors in prefectures dose not significantly change our estimates in any important way.

Restricting control group schools Finally, we conducted an analysis excluding schools in prefectures in the control group and those whose districts were modified in some way during the analysis period. We restricted the control group to schools in prefectures where no changes, including partial modifications, were made to the school zone system during the analysis period.[10]

Figure A.10 shows the estimation results when using a restricted sample. The estimation results do not differ significantly from those obtained using the full sample, suggesting that the modification of school zone regulations in some prefectures does not cause serious bias in our estimation.

Although these results are insufficient to discuss how the elimination of school zones has changed the career paths of high school students, it can be inferred that the increase in the university enrollment rate represents a change in the number of male students who would have previously worked immediately after graduation or of female students who would have initially attended two-year colleges but are now entering universities.

References

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[10] In our analysis, we included schools in prefectures that did not eliminated school zones as the control group. However, as Table A.1 indicates prefectures some prefectureshave retained the school zone system and expanded the size of school zones or modified their boundaries. One may be concerned that schools in prefectures with changes in school zones during the analysis period may have been an inappropriate control group.

Prefecture	Timing of reform	# of schools (in 2003)	Prefecture	Timing of reform	# of schools (in 2003)
Hokkaido	*	324	Shiga	2006	54
Aomori	2005	87	Kyoto	*	97
Iwate	*	96	Osaka	2014	273
Miyagi	2010	106	Hyogo	*	206
Akita	2005	64	Nara	2006	60
Yamagata		68	Wakayama	2003	49
Fukushima		109	Tottori	2007	33
Ibaraki	2006	132	Shimane	2008	50
Tochigi	2004	82	Okayama		94
Gunma	2007	86	Hiroshima	2006	136
Saitama	2004	210	Yamaguchi	2016	91
Chiba	*	203	Tokushima		46
Tokyo	2003	440	Kagawa		45
Kanagawa	2005	258	Ehime		70
Niigata	2008	121	Kochi	2012	48
Toyama		54	Fukuoka	*	180
Ishikawa	2005	61	Saga	*	46
Fukui	2004	36	Nagasaki	*	86
Yamanashi	2007	46	Kumamoto	*	85
Nagano	*	106	Ohita	2008	70
Gifu	2018	91	Miyazaki	2008	56
Shizuoka	2008	146	Kagoshima	*	104
Aichi		228	Okinawa		65
Mie		75			

Table A.1: Timing of reforms in each prefecture

Note: This table shows the timing of the reform and the number of schools in 2003 in all prefectures. The timing of the reform shows the year in which school zones were eliminated in each prefecture. Blank columns indicate prefectures that have not eliminated school zones by 2022. Prefectures whose reform years are marked with an asterisk are those where school zones were not eliminated but where school zone modifications (e.g., changes in school zone boundaries or consolidation of some school zones) were made during the 2003-2019 analysis period.

	All	Public schools	Private schools
Students			
Number of students	775.492	732.822	899.103
	(326.088)	(240.484)	(475.856)
Share of female students	0.506	0.500	0.523
	(0.246)	(0.197)	(0.351)
Faculty			
Number of full time teachers	50.442	51.237	48.140
	(15.604)	(12.916)	(21.420)
Share of female teachers	0.278	0.281	0.270
	(0.122)	(0.102)	(0.168)
Students-teacher ratio	15.251	14.137	18.477
	(3.657)	(2.528)	(4.427)
Number of assistant teachers	11.824	7.137	25.402
	(13.405)	(6.702)	(17.954)
Admission			
Competition rate	1.866	1.396	3.227
	(1.342)	(0.384)	(2.024)
Share of admissions from another prefecture	0.030	0.007	0.096
	(0.089)	(0.024)	(0.153)
Career path of graduates			
University enrollment rates	0.335	0.301	0.433
	(0.227)	(0.211)	(0.242)
Two-year college enrollment rates	0.081	0.079	0.087
	(0.065)	(0.052)	(0.092)
Employment rates	0.190	0.215	0.117
	(0.198)	(0.207)	(0.146)
Vocational school enrollment rates	0.199	0.215	0.152
	(0.116)	(0.112)	(0.116)
Others			
Dropout rate (in 2004)	0.036	0.034	0.042
	(0.040)	(0.042)	(0.034)
Observations	5700	4352	1348

Table A.2: Descriptive statistics of schools as of 2003

Note: This table shows the descriptive statistics for all schools in 2003. The numbers in the table show the mean values for each variable, and the numbers in parentheses are the standard deviations. The dropout rate was the change in the number of students between 2003 and 2004; it can be considered as the 2004 value.

	(1) Eliminated in 2003-2009	(2) Eliminated in 2010-2018	(3) Not eliminated	(4) Difference between (1) and (3)	(5) Difference between (2) and (3)
Mean of university enrollment rates					
All schools	0.301	0.289	0.284	-0.016	-0.004
	(0.064)	(0.052)	(0.068)	(0.021)	(0.026)
Public schools	0.275	0.261	0.273	-0.003	0.011
	(0.047)	(0.053)	(0.067)	(0.018)	(0.026)
Private schools	0.375	0.382	0.331	-0.043	-0.051
	(0.143)	(0.105)	(0.104)	(0.039)	(0.049)
Standard deviation of university enrollment rates					
All schools	0.217	0.215	0.214	-0.004	-0.001
	(0.019)	(0.032)	(0.029)	(0.008)	(0.015)
Public schools	0.208	0.199	0.209	0.001	0.010
	(0.021)	(0.047)	(0.038)	(0.010)	(0.021)
Private schools	0.191	0.217	0.203	0.012	-0.014
	(0.052)	(0.036)	(0.049)	(0.016)	(0.018)
Number of schools per area	0.451	0.524	0.395	-0.056	-0.129
	(0.913)	(1.096)	(0.638)	(0.247)	(0.469)
Observations	21	6	20		

Table A.3: Comparison of prefectures that have eliminated school zones and those that have not

Note: This table shows the characteristics of each prefecture by the time school zones were eliminated. The numbers in columns (1) through (3) represent the mean of each variable for each group, and the numbers in parentheses are the standard deviations. The numbers in columns (4) and (5) represent the difference in sample averages, and the numbers in parentheses indicate the standard error of the t-test for the difference in sample averages.

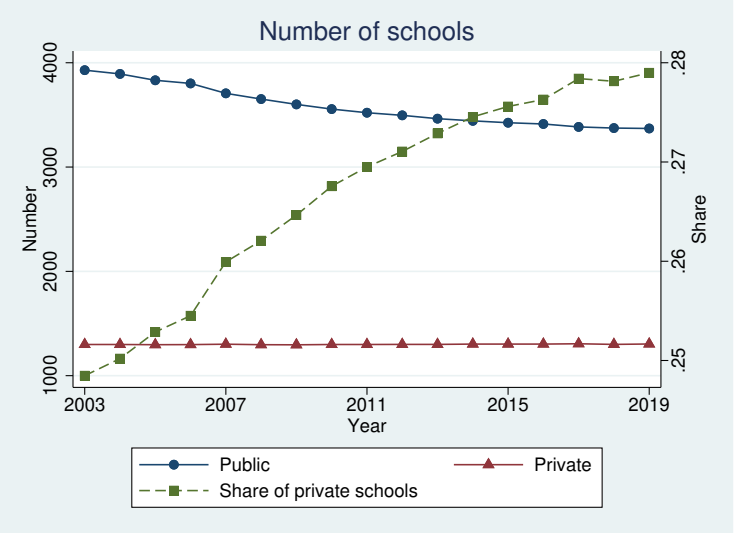


Figure A.1: Change in the number of schools from 2003 to 2019

Note: This figure shows the transition of the number of schools from 2003 to 2019 for public schools and private schools. The navy line with dots indicates the number of public schools and the red line with triangle indicates the number of private schools. The figure also shows the transition in the share of private schools, which is shown as a green dashed line with squares.

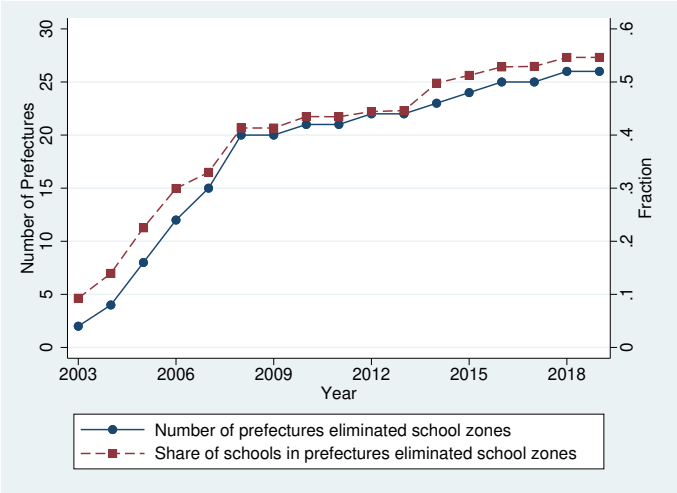


Figure A.2: Number of prefectures that have eliminated school districts

Note: This figure shows the transition in the number of prefectures that eliminated school zone regulation and the share of schools in prefectures that eliminated school zones from 2003 to 2019. The solid-line indicates the number of prefecture that have eliminated school zones. The dashed line indicates the change in the percentage of schools located in prefectures where school zones were eliminated.

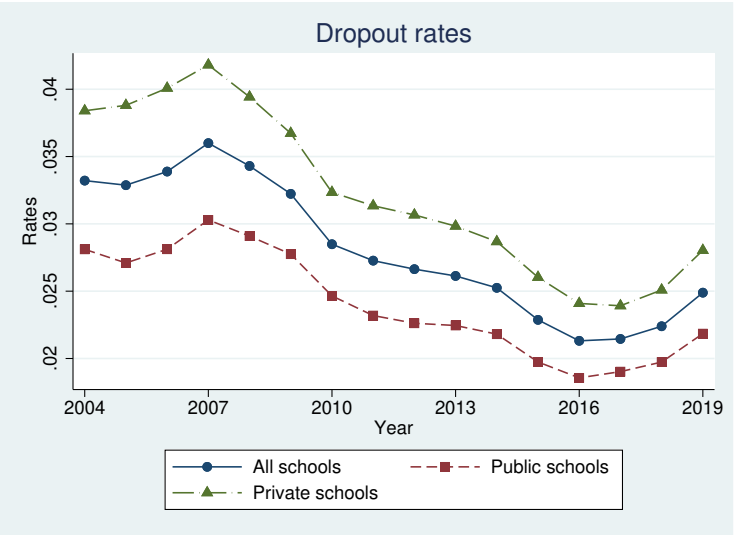


Figure A.3: The change in dropout rate from 2004 to 2019

Note: This figure shows the transition of the mean dropout rates from 2004 to 2019 for all public and private schools. These values were calculated using weights based on the number of students. The navy line with dots represent the mean for all schools, the red dashed line with squares the mean for public schools, and the green dashed line with triangle the mean for private schools.

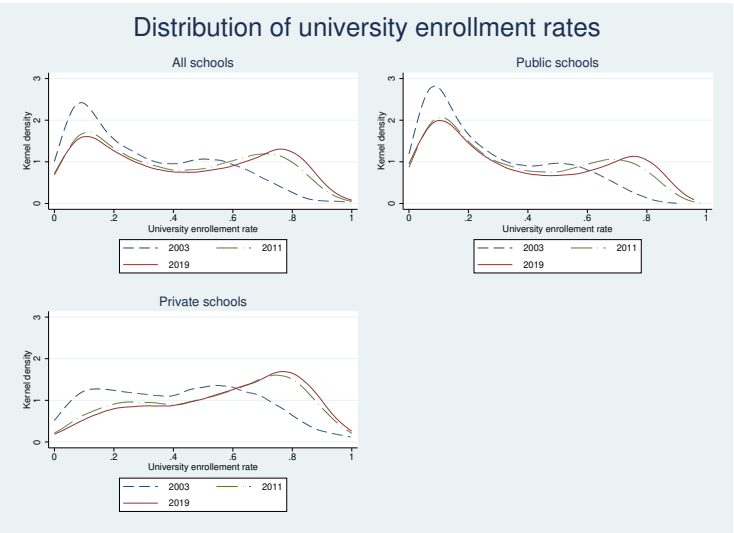


Figure A.4: The change in the distribution of university enrollment rates from 2003 to 2019

Note: These graphs show the distribution of university enrollment rates for all schools, public schools, and private schools, and the evolution of the distribution. The blue dashed, green dashed, and red solid curves show the kernel density for university enrollment rates in 2003, 2011, and 2019, respectively.

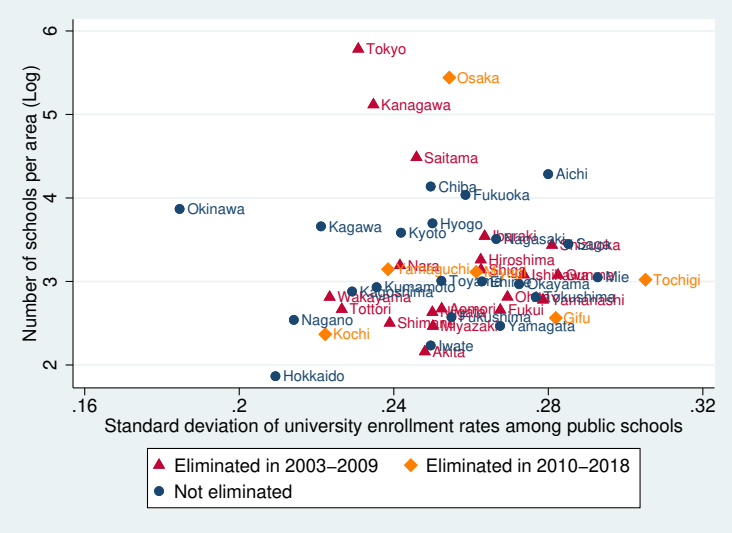
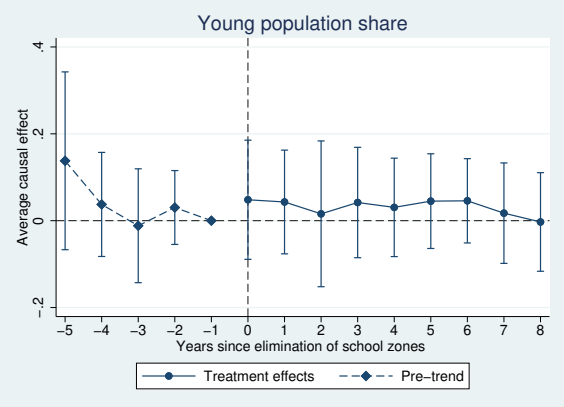
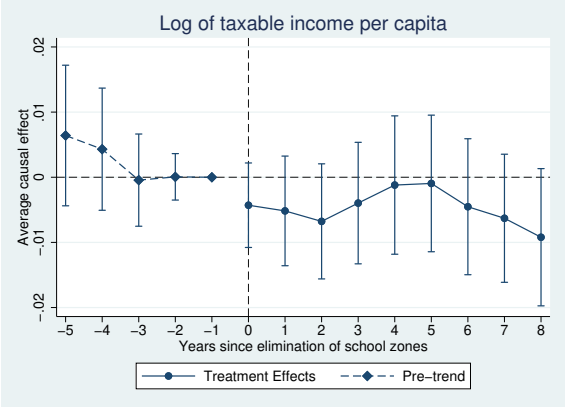


Figure A.5: Raw comparison between treated schools and untreated schools

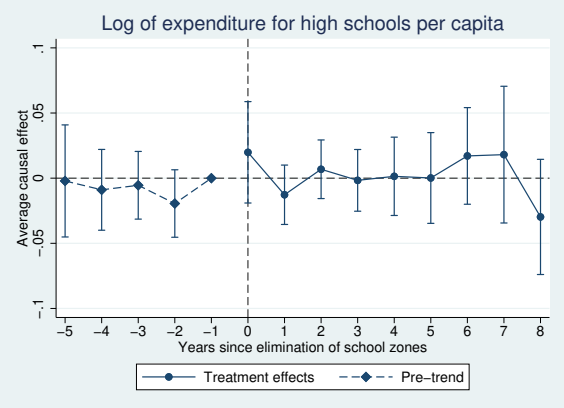
Note: This graph is a scatter plot showing the relationship between the standard deviation of the university enrollment rate in 2003, the logarithmic number of schools per area in 2003, and the timing of the elimination of the school zone system for 47 prefectures in Japan. Red triangles correspond to prefectures where school zones were eliminated between 2003 and 2009, orange diamonds to prefectures where school districts were eliminated between 2010 and 2018, and blue dots to prefectures where school districts were not eliminated.



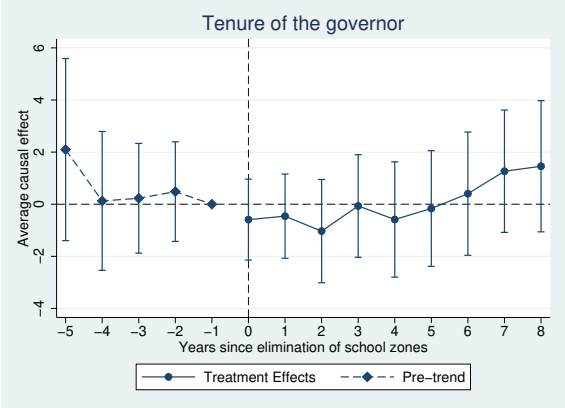
(a) Share of population under age 15



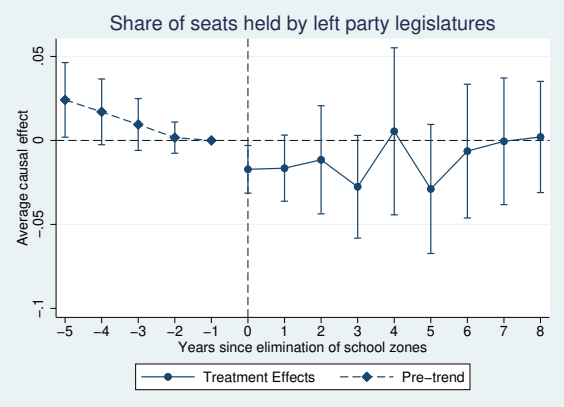
(b) Per capita taxable income



(c) Expenditure on public education



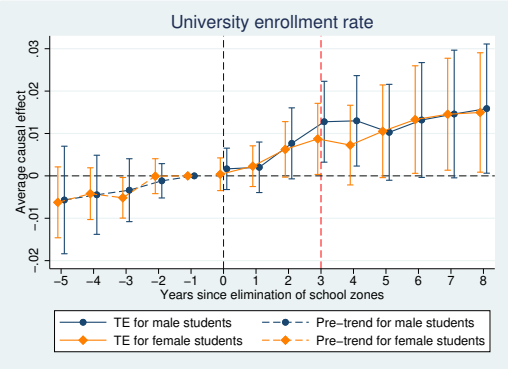
(d) Tenure of the governor



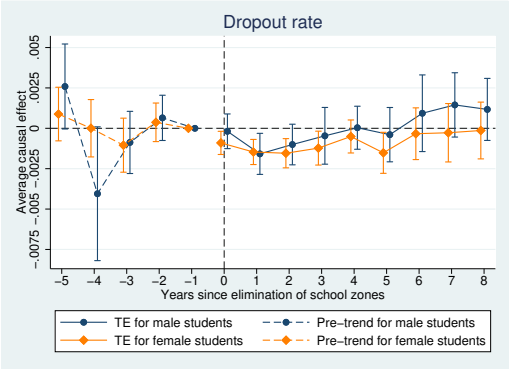
(e) Share of seats held by left-party legislatures

Figure A.6: Changes in time-varying variables for prefectures before and after school zone reform

Note: These figures plot event-study estimates and 95% confidence intervals using prefecture-level panel data. The dependent variables are (a) the share of the population under the age of 15, (b) the logarithm of per capita taxable income, (c) public expenditure on education per students, (d) tenure of the governor, and (e) the share of seats held by left-party in prefectural legislatures. The straight line shows the estimated treatment effect of the reform and the dashed line shows the estimated pre-trend. All regressions control for prefecture and year fixed effects. Only untreated samples were used to estimate the pre-trends.



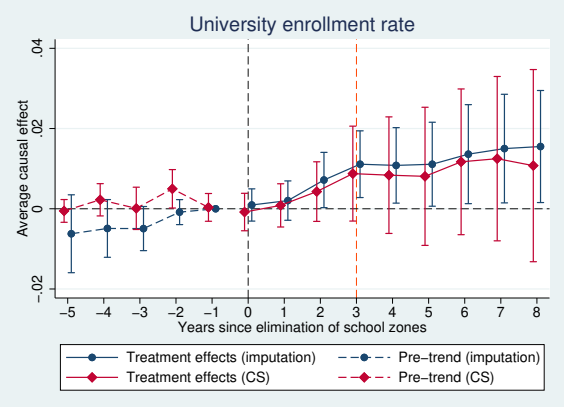
(a) University enrollment rates



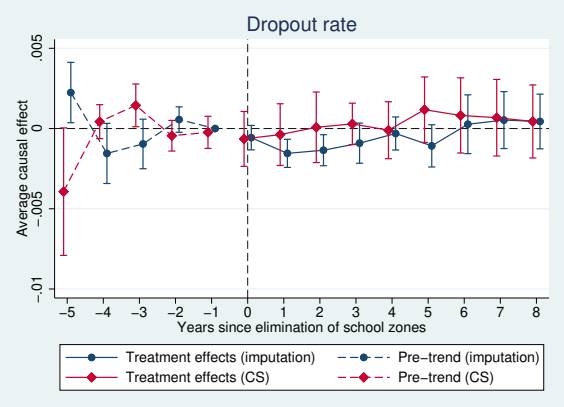
(b) Dropout rate

Figure A.7: Average effect by gender

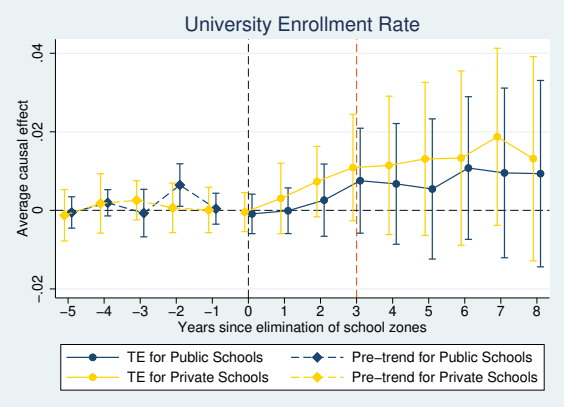
Note: These figures plot event-study estimates and 95% confidence intervals when the sample is analyzed separately for male and female students. The dependent variables are university enrollment rate in Panel (a) and dropout rate in Panel (b). The straight line shows the estimated treatment effect of the reform and the dashed line shows the estimated pre-trend. The navy line shows estimates for the outcomes of male students, while the orange line shows estimates for those of female students. The vertical red dashed line in Panel (a) indicates three years after the elimination of school zones. All regressions control for school fixed effects and year fixed effects, and observations are weighted by the number of graduates in Panel (a) and number of students in Panel (b). Only untreated samples were used to estimate the pre-trends.



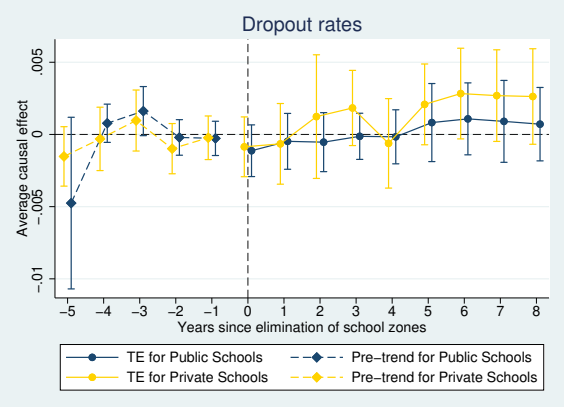
(a) University enrollment rates



(b) Dropout rates



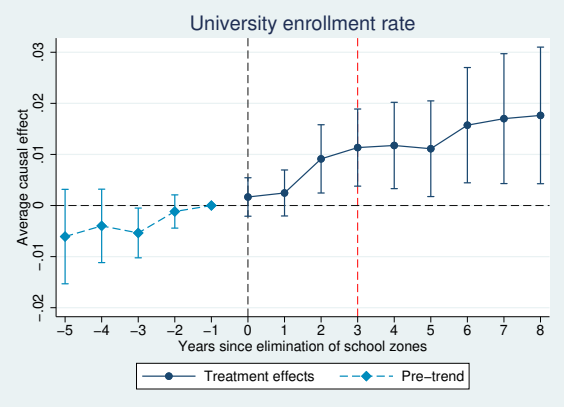
(c) University enrollment rates



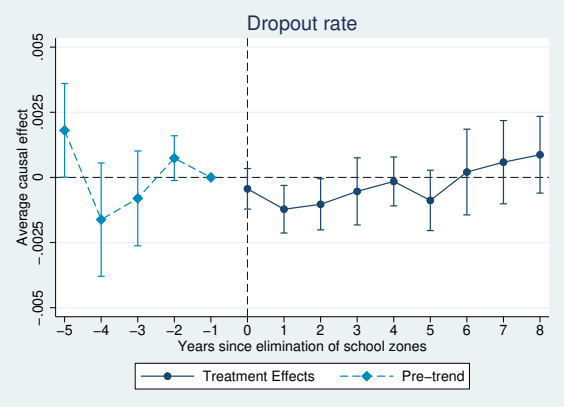
(d) Dropout rates

Figure A.8: Estimation results using estimator by Callaway and Sant'Anna (2021)

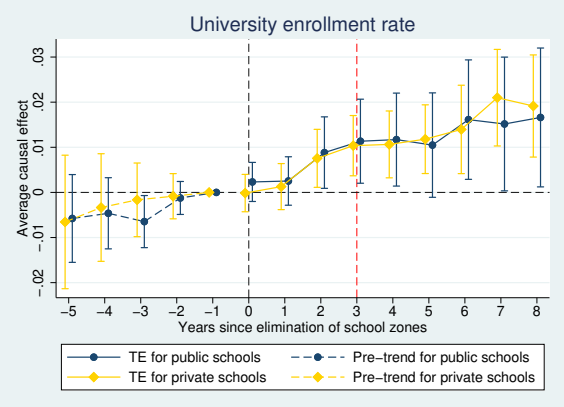
Note: These figures plot event-study estimates and 95% confidence intervals using the estimator of Callaway and Sant'Anna (2021). Panels (a) and (b) present the estimates using the imputation method, which are shown in Figure 4, for comparison. The navy line shows the estimates using the imputation method, and the red line shows the Callaway and Sant'Anna (2021) estimates. In Panels (c) and (d), the sample is analyzed separately for public and private schools. The navy line shows the estimates for public schools, and the yellow line shows the estimates for private schools. In all panels, the straight line shows the estimated treatment effect of the reform and the dashed line shows the estimated pre-trend. The dependent variables are the university enrollment rates in Panels (a) and (c), and the dropout rates in Panels (b) and (d). All regressions control for school and year fixed effects, and the observations are weighted by the number of graduates in Panels (a) and (c), and the number of students in Panels (b) and (d). The red dashed line in Panels (a) and (c) indicates three years after the elimination of school zones.



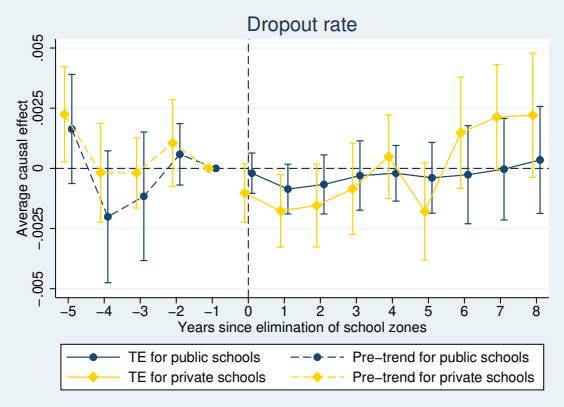
(a) University enrollment rates



(b) Dropout rates



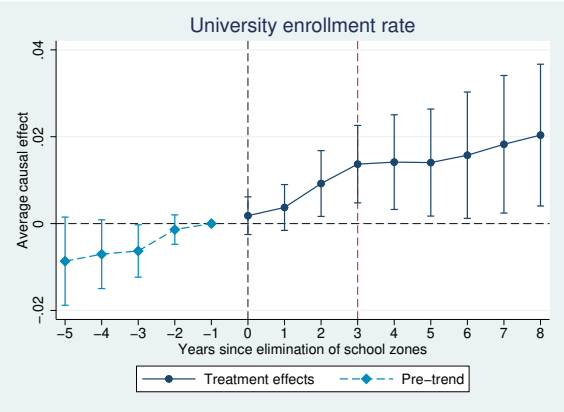
(c) University enrollment rates



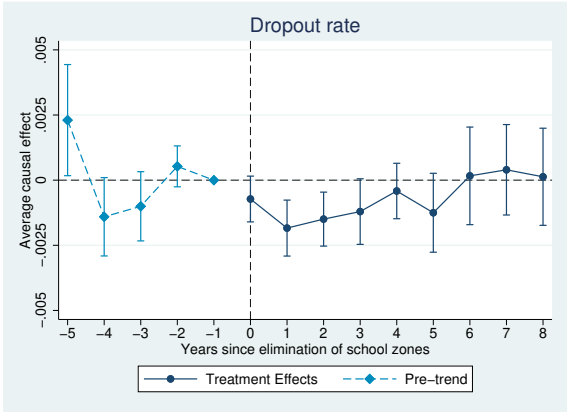
(d) Dropout rates

Figure A.9: Estimation results controlling time-varying factors

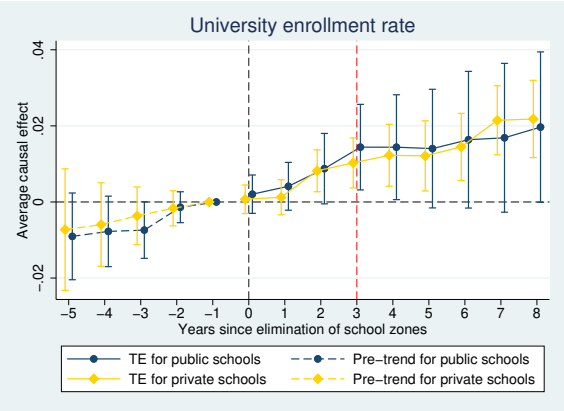
Note: These figures plot event-study estimates and 95% confidence intervals where events are the elimination of school zones. All regressions control for the prefectural population share under the age of 15, log of per capita taxable income, public expenditure on public education per students, tenure of the prefecture governor, and share of seats held by the left party in prefectural legislatures in addition to school fixed effects and year fixed effects. The dependent variables are the university enrollment rate in Panel (a) and (c), and the dropout rate in Panel (b) and (d). Observations are weighted by number of graduates in Panel (a) and (c) and number of students in Panel (b) and (d). In panel (c) and (d), the sample is analyzed separately for public and private schools, the navy line shows estimates for public schools and the yellow line shows estimates for private schools. The straight line shows the estimated treatment effect of the reform and the dashed line shows the estimated pre-trend. Only untreated samples were used to estimate pre-trends. The red dashed line in Panel (a) and (c) means three years after the elimination of the school zones.



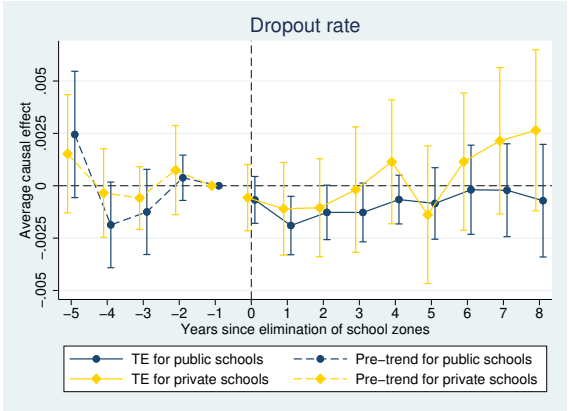
(a) University enrollment rates



(b) Dropout rates



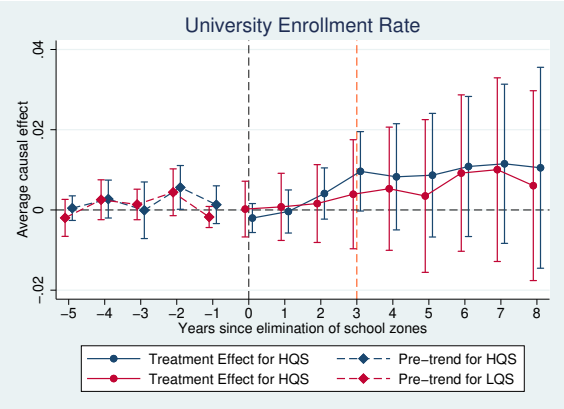
(a) University enrollment rates



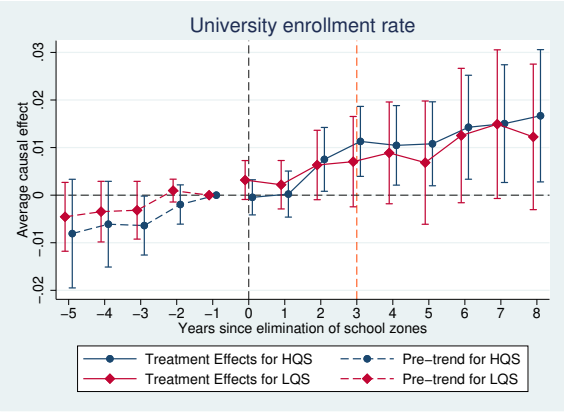
(b) Dropout rates

Figure A.10: Estimation results using a restricted sample

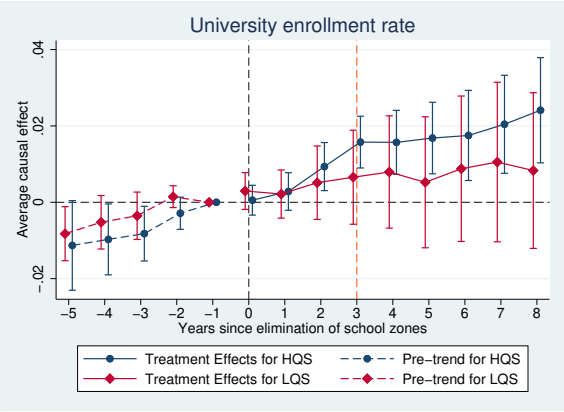
Note: These figures plot event-study estimates and 95% confidence intervals where events are elimination of school zones using a restricted sample that excludes schools in prefectures where the school zone remained in 2019 but changes to school zones were made after 2003. The dependent variables are the university enrollment rate in Panels (a) and (c), and the dropout rate in Panels (b) and (d). Observations are weighted by the number of graduates in Panels (a) and (c) and the number of students in Panels (b) and (d). In Panels (c) and (d), the sample is analyzed separately for public and private schools; the navy line shows the estimates for public schools, while the yellow line shows the estimates for private schools. The straight line shows the estimated treatment effect of the reform, while the dashed line shows the estimated pre-trend. Only untreated samples were used to estimate the pre-trends. Vertical red dashed lines in Panels (a) and (c) indicate three years after the elimination of school zones. All regressions control for school and year fixed effects.



(a) Estimator by Callaway and Sant'Anna (2021)



(b) Imputation estimator with covariates



(c) Imputation estimator using restricted sample

Figure A.11: Robustness of estimated effects by school level

Note: These figures plot event-study estimates and 95% confidence intervals when each sample is analyzed separately for high- and low-quality schools. High-quality schools (HQS) were those whose graduate university enrollment rate as of 2003 was above the median, while low-quality schools (LQS) were below the median among the prefectures. The dependent variable was university enrollment rate. The straight line shows the estimated treatment effect of the reform, while the dashed line shows the estimated pre-trend. The navy line shows the estimates for HQS, and the red line shows the estimates for LQS. The vertical vertical red dashed lines indicate three years after the elimination of school zones. All regressions controlled for school and year fixed effects, and the observations were weighted by the number of graduates. Panel (a) uses the estimator of Callaway and Sant'Anna (2021), while Panels (b) and (c) used the estimator proposed by Borusyak et al. (2023). In Panel (b), the prefectural population share under the age of 15, log of per capita taxable income, public expenditure on public education per student, tenure of the prefecture governor, and share of seats held by the leftist party in prefectural legislatures are also controlled. In Panel (c), a restricted sample that excluded schools in prefectures where the school zone remained in 2019 but changes to school zones were made after 2003 was used.

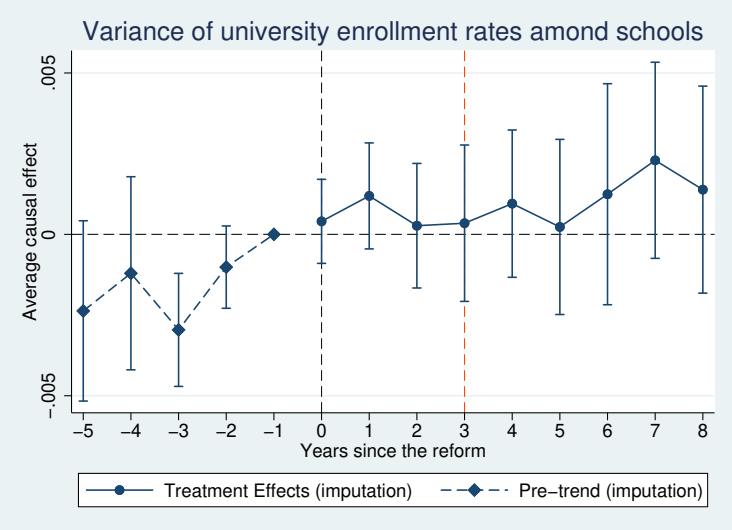
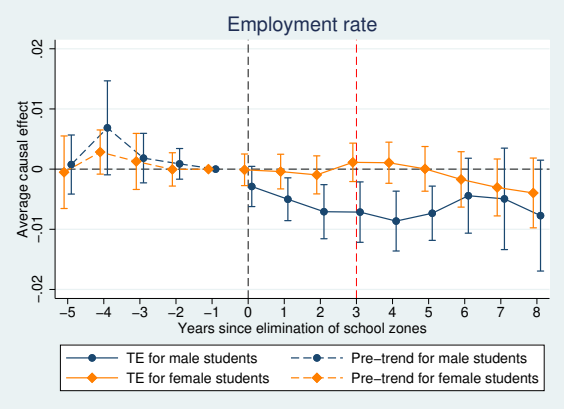
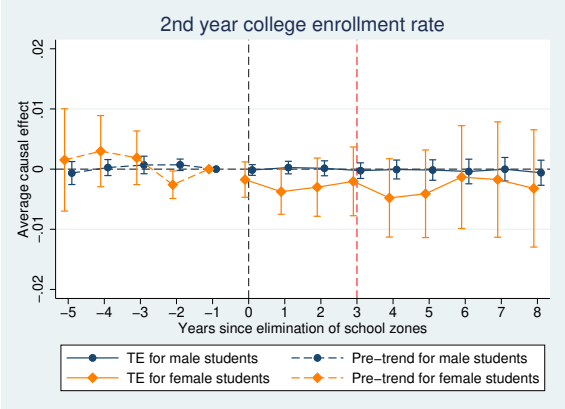


Figure A.12: Average effect on variance of university enrollment rate

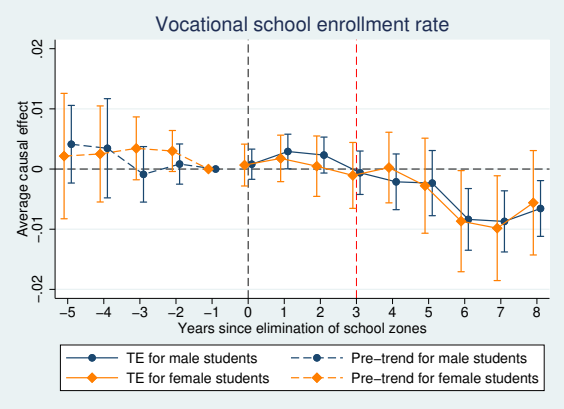
Note: These figures plot event-study estimates and 95% confidence intervals using prefecture-level panel data. The dependent variable is the standard deviation of the university enrollment rate in schools in the prefecture. The straight line shows the estimated treatment effect of the reform and the dashed line shows the estimated pre-trend. The vertical red dashed lines indicate three years after the elimination of school zones. All regressions control for prefecture and year fixed effects. Only untreated samples were used to estimate the pre-trends.



(a) Employment



(b) Two-year junior college



(c) Vocational school

Figure A.13: Average effect on other career paths

Note: These figures plot event-study estimates and 95% confidence intervals when the sample is analyzed separately for male and female students. The dependent variables are the employment rate of graduates in Panel (a), the two-year junior college enrollment rate in Panel (b), and the vocational school enrollment rate in Panel (c). The straight line shows the estimated treatment effect of the reform, while the dashed line shows the estimated pre-trend. The navy line shows estimates for the outcomes of male students, and the orange line shows estimates for those of female students. The vertical red dashed lines indicate three years after the elimination of school zones. All regressions control for school and year fixed effects, and the observations are weighted by the number of graduates in Panel (a) and the number of students in Panel (b). Only untreated samples were used to estimate the pre-trends.

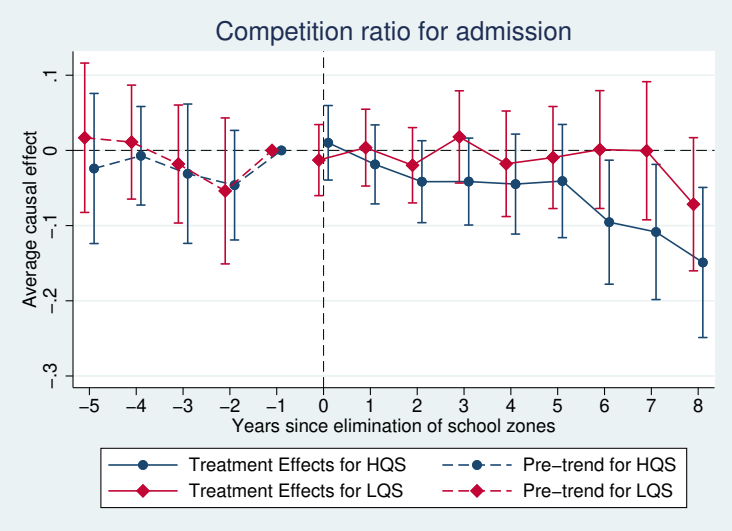


Figure A.14: Average effects on competition rate

Note: These figures plot event-study estimates and 95% confidence intervals when each sample is analyzed separately for HQS and LQS. HQS were those whose graduate university enrollment rate as of 2003 was above the median, and LQS were below the median among the prefectures. The dependent variable is the competition rate, which is defined as the ratio of applicants to the admission capacity. The straight line shows the estimated treatment effect of the reform, while the dashed line shows the estimated pre-trend. The navy line shows the estimates for HQS and the red line shows the estimates for LQS. All regressions were controlled for school and year fixed effects, and the observations were weighted by the number of graduates. Only untreated samples were used to estimate the pre-trends.