Journal of The Japanese and International Economies 74 (2024) 101337

Contents lists available at ScienceDirect

Journal of The Japanese and International Economies

journal homepage: www.elsevier.com/locate/jjie

The effect of regional import shocks on job flows in Japanese manufacturing establishments☆

Masahiro Endoh

Keio University, Japan

ARTICLE INFO

JEL codes:
F14
F16
F61
F66
J23

Keywords:
Establishments
Entry
Exit
Import shocks
Job flows

ABSTRACT

Using a dataset of all Japanese manufacturing establishments in 2006 and 2016 and industry- and region-level import shocks, this study examined the impact of the China Shock on the job flows of establishments. Regression analyses found that the industry-level import shock increased the probability of exiting in only a few groups. Interestingly, small establishments in single-unit firms located in non-agglomerated regions adopted a hibernation strategy to cope with the region-level import shock. Furthermore, surviving establishments in this category accelerated both job creation and destruction in response to these two import shocks, thereby amplifying the overall magnitude of job flows. These results became observable owing to the use of establishment-level observations and a detailed classification of job flows.

1. Introduction

The effects of import competition on the size, exit, and entry of firms and establishments are essential factors through which globalization impacts domestic employment. One of the seminal works on establishment-level adjustment to import shocks is Bernard et al. (2006), which used U.S. manufacturing plant-level data to demonstrate that plant survival and growth are negatively associated with its industry exposure to imports from low-wage countries.[1] After Bernard et al. (2006), previous studies using firm- and establishment-level data have also almost unanimously demonstrated the negative impact of import competition on survival rates and employment growth in various countries.[2]

Most previous studies in this research area have used industry-level import shocks, defined as industries in which firms or establishments are doing business, as an index of the import shocks affecting them. Some readers might consider the consistent use of industry-level indices to be too rigid, given that many studies have revealed the significant impact of region-level import shocks on various aspects of regional labor markets.[3] Autor et al. (2013) is one of the most influential studies in this research area, while Acemoglu et al. (2016) present the reallocation effect of employment and aggregate demand effect as region-level idiosyncratic

☆ Grant-in-Aid from JSPS KAKENHI (grant number JP21H00713). I appreciate the comments and discussions from participants at the JSIE Kanto meeting at Nihon University. I would also like to thank the Editor and the anonymous referee for their valuable feedback, which was instrumental in revising the manuscript. The use of statistics prepared by the Ministry of Internal Affairs and Communications and the Ministry of Economy, Trade and Industry was under the special authorization and guidance of the respective ministries. Because the observations in the dataset are confidential, no individual entries can be made public. The author declares no conflict of interest. The author is solely responsible for all errors and omissions.

E-mail address: endoh@keio.jp.

[1] The term “shock” is defined here as any change in the business or economic environment that occurs exogenously outside the economic entities being studied without implying the magnitude or scope of its impact. “Import shock” refers to changes in imports that occur independently of the establishments’ activities.

[2] The negative impact of import competition on survival rates is observed in Mion and Zhu (2013) for Belgium, Iacovone et al. (2013) for Mexico, Groizard et al. (2015) for California, USA, Hayakawa and Matsuura (2017) for Indonesia, César and Falcone (2020) for Chile, and Torreggiani and Andreoni (2023) for South Africa, among others. Meanwhile, the negative impact on employment growth is found in Mion and Zhu (2013) for Belgium, Uysal et al. (2015) for the USA, César and Falcone (2020) for Chile, Hauptmann and Schmerer (2020) for Germany, and Torreggiani and Andreoni (2023) for South Africa.

[3] Some previous studies such as Hayakawa et al. (2021) construct and utilize firm-level import shocks that are more detailed than industry-level shocks. However, they do not consider the effects of regional import shocks simultaneously.

https://doi.org/10.1016/j.jjie.2024.101337
Received 5 May 2024; Received in revised form 16 October 2024; Accepted 21 October 2024
Available online 24 October 2024

factors that magnify industry-level shocks within a region, yielding different results from industry-level analyses. Therefore, it is natural to assume that regional shocks affect employment in firms and establishments in a region. This study estimates the effect of import shocks on establishments' jobs by simultaneously considering both industry- and region-level imports. All Japanese manufacturing establishments were observed between 2006 and 2016. To the best of my knowledge, this is the first attempt to integrate region-level import shocks with establishment-level job flows for establishment-level analysis.

Additionally, this study demonstrates the impact of import shocks on two aspects of job flows that have rarely been examined in firm- or establishment-level analyses. The first aspect is job creation and destruction. Even if import shocks lead to a reduction in workforce within establishments, this does not necessarily mean that they weaken job creation or strengthen job destruction. Import shocks may strengthen job flows in both directions, resulting in the amplification of the overall magnitude of job flows. While the effects of imports on job creation and destruction are examined in some industry- and region-level studies, only Groizard et al. (2015) consider this aspect in the establishment-level literature. Using data from Californian establishments, Groizard et al. (2015) demonstrates that the decline in input and final-good trade costs affects job creation and destruction in the same direction. That is, in less productive establishments, a decline in trade costs suppresses employment by decreasing job creation or increasing job destruction, whereas the opposite occurs in more productive establishments. This study presents a different result using Japanese establishment data, showing that strengthening import competition activates both job creation and destruction for small establishments in single-unit firms located in non-agglomerated regions, which is referred to as the amplifying effect of import shocks on job flow.

The second aspect of this study concerns industry switching. Establishments react to import competition not only by adjusting their employment size or ceasing operations but also by shifting to other industries. Although establishments often change their business domain, as demonstrated by Japanese data (outlined in the next section), industry switching has not been a focus of studies thus far, with the exceptions of Bernard et al. (2006) and Behrens et al. (2020). This study sheds light on this issue by examining how manufacturing establishments, in response to import shocks, either shift to the non-manufacturing sector or remain within the manufacturing sector. One intriguing finding is that the industry-level import shock particularly influences the decisions of manufacturing establishments in non-agglomeration regions. However, whether these establishments are induced to shift to the non-manufacturing sector or continue in manufacturing depends on factors such as their size and the number of establishments within the firm.

Two strings of studies are closely related to this topic. The first concerns the impact of the "China Shock" on job flows. In aggregate-level analyses, influential studies such as Autor et al. (2013) and Acemoglu et al. (2016) estimate the China Shock on net job flows in local labor markets and industries. Taniguchi (2019) and Kainuma and Saito (2022) expand their method and apply it to Japanese regional data, whereas Kiyota et al. (2021) use industry-level data from six countries, including Japan. Asquith et al. (2019) decompose net job changes into job births, deaths, expansions, and contractions, where job births arise from the entry of establishments, and examine how imports from China affect these components. Endoh (2023) employs a similar method using industry- and region-level aggregated data in Japan, finding that the China Shock primarily influenced job changes through the extensive margin (establishment entries and exits). Since their industry- and region-level data are constructed by aggregating establishment-level data, the current study complements the aggregated-level analyses of import effects on job flows and provides insights into how their results arise from the reactions of establishments.

The second approach uses Japanese firm-level data to observe the impact of import shocks on employment and wages. Hayakawa et al. (2021) present results indicating that the high penetration rates of imports from China decrease employment in larger firms but not in smaller ones, and the decline in employment primarily stems from firm exits. Matsuura (2022) uses a dataset comprising larger Japanese firms and reveals that import competition decreases the number of workers engaged in manufacturing activities but not the total number of workers. Furthermore, such competition reduces the share of manufacturing workers relative to the total number of workers more significantly in larger firms. Endoh (2021) estimates the effects of import competition from Asia on the labor income inequality of Japanese manufacturing workers and finds that salary changes are larger, positively and negatively, for higher- and lower-paid workers, respectively, indicating a widening labor income inequality. This study extends these studies by incorporating regional import shocks, exploring job creation and destruction as drivers of employment and wage changes, and considering the phenomenon of industry switching.[4]

The structure of this study is as follows. Section 2 examines the decadal change in Japanese manufacturing establishments and jobs from 2006 to 2016. The data and estimation equations are presented in Section 3. The regression results for exits, survivors, and entries are presented in Section 4. Finally, Section 5 presents conclusions.

2. Transition of Japanese establishments and jobs

This section examines decade-long changes in Japanese manufacturing establishments and their jobs from 2006 to 2016, categorized by firm type and establishment size. Initially, all manufacturing establishments are divided into those operating independently as single-establishment firms and those affiliated with multi-unit firms.[5] Subsequently, they are further classified into five establishment size groups based on workforce size. This classification is motivated by the potential variation in responses to import shocks, depending on firm structure and business unit size. Regarding firm structure, multi-unit firms that manage multiple establishments and offices centrally, are expected to adjust workforce sizes across units more flexibly than single- unit firms to mitigate import shocks and sustain operations. The size of business units may also influence responses to import shocks. Smaller and larger establishments exhibit different trends over time, with smaller establishments more likely to cease operations, and larger ones tending to downsize their workforce, as illustrated in the following Figs. 1–8. Consequently, it is reasonable to expect smaller and larger establishments to respond differently to import shocks.

2.1. All establishments

Fig. 1 shows the number of manufacturing establishments of single-unit (Panel A) and multi-unit (Panel B) firms in 2006 and 2016. Establishment sizes are categorized into five groups based on the number of workers: fewer than 5, 5–9, 10–49, 50–99, and 100 or more. For the modes of change, establishments that existed in 2006 are classified into three categories, which are depicted in bars for 2006 in both Panels A and B. "Survivors" are establishments that operated in the manufacturing sector both in 2006 and 2016. "Exits" are those that existed in 2006 but closed their businesses by 2016. "Changes to non-

[4] Regarding industry-switching due to import shocks, although not employing firm-level data, Tomiura (2004) addresses how job creation and destruction in Japanese industry data respond to changes in import prices. He finds that a decrease in import prices accelerates job destruction through plant transfers to other industries in sectors with high import shares.

[5] Multi-unit firms are defined as firms that have multiple establishments, regardless of industry classification. This definition includes firms with only one manufacturing establishment and other non-manufacturing establishments. Therefore, establishments classified as part of multi-unit firms do not necessarily have other manufacturing establishments within the same firm.

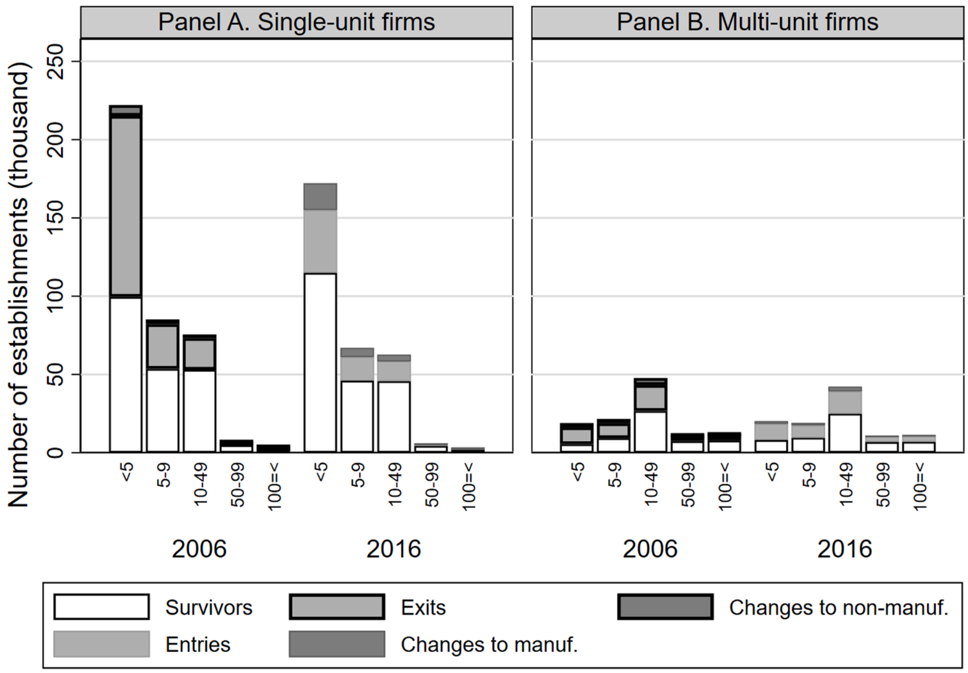

Fig. 1. Number of establishments by their types.

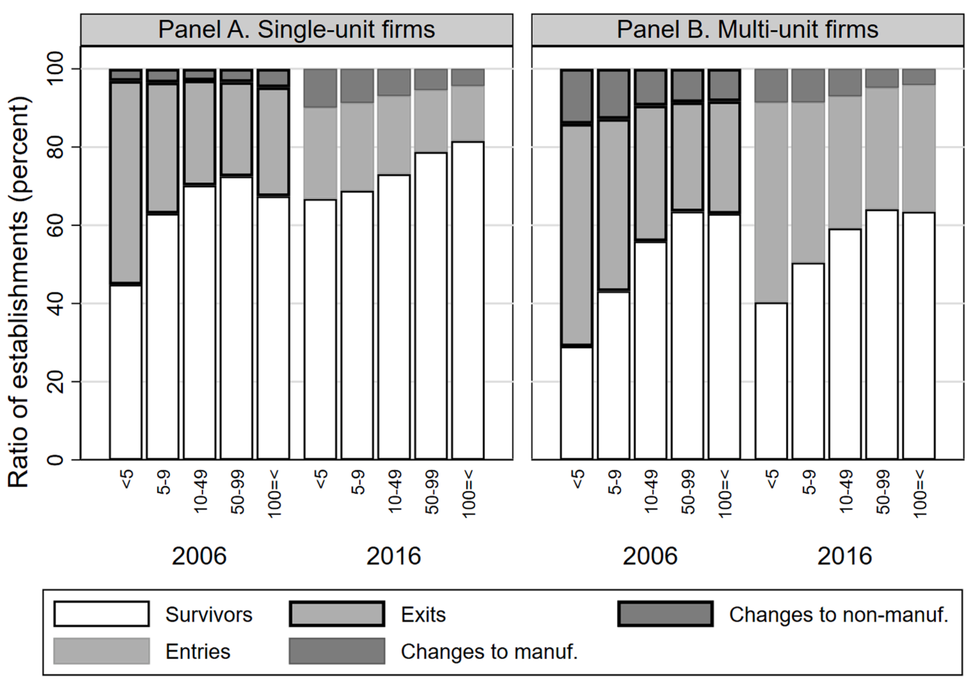

Fig. 2. Ratio of establishments by their types.

manuf." are those that switched their businesses to the non-manufacturing sector between 2006 and 2016. Similarly, establishments that existed in 2016 are classified into three categories and are expressed as bars for 2016 in both panels. The definition of "survivors" is the same as that for the bars in 2006. "Entries" are establishments that were newly opened in the manufacturing sector by 2016. "Changes to manuf." refers to establishments that shifted their business domains from the non-manufacturing sector to the manufacturing sector between 2006 and 2016.

In 2006, the total number of establishments belonging to single-unit firms (Panel A) was 393 thousand, significantly larger than those belonging to multi-unit firms (Panel B), which totaled 112 thousand. Among these 505 thousand establishments in 2006, 222 thousand (44%) were single-unit firms with four or fewer workers. This category dominated the others in terms of number of establishments. These characteristics were also observed in 2016. The total number of establishments decreased to 413 thousand in 2016, a reduction of 92 thousand from 2006. The limited number of newly opened establishments in single-unit firms contributed to this substantial decrease. More than half of this decline occurred within the dominant category of establishments with four or fewer workers in single-unit firms, which experienced a decrease of 50 thousand establishments, bringing the total number of

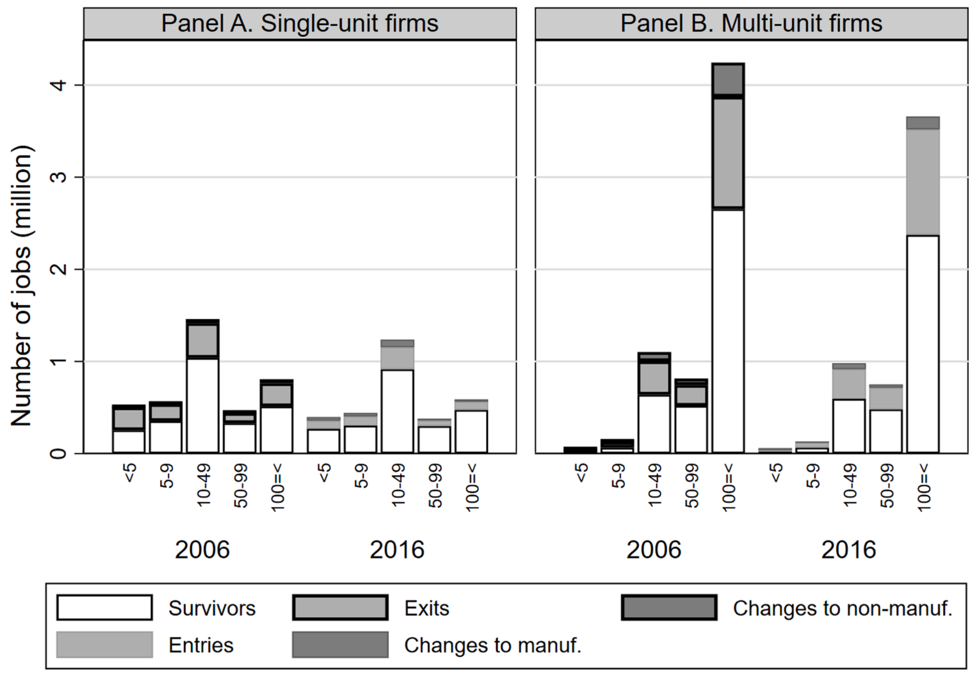

Fig. 3. Number of jobs by establishment types.

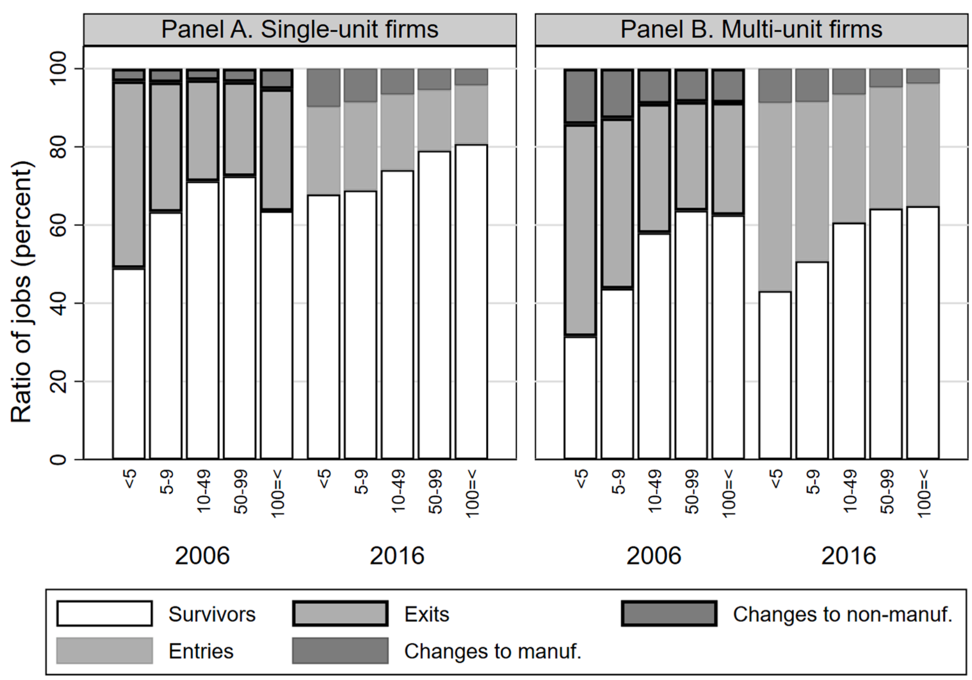

Fig. 4. Ratio of jobs by establishment types.

establishments to 172 thousand. Fig. 1 also illustrates that the shift in establishments' business domains between the manufacturing and non-manufacturing sectors contributed only a small portion to the decadal change in the total number of manufacturing establishments in each category. However, some categories experienced a considerable number of establishments changing their business sectors. For example, single-unit firms with four or fewer workers in 2016 included as many as 17 thousand manufacturing establishments that shifted their business from the non-manufacturing sector between 2006 and 2016.

As the number of establishments in Fig. 1 varies widely across categories, it is difficult to distinguish between modes in some categories. Fig. 2 shows the ratio of establishments in each category according to their mode type. Fig. 2 illustrates the two distinctive features of the opening and closure of establishments. First, there was significant activity at both entry and exit, particularly in establishments with fewer workers. Considering establishments with four or fewer workers, more than half of those that existed in 2006 disappeared by 2016. The exit ratios of single-unit and multi-unit firms were 52% and 56%, respectively. On the entry side, among the establishments in these categories in 2016, entries were 23% of single-unit firms and 51% of multi-unit firms. The exit and entry ratios decreased as the number of workers in the establishments increased. For instance, in Panel A (establishments in

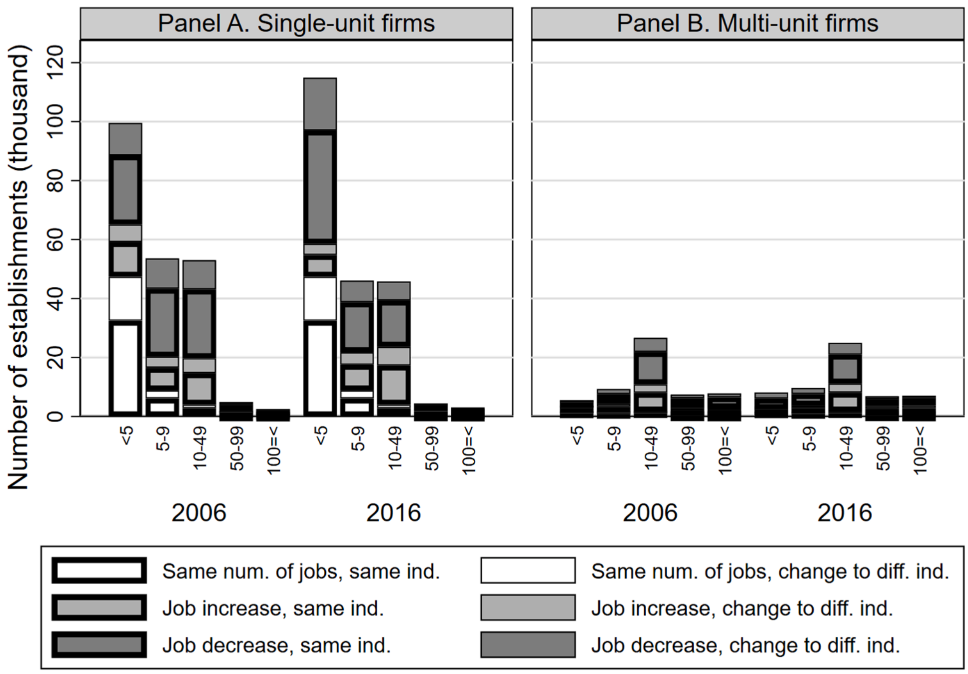

Fig. 5. Number of surviving establishments by their types.

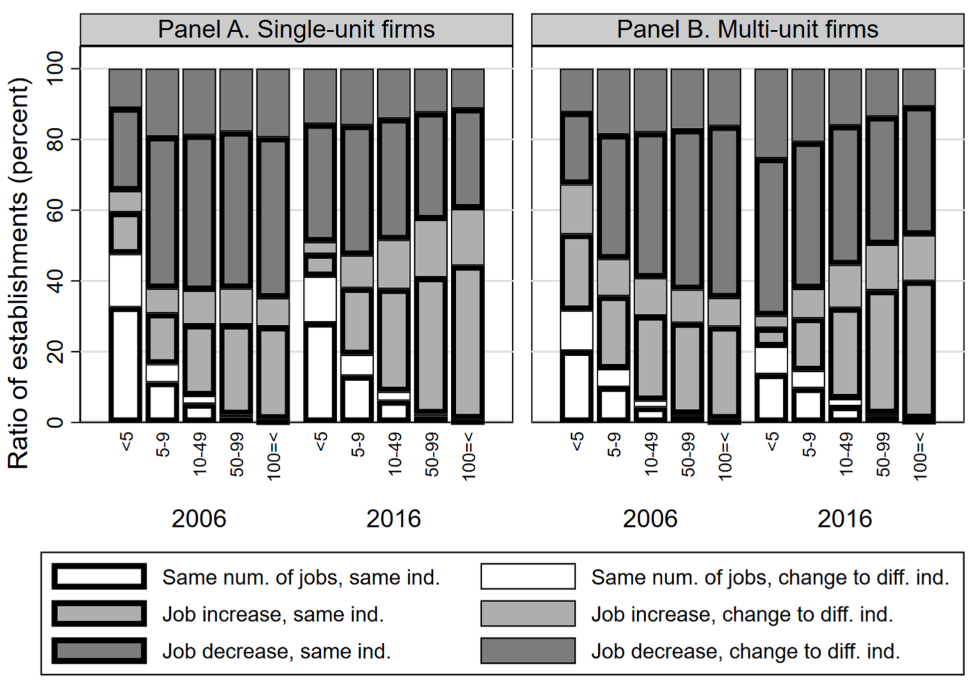

Fig. 6. Ratio of surviving establishments by their types.

single-unit firms), the exit ratio decreases from 52% for establishments with four or fewer workers in 2006 to 24% for those with 50–99 workers. Similarly, the entry ratio decreased from 23% for establishments with four or fewer workers in 2016 to 14% for those with 100 or more workers.

Second, the entry ratios exhibit a significant difference between establishments in single-unit and multi-unit firms, whereas their exit ratios are relatively similar. For establishments in single-unit firms (Panel A), entry ratios range from 23% (for establishments with four or fewer workers) to 14% (for establishments with 100 or more workers), while establishments in multi-unit firms (Panel B) have ratios more than double those figures, ranging from 51% (for establishments with four or fewer workers) to 31% (for establishments with 50–99 workers). This finding suggests that the primary reason for the substantial decline in the number of establishments is the low entry ratios of establishments in single-unit firms.

Although small establishments with fewer than five workers accounted for nearly half of all establishments in both 2006 and 2016, their share of total jobs was significantly small. Instead, large establishments in multi-unit firms dominate other categories in terms of job numbers. The results are shown in Fig. 3. In 2006, the total number of jobs was 10.2 million, with 3.8 million in single-unit firms and 6.4

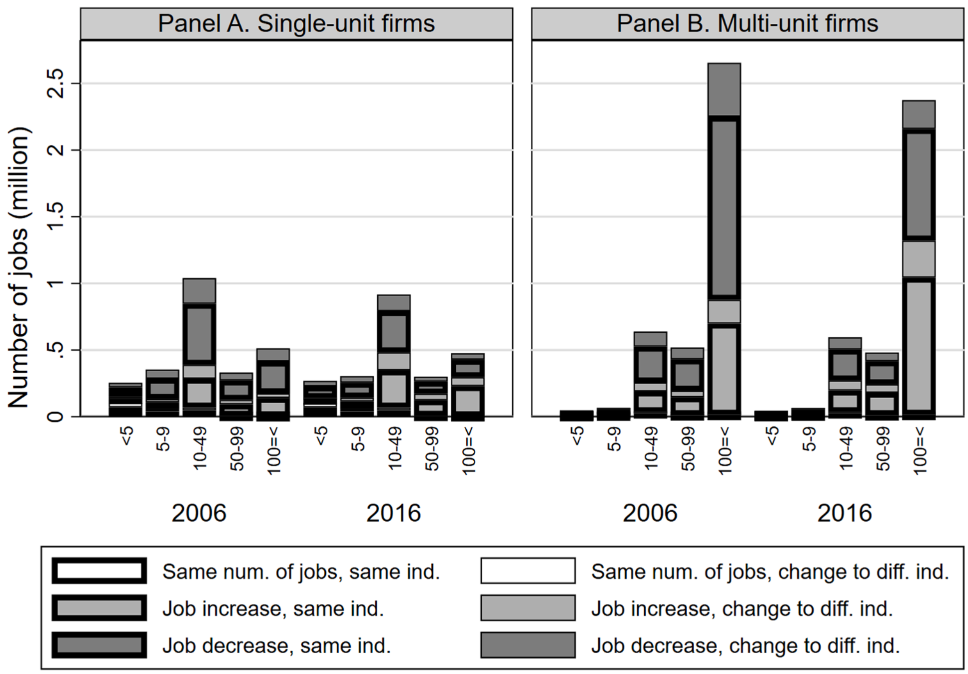

Fig. 7. Number of jobs by surviving establishment types.

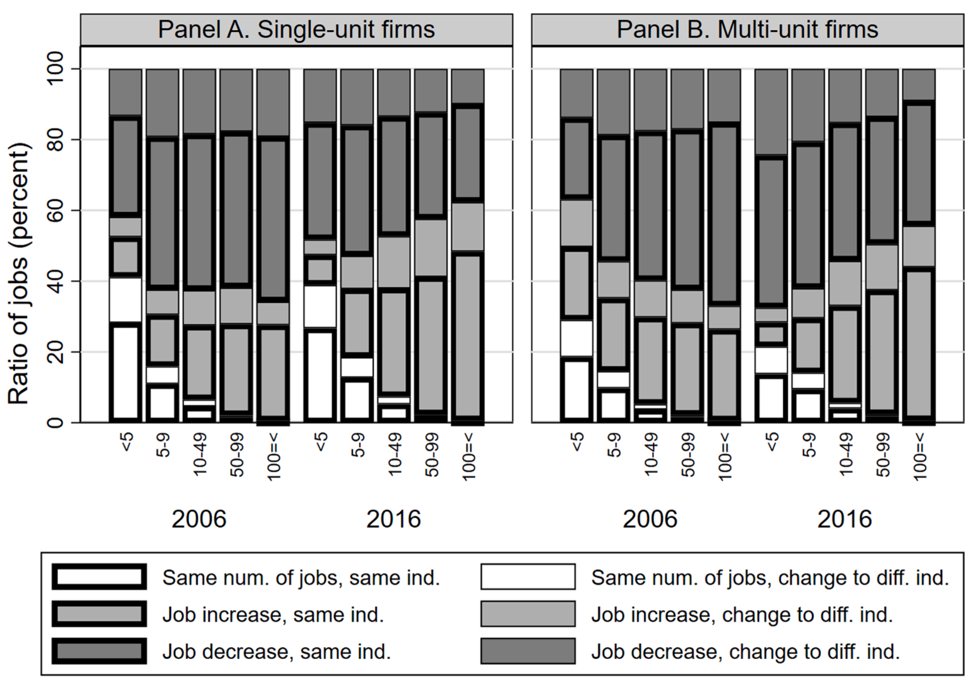

Fig. 8. Ratio of jobs by surviving establishment types.

million in multi-unit firms. Among the ten categories in 2006, establishments with 100 or more workers in multi-unit firms had 4.2 million jobs, surpassing all others. In 2016, the total number of jobs decreased by 1.6 million to 8.6 million. The decrease was evenly split between single- and multi-unit firms, each experiencing a reduction of 0.8 million jobs, resulting in 3.0 million jobs in single-unit firms and 5.6 million jobs in multi-unit firms. However, the ratio of decrease was higher for single-unit firms than for multi-unit firms. The categories with the largest decline in job numbers were establishments with 100 or more workers in multi-unit firms, dropping by 0.6 million to 3.7 million jobs. Fig. 4 illustrates the job ratios within each category across the five modes, displaying a pattern similar to that shown in Fig. 2.[6]

Figs. 1–4 provide background information for the empirical analyses of manufacturing establishments' survival, entry, exit, and shift to and from non-manufacturing sectors. The results are presented in Tables 2, 3, 4, and 7 in Section 4.

[6] In this study, the terms "worker" and "job" are interchangeable in many parts. The term "job" is primarily used to emphasize changes in the number of workers resulting from decisions made by firms and establishments, particularly in response to external shocks such as import shocks.

2.2. Survivors

The survivors of manufacturing establishments in Figs. 1–4 can be further divided into six modes of change, as illustrated in Figs. 5–8. These six modes are the products of three modes in terms of job changes and two modes in terms of industry changes. For job changes, "same num. of jobs," "job increase," and "job decrease" represent establishments that had the same number of jobs in 2006 and 2016, increased the number of jobs between these two periods, and decreased the number between the two periods, respectively. For industry changes, "same ind." and "change to diff. ind." represent establishments that conducted their business in the same industry in 2006 and 2016 and changed their business domain to a different industry within the manufacturing sector.[7]

Regarding the number of establishments, Fig. 5 shows that smaller establishments in single-unit firms have larger shares. In 2006, among 270 thousand surviving establishments, 100 thousand (37%) were single-unit firms with four or fewer workers, and the number increased to 206 thousand (76%) in the three categories of single-unit firms with fewer than 50 workers.

Fig. 6 depicts the shares of the six modes in each category. Regarding job changes, larger establishments tended to decrease their jobs more in the coming decade. For single-unit firms (Panel A), more than 60% of the establishments in four categories covering establishments with five or more workers in 2006 experienced workforce shrinkage over the next ten years. This tendency was more clearly seen for multi-unit firms (Panel B). The share of establishments decreasing their workforce from 2006 to 2016 was 33% in the category of four or fewer workers in 2006, and the share increased as the number of workers represented in the category increased, reaching 65% in the category of 100 or more workers.[8] Concerning industry changes, it is intriguing that approximately 30% of establishments experienced a change in business domains during the ten years in each category. For example, a category with four or fewer workers and one with 100 or more workers in single-unit firms in 2006 contained 32% and 28% of the establishments, respectively, that changed their business by 2016. This finding highlights the importance of considering business domain changes when examining establishments' reactions to import shocks. This factor is incorporated into the empirical analysis, with the results presented later in Section 4, Table 6.

Fig. 7 shows the number of jobs in each category for each type of firm. In 2006, the number of jobs in surviving establishments was 6.4 million, with 2.5 million in single-unit firms and 3.9 million in multi-unit firms. Among the ten categories in 2006, those representing establishments for multi-unit firms with 100 or more workers accounted for 2.7 million jobs, dominating the other categories. While all figures regarding the number of jobs decreased in 2016, their relative size remained the same. Fig. 8 shows the job ratios within each category for the six modes. This figure closely resembles Fig. 6.

The examination of decade-long changes in Japanese manufacturing establishments and their jobs, as discussed in this section, clarifies two facts. First, establishments actively altered their businesses, not only through exits and entries, but also by shifting to the non-manufacturing sector and other industries within the manufacturing sector. Second, the proportion of establishments that changed their businesses varied depending on the firm type and establishment size. These findings provide guidance for selecting an appropriate regression equation form and variables in the following sections.

3. Data and estimation equations

3.1. Establishments

The dataset constructed for this study comprises all private Japanese manufacturing establishments in 2006 and 2016. These data were derived from the following Japanese business data sources: *The Establishment and Enterprise Census* conducted in 2006, *The Economic Census for Business Frame* in 2009, and *The Economic Census for Business Activity* in 2012 and 2016 (hereafter referred to as *the Censuses*). *The Censuses* were conducted by the Statistics Bureau, Ministry of Internal Affairs and Communications of Japan (and the Ministry of Economy, Trade, and Industry of Japan, for *The Economic Census for Business Activity*). The recorded information in *the Censuses* contains details such as the name, address, number of workers, and industry classification of all establishments and firms in Japan. *The Censuses* from 2006, 2009, 2012, and 2016 were used to identify the same establishments in both 2006 and 2016, as *the Censuses* during this period did not employ a system of permanent identification numbers for establishments. Therefore, the pairwise matching of successive *Censuses* was required. The constructed dataset was composed of 270,140 establishments that conducted business in the manufacturing sector in both 2006 and 2016; 235,218 establishments that operated in the manufacturing sector in 2006 but moved to the non-manufacturing sector or closed their business in 2016; and 143,310 establishments that operated in the non-manufacturing sector or did not exist in 2006 but were operating in the manufacturing sector in 2016.

As the dataset used in this study includes only manufacturing establishments, readers may consider that the impact of import shocks on job flows estimated in this study differs significantly from that on non-manufacturing establishments. This perspective is valid, given that imports of manufacturing goods indirectly affect job flows in non-manufacturing establishments through input-output networks and changes in regional demand. Moreover, some non-manufacturing establishments, particularly those in protected sectors, may be more vulnerable to import shocks.[9] Therefore, it is important to note that the results estimated in this study represent the outcomes for manufacturing establishments and not the entire Japanese economy.

3.2. Import shocks and instrumental variables

Previous studies that estimated the impact of import shocks on employment at the firm or establishment level predominately used the import penetration ratio as an import variable (e.g., Bernard et al., 2006). The import penetration ratio is the real value of imports divided by the real value of the supply to domestic consumers. Since the exit, entry, industry switching, or changing size of establishments depend on both the industry-level import shock as a common impact on establishments in the same industry, and the region-level import shock, through an impact on the local economy where establishments are located, this study employed two variables representing industry- and region-level import shocks.

In the context of Japan, imports from China were well-suited as variables for import shocks from 2006 to 2016. During this period,

[7] This study uses the classification of 108 manufacturing industries listed in Table A.2 of Endoh (2023).

[8] It is worth noting that the characteristics of shares of the six modes in 2016 provide little insight into how establishments alter their workforce size depending on the firm type and establishment size, as the 2016 categories reflect the outcomes of a decade of job churning by survivors. In 2016, categories with a larger number of workers tended to have a smaller share of job-decreasing establishments and a larger share of job-increasing establishments for both single- and multi-unit firms. This outcome occurred because more establishments in a category with a larger number of workers in 2016 were situated in that category owing to workforce expansion.

[9] It is reasonable to assume that agriculture, which is considered one of the most protected industries in Japan, is more extensively and negatively affected by the increasing imports of agricultural produce and food products. This is one reason why workers in the agricultural sector strongly oppose trade liberalization, as demonstrated by Tomiura et al. (2016) and Tomiura et al. (2021).

China was not only the country from which Japan has imported manufacturing products the most each year, but also the growth in Japanese manufacturing imports from which has also outpaced the increase in imports from other countries and regions. To illustrate this quantitatively, the total value of manufacturing imports (excluding petroleum and coal products and smelting and refining of non-ferrous metals) from China was 12.5 trillion Japanese Yen (JPY) in 2006, and the imports increased by 46% to 18.3 trillion JPY in 2015.[10] By comparison, manufacturing imports from the other Asian countries increased by 33% (from 9.7 to 12.9 trillion JPY), while those from the rest of the world increased by 13% (from 15.1 to 17.1 trillion JPY) during the same period. Among the product categories, communication equipment and related products stand out because of the significant increase in imports from China. This category ranked at the top of Japan's list of products imported from China in 2015, with import values skyrocketing from 733 billion JPY in 2006 to 2.85 trillion JPY in 2015. In contrast, the import value of communication equipment and related products from other Asian countries increased only modestly, from 649 billion JPY in 2006 to 790 billion JPY in 2015.

Japanese establishments experienced other major shocks between 2006 and 2016, such as the global financial crisis of 2007–2008 and the Great East Japan Earthquake of 2011. Although these events had some impact on job flows in establishments, I assume they did not have a lasting effect through 2016. Establishments located in the evacuation zones affected by the Fukushima nuclear disaster following the 2011 earthquake are not included in this study.

The industry-level import shock from China for industry *i*, Δt_i^C is constructed as follows:

$$\Delta t_i^C \equiv \frac{\Delta m_{i,2006}^C}{y_{i,2006} + m_{i,2006} - e_{i,2006}}. \tag{1}$$

The numerator of the fraction $\Delta m_{i,2006}^C \equiv m_{i,2016}^C - m_{i,2006}^C$ is the total change in Japanese import of goods classified as manufacturing industry *i* from China between 2006 $\left(m_{i,2006}^C\right)$ and 2016 $\left(m_{i,2016}^C\right)$.[11] The denominator $y_{i,2006} + m_{i,2006} - e_{i,2006}$ is the total supply of goods classified as industry *i* in the Japanese market in 2006, which is domestic output ($y_{i,2006}$) plus imports ($m_{i,2006}$) minus exports ($e_{i,2006}$). Japanese domestic outputs were obtained from *Census of Manufacture*, Ministry of Economy, Trade and Industry, and imports and exports were obtained from Japan Customs, Ministry of Finance. These figures are deflated by Japanese GDP deflators to 2005's values.

The region-level import shock for region *r*, Δt_r^C is constructed from the industry-level import shock and the Bartik instrument, as in Eq. (2).

$$\Delta t_r^C \equiv \sum_i \frac{E_{i,r,2006}}{E_{r,2006}} \Delta t_i^C, \tag{2}$$

where $E_{i,r,2006}$ is industry *i*'s total number of jobs in region *r* and $E_{r,2006}$ is the total number of manufacturing jobs in region *r*, both in 2006. Eq. (2) assumes that national trade shocks in an industry are equally apportioned among all jobs belonging to that industry.[12]

Japanese imports from China were instrumented by the imports of eight developed countries from China, by applying the methods of Autor et al. (2013) and Acemoglu et al. (2016). The countries were Australia, Denmark, Finland, Germany, New Zealand, Spain, Switzerland, and the United States.[13] The sum of the decadal changes of the import of the eight countries from China from 2006 in industry *i*, $\Delta w_{i,2006}$, was applied instead of $\Delta m^C{}_{i,2006}$ in Eq.s (1) and (2) to construct an instrumental variable (IV) for each Japanese import index.[14] In addition, total supply in the denominator of Eq. (1) and the number of jobs in Eq. (2) are changed to those of a decade prior when constructing IV, because contemporaneous output and employment were affected by anticipated imports from China. This is the typical procedure described by Autor et al. (2013). Therefore, the IV for import shocks defined in Eq.s (1) and (2) is expressed as follows:

$$\Delta iv_i \equiv \frac{\Delta w_{i,2006}}{y_{i,1996} + m_{i,1996} - e_{i,1996}} \tag{3}$$

and

$$\Delta iv_r \equiv \sum_i \frac{E_{i,r,1996}}{E_{r,1996}} \Delta iv_i. \tag{4}$$

3.3. *Employment areas and industries*

Following Autor et al. (2013) and Dauth et al. (2014), I define regional economic units in Japan from the concept of local labor markets. For this purpose, I adopt the concept of urban employment areas, developed by the Center for Spatial Information Service at the University of Tokyo.[15] I employ the demarcation of metropolitan and micropolitan employment areas in 2010 as the definition of regions in this research. There were 228 regions per period.[16] Their sizes varied. The Tokyo metropolitan area had 2.2 million manufacturing jobs in 2006, the largest number among all of the regions, whereas the Kutchan micropolitan area in Hokkaido had as few as 336 manufacturing jobs in the same year. Some municipalities did not belong to any regions, and the coverage of jobs in all regions was approximately 95 percent.

In 2006, there were 108 manufacturing industries, ranging in the number of jobs from 262 for fur skins to one million for motor vehicles, parts, and accessories. Petroleum and non-ferrous metal refinements were excluded from the analysis. Job information for each industry was collected from establishments in metropolitan and micropolitan employment areas in 2010. Therefore, the sum of jobs across industries

[10] Petroleum and coal products and smelting and refining of non-ferrous metals were excluded from the analysis. This was based on the fact that domestic production of mineral resources is very scarce in Japan and that refining is one of the least labor-intensive industries. Therefore, the import penetration ratios of these industries are exceptionally high compared with other industries, and the same changes in import penetration ratios of the two industries affect very few establishments and workers.

[11] The actual interval of evaluating job change from 2006 to 2016 was 116 months due to the change in the survey dates of *the Censuses*. Thus, the corresponding change in trade is obtained by multiplying the change in trade between 2006 and 2015 by $\frac{29}{27}$.

[12] Many studies in the China shock literature employ not only the direct effect of import shocks, but also the indirect effect through the input-output linkage. However, this study addresses only the direct impact for the practical reason that using indirect effect variables as independent variables of interest is beyond the processing power of the computer used in this study.

[13] World trade data were obtained from the World Integrated Trade Solution. They were deflated using Japanese GDP deflators under the assumption that exchange rates follow purchasing power parity.

[14] Different from Bernard et al. (2006), the present study estimated the impact of trade changes in the 10 years on employment changes in the same period, to make the time frame of causality consistent with the literature concerning trade impacts on job flows (e.g., Autor et al., 2013; Acemoglu et al., 2016; and Asquith et al., 2019).

[15] The definitions and the code tables of urban employment areas are available at http://www.csis.u-tokyo.ac.jp/UEA/uea_code_e.htm.

[16] When collecting establishments into urban employment areas, I deleted establishments located in 10 municipalities where more than one-quarter of each area was designated as evacuation zones after the Fukushima nuclear disaster of 2011.

was the same as that across regions.

3.4. Estimation equation

The dependent variables used in the estimation of job flows in the manufacturing sector include multiple choices of exits, entries, and changes in industries as well as a continuous variable representing the workforce change ratio, all defined at the establishment level.

When the outcomes of job flows are expressed as multiple choices, they are regressed using a probit or multinomial probit model:

$$\Pr(\text{ Outcome }_{e,r,i}) = \Phi(\beta_1 \Delta t_i^C + \beta_2 \Delta t_r^C + \boldsymbol{X}_e' \boldsymbol{\beta}_3 + \boldsymbol{X}_r' \boldsymbol{\beta}_4 + \boldsymbol{X}_i' \boldsymbol{\beta}_5 + \beta_6 X_{ir} + \epsilon_e), \tag{5}$$

where $Outcome_{e,r,i}$ is the choice of establishment e in region r in industry i, $\boldsymbol{X_e}$ contains three sets of variables for each establishment (five dummy variables of establishment longevity in 2006, the ratio of regular workers to total workers in 2006, and the ratio of female workers to total workers in 2006), $\boldsymbol{X_r}$ contains three sets of variables by region (seven dummy variables of large regions, regional ratio of female workers to total workers, and regional ratio of manufacturing workers to total workers), $\boldsymbol{X_i}$ is a set of nine dummy variables of comprehensive industry groups, and X_{ir} is $E_{i,r,2006}/E_{r,2006}$ to control the agglomeration of industry i in region r, the industry and the region in which establishment e is doing business.[17] When the choice for entries is used as a dependent variable, $\boldsymbol{X_e}$ is excluded from the set of control variables and the ratio of the number of jobs disappeared due to the exit of establishments between 2006 and 2016 in comparison to the total number of jobs in 2006 in region r is used instead. This ratio controls the population of potential entries into the business, as a higher ratio results in more workers and capital being freed and available for new businesses.[18]

When the outcome is the ratio of workforce change, which is a continuous variable, the following linear regression model was used:

$$\text{Outcome }_{e,r,i} = \alpha + \beta_1 \Delta t_i^C + \beta_2 \Delta t_r^C + \boldsymbol{X}_e' \boldsymbol{\beta}_3 + \boldsymbol{X}_r' \boldsymbol{\beta}_4 + \boldsymbol{X}_i' \boldsymbol{\beta}_5 + \beta_6 X_{ir} + \epsilon_e, \tag{6}$$

where $Outcome_{e,r,i}$ is the workforce change ratio of establishment e in region r in industry i for which the number of workers changes from $job_{e,2006}$ in 2006 to $job_{e,2016}$ in 2016. The ratio is defined as follows:

$$\text{Outcome }_{e,r,i} \equiv \frac{2(job_{e,2016} - job_{e,2006})}{job_{e,2016} + job_{e,2006}}. \tag{7}$$

The maximum ratio is 2 (entries) and the minimum is −2 (exits). For surviving establishments, the range is $-2 < Outcome_{e,r,i} < 2$.

The descriptive statistics of the main variables are presented in Table 1. These statistics illustrate the declining workforce in Japan's manufacturing sector between 2006 and 2016. For instance, the mean value of the worker change ratio for surviving establishments is negative (−0.152), and the number of establishments exiting the manufacturing sector (235,218) exceeded those entering it (143,310). The ratio of entries from the non-manufacturing sector to total entries (0.244) surpassed the ratio of exits to the non-manufacturing sector to total exits (0.104), partly because of the larger population of establishments in the non-manufacturing sector than in the manufacturing sector. Regarding import shocks from China, while the region-level shock has a mean value similar to that of the industry-level shock, its standard deviation is significantly smaller.

Table 1
Descriptive statistics.

	Mean	Std. Dev.	P5	P50	P95
Establishments surviving in the manufacturing sector (# obs.: 270,140)					
Number of workers in 2006	23.630	120.764	1	6	79
Number of workers in 2016	21.486	125.421	1	5	73
Worker change ratio	−0.152	0.453	−1	−0.5	0.588
Industry-level import shock (Δt_i^C)	0.028	0.060	−0.016	0.014	0.092
Region-level import shock (Δt_r^C)	0.029	0.009	0.016	0.030	0.039
Establishments exiting from the manufacturing sector (# obs.: 235,218)					
Number of workers in 2006	16.046	96.158	1	4	50
Choice of exiting from the business	0.896	0.305	0	1	1
Choice of shifting to non-manuf.	0.104	0.305	0	0	1
Industry-level import shock (Δt_i^C)	0.028	0.062	−0.024	0.014	0.092
Region-level import shock (Δt_r^C)	0.029	0.008	0.016	0.030	0.039
Establishments entering into the manufacturing sector (# obs.: 143,310)					
Number of workers in 2016	19.609	93.417	1	5	66
Choice of entering into the business	0.756	0.430	0	1	1
Choice of shifting from non-manuf.	0.244	0.430	0	0	1
Industry-level import shock (Δt_i^C)	0.026	0.058	−0.029	0.014	0.092
Region-level import shock (Δt_r^C)	0.028	0.009	0.015	0.030	0.039

4. Results

In this study, observations are classified into 12 groups based on three criteria, and regression analyses are conducted separately for each group. The first criterion determines whether an establishment is located in a region where its industry is agglomerated. This study employs $E_{i,r,2006}/E_{r,2006}$ to identify agglomerated industries in specific regions. Industry i is considered agglomerated in region r if the index is greater than the national ratio of the number of workers in industry i to the total number of manufacturing workers. This criterion assumes that industrial agglomeration not only affects the business of establishments in the industry but also influences the impact of import shocks on their business. Behrens et al. (2020) examined this aspect. Canadian textile and clothing plant data revealed that the China Shock caused plants to close or switch to other industries less frequently within clusters in the following two years.

The second and third criteria are discussed in Section 2. The second criterion distinguishes establishments in single- and multi-unit firms. This differentiation recognizes that multi-unit firms with multiple establishments have room to adjust their organizational structure to absorb and respond to import shocks. Therefore, establishments in multi-unit firms may respond differently to import shocks than single-unit firms, in which establishment exits directly lead to firm exits. The third criterion considers the number of workers. This factor is expected to influence establishments' prospects for increasing or decreasing their workforce, as well as their likelihood of exiting or surviving in their respective businesses.

4.1. Exits

The effects of industry- and region-level import shocks on establishments' exits were estimated using probit and IV probit models. The

[17] Regarding the establishments' longevity, *the Censuses* conducted between 1996 and 2006 were used to obtain information on establishments' entry.

[18] While the ratio of job losses attributed to exits to total jobs in a region is influenced, in part, by import shocks from China owing to import competition in the manufacturing sector, it remains a useful control variable for regional characteristics. This is because the ratio is determined by many other influential regional factors including shocks to the non-manufacturing sector, demographics, and infrastructure supply. Notably, the regression results, explained later, change little when the ratio of job losses to total jobs is included in a set of control variables.

results are summarized in Tables 2 and 3, respectively. The observations consist of establishments in operation in 2006. The dependent variable is the exit dummy, which takes the value of one if the establishment was not operational in 2016. Panels A and B present the results for establishments in the non-agglomeration and agglomeration regions of their respective industries. Single-unit firms were classified into three groups based on the number of workers in 2006: fewer than 5 (Column 1), 5–50 (Column 2), and more than 50 (Column 3). Establishments in multi-unit firms were similarly classified into three groups: fewer than 10 (Column 4), 10–100 (Column 5), and more than 100 (Column 6). Both tables report three sets of results: using only industry-level shocks (Panels A1 and B1), using only region-level shocks (Panels A2 and B2), and using both shocks (Panels A3 and B3).

Two notable findings were obtained by comparing the regression results in Tables 2 and 3. First, the estimated coefficients exhibit notable differences, underscoring the significance of employing the IV method. Possible weak identification does not produce biased results because Kleibergen–Paap *F* statistics are sufficiently large. Second, the estimated coefficients of two import shocks when used separately (Panels A1, A2, B1, and B2) and those when used together (Panels A3 and B3) are very similar. This suggests that the two import shocks are close to orthogonal, making it safe to use them simultaneously.[19] The estimation results in the following tables were all obtained using the IV method and including both import shocks simultaneously.

Panels A4 and B4 in Table 3 report the marginal effects of import shocks when employed simultaneously, as obtained from Panels A3 and B3. Only a few cases exist for which import shocks significantly affect establishment exits. The industry-level import shock promotes the exit of establishments in multi-unit firms with fewer than 10 workers located in non-agglomeration regions (Panel A4, Column 4) and single-unit firms with 5 to 50 workers located in agglomeration regions (Panel B4, Column 2). Interestingly, the region-level import shock deters establishments in single-unit firms with fewer than five workers located in non-agglomerated regions from exiting (Panel A4, Column 1), contrary to the usual prediction. To examine the reason for this seemingly opposing result, I ran a regression with more options. The estimated marginal effects are summarized in Table 4.

There are four choices of manufacturing establishments in Table 4: (a) exiting from the business, corresponding to the dependent dummy variable value of one in Tables 2 and 3, (b) shifting to the non-manufacturing sector, (c) remaining in the manufacturing sector but decreasing its number of jobs, and (d) remaining in the manufacturing sector and increasing its number of jobs or keeping it constant.[20] Among four choices, (a), (b), and (c) contribute to the decrease of workers in the manufacturing sector, while (d) increases their number. Concerning the effect of region-level import shocks on the choice of establishments in single-unit firms with fewer than five workers located in non-agglomeration regions (Panel A, Column 1), they responded to the region-level import shock by decreasing their number of jobs while remaining in the manufacturing sector (choice c) rather than closing their business completely (choice a). This “hibernation” strategy works for establishments in this category since most of their workers are self-employed and their unpaid family members. Establishments in the same category, but located in agglomeration regions (Panel B, Column 1), exhibited positive and statistically significant marginal effects of the two import shocks on the choice to maintain or increase the number of jobs while remaining in the manufacturing sector (choice d). This may also be interpreted as a variant of “hibernation” in agglomeration regions.

Another noteworthy finding is that, first, the industry-level import shock guides smaller establishments in single-unit firms and larger establishments in multi-unit firms in non-agglomeration regions (Panel A, Columns 1, 5, and 6) to shift to the non-manufacturing sector (choice b), but, in contrast, it deters larger establishments in single-unit firms in agglomeration regions (Panel B, Columns 2 and 3) and smaller establishments in multi-unit firms in non-agglomeration regions (Panel A, Column 4) from selecting this choice. These contrasting results may be attributed to two factors. The first is adaptability. Smaller establishments in single-unit firms are flexible in changing their primary business field, and establishments in multi-unit firms are under the control of their headquarters and, therefore, frequently alter their size and business field according to the firm’s strategy. The second is the agglomeration of industries. Establishments in an industry experience fewer positive externalities from other establishments operating in the same industry in regions where that industry is not agglomerated. Therefore, establishments in non-agglomerated regions tend to shift to the non-manufacturing sector in response to import shocks, whereas those in agglomerated regions have little incentive to do so.

While there are some intriguing findings in Table 4 as explained above, it is difficult to conclude that industry- and region-level import shocks have a systematic effect on promoting the exit of establishments from business across various groups. Endoh (2023) presents an estimation result indicating that the industry-level import shock promotes the exit of small establishments but has little effect on larger establishments. The former result may primarily stem from the responses of the two groups in this study, while the latter aligns with the findings in Table 4.

4.2. Survivors

For establishments conducting business in 2006 and surviving for a decade up to 2016, their workforce change ratios, defined by Eq. (7), were regressed on two import shocks and other control variables, as explained in Eq. (6). The results are presented in Table 5. The classification criteria for establishments into the 12 groups are the same as those for exits in Section 4.1, except that the number of workers, used as an index of establishment size, was the simple average in 2006 and 2016. It is notable that the industry-level import shock has statistically significant effects at the 0.05 level only for two out of the twelve groups, and that the effect of the region-level shock does not show statistical significance in any group.

However, this does not imply that the region-level import shock has little effect on workforce changes across all groups. When the regression analysis is applied separately to surviving establishments with increasing or decreasing workforce, different results were obtained. Specifically, the estimation method of the analysis is adjusted as follows. First, the surviving establishments are divided further in each category in Table 5 into establishments with increasing workforce and those with a decreasing one. In this treatment, establishments that did not change their number of jobs from 2006 to 2016 are removed from the observations. Second, each of two import shocks (Δt_i^C or Δt_r^C) in Eq. (6) is replaced with two interaction terms, constructed using two types of dummies for industry change, to observe the impact of import shocks on it. The dummy variable for maintaining their business in the same industry is d_ind^{same} and the one for changing to a different industry within the manufacturing sector is d_ind^{diff}. Third, four types of import interaction terms as well as other control variables are regressed on the establishments’ job changes, using separate observations of those with an increasing number of jobs and those with decreasing ones.

The results using these four variables concerning import shocks are presented in Table 6. Panels A1 and B1 are the results when establishments with increasing number of jobs are used as observations and Panels A2 and B2 are the results when those with decreasing number of jobs are used. The estimated coefficients of interaction terms can be directly interpreted as the extent to which the workforce in

[19] For readers’ reference, the estimates of all control variables for Panel A3 are reported in Table A1 in the Appendix.

[20] The choices of remaining in the manufacturing sector (choices c and d) include cases in which an establishment shifts from one industry to another in the manufacturing sector.

Table 2
Establishments' exit, probit.

Variables	Establishments in single-unit firms			Establishments in multi-unit firms		
	< 5 (1)	5 - 50 (2)	50 < (3)	< 10 (4)	10 - 100 (5)	100 < (6)
A. Coefficients for establishments in non-agglomeration regions						
A1. Using the industry-level import shock						
Δt_i^C	−0.279*** (0.093)	−0.160 (0.126)	−0.156 (0.473)	−0.111 (0.188)	−0.172 (0.203)	−0.520 (0.538)
Pseudo R^2	0.01	0.02	0.04	0.02	0.03	0.03
A2. Using the region-level import shock						
Δt_r^C	−0.762 (0.532)	0.308 (0.676)	2.280 (3.117)	−0.804 (1.273)	0.307 (1.046)	−0.417 (3.047)
Pseudo R^2	0.01	0.02	0.04	0.02	0.03	0.03
A3. Using two import shocks						
Δt_i^C	−0.278*** (0.093)	−0.159 (0.126)	−0.135 (0.475)	−0.113 (0.188)	−0.171 (0.203)	−0.523 (0.538)
Δt_r^C	−0.755 (0.532)	0.293 (0.676)	2.223 (3.129)	−0.814 (1.273)	0.299 (1.046)	−0.540 (3.048)
Pseudo R^2	0.01	0.02	0.04	0.02	0.03	0.03
# obs.	91,981	64,659	3,364	18,480	24,450	3,816
B. Coefficients for establishments in agglomeration regions						
B1. Using the industry-level import shock						
Δt_i^C	−0.123** (0.052)	−0.210*** (0.066)	0.070 (0.262)	−0.219 (0.145)	−0.377*** (0.118)	0.188 (0.220)
Pseudo R^2	0.01	0.02	0.04	0.02	0.03	0.03
B2. Using the region-level import shock						
Δt_r^C	−1.597*** (0.497)	−0.248 (0.548)	−2.349 (1.847)	0.449 (1.158)	0.432 (0.803)	0.371 (1.569)
Pseudo R^2	0.01	0.02	0.04	0.02	0.03	0.03
B3. Using two import shocks						
Δt_i^C	−0.117** (0.052)	−0.209 *** (0.066)	0.093 (0.263)	−0.221 (0.146)	−0.380*** (0.118)	0.185 (0.220)
Δt_r^C	−1.551*** (0.498)	−0.193 (0.548)	−2.392 (1.854)	0.523 (1.159)	0.539 (0.804)	0.256 (1.571)
Pseudo R^2	0.01	0.02	0.04	0.02	0.03	0.03
# obs.	130,102	96,363	6,562	22,043	35,110	8,428

Notes: Estimates of other independent variables have not been reported. Robust standard errors are in parentheses.
*** $p < 0.01$.
** $p < 0.05$

Table 3
Establishments' exit, IV probit.

Variables	Establishments in single-unit firms			Establishments in multi-unit firms		
	< 5 (1)	5 - 50 (2)	50 < (3)	< 10 (4)	10 - 100 (5)	100 < (6)
A. Establishments in non-agglomeration regions						
A1. Coefficients when using the industry-level import shock						
Δt_i^C	0.032 (0.148)	0.341* (0.199)	0.860 (0.631)	0.678** (0.321)	0.213 (0.314)	−1.143 (0.707)
K-P F stat.	23,909	7,609	433	2,289	2,123	285
A2. Coefficients when using the region-level import shocks						
Δt_r^C	−2.026** (0.799)	0.738 (1.017)	3.416 (4.869)	−1.246 (1.849)	−0.161 (1.531)	−3.919 (4.623)
K-P F stat.	11,310	8,011	481	2,151	3,091	430
A3. Coefficients when using two import shocks						
Δt_i^C	0.038 (0.148)	0.342* (0.199)	0.910 (0.634)	0.676** (0.321)	0.212 (0.314)	−1.168* (0.707)
Δt_r^C	−2.031** (0.800)	0.739 (1.017)	4.077 (4.889)	−1.246 (1.851)	−0.157 (1.530)	−3.856 (4.622)
K-P F stat.	12,333	3,809	243	1,141	1,066	215
A4. Marginal effects of A3						
Δt_i^C	0.015 (0.058)	0.115* (0.067)	0.282 (0.197)	0.265** (0.126)	0.075 (0.111)	−0.395* (0.239)
Δt_r^C	−0.803** (0.316)	0.249 (0.343)	1.262 (1.513)	−0.488 (0.725)	−0.056 (0.541)	−1.305 (1.565)
B. Establishments in agglomeration regions						
B1. Coefficients when using the industry-level import shock						
Δt_i^C	−0.055 (0.091)	0.415*** (0.111)	0.166 (0.352)	−0.145 (0.235)	−0.162 (0.183)	0.190 (0.277)
K-P F stat.	25,197	13,648	1,040	2,697	3,799	1,472
B2. Coefficients when using the region-level import shock						
Δt_r^C	−1.399* (0.823)	−0.888 (0.849)	−1.711 (2.721)	0.508 (1.716)	1.939 (1.187)	0.159 (2.305)
K-P F stat.	18,653	12,969	838	2,308	4,680	1,324
B3. Coefficients when using two import shocks						
Δt_i^C	−0.051 (0.091)	0.417*** (0.111)	0.182 (0.351)	−0.148 (0.234)	−0.175 (0.183)	0.189 (0.278)
Δt_r^C	−1.388* (0.821)	−0.916 (0.850)	−1.765 (2.722)	0.537 (1.714)	1.957* (1.187)	0.057 (2.309)
K-P F stat.	17,349	8,739	420	1,483	2,220	663
B4. Marginal effects of B3						
Δt_i^C	−0.020 (0.036)	0.145*** (0.038)	0.056 (0.109)	−0.058 (0.092)	−0.062 (0.064)	0.062 (0.091)
Δt_r^C	−0.547* (0.323)	−0.318 (0.295)	−0.546 (0.841)	0.210 (0.670)	0.689* (0.418)	0.019 (0.754)

Notes: Estimates of other independent variables have not been reported. Robust standard errors are in parentheses. The number of observations is the same as the corresponding one in Table 2.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

Table 4
Establishments' changes in jobs and industries, IV multinomial probit.

Variables	Establishments in single-unit firms			Establishments in multi-unit firms		
	< 5 (1)	5 — 50 (2)	50 < (3)	< 10 (4)	10 — 100 (5)	100 < (6)
A. Marginal effects on establishments in non-agglomeration regions						
(a) Exiting from the business						
Δt_i^C	0.026 (0.058)	0.115* (0.067)	0.291 (0.195)	0.260** (0.125)	0.082 (0.111)	−0.347 (0.240)
Δt_r^C	−0.790*** (0.315)	0.241 (0.343)	1.411 (1.511)	−0.539 (0.724)	0.036 (0.545)	−1.297 (1.579)
(b) Shifting to the non-manufacturing sector						
Δt_i^C	0.086*** (0.020)	−0.047* (0.028)	−0.076 (0.099)	−0.196** (0.093)	0.174*** (0.067)	0.351*** (0.134)
Δt_r^C	0.175 (0.118)	0.110 (0.141)	−2.079** (0.947)	−0.942* (0.509)	−0.266 (0.383)	1.546 (1.132)
(c) Decreasing number of jobs, remaining in the manufacturing sector						
Δt_i^C	−0.079* (0.043)	−0.015 (0.073)	−0.009 (0.226)	0.005 (0.095)	−0.236** (0.114)	0.264 (0.242)
Δt_r^C	0.444** (0.224)	−0.001 (0.367)	0.875 (1.715)	0.698 (0.539)	−0.046 (0.542)	1.492 (1.656)
(d) Constant or increasing number of jobs, remaining in the manufacturing sector						
Δt_i^C	−0.032 (0.053)	−0.053 (0.064)	−0.206 (0.202)	−0.068 (0.097)	−0.020 (0.099)	−0.269 (0.228)
Δt_r^C	0.171 (0.283)	−0.351 (0.319)	−0.207 (1.509)	0.783 (0.559)	0.276 (0.476)	−1.740 (1.463)
B. Marginal effects on establishments in agglomeration regions						
(a) Exiting from the business						
Δt_i^C	−0.018 (0.036)	0.144*** (0.038)	0.068 (0.109)	−0.054 (0.091)	−0.056 (0.064)	0.079 (0.091)
Δt_r^C	−0.484 (0.322)	−0.319 (0.294)	−0.427 (0.843)	0.209 (0.670)	0.723* (0.420)	−0.004 (0.754)
(b) Shifting to the non-manufacturing sector						
Δt_i^C	0.005 (0.011)	−0.029** (0.014)	−0.142*** (0.051)	0.054 (0.064)	0.019 (0.041)	−0.033 (0.057)
Δt_r^C	−0.249** (0.103)	−0.171 (0.108)	−0.296 (0.363)	−0.515 (0.458)	0.254 (0.289)	1.075 ** (0.485)
(c) Decreasing number of jobs, remaining in the manufacturing sector						
Δt_i^C	−0.053 (0.026)	−0.076* (0.042)	−0.005 (0.131)	0.086 (0.068)	0.031 (0.067)	0.154 (0.106)
Δt_r^C	−0.074 (0.229)	0.453 (0.314)	0.178 (0.989)	−0.065 (0.499)	−0.338 (0.427)	−0.364 (0.835)
(d) Constant or increasing number of jobs, remaining in the manufacturing sector						
Δt_i^C	0.066** (0.032)	−0.039 (0.036)	0.079 (0.114)	−0.087 (0.074)	0.006 (0.057)	−0.201** (0.090)
Δt_r^C	0.807*** (0.288)	0.037 (0.275)	0.546 (0.873)	0.371 (0.537)	−0.639* (0.382)	−0.708 (0.709)

Notes: Estimates of other independent variables have not been reported. Robust standard errors are in parentheses. The number of observations and Kleibergen–Paap F statistic are the same as the corresponding ones in Tables 2 and 3, respectively.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

Table 5
Establishments' job changes, IV, two import indices.

Variables	Establishments in single-unit firms			Establishments in multi-unit firms		
	< 5 (1)	5 - 50 (2)	50 < (3)	< 10 (4)	10 - 100 (5)	100 < (6)
A. Coefficients for establishments in non-agglomeration regions						
Δt_i^C	−0.019 (0.071)	0.004 (0.082)	−0.080 (0.260)	−0.116 (0.220)	0.106 (0.172)	−0.422 (0.319)
Δt_r^C	−0.507 (0.383)	−0.002 (0.367)	−0.848 (1.778)	0.657 (1.045)	−0.456 (0.714)	−3.707* (1.985)
K-P F stat.	6,999	2,345	161	485	562	132
# obs.	46,102	38,823	2,298	7,063	13,507	2,238
B. Coefficients for establishments in agglomeration regions						
Δt_i^C	0.081* (0.045)	0.112** (0.051)	−0.105 (0.144)	0.016 (0.162)	−0.113 (0.094)	−0.515 *** (0.167)
Δt_r^C	0.508 (0.384)	−0.425 (0.353)	−0.501 (0.968)	−0.556 (1.116)	−0.686 (0.599)	−1.184 (1.027)
K-P F stat.	8,341	4,537	265	600	1,227	471
# obs.	64,015	57,727	4,462	8,782	19,923	5,200

Notes: Estimates of other independent variables have not been reported. Robust standard errors are in parentheses.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

establishments in each of the two groups (d_ind^{same} and d_ind^{diff}) is affected by two types of import shocks (Δt_i^C or Δt_r^C), since these two groups were mutually exclusive and collectively exhaustive in each subgroup of establishments. For instance, in Panel A1, Column 1, $\Delta t_i^C \times d\_ind^{same}$ has an estimated coefficient of 0.276. This implies that the mean value of Δt_i^C for surviving establishments (0.028 in Table 1) enhanced the workforce change ratio defined by Eq. (7) by 0.008 (i.e., = 0.276 × 0.028) for establishments whose jobs increased and whose primary industry did not change over the past decade. Similarly, in Panel A2, Column 1, $\Delta t_i^C \times d\_ind^{diff}$ has an estimated coefficient of −0.189. This implies that the mean value of Δt_i^C in this period diminished the workforce change ratio by 0.005 (i.e., = −0.189 × 0.028) for establishments whose jobs decreased and whose primary industry changed to the other one.[21]

Table 6 presents two points worth examining as the results of import shocks. First, in non-agglomeration regions, they amplify the workforce increase and decrease in a group of establishments in single-unit firms with 50 or less jobs. There are a few estimates with statistical significance at the 0.05 level in the Table. Whereas some are located

[21] For readers' reference, the estimates of all control variables for Panels B1 and B2 are reported in Tables A2 and A3 in the Appendix.

Table 6
Establishments' job changes, IV, four import indices.

Variables	Establishments in single-unit firms			Establishments in multi-unit firms		
	< 5 (1)	5 - 50 (2)	50 < (3)	< 10 (4)	10 - 100 (5)	100 < (6)
A.Coefficients for establishments in non-agglomeration regions						
A1. Establishments with increasing number of jobs						
$\Delta t_i^C \times d\_ind^{same}$	0.276** (0.137)	0.249* (0.151)	−0.076 (0.362)	0.221 (0.379)	−0.259 (0.222)	−0.585 (0.417)
$\Delta t_i^C \times d\_ind^{diff}$	0.099 (0.159)	−0.131 (0.114)	0.293 (0.360)	−0.076 (0.302)	0.018 (0.220)	0.702 (0.613)
$\Delta t_r^C \times d\_ind^{same}$	0.038 (0.614)	0.078 (0.433)	−0.335 (1.529)	1.761 (1.382)	−1.412* (0.796)	−3.346* (1.797)
$\Delta t_r^C \times d\_ind^{diff}$	0.178 (0.630)	1.313 *** (0.458)	1.740 (1.739)	1.739 (1.469)	−0.437 (0.855)	−4.065** (1.970)
K-P *F* stat.	320	211	37	25	82	31
# obs.	6,529	11,651	1,063	1,656	5,051	1,039
A2. Establishments with decreasing number of jobs						
$\Delta t_i^C \times d\_ind^{same}$	−0.318*** (0.091)	−0.065 (0.111)	0.029 (0.425)	−0.745*** (0.283)	0.264 (0.259)	−0.193 (0.407)
$\Delta t_i^C \times d\_ind^{diff}$	−0.189* (0.101)	−0.067 (0.100)	−0.149 (0.263)	0.192 (0.250)	−0.308 (0.209)	−0.050 (0.410)
$\Delta t_r^C \times d\_ind^{same}$	−0.724* (0.401)	0.465 (0.363)	−1.497 (2.032)	1.339 (0.950)	−0.069 (0.697)	−1.135 (1.953)
$\Delta t_r^C \times d\_ind^{diff}$	−0.985 ** (0.425)	−0.521 (0.377)	−0.943 (2.071)	−0.522 (0.993)	−0.268 (0.778)	−3.421 (2.107)
K-P *F* stat.	1,255	448	54	69	115	38
# obs.	19,864	21,969	1,192	4,017	7,689	1,184
B. Coefficients for establishments in agglomeration regions						
B1. Establishments with increasing number of jobs						
$\Delta t_i^C \times d\_ind^{same}$	0.181** (0.088)	0.057 (0.086)	−0.299 (0.208)	0.242 (0.278)	−0.221* (0.126)	−0.362* (0.194)
$\Delta t_i^C \times d\_ind^{diff}$	0.251** (0.105)	0.093 (0.073)	0.016 (0.216)	0.079 (0.264)	−0.220* (0.128)	−0.000 (0.272)
$\Delta t_r^C \times d\_ind^{same}$	−0.642 (0.598)	−0.266 (0.393)	−0.690 (1.004)	−1.047 (1.393)	−0.433 (0.645)	−0.889 (1.021)
$\Delta t_r^C \times d\_ind^{diff}$	−0.507 (0.612)	−0.007 (0.415)	0.302 (1.042)	0.353 (1.470)	0.255 (0.674)	−0.176 (1.108)
K-P *F* stat.	655	554	52	42	124	96
# obs.	8,746	17,534	2,010	2,131	7,365	2,136
B2. Establishments with decreasing number of jobs						
$\Delta t_i^C \times d\_ind^{same}$	−0.064 (0.058)	0.082 (0.075)	−0.281 (0.212)	−0.047 (0.228)	0.123 (0.144)	0.061 (0.204)
$\Delta t_i^C \times d\_ind^{diff}$	−0.089 (0.062)	−0.081 (0.061)	0.023 (0.155)	0.514*** (0.186)	−0.168 (0.112)	−0.427* (0.245)
$\Delta t_r^C \times d\_ind^{same}$	0.317 (0.385)	−0.268 (0.356)	1.370 (0.958)	−1.187 (1.089)	−0.299 (0.611)	−0.807 (1.040)
$\Delta t_r^C \times d\_ind^{diff}$	0.211 (0.409)	−0.599 (0.386)	−0.053 (1.084)	−1.470 (1.106)	−0.673 (0.650)	−1.983 (1.220)
K-P *F* stat.	2,023	939	74	98	190	149
# obs.	27,602	32,594	2,376	4,899	11,502	3,007

Notes: Estimates of other independent variables have not been reported. Robust standard errors are in parentheses.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

sporadically on the Table and do not bring us a systematic interpretation of import shocks, one systematic result is evident in Columns 1 and 2 of Panels A1 and A2. They indicate that, on the one hand, the industry-level import shock assists the increase of workforce sizes in establishments with less than 5 jobs remaining in the same industry (0.276) and the region-level import shock assists it in establishments with 5 to 50 jobs shifting to the different industry (1.313). On the other hand, the industry-level import shock promotes the decrease of workforce sizes in establishments with less than 5 jobs remaining in the same industry (−0.318). Further, the region-level import shock promotes it in establishments with less than 5 jobs shifting to the different industry (−0.985). This demonstrates the amplification effect of import shocks on job churning in these small surviving establishments.

Second, coefficients for interaction terms with the region-level import shock (Δt_r^C) are generally notably larger than those with the industry-level import shock (Δt_i^C). Given that the mean values of the two import shocks are quite similar (Table 1), the import shock affecting establishments through changes in regional economic activity is crucial to the extent to which the import shock intensifies changes in workforce size. One explanation is that the regional import shock compels many establishments in the region to simultaneously change their labor demand, leading to a larger regional labor shift between establishments.

4.3. Entries

When examining how import shocks affect the entry of establishments into the manufacturing sector, the most critical challenge is the lack of data on the population of potential entries. Therefore, it is difficult to estimate how import shocks deter certain types of potential entrants from establishing themselves in the manufacturing sector or how they encourage others to enter the market. The observable data reflect only the results of entries, and using these data does not allow us to determine the causality from import shocks to entries; the data are correlational only.

Considering this limitation, I conducted a regression analysis of manufacturing establishments operating in 2016 using Eq. (5), import shocks, and the control variables in Section 3.4. Establishments operating in the manufacturing sector in 2016 were considered to have made one of three choices: (a) survived in the manufacturing sector for a decade, (b) became newly established in the manufacturing sector, or (c) shifted from the non-manufacturing sector to the manufacturing sector. The estimated marginal effects are summarized in Table 7. The classification criteria for establishments into 12 groups were the same as before, except that the number of workers in 2016 was used as an index of establishment size.

Table 7 provides clear results for survivors and entries. Regarding estimated coefficients of import shocks with statistical significance at the 0.05 level, the coefficients for surviving in the manufacturing sector (choice a) are all positive, while those for setting up an establishment (choice b) and shifting from the non-manufacturing sector (choice c) are all negative, both in Panels A and B. There are more statistically significant coefficients in Panel B than in Panel A, indicating that the impact of import shocks on industry entries becomes more observable in regions with more establishments operating in that industry. Although the coefficients with statistical significance are sporadic in Table 7, it is clear that both industry- and region-level import shocks increased the ratio of survivors and decreased the ratio of entries into operating establishments.

Table 7
Establishments' entry to the manufacturing sector, IV multinominal probit.

Variables	Establishments in single-unit firms			Establishments in multi-unit firms		
	< 5 (1)	5 - 50 (2)	50 < (3)	< 10 (4)	10 - 100 (5)	100 < (6)
A. Marginal effects on establishments in non-agglomeration regions						
(a) Survived in the manufacturing sector						
Δt_i^C	0.016 (0.053)	0.081 (0.072)	0.295 (0.253)	0.219* (0.133)	0.364*** (0.122)	0.242 (0.269)
Δt_r^C	0.590* (0.322)	0.253 (0.366)	0.469 (1.387)	2.128*** (0.665)	0.708 (0.558)	−2.465 (1.519)
(b) Newly set up an establishment in the manufacturing sector						
Δt_i^C	0.007 (0.047)	0.112* (0.064)	0.018 (0.210)	−0.152 (0.134)	−0.298** (0.119)	−0.357 (0.262)
Δt_r^C	−0.623** (0.292)	−0.276 (0.328)	0.977 (1.202)	−1.536** (0.664)	−0.642 (0.535)	2.003 (1.481)
(c) Shifted from the non-manufacturing sector						
Δt_i^C	−0.022 (0.034)	−0.193*** (0.045)	−0.313* (0.181)	−0.067 (0.078)	−0.066 (0.064)	0.115 (0.116)
Δt_r^C	0.033 (0.210)	0.023 (0.229)	−1.446* (0.869)	−0.591 (0.412)	−0.066 (0.317)	0.462 (0.667)
K-P *F* stat.	9,885	4,051	228	1,431	1,176	299
# obs.	77,193	54,576	3,006	18,136	22,526	3,811
B. Marginal effects on establishments in agglomeration regions						
(a) Survived in the manufacturing sector						
Δt_i^C	−0.052 (0.040)	0.078 (0.050)	0.153 (0.154)	0.363*** (0.105)	0.129 (0.081)	0.135 (0.130)
Δt_r^C	2.043*** (0.336)	1.573*** (0.319)	0.860 (0.941)	1.760*** (0.659)	0.307 (0.467)	2.029** (0.944)
(b) Newly set up an establishment in the manufacturing sector						
Δt_i^C	0.035 (0.037)	0.004 (0.045)	−0.196 (0.143)	−0.197* (0.106)	−0.118 (0.077)	−0.089 (0.126)
Δt_r^C	−1.035*** (0.312)	−0.934*** (0.290)	0.768 (0.814)	−1.414** (0.660)	−0.547 (0.449)	−1.799* (0.921)
(c) Shifted from the non-manufacturing sector						
Δt_i^C	0.018 (0.022)	−0.081*** (0.028)	0.043 (0.074)	−0.166*** (0.062)	−0.011 (0.042)	−0.046 (0.050)
Δt_r^C	−1.008*** (0.187)	−0.639*** (0.185)	−1.628*** (0.591)	−0.346 (0.353)	0.240 (0.226)	−0.230 (0.400)
K-P *F* stat.	11,436	6,198	397	1,277	1,649	592
# obs.	94,592	75,094	5,037	21,073	30,450	7,177

Notes: Estimates of other independent variables have not been reported. Robust standard errors are in parentheses.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

5. Conclusion

Using a dataset comprising all Japanese manufacturing establishments from 2006 to 2016, this study examined the impact of import shocks from China on detailed job flows in exiting, entering, and surviving establishments. Both industry- and region-level import shock indices were utilized along with regional import shocks in the job flow of establishments, which is a novel aspect of this study.

The regression results are summarized as follows. First, regarding exits and switching to the non-manufacturing sector, the industry-level import shock increased the probability of exiting in only a few groups. Interestingly, for small establishments in single-unit firms in non-agglomeration regions, the region-level import shock decreased the probability of exiting and instead increased the probability of their workforce size decreasing while remaining in the manufacturing sector. This reaction is presumed to be part of their hibernation strategy. Additionally, industry-level import shocks induced establishments to make different choices regarding shifting to the non-manufacturing sector depending on their adaptability and the level of agglomeration in the industry. Second, the impact on job flows in some groups of surviving establishments was noticeable. Both industry- and region-level import shocks accelerated job creation and destruction in these establishments, leading to an amplification of the overall size of job flows. Regional import shocks had generally a stronger effect on job flows, presumably because of an additional impact on establishments' employment through regional economic activities. Third, when observing the correlation between past import shocks and the type of currently operating establishments, both types of import shocks increased the ratio of survivors and decreased that of entries.

This study contributes to the literature by interpreting phenomena that seemingly contradict the prediction of the impact of import shocks on job flows. This includes the finding that a regional import shock *decreases* the probability of establishments in a certain group exiting, which is attributed to their hibernation reaction. Additionally, the two import shocks do not have systematic effects on net workforce changes in surviving establishments. One reason for this is that import shocks simultaneously enhance both job creation and destruction in certain groups of establishments, offsetting each other and resulting in little impact on net job changes. Revealing causality from import shocks to the entry of establishments or firms is the next task, as the analysis framework proposed in this study is not well-suited to address this issue.

CRediT authorship contribution statement

Masahiro Endoh: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Appendix

Estimates of the control variables for Panel A3 of Table 3, Panel B1 of Table 6, and Panel B2 of Table 6 are presented in Tables A1, A2, and A3, separately, for reference.

Table A1
Estimates of control variables for Panel A3 of Table 3.

Control variables	Establishments in single-unit firms			Establishments in multi-unit firms		
	< 5	5 – 50	50 <	< 10	10 – 100	100 <
	(1)	(2)	(3)	(4)	(5)	(6)
X_e: Variables for establishments						
Found in Oct. 01–Jun. 04	−0.010	−0.073**	−0.069	−0.075**	−0.057	0.053
	(0.025)	(0.029)	(0.132)	(0.037)	(0.039)	(0.107)
Found in Jul. 99–Oct. 01	−0.095***	−0.148***	−0.162	−0.253***	−0.214***	−0.280**
	(0.024)	(0.028)	(0.128)	(0.036)	(0.039)	(0.113)
Found in Oct. 96–Jul. 99	−0.157***	−0.167***	−0.221	−0.255***	−0.234***	−0.226*
	(0.028)	(0.032)	(0.144)	(0.043)	(0.044)	(0.124)
Found before Oct. 96	−0.099***	−0.332***	−0.388***	−0.352***	−0.420***	−0.517***
	(0.017)	(0.020)	(0.098)	(0.026)	(0.028)	(0.078)
Ratio of regular workers	0.097***	−0.383***	−0.438***	−0.308***	−0.463***	−0.301***
	(0.024)	(0.023)	(0.109)	(0.036)	(0.038)	(0.103)
Ratio of female workers	−0.174***	0.030	0.007	−0.071*	−0.075*	−0.331**
	(0.016)	(0.026)	(0.132)	(0.037)	(0.045)	(0.140)
X_r: Variables for regions						
Kanto	0.029	0.015	0.109	0.021	0.072*	0.100
	(0.020)	(0.025)	(0.113)	(0.045)	(0.039)	(0.114)
Chubu	0.043**	0.014	0.201*	0.008	0.057	−0.061
	(0.019)	(0.024)	(0.109)	(0.044)	(0.038)	(0.118)
Kinki	0.073***	0.072***	0.201*	0.019	0.047	0.009
	(0.019)	(0.024)	(0.106)	(0.043)	(0.037)	(0.110)
Chugoku	0.004	−0.053*	0.127	−0.052	0.004	0.072
	(0.025)	(0.030)	(0.137)	(0.054)	(0.048)	(0.145)
Shikoku	0.025	0.002	0.117	−0.069	−0.079	−0.110
	(0.034)	(0.040)	(0.202)	(0.077)	(0.069)	(0.221)
Kyushu, Okinawa	−0.053**	0.022	0.194	−0.026	0.113**	−0.161
	(0.025)	(0.030)	(0.143)	(0.055)	(0.049)	(0.159)
Ratio of female workers	−1.922***	−2.061***	−2.925*	−0.050	−0.088	−0.232
	(0.270)	(0.341)	(1.641)	(0.656)	(0.566)	(1.611)
Ratio of manuf. workers	−0.542***	−0.910***	−1.277***	−0.258	−0.321**	0.047
	(0.069)	(0.090)	(0.425)	(0.170)	(0.144)	(0.391)
X_i: Variables for industry groups						
Textile, apparel	0.248***	0.191***	0.305**	0.108**	0.211***	0.139
	(0.020)	(0.025)	(0.134)	(0.051)	(0.046)	(0.149)
Wood, furniture, paper	−0.018	−0.004	0.001	0.049	−0.041	−0.194*
	(0.017)	(0.020)	(0.106)	(0.038)	(0.035)	(0.106)
Ceramic, stone, clay	−0.095***	0.087***	0.157	−0.023	0.074*	0.071
	(0.029)	(0.032)	(0.176)	(0.050)	(0.043)	(0.150)
Chemical	0.074***	−0.035	−0.169*	−0.075*	−0.095***	−0.149*
	(0.023)	(0.023)	(0.099)	(0.039)	(0.033)	(0.086)
Metals	−0.050***	−0.051**	−0.069	−0.037	−0.037	−0.057
	(0.019)	(0.021)	(0.100)	(0.038)	(0.034)	(0.095)
General machinery	−0.063***	−0.053**	−0.136	−0.095**	−0.020	−0.103
	(0.019)	(0.023)	(0.099)	(0.040)	(0.037)	(0.098)
Electrical, electronic, transp.	0.068***	0.094***	0.184**	0.051	0.137***	0.179**
	(0.021)	(0.023)	(0.086)	(0.041)	(0.034)	(0.081)
Miscellaneous	−0.086***	−0.048	−0.161	−0.029	−0.013	0.191
	(0.021)	(0.030)	(0.219)	(0.053)	(0.056)	(0.212)
X_{ir}: Variable for industry–region						
Industry emp. share in the region	2.080***	0.785*	−0.911	3.091***	1.477**	−2.083
	(0.370)	(0.412)	(1.484)	(0.706)	(0.595)	(1.292)

Notes: Panel A3 of Table 3 reports the estimates of the two import shocks. The base groups of the dummies for the year found, region, and industry are Jun. 04–Oct. 06, Hokkaido and Tohoku, and food. Robust standard errors are in parentheses. The number of observations and Kleibergen–Paap *F* statistic are the same as the corresponding ones in Panel A of Table 2 and Panel A3 of Table 3, respectively.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

Table A2
Estimates of control variables for Panel B1 of Table 6.

Control variables	Establishments in single-unit firms			Establishments in multi-unit firms		
	< 5	5 – 50	50 <	< 10	10 – 100	100 <
	(1)	(2)	(3)	(4)	(5)	(6)
X_e: Variables for establishments						
Found in Oct. 01–Jun. 04	−0.026	−0.048***	0.022	−0.091***	−0.081***	−0.096**
	(0.017)	(0.012)	(0.044)	(0.030)	(0.023)	(0.045)
Found in Jul. 99–Oct. 01	−0.003	−0.060***	−0.071*	−0.066**	−0.100***	−0.078*
	(0.015)	(0.011)	(0.037)	(0.029)	(0.022)	(0.045)

(*continued on next page*)

Table A2 (*continued*)

Control variables	Establishments in single-unit firms < 5 (1)	5 – 50 (2)	50 < (3)	Establishments in multi-unit firms < 10 (4)	10 – 100 (5)	100 < (6)
Found in Oct. 96–Jul. 99	−0.002	−0.053***	−0.019	−0.108***	−0.124***	−0.118**
	(0.017)	(0.013)	(0.044)	(0.030)	(0.023)	(0.049)
Found before Oct. 96	−0.048***	−0.099***	−0.094***	−0.107***	−0.196***	−0.146***
	(0.011)	(0.008)	(0.031)	(0.020)	(0.016)	(0.035)
Ratio of regular workers	0.249***	0.091***	−0.028	0.100***	0.017	0.027
	(0.016)	(0.010)	(0.035)	(0.031)	(0.023)	(0.036)
Ratio of female workers	−0.192***	−0.006	0.018	0.039	0.028	0.023
	(0.011)	(0.013)	(0.042)	(0.034)	(0.027)	(0.041)
X_r: Variables for regions						
Kanto	−0.040***	0.019*	0.027	−0.057*	0.001	0.032
	(0.014)	(0.010)	(0.025)	(0.034)	(0.016)	(0.027)
Chubu	−0.054***	0.012	0.016	−0.063*	−0.004	−0.004
	(0.013)	(0.009)	(0.022)	(0.032)	(0.015)	(0.025)
Kinki	−0.016	0.031***	0.051**	−0.041	0.008	0.019
	(0.013)	(0.009)	(0.024)	(0.032)	(0.016)	(0.027)
Chugoku	−0.045***	0.009	−0.010	−0.030	−0.002	−0.014
	(0.017)	(0.012)	(0.029)	(0.039)	(0.019)	(0.030)
Shikoku	−0.014	0.024*	0.019	−0.062	−0.002	0.060
	(0.021)	(0.014)	(0.031)	(0.060)	(0.026)	(0.045)
Kyushu, Okinawa	−0.050***	0.028**	0.012	−0.041	−0.005	0.042
	(0.016)	(0.011)	(0.028)	(0.039)	(0.019)	(0.033)
Ratio of female workers	0.038	0.196	0.090	−0.031	−0.517**	0.484
	(0.163)	(0.134)	(0.331)	(0.532)	(0.218)	(0.370)
Ratio of manuf. workers	0.099**	0.142***	0.040	0.044	−0.010	0.250**
	(0.043)	(0.035)	(0.093)	(0.122)	(0.058)	(0.107)
X_i: Variables for industry groups						
Textile, apparel	−0.019	−0.022**	0.012	−0.048	−0.024	−0.009
	(0.013)	(0.011)	(0.031)	(0.036)	(0.021)	(0.043)
Wood, furniture, paper	−0.052***	−0.091***	−0.026	0.010	−0.017	−0.015
	(0.013)	(0.009)	(0.029)	(0.030)	(0.016)	(0.028)
Ceramic, stone, clay	−0.035**	−0.095***	−0.045	−0.039	−0.003	−0.046
	(0.016)	(0.012)	(0.040)	(0.033)	(0.019)	(0.050)
Chemical	−0.059***	−0.055***	0.001	−0.027	−0.008	0.015
	(0.017)	(0.011)	(0.029)	(0.031)	(0.016)	(0.026)
Metals	−0.073***	−0.094***	−0.050*	0.016	0.000	−0.048
	(0.013)	(0.010)	(0.027)	(0.031)	(0.017)	(0.029)
General machinery	−0.083***	−0.107***	−0.046*	0.015	−0.013	−0.035
	(0.013)	(0.010)	(0.028)	(0.031)	(0.017)	(0.026)
Electrical, electronic, transp.	−0.055***	−0.066***	−0.010	−0.034	0.011	0.008
	(0.017)	(0.011)	(0.027)	(0.037)	(0.019)	(0.028)
Miscellaneous	−0.019	−0.017	0.018	0.035	−0.006	−0.036
	(0.014)	(0.014)	(0.049)	(0.038)	(0.028)	(0.054)
X_{ir}: Variable for industry–region						
Industry emp. share in the region	−0.127**	−0.050	0.078	0.162	0.088	0.003
	(0.052)	(0.035)	(0.085)	(0.154)	(0.071)	(0.081)
Constant	0.438***	0.273***	0.336**	0.493**	0.706***	0.166
	(0.075)	(0.062)	(0.163)	(0.247)	(0.104)	(0.175)

Notes: Panel B1 of Table 6 reports the estimates of the four import shocks. The base groups of the dummies for the year found, region, and industry are Jun. 04–Oct. 06, Hokkaido and Tohoku, and food. Robust standard errors are in parentheses. The number of observations and Kleibergen–Paap *F* statistic are the same as the corresponding ones in Panel B1 of Table 6.

*** $p < 0.01$.

** $p < 0.05$.

* $p < 0.1$.

Table A3

Estimates of control variables for Panel B2 of Table 6.

Control variables	Establishments in single-unit firms < 5 (1)	5 – 50 (2)	50 < (3)	Establishments in multi-unit firms < 10 (4)	10 – 100 (5)	100 < (6)
X_e: Variables for establishments						
Found in Oct. 01–Jun. 04	0.005	0.022*	−0.058	0.017	0.001	−0.051
	(0.013)	(0.013)	(0.053)	(0.030)	(0.024)	(0.057)
Found in Jul. 99–Oct. 01	0.008	0.009	−0.061	0.011	0.016	0.032
	(0.012)	(0.012)	(0.049)	(0.027)	(0.022)	(0.059)
Found in Oct. 96–Jul. 99	0.008	0.041***	0.019	0.044	0.022	−0.027
	(0.013)	(0.013)	(0.049)	(0.028)	(0.024)	(0.062)
Found before Oct. 96	0.011	0.039***	−0.001	0.019	0.032*	0.022
	(0.009)	(0.009)	(0.034)	(0.020)	(0.017)	(0.042)
Ratio of regular workers	0.100***	0.164***	0.340***	0.115***	0.252***	0.334***

(continued on next page)

Table A3 (*continued*)

Control variables	Establishments in single-unit firms			Establishments in multi-unit firms		
	< 5 (1)	5 – 50 (2)	50 < (3)	< 10 (4)	10 – 100 (5)	100 < (6)
	(0.009)	(0.009)	(0.041)	(0.024)	(0.020)	(0.039)
Ratio of female workers	0.035***	−0.009	0.037	−0.001	0.037*	0.164***
	(0.008)	(0.010)	(0.040)	(0.024)	(0.021)	(0.042)
X_r: Variables for regions						
Kanto	0.008	−0.007	0.008	−0.009	0.006	−0.010
	(0.009)	(0.008)	(0.029)	(0.025)	(0.015)	(0.030)
Chubu	0.026***	0.015*	0.066**	−0.008	0.010	0.009
	(0.009)	(0.008)	(0.027)	(0.025)	(0.014)	(0.029)
Kinki	0.025***	0.015*	0.067**	0.026	0.011	0.002
	(0.009)	(0.008)	(0.028)	(0.024)	(0.015)	(0.030)
Chugoku	0.013	−0.004	0.032	0.006	0.001	0.010
	(0.012)	(0.011)	(0.038)	(0.032)	(0.018)	(0.037)
Shikoku	0.022	−0.023**	0.054	−0.050	−0.001	−0.055
	(0.013)	(0.012)	(0.043)	(0.043)	(0.024)	(0.049)
Kyushu, Okinawa	0.028**	0.003	0.085***	−0.029	0.010	0.057
	(0.011)	(0.010)	(0.031)	(0.031)	(0.018)	(0.035)
Ratio of female workers	−0.175	−0.154	−0.496	0.353	0.137	−0.567
	(0.110)	(0.109)	(0.376)	(0.353)	(0.219)	(0.375)
Ratio of manuf. workers	−0.067**	−0.050*	−0.130	0.109	0.059	0.151
	(0.028)	(0.030)	(0.108)	(0.095)	(0.058)	(0.110)
X_i: Variables for industry groups						
Textile, apparel	−0.045***	−0.078***	−0.083***	−0.058*	−0.057***	−0.107***
	(0.009)	(0.009)	(0.032)	(0.031)	(0.018)	(0.039)
Wood, furniture, paper	−0.055***	−0.045***	−0.104***	−0.047*	−0.044***	−0.087***
	(0.008)	(0.007)	(0.029)	(0.024)	(0.015)	(0.032)
Ceramic, stone, clay	−0.069***	−0.065***	−0.157***	−0.041	−0.106***	−0.193***
	(0.011)	(0.011)	(0.055)	(0.030)	(0.018)	(0.041)
Chemical	−0.039***	−0.021**	−0.123***	−0.039	−0.035**	−0.065**
	(0.012)	(0.009)	(0.031)	(0.029)	(0.016)	(0.026)
Metals	−0.051***	−0.010	−0.066**	−0.025	−0.040**	−0.052*
	(0.009)	(0.008)	(0.028)	(0.025)	(0.016)	(0.027)
General machinery	−0.048***	−0.024***	−0.075***	−0.023	−0.059***	−0.051*
	(0.009)	(0.008)	(0.028)	(0.026)	(0.016)	(0.027)
Electrical, electronic, transp.	−0.078***	−0.059***	−0.170***	−0.056*	−0.096***	−0.130***
	(0.011)	(0.009)	(0.028)	(0.031)	(0.017)	(0.030)
Miscellaneous	−0.066***	−0.050***	−0.138**	−0.027	−0.071***	−0.194***
	(0.010)	(0.010)	(0.061)	(0.029)	(0.024)	(0.057)
X_{ir}: Variable for industry–region						
Industry emp. share in the region	0.004	−0.044	0.008	0.069	−0.085	−0.121
	(0.037)	(0.030)	(0.074)	(0.115)	(0.059)	(0.091)
Constant	−0.582***	−0.431***	−0.308*	−0.789***	−0.666***	−0.373**
	(0.053)	(0.052)	(0.179)	(0.169)	(0.103)	(0.189)

Notes: Panel B2 of Table 6 reports the estimates of the four import shocks. The base groups of the dummies for the year found, region, and industry are Jun. 04–Oct. 06, Hokkaido and Tohoku, and food. Robust standard errors are in parentheses. The number of observations and Kleibergen–Paap *F* statistic are the same as the corresponding ones in Panel B2 of Table 6.

*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

Data availability

The authors do not have permission to share data.

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