The effect of large firms on employment in small firms: A study based on establishment location

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Abstract

The employment effect of large firms on small firms has rarely been studied. Using establishment data in Japan, this study examines firms with the top 1% of sales, comparing the effect of such firms with many employees (more than the small- and medium-sized enterprise thresholds or 1000 employees) and that of firms with many branch offices. The firms with the top 1% of sales have a positive impact on the change in the number of employees in firms with the bottom 25%, 20%, or 10% of sales and that of firms with few employees (small- and medium-sized enterprises or smaller) located in the same commuting zone. Comparing this positive effect with the results using other large-firm criteria, firms with many branch offices sell the top 1% of volume and hire many employees simultaneously, and their impact on small firms' employment growth in the same commuting zone is the largest. Firms with many employees increase the number of employees in small and medium enterprises with 10 or more employees but do not affect firms with fewer than 10 employees. In contrast, firms with the top 1% of sales have a positive impact on those with fewer than 10 employees as well as those with 10 or more employees. We did not find the positive effects on small firms' labor productivity. Invigorating large firms' economic activities is more important than skill or knowledge spillovers through those firms' job rotation and co-workers for small firms' employment growth in the same commuting zone.

Large firms based on any criteria increase the number of employees in small firms with fewer than 10 employees and small firm with low sales volume in the wholesale, retail trade, accommodations, restaurant and bar, life-related services, and amusements industries. A positive spillover effect from large firms to the local economy is observed. However, large firm employees' high consumption demand seems to reduce small firms' labor productivity. Additionally, the distribution of the establishments affiliated with large firms differs among regions. Therefore, not all regions can benefit from the effect of large firms.

Keywords: large firms; firm size; spatial spillovers; local economy
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1. Introduction

This study examines the effect of large firms on the employment in small firms that are located in the same commuting zone using Japanese establishment-level data. This study considers firms with the top 1% of sales to be large firms because the "superstar" firms attract discussion in terms of reallocation of labor and a decline in the labor share (Autor, Dorn, Katz, Patterson, and Van Reenen, 2020), subject to regulations in the United States and EU, and an unequal tax burden (Saez and Zucman, 2020) along with making major innovations and leading the business worldwide. To explore factors that determine the effect of large firms, this study compares the effect of firms with the top 1% of sales with the effect of the firms with a high number of employees (more than the small- and medium-sized enterprise [SME] threshold or 1000 employees) and that of firms with a high number of branch offices. The specialization and diversity of industry have been well studied; however, the employment effect of large firms on small firms has rarely been studied, and this study clarifies this effect, while the positive effects of industrial specialization and diversity are not observed.

Large firms such as the firms with top 1% of sales have substantial financial resources and invest in research and development (R&D), which drives their innovation-led growth. They accumulate the introduction of technology and management know-how. Innovation growth increases the sales of these firms. The increase in their sales increases labor demand from local suppliers within the same industry, from business partners in other industries, and from non-tradable sectors in the local economy through consumption by employees of these firms.

Considering criteria based on the number of employees, large firms offer a variety of jobs and diverse employees. Employees gain from a job rotation policy as they can experience different types of jobs and benefit from the option of enhancing their skills. They are also inspired by multiple co-workers. These factors improve their productivity and increase the performance of the establishment, thereby increasing their sales. Thus, even if the establishment itself does not have large number of employees, an establishment affiliated with large firms increases local labor demand though suppliers, business partners, and local consumption.

Job rotation that is sometimes associated with job transfer (relocation) is important to promote in Japanese firms. If firms with a large number of branch offices are analyzed as large firms, the effect of job rotation or job transfer can be observed more directly. If employees accumulate their skills and knowledge via job rotation with transfer, small firms in the same commuting zone experience a positive spillover effect. However, as described in detail in Section 3.1, firms with a large number of branch offices also hire a large number of employees and have high amounts of sales.

By obtaining establishment-level data that cover nearly all business organizations in Japan, this study can use establishment location, while previous studies used head-office location.

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Furthermore, the data include both firm-level and establishment-level information as some firms have multiple establishments in different parts of the country. Therefore, this study is able to analyze the impact of large firms through each establishment in the context of the local economy.

However, in contrast to the positive effect explained above, large firms may compete for labor inputs in the local labor market, and a competitive advantage gained through economies of scale may negatively affect the employment and labor productivity of establishments that belong to small firms in the same commuting zone. The positive and negative effects of large firms' establishment on small firms require empirical estimation. In addition, this study examines the effect of large firms through each establishment. If the functions between the head office and branch offices of large firms in rural areas are different, large firms' effect on the change in the number of employees in small firms is not observed. Using the establishment location in this study can facilitate analyzing this issue. This is important in order to consider regional revivals.

The large firms' establishments, regardless of the criteria used to define the concept of large firms, are unevenly distributed in Japan. If the positive spillover effect from the large firms described above exists, differences between regions with large firms and those with no large firms widen. Regional revivals have been a political issue in Japan. Young people migrate to urban areas from rural areas for employment. Moreover, urbanization has accelerated in most countries. If large firms have a positive impact on small firms, and the establishments of large firms tend to be concentrated, firm size is important when regional revivals are considered. Other factors, such as industrial specialization and industrial diversity in each region, may affect the firms in those regions as well. This study examines whether the effect of large size is observed despite that we control for these factors.

The instrumental variable technique is applied to estimate the effect of an increase in the sales of large firms on small firms' employment growth as well as their labor productivity growth. Because unobserved amenity and variation in the change in large firms' sales of across commuting zones are driven by unobserved factors, Ordinary Least Squares regression (OLS) is biased. For example, a municipality that has unobserved high-quality amenities attracts large firms with strong economic performance. High-quality amenities also attract small firms. Hence, OLS is biased. Variation in the change in the sales of large firms across commuting zones driven by unobserved factors brings estimation bias. For example, a positive regional economic shock attracts highly skilled workers. The increase in the number of residents increases the number of employees in small firms. Both large and small firms then hire many employees. Hence, again, OLS is biased. Therefore, this study uses the instrumental variable model.

As a result, large firms have a positive impact on the employment growth of small firms; that is, the increase in the sales of the firms with the top 1% of sales has a positive impact on the change in the number of employees in firms with the bottom 25%, 20%, and 10% sales, that of SMEs, that of SMEs with 10 or more employees, that of firms with fewer than 10 employees, and

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that of firms with no and with one branch office. Firms with many branch offices have the largest magnitude of impact on the increase in the number of employees in small firms in the same commuting zone. Such firms have the following characteristics: a high number of sales, employees, and branch offices. Firms with a high number of employees, namely, more than the threshold for SMEs or 1000 or more employees, have a positive impact on small and medium enterprises with 10 or more employees, but it is insignificant for firms with fewer than 10 employees. In contrast, firms with the top 1% of sales have a positive impact on small firms with fewer than 10 employees as well. It seems that invigorating activities are more efficient in having an effect on the employment growth of small firms than the spillover effect from firms with high numbers of employees who accumulate skills and knowledge through job rotation and co-workers. However, the effect of large firms is complex, and this study does not intend to deconstruct the impact based on the relevant functions. Furthermore, the increase in sales in large firms, regardless of the criteria, reduce the labor productivity of the establishments of small firms with more than 50 and fewer than 300 employees. Such firms may conflict with each other.

Regarding the impact on the local economy, firms with the top 1% of sales, a high number of employees, and a high number of branch offices increase the number of employees in small firms with fewer than 10 employees and those at the bottom of sales in non-tradable sectors, such as the hospital, schools and postal service, wholesale, retail trade, accommodations, restaurant and bar, life-related services, and amusement industries. The positive spillover effect of large firms on the local economy can be observed. These findings indicate the important role of large firms for regional revival together with financial support. However, the labor productivity of small firms with fewer than 10 employees in the non-tradable sectors does not appear to improve.

The remainder of this study is organized as follows. Section 2 provides an overview of relevant previous studies. Section 3 explains the criteria for firm size and shows the geographic distribution of the establishments of large and small firms. Section 4 explains the data. Section 5 describes the empirical estimation model. Section 6 presents the estimation results. Finally, Section 7 presents the conclusions and discussion.

2. Literature

"Superstar" firms such as Google, Amazon, Facebook, and Apple attract attention, and this issue affects the motivation of this study. Autor, Dorn, Katz, Patterson, and Reenen (2020) argue that the increase in the number of "superstar" firms decreases labor share; they conclude that this primarily occurs due to reallocation of the incumbents. Therefore, this study focuses on the large firms with the top 1% of sales rather than "superstar" firms to analyze whether they have a positive

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spillover effect on small firms in the same commuting zone or whether they poach employment.

A few studies have found a positive effect of large labs, particularly in the science sectors. Agrawal, Cockburn, Galasso, and Oettl (2014) find that the presence of at least one large lab and numerous small labs increases the number of patents. As described in Section 1, several factors can be considered to positively affect small firms in the same commuting zones. R&D externality to neighboring firms has been studied. Lööf and Johansson (2014) demonstrate that persistent R&D has positive externality and improves productivity in larger cities using Swedish manufacturing and service firms-panel data. Crespi, Criscuolo, Haskel, and Slaughter (2008) find that the competitors, suppliers, and plants in the same business group constitute the primary knowledge source, that these knowledge flows increase Total Factor Productivity (TFP), and that competitors bring the spillover of the free information flow. Substantial financial resources and investment in large firms' R&D is a potential positive externality source for other firms located nearby. Thus, studies on agglomeration and diversity have been developed, as described later in this section.

Peer effects from colleagues are also discussed from the positive and negative sides; however, the effect on other firms located nearby is not always a focus (Mas and Moretti, 2009; Tan and Netessine, 2019; Berlinski and Ramos, 2020). Hasan and Koning (2019) use the entrepreneurship bootcamp experiment and find that entrepreneurs without prior connections experienced the greatest spillovers, but the spillover effect is limited for those with many prior connections. Focusing on entrepreneurs in their study infers that there is a potential peer effect of large firms on local entrepreneurs or small firms. Agrawal, McHale, and Oettl (2017) argue that hiring a person from the right tail of output distribution has both a positive and a negative impact on incumbent productivity, and it is most efficient for non-highly-ranked institutions using biologist data. If recruiting happens between firms located nearby, it is possible that a high performer in a large firm will bring positive externality to neighboring small firms.

Inside a firm, if job rotation improves the employee's performance and thus increases the firm's sales, it increases the demand of suppliers in the same commuting zones as well as consumption demand. Job rotations are frequently observed in large firms in Japan. Kampkötter, Harbring, and Sliwka (2018) find a positive effect of job rotations using German data in banking and financial services. The performance of employees rotated between jobs is stronger than that of non-rotated employees. Using Danish data, Eriksson and Ortega (2006) test three hypotheses regarding firms that adopt job rotation. They argue that the employee learning and employer learning hypotheses are supported, but the employee motivation hypothesis is rejected.

Du and Vanino (2020) analyze not the effect of large firms but the effect of fast-growth firms on non-fast-growth firms operating in the same region in regard to employment growth and labor productivity. They show both positive and negative externality effects of fast-growth firms on proximately located non-fast-growth firms. Sharing special suppliers reduces the cost of inputs and shipping because of increased demand, pooling of labor market results among suitably skilled labor,

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and knowledge spillover. In contrast, high rental and transportation costs and crowding-out effects arise due to competition from fast-growth firms, as does labor poaching when skilled labor is limited. These channels correspond to the externality effects of large firms.

Regarding literature related to firm size, Kim and Ro (2017) analyze the inter-industry spillover effect between large firms and small- and medium-sized firms in Korea. They argue that the share of small firms decreases in developed countries because employees concentrate on large firms; however, there is another view that small firms create employment and become sources of economic growth. The authors use industry-level data based on firm size and find that the R&D size of the other firms (i.e., small- and medium-sized firms for large firms and vice-versa) increase TFP in Korea, the spillover effect is asymmetric, and large firms benefit more from spillover effects.

Regarding the effect of firms on the local economy and labor demand in the same geographic area, Hornbeck and Moretti (2019) focus on the spillover effects of tradable sectors to non-tradable sectors[1] and find that productivity gains in manufacturing lead to significant increases in employment and average earnings in the local economy. Moretti (2010) argues that employment growth in tradable sectors creates employment in non-tradable sectors. Therefore, firms and people settle in innovative cities that become increasingly prosperous. In contrast, cities with no industries or sectors that drive innovation decline quickly. Moretti and Tuline (2013) and Kazekami (2017) empirically demonstrate this argument. This study examines the effect of large firms on employment in small firms in non-tradable sectors in the same commuting zone as well as the overall effect on small firms in the same commuting zone.

Analyses of the interaction effects between firms in the same geographic space (e.g., the same commuting zone, municipality, or region) have been developing in the regional studies. The main classical theories are the Marshall–Arrow–Romer (MAR) view on the specialization of industry, Jacobs' (1969) theory regarding the diversity of industry, and Porter's (1990) theory on competitive advantage. This study examines whether there is the effect of large firms after controlling for the specialization and diversity of industry. We are curious as to whether large firms have some impact on small firms in the same space beyond the specialization, diversity, and industrial structure effects. Thus, this study provides empirical analyses. For example, Bishop and Gripaios (2010) identify the effects of several externalities on employment growth using British sector-level data. They find a negative impact from specialization and positive impact of diversity and local competition, considering the spatial autocorrelation. This study follows the measurement methods for specialization (location quotient [LQ]) and diversity that they and other previous studies

[1]Tradable sectors include sectors in which goods and services are traded, such as the manufacturing and information technology industries. Thus, demand is not limited to the residents of the region. Non-tradable sectors include sectors in which goods and services are consumed at the location where they are supplied, such as retail and wholesale trade. Hence, demand is determined by the number of residents in the location and those residents' income level. If the income of tradable sectors located in the same region is high, then the aggregate demand of non-tradable sectors is high as well.

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use. Wixe (2015) analyzes the effect of a broad range of plant-level spatial externalities in Sweden. Wixe (2015) finds a positive effect of specialization and competition on labor productivity but no evidence of diversity.

Galliano, Magrini, and Triboulet (2015) also examine the impact of Marshall's and Jacobs' externalities. However, they analyze these externalities not in regard to firm-level employment growth but in regard to a firm's innovation performance. Notably, they indicate that the location of the head office has often been highlighted, but the location of other firm units influences knowledge spillover. They use the location at which a minimum of 50% of a firm's total employees work. This study uses the establishment location rather than the head office location to capture the effect through establishments affiliated with large firms, which can be located anywhere in the country. While they use the location quotient (LQ) to capture specialization externality, the Herfindhal index captures the level of diversification. Hervas-Oliver, Sempere-Ripoll, Alvarado, and Estelles-Miguel (2018) analyze specialization capturing the location quotient (LQ) and Jacobian diversity capturing the Herfindahl index on innovation and find that these gains are heterogeneous. This study estimates the effect of large firms on employment growth and labor productivity rather than innovation because creating job opportunities is an important political and economic issue in Japan.

Finally, many studies (Kondo, 2015; Dominic, Arbia, and Groot, 2013; Barrios, Bertinelli, and Strobl, 2006; Gervais and Jensen, 2019) demonstrate the geographical concentration of industries, while some measure the decline in industrial concentration in India from 1998 to 2013 (Amirapu, Hasan, Jiang, and Klein, 2019). Using data from the United States (US), Brynjolfsson, McAfee, Sorell, and Zhu (2008) find that information technology (IT)-intensive industries became more concentrated than non-IT-intensive industries after 1995. Bessen (2017) finds that the adoption of proprietary IT accelerates industry concentration and induces larger establishment sizes, thereby accelerating firms' operating margins and increasing labor productivity for the top four firms in each industry. If a positive effect of large firms through each establishment on the employment growth of small firms exists, uneven distribution of the establishment of large firms limits its effect and widens the difference between regions. This relates to the revival of regional businesses as well. The present study shows the distribution map of large and small firms' establishments in Section 3.2.

3. Criteria of firm size and geographic distribution

3.1. Criteria of firm size

First, this study categorizes firms by size based on firm-level sales. This does not refer to sales at each establishment level. The reason for this is that even if an establishment is small, employees of large firms have an opportunity to enhance their skills through R&D investment and

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training. This study estimates whether these establishments improve the skill level of local small firms, provide a positive spillover effect, or increase the demand of non-tradable sectors that are proximately located through higher wages. Hence, firm-level data are used to determine which firms qualify as "large" based on the amount of sales, and establishment-level data, including location information, are used to estimate the effect of large firms on small firms' establishments.

This study determines that large firms are in the top 1% of sales in each industry (medium industrial classification level; this study uses Japan Standard Industrial Classification throughout) because the volume of establishments of large firms by this threshold is equivalent to the volume of establishments when firms are determined by the criterion using the number of employees described in the following. Table 1 indicates the matrix by each criterion for firm size. Each cell indicates the percentage of the number of establishments by category. The establishments affiliated with the firms with the top 1% of sales account for 13.41%. The share of the number of establishments affiliated with the firms with more employees in SMEs is 11.63% (those with a higher number of SMEs and fewer than 1000 employees account for 4.41%; those with 1000 employees or more account for 7.22%). This study uses firms with the bottom 10%, 20%, or 25% of sales as small firms when the criterion is the firm's sales.

Second, this study uses the criterion of the number of employees and compares the results with those based on the criterion of the volume of sales. This criterion aims to more directly capture the peer effect from a high number and different types of co-workers as well as the effect of experiencing several types of jobs. For this criterion, this study uses two types of criteria. One is the Japanese criterion, while the other is the OECD criterion.

The small and medium enterprise agency in Japan determines SMEs by industry. The threshold of number of employees excluding temporary workers is fewer than 50 persons for the retail trade industry, 100 persons for wholesale and service industries, and 300 persons for manufacturing and other industries. Additionally, many Japanese governmental statistics such as the Basic Survey on Wage Structure publish data based on firms with fewer than 10, 10 to 99, 100 to 999, and 1000 or more employees. Thus, this study considers firms for which the number of employees is above the SME threshold or with 1000 employees or more to be large firms. SMEs, firms with at least 10 employees but fewer employees than SMEs, and firms with zero to nine employees are considered small firms.

The OECD definition is simpler. A micro-firm is one with zero to nine employees, a small firm has 10 to 49 employees, and a medium-sized firm has 50 to 249 employees. Thus, this study considers firms with 250 or more employees to be large firms based on the OECD definition.

Finally, this study divides data by the number of branch offices to consider job rotation involving location transfer. This study investigates the effect of establishments of firms in the top 1 %, 10%, or 20% of number of branch offices. The outside portion of the matrix in Table 1 indicates the median number of branch offices by category divided by the number of employees in the firm.

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The median numbers of branch offices of firms with 1000 or more employees and that of firms with more employees than the SME threshold but fewer than 1000 employees are 223 and 32 branch offices, respectively. The threshold numbers of branch offices for the top 10% and 20% are 320 and 78 branch offices, respectively. Therefore, firms in the top 20% for number of branch offices hire many employees simultaneously. This study examines the effect on firms with no branch offices as well as on small firms.

Table 1 indicates the overlap between the above criteria. However, approximately 2.95% and 0.05% of total establishments shown in the row indicating the establishment of firms with the top 1% of sales are not firms with a high number of employees. The number of employees is less than the threshold for SMEs. In contrast, regarding large firms above the SME threshold but fewer than 1000 employees and those with 1000 employees or more, the majority earn the top 1% of sales. However, a small percentage of firms earn less than the top 1% of sales.

Regarding the upper left portion of the matrix in Table 1, establishments of firms with the bottom 10%, 20%, or 25% of sales are those with fewer than 10 employees in most cases. In contrast, most establishments of firms with fewer than 10 employees range between the bottom 25% and 75% of sales. Therefore, if this study considers firms with few employees to be small firms, they do not necessarily equate to firms with the bottom 10%, 20%, or 25% of sales.

3.2. Geographic Distribution

Figure 1 indicates the geographic distribution of the number of establishments within each firm size. The red color is the highest range, and the dark blue is the fewest range. Figure 1.a. indicates the number of establishments of firms with the top 1% of sales. Those establishments are primarily concentrated in the Tokyo commuting zone. The area with the second heaviest concentration is the Osaka commuting zone, and the third is the Tokai area. When this study uses the criterion of the number of employees and a map of the number of establishments of firms with a number of employees that exceeds the SME threshold is drawn, the maps is similar to Figure 1.a. Hence, this study limits firms as large firms, and a map of the number of establishment of firms with 1000 employees or more is drawn as in Figure 1.b. Figure 1.b. indicates that the establishments affiliated with the firms with 1000 or more employees are primarily more concentrated in the Tokyo commuting zone than the firms with the top 1% of sales (Figure 1.a). Figure 1.c. shows the establishments of firms in the top 20% for number of branch offices and indicates that those establishments are concentrated in the Tokyo commuting zone, but the number is lower than that for the establishments of firms with the top 1% of sales in Figure 1.a. and with 1000 or more employees in Figure 1.b. although it is colored red in Figure 1.c. as well. Figures 1.d. to 1.f. refer to the establishments of small firms. Figure 1.d. indicates that the establishments of firms with the bottom 10% of sales are widely spread around the country. Figure 1.e. indicates that the establishments of

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firms with fewer than 10 employees are also spread around country, and the number of establishments is higher than in Figure 1.d. Figure 1.f. reflects the number of establishments of SMEs with 10 or more employees. The number is less than in Figure 1.e. and concentrated in the Tokyo and Osaka commuting zones, but such establishments also exist in rural areas.

4. Data

This study uses data from the Economic Census for Business Activities for 2012 and 2016 (information for 2011 and 2015 is included in the data collected in 2012 and 2016), conducted by the Ministry of Internal Affairs and Communications and the Ministry of Economy, Trade and Industry. The data for 2016 are the latest published data, and those for 2012 are the second newest. The survey is conducted every few years. The Economic Census for Business Activities covers all establishments and firms in Japan because this census aims to identify Japan's industrial structure comprehensively and to compile information on the population for conducting various statistical surveys on establishments and firms. The data are collected by each establishment, including information on with which firm each establishment is affiliated and in which municipality it is located. Only aggregated data are published. However, if we intend to use micro data at the establishment level, an application is required.

Table 2 presents the descriptive statistics. The mean of change in total number of employees is 0.2, but the standard deviation is large. The average change in labor productivity increases, and the average aggregated labor productivity in the commuting zones is positive. On average, Japan's industrial structure is specialized for a small number of industries because the mean of the LQ is more than one. Additionally, each commuting zone has approximately 160 industrial sectors, while there are 519 sectors by small industrial classification level because the mean of the industrial diversity index is 5.07. The LQ and diversity index are explained by equations (2) and (3) in Section 5. The maximum number of years for which a firm that the establishment belongs to has been open is set at 37 for firms that opened before 1984 due to the data collecting method, and the exact number of years is used for those that opened after 2005. The net entry rate is slightly positive. Hence, the dynamic of the local economy is slightly silent. The shares of establishments in the restaurant and bar industry and the accommodations industry are the highest on average.

5. Empirical model

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To estimate the effect of the increase in the sales of large firms on the employment growth in the establishments of small firms, this study examines the following model:

$$\begin{aligned}\Delta EMP_{ict} = {} & \beta_0 + \beta_1 \Delta Large_{ct} + \beta_2 \Delta Sales_{ict} + \beta_3 Sing_{ict} + \beta_4 EMP_{ict-1} + \beta_5 \Delta LP_{ict} \\ & + \beta_6 LQ_{kct-1} + \beta_7 Div_{ct-1} + \beta_8 fAge_{ict} + \beta_9 nentry_{ct} + \beta_{10} \Delta lp_{ct} \\ & + \beta_{11} empl_{ct-1} + \beta_{12} dummy_{ict} + \varepsilon_{it} + \varepsilon_{ct}\end{aligned} \tag{1}$$

The dependent variable, ΔEMP_{ict}, represents the change in the number of employees of establishment *i,* which belongs to small firms in commuting zone *c* in year *t*. The total number of employees is composed of the individual employer, family employees, paid officers, regular employees, part-time employees, and temporary employees. The dispatched workers and employees who are on loan are not included because they are accounted for by the original establishment.

A commuting zone provided by the Center for Spatial Information Science at the University of Tokyo is used. The commuting zone comprises the central city and suburban areas from where more than 10% residents commute to the central city. The central city is a Densely Inhabited District with a population of more than 10,000. A Densely Inhabited District refers to a district with several contiguous areas and a population density (the unit area is a district based on a statistical census of the population) of more than 4000 per square kilometer in the municipality and more than 5000 thousand aggregated number of residents. There are 222 commuting zones. The definition of small firms is explained in Section 3.1.

We focus on the estimation coefficient of $\Delta Large_{ct}$. This is the aggregate change in the real sales of all establishments belonging to large firms that are in the same commuting zone c with the establishment *i* of a small firm. As mentioned earlier, if $\Delta Large_{ct}$ increases, knowledge spillover occurs from the establishments of large firms to the establishments of small firms. The demand for intermediate inputs increases, and labor demand in the establishment of small firms thus increases as well. If consumption demand increases through the wages of establishments of large firms, the demand for establishments of small firms increases, and labor demand grows. Therefore, we focus on β_1 whether there is a positive effect of large firms on the employment growth of small firms. To calculate the changes in real sales, we adjust nominal sales to real sales using GDP deflators by economic activities. The GDP deflator with benchmark year 2015 was obtained from the Japan Cabinet Office.

As for controlling for the establishment characteristics of small firms, $\Delta Sales_{ict}$ is the change in real sales of establishment *i* of a small firm because the increase in sales increases labor demand. $Sing_{ict}$ equals one if the small firm that establishment *i* belongs to is a single establishment and zero if the small firm that establishment *i* belongs to has multiple establishments. Seventy-two percent of establishments are single establishments. In equation (1), EMP_{ict-1} is the employment level of establishment *i* of a small firm in year *t-1*. ΔLP_{ict} is the change in labor

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productivity of establishment *i* of a small firm because if labor productivity increases, there is a relative decline in labor. $fAge_{ict}$ represents the number of years since the firm that establishment *i* belongs to opened. However, the data reflect whether firms opened before 1984, during the period from 1985 to 1994, or during the period from 1995 to 2004. After 2005, the survey collects the opening year information. Therefore, this study determined the number of years that have passed since the firm opened to be 37 (2021 minus 1984), 32, and 22 if a firm opened before 1984, between 1985 and 1994, or between 1995 to 2004, respectively. This study uses the exact number of years for firms that opened after 2005.

As for controlling the commuting zone characteristics, LQ_{kct-1} is the LQ. This captures the specialization of industry in year *t-1* and is calculated as follows:

$$LQ_{kc} = \frac{e_{k,c}/e_c}{e_k/e}, \quad (2)$$

where $e_{k,c}$ is the number of employees in sector k (small industrial classification level) in commuting zone *c*, and e_c is the total number of employees in commuting zone *c*. e_k is the total number of employees in sector *k,* and e is the total number of employees. An LQ above 1 means that sector k is overrepresented in commuting zone *c* relative to the nation as a whole. Namely, it indicates a relative specialization of the commuting zone.

Div_c is the diversity of industry and is measured by the following equation:

$$Div_c = \sum_{k=1}^{n} Spe_{ck} \ln\left(\frac{1}{Spe_{ck}}\right) \quad (3)$$

As noted above, Spe_{cp} is the ratio of the number of employees in sector *k* to the total number of employees in commuting zone *c*. There are *n* different sectors. Div_c varies from zero if all employment is concentrated in one sector to ln(n) if employment is spread evenly across all sectors. To account for the level of competition and the dynamics of local industries, $nentry_{ct}$ is the net entry rate of establishments in commuting zone *c* (percentage), Δlp_{ct} is the growth of labor productivity in commuting zone *c*, and $empl_{ct-1}$ is the number of employees in commuting zone *c* in year *t-1*. We also control for the industry of the firm to which establishment *i* belongs; $dummy_{ict}$ is the industry dummy (large industrial classification level).[2]

In addition, this study examines the effect of large firms on the labor productivity of the establishments in small firms in the same commuting zone.

$$\begin{aligned}\Delta LP_{ict} = {} & \gamma_0 + \gamma_1 \Delta Large_{ct} + \gamma_2 \Delta Sales_{ict} + \gamma_3 Sing_{ict} + \gamma_4 EMP_{ict-1} + \gamma_5 LP_{ict-1} + \gamma_6 LQ_{kct-1} \\ & + \gamma_7 Div_{ct-1} + \gamma_8 fAge_{ict} + \gamma_9 nentry_{ct} + \gamma_{10} \Delta lp_{ct} + \gamma_{11} empl_{ct-1} \\ & + \gamma_{12} dummy_{ict} + \varepsilon_{it} + \varepsilon_{ct}\end{aligned}$$

[2] If the establishment had existed only in 2012 or both in 2012 and in 2016, this study uses information regarding the industry as it was in 2012. If the establishment existed only in 2016, the study uses information regarding the industry as it was in 2016.

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(4)

ΔLP_{ict} is the change in labor productivity of establishment *i,* which belongs to a small firm in commuting zone *c* in year *t*. Labor productivity is calculated as the establishment's real sales output per employee. In the equation (4), we control for the level of labor productivity in year t-1 rather than the change in labor productivity of establishment *i* of a small firm as in equation (1).

Next, this study focuses on the effect of large firms through each establishment on the local economy. This study limits the industry of the dependent variables only for the non-tradable sectors. That is, the dependent variables are the change in number of employees of establishment *i,* which belongs to a small firm in commuting zone *c* in year *t,* or the change in labor productivity of establishment *i,* which belongs to a small firm in commuting zone *c* in year *t,* in the wholesale, retail trade, accommodations, restaurants and bar, life-related services, and amusement industry. Moreover, this study adds the education and learning support industry, the medical, healthcare and welfare industry, the compound services industry, and not-otherwise-specified services to those industries as non-tradable sectors.

Ordinary least squares (OLS) estimation has a bias, as explained in Section 1. Unobserved amenity and variation in the change in large firms across commuting zones driven by unobserved factors are potential sources of bias. Therefore, following Moretti (2004), this study uses the Bartik instrument variable.

$$IV_c = \sum_m \omega_{mc} \Delta P_m \tag{5}$$

ω_{mc} is the share of firm size *m* (firm size is categorized by the volume of sales, the number of employees, or the number of branch offices, as mentioned in Section 3.1)[3] in commuting zone *c*, and ΔP_m is the nationwide change in the real sales of firm size *m*, excluding the change in real sales in commuting zone *c*. When we estimated equations (1) and (4), standard errors are clustered in the commuting zone and the industry classification of establishments.

6. Results

[3] As for the criterion of the volume of sales, *m* is 9: the bottom 10%, 10-20%, 20-25%, 25-50%, 50-75%, 75-80%, 80-90%, 90-99%, and top 1% of sales; for the criterion of the number of employees, *m* is 5: no permanent employees, one to nine employees, 10 employees to the SME threshold, the SME threshold to 999 employees, and 1000 employees or more; for the criterion of the number of branch offices, *m* is 7: the bottom 25%, 25-50%, 50-75%, 75-80%, 80-90%, 90-99%, and the top 1%. Because the bottom 25% of establishments do not have branch offices, we cannot divide these establishments into the bottom 10% and 10-20%.

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6.1. The effects on small firms

The estimation results of equation (1) are presented in Table 3. Tables 3 considers the firms with bottom 25%, 20%, or 10% of sales to be small firms. Columns (1) to (3) in Table 3 indicate that the increase in the sales of the establishments in firms with the top 1% of sales increases the number of employees in the establishments of small firms. The impact of the increase in the sales of large firms on the establishments of small firms with the bottom 25% of sales is the largest among columns (1), (2), and (3). The estimation coefficient for the establishments of small firms with the bottom 10% of sales is the smallest. The higher sales of the establishments of small firms are, the stronger the effects of large firms are.

Columns (4) to (6), and columns (7) to (9) are the results when we use the firms with a number of employees above the SME threshold and those with 1000 or more employees as large firms. Remarkably, the large firms determined by the number of employees do not increase the number of employees of the establishments of small firms with the bottom 10% of sales. The opportunities to experience different types of jobs and enhance their skills or be inspired by co-workers were not efficient for positive spillover to small firms in the same commuting zone in terms of the number of employees.

Comparing the magnitudes of the estimation coefficients among columns (1) to (9), the coefficient is largest when large firms are considered to be firms with 1000 or more employees. An increase of one million yen (approximately 10 thousand US dollars) in sales for large firms leads to 0.0000647 more employees in the establishments of small firms in their commuting zone. Firms with 1000 or more employees are the larger among the large firms, as shown in the matrix in Table 1. However, the much larger firms, those with a large number of branch offices, do not increase the number of employees of the establishments of small firms with the lowest sales, as shown in columns (10) to (15). The coefficients are insignificant or even negative. The opportunities of job rotation and locational transfer do not affect the employment growth of small firms, as determined by their volume of sales, in the same commuting zone.

The lower portion of Table 3 indicates the estimated coefficients of the instrumental variable in the first stage. They are significant in all columns[4]. The Wald F statistics[5] passed the Stock-Yogo critical values; thus, it is not a weak instrumental variable. An under-identification test (Kleibergen-Paap rk LM statistic) and overidentification test (Hansen J statistic) of all instruments passed for all cases.

An increase in sales of firms' own establishments increases employment when small firms are considered those with the bottom 25% of sales, as shown in the second row in Table 3. However,

[4] Large firms see an increase their sales above the national average in some commuting zones. Hence, the sign of the coefficient is slightly negative.

[5] The Wald F statistics for Table 5 to 7 are available upon request.

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the effect is insignificant when the small firm earns less, that is, the bottom 20% or 10% of sales. Even if the sales increase, it is not enough to hire more employees for these micro-firms when the effect of large firm, industrial specialization, diversity, industry dummy and other conditions are controlled. One single establishment has a negative impact on employment growth. The level of employment at the beginning of the estimation period and an increase in labor productivity have a negative impact on employment growth in the establishments of small firms. This is consistent with the labor economics theory. The coefficients of local specialization captured by the LQ are significantly and insignificantly negative from columns (1) to (15). Local specialization decreases the number of employees of small firms with the bottom 25% of sales. This is consistent with Bishop and Gripaios (2010). The coefficients for industrial diversity are significantly negative or insignificant[6]. Therefore, in the Japanese case, we do not observe the positive impact of industrial specialization and diversity on the employment growth of small firms. Under such a situation, we find that an increase in sales of establishments of large firms increases the number of employees of small firms in the same commuting zone.

The number of years that have passed since opening, that is, being an older firm, has a negative impact on the employment growth of the establishments of small firms. This is accord with our assumptions. Older firms hire fewer new employees than new firms that are growing rapidly. The net entry rate of the establishment increases the number of employees of the establishments of small firms. Regardless of the industry category of new establishments, the entry of a new establishment in the commuting zone has a positive impact. There is no spillover from the aggregated increase in the labor productivity in establishments located in the same commuting zone. The aggregated employment level at the beginning of the estimation period in the commuting zone has a slightly negative impact on the employment growth of the establishments of small firms. The number of employees does not increase much if the employment level in the commuting zone was already high.

Table 4 indicates the impact of large firms on the establishment of small firms when the criteria for determining small firms are changed. The upper portion of Table 4 indicates the effect of large firms on small firms as determined by the Japanese SME definition. Only the estimated coefficients of the increase in the sales of large firms, β_1, are shown in Table 4. The increase in the sales of large firms increases the number of employees in the establishment of small firms with at least 10 employees but fewer employees than the SME threshold, regardless of which criteria are used to define large firms. However, there is no impact in terms of an increase in the sales of large firms on the establishment of small firms with fewer than 10 employees when the criterion for

[6] The correlation between the aggregate change in the real sales of all establishments of large firms in the commuting zone (ΔLarge) and LQ is -0.04 and that between ΔLarge and the industrial diversity is approximately 0.49. The effect of specialization and diversity of industry are not captured by the effect of large firms.

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defining large firms is the number of employees and the number of branch offices. Only an increase in the sales of the firms with the top 1% of sales is effective for small firms with fewer than 10 employees. We can interpret this as indicating that the effects of financial power, investment in R&D and accumulating skills and know-how affect efficiency more than opportunities to experience different types of jobs, inspiration from co-workers, or job transfer associated with relocation. However, this study does not highlight such individual factors in the complex effects of large firms.

The middle portion of Table 4 indicates the results of large firms on small firms determined based on the number of employees using the OECD definition. The results are similar to those in the upper portion of Table 4. The effect of large firms on small firms with fewer than 50 employees is insignificant when the large firms were determined using the criterion of the number of employees or that of the number of branch offices. Thus, a high number of employees or branch offices alone do not improve employment growth in the establishment of small firms in the same commuting zone. Invigoration of business activities is needed.

The lower portion of Table 4 shows the effect of large firms on firms that do not have branch offices. Firms with the top 1% of sales and those with a large number of employees do not increase the number of employees of firms with no branch offices. Firms in the top 1% or 20% for number of branch offices have positive impacts.

Additionally, this study investigates the effect of large firms on the labor productivity of the establishments of small firms. The upper portion of Table 5 indicates that large firms do not improve the labor productivity of the establishments of firms with the lowest sales in the same commuting zones. We do not observe a skill spillover effect. Moreover, an increase of sales in large firms, regardless of which criteria are used to categorize them, reduce the labor productivity of the establishments of firms with 50 to 249 employees or fewer employees than the SME threshold, as shown in the lower portion of Table 5. Table 1 indicates that some firms have greater than the top 50% of sales and hire a low number of employees. Large firms, based on any criteria, and those with sales over the top 50% and that hire 50 to 249 or fewer employees than the SME threshold may conflict with each other.

6.2. Effects on the local economy

Next, this study investigates the effect of large firms on the local economy. The upper portion of Table 6 shows the effect of large firms on the change in the number of employees in the wholesale, retail trade, accommodations, restaurant and bar, life-related services, and amusement industries. The goods and services in these sectors are supplied and demanded at the same locations. As shown in the first row of Table 6, increases in the sales of large firms, regardless of the criteria, increase employment in the establishments of the firms with the lowest sales in these industries in the same commuting zone. Furthermore, the third row shows that when small firms are determined

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by the number of employees, large firms of any criteria have a positive impact on the establishments of small firms with fewer than 10 employees. Therefore, the theory described in Moretti (2010) holds. The employees of the establishments of large firms consume more goods and services in the same commuting zone because their sales increase, and the increase in their consumption has a positive impact on the employment growth of the establishments of small firms.

The lower portion of Table 6 shows the effects of large firms on the employment growth of the establishments of small firms in the industries examined in the upper portion of Table 6 as well as the following industries: the education and learning support industry, medical, healthcare and welfare industry, compound services industry, and not-otherwise-specified services. Namely, this study adds services in non-tradable sectors that are more necessary rather than depending on consumer preference. The ninth row indicates similar results to those in the third row. The increase in sales of firms with the top 1% of sales, with more than the SME threshold number employees or at least 1000 employees, and that are in the top 1% or 20% in number of branch offices have a positive impact on the increase in the number of employees of the establishments of small firms with fewer than 10 employees in the local economy. As the sales of large firms based on any criteria increase, the number of employees increases in local clinics and education support services, among others. However, the seventh row in Table 6 indicates that an increase in the sales of firms with the high number of branch offices does not increase the number of employees in small firms in the local economy. It seems that relatively necessary services such as education and medical and healthcare services are not consumed to a higher degree when sales of relatively larger firms, that is, firms with large number of branch offices, increase. The consumption volume may be limited if the wages of the employees in those firms increase.

Furthermore, an increase in large firms does not affect the number of employees of the establishments of firms with no branch offices. This may be because the criterion is too wide to consider the effect on the local economy. Table 6 does not indicate the results on the labor productivity of establishments of small firms, but increases in the establishments of large firms reduce the labor productivity of small firms in non-tradable sectors. The results are available upon request. The large volume of consumption demand may discourage the improvement of the labor productivity of the establishments of small firms in the wholesale, retail trade, accommodations, restaurant and bar, life-related services, and amusement industries as well as the education and learning support industry, medical, healthcare, and welfare industry, compound services industry, and not-otherwise-specified services.

6.3. Robustness check: the effects in the rural areas

As mentioned in Figure1, the establishments of large firms concentrate in the metropolitan areas (Tokyo, Osaka and Tokai commuting zones). To confirm whether the effect of large firms

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through each establishment exists even in the small rural commuting zones, this study limits the commuting zones whose aggregate change in the real sales of all establishments belonging to large firms that are in the same commuting zone with the establishment of a small firm are less than the median value and conducts the above estimation model. The results in the upper portion of Table 7 are similar to those of Table 3 (whole country). The increase in sales of large firms based on any criteria increases the number of employees in firms with the bottom 25%, 20%, or 10% of sales. Furthermore, the magnitude of coefficient is larger than that for the whole country. An increase of 100 million yen (approximately one million US dollars) in sales for large firms leads to 1.19 more employees in the establishments of small firm in their commuting zone in Column (1) of Table 7. However, the positive impact on small firms determined based on the number of employees is not observe. In the small commuting zones, large firms and those with the fewer employees than the SME threshold and have high amounts of sales may conflict with each other.

The lower portion of Table 7 indicates the effect of large firms on the local economy. Large firms have positive impacts on the change in the number of employees, particularly in the firms with the bottom 25% and 20%, and that of SMEs in the wholesale, retail trade, accommodations, restaurant and bar, life-related services, and amusement industries. Therefore, the effect of large firms through each establishment exists even in the small rural commuting zones.

7. Conclusions and discussion

This study investigates the effect of an increase in the sales of the establishments of large firms on the employment growth and labor productivity of small firms in the same commuting zone using establishment data in Japan. “Superstar” firms attract attention around the world in terms of the impact on employees, competition, and tax burden together with their innovative power and rapid growth. This study explores whether an effect of large firms, even those much smaller than “superstar” firms, on small firms in the same space exists after controlling for the effects of industrial specialization and diversity.

Large firms have adequate investment in R&D, and their employees enjoy rich experience gained through job rotation and inspiration from many colleagues. However, if large firms provide positive spillover effects to small firms through these factors, these large firms are unevenly distributed around the country. Their headquarters tend to cluster in the capital, but their branch offices exist outside this area. Hence, this study investigates the effects of establishments affiliated with large firms on small firms in the same commuting zones. By obtaining establishment-level data, this study, was able to analyze such effects.

As a result, an increase in the sales of the establishments of large firms positively impacts

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the employment growth of the establishments of small firms even when local industrial specialization and diversity, the dynamics of the local economy, and the economic environment at the beginning of the estimation period are controlled for. Furthermore, in this Japanese case, we do not find a positive effect of industrial specialization and diversity. Among large firms, those with the top 1% of sales that hire many employees and have many branch offices have the largest impact. Firms with the top 1% of sales and those with more employees than the SME threshold largely overlap. However, some firms earn the top 1% of sales, but the number of employees is below the SME threshold. This study compares the effect of large firms by the criteria used to categorize their size. According to the results by criteria for large firms, having a high number of employees or branch offices alone does not improve the employment growth in the establishments of small firms in the same commuting zone; invigoration of economic activities is needed rather than the accumulation of skill and knowledge through job rotation and co-workers in large firms. Moreover, the effect of large firms is complex; however, investigating the individual factors of large firms is beyond the scope of this study. Regarding the effect on the local economy, an increase of large firms increases the number of employees in firms with fewer than 10 employees in the same commuting zone. The employees of the establishments of large firms consume more goods and services and increase the number of employees of the establishments of small firms.

These results indicate the importance of the role of large firms in regional revival alongside financial support. However, the distribution of the establishments affiliated with large firms differs among regions. Therefore, not all regions can benefit from the effect of large firms. The solution as to how to reduce the differences among regions is beyond the scope of this study and is left for future research.

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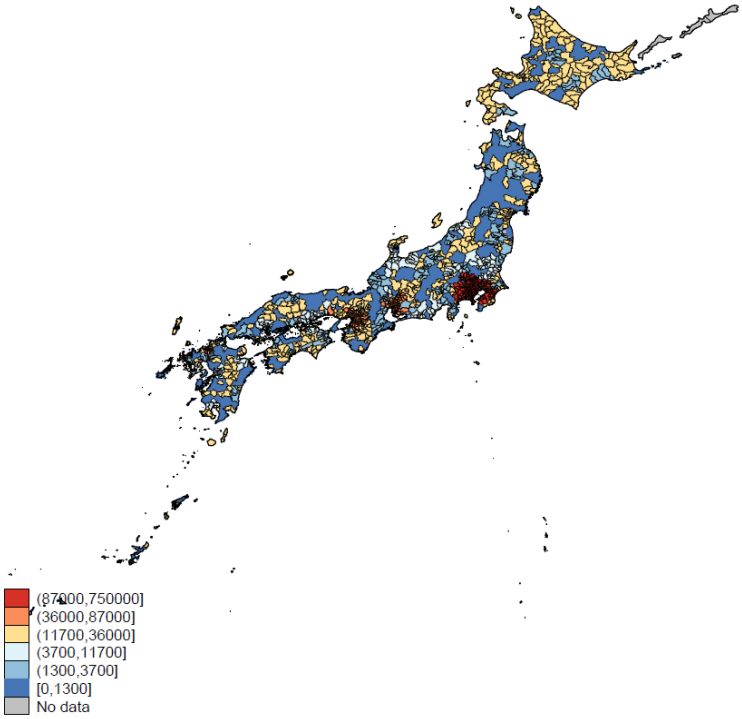

Figure 1.a. the number of establishments of firms with top 1% of sales

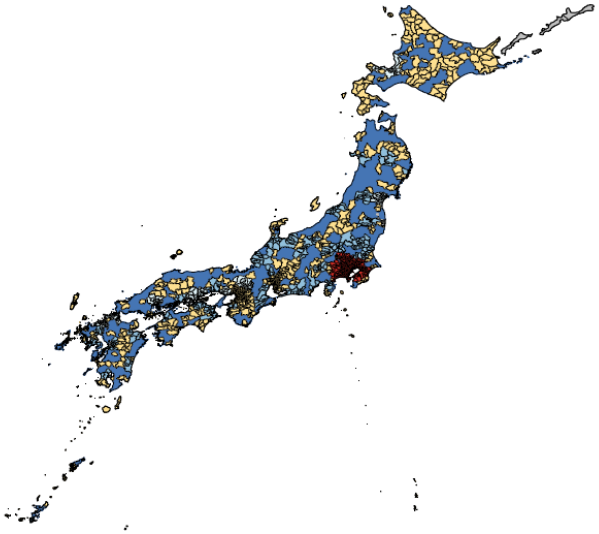

Figure 1.b. the establishments affiliating to the firms with more than 1000 employees

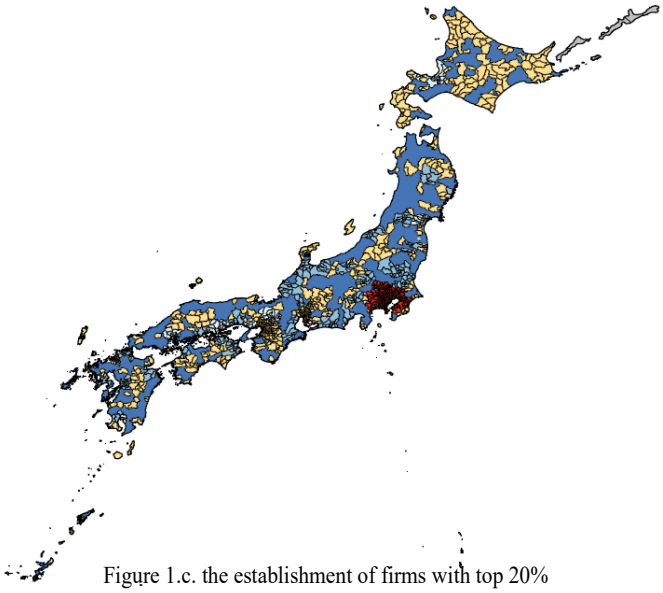

Figure 1.c. the establishment of firms with top 20% branch offices

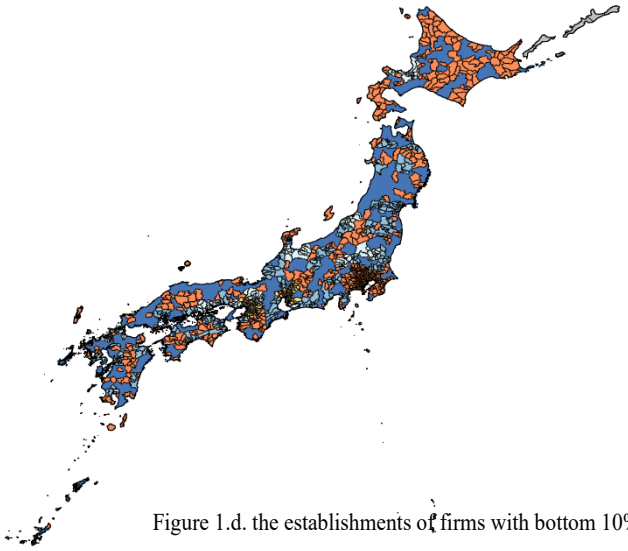

Figure 1.d. the establishments of firms with bottom 10% sales

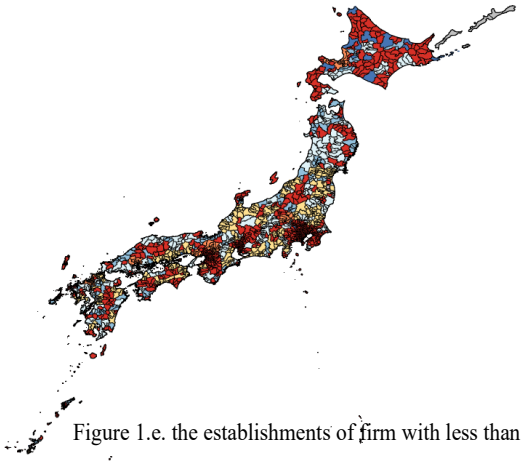

Figure 1.e. the establishments of firm with less than 9 employees

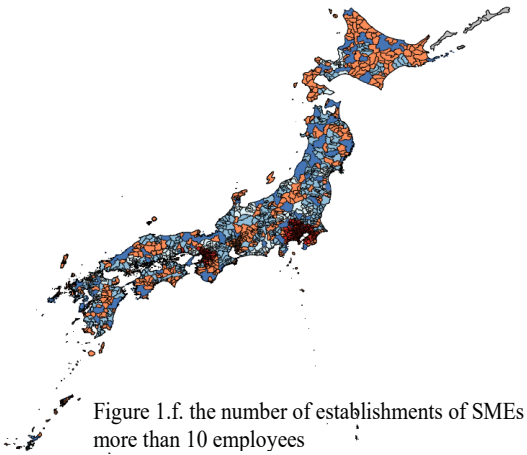

Figure 1.f. the number of establishments of SMEs but more than 10 employees

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Table1 Matrix by each criterion for firm size (the criterion of the volume of sales × the criterion of the number of employees)

		the criterion of the number of employees					
		No permanent employees	1~9	10 employees to the SME	the SME threshold to 999	1000 employees or more	Total
the criterion of the volume of sales	Bottom 10%	0.03	7.34	0.03	0.00	0.00	7.39
	10～20%	0.02	7.30	0.03	0.00	0.00	7.35
	20～25	0.02	4.90	0.08	0.02	0.01	5.02
	25～50	0.07	18.41	0.41	0.00	0.00	18.90
	50~75	0.05	17.57	2.22	0.00	0.00	19.84
	75~80	0.01	2.99	1.16	0.00	0.00	4.17
	80~90	0.02	4.73	4.33	0.02	0.00	9.10
	90~99	0.02	1.97	11.66	1.02	0.15	14.82
	Top1% of sales	0.00	0.05	2.95	3.35	7.05	13.41
	Total	0.24	65.27	22.86	4.41	7.22	100
	Median number of branch offices	0	0	4	32	223	

Note: Each cell indicates the percentage of the number of establishments by category

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Table2 Descriptive statistics

Variable		Mean	Std. dev.	Min	Max
ΔEMP	Change in the number of employees of establishment	0.20	42.15	-23979	24601
ΔLP	Change in labor productivity of establishmen	43.96	38273.48	-7.23E+07	1.48E+07
ΔSales	Change in real sales of establishment of a small firm	0.002	0.77	-965.07	388.35
Sing	Single establishment dummy	0.72	0.45	0	1
EMP	Employment level of establishment in t-1	8.74	51.40	0	23995
LQ	Specialization of industry	1.27	2.83	0	673.733
Div	Diversity of industry	5.07	0.18	4.126502	5.226066
fAge	Number of years since the firm opened	26.02	10.63	5	37
nentry	Net entry rate of establishments (percentage)	0.66	3.27	-12.60974	43.9834
Δlp	Growth of labor productivity in commuting zone	130.94	377.18	-15294.42	54567.36
empl	Number of employees in commuting zone in t-1	411488.50	703537.40	1	2760136
dummy	Industry dummy				
	agriculture and forestry (reference)	0.00	0.07	0	1
	fisheries	0.00	0.02	0	1
	mining and quarrying of stone and gravel	0.00	0.02	0	1
	construction	0.10	0.29	0	1
	manufacturing	0.10	0.30	0	1
	electricity, gas, heat supply and water	0.00	0.03	0	1
	information and communications	0.01	0.11	0	1
	transport and postal services	0.03	0.16	0	1
	wholesale and retail trade	0.25	0.43	0	1
	finance and insurance	0.02	0.13	0	1
	real estate and goods rental and leasing	0.07	0.25	0	1
	scientific research, professional and technical services	0.04	0.21	0	1
	accommodations, restaurant and bar	0.12	0.32	0	1
	life-related services and amusement services	0.08	0.28	0	1
	education, learning support	0.03	0.17	0	1
	medical, health care and welfare	0.07	0.26	0	1
	compound services	0.01	0.09	0	1
	not-otherwise-specified services	0.06	0.24	0	1
ΔLarge	the aggregate change in the real sales of all establishments belonging to				
	firms with the top 1% of sales	1060.17	1636.55	-93.91847	4891.477
	firms with more than the threshold for SMEs	1301.414	2052.868	-77.2136	5865.148
	firms with 1000 or more employees	707.4377	1109.953	-78.52102	3617.519
	firms with the top 1 % of number of branch offices	0.0198857	0.7714194	-388.258	965.1647
	firms with the top 20% of number of branch offices	243.1485	345.9518	-80.59726	1807.618
IV	IV for criteria based on the amount of sales	1721.35	309.72	797.899	2644.321
IV	IV for criteria based on the number of employees	2792.376	265.2467	1990.859	3686.728
IV	IV for criteria based on the number of branch offices	3034.842	746.4814	1738.459	4346.608
Number of observations		4,773,291			

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Table 3 The effects on small firms with the bottom 25%, 20% or 10% of sales by large firms based on the amount of sales, the number of employees and the number of branch offices

	Criteria of large firm: the increase in the sales of the firms with														
	the top 1% of sales			a number of employees above the SME threshold			1000 or more employees			the top 1 % of number of branch offices			the top 20% of number of branch offices		
	The dependent variable is the change in the number of employees of establishment which belongs to firms with the bottom														
	25%	20%	10%	25%	20%	10%	25%	20%	10%	25%	20%	10%	25%	20%	10%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
△Large	5.29e-05***	3.07e-05**	2.37e-05*	3.51e-05***	1.78e-05*	1.62e-05	6.47e-05***	3.30e-05*	2.99e-05	-0.189	-0.474*	-0.0633	-2.40e-05	-6.00e-05*	-8.00e-06
	(1.78e-05)	(1.34e-05)	(1.43e-05)	(1.30e-05)	(1.01e-05)	(1.19e-05)	(2.40e-05)	(1.87e-05)	(2.19e-05)	(0.265)	(0.272)	(0.268)	(3.35e-05)	(3.45e-05)	(3.39e-05)
△Sales	66.63*	50.56	23.06	66.62*	50.56	23.06	66.62*	50.56	23.06	66.41*	50.07	22.98	66.60*	50.54	23.04
	(37.79)	(33.01)	(16.14)	(37.79)	(33.01)	(16.14)	(37.79)	(33.01)	(16.14)	(37.77)	(33.00)	(16.13)	(37.78)	(33.00)	(16.14)
Sing	-0.476***	-0.746***	-1.562***	-0.477***	-0.746***	-1.562***	-0.477***	-0.746***	-1.562***	-0.481***	-0.748***	-1.564***	-0.481***	-0.748***	-1.564***
	(0.118)	(0.179)	(0.344)	(0.117)	(0.178)	(0.344)	(0.117)	(0.178)	(0.344)	(0.115)	(0.178)	(0.344)	(0.115)	(0.178)	(0.344)
EMP	-0.356***	-0.722***	-0.829***	-0.356***	-0.722***	-0.829***	-0.356***	-0.722***	-0.829***	-0.356***	-0.722***	-0.829***	-0.356***	-0.722***	-0.829***
	(0.100)	(0.0541)	(0.0406)	(0.100)	(0.0541)	(0.0406)	(0.100)	(0.0541)	(0.0406)	(0.100)	(0.0541)	(0.0406)	(0.100)	(0.0541)	(0.0406)
ΔLP	-0.000357***	-0.000217***	-6.61e-05*	-0.000357***	-0.000217***	-6.61e-05*	-0.000357***	-0.000217***	-6.61e-05*	-0.000357***	-0.000217***	-6.59e-05*	-0.000357***	-0.000217***	-6.59e-05*
	(9.53e-05)	(7.88e-05)	(3.77e-05)	(9.53e-05)	(7.88e-05)	(3.77e-05)	(9.53e-05)	(7.88e-05)	(3.77e-05)	(9.53e-05)	(7.87e-05)	(3.77e-05)	(9.53e-05)	(7.87e-05)	(3.77e-05)
LQ	-0.00657**	-0.00286	-0.00155	-0.00652**	-0.00281	-0.00153	-0.00651**	-0.00280	-0.00152	-0.00620**	-0.00256	-0.00138	-0.00621**	-0.00257	-0.00138
	(0.00285)	(0.00180)	(0.00139)	(0.00284)	(0.00178)	(0.00139)	(0.00283)	(0.00178)	(0.00139)	(0.00278)	(0.00173)	(0.00135)	(0.00278)	(0.00173)	(0.00135)
Div	-0.0935***	-0.0768***	-0.0476	-0.0844***	-0.0687***	-0.0440	-0.0840***	-0.0686***	-0.0439	-0.0499**	-0.0466**	-0.0284	-0.0458**	-0.0363	-0.0271
	(0.0294)	(0.0295)	(0.0312)	(0.0259)	(0.0263)	(0.0299)	(0.0259)	(0.0263)	(0.0298)	(0.0212)	(0.0235)	(0.0260)	(0.0226)	(0.0246)	(0.0267)
fAge	-0.0301***	-0.0229***	-0.0218***	-0.0301***	-0.0229***	-0.0218***	-0.0300***	-0.0229***	-0.0218***	-0.0300***	-0.0229***	-0.0218***	-0.0300***	-0.0229***	-0.0218***
	(0.00251)	(0.00149)	(0.00110)	(0.00251)	(0.00149)	(0.00110)	(0.00251)	(0.00149)	(0.00110)	(0.00250)	(0.00148)	(0.00110)	(0.00250)	(0.00148)	(0.00110)
nentry	0.00267*	0.00331***	0.00426***	0.00322**	0.00380***	0.00447***	0.00324**	0.00381***	0.00448***	0.00574***	0.00556***	0.00556***	0.00578***	0.00566***	0.00557***
	(0.00140)	(0.00119)	(0.00137)	(0.00134)	(0.00123)	(0.00141)	(0.00134)	(0.00122)	(0.00141)	(0.00118)	(0.00114)	(0.00145)	(0.00119)	(0.00114)	(0.00146)
Δlp	7.46e-06	1.58e-05	4.95e-06	7.43e-06	1.58e-05	5.06e-06	7.24e-06	1.57e-05	4.97e-06	5.82e-06	1.53e-05	4.97e-06	5.60e-06	1.48e-05	4.90e-06
	(1.60e-05)	(1.50e-05)	(1.56e-05)	(1.47e-05)	(1.40e-05)	(1.54e-05)	(1.47e-05)	(1.40e-05)	(1.54e-05)	(1.10e-05)	(1.18e-05)	(1.45e-05)	(1.09e-05)	(1.18e-05)	(1.46e-05)
empl	-1.16e-07***	-7.70e-08**	-5.40e-08*	-9.89e-08***	-6.16e-08**	-4.77e-08	-9.89e-08***	-6.16e-08**	-4.77e-08	-6.63e-09	1.30e-09	-7.07e-09	-5.74e-09	3.48e-09	-6.77e-09
	(4.07e-08)	(3.35e-08)	(3.07e-08)	(3.75e-08)	(3.14e-08)	(3.13e-08)	(3.75e-08)	(3.14e-08)	(3.13e-08)	(1.06e-08)	(1.25e-08)	(1.29e-08)	(1.16e-08)	(1.31e-08)	(1.38e-08)
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	3.998***	5.416***	5.928***	3.958***	5.380***	5.912***	3.956***	5.379***	5.911***	3.810***	5.285***	5.845***	3.791***	5.237***	5.839***
	(0.489)	(0.374)	(0.481)	(0.493)	(0.372)	(0.478)	(0.493)	(0.372)	(0.478)	(0.496)	(0.366)	(0.471)	(0.487)	(0.371)	(0.475)
Observations	924,406	688,202	341,236	924,406	688,202	341,236	924,406	688,202	341,236	924,406	688,202	341,236	924,406	688,202	341,236
R-squared	0.203	0.397	0.468	0.203	0.397	0.468	0.203	0.397	0.468	0.203	0.397	0.468	0.203	0.397	0.468
IV (first stage)	-1.589***	-1.612***	-1.540***	-2.233***	-2.258***	-2.125***	-1.209***	-1.223***	-1.151***	-.00005***	-.00005***	-.00005***	-.420***	-.420***	-.418***
	(0.280)	(0.289)	(0 .285)	(0.410)	(0 .419)	(0.409)	(0.222)	(0.227)	(0.221)	(9.60e-07)	(9.92e-07)	(1.04e-06)	(0.009)	(0.009)	(0.010)
Wald Ftest	26955.73	20817.59	10699.3	88858.94	64504.2	31274.71	87358.15	63579.94	30844.34	1.00E+06	6.20E+05	1.70E+05	1.60E+06	1.10E+06	3.80E+05

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

△Large=the aggregate change in the real sales of all establishments belonging to large firms;△Sales=Change in real sales of establishment of a small firm; Sing = Single establishment dummy;EMP= Employment level of establishment in t-1; △LP =Change in labor productivity of establishmen; LQ=Specialization of industry; Div= Diversity of industry ;fAge=Number of years since the firm opened; nentry=Net entry rate of establishments (percentage); △lp=Growth of labor productivity in commuting zone; empl=Number of employees in commuting zone in t-1;

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Table 4 The effect of large firms on the establishment of small firms by the criteria of firm size

	Criteria of large firm: the increase in the sales of the firms with														
	the top 1% of sales			a number of employees above the SME threshold			1000 or more employees			the top 1 % of number of branch offices			the top 20% of number of branch offices		
small firm=	SMEs	10 to SME #1	0 tp 9	SMEs	10 to SME #1	0 tp 9	SMEs	10 to SME #1	0 tp 9	SMEs	10 to SME #1	0 tp 9	SMEs	10 to SME #1	0 tp 9
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
△Large	0.000106***	0.000429***	2.62e-05**	4.76e-05*	0.000316***	5.78e-06	8.79e-05*	0.000583***	1.07e-05	2.227**	10.05***	0.334	0.000282**	0.00128***	4.22e-05
	(3.67e-05)	(0.000130)	(1.22e-05)	(2.54e-05)	(0.000102)	(9.23e-06)	(4.68e-05)	(0.000187)	(1.70e-05)	(1.000)	(3.454)	(0.364)	(0.000128)	(0.000443)	(4.64e-05)

	Criteria of large firm: the increase in the sales of the firms with											
	the top 1% of sales				a number of employees above the SME threshold				1000 or more employees			
small firm=	OECD #2	50 to 249	10 to 49	0 to 9	OECD #2	50 to 249	10 to 49	0 to 9	OECD #2	50 to 249	10 to 49	0 to 9
	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)
△Large	9.07e-05***	0.00107***	5.99e-05	2.62e-05**	3.27e-05	0.000905***	-1.82e-05	5.78e-06	6.04e-05	0.00167***	-3.35e-05	1.07e-05
	(3.34e-05)	(0.000278)	(6.51e-05)	(1.22e-05)	(2.27e-05)	(0.000225)	(4.46e-05)	(9.23e-06)	(4.18e-05)	(0.000413)	(8.23e-05)	(1.70e-05)

	Criteria of large firm: the increase in the sales of the firms with							
	the top 1 % of number of branch offices				the top 20% of number of branch offices			
small firm=	OECD #2	50 to 249	10 to 49	0 to 9	OECD #2	50 to 249	10 to 49	0 to 9
	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)
△Large	1.823*	28.09***	-2.270	0.334	0.000231*	0.00357***	-0.000290	4.22e-05
	(0.933)	(7.435)	(1.469)	(0.364)	(0.000119)	(0.000956)	(0.000186)	(4.64e-05)

	Criteria of large firm: the increase in the sales of the firms with				
	the top 1% of sales	a number of employees above the SME	1000 or more employees	the top 1 % of number of branch offices	the top 20% of number of branch offices
small firm=	firms with no branch offices				
	(36)	(37)	(38)	(39)	(40)
△Large	4.63e-05	2.71e-05	5.00e-05	9.137***	0.00117***
	(8.45e-05)	(6.47e-05)	(0.000119)	(2.702)	(0.000347)

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The dependent variable is the change in the number of employees of establishment which belongs to small firms.

#1 at least 10 employees but fewer employees than the SME threshold

#2 Small firms based on the OECD definition; firms with fewer than 250 employees.

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Table 5 The effects of large firms on the labor productivity of small firms

	Criteria of large firm: the increase in the sales of the firms with														
	the top 1% of sales			a number of employees above the SME threshold			1000 or more employees			the top 1 % of number of branch offices			the top 20% of number of branch offices		
small firm=	25% #3	20%	10%	25%	20%	10%	25%	20%	10%	25%	20%	10%	25%	20%	10%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
△Large	-0.00129	-0.00204	-0.000615	0.000574	-0.000809	0.000324	0.00106	-0.00149	0.000598	69.88	48.76	96.18	0.00884	0.00616	0.0121
	(0.00191)	(0.00215)	(0.00295)	(0.00152)	(0.00178)	(0.00284)	(0.00281)	(0.00330)	(0.00525)	(52.13)	(54.87)	(62.26)	(0.00661)	(0.00694)	(0.00783)

	Criteria of large firm: the increase in the sales of the firms with														
	the top 1% of sales			a number of employees above the SME threshold			1000 or more employees			the top 1 % of number of branch offices			the top 20% of number of branch offices		
		10 to SME			10 to SME			10 to SME			10 to SME			10 to SME	
small firm=	SMEs	#1	0 tp 9	SMEs	#1	0 tp 9	SMEs	#1	0 tp 9	SMEs	#1	0 tp 9	SMEs	#1	0 tp 9
	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
△Large	-0.0578***	-0.309**	0.00642	-0.0185	-0.188**	0.0307	-0.0343	-0.347**	0.0567	-280.6	-4,867*	688.8	-0.0355	-0.619*	0.0869
	(0.0207)	(0.135)	(0.0179)	(0.0163)	(0.0931)	(0.0219)	(0.0302)	(0.172)	(0.0405)	(558.5)	(2,873)	(462.1)	(0.0706)	(0.368)	(0.0583)

	Criteria of large firm: the increase in the sales of the firms with											
	the top 1% of sales				a number of employees above the SME threshold				1000 or more employees			
small firm=	OECD #2	50 to 249	10 to 49	0 to 9	OECD #2	50 to 249	10 to 49	0 to 9	OECD #2	50 to 249	10 to 49	0 to 9
	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)	(41)	(42)
△Large	-0.0557***	-0.299***	-0.172*	0.00642	-0.0256*	-0.225***	-0.0365	0.0153	-0.0473*	-0.415***	-0.0673	0.0283
	(0.0205)	(0.106)	(0.0922)	(0.0179)	(0.0151)	(0.0795)	(0.0742)	(0.0147)	(0.0278)	(0.146)	(0.137)	(0.0271)

	Criteria of large firm: the increase in the sales of the firms with							
	the top 1 % of number of branch offices				the top 20% of number of branch offices			
small firm=	OECD #2	50 to 249	10 to 49	0 to 9	OECD #2	50 to 249	10 to 49	0 to 9
	(43)	(44)	(45)	(46)	(47)	(48)	(49)	(50)
△Large	-245.1	-4,476*	-1,952	688.8	-0.0310	-0.568*	-0.249	0.0869
	(557.5)	(2,365)	(1,984)	(462.1)	(0.0705)	(0.301)	(0.254)	(0.0583)

	Criteria of large firm: the increase in the sales of the firms with				
	the top 1% of sales	a number of employees above the SME threshold	1000 or more employees	the top 1 % of number of branch offices	the top 20% of number of branch offices
small firm=	firms with no branch offices				
	(51)	(52)	(53)	(54)	(55)
△Large	-0.889	-0.0992	-0.183	-8,934	-1.157
	(0.665)	(0.390)	(0.719)	(9,239)	(1.223)

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The dependent variable is the change in labor productivity of establishment which belongs to small firms.

#1 at least 10 employees but fewer employees than the SME threshold

#2 Small firms based on the OECD definition; firms with fewer than 250 employees.

#3 firm with the bottom of 25%, 20% or 10% of sales

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Table 6 The effect of large firm on local economy

Local economy= the wholesale, retail trade, accommodations, restaurant and bar, life-related services, and amusement industries

	Criteria of large firm: the increase in the sales of the firms with														
	the top 1% of sales			a number of employees above the SME threshold			1000 or more employees			the top 1 % of number of branch offices			the top 20% of number of branch offices		
small firm=	25% #1	20%	10%	25%	20%	10%	25%	20%	10%	25%	20%	10%	25%	20%	10%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
∆Large	5.31e-05*	5.68e-05**	3.97e-05*	4.23e-05*	4.76e-05*	4.03e-05*	7.81e-05*	8.79e-05*	7.43e-05*	0.468**	0.551*	0.773**	6.01e-05*	7.09e-05*	9.98e-05*
	(2.72e-05)	(2.85e-05)	(2.30e-05)	(2.44e-05)	(2.69e-05)	(2.42e-05)	(4.49e-05)	(4.94e-05)	(4.46e-05)	(0.236)	(0.288)	(0.391)	(3.12e-05)	(3.79e-05)	(5.14e-05)

	Criteria of large firm: the increase in the sales of the firms with									
	the top 1% of sales		a number of employees above the SME threshold		1000 or more employees		the top 1 % of number of branch offices		the top 20% of number of branch offices	
small firm=	SMEs	0 tp 9	SMEs	0 tp 9	SMEs	0 tp 9	SMEs	0 tp 9	SMEs	0 tp 9
	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)
∆Large	1.92e-05	6.37e-05**	1.81e-05	3.59e-05**	3.34e-05	6.62e-05**	0.383	1.277***	4.88e-05	0.000162***
	(3.19e-05)	(2.82e-05)	(2.71e-05)	(1.79e-05)	(5.00e-05)	(3.30e-05)	(0.580)	(0.364)	(7.52e-05)	(5.14e-05)

	Criteria of large firm: the increase in the sales of the firms with				
	the top 1% of sales	a number of employees above the SME threshold	1000 or more employees	the top 1 % of number of branch offices	the top 20% of number of branch offices
small firm=	firms with no branch offices				
	(26)	(27)	(28)	(29)	(30)
∆Large	5.90e-05	-0.000233*	-0.000429*	0.953	0.000121
	(7.14e-05)	(0.000122)	(0.000225)	(2.153)	(0.000275)

Local economy =the avobe industries as well as the education and learning support industry, the medical, healthcare and welfare industry, the compound services industry, and not-otherwise-specified services.

	Criteria of large firm: the increase in the sales of the firms with														
	the top 1% of sales			a number of employees above the SME threshold			1000 or more employees			the top 1 % of number of branch offices			the top 20% of number of branch offices		
small firm=	25% #1	20%	10%	25%	20%	10%	25%	20%	10%	25%	20%	10%	25%	20%	10%
	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)	(41)	(42)	(43)	(44)	(45)
∆Large	7.82e-05***	5.15e-05**	2.98e-05*	6.49e-05**	4.73e-05**	3.46e-05*	0.000120**	8.73e-05**	6.39e-05*	0.283	0.00895	0.276	3.66e-05	1.16e-06	3.56e-05
	(2.88e-05)	(2.29e-05)	(1.68e-05)	(2.75e-05)	(2.23e-05)	(1.82e-05)	(5.07e-05)	(4.11e-05)	(3.35e-05)	(0.277)	(0.310)	(0.310)	(3.59e-05)	(4.01e-05)	(3.98e-05)

	Criteria of large firm: the increase in the sales of the firms with									
	the top 1% of sales		a number of employees above the SME threshold		1000 or more employees		the top 1 % of number of branch offices		the top 20% of number of branch offices	
small firm=	SMEs	0 tp 9	SMEs	0 tp 9	SMEs	0 tp 9	SMEs	0 tp 9	SMEs	0 tp 9
	(46)	(47)	(48)	(49)	(50)	(51)	(52)	(53)	(54)	(55)
∆Large	3.91e-05	5.66e-05***	2.74e-05	3.70e-05**	5.05e-05	6.84e-05***	1.010	1.364***	0.000129	0.000174***
	(4.14e-05)	(1.94e-05)	(3.45e-05)	(1.44e-05)	(6.37e-05)	(2.65e-05)	(1.453)	(0.358)	(0.000186)	(4.93e-05)

	Criteria of large firm: the increase in the sales of the firms with				
	the top 1% of sales	a number of employees above the SME threshold	1000 or more employees	the top 1 % of number of branch offices	the top 20% of number of branch offices
small firm=	firms with no branch offices				
	(56)	(57)	(58)	(59)	(60)
∆Large	0.000218	-0.000141	-0.000260	2.118	0.000274
	(0.000157)	(9.32e-05)	(0.000172)	(2.485)	(0.000320)

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The dependent variable is the change in the number of employees of establishment which belongs to small firms.

#1 firm with the bottom of 25%, 20% or 10% of sales

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Table 7 Robustness check: the effects in the rural areas

	Criteria of large firm: the increase in the sales of the firms with								
	the top 1% of sales			a number of employees above the SME threshold			1000 or more employees		
small firm=	25% #1	20%	10%	25%	20%	10%	25%	20%	10%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
△Large	0.0119***	0.0105***	0.00998*	0.0220**	0.0205**	0.0230*	0.0204**	0.0187**	0.0216*
	(0.00402)	(0.00392)	(0.00520)	(0.00987)	(0.00992)	(0.0135)	(0.00892)	(0.00884)	(0.0125)

	Criteria of large firm: the increase in the sales of the firms with								
	the top 1% of sales			a number of employees above the SME threshold			1000 or more employees		
small firm=	SMEs	10 to SME #1	0 tp 9	SMEs	10 to SME #2	0 tp 9	SMEs	10 to SME #1	0 tp 9
	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
△Large	0.00318	0.0138	0.000240	0.00327	0.0655	0.000175	0.00282	0.0523	0.000155
	(0.00495)	(0.0176)	(0.00253)	(0.0106)	(0.0434)	(0.00585)	(0.00918)	(0.0331)	(0.00517)

Local economy= the wholesale, retail trade, accommodations, restaurant and bar, life-related services, and amusement industries

	Criteria of large firm: the increase in the sales of the firms with								
	the top 1% of sales			a number of employees above the SME threshold			1000 or more employees		
small firm=	25% #1	20%	10%	25%	20%	10%	25%	20%	10%
	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)
△Large	0.00952**	0.0107**	0.00872*	0.0199*	0.0232*	0.0236	0.0193*	0.0225*	0.0236
	(0.00415)	(0.00464)	(0.00447)	(0.0118)	(0.0137)	(0.0154)	(0.0114)	(0.0134)	(0.0157)

	Criteria of large firm: the increase in the sales of the firms with					
	the top 1% of sales		a number of employees above the SME threshold		1000 or more employees	
small firm=	SMEs	0 tp 9	SMEs	0 tp 9	SMEs	0 tp 9
	(28)	(29)	(30)	(31)	(32)	(33)
△Large	0.00198	0.00210	0.0281	0.0146	0.0251*	0.0133
	(0.00528)	(0.00297)	(0.0172)	(0.00931)	(0.0144)	(0.00807)

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The dependent variable is the change in the number of employees of establishment which belongs to small firms.

#1 firm with the bottom of 25%, 20% or 10% of sales

#2 at least 10 employees but fewer employees than the SME threshold

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【要約】

大企業が小規模企業の雇用へ与える影響についての分析はこれまであまりなされてこなかった。本論文では、日本の事業所単位のデータを用い、大企業の基準を売上上位1%企業、および従業員数が中小企業規模以上、1000人以上、多数の支社を持つ企業として分析した。売上上位1%企業の売上の増加は同一通勤圏（都市雇用圏）の売上下位25%、20%、10%企業および中小企業規模基準より人数の少ない企業の雇用に正の影響を与えていた。この結果を他の大企業の基準を用いた場合と比較すると、多数の支社を持つ企業の売上増加が与える影響が最も大きくなった。従業員数が多い企業も、従業員数が10人以上の中小企業規模企業の雇用を増やすが、従業員が10人未満の企業へは効果がなかった。これに対し、売上上位1%企業は従業員が10人未満の企業に対しても雇用を増加させていた。さらに、大企業が小規模企業の労働生産性に与える影響を推計すると有意な結果はみられなかった。大企業と同一通勤圏の小規模企業の雇用には、大企業の活発な経済活動の方が、転勤や同僚の多さから生まれる技能や知識の波及から生まれる効果よりも重要であるといえよう。

また、いずれの基準を用いても大企業の売上増加は、地域の小売業、卸売業、飲食宿泊業、生活関連サービス業、娯楽業の小規模企業の雇用増加をもたらす。つまり、大企業から地域経済への正の波及効果が観察された。しかしながら、大企業からの消費需要の増加はそれら小規模企業の労働生産性を下げている可能性がある。さらに、大企業の事業所は地域により偏在しているため、全ての地域が大企業からの正の雇用効果の恩恵を受けられるわけではない。

【掲載した結果が独自集計であること】

論文7頁3.1節で独自集計の方法を説明（First, this study categorizes firms by size based on firm-level sales〜、This study determines that large firms are〜）。また、10頁4節冒頭で、経済センサスの説明と、公表版は集計データでありミクロデータの利用には申請が必要であることを明記。さらに、19頁の謝辞（Acknowledgement）にてデータ提供を受けたことを記載。