共同利用・共同研究拠点 Joint Usage/Research Center
東京大学 The University of Tokyo
空間情報科学研究センター
Center for Spatial Information Science

Discussion Paper Series

No. 181
CSIS Discussion Paper

May 2023

Path-dependence in the location of business agglomeration: Case of postwar land requisition

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ABSTRACT

Is the spatial distribution of business activity uniquely determined? This paper sheds light on this question by investigating the impact of land requisition by the US Army during the post-WW2 period in Yokohama City, Japan. Using the newly digitized location information of firms before and after WW2, this study examines whether the forced relocation of firms persistently altered the distribution of business activities. I show that land requisition reduces the size of incumbent agglomerations, and this negative effect lasted even after the occupied land was retroceded. I additionally show that the within-city relocation and the failure of public investment drove the decline of the agglomeration. My findings imply the location of economic agglomeration is not necessarily uniquely determined.

Keywords: path dependence, multiple equilibria, urban land use, requisition

JEL code: R12, R52, R58, N95

1. Introduction

Agglomeration of industry and population is a crucial driver of urban economic growth. However, owing to its place-based nature, it often faces local negative shocks, such as man-made and natural disasters and other various economic shocks. Therefore, it is important to understand the shock sensitivity of agglomeration — whether and how agglomeration bounces back from shocks (Martin & Sunley, 2015).

By exploiting the local negative shocks as natural experiments, the empirical literature has tested the multiple equilibria in the location of economic activities predicted by the seminal theoretical literature in spatial economics like Fujita et al. (1999). So far as known, they have shown that the physical shocks destroying structures and killing people only modestly shifted the spatial distribution of economic activities (Glaeser, 2022). A location with advantageous fundamentals makes the economic agents move back despite the destruction (e.g., Davis & Weinstein, 2002). Even under multiple equilibria, agglomeration recovers because of the self-fulfilling expectation and makes a negative shock undone (Takeda & Yamagishi, 2023). Furthermore, the damaged location sometimes experiences greater growth because a shock can be a catalyst for creative destruction through the reduction of demolition costs and the replacement of obsolete systems (Hornbeck & Keniston, 2017) or be a driver of policy intervention for urban renewal (Hu & Wang, 2019).

Although there are a few investigations that clearly found empirical evidence of multiple equilibria by exploiting the local shock as a natural experiment (e.g., Redding et al., 2011; Xu & Itoh, 2018), their implications for the whole urban economy are limited because they focused on a specific industrial sector like transportation. One of the focal points in testing multiple equilibria in an urban economy beyond a specific sector is initial heterogeneity in the first or second-nature geographies (e.g., Cuberes, 2009). While the majority of empirics assessing the impact of a local shock on outcomes of urban economy (e.g., population, business location) have rejected multiple equilibria, it might be driven by the context such that the ex-ante heterogeneity like the geographical constraint to relocate the agglomeration guarantees uniqueness of equilibrium (Lee & Lin, 2018; Lin & Rauch, 2022). In this respect, there is still room to examine if the single equilibrium in the distribution of economic activities indeed holds even though the initial condition is relatively homogeneous across locations.

To address this issue, I conduct the empirical analysis using the combination of the allied bombings of Japanese cities during WW2 and postwar urban land requisition in Yokohama, one of the Japanese biggest trading port cities, as exogenous variations. The bombings completely destroyed Yokohama's developed area. The remarkable difference in the recovery process from other Japanese cities was that land in the central business district (CBD) in Yokohama was almost unavailable for 5–15 years after the end of WW2 due to occupation by the US Army. At its peak, the area of requisitioned land reached 16 million square meters. It was 62% of the total requisitioned areas all over Japan. Since the Army also occupied about 90% of port facilities, trade sectors as Yokohama's key industrial sectors hardly relaunch their business under the requisition until 1950.

The examination of Yokohama's case in this study has several features in terms of data and the design of empirical analysis. To examine these questions, I newly digitize the location information of firms collected from city business directories and construct block-level panel data on the number of offices in commercial districts in Yokohama between 1930 and 1974. By utilizing this dataset, I can track the dynamics of the location of business agglomerations on a spatially detailed scale. The within-city analysis relying on the combination of two exogenous shocks (bombings and requisition) has several advantages for identification. First, I can test multiple equilibria under the condition that the ex-ante heterogeneity across blocks is small. The topography of Yokohama's commercial area is almost flat and hardly has variation. In addition, the bombings in advance of requisition destroyed all the urban structures in the area. In this sense, there were few hampers in the formation of alternative agglomeration. Second, the primary purpose of the requisition was based on the military strategies of the US Army and not necessarily on economic and institutional reasons. In this sense, the land requisition can be plausibly uncorrelated with local socioeconomic features. Third, the requisition was compelling for all economic agents in Yokohama.

The empirical findings in this study suggest that the postwar requisition dispersed economic activities from the CBD, which was not undone even in the 1970s. These results imply that postwar Yokohama's CBD underwent a different path of postwar growth from the average trend in Japanese cities. For an in-depth understanding of this negative association, I empirically test several anecdotes in line with theoretical findings in spatial economics. I show that an alternative core of business activities has persistently developed outside the incumbent CBD since the 1960s. This might be the consequence of cumulative causation (Ottaviano & Puga, 1998) triggered by the lockout of offices from CBD. Although forcedly relocated business activities should have moved back to the original location after the lifting of the requisition as with other Japanese cities, CBD has not recovered its superior position in the prewar period. Unlike Davis & Weinstein (2002; 2008), this result implies that the location of agglomeration cannot be determined by the location fundamentals alone. I also show that public investment such as land readjustment mitigates the negative association while uninvested requisitioned plots faced a more severe situation. This might correspond to the theoretical prediction by Allen & Donaldson (2022) where multiple stable equilibria tend to emerge if lagged agglomeration effects by the history of investment is strong. In other words, the exogenous change in the allocation of investment by the requisition might have shifted equilibrium distribution to another steady state.

This study contributes to several strands of literature. The primary literature focuses on shock sensitivity in the geographical distribution of economic activities. Originating from the pioneering work by Davis & Weinstein (2002), the empirics of spatial economics have examined whether agglomeration bounces back from exogenous shocks like wartime destructions (Davis & Weinstein, 2008; Miguel & Roland, 2011; Feigenbaum et al. 2022; Takeda & Yamagishi, 2023), natural disasters (Imaizumi et al. 2016; Hornbeck & Keniston, 2018; Hu & Wang, 2019; Okazaki et al., 2019; Siodla, 2021), and political shocks (Redding et al., 2011; Ahlfeldt et al. 2015).

Although the literature above employs credible identification and estimation strategies, the findings are mixed. Related to the heterogeneous initial condition, the difference in the spatial unit across the empirical investigations might make the variation in these findings (Lin & Rauch, 2022). While the majority of empirics have focused on the inter-city change in the distribution of economic activities, intra-city level investigations are still scarce. I fill this gap in the literature by the block-level analysis within a city. In addition, by exploiting the case of Yokohama, I can analyze the role of the institution in the recovery process of agglomeration. As a related empirical finding, Brakman et al. (2004) showed that the damages brought by WW2 had a permanent negative impact on the city size in east Germany unlike the west, and they guessed that this decline in the east arose from a dysfunction of the market by the socialist system. Relying on an alternative approach, Bosker et al. (2007) also confirmed the multiple equilibria in the location of agglomeration in the same context. Focusing on the requisition as an alternative form of economic dysfunction, I complement this literature by empirically testing if their guess holds on a within-city scale.

This study also contributes to the empirical literature regarding the restrictions on urban land use and the persistence of land use. Physical obstacles to land use due to topographic features (Saiz, 2010; Harari, 2020) and excessive land use regulations (e.g., Turner et al., 2014; Glaeser & Gyourko, 2018) hamper economic activities through various channels. Land requisition in Yokohama was only a temporary restriction on urban land use. Nevertheless, its long-term effects might be preserved in light of recent empirical findings suggesting that historical urban land use (policy) has persistent effects (Banerjee & Iyer, 2005; Brooks & Lutz, 2019; Allen & Leonard, 2021; Yamasaki et al., 2021; Miranda, 2022). Therefore, this study can also be regarded as an empirical examination of the long-term impacts of land-use restriction by exploiting the requisition as a natural experiment.

The remainder of this paper is organized as follows. Section 2 describes the historical background of Yokohama City and its postwar requisition. Section 3 explains the data and econometric specifications. Section 4 presents the results of the study, and Section 5 concludes.

2. Historical Background

2.1 History of Yokohama until WW2

Yokohama is located 30 km south of Tokyo and is one of the core cities in the Greater Tokyo Area[1]. Yokohama has a population of approximately 3.7 million, and it is the second-largest city in Japan. Until the middle of the 19th century, during the Edo period, Yokohama was just a small fishing village. However, it experienced sudden and rapid economic growth since Yokohama Port was designated as a port city open for trade with the West in 1859. After the opening, economic activities were concentrated in five coastal wards: Naka, Nishi, Minami, Kanagawa, and Tsurumi. Figure 2.1 shows the location of these wards, the commercial districts in 1947, CBD (a hinterland of Yokohama Port surrounded by the Ohoka River and Nakamura River), and two commercial districts.

Due to its proximity to Tokyo and the agglomeration of the spinning industry formed in its hinterland, Yokohama was one of the largest port cities in Japan in the early 20th century. It formed the commercial agglomeration of financial, wholesale, retail, and trade sectors centering around Yokohama Port, as well as manufacturing agglomeration. Although the 1923 Great Kanto Earthquake hit Yokohama and caused serious damage, its economic agglomeration soon recovered, and it achieved a larger level of growth[2]. In 1940, Yokohama's population reached nearly 1 million.

Due to its crucial role in economic activities and munition production, Yokohama was an important target of the allied bombing during WW2. Particularly, two bombings on April 18 and May 29, 1945, destroyed Yokohama's urban function. As shown in Figure 2.2, the burned area by the bombings reached 42 % of the urban area, and approximately 11,900 buildings

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[1] The description of historical context in this section largely relies on Yokohama City (1981; 1999; 2000; 2019), and Hattori & Saito (1983).

[2] For example, Okazaki et al. (2019) empirically showed that the earthquake achieved creative destruction in Yokohama City through the upgrade of machine technology and/or the survival of efficient firms.

were destroyed. The number of sufferers was approximately 4 hundred thousand and at least 19000 people were killed.

2.2 Postwar land requisition by the US Army

Soon after the end of WW2, the US Army began the countrywide occupation of Japan in advance of the official unconditional surrender. Yokohama was selected as the core occupation site for the mission. This was because of the proximity to the US Air Force base in a neighboring city and the intention of the Japanese government to defend the national polity, centering on the emperor (and his residence in Tokyo). In this sense, Yokohama can be seen as a location of interest in both the US and Japan. Along with the establishment of the headquarters of the US Eighth Army and conducting military government in the Far East, the occupation of Yokohama became full-fledged.

The US Army requisitioned a large part of Yokohama’s CBD. In 1952, at the peak of the occupation, the area of requisitioned land reached 16 million square meters, which was 62% of the total requisitioned area all over Japan. Additionally, because approximately 90% of port facilities were also occupied, trade sectors in Yokohama hardly relaunch their business. Plyarticular, the requisition share was largest in Naka Ward, the CBD of Yokohama City. Approximately 74% of plots in Naka were requisitioned by the army.

During the requisition, citizens and firms in Yokohama were forced to move out of the CBD, which was completely transformed into a location for military activities. Figure 2.3 shows the usage of requisitioned plots and buildings around Naka and Yokohama Port in the late 1940s. The surviving buildings were military offices, dormitories of officers, post exchanges, and clubs. In the burned area, new military facilities such as barracks, airstrips, and parking areas for military vehicles were built.

As shown in Figure 2.4, while coastal districts (so-called Kannai) and parts of port facilities were lifted around 1950, the requisition continued in inland districts because of the Korean War. Since the US Eighth Army was the main troop during the war, Yokohama has played a crucial role as a key supply base. Along with the armistice in 1952, a large part of the US forces moved to neighboring cities like Yokosuka and the requisition was gradually lifted.

2.3 Delay in post-requisition reconstruction

Despite a postwar construction boom throughout Japan, reconstruction in the former-requisitioned areas progressed very slowly. Since the requisitioned plots were returned in a state of greenfield without any construction, firms in the CBD had to rebuild their places for business from scratch. Additionally, because of occupation, infrastructure facilities such as roads were too dilapidated to restart economic activities, and the shortage of public budget made it difficult to implement large-scale repairs. This difficulty in reconstruction resulted in the relocation of offices to other regions, which led to the shrinkage of commercial agglomeration in the CBD.

The main destinations of the relocated offices were other commercial districts in Yokohama City. Particularly, the relocated or newly established offices were concentrated in the blocks outside the CBD in Naka Ward (called the "Noge Area"). Noge was a historical commercial area and one of the few blocks that escaped the requisition. Despite the fatal damage caused by the bombings, the black market in Noge began to grow soon after WW2 and formed the largest busy street in Yokohama by the end of the 1940s. After the end of the requisition, many restaurants and bars continued their businesses.

The other destination was the district surrounding Yokohama Station. A large part of the district was marshy until the 1920s, and urban development began after the completion of landfills. Despite good access to the railway, the western entrance of the station remained undeveloped for decades until the beginning of the 1950s. However, due to the development project by a private railway company and the postwar land readjustment project by the government, a new commercial area was constructed. After the completion of these projects, the district established its position as an alternative CBD. The highest point of land price in Yokohama City has been in front of Yokohama Station since the 1960s, while the highest point was in the requisitioned CBD in the prewar period (Suzuki, 2022).

The relocated firms' destinations were not limited to Yokohama City. The US Army occupied approximately 90% of the port facilities of Yokohama and utilized them as a key military base for the Korean War. This led to the outflow of trading companies, maritime industries, wholesale agents, and the financial sector from Yokohama City. After leaving only the subsidiaries in Yokohama, the headquarters were closed and relocated to Tokyo. As described by Yokohama City University (1957), while the number of wholesale agents per 1000 retail companies was 140 in 1933, it decreased to 57 in 1950.

The shortage in the update of urban infrastructure and land use due to policy intervention spurred the relocation of economic activities. The primary policy for postwar reconstruction in Japanese cities was land readjustment projects and infrastructure investments such as roads, parks, and sewage systems. While Yokohama was also regarded as a target of this project and the development plan was devised, it could not contain the requisitioned area, and target regions were only to fragment on a small scale. As a result, the obsolete urban structure and complicated land ownership relationship remained in the CBD due to the lack of readjustment, which hampered post-requisition reconstruction.

3. Methodology

3.1 Data

3.1.1 Office location

I constructed a dataset of the block (chome) -level number of offices spanning 45 years, covering the pre-war and post-war periods. The dataset was procured from the business directories published by the Yokohama Chamber of Commerce (YYC) in 1930, 1939, 1955, 1959, 1965, and 1974[3] (YYC, 1930, 1939, 1955, 1959, 1965, 1974). The directories cover basic information such as company name, address, and representative name for the members of the YYC and some other registered firms. These directories were digitized and aggregated at the block level[4][5]. The aggregated dataset covers commercial districts in five coastal wards: Naka, Nishi, Minami, Kanagawa, and Tsurumi. The definition of commercial districts was based on postwar reconstruction urban planning in 1947 (Yokohama City, 2000).

3.1.2 Requisitioned regions

I digitized a map showing the requisitioned regions (Yokohama City, 1954). Figure 3.1 shows the original version of the map. The regions were categorized according to their requisition status in 1954. The regions colored red and yellow were already (or to be) lifted, whereas those colored pink were still occupied by the US Army. This map confirms that approximately half of the CBD area was requisitioned. From the digitized map, I calculated,

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[3] In the 1980s, there were alternative big events in/near the CBD area affecting commercial activities like the closure of a large shipbuilding yard (Mitsubishi Jukogyo Yokohama Zosenjo) and the waterfront development projects (Yokohama Minatomirai 21). Thus, I do not include the observations from the directories published more recently because these events might distort the evaluation of the effects of requisition.

[4] Although the industrial classification is available for each office in the directories, it is difficult to conduct consistent industrial-level analysis because the classification relied on the product (e.g., textile, food) in the prewar period but on business type (e.g., manufacturing, wholesale) in the postwar period.

[5] In the process of aggregation, I relied on the block division in 1959.

for example, the binary variable taking a value of one if a block was in a requisitioned region and the share of a requisitioned area in each block.

3.1.3 Postwar land readjustment project

A map of the target regions of the land readjustment project is available for Yokohama City (1986). This map was digitized to calculate, for example, the binary variable taking a value of one if a block was in a readjusted region and the share of a readjusted area in each block.

3.1.4 Demographic feature

I used the population variable in the initial period as a control variable to consider the difference in the level of economic activities among the blocks. The block-level population data of Yokohama City are available from the 1935 National Census of the pre-war period (Yokohama City, 1936). The population share of each block is calculated.

3.2 Econometric specifications

The main hypothesis of this study is that the postwar land requisition persistently shrank business agglomeration. As the anecdotes in the previous section show, the CBD of Yokohama experienced the outflow of commercial and trading-relevant activities and the emergence of an alternative CBD under the land requisition by the US Army. Unlike other Japanese cities, this additional constraint might have hampered the postwar reconstruction of the CBD and made the CBD's centripetal force permanently lower, while citizens could not have clear prospects for post-requisition reconstruction. In sum, I hypothesize that requisition incurred long-run negative effects on commercial activities in the CBD.

Using the number of offices in each block as an outcome, I evaluate the effects of land requisition in the CBD by estimating the difference-in-differences (DD) method. By combining DD with fixed-effect panel estimation, I controlled for various time-invariant and unobservable factors. The outcome takes a non-negative and small integer value, and contains many zeros.

Additionally, the distribution of outcomes was highly right-skewed[6]. Thus, it is assumed that it follows a negative binomial distribution[7]. The baseline specifications are as follows:

$$E[Y_{it}] = \exp[\rho_t + \kappa_i + req_i \times postwar_t \beta + \mathbf{x}_{it}\boldsymbol{\gamma}], \tag{1}$$

where Y_{it} is the number of offices in block i in period t; ρ_t is the time fixed effect that controls for macroeconomic trends common to all blocks; κ_i is the individual (block) fixed effect that controls for time-invariant block-specific factors such as geographic characteristics (e.g., area, terrain, proximity to port) and historical features before 1930. $req_i \times postwar_t$ is a variable of interest, in which req_i is a dummy variable taking a value of 1 if block i was in a requisitioned region in the CBD and 0, otherwise, and $postwar_t$ takes a value of 1 during the postwar period and 0, otherwise. Thus, the treatment group consists of blocks inside the requisitioned regions, whereas the control group is composed of those in commercial districts outside the regions. $\mathbf{x}_{it}$ is a set of control variables, including the interaction term between the population share of each block and the year dummies. The main hypothesis was supported if $\beta < 0$.

While req_i takes a value of 1, even if only 1% of block i's area is requisition by its definition, the intensity of requisition varies across blocks. Thus, we also use an alternative treatment variable, req_h_i, which takes a value of 1, if the share of the requisitioned area exceeds 50% of block i's total area.

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[6] See Figure A.1 and Table A.1 for the descriptive statistics of the (in)dependent variables.

[7] The blocks with no office in 1930 were dropped from the dataset to avoid the zero-inflation. After that, the share of zero dropped to 9.1% of all observations.

4. Descriptive analysis

4.1 Time series variation in the number of offices

To compare the trend of change in the number of offices between the treatment group (inside the requisitioned regions in the CBD) and the control group (outside), I show the time series variation from 1930 to 1974 in Figure 4.1. On average, in 1930 and 1939, the blocks in the treatment group had nearly twice as many offices as those in the control group. Additionally, the trend of change in the number of offices appeared parallel between groups.

However, in 1955 and 1959, the trend observed during the pre-war period was reversed. The number of offices in the treated blocks was lower than that in the untreated blocks. Although treated blocks gradually recovered their absolute size after 1965, their superior position compared with untreated blocks did not return to the pre-war level because the untreated blocks experienced simultaneous growth.

4.2 Spatial distribution of offices

Figure 4.2 geographically visualizes the rate of change in the number of offices between 1939 and 1955 around the CBD, Noge area, and Yokohama Station. The cold-colored blocks decreased the number of offices, whereas the number of warm-colored blocks increased. The shaded area represents the requisite area of the CBD. Since the shaded blocks were immediately after the turnback or were still occupied in 1955, it can be observed that these blocks experienced a great decline. In contrast, the blocks in the Noge area and neighboring Yokohama Station (peripheral blocks) had the largest growth rate.

I also visualize the rate of change between 1939 and 1974 in Figure 4.3. In the former requisitioned blocks, some blocks experienced growth, while others did not, and it was difficult to find a clear spatial pattern. In contrast, growth in peripheral blocks was consistently observed in 1974.

Similar trends are observed in the density map. Figure 4.4 shows the density of offices (the number of offices divided by a block's area) for each period. In 1939, only blocks in the CBD formed commercial agglomerations. The business district, made up of the trading and financial industries, was located in the coastal blocks, while the inland blocks shaped a shopping district. However, in 1955, the CBD lost its density, while alternative agglomeration emerged in the Noge area. Although the density in the coastal blocks seemed to recover until 1974, the inland blocks could not regain their density. Instead, newly formed agglomerations can be observed around the Yokohama Station.

5. Results

To test the effect of the requisition (and its duration) on the number of firms, I first show the estimation results for the specifications described in Section 3.2. For an in-depth understanding of the obtained results, I also present the results of an additional analysis. Finally, I conducted a series of robustness checks to examine the stability of the obtained results.

5.1 Baseline results

Table 5.1 shows the baseline results to test the main hypothesis (postwar land requisition shrank business agglomeration). In Column (1), even when controlling for the block and year fixed effect, the coefficient of the treatment variable, *req*×*postwar* is significantly negative. This result implies a negative association between requisition and the number of offices. Column (2) also shows the estimation results, including the population share of each block as an additional control variable. The value of the estimated coefficient hardly changed. To distinguish the long-term impacts of the requisition, I also show the result excluding the observations in the 1950s in Column (3). The estimated coefficient is still negatively significant while the absolute value becomes smaller than the Columns (1) and (2).

Column (4) shows the result using the alternative treatment variable *req_h* taking a value of one if the share of the requisitioned area exceeds 50% of the block's total area. The estimated coefficient is indeed negatively significant and its absolute value is larger than those obtained in Columns (1) and (2) using a baseline treatment variable. Column (5) the result excluding the observations in the 1950s. It can be confirmed that the negative association is indeed significant. These results imply that the negative association is stronger when the requisition intensity is higher, which lasted even after the end of the requisition.

For each treatment variable, I report the incidence rate ratio (IRR) calculated as the exponential of the estimated regression coefficient. In the case of count data regression, IRR represents the rate of change in the dependent variable for one unit increase in an independent variable when other variables are constant (Hilbe, 2011). In the estimation results using all observations, IRRs for treatment variables range from 0.388 to 0.477. This result suggests that the number of offices decreased to 38.8 ~ 47.7% of that before the requisition averaged over an entire period, controlling for the trend of outcome observed in the untreated blocks, individual and time fixed effects. Even excluding the observations in the 1950s, IRRs are less than 0.7, which implies the long-lasting decline of the incumbent agglomeration.

Figure 5.1 shows the event study plot using 1939 as the reference period. Specifically, I estimate time-varying treatment effects β_{1t} based on the following specification:

$$E[Y_{it}] = \exp[\rho_t + \kappa_i + \textstyle\sum_{t \neq 1939} req_i \times dum\_y_t \beta_{1t} + \mathbf{x}_{it}\boldsymbol{\gamma}], \qquad (2)$$

where dum_y_t is a year dummy. The estimated coefficient for 1930 was almost zero and statistically insignificant. Thus, there is no convincing evidence that the parallel trend assumption is violated. The absolute values of the coefficients in 1955 and 1959 are larger than the baseline estimate in Table 5.1, whereas those in 1965 and 1974 are smaller. While the negative association was stronger in the 1950s, when some of the requisitioned blocks were immediately after the turnback or still occupied, this association was mitigated with the march of time. However, it is noteworthy that the negative shock of requisition does not seem completely undone because the estimates after 1965 are still significantly negative. Overall, the obtained results support the main hypothesis. In Figure 5.3, I calculate IRR for each estimated coefficient of Eq. (2) shown in Figure 5.2 to capture the time series variation in the change of rate in the number of offices. While the number of offices decreased to 30 ~ 40% of that before the requisition in the 1950s, it recovered to approximately 65% after the 1960s.

5.2 Additional analysis

From the discussion in Section 2.3, the main reasons for the delay in post-requisition reconstruction are as follows: (1) within-city relocation of agglomeration; (2) outflow of trade-relevant industries to neighboring cities; and (3) low usability of the requested area due to the absence of the integrative land readjustment project. Because the dataset does not cover the information of offices outside Yokohama, I conduct an additional analysis focusing on within-city relocation and the low usability of requisitioned regions in this section.

5.2.1 Within-city relocation of agglomeration

The main results imply that the requisitioned blocks experienced a prolonged decline in the agglomeration of commercial activities. In contrast, from the descriptive analysis of the spatial distribution of offices in Section 4.2, the area around Yokohama Station has emerged as an alternative CBD since the 1960s. To link these findings, I conducted an empirical examination based on the following DID specification:

$$E[Y_{it}] = \exp[\lambda_t + \eta_i + station_i \times postwar_t \beta' + \mathbf{x}_{it}\boldsymbol{\delta}], \quad (3)$$

where $station_i$ takes a value of 1 if block i is in the districts neighboring Yokohama Station (specifically Minami-saiwai, Kita-saiwai, Tsuruya, and Takashima-dori). One caveat is that the number of blocks in these districts is only eight, so the ratio between the treated and untreated units is quite unbalanced. Note that the dataset for this examination does not include observations of blocks in the requisitioned area.

Table 5.2 show the estimation results of Eq. (3). As shown in Column (1), the coefficient of the treatment variable *yoko* ×*after* is significantly positive. This result implies that the blocks around Yokohama Station experienced growth in business activities in the post-war period. Column (2) shows the estimation results including the population share of each block as an additional control variable. The value of the estimated coefficient hardly changed.

I also show an event study plot using 1939 as the reference period in Figure 5.3. The estimated coefficient in 1930 was negative but barely insignificant. In the postwar period, however, the coefficients became positive, although those in the 1950s were insignificant.

From these results, the blocks around Yokohama Station have grown at an accelerated pace since the 1960s, compared with other blocks.

5.2.2 Role of land readjustment project

As described in Section 2.3, although Yokohama City was a target of the postwar land readjustment project, the government could not conduct it on an integrative scale because of the requisition. Figure 5.4 shows the digitized map of the readjusted regions, together with a map of commercial districts and requisitioned regions in the CBD. It can be confirmed that not all requisitioned blocks in the CBD were covered. To test the difference in post-war reconstruction depending on policy intervention, I estimate the following specification:

$$E[Y_{it}] = \exp[\rho_t'' + \kappa_i'' + req_i \times postwar_t\theta_1 + req_i \times postwar_t \times read_{it}\theta_2 + \mathbf{x}_{it}\boldsymbol{\gamma}''], \tag{4}$$

where $read_{it}$ takes a value of 1 if block i was the target of the readjustment project. Since the majority of the project was completed in 1965, $read_{it}$ takes a value of 1 in 1965 and 1974 for each targeted block. A single term $read_{it}$ is included in $\mathbf{x}_{it}$. If the availability of the readjusted land really matters in the reconstruction, I hypothesize that θ_2 is significantly different from zero and even positive.

Table 5.3 shows the estimation results of Eq. (4). In Column (1), the estimated coefficient of the baseline treatment variable, the interaction term between *req* and *after*, is still negatively significant, and its magnitude is larger than the baseline results in Column (2) of Table 5.1. By contrast, the triple interaction term, *req*×*postwar*×*read* is positively significant. As Column (2) shows that this association becomes sharper when using the alternative treatment variable. These results imply that the negative association between requisition and economic activities was mitigated by the improvement in the quality of land, although the requisition did not completely undo a negative shock.

5.3 Robustness check

5.3.1 Alternative outcome

As shown in Section 4.1, the decline in the requisitioned CBD was not only absolute but also relative. To capture this relative decline more explicitly, I also conduct a linear DD using the share variable as an outcome, defined as follows[8]:

$$share_{it} = Y_{it}/\sum_j Y_{jt}. \tag{5}$$

Figure A.2 shows the time series variation of the office share from 1930 to 1974 for the treatment and control groups. During the prewar period, the office share was larger in the treated (requisitioned) groups, and the share was almost invariant in both groups. As in the case of the number of offices, the trend of office share seems to be similar between groups. In the 1950s, however, the untreated (non-requisitioned) blocks became dominant. Although the treated blocks partially recovered their position after the 1960s, they could not bounce back to the level observed in the prewar period.

This observation can also be confirmed by regression DD. Figure A.3 shows the event study plot using the share variable as the outcome. The treatment variable in 1930 was negative but insignificant. Thus, I cannot find convincing evidence that the parallel trend assumption is violated even when relying on the share variable. The treatment variables in the postwar period have a similar trend to that observed when using the baseline specification (Figure 5.1). Indeed, the negative shock of the requisition does not seem to be completely undone.

5.3.2 Excluding blocks in Tsurumi Ward

[8] Another motivation of the analysis relying on the share variable is to check the sensitivity of the parallel trend to the model specification. See, for example, Fredriksson & de Oliveira (2019) for details of the scale dependence in the parallel trend assumption. Note that the distribution of the outcome remains right-skewed even after taking the share.

In the baseline analysis, the dataset included five coastal wards: Yokohama City, Naka, Nishi, Minami, Kanagawa, and Tsurumi. However, compared to other wards, Tsurumi historically has commercial regions with many manufacturing plants. This mixed land use might have made Tsurumi unsuitable for inclusion in the control group. To address this problem, I also conducted DD, excluding the blocks in Tsurumi. Table A.2 shows the estimation results. It can be found that the exclusion of the observation in Tsurumi hardly alters the main results shown in Table 5.1.

5.3.3 Alternative definition of treatment group

The treatment variable in the baseline specification is defined as the requisitioned block in the CBD. However, as shown in Figure 3.1, the requisitioned regions were not limited to the CBD, and some other blocks outside the CBD were also occupied in the postwar period (although the duration of the requisition was generally shorter outside the CBD). To capture the overall impact of the requisition in Yokohama City, I estimate the following specification.

$$E[Y_{it}] = \exp[\zeta_t + \tau_i + req\_all_i \times postwar_t \beta'' + \mathbf{x}_{it}\boldsymbol{\xi}], \tag{6}$$

where req_all_i takes a value of 1 if block i was in a requisitioned region. I also estimate the following triple differences (DDD) to evaluate the heterogeneity in the effect of the requisition between the CBD and the periphery:

$$E[Y_{it}] = \exp[\zeta'_t + \tau'_i + req\_all_i \times postwar_t \beta''_1 + req\_all_i \times postwar_t \times cbd_i \beta''_2 + \mathbf{x}_{it}\boldsymbol{\xi}'], \tag{7}$$

where cbd_i takes a value of 1 if block i was in the CBD. The interaction term between cbd_i and $postwar_t$ is included in $\mathbf{x}_{it}$.

Table A.3 shows the estimation results. As shown in Column (1), compared to the baseline results in Table 5.1, the estimated coefficient of *req_all*×*postwar* is marginally smaller than that of the baseline treatment variable *req_all*×*postwar* but almost unchanged. Column

(2) shows the result when introducing the triple interaction term *req_all×postwar×cbd,* and it can be confirmed the estimated coefficient of this term is also negative. This result suggests that the negative association between the requisition and economic activities was stronger inside CBD.

5.3.4 Excluding blocks in the main destinations of relocation

As shown in Sections 4.2 and 5.2.1, the peripheral blocks of CBD experienced growth in economic activities despite the decline in CBD. However, this result implies an issue when estimating DD as a violation of SUTVA (the stable unit treatment value assumption) at the same time. To address this problem, I also conducted DD excluding the blocks in the main destinations of relocation, the blocks in the Noge Area, and around Yokohama Station. Table A.4 shows the estimation results. Although the absolute value of the estimated coefficient is smaller than that in the baseline results (see Table 5.1), it is still negatively significant, as shown in Column (1). Additionally, Column (2) implies that the magnitude of negative association is almost same as the baseline when using the blocks whose share of requisitioned area exceeds 50% as the treated units.

5.3.5 Controlling for market potential variable

In addition to the population share, I also estimate the specification, including a control variable serving as a proxy for market potential (MP). The MP variable is defined as follows:

$$MP_i = \sum_{k \in R_i} \ln[visitors_k], \tag{8}$$

where R_i represents a set of tram stops in 1932 within 1 km from block i's centroid; $visitors_k$ is the number of passengers getting off at tram stop k[9]. I included the interaction term between *MP* and year dummies as the control variables. One caveat when including *MP* is the considerably strong correlation with the treatment variable. The value of the correlation coefficient is 0.75, which exceeds the threshold (|correlation|>0.7), where the model estimation is severely distorted by multicollinearity in general (Dorman et al. 2013). Thus, the results obtained should be interpreted with caution. Table A.5 shows the estimation results. It can be found that inclusion of the MP variable does not alter the main results shown in Table 5.1.

[9] $visitors_k$ is average value of the observation on October 6th, 1932 and that on November 8th, 1933. See Yokohama City (1940) for more detail.

6. Conclusion

This study addresses whether the spatial distribution of business activity has multiple equilibria. To empirically test this question, I exploit the combination of the allied bombings during WW2 and postwar urban land requisition by the US Army in Yokohama as exogenous variations. The recent literature implies that the mixed empirical findings regarding multiple equilibria might be governed by the ex-ante heterogeneity in the first and second-nature geography. The combination of these shocks and within-city analysis enables me to test the question under the condition that the heterogeneity across blocks is smaller. This is because I can examine the impact of exogenous shift of business activities and its persistency under the condition that the urban structures built on the plain were almost destroyed by the bombing.

I construct block-level panel data on the number of offices in the commercial district of Yokohama covering the prewar and postwar periods. Using fixed-effect difference-in-differences, I find that the requisitioned blocks experienced a decline in economic activities. The results also imply that the negative shock was not completely undone, even 30 years after the end of WW2. This result is contradictory to the majority of findings in existing empirics showing that the economic activities moved back to the original location and agglomeration recovered despite the negative shock.

I also empirically test several anecdotes regarding the causes of this decline. First, the blocks around Yokohama Station, the main destination of relocated offices, experienced growth in business activities in the postwar period. Growth began in earnest after the 1960s. This coincided with the completion of the development project at the station. Second, the results imply that the land readjustment project in the postwar period as a policy intervention to improve land usability mitigated the negative shock, whereas the requisitioned blocks without the intervention faced a more severe situation.

This study has several implications. Relevant to land use restriction, the unavailability of land is advantageous in business activities and incurs long-term economic decline, even if it is temporary. Although the requisition in Yokohama is indeed an extreme case, the results showed the harmful aspect of the excessive regulation of urban land use, as discussed in the literature on urban economics.

From the perspective of regional economic resilience, findings suggest that prolongation of negative shock cancels out the mechanism of creative destruction and the self-organized recovery of agglomeration. Another implication regarding resilience is that a policy intervention for reconstruction plays a crucial role in the absence of a self-organized process in the recovery of agglomeration. Considering these implications, a reconstruction policy should be implemented as soon as possible after a shock by eliminating tangible and intangible barriers.

Acknowledgments

We thank Olga Demidova, Shota Fujishima, Shinya Fukui, Mizuki Kawabata, Hiroshi Kumanomido, Naoto Mikawa, Mariko Nakagawa, Kentaro Nakajima, Chihiro Shimizu, Atsushi Yamagishi, and Junichi Yamasaki for their comments and suggestions. An early version of this paper was presented at the CSIS DAYS 2021, the 61th ERSA Congress, and at the 36th Applied Regional Science Conference (ARSC). We thank the participants of these conferences for their helpful comments and suggestions.

Declaration of Interest Statement

This study was supported by the Japan Society for the Promotion of Science (JSPS) under KAKENHI Grant Numbers 22K13411, and Obayashi Foundation.

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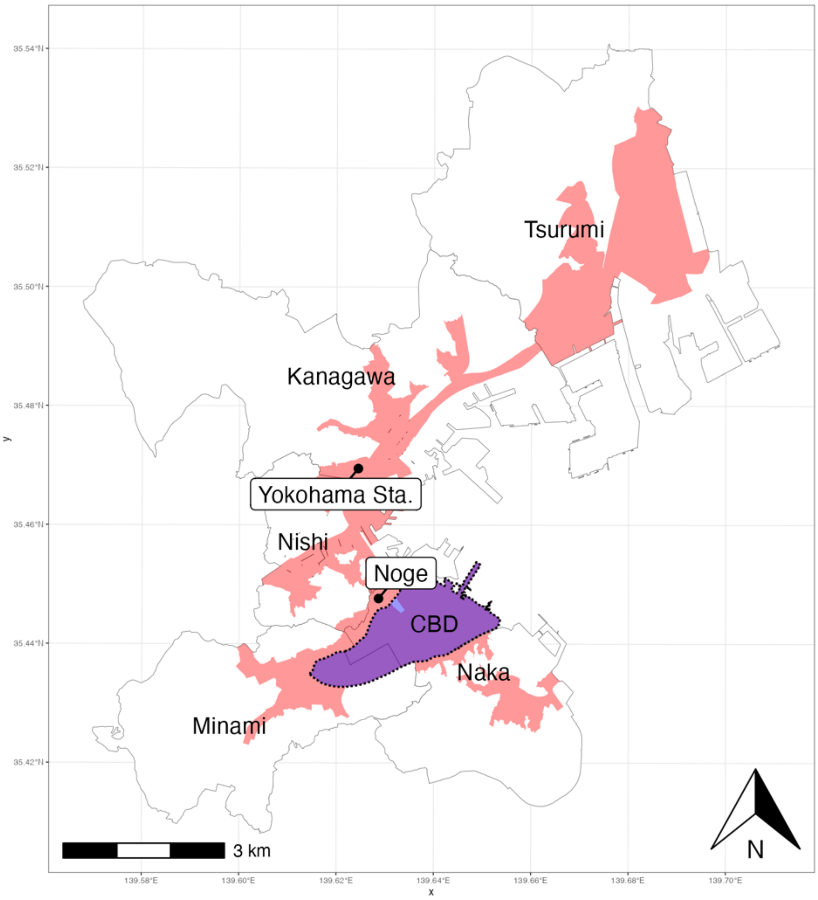
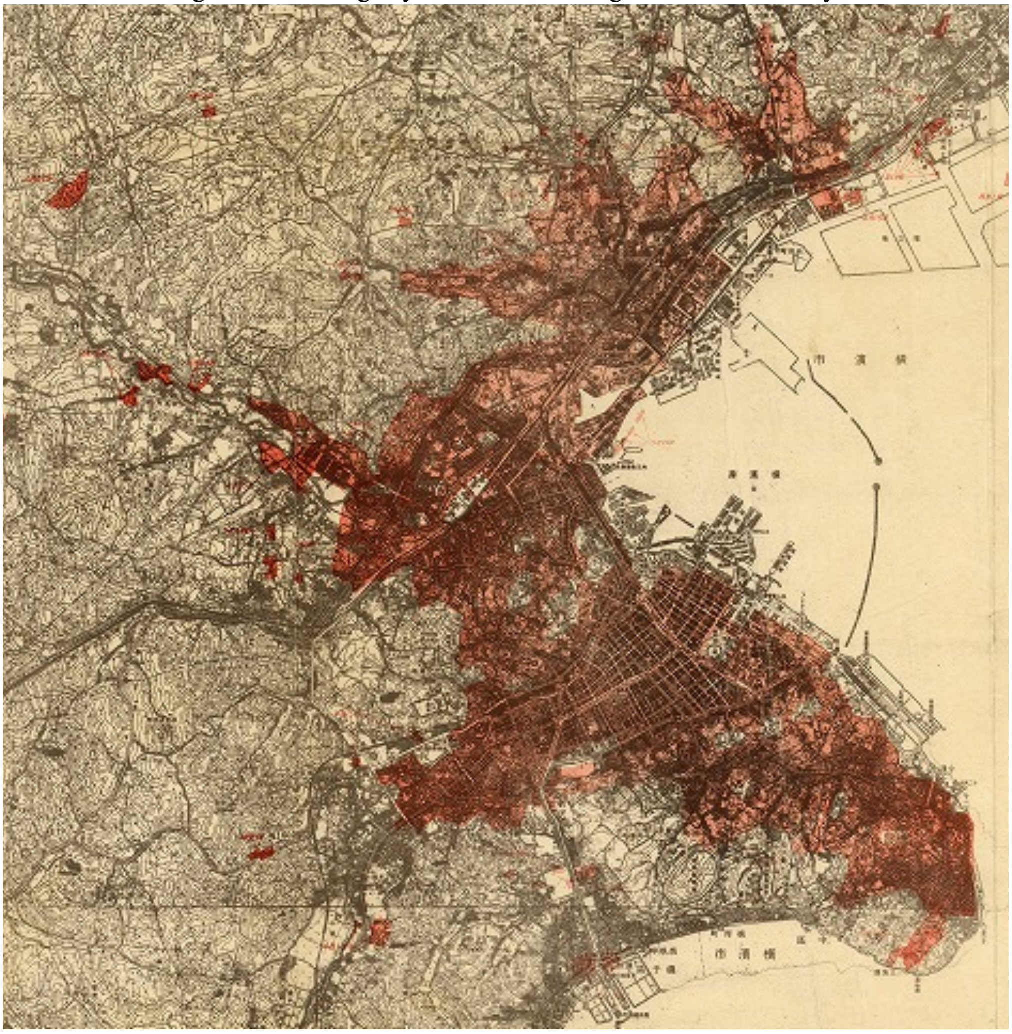
Figure 2.1: Location of the coastal wards and CBD



Notes: The red area represents the commercial area in 1947. The purple area represents the CBD.

Figure 2.2: Damage by the allied bombings in Yokohama City

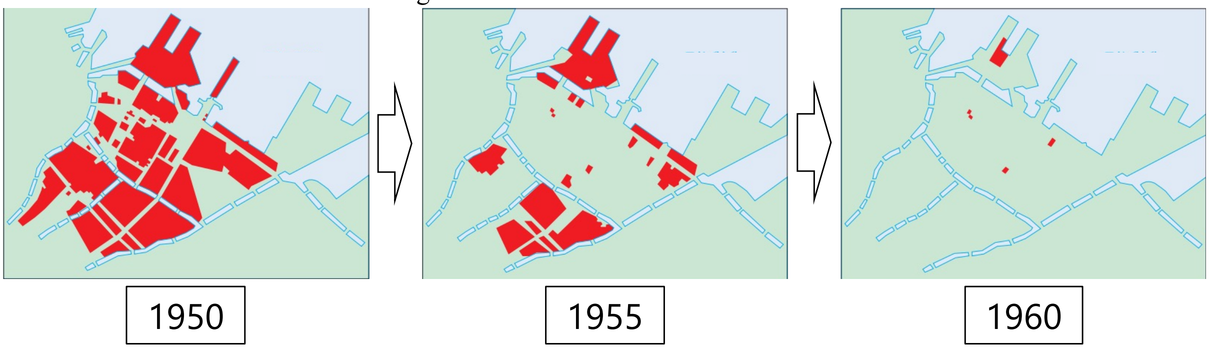


Notes: The black areas represent urban areas. The red-hatched area represents the damaged area. This map is available from the Yokohama Archives of History.

Figure 2.3 Usage of requisitioned plots

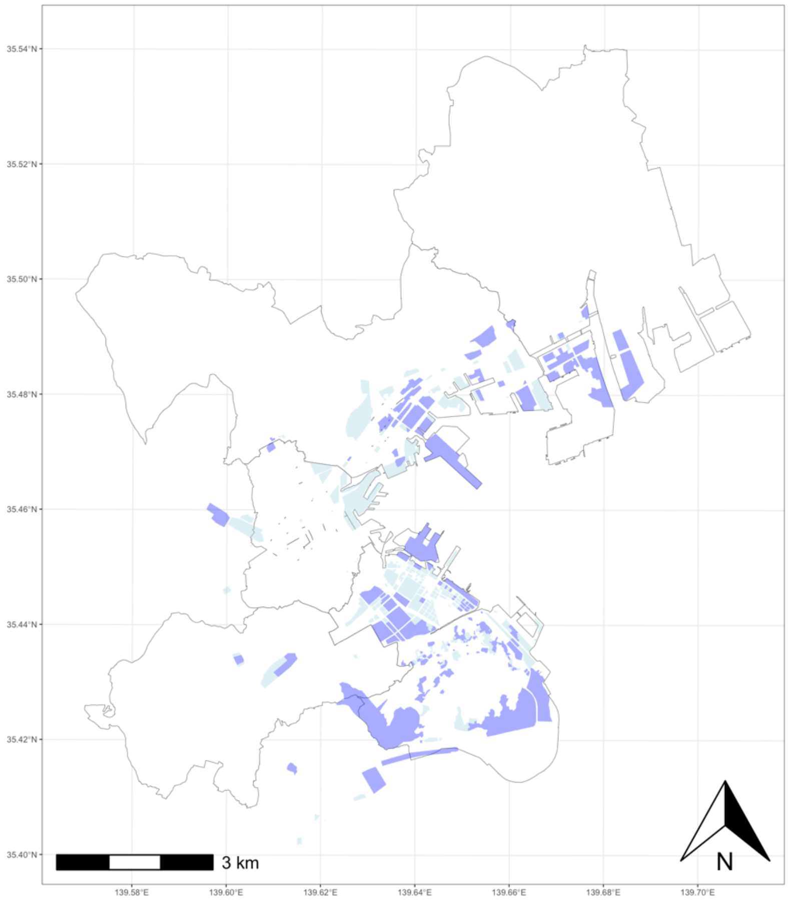
Notes: The source of this map is GHQ (1949).

Figure 2.4 Process of land retrocession



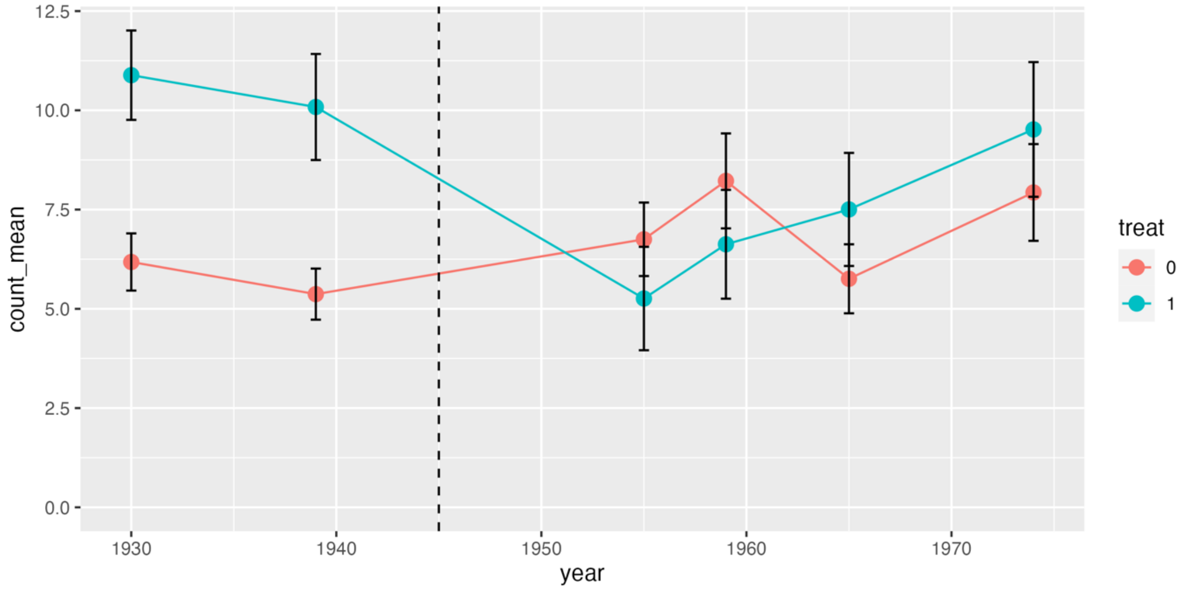
Note: The red area represents the requisitioned area for each period. Yokohama City (1997) was the source of the maps.

Figure 3.1 Requisitioned regions



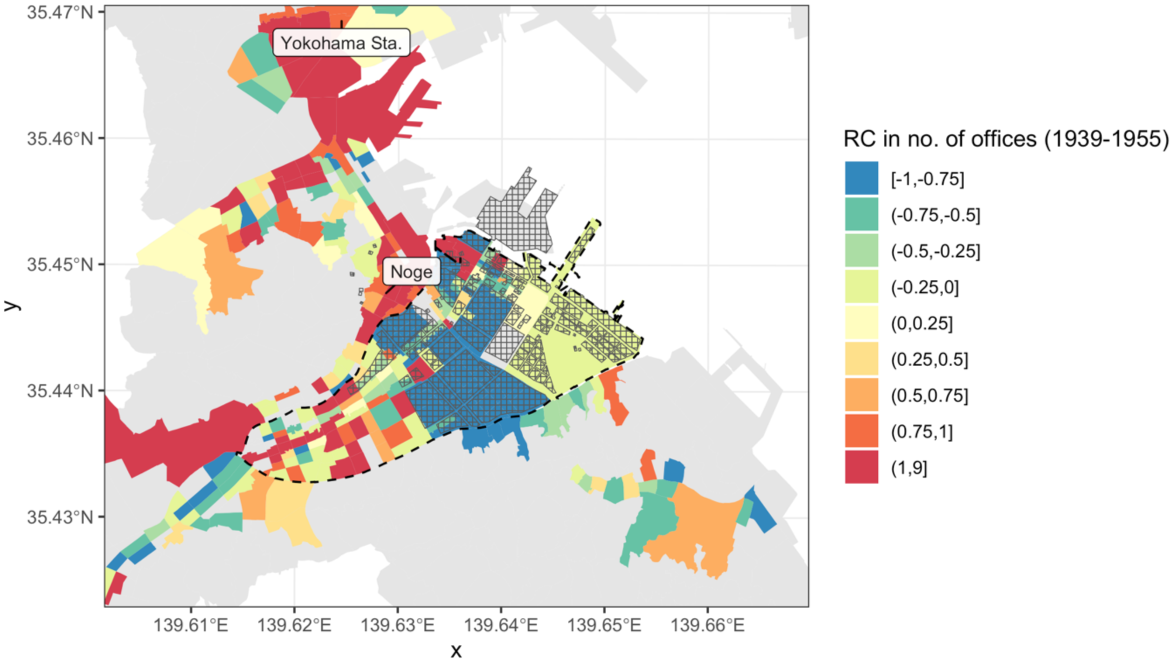
Note: The original version is in Yokohama City (1954). The blue area was retroceded after 1954. The area colored with light blue was retroceded before 1954.

Figure 4.1 Time series variation of the number of offices



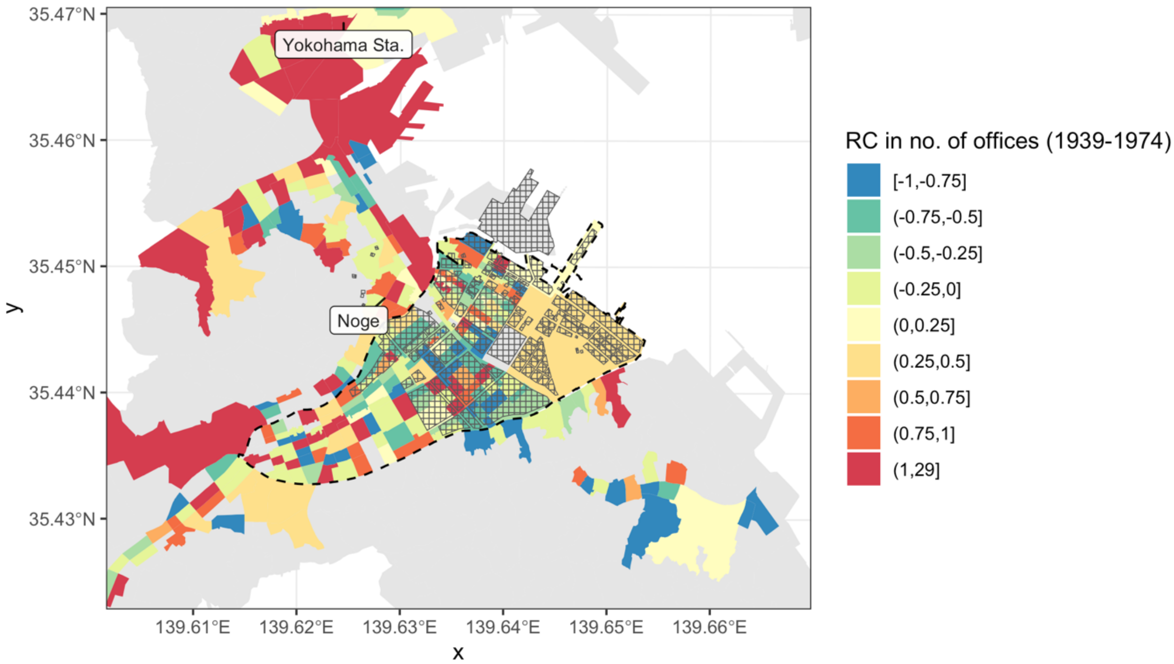
Notes: The blue line represents the average number of offices in the treatment group in each period and the red lines represent those in the control group. Arrow indicates the standard error of each observation.

Figure 4.2 Rate of change in the number of offices (1939-1955)



Note: The hatched area represents the requisite areas in the CBD. The dashed line represents the National Railway routes.

Figure 4.3 Rate of change in the number of offices (1939-1974)



Note: The hatched area represents the requisite areas in the CBD. The dashed line represents the National Railway routes.

Figure 4.4 Density map of offices

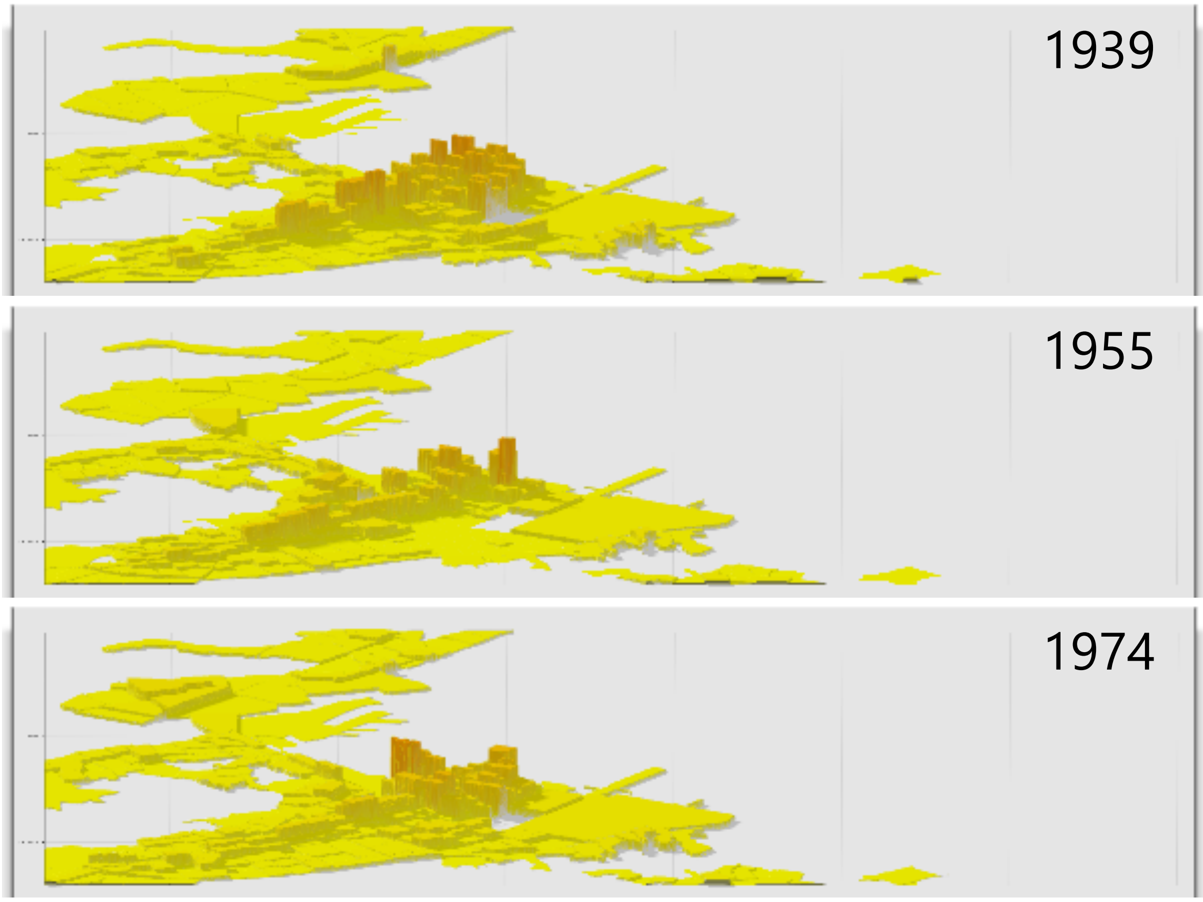
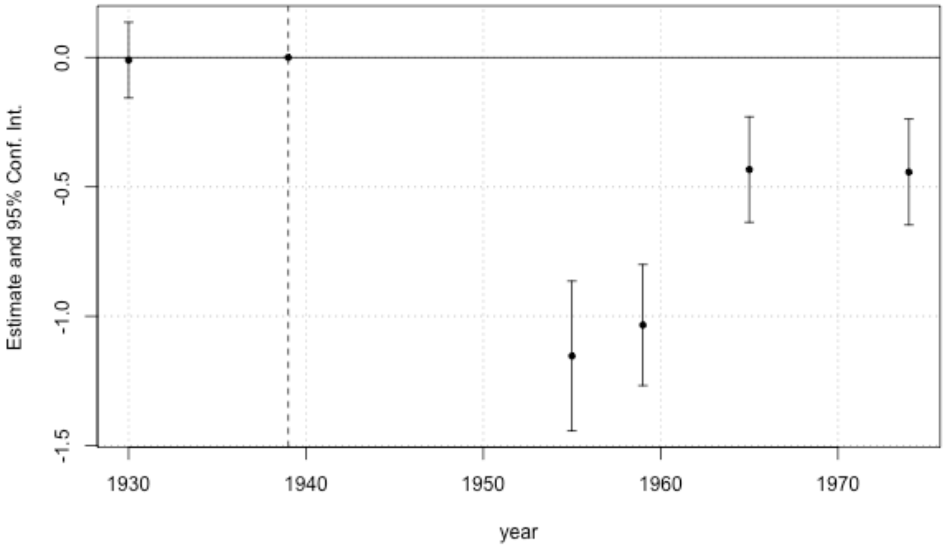


Table 5.1 Baseline results

	(1)	(2)	(3)	(4)	(5)
Req×postwar	−0.768*** (0.097)	−0.741*** (0.098)	−0.381*** (0.095)		
Req_h×postwar				−0.947*** (0.098)	−0.470*** (0.102)
IRR	0.464	0.477	0.683	0.388	0.625
Block FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Control	None	Population	Population	Population	Population
Observations	1,920	1,920	1,280	1,920	1,280

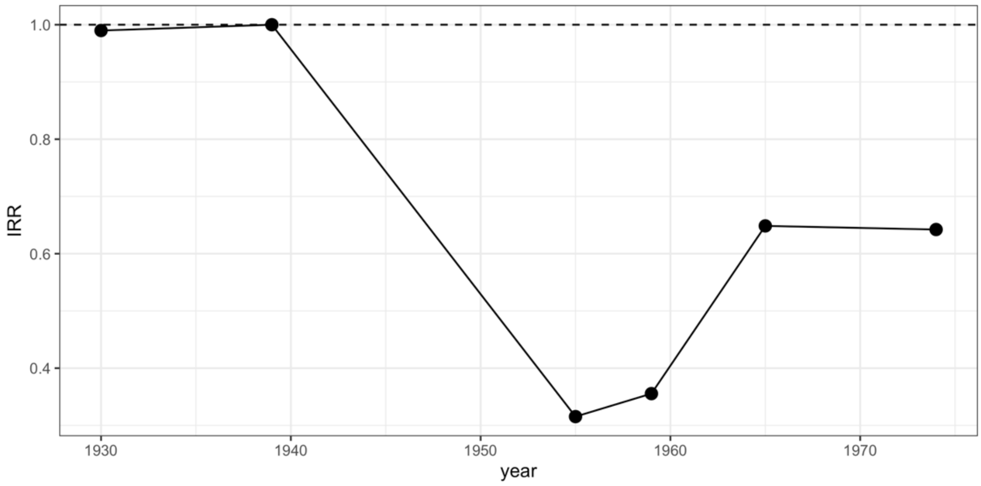
Notes: The estimation results of negative binomial regression formulated in Eq. (1) are reported. The dependent variable is the number of offices. *Req* takes a value of 1 if a block was in a requisitioned region in the CBD and 0, otherwise. *Postwar* takes a value of 1 during the postwar period and 0, otherwise. *Req_h* takes a value of 1 if the share of the requisitioned area exceeds 50% of a block's total area. In Columns (3) and (5), the observations in 1955 and 1959 are excluded. The incidence rate ratios for the regression coefficients of treatment variables, *Req×postwar* and *Req_h×postwar*, are reported in IRR. The levels of statistical significance are as follows: *** 1%, ** 5%, and * 10%. Standard errors were clustered at the block level.

Figure 5.1 Event study plot for the baseline result



Notes: The estimation results of negative binomial regression formulated in Eq. (2) are reported. The dependent variable is the number of offices. Each point represents a point estimate of the regression coefficient of the time-varying treatment variable $req \times dum\_y$. The arrow for each point represents the 95% confidence interval for each point estimate.

Figure 5.2 Incidence Rate Ratios for estimated coefficients of treatment variables



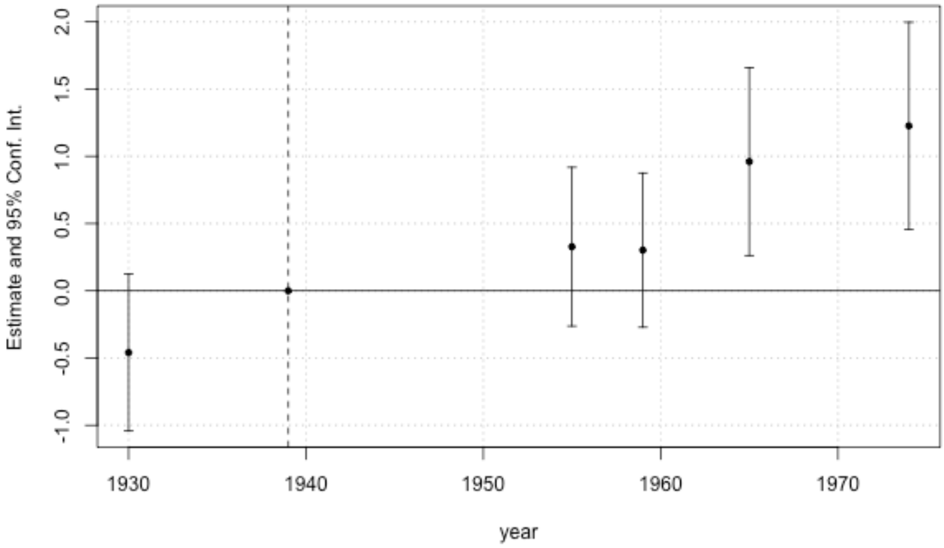
Notes: The estimation results of negative binomial regression formulated in Eq. (2) are reported. The dependent variable is the number of offices. Each point represents the incidence rate ratio (exponential of point estimate of the regression coefficient) of the time-varying treatment variable $req \times dum\_y$.

Table 5.2 Estimation results (within-city relocation of agglomeration)

	(1)	(2)
Station×postwar	0.935*** (0.274)	0.978*** (0.274)
IRR	2.547	2.659
Block FE	Yes	Yes
Year FE	Yes	Yes
Control	None	Population
Observations	1,134	1,134

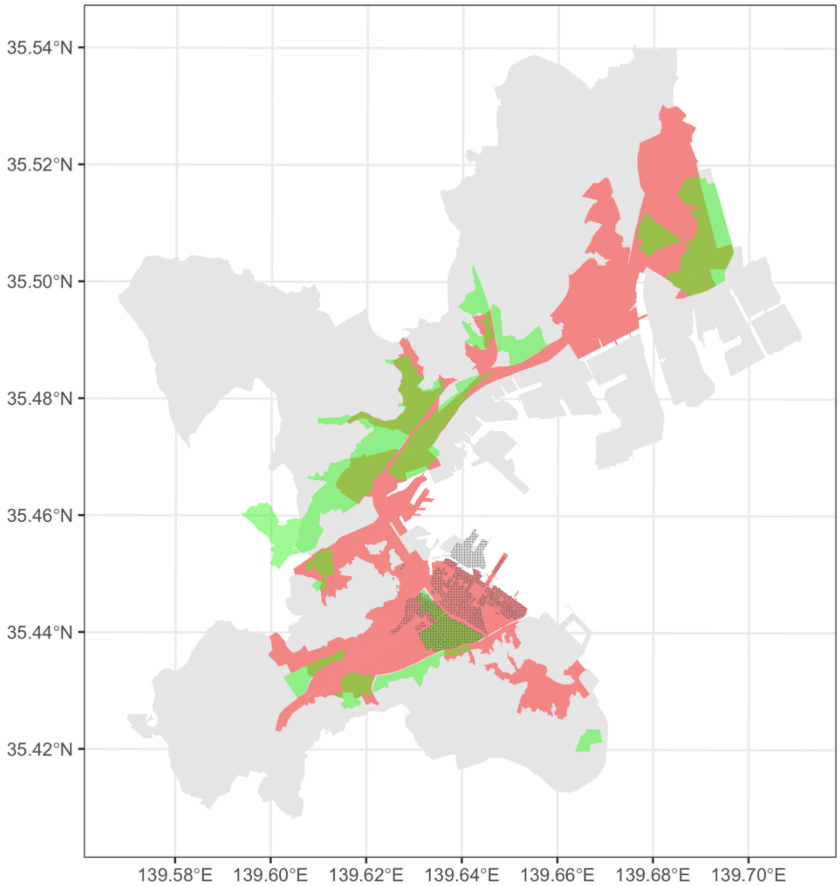
Notes: The estimation results of negative binomial regression formulated in Eq. (3) are reported. The dependent variable is the number of offices. *Station* takes a value of 1 if a block was in the neighborhood of the Yokohama Station and 0, otherwise. *Postwar* takes a value of 1 during the postwar period and 0, otherwise. The incidence rate ratios for the regression coefficients of treatment variable *Station*×*postwar* are reported in IRR. The blocks in the requisitioned regions in CBD are excluded from the observations. The levels of statistical significance are as follows: *** 1%, ** 5%, and * 10%. Standard errors were clustered at the block level.

Figure 5.3 Event study plot (within-city relocation of agglomeration)



Notes: The dependent variable is the number of offices. Each point represents a point estimate of the regression coefficient of the time-varying treatment variable *station*×*dum_y*. The arrow for each point represents the 95% confidence interval for each point estimate. The blocks in the requisitioned regions in CBD are excluded from the observations.

Figure 5.4 Readjusted regions and commercial districts



Note: The green area represents the target area of the readjustment project. The red area represents the commercial area. The hatched area represents the required area.

Table 5.3 Estimation results (land readjustment project)

	(1)	(2)
Req×postwar	−0.796*** (0.104)	
Req×postwar×read	0.318* (0.175)	
Req_h×postwar		−1.07*** (0.112)
Req_h×postwar×read		0.490*** (0.185)
Block FE	Yes	Yes
Year FE	Yes	Yes
Control	Population	Population
Observations	1,920	1,920

Notes: The estimation results of negative binomial regression formulated in Eq. (4) are reported. The dependent variable is the number of offices. *Req* takes a value of 1 if a block was in a requisitioned region in the CBD and 0, otherwise. *Postwar* takes a value of 1 during the postwar period and 0, otherwise. *Req_h* takes a value of 1 if the share of the requisitioned area exceeds 50% of a block's total area. *Read* takes a value of 1 if a block was the target of the readjustment project. The levels of statistical significance are as follows: *** 1%, ** 5%, and * 10%. Standard errors were clustered at the block level.

Appendix

Table A.1 Descriptive statistics

	n	mean	sd	min	max
No. of offices	1920	7.361	14.365	0	213
Req	1920	0.409	0.492	0	1
Req_h	1920	0.291	0.454	0	1
Read	1920	0.095	0.293	0	1
Population share	1920	0.003	0.007	0	0.074

Figure A.1 Distribution of the number of offices

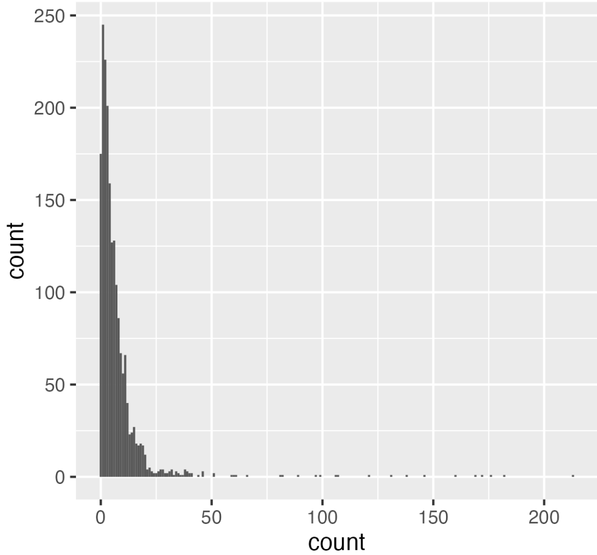
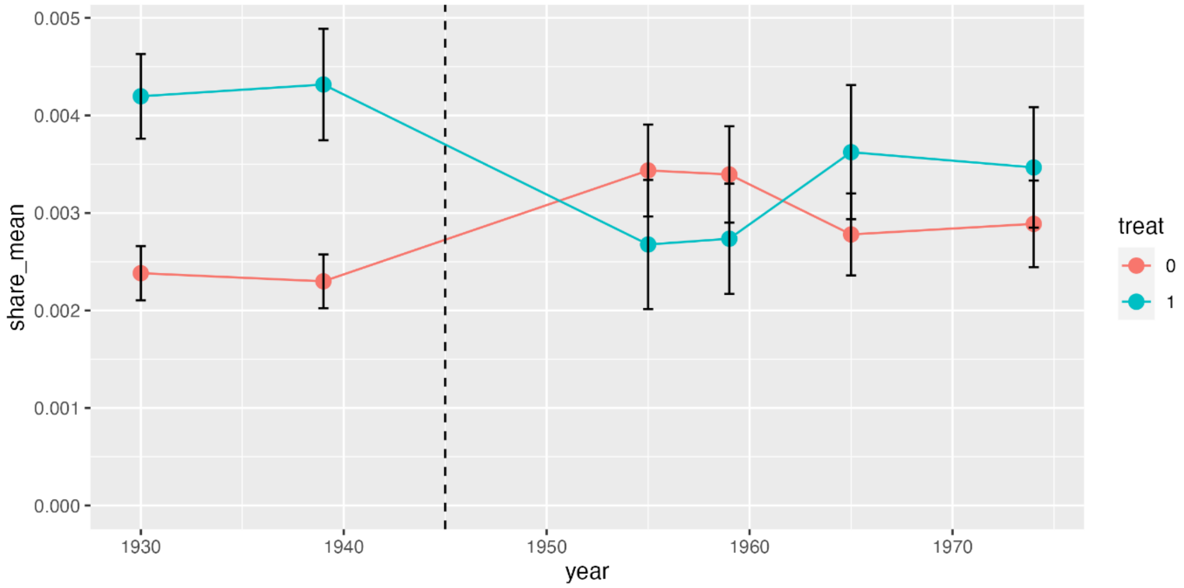
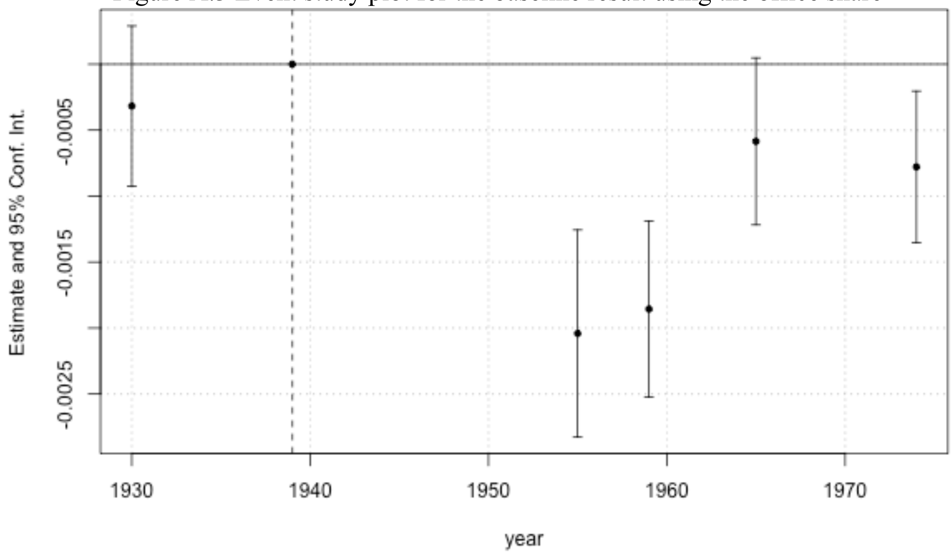


Figure A.2 Time series variation of the office share



Notes: The blue line represents the average number of offices in the treatment group in each period and the red lines represent those in the control group. Arrow indicates the standard error of each observation.

Figure A.3 Event study plot for the baseline result using the office share



Notes: The dependent variable is the office share. Each point represents a point estimate of the regression coefficient of the time-varying treatment variable *station*×*dum_y*. The arrow for each point represents the 95% confidence interval for each point estimate.

Table A.2 Estimation results (excluding blocks in Tsurumi Ward)

	(1)	(2)	(3)
Req×postwar	−0.786*** (0.096)	−0.789*** (0.100)	
Req_h×postwar			−0.990*** (0.099)
Block FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Control	None	Population	Population
Observations	1,914	1,914	1,914

Notes: The levels of statistical significance are as follows: *** 1%, ** 5%, and * 10%. Standard errors were clustered at the block level.

Table A.3 Estimation results (alternative definitions of treatment group)

	(1)	(2)
Req_all×postwar	−0.741*** (0.089)	−0.390** (0.162)
Req_all×postwar×CBD		−0.545*** (0.203)
Block FE	Yes	Yes
Year FE	Yes	Yes
Control	Population	Population
Observations	1,920	1,920

Notes: The levels of statistical significance are as follows: *** 1%, ** 5%, and * 10%. Standard errors were clustered at the block level.

Table A.4 Estimation results (excluding blocks in the main destinations of relocation)

	(1)	(2)
Req×postwar	−0.693*** (0.101)	
Req_h×postawar		−0.944*** (0.112)
Block FE	Yes	Yes
Year FE	Yes	Yes
Control	Population	Population
Observations	1,685	1,344

Notes: The levels of statistical significance are as follows: *** 1%, ** 5%, and * 10%. Standard errors were clustered at the block level.

Table A.5 Estimation results (controlling for market potential variable)

	(1)	(2)
Req×postwar	−0.807*** (0.131)	
Req_h×postwar		−0.988*** (0.118)
Block FE	Yes	Yes
Year FE	Yes	Yes
Control	Population, MP	Population, MP
Observations	1,908	1,908

Notes: The levels of statistical significance are as follows: *** 1%, ** 5%, and * 10%. Standard errors were clustered at the block level.