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RIETI Discussion Paper Series 25-E-039

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IETI Discussion Paper Series 25-E-039

April 2025

Impact of the Closure of Large Establishments on Regional Productivity*

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Abstract

This paper investigates the impact of the exit of regionally dominant establishments on the productivity of the remaining local firms. Using establishment-level data from the Japanese manufacturing sector, we estimate the net effect of these exits through a difference-in-differences analysis, focusing on the top 1% of establishments that exited between 1999 and 2010. Our findings indicate a significant negative effect on regional productivity: exits reduced the productivity of the remaining establishments by about 1% within five years post-exit and by 0.7-0.8% within ten years. However, most of these declines can be attributed to the decreased demand associated with exits. Controlling for the factor of change in demand associated with exits, the exits themselves have little impact on total factor productivity (TFP) in either the short or long term. These results suggest that the legacy of large establishments in improving local TFP largely persists even after their exit.

Keywords: productivity, regional dominant establishment, firm exit, demand change
JEL classification: C33, L60, R30

*This study is conducted as a part of the Project “Sustainable Development of Local Businesses and the Role of Regional Financial Institutions” undertaken at the Research Institute of Economy, Trade and Industry (RIETI). The draft of this paper was presented at the RIETI DP seminar. The authors would like to thank participants of the RIETI DP Seminar for their helpful comments. They are also grateful for helpful comments and suggestions by Nobuyoshi Yamori, Kozo Harimaya, and Yoshihiro Asai. This study utilizes the micro data of the questionnaire information based on the “Census of Manufacture," conducted by the Ministry of Economy, Trade and Industry (METI), and the “Economic Census for Business Activity," jointly conducted by the Ministry of Internal Affairs and Communications (MIC) and METI, as well as the Kogyotokei Converter, which is provided by RIETI.

1 Introduction

The agglomeration and entry of new establishments enhance regional productivity through network externalities and competitive pressures, which drive out less productive firms (Greenstone et al., 2010; Combes et al., 2012). The simple inverse of this is that the exit of an establishment could potentially reduce the productivity of those that remain. However, studies pioneered by Baily et al. (1992) and Foster et al. (2001) suggest that firm exits enhance industry and regional productivity through compositional and resource reallocation effects. Baily et al. (1992) argue that the exit of low-productivity firms in U.S. manufacturing facilitates resource reallocation to more productive firms, boosting both industrial and regional productivity. They estimate that such reallocation effects account for approximately one-third of industry growth. Similarly, Foster et al. (2001) find that firm exits explain about 18% of manufacturing growth through reallocation effects, while compositional changes from replacing less productive firms with new entrants contribute 22% to the growth rate.

It is not the impact of the exit of low-productivity establishments that this paper examines. Rather, it is the direction of the effect of the exit of large establishments, those with relatively high productivity, on the productivity of the remaining establishments in the region. More specifically, what is to be clarified is whether, contrary to the effect of entry, the exit of large establishments would reduce regional productivity, and whether the result that the exit of low-productivity establishments has a positive effect on regional productivity holds when large establishments exit. To deepen our understanding of how dominant firms' presence and exit shape regional productivity, this study assumes that the magnitude of the impact could differ significantly between entry and exit. While entry by new establishments can spur productivity through agglomeration benefits, the exit of a dominant firm might not automatically imply an equal but opposite impact on productivity. Specifically, if the productivity gains generated by a major establishment's presence are embedded within the region in terms of accumulated knowledge and skills, these benefits could persist even after the firm leaves. By examining post-exit productivity, we investigate whether the productivity enhancements from large establishments represent enduring regional assets (stock effects) or temporary advantages (flow effects) that dissipate upon exit. Our study uses a difference-in-differences framework, focusing on cases wherein top 1% establishments by value-added exited between 1999 and 2010. We define the treatment group as establishments in municipalities that experienced the exit of these top firms, while the control group includes establishments in the region without exits during the period. This setup allows us to assess the localized impact of exits, particularly in regions with an established presence of productive firms.

Our analysis accounts for several key considerations outlined in previous research. First, we avoid simultaneity bias stemming from the pathways through which local productivity influences exit decisions through two strategies: the use of narrative information and sample partitioning. Following Romer and Romer's (2004 , 2010) methodology, we utilize comprehensive narratives to examine exit reasons, verifying that exit decisions are not directly related to the productivity of the affected regions.[1] We use the Nikkei Value Search (NVS), in which dedicated reporters for articles published in the *Nikkei newspaper*, a major Japanese daily newspaper, provide context on exit motivations, including local environmental changes and parent company factors. These narrative data allow us to classify exit reasons and identify cases wherein the decision to exit a large establishment is not due to local productivity. Furthermore, we have added a sub-sample analysis. Specifically, we exclude establishments in the same industry as the exiting firm from the sample to mitigate the simultaneity bias that might arise if low productivity among related

[1] See Roos and Reccius (2024, Sec. 2.3) for a review of studies that employ a narrative approach to address endogeneity problems.

firms contributes to exit decisions of large establishments. Second, we address the heterogeneity in the timing of the exits by using a staggered difference-in-differences analysis of Callaway and Sant'Anna (2021), as uniform timing assumptions may introduce bias. Third, we devise a method to remove the impact of strategic actions in the anticipation of exits. For example, if a less productive establishment enters the market in anticipation of the exit of a large establishment, the effect of the exit on the productivity of the originally active local establishment cannot be identified. To eliminate the possibility of other establishments acting strategically in anticipation of the exit of large establishments, we construct a dataset consisting only of establishments that cannot take strategic action. Fourth, we establish appropriate treatment and control groups. The regions where the exiting large establishments are located, and thus the treatment groups, may have different attributes from those of other regions at the time they were chosen as the location of the large establishments. With the benefit of data that could identify the parent company of each establishment, we carefully take steps to align conditions other than exit in the two groups. Finally, and most importantly, we remove the effects of demand changes when estimating the productivity of establishments. A common analytical challenge in studies examining the impact of large firms' entry and exit on regional productivity is the inclusion of demand effects in productivity estimation. This makes it difficult to distinguish whether productivity changes stem from firm activities or shifts in demand. As the exit of large establishments can alter the demand for the goods of other establishments remaining in the region, a refined analytical approach is needed. Following the method developed by De Loecker (2011), we construct a productivity estimation model that removes demand effects, allowing for a more accurate analysis of changes in total factor productivities following the exits of large establishments.

The main findings reveal that the exit of large establishments reduces the productivity of the remaining establishments in the region by up to 1.1% in the short term and 0.8% in the long term. However, most of the decline is attributable to the change in demand associated with the exit, and the decline in total factor productivity is not observed to be significant when the effect of the change in demand is controlled. These findings suggest that the knowledge and skills imparted by large establishments leave lasting legacy effects, enabling the region to retain certain benefits even after the establishment's departure.

The remainder of this paper is organized as follows. Section 2 reviews the related literature. Section 3 introduces the dataset and estimation models, and Section 4 presents the estimation strategy. Here, we discuss the potential challenges and outline strategies for addressing these issues. Section 5 details the regression results, and Section 6 presents additional validation. The final section summarizes the findings and discusses their implications.

2 Literature review

Previous studies on productivity across various countries have shown that firm agglomeration and the entry of large establishments tend to increase the productivity of plants, establishments, and firms in the region of entry. Combes et al. (2012), a leading study on agglomeration economies, used French establishment-level data to demonstrate that agglomeration effects, rather than selection effects, drive regional productivity increases when firms cluster together. This positive impact of agglomeration on regional productivity has also been confirmed in Japan, the focus of our study, using the Combes et al. (2012) methodology (Arimoto et al., 2014; Kondo, 2016; Konishi and Saito, 2020; Adachi et al., 2022). A broad range of studies on other countries using various approaches has further validated agglomeration effects on productivity, reinforcing theories that explain urbanization and economic growth.[2] Focusing on the entry of specific

[2]See Rosenthal and Strange (2004) for an early comprehensive review of the agglomeration effects.

large establishments, some studies indicate that such entries can significantly enhance local productivity. For instance, Greenstone et al. (2010) found that in the U.S., the establishment of "Million Dollar Plants" raised county productivity by 12%. Iacovone et al. (2015) demonstrated that Walmart's entry into certain areas of Mexico increased local firm productivity through the exit of less efficient firms, reallocating transactions, and driving efficiency gains. Cho et al. (2023) demonstrated that the entry of large retailers into a region in Korea not only weeds out low-productivity retailers in that region but also raises the labor productivity of the region by attracting highly productive retailers from other regions. Giroud et al. (2024) also found that large plant entries in the U.S. had broad productivity impacts, extending up to a 50-mile radius.[3]

While studies on entry effects on the local economy are abundant, research examining the impact of large establishment exits is heavily weighted toward analyses that examine the impact on employment. For instance, Jofre-Monseny et al. (2018) analyzed the employment effects of large plant closures in Spain, finding that for every 10 layoffs, local employment decreased by 6-7 workers, as the remaining firms and new entrants partially absorbed the unemployed. Gathmann et al. (2020) reported that large-scale closures in Germany will result in the loss of approximately 3% of the total employment in the region due to decreased demand and supply chain disruptions.

Among studies specifically addressing the impact of the exit of large businesses on the local economy, Moretti (2021) is the closest to ours. He uses the number of patents as a proxy measure of productivity to estimate the impact of the exit of large establishment and finds that the closure of Kodak's research laboratory in Rochester reduced productivity in the region by 20%. Our study similarly investigates the impact of large establishment exits on regional productivity, but it diverges from Moretti (2021) in three critical aspects. First, rather than analyzing a single firm's exit, we estimate the effects using a broad dataset on the top 1% of establishments by industry size using national establishment-level data spanning 1994-2015. Analyzing only one case can over- or understate exit effects depending on case selection; our large micro-dataset avoids this bias. Second, our dataset enables us to estimate total factor productivity (TFP) directly, allowing us to measure regional productivity impacts without using patents as a proxy. Third, we leverage information on the parent companies of exiting establishments, allowing us to more accurately establish treatment and control groups within a difference-in-differences framework.

3 Data and models

3.1 Census of Manufacture (CM)

This study focuses on changes in productivity within the manufacturing sector, which is a core industry, at least in Japan. Analyzing firm productivity requires establishment-level data, and we can utilize high-quality panel data based on the Census of Manufacture (CM), widely used by many researchers studying firm productivity in Japan (Norsworthy and Malmquist 1983; Nakamura 1985; Jorgenson et al. 1987; Kondo 2016). The CM dataset is provided by the Ministry of Economy, Trade and Industry, and the availability of microdata in our research over a long period, from 1994 to 2015, is another advantage of using the CM data with Japan as the

[3]Although these studies examine the productivity impact of large business entries, a larger body of literature explores outcomes beyond productivity. For example, Cho et al. (2015) assessed the effect of large discount store entries on local retail employment in Korea, finding that two-thirds of job growth was directly linked to the entry of the large store itself. Hwang (2022) observed that foreign store entries lowered local firms' markups due to increased competition. Similarly, Chenarides et al. (2024) found that the entry of hard discounters reduced markups among existing retailers by 7.3%.

target country.[4] This study covers not only large establishments but also small and medium-sized enterprises (SMEs).

The advantage of using CM data is that each establishment is assigned a unique code, allowing us to track changes over time and construct establishment-level panel datasets. Additionally, the CM data covers a wide range of firms, including both publicly listed and unlisted companies. The CM survey has two forms: the first is Ko (Form A), which targets establishments with 30 or more employees, and the second is Otsu (Form B), which targets establishments with fewer than 29 employees. We focus exclusively on the data from Form A, targeting all establishments with 30 or more employees. There are two reasons for this. First, Form B data has many missing values, which undermines the reliability of the analysis. Second, using only Form A data allows us to exclude dormant companies that were established in Japan to avoid paying taxes. Therefore, it is preferable to use data from Form A to exclude firms not actually engaged in business from the analysis. In addition to firms with fewer than 29 employees, we exclude samples in which the variables required to estimate the production function have negative values. The data used in this study were classified using 2-digit industry codes in the manufacturing sector.

When estimating the production function for each establishment, the input variables include labor and capital stock, and intermediate inputs consist of materials, fuel, energy, and outsourced production. Since the CM survey lacks data on working hours and utilization rates of capital, labor is measured by the number of employees, and capital stock is measured by the book value at the end of the fiscal year. All nominal values are deflated using relevant price indices. The deflators are available from the Bank of Japan and the Cabinet Office. Table 1 details the descriptive statistics for the entire sample.

Table 1: Descriptive statistics for all samples (1994-2015)

	average	standard deviation
Sales (shipment) value	904231.8	4237195.0
Total number of workers	1919.3	4234.9
Capital	170877.3	702701.4
Intermediate input	533262.8	2815404.0

Source. Data is from the Census of Manufacture (CM), except for 2011 and 2014. In 2011 and 2014, the Economic Census (EC) survey used the same questionnaire as the CM survey, so for those two years, we use the data from the EC survey.

Note. The number of establishments per year is 6332 in the smallest year and 8076 in the largest year.

This study examines the effect of the exit of large-scale establishments from a region between 1999 and 2010 on the productivity of other establishments that continued to operate in the same region. To capture this effect, we conduct a difference-in-differences analysis, measuring productivity over a five-year period before and after the exit event and assess whether there is a statistically significant change. A key concern in our analysis is to estimate the causal effect of large-scale establishment exits while excluding the influence of other establishments that may have strategically entered or exited the region in response to such exits. Some establishments in our sample entered the region immediately before a large establishment exited, whereas others

[4] The CM survey was not conducted in 2011 and 2014, but since the EC survey–using the same questionnaire as the CM survey–was jointly carried out by the Ministry of Economy, Trade and Industry and the Ministry of Internal Affairs and Communications, we use the EC survey data for those two years.

exited shortly thereafter. These establishments may have made strategic decisions to enter or exit in anticipation of large-scale exits.

To isolate the effect of large-scale exits on the productivity of establishments that remained in the region, we construct our sample according to the following three criteria. First, we select establishments that continued to operate across the exit year of the large-scale establishment. Second, we retain only those that remained in operation throughout the five years following the exit. Third, we further restrict the sample to establishments that were already operating for at least five years before the exit. By focusing on establishments that satisfy all three criteria, we exclude those that may have responded strategically to the exit event by entering or exiting the region. This enables us to estimate the impact of the large-scale exit on the remaining establishments without confounding effects from strategic behavior.

However, this approach is not suitable for testing the "revolving door" hypothesis, as explored in studies such as Audretsch (1995) and Nakamura (2023). Their analyses compare the productivity of exiting and entering establishments to explain changes in regional or industry-level productivity. Because our framework deliberately excludes the effects of entry and exit, it is not designed to address the questions posed by such studies.[5]

3.2 Estimation models

Our analysis consists of two major steps. We estimate the total factor productivity (TFP) of the establishments in the first step and then estimate the impact of the exit on the productivity of establishments in the region through a difference-in-differences analysis using the region from which the large establishments exited as the treatment group in the second step. An estimate of TFP by the simplest method is obtained by estimating the production function expressed as

$$y_{it} = \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \omega_{it} + \epsilon_{it}, \tag{1}$$

where y_{it} is the output, l_{it} is the labor, k_{it} is the capital, m_{it} is the input of intermediate goods, and ϵ_{it} is the error term at establishment i at year t. Variables denoted by lowercase letters are on a logarithmic scale. Productivity ω_{it} is obtained by estimating (1) and using the coefficients obtained.

However, rather than estimating (1) directly, we follow some approaches in previous studies that avoid the simultaneity and selection biases associated with simply estimating (1).

3.2.1 Two-way fixed effect (TWFE) and Staggered DID models

The first estimation model we use is a DID model with two-way fixed effect (DID-TWFE), following Greenstone et al. (2010), which is given by

$$y_{it} = \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \tau \cdot Dum_{treat} \times 1(close\ year > t) + FE_i + FE_t + FE_{ind} + \epsilon_{it}, \tag{2}$$

where FE_i, FE_t, and FE_{ind} are fixed effects dummies for establishments, years, and industries, respectively, classified into two digits. This approach considers the five terms after the fourth term on the right-hand side to constitute productivity and attempts to capture the effect of exit, represented by the dummy variable, on productivity. This method implicitly assumes that exits affect only productivity and that prices and demand for goods are unaffected by exits. If the exit of a large establishment affects, for example, demand for other establishments in the

[5] For reference, we report estimation results based on the full sample–including establishments that may have entered or exited strategically in response to the exit of large-scale establishments–in Appendix A.

region, then estimation based on (2) will have a bias, and the effects of demand changes would need to be removed.

We also address that the timing of exits varies from establishment to establishment by using a staggered difference-in-differences model per Callaway and Sant'Anna (2021), as uniform timing assumptions may introduce bias. An analysis that considers differences in the timing of exits is conducted as a second estimation task using a staggered DID model.

3.2.2 2step LP model: Two step estimation with Levinsohn and Petrin (2003)

The third model in this paper uses the method of Levinsohn and Petrin (2003). In this approach, we first estimate productivity and then identify the impact of large establishments exiting on estimated productivity.

Because the application of OLS in equations (1) and (2) may suffer from endogeneity issues due to correlations between input factors and TFP, several methods have been proposed to address endogeneity in the estimation of production functions, including those by Olley and Pakes (1996), Levinsohn and Petrin (2003), and Wooldridge (2009), among others. Taking advantage of the available data on intermediate inputs other than labor and capital, this study adopts the approach of Levinsohn and Petrin (2003), which avoids the endogeneity problem by assuming that firms know capital and productivity when determining intermediate goods inputs.[6] Specifically, we assume that when establishment i decides the input of intermediate goods at time t, m_{it}, it knows the levels of capital k_{it} and productivity ω_{it}, $m_{it} = M(k_{it}, \omega_{it})$. Furthermore, we assume that higher productivity leads to higher intermediate goods inputs. This makes M a monotonically increasing function with respect to ω_{it}, so that we have $\omega_{it} = M^{-1}(k_{it}, m_{it})$. With these assumptions, the production function can be estimated and productivity can be calculated simultaneously.

Denoting the productivity estimated in the first stage as ω_{it}, the model estimated in the second step to identify the impact of the exit of large establishments on the productivity of the remaining local establishments is as follows:

$$\omega_{it} = \tau \cdot Dum_{treat} \times 1(close\ year > t) + FE_i + FE_t + FE_{ind} + u_{it}, \tag{3}$$

where u_{it} is the error term. This approach examines productivity changes at other establishments after a large establishment exits, and does not explicitly consider the impact of the exit of large establishments at the time productivity is estimated.

3.2.3 De Loecker (2011) model

The fourth estimation model we use is that of De Loecker (2011), which incorporates the possibility that the exit of large establishments changes the demand faced by other establishments in the estimation. In general, when estimating a production function, the output on the left-hand side is taken as the output value. However, this variable consists of the product of price and output, and factors on the demand side are included in the price. This point is discussed in more detail in Loecker and Syverson (2021), who show that output-value-based TFP (TFPR) and output-based TFP (TFPQ) are different, and they can be related as $\ln TFPR = \ln P + \ln TFPQ$, where P is the price level.

To estimate output-based TFP using output-value data, demand factors must be controlled. and De Loecker (2011)'s approach begins the analysis by setting up the following estimation model:

[6] Adachi et al. (2022) confirm that there is no marked difference in productivity estimated using the models of Olley and Pakes (1996), Levinsohn and Petrin (2003), and Wooldridge (2009) with CM data.

$$y_{it} = \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \beta_s q_{st} + \xi_{it} + \omega_{it} + \epsilon_{it}. \tag{4}$$

As in Levinsohn and Petrin (2003), we address the correlation between TFP and inputs by assuming intermediate inputs as follows:

$$m_{it} = M_t(k_{it}, \omega_{it}, exit_{it}, q_{st}, D), \tag{5}$$

where $exit_{it}$ is an exit dummy variable and D consists of ξ_s, which is a dummy variable representing industry s. What is characteristic in (4) is the addition of the fourth and fifth terms to control for the effect of demand change. ξ_{it} is the term that captures demand shocks, which is defined as follows:

$$\xi_{it} = \xi_s + \tau \times exit_{it} + \tilde{\xi}_{it}, \tag{6}$$

where $\tilde{\xi}_{it}$ denotes the error term. (6) is based on the assumption that demand changes with exits but is absorbed by fixed effects. q_{st} in (4) captures the industry demand, which is given by

$$q_{st} = \sum_{i=1}^{N_s} ms_{ist} \times y_{ist}, \quad \text{where} \quad ms_{ist} = \frac{Y_{ist}}{\sum_{i=1}^{N_s} Y_{ist}}. \tag{7}$$

The variables shown in lower case are also on a logarithmic scale in (7). N_s is the number of establishments in industry s and ms_{ist} is the market share. Both y_{ist} and Y_{ist} represent the value of production in industry s. However, the former is a logarithmic representation, and the latter is the production value itself. Having q_{st} in (4) plays a role in controlling for factors that cannot be fully eliminated by fixed effects alone to account for individual establishment-level price fluctuations.

Next, we assume that the productivity obtained by estimating (4) has the following properties:

$$\omega_{it} = \alpha_0 + \alpha_1 \omega_{it-1} + \tau \times exit_{it-1} + u_{it}, \tag{8}$$

which assumes that the exit of large establishments will affect output through two paths. The first path is that the exit of one establishment affects the productivity of other establishments that remain active, which in turn changes the output of other establishments. In (8), this pathway is captured in the form that the presence or absence of an exit affects productivity in the next year. The second pathway is that the exit of one establishment affects the demand and prices faced by other establishments, which in turn changes the output of those establishments. This is captured by the exit dummy in (6). This approach assumes that decisions involving the exit of large establishments are not affected by the level of productivity of other establishments operating in the same region.

3.2.4 Modified LP model

In both the LP and DL models, intermediate inputs have been assumed to be a function of capital. In addition, intermediate inputs are a function of productivity in the LP model and productivity and exit dummy in the DL model. These assumptions are made to avoid biases associated with the correlation between the factors of production and productivity; however, the differences between these assumptions make it difficult to directly compare the 2step LP results with the DL results. To allow for a comparison, we apply the assumptions regarding intermediate inputs in the DL model to the estimation of the LP model. That is, we assume that intermediate inputs in the LP model are a function of capital, productivity, and exit dummies for the estimation model, which is referred to the Modified LP model

It should be noted that this model allows intermediate inputs in the LP model to be a function of the exit dummy variable, as assumed by the DL model, and demand factors are still not controlled for in the productivity estimation.

4 Estimation strategy

4.1 Treatment and control groups

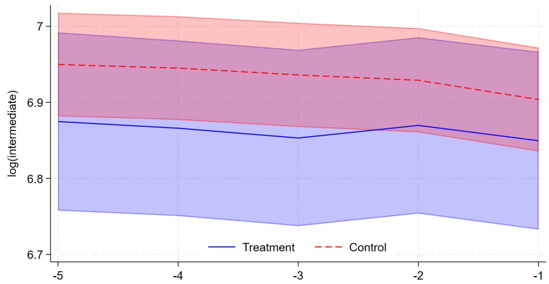
The treatment group is defined as those establishments that remain and continue to operate in the municipality from which the large establishments have exited. Exiting large establishments are under the control of the parent company, which usually has multiple establishments in different regions. In such cases, the exit of an establishment located in a region under the control of a particular parent company does not mean the exit of a different establishment of the same parent company in other regions. Therefore, the region where establishments exited is set as the treatment group, and the regions where there were no exits is set as the control group. For example, assume that firm X has establishments a and b in regions A and B, respectively, but has no establishment in region C. When an establishment a is closed due to some external shock, the treatment group consists of all other establishments operating in region A, except for establishment a, and the control group consists of establishments operating in region B. Establishments operating in region C are not included in either the treatment or control group. We set up the two groups in this way because regions in which firm X has establishments are likely to have similar characteristics. In this example, regions A and B can be characterized only by differences in whether or not an establishment has exited, while regions A and C or B and C may have different conditions for establishing an establishment. Therefore, regions A and B are set as the treatment and control groups, respectively, and region C is not included in the analysis. Based on these ideas, we leverage the inclusion of parent company information in our dataset to minimize the differences between regions that experience exits of large establishments and those that do not.

To check for differences between the treatment and control groups, we observe trends in three inputs and one output before the exit of large establishments. Figure 1 illustrates the trends of intermediate input, capital stock, labor, and output separately for the treatment and control groups starting from five years before the exit of large establishments. The blue line represents the treatment group, the red line represents the control group, and the bands attached to each group represent 95% confidence intervals. These show that the levels of capital stocks differ between the treatment and control groups, but the trend of change is not significantly different between the two groups. Other production inputs, i.e., intermediate input and labor, and outputs do not differ significantly between the treatment and control groups, neither in their levels nor trends.

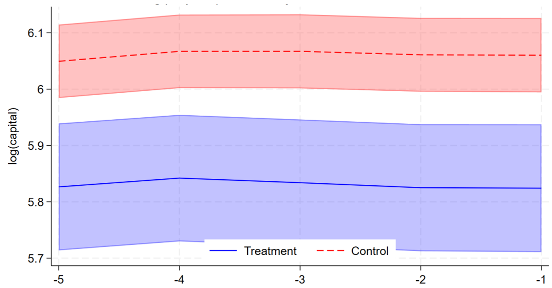
4.2 Definition of "large" establishments

For our analysis, we define the exit of large establishments. In our paper, "large establishments" are defined as establishments that recorded the top 1% of total sales in the industry to which the establishment belongs between 1994 and 2015 and that exited the region in which they recorded those sales during the analysis period.[7] We identify 31 establishments that recorded sales in the top 1% of the industry within this period but subsequently exited. These establishments meet

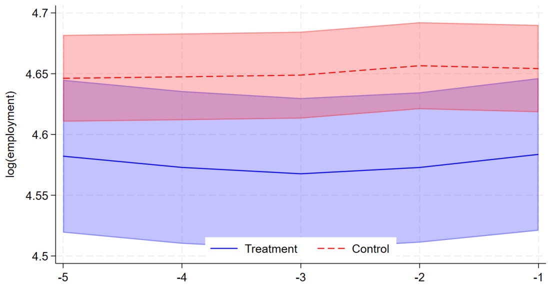
[7]We have defined large-scale establishments using "1%" in line with Piketty and Saez (2023), which examined the impact of top high-income earners in the income distribution.



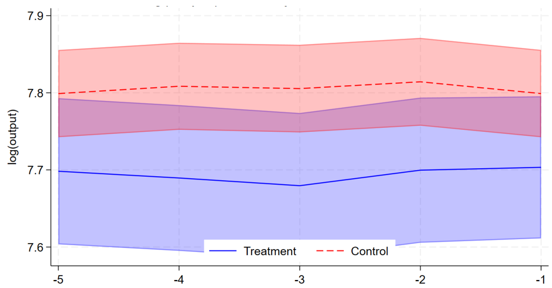
(a) Intermediate input



(b) Capital



(c) Employment



(d) Output

Figure 1: Trends by treatment with 95% confidence interval
Note. $-t$ on the horizontal axis represents t years before the large establishments exit.

the condition that no other top 1% establishments operate in the same region until 2015, the last year of the analysis. This condition is imposed because if another top 1% establishment continues to operate at the same location after the exit of a large establishment, it would be impossible to capture the effects of the exit on the productivity of other establishments in the region.

In our analysis, we exclude four more establishments from the sample of these 31 establishments and use data from the 27 top 1% establishments in our estimation. The 27 selected establishments are required to have their parent firms have other establishments in other regions. Conversely, the four establishments that were excluded from the sample did not have parent firms that owned other establishments. This condition is imposed, as explained in Section 4.1, to set appropriate control and treatment groups.

Figure 2 shows the timing of the exit of 31 large establishments. The timing of these establishments' exits is concentrated in two periods. The first was in 2002, when the dotcom bubble burst and caused a global economic crisis. The second was the global financial crisis of 2008 and the following year. These two periods alone account for more than half of the 31 cases of exits, suggesting that many of the exits of large establishments under analysis are due to external economic shocks.

Kawai and Takagi (2011) examine the reasons for the negative impact that the global financial crisis had on Japanese manufacturing. According to their study, the financial crisis caused a sharp decline in demand in the U.S. and Europe and the appreciation of the yen, which dealt a heavy blow to Japan's export-dependent manufacturing industry. In particular, orders for highly export-dependent products such as automobiles and electrical equipment plummeted, and tight global credit markets made it difficult for Japanese manufacturing firms to raise funds, forcing them to scale back production, including plant closures.

The largest number of large establishments exited in Tokyo and Osaka, the two most populous prefectures, with four exits from each. Looking at the regional distribution of the number of

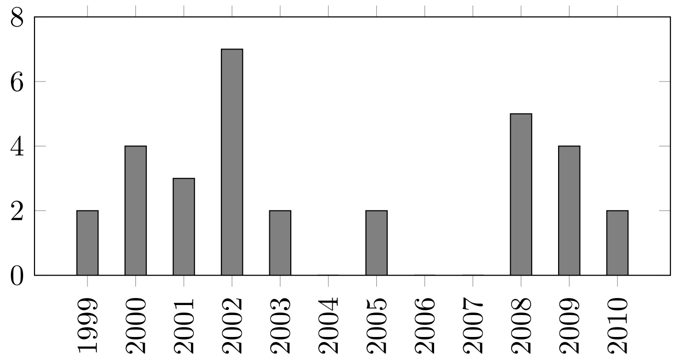


Figure 2: Number of exits of top 1% establishments

exits, there were 19 in 11 prefectures called 'urban areas' and 12 in other regions.[8] The former figure accounts for approximately 60% of the total number of exits, but since urban regions account for 53% of the total population and 70% of the total output, this does not mean that exits are concentrated in urban regions. In our sample, there are no cases where multiple large establishments exited from the same municipality.

There was a wide range of industries with large establishment exits. The largest number of exits occurred in the general machinery and equipment industry, with eight large establishments exiting. The electrical machinery industry was next with four, followed by the textile and wood-processing industries, with three each. In addition, there were two cases each of large establishment exits in the chemical, beverage, tobacco, and feed, machinery and equipment for production, and information and communication machinery and equipment industries, as well as exits in the printing, steel, food, electronic components, devices, electronic circuits, and ceramic and earthenware products industries.

4.3 Endogeneity

What must be considered when conducting a difference-in-differences analysis is the possibility of a correlation between TFP and the decision to exit. The exit of a large establishment may have an impact on the productivity of establishments in the region, but the reverse could also be true; the productivity level of other establishments in the region may also influence the decision of large establishments to exit. To address this endogeneity, we adopt two approaches: a narrative approach and a subsample approach.

4.3.1 Narrative approach

The standard narrative approach attempts to identify the causal relationships among variables based on historical sources and documents related to the background and circumstances of a particular event or policy change. Specifically, by describing the background and reasons for an event in detail, it is easier to assume that the event is an "exogenous shock" that occurred independently of other factors, thereby increasing the reliability of causal inferences. In a pioneering study employing this approach, Romer and Romer (2004, 2010) examined historical documents and congressional records on U.S. monetary and fiscal policies to analyze the impact of policy changes. Specifically, they identified whether government policy decisions were dependent on

[8] Japan has 47 prefectures, of which 11 (Tokyo, Saitama, Chiba, Kanagawa, Osaka, Hyogo, Kyoto, Shiga, Aichi, Fukuoka, and Miyagi) are often referred to as urban regions.

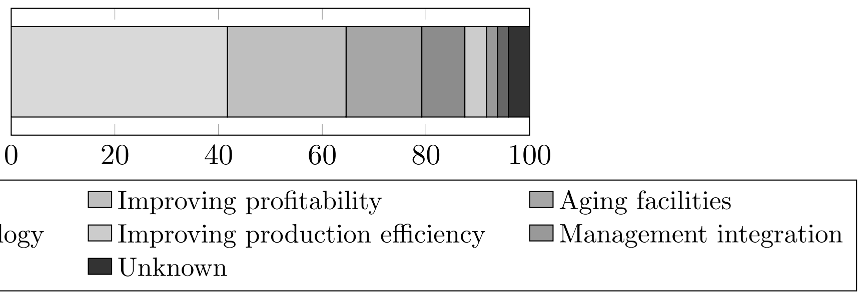


Figure 3: Reasons for exit of top 1% establishments (%)

Note. There can be multiple reasons for exiting. In 31 exit cases, there were 48 reasons for exiting, and this table shows their respective shares.

economic conditions and identified policy changes that could be considered an external shock independent of the economic situation.

The series of studies that take a narrative approach differ from our study, which concerns firms' decisions regarding the exit from the market, in that they concern decisions about government policies. However, some studies, such as ours, adopt this approach to the endogeneity problem associated with the analysis of firms' decisions. For example, Pitschner (2020) addresses the endogeneity problem in identifying factors that influence pricing decisions by examining firms' financial reports and earnings release documents to extract detailed contextual information to analyze firms' pricing behavior.

To ensure the exogenous nature of reasons for exiting large establishments, we conduct a narrative analysis using contextual information in the Nikkei Value Research (NVR) database.[9] NVR is a database of information on firms provided by Japan's largest daily business newspaper, covering detailed information on firms primarily in Japan. The database is based on information collected by Nikkei Newspaper reporters and aggregates a wide range of data on corporate management conditions, business strategies, investment plans, and industry trends. Specifically, it includes corporate financial data, news articles, analyst reports, and industry analyses that can be used to obtain the overall picture of a firm's decisions. The database includes detailed background information such as why a firm started, downsized, or exited a particular business. As it contains information obtained by Nikkei reporters through interviews and surveys of firms and related parties, it is unique in that it provides insight into the inner workings and intentions of a firm, which cannot be obtained from official announcements alone. For example, when investigating the reasons for a firm's withdrawal from a particular region, we consider both the official announcement of "unprofitable" and the changes in management strategy and external shocks (regulatory changes, intensified competition, etc.) that underlie such a withdrawal in detail. Such information can help when conducting causal analyses that address endogeneity problems.

The endogeneity issue we are most concerned with in this paper is to rule out the possibility that low productivity in the region influences the decision to exit of the establishment. Figure 3 summarizes the reasons for closing local establishments for 31 exit cases we determined could avoid this issue. The most common reason for exiting in the sample was declining demand, accounting for 41.7% of all reasons. The next most common reason was to improve profitability through cost reductions and other measures, accounting for 22.9% of the total reasons. These accounted for 64.6% of the total, and the timing of the exits for these reasons coincides with

[9] `https://nvs.nikkei.co.jp/`.

two external economic shocks. The economic shocks that occurred overseas, an external event for Japanese establishments, forced domestic establishments to rapidly reduce demand and cut costs, forcing the closure of plants and offices.

Other reasons for exiting include aging facilities at 14.6%, followed by the introduction of new technology at 8.3%. In addition, production efficiency improvements and management integration follow these reasons. All of these are internal information held by the large establishments that have exited and are not available to other establishments operating in the same region. Therefore, it is not easy to anticipate the exit of large establishments based on these reasons and take strategic action to change the productivity in advance. The last remaining reason is the exit due to policy changes, which can also be considered an external shock for other establishments that continue to operate in the region.

4.3.2 Subsample approach

The method of using narrative information from interviews and other surveys to identify the reasons for leaving raises the question of whether respondents are answering honestly. For example, a large establishment may decide to leave because of low productivity at establishments in the region; however, instead of taking this as the same reason for leaving, it may shift other external factors as the cause of its exit. As a second approach to addressing the endogeneity associated with the decision to exit, we construct a subsample that excludes other establishments in the industry to which the exiting large establishments belong. It is plausible that the concerns that decisions involving the exit of large establishments are due to the low productivity of other firms in the region could arise in relation to the productivity of other firms in the same industry as the industry to which the exiting establishment belongs. Thus, dropping establishments belonging to the same industry as the exiting large establishments from the sample can be expected to avoid simultaneity bias.

In the analysis that follows, we use Sample A as the dataset that includes all establishments and Sample B as the dataset that removes establishments from Sample A that belong to the same industry as exiting large establishments.

4.4 Strategic entry and exit of establishments

When a large establishment exits a region, other establishments may strategically decide to enter or exit in anticipation of this event. For instance, some establishments with relatively low productivity might enter the region to capture demand left behind by the exiting large establishment. In this case, in addition to the impact of large establishment exits on the productivity of existing firms in the same region, the analysis captures the effect of new entrants' productivity on regional productivity. Consequently, post-exit productivity of the treatment group may be underestimated.

When estimating the impact of a large establishment's exit, including establishments that enter immediately after or exit just before the exit of the large establishment would introduce data influenced by the strategic behavior described above. To avoid bias in estimating the effects of a large establishment's exit due to such strategic entry and exit behavior, this study excludes establishments that enter or exit around the time of the large establishment's exit and restricts the sample to those that remained active throughout the entire period surrounding the exit event. The main results presented in the following analysis are based on this restricted sample. However, we also provide supplementary analyses in Section 6.3 using the full sample, which includes establishments that entered or exited around the time of the large establishments' exits.

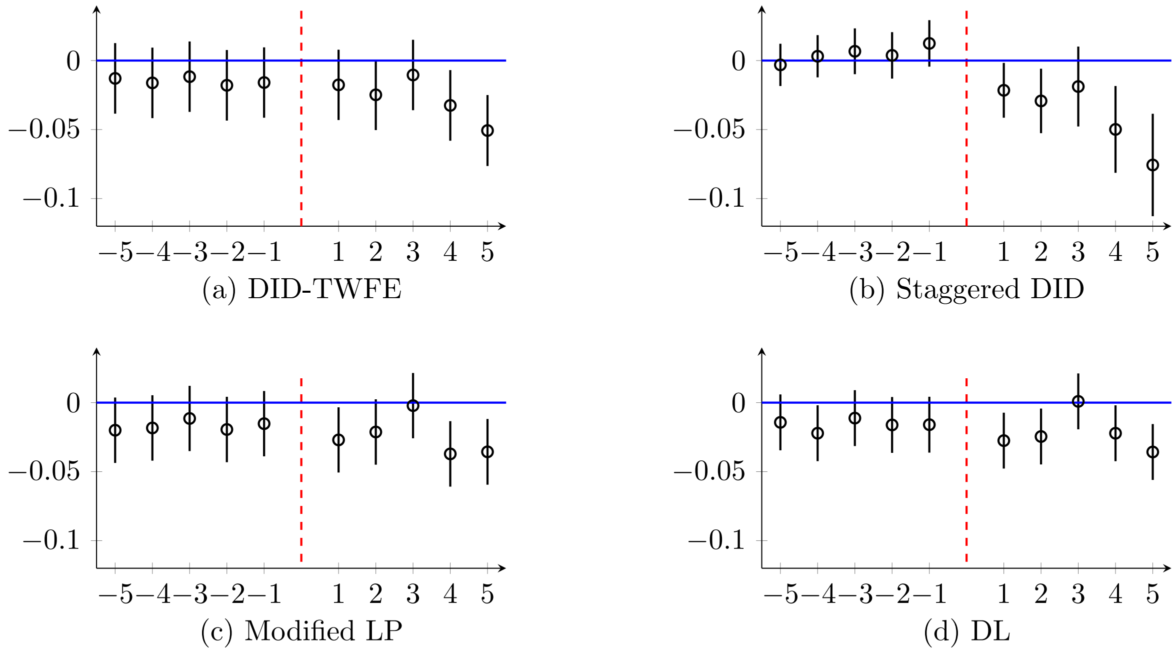


Figure 4: Average treatment effect (5 years, Sample A)

Note. The vertical dotted line indicates the timing of the exit of large establishments. Vertical lines for each year are 95% confidence intervals, and circles indicate the estimates. The same applies to subsequent figures.

5 Results

5.1 Parallel trend

We first note a parallel trend in the difference-in-differences analysis. The analysis in this paper is divided into two samples: one that dropped establishments in the same industry as the exiting establishment for each and one that includes them. Because the results on parallel trends are the same for both samples, we report only those results for the case that includes establishments in all industries in Sample A.[10]

The vertical axis in Figure 4 shows the mean causal effect in the treatment group for four models, i.e., DID-TWFE, Staggered DID, Modified LP, and DL.[11] DID-TWFE refers to the basic DID with a two-way fixed effects model, whereas Staggered DID refers to the DID-TWFE model that accounts for differences in the timing of exits. We estimate the productivity of these two models based on (2). The modified LP model estimates productivity using the approach of Levinsohn and Petrin (2003), which aligns the assumptions regarding intermediate inputs with those of the DL model. This allows for a comparison between the results of the LP model, which does not control for demand factors, and those of the DL model, which does. DL is the approach used by De Loecker (2011) and estimates productivity based on (4)-(8), which includes an exit dummy in the production function and estimates productivity after taking demand factors into account.

The vertical dotted line represents the year in which the large establishments exited, and the horizontal axis represents the period before and after the exit. These figures show that the parallel trends between the treatment and control groups prior to exit are ensured. The presence

[10]See Appendix B for the average treatment effect when using Sample B.
[11]The results of 2step LP are almost the same as those of Modified LP, so the figure is omitted.

or absence of an announcement effect is worth mentioning. The announcement of a decision by a large establishment to exit may be made one to two years before the actual exit. In this case, such announcements prior to the year of exit may result in behavioral changes that affect the productivity of local establishments. If behavior change occurred, we would expect the parallel trend between the treatment and control groups to be broken before exiting. However, no such event was observed in any of the models shown in Figure 4. Therefore, it is safe to assume that the announcement effect does not have an impact when capturing the effect of exiting large establishments.

5.2 Impact of exit on local productivity

Figure 4 (a)-(c) reveal that, after the exit of large establishments, the impact tends to be in the negative direction, which is stronger after the fifth year than in the first few years. This impact is quantified in Table 2, which shows our estimation results for the short term, i.e., within five years.

Table 2: Impacts over 5 years after the exit

	Sample A		Sample B	
	estimate	N	estimate	N
DID-TWFE	-0.017^{***}	37609	-0.011^{***}	35691
	(0.005)		(0.005)	
Staggered DID	-0.039^{***}	37609	-0.031^{**}	35677
	(0.012)		(0.012)	
2step LP	-0.017^{***}	37609	-0.010^{*}	35691
	(0.005)		(0.005)	
Modified LP	-0.011^{***}	34716	-0.009^{**}	32914
	(0.004)		(0.004)	
DL	-0.0007	31823	0.0004	30211
	(0.0034)		(0.0035)	

Note. $***$, $**$, and $*$ denote that the estimates are significant at the 1%, 5%, and 10% levels, respectively. The numbers in parentheses are standard errors. Sample A includes establishments operating in the same industry as the exiting large establishment, while Sample B excludes them.

In Table 2, the first four approaches estimate changes in productivity without controlling for demand factors, and only the last DL model controls for demand. To examine the effect of the exits of large establishments, we examine the results for Sample A. In Sample A, the estimates are significantly negative in all of the first four models, and the maximum effect of the exit of large establishments on regional productivity is -3.9%, which is the estimate under the Staggered DID model. Even under the Modified LP model, which can be directly compared to the De Loecker (2011) model, exits reduce productivity by 1.1%. However, when we apply the De Loecker (2011) model, which estimates productivity after controlling for demand factors, the regional productivity decline associated with exits is no longer significantly detected.

The values shown in the Sample B column are the estimated results if establishments in the same industry as the large establishments that exited were dropped from the sample to address the possibility of simultaneity bias. Compared to the results with Sample A, the significance is lower and the coefficient is smaller in the first four models. Nevertheless, a significant negative impact of large establishments exiting is still detected. However, consistent with the estimation results for Sample A, the DL model results for Sample B–which account for changes in demand–indicate that, once demand factors are controlled for, the exit of establishments has no significant effect on regional productivity. From these findings, it is possible to observe a certain degree of impact of the exit of large scale establishments on regional productivity; however, most of the impact can be explained by the change in demand associated with the exit, and the decline in TFP itself is not expected to be large.

5.3 Implications

Based on Table 2, we examine how the exits of large establishments affect the productivity of other establishments in the region. In both Samples A and B, we find that TFP does not change significantly when we control for the effect of demand shifts associated with the exit of large establishments in the estimation. This implies that the observed decline in productivity reflects the response of local establishments to the demand shock by lowering prices.

To illustrate this mechanism, we consider the situation in which local businesses supply intermediate goods to large establishments. When a large establishment exits, these suppliers lose a major buyer of their products. To avoid holding inventory due to a decline in demand, they are compelled to lower prices. In models that do not control for demand effects, price reduction is reflected as a decline in estimated productivity, given the same input levels.[12]

This explanation is consistent with the differences in the magnitude of estimates between Samples A and B. Sample A includes establishments in the same industry as the large establishments that exited, where close business relationships likely existed. Consequently, the exit of large establishments would have a significant impact on reducing demand for other establishments within the same industry, which would force greater price reductions, and thus lower productivity. In contrast, Sample B excludes establishments from the same industry as the exiting large establishments, implying that establishments in Sample B had relatively fewer business ties with the exiting firms. As a result, the impact of demand reduction following the exit of large establishments is smaller in Sample B than in Sample A. Therefore, price declines and associated productivity losses are relatively small, as clearly shown in Table 2.

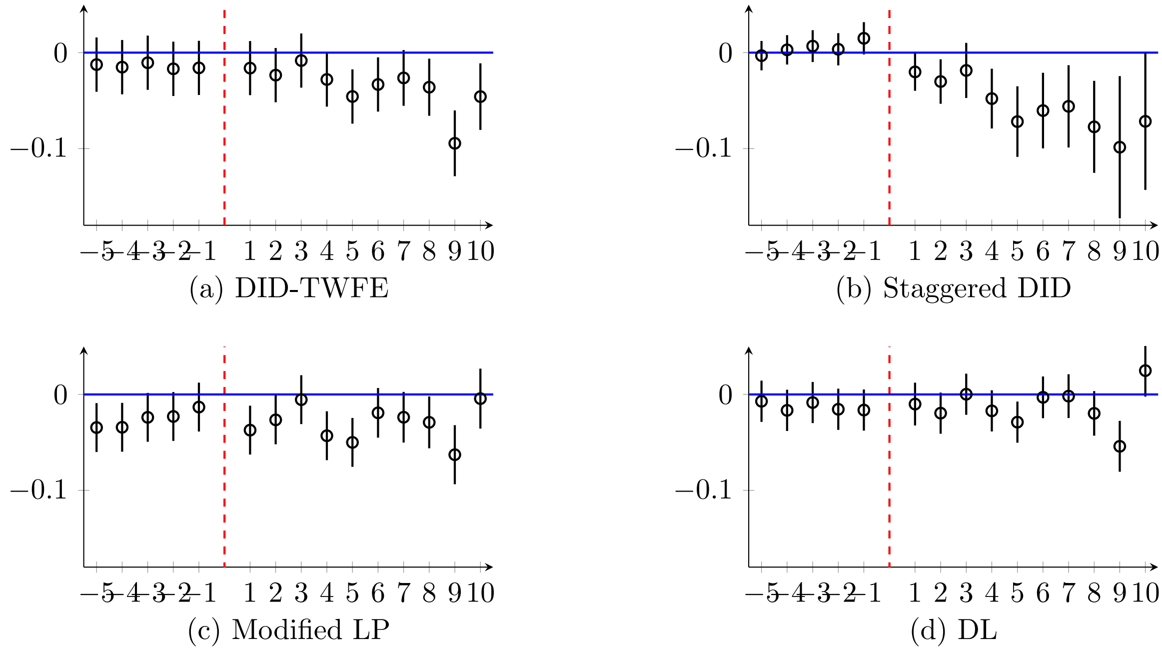
6 Additional validation and discussion

6.1 Impact within 10 years of exit

Figure 4 in the previous section shows that the impact of the exit of large establishments appears to emerge some years after the exit. Based on this observation, it may be necessary to take a longer-term view of the impact of exits, rather than the five-year period as discussed in Section 5.2. In this section, we discuss the results of our estimates of impacts over the 10-year post-exit period. The time period for which we have available data is from 1994 to 2015. Thus, for large establishments that exited before 2005, the impact of the exit can be captured over the 10-year post-exit period. It should be noted, however, that the impact of exiting establishments after 2005 is not necessarily captured over a 10-year period. Therefore, the long-term effects shown here are a mix of impacts through 2015 from establishments exiting before 2005 and impacts over less than 10 years through 2015 from establishments exiting after 2005.

[12] It is also possible that local establishments responded to the exit of large establishments by reducing production instead of lowering prices. However, if this were the case, a decline in productivity would be observed across all models, including the DL model, regardless of whether demand effects are controlled for. By contrast, if establishments respond by lowering prices, we should observe a productivity decline in the DID-TWFE, Staggered DID, 2step LP, and Modified LP models but not in the DL model. As shown in Table 2, the results align with the latter scenario, suggesting that local establishments primarily respond to the exit of large establishments by lowering their prices.

Figure 5 illustrates the long-term effects of large establishments exiting. The DID-TWFE, Staggered DID, and Modified LP models detect a certain negative impact after the fourth or fifth year after exits. However, in the DL model, which removes the factor of demand change associated with exits, we do not observe that exits have had a long-term effect on reducing the total factor productivity of the other remaining establishments in the region. This is specifically confirmed in the estimation results in Table 3.



(a) DID-TWFE

(b) Staggered DID

(c) Modified LP

(d) DL

Figure 5: Average treatment effect (10 years, Sample A)

Although the results in Table 3 show some change in significance level from the results in Table 2 depending on the model, the estimation results from the first four models show that, similar to Table 2, the exit of large establishments reduces the productivity of other establishments in the region by more than 0.8% in Sample A. However, the estimated results of the DL model, which removes the effect of demand changes, are again not significant, and we cannot reject the null hypothesis that exits have no impact on TFP in the region. In Sample B, where some establishments are excluded from the sample to eliminate the possibility of simultaneity bias, the estimation results are generally similar to those in Sample A; the first four models show that the exit of large establishments reduces regional productivity by more than 0.7%. In addition, in the results for Sample B, we did not observe that the exit of large establishments had a significant effect on the productivity of other establishments in the region when we estimated productivity, controlling for changes in demand. As in the previous section, the tendency for the coefficient values to be smaller in Sample B than in Sample A remains the same. This suggests that, as with the results in Table 2, most of the decline in productivity due to exits is attributable to demand factors and that the effect of the exit of large establishments on regional productivity has largely disappeared over a 10-year period.

Figure 5(a)-(b) clearly show that the productivity of local establishments does not decline immediately after the exit of large establishments, but after a certain period of time (about five years). This is illustrated by two examples. First, in the case of an auto parts manufacturer facing the exit of a major auto plant, orders will not immediately decline sharply among the remaining local establishments, as the large establishments that are exiting will gradually

Table 3: Impacts over 10 years after the exit

	Sample A		Sample B	
	estimate	N	estimate	N
DID-TWFE	-0.022^{***}	48025	-0.015^{***}	45422
	(0.004)		(0.005)	
Staggered DID	-0.050^{***}	47165	-0.031^{**}	44619
	(0.015)		(0.014)	
2step LP	-0.023^{***}	48025	-0.015^{***}	45422
	(0.003)		(0.003)	
Modified LP	-0.008^{**}	44176	-0.007^{**}	41756
	(0.003)		(0.003)	
DL	-0.0010	40689	-0.0009	38544
	(0.004)		(0.004)	

Note. $***$, $**$, and $*$ denote that the estimates are significant at the 1%, 5%, and 10% levels, respectively. The numbers in parentheses are standard errors. Sample A includes establishments operating in the same industry as the exiting large establishment, while Sample B excludes them..

transfer production to other sites. In addition, the remaining local establishments can maintain sales by developing new orders to replace larger establishments. However, after a certain period, it becomes difficult to develop new clients and a decline in demand becomes apparent. This would force a reduction in selling prices, and under an estimated model of productivity that does not control for demand, the productivity of the remaining establishments would decline. Second, when large establishments exit, the facilities are demolished, and emergency assistance is provided by the local government. This creates an increase in demand, thus maintaining demand for the remaining local establishments. However, after a certain period of time, as new orders associated with demolition projects and local government support end, the remaining local establishments face lower demand, resulting in lower prices, and in the absence of demand controls, lower estimated productivity.

6.2 Independence of treatment and control groups

Suppose firm X has a large establishment in region A and this establishment exits. In this case, the capital, land, etc. owned by this establishment would be sold or transferred to the market. Some workers would move to other establishments in the same region, while others might move to establishments owned by firm X in another region B. In our analysis, we include region A in the treatment group and region B in the control group; however, if workers move to establishments in other regions within the same firm, the independence of the treatment and control groups may not be satisfied.

To determine whether the exit of large establishments resulted in the relocation of labor from establishments in the treatment group to establishments in the control group, we compared the number of employees and the total workforce; that is, the number of employees in broad terms multiplied by the number of working days before and after the exit of the

Table 4 shows the pre- and post-exit changes in the number of employees and the total workforce per establishment that the parent company of the exiting establishment has in other regions, i.e., control group.[13] Prior to the exit of a large establishment in one region, there

[13]Of course, we have information on the number of employees and the total workforce at establishments in the

were 243 establishments operating in other regions with the same parent company as the exiting establishments, which employed 788.73 employees per establishment and had a total of 9462.85 workers. After the establishments left, the number of establishments that continued their activities in other regions was 137, while the number of employees and total workforce per establishment decreased to 702.03 and 8423.55, respectively. If workers were reassigned to other establishments across regions following the exit of an establishment, it would not be surprising to see an increase in the number of employees or total working hours after the exits. However, the figures are lower after the exit than before. Moreover, the differences in the numbers before and after the crisis were not statistically significant. Therefore, it is reasonable to conclude that labor mobility that would compromise the independence of the treatment and control groups did not occur.

Table 4: Change in employment at control group establishments

	pre-exit	post-exit
Number of employees	788.73	702.03
Difference	76.69	
Total workforce	9462.85	8423.55
Difference	1039.29	
N	243	137

Note. The data are from Sample *A*. None of the results of the test for differences were significant. *Number of employees* is the total number of employees without fixed terms of office and of executives who work full-time and are paid monthly. *Total workforce* includes not only employees without fixed terms, but also workers with fixed terms, such as part-timers, short-term part-timers, and temporary workers. The latter figure is calculated by multiplying the number of days worked by each employee. 243 (137) represents the total number of establishments, other than the exited large establishments, owned by the same firm during the pre-exit (post-exit) period.

7 Conclusion

This study examines the impact of the exits of large establishments on regional productivity in Japan's manufacturing sector. Using establishment-level data from 1994 to 2015, we focused on top 1% establishments that exited between 1999 and 2010 by employing a difference-in-differences approach. The findings revealed that although the quantitative effects vary slightly depending on the estimated model, all models indicate that the closure of large establishments reduces the productivity of other establishments remaining in the region. However, these results were obtained before removing the demand change factor when estimating total factor productivity (TFP). Applying De Loecker's (2001) approach and controlling for demand changes associated with the exit of regionally dominant establishments, we find that exits have little or no effect on regional productivity in both the short and long terms. Following the framework proposed by Loecker and Syverson (2021), which decomposes changes in output-value-based TFP (TFPR) into changes in prices and output-based TFP (TFPQ), our results suggest that the observed decline in TFPR following the exit of large establishments is attributable to a drop in prices caused by reduced demand rather than to any change in TFPQ itself. This implies

treatment group before their exit. However, since these establishments disappear from the data after exiting, there is no information on them post-exit, so we can only show pre- and post-exit changes for the control group.

that the legacy of large establishments in enhancing regional TFPQ continues even after their exit.

This study addresses several methodological challenges to ensure robust results. First, it accounts for potential endogeneity between inputs and productivity when estimating productivity. Additionally, we controlled for possible reverse causality, in which regional productivity trends can influence firms' exit decisions. Specifically, we leverage the Nikkei Value Search narrative database to exclude cases suspected of endogeneity and establishments within the same industry as the exiting firm, thus minimizing any influence from other industry-related establishments. Furthermore, we take advantage of the characteristics of our data, which include information on the parent firm of each establishment and the addresses of the parent firms' establishments throughout Japan. This contributes to reducing the differences in characteristics related to the location of establishments between the treatment and control groups. These rigorous approaches contribute to the literature by focusing on the less-studied effects of firm exit and offering new insights into regional productivity dynamics following the departure of dominant establishments.

In conclusion, we highlight one possible direction for extending this area of research and addressing its limitations. As discussed in Section 4.3, we address the issue of endogeneity by excluding other establishments in the same industry as the exiting large establishments. This approach assumes that these establishments are more likely to have close business relationships with the exiting firms. An alternative method would be to use input-output tables to identify establishments that are more directly connected to the exiting firm and exclude those from the sample instead.

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Appendix A

We present the estimation results in Tables 5 and 6, using the full sample, which includes establishments potentially engaging in strategic entry or exit in anticipation of a large-scale exit. Table 5 shows that the short-term results in Table 2 remain largely consistent. In the first four estimation models in Sample A, which do not control for demand factors, the exit of a large establishment has a significantly negative impact on the productivity of the remaining establishments in the region. In contrast, the DL model, which does control for demand, shows no significant effect. Additionally, as in Table 2, using Sample *B* instead of Sample *A* results in weaker significance and smaller coefficient estimates.

	Sample A		Sample B	
	estimate	*N*	estimate	*N*
DID	-0.010***	79,731	-0.005	75,162
	(0.004)		(0.004)	
Staggered DID	-0.027***	79,542	-0.026***	74,934
	(0.009)		(0.009)	
LP (2step)	-0.011***	79,731	-0.006	75,162
	(0.004)		(0.004)	
Modified LP	-0.011***	70,335	-0.008*	66,224
	(0.004)		(0.004)	
DL	-0.002	61,654	-0.002	58,156
	(0.003)		(0.003)	

Table 5: Impacts over 5 years after the exit (Data includes entry/exit)

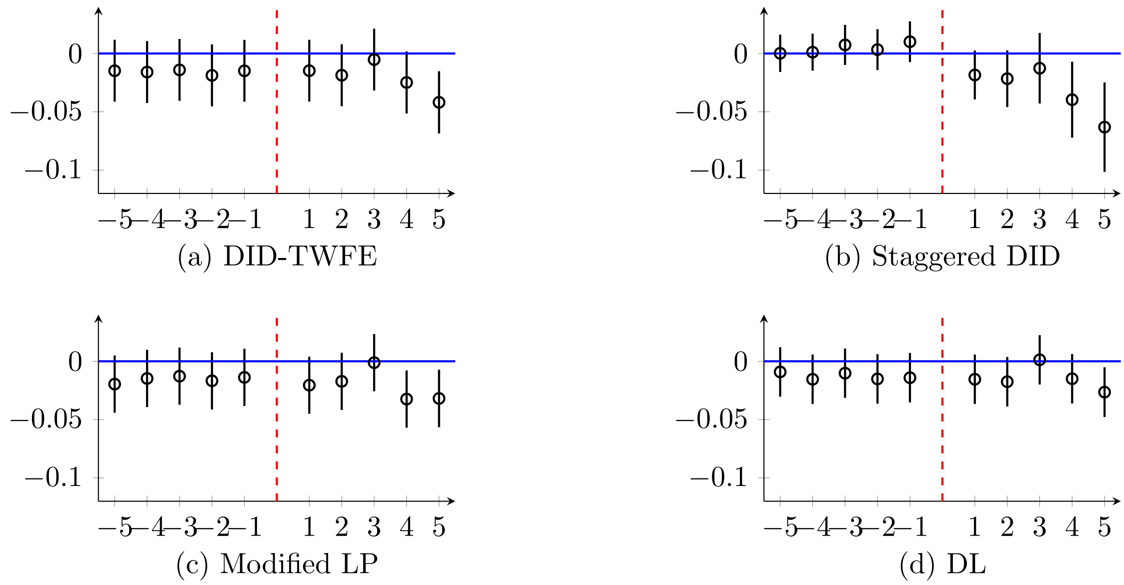
The long-term effects in Table 6 show some variation compared with those in Table 3. Notably, the DL model detects a significantly negative impact of large establishments' exits on the productivity of continuing establishments, suggesting that including establishments that entered shortly before or exited soon after the exit may lead to an overestimation of their negative impact on the productivity of other establishments that remained in the region.

	Sample A		Sample B	
	estimate	*N*	estimate	*N*
DID	-0.014***	98,001	-0.007*	92,275
	(0.004)		(0.004)	
Staggered DID	-0.044***	97,823	-0.042***	91,990
	(0.011)		(0.011)	
LP (2step)	-0.017***	98,001	-0.009**	92,275
	(0.004)		(0.004)	
Modified LP	-0.008***	87,475	-0.005	82,219
	(0.004)		(0.004)	
DL	-0.006**	78,248	-0.006**	73,685
	(0.002)		(0.002)	

Table 6: Impacts over 10 years after the exit (Data includes entry/exit)

Appendix B

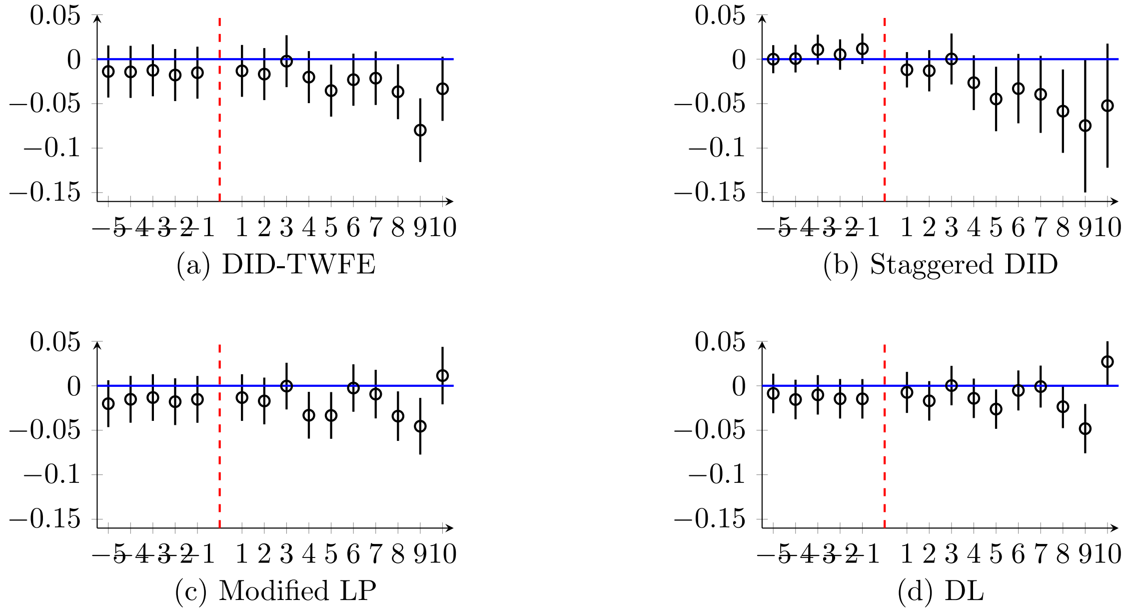
In this appendix, we show the evolution of the average treatment effect of large establishments exiting when using Sample B in the short (five years) and long term (ten years).



(a) DID-TWFE (b) Staggered DID

(c) Modified LP (d) DL

Figure 6: Average treatment effect (5 years, Sample B)



(a) DID-TWFE (b) Staggered DID

(c) Modified LP (d) DL

Figure 7: Average treatment effect (10 years, Sample B)