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Structural Changes in Japanese Firms: Business Dynamism in an Aging Society

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Structural Changes in Japanese Firms: Business Dynamism in an Aging Society[1]

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Abstract

The COVID-19 pandemic has posed a serious threat to the survival of Japanese firms, highlighting the importance of understanding how and why firms exit. In this paper, we use a rich firm-level dataset of Japanese firms to document how firm exit patterns have evolved between 2007 and 2017. Firm exit patterns have been heavily influenced by Japan's demographic trends, as a majority of exits in recent years were voluntary exits of firms (business closures) owned by CEOs aged 65 years or older without business successors. In contrast to this increase in voluntary exits, other "traditional" firm exits (such as bankruptcies), have declined. These findings underscore the importance of addressing business transition issues in a rapidly aging society.

JEL Classification Numbers: D22, G33, L10, L14, R11

Keywords: firm growth, business succession, population aging, firm exits, inter-firm-network, zombie firms

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I. INTRODUCTION

Business dynamism, defined as the turnover of firm entry and exit, plays a key role in the efficient allocation of resources, with important implications for aggregate employment, growth and productivity (Acemoglu 2008). New businesses create jobs, raise productivity and promote innovations by replacing older and less productive firms (Prescott and Ohanian 2014; Decker et al. 2014; and Karahan, Pugsley, and Şahin, 2019). For this reason, previous studies of business dynamism largely focused on firm entry and ways to promote the entry of potentially productive start-up firms. In contrast, the issue of how and why firms exit has received relatively less attention, even though firm exits play an equally important role as firm entry in determining efficient resource allocation. In fact, in numerous studies, firm exit rates were often assumed to be exogenously determined.[2,3] However, in light of the COVID-19 pandemic, the discussion has now shifted to better understand why firms exit. Questions such as which firms are likely to exit, the potential spillover effects of a firm exit through supply chains, and policies that could prevent healthy firms from exiting, are of prime importance to policymakers.[4]

In this paper, we analyze firm exit patterns of Japanese firms, using a unique firm-level data set from 2007 to 2017 that contains information on firms' balance sheets as well as how firms exited if a firm exited during the sample period. The dataset also provides information on inter-firm transactional data which enable us to identify the structure of a firm's supply chain.

We find that firm exit rates in Japan are still very low compared to other advanced economies (Colacelli and Hong, 2019; OECD 2017). Overall financial health of Japanese firms improved in recent years, demonstrated by very low bankruptcy rates and declining ratio of "zombie firms". At the same time, the majority of firm exits that has taken place in recent years is voluntary exits of firms (business closures). We find that voluntary exits of Japanese firms are strongly positively correlated with the age of the chief executive officer (CEO). In fact, Japanese firms with a long history of family businesses now face difficulties in securing a next-generation family member with the desire and skills to take over family businesses. As a result, older CEOs who are at their retirement age or even past their retirement age decide to close their businesses voluntarily, even though, in some cases, the firms are perfectly solvent. In fact, this phenomenon is prevalent, as we observe a broad-based increase in voluntary exits by older CEOs across sectors and across regions. However, voluntary exits are relatively more pronounced in rural areas than in urban areas for the following reasons. First, there are more elderly CEOs in rural areas in urban areas, reflecting the uneven demographic trend in Japan where population aging and shrinking occurs faster in rural areas. Second, everything else equal, it is more difficult for firms in rural areas to find business partners, as firms are less densely populated in those regions while firms tend to look for business

[2] Hsieh and Klenow (2014) show life-cycle dynamics of firms in the economy are closely linked to aggregate productivity. The paper, however, focuses on entry barriers that prevent productive firms from entering and other distortions which prevent entrants from growing.

[3] Research on firm exits have largely focused on the exit patterns of economically and financially distressed firms (Bhattacharjee et al. 2009 and Balcaen et al. 2012).

[4] Hong et al. (2020) documents how the COVID-19 outbreak affected the firm exit patterns in Japan (https://www.rieti.go.jp/en/columns/a01_0607.html).

partners from the same region. We also find that inter-firm networks also matter in voluntary exits, as firms with fewer connections are more likely to choose voluntary exits, while voluntary exits of firms, in turn, are positively correlated with firm exits of connected firms.

This unique feature of voluntary firm exits in Japan, which is inarguably tied to the country's demographic trends, requires a rethinking of how we connect firm exits with the efficient allocation of resources. It also motivates a renewed thinking in designing policies to improve the mechanism of voluntary exits, which should have different considerations compared to the measures addressing standard bankruptcies. In "traditional" firm exits (bankruptcies), firm exits occur almost always in an involuntary fashion. In this setting, a sound resolution mechanism should be implemented to help facilitate firm exits, while minimizing the costs associated with firm exits. In this process, private banks play a key role in screening and monitoring firms' performance, and in assessing whether a firm should stay in the market or exit by evaluating firms' financial performances, i.e. profitability and productivity. However, in the case of voluntary exits, a resolution mechanism that facilitates bankruptcies may not be useful, especially when firms considering voluntary exits are healthy ones. Furthermore, measures that matter for bankruptcy decisions (such as profitability and productivity) may play a less important role in the CEO's decision to close a business. Firm characteristics, the characteristics of CEOs, such as the age of CEOs, and the likelihood of finding business successors will play a more prominent role in the decision-making process of CEOs in deciding whether to exit voluntarily or continue their businesses. In such cases, to what extent private banks can help ensure efficient voluntary exits is not straightforward. What is equally important is to establish an efficient market mechanism that reduces search frictions that prevent the CEOs from finding suitable business successors. Absent such a market mechanism that enables matching between the retiring CEOs and their potential successors, voluntary exits of potentially healthy firms could arise if the costs of searching exceed the benefits of finding successors and continuing business.

Another important feature of firm exits in Japan, regardless of the exit type, is that firm exits could result in non-negligible spillover effects due to a highly interconnected firm supply network (Bernard, Moxnes, and Saito (2019), Hong et al. (2020)). The exit of a firm, whether it be a voluntary exit or a bankruptcy, could therefore trigger an exit (or exits) of other companies connected through the inter-firm supply network. In our analysis, the exact magnitude of such propagation effects of a firm's exit differs across industries and also depends on the location of firms.

These findings highlight the importance of addressing structural issues of Japanese firm exits related to demographic trends, as those issues will only strengthen in the future with a shrinking and aging population. According to the *2017 White Paper on Small and Medium Enterprises in Japan* published by the Small and Medium Enterprise Agency (SMEA), one third of the CEOs of Japanese medium-sized firms mentioned 'cannot secure successor' as a reason that could make them consider business closure. This was the second-highest response by CEOs for considering closing their business.[5] When the survey was conducted specifically for small firms, challenges in

[5] The number one reason for considering business closure in the same survey was "poor earnings."

finding a successor was the number one reason for considering business closure, with nearly half of the respondent firms checking 'cannot secure successor.' The same survey conducted for 2018 also reported that nearly half of the CEOs over 60 years old have not determined who will succeed them (SMEA 2018).

This study contributes to several strands of the literature. First, the paper contributes to a large literature that discusses the determinants of firm growth and the importance of business dynamism in aggregate productivity and employment. Studies highlight the importance of business dynamism as a source of growth (Davis et al. 2007), focusing on the importance of looking at firm age distribution to understand implications for aggregate productivity and employment (Hsieh and Klenow, 2014). Fujii, Saito, and Senga (2017) demonstrate that younger firms create more jobs than older firms in Japan, and the existence of unproductive old firms suggests inefficiency in firm dynamism. Second, there is a growing literature that analyzes the importance of inter-firm networks in firm growth and the propagation of shocks. For instance, Bernard, Moxnes, and Saito (2019) show that an increased connectivity through transportation, namely, the Kyushu Shinkansen line, led to firm growth. Also, Fujii, Saito, and Senga (2017) shows that the relationship between transaction network and firm growth differs by firm age, highlighting the importance of building appropriate transactional relationship for younger firms. Recent studies also focus on how inter-firm network serves to amplify macroeconomic fluctuations. As observed during the Global Financial Crisis (GFC) and large-scale natural disasters, the propagation of micro-level shocks could generate macroeconomic fluctuations (Acemoglu et al. 2012; Carvalho 2014; Ogura, Okui, and Saito 2015; and Carvalho et al. 2017). While these studies mainly pay attention to effects of repercussions of temporary negative shocks, the findings also suggest that propagation of positive shocks could promote firm growth, spreading inter-firm network and contribute to macroeconomic growth. It is therefore worth considering policies that initiate macroeconomic growth by making use of inter-firm networks. Third, this study contributes to the literature on "zombie firms" issues in Japan. The low exit rate of Japanese firms is well-documented in the literature (Caballero, Hoshi, and Kashyap 2008; Fukuda and Nakamura 2011; Imai 2016; and Goto and Wilbur 2019). The congestion created by zombie firms reduces the profits of healthy firms, which distorts efficient resource allocation by discouraging entry and investment of potentially healthier and more productive firms.[6] Finally, this paper contributes to the relatively under-researched area of firm exit patterns. Studies focus on distressed firms and how different types of exits (bankruptcy, voluntary liquidation, and M&A) are suitable for firm characteristics. Harhoff, Stahl, and Woywode (1998) and Prantl (2003) consider different types of exits, while Bhattacharjee et al. (2009) and Balcaen et al. (2012) focus on the exit process of old and mature firms, as opposed to young firms. Doi (1999) studies the determinants of firm exits focusing on the Japanese manufacturing firms from 1981 to 1989. Our study contributes to this literature by exploring a unique phenomenon in Japan where voluntary exits are not necessarily related to the financial health of firms, but to business succession.

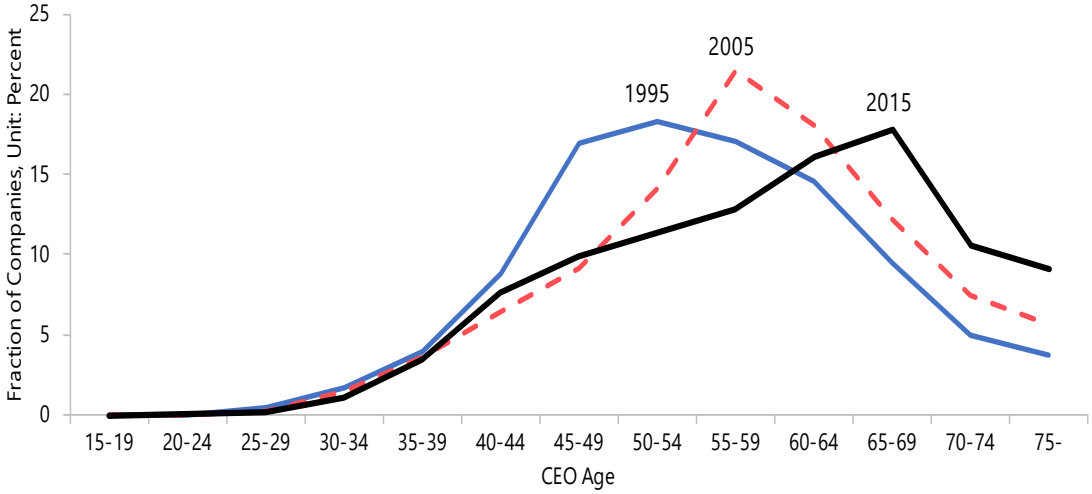
[6] See Davis et al. (2007) and Haltiwanger, Jarmin, and Miranda (2011, 2012) for the importance of firm age and aggregate productivity and employment.

The paper is organized as follows. Section 2 describes the importance of business succession issues in Japan in the context of an aging and shrinking population. Section 3 describes the data sets used for our analysis. Section 4 discusses the changing patterns of firm exits in Japan and the factors driving these trends, including aging CEOs and business succession issues. Voluntary exit patterns are extensively discussed. Section 5 shows the empirical results on the impact of a firm's exit on other firm's performance and exit patterns, when firms are connected in a production network. Section 6 discusses recent government policies adopted to address voluntary firm exit issues in Japan and concludes with some policy implications.

II. Aging Society and Business Succession in Japan

Managers in Japan are aging (Figure 1). The peak of the CEO age distribution for Japanese small- and medium-sized enterprises (SMEs) has shifted to the right during the last two decades. In 1995, the age group that had the largest share of CEOs was the age group between 50 to 54 years. In 2015, it was the age group between 65 to 69 years that had the largest share of CEOs. The fraction of companies having CEOs over 65 years old in 2015 was 37 percent, which was nearly two times larger than the fraction of 18 percent in 1995.[7]

Figure 1. CEO Age Distribution for Japanese SMEs



Source: 2019 White Paper on Small and Medium Enterprises in Japan.

Note: The figure displays the percentage of small and medium-sized companies with CEO age in each of the respective bins.

According to the survey by the SMEA (2017), not being able to find business successors is mentioned as a serious threat to business transition. Japanese companies cited aging or aging-related challenges as key reasons for considering business closure. Nearly a third of medium-sized companies who participated in the survey reported 'cannot secure successor' as the second important reason for considering exits, followed by 'poor earnings'. Relatedly, about one in five companies (22.7 percent) reported 'getting old (physical strength/judgement declining)' as the

[7] We obtain similar results to these when using the Tokyo Shoko Research (TSR) data for 2015. The peak of the CEO age distribution is the age group between 65 to 69 years.

reason for considering business closure. For small firms, nearly half of the respondent firms checked 'cannot secure successor' as the number one reason which would make firms consider business closure. Using the TSR data, we confirm that business owners in Japan are aging in the sample of firms covered (see Section 3 for data descriptions). The average age of CEO for the firms observed in the data is 61 years old for the 2017 data. The fraction of companies having CEOs who are over 65 years of age was as high as 41 percent. There is little difference across industries in terms of the average age of CEOs, with the construction sector having the youngest average age of 60 years, and the wholesale sector having the oldest average age of 62 years (Annex I).

III. DATA DESCRIPTION

For our analysis, we draw upon the data set provided by Tokyo Shoko Research, LTD (TSR, hereafter). This is a rich longitudinal firm-level data for both listed and unlisted Japanese firms. The TSR data consists of firm information and transactional relationship information at annual frequency. It covers about 1.2 million Japanese firms from 2007 to 2017.

Firm information includes the basic information for each firm, including industry classification (Japanese Standard Industrial Classification 4-digit), address of the firm, number of employees, total sales amount, the year of establishment, CEO's name and his/her birth date. Transactional relationship information includes a list of firms that serve as suppliers (upstream firms) and customers (downstream firms) of each firm, each up to 24 companies.[8] About 91 percent of total firms are small and medium-sized enterprises (SMEs) in the 2017 data set.[9,10] Importantly, the data set contains information on firm exits. For the firms that exited, the TSR provides information how a firm exited, i.e. type of firm exits, which can be categorized into three groups: *tosan* (bankruptcy), *gappei* (merger), and voluntary exit.[11,12]

Although the TSR data does not cover the universe of firms in Japan, it resembles closely the distribution of the Census data in terms of geographic coverage and firm size. We show this by comparing the distributions of firms by prefecture and by firm size using both the TSR data and

[8] See Carvalho et al. (2017) and Bernard, Moxnes, and Saito (2019) for more details on TSR data.

[9] For retail industry, we define a firm to be an SME if total number of employees is less than 50 persons. For wholesale and service industry, we define a firm to be an SME if total number of employees is less than 100 persons. For the rest, including manufacturing, transportation and all other categories not mentioned above, we define a firm to be an SME if total number of employees is less than 300 persons.

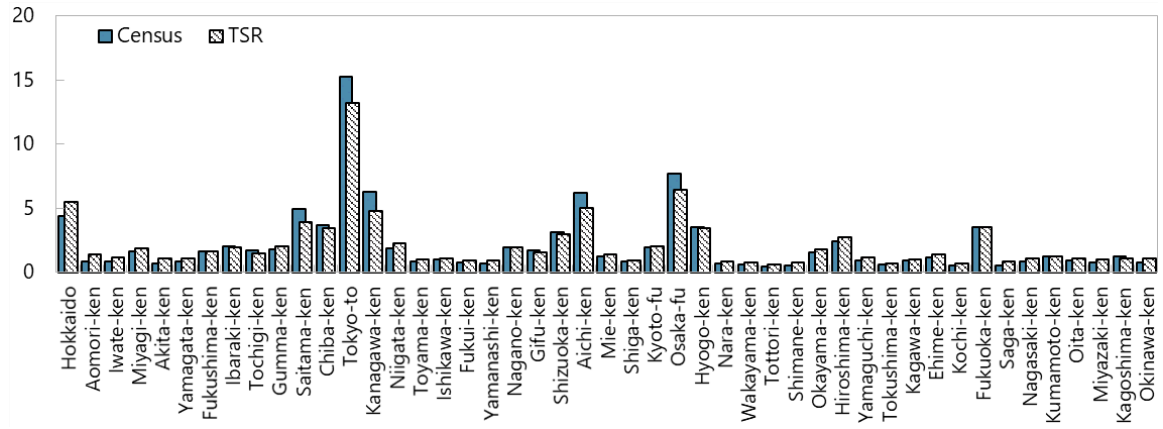
[10] The definition of an SME by the Ministry of Economy, Trade and Industry differs across industries. For wholesale trade industry, an SME is a company whose capital or total amount of investment does not exceed ¥100 million or hires less than 100 employees. For service industry, an SME is a company that has capital or investment that does not exceed ¥50 million or has less than 100 employees. For retail industry, an SME is a company that has capital or investment that does not exceed ¥50 million or hires less than 50 persons. For the rest of the industry including manufacturing, construction and transportation, an SME is a company whose capital or total amount of investment does not exceed ¥300 million or hires less than 300 persons.

[11] The TSR data distinguishes three different types of voluntary exits: *kyugyo* (temporarily suspension of business), *haigyo* (business closure), and *kaisan* (dissolution of company).

[12] TSR also includes credit rating scores, ranging from 1 to 100; 1 denotes the highest default risk and 100 denotes the lowest default risk, based on various source of information including firm's balance sheets, age, network, governance, and other qualitative information.

the Census data. Figure 2 displays the fraction of firms in each of the 47 prefectures as of October 1, 2016. The Census data come from the 2016 Economic Census for Business Activity conducted by the Statistics Bureau of Japan. The percentage figures based on the TSR dataset are nearly equal to those based on the Census survey for many prefectures. Exceptions include Tokyo, Kanagawa, Osaka, Aichi, and Hokkaido, where there exist small differences ranging from 1 to 2 percentage points between the TSR and Census survey.

Figure 2. Comparison of Geographical Distribution: Census Data vs. TSR Data



Sources: Statistics Bureau of Japan, Tokyo Shoko Research, LTD and authors' calculations.

Note: The figure plots the percentage of firms in each of the 47 prefectures in Japan in 2016. Census denotes the 2016 Economic Census for Business Activity. TSR denotes the 2016 TSR dataset.

Furthermore, Table 1 compares the distribution of firms by firm size using the Census survey and the TSR dataset. The firm size distribution of the TSR data closely resembles that of the Census data. The largest gaps are found for micro-enterprises where the number of employees per firm is less than 10 persons. However, if we adopt an alternative grouping of these firms (for instance, less than 10 employees), the gap between the two datasets decreases.

Table 1. Comparison of Firm Size Distribution: Census Data vs. TSR

	Number of Employees									
	0-4	5-9	10-19	20-29	30-49	50-99	100-299	300-999	1000-1999	2000-
Census	56.2	17.5	11.8	4.7	3.9	3.0	2.0	0.6	0.1	0.1
TSR	49.3	21.6	13.3	4.9	4.2	3.3	2.4	0.8	0.1	0.1

Sources: Statistics Bureau of Japan, Tokyo Shoko Research, LTD and authors' calculations.

Note: The table reports the percentage of firms with the number of employees in each of the respective bins in 2016. Census denotes the 2016 Economic Census for Business Activity. TSR denotes the 2016 TSR dataset.

IV. Changing Patterns of Japanese Firm Exits

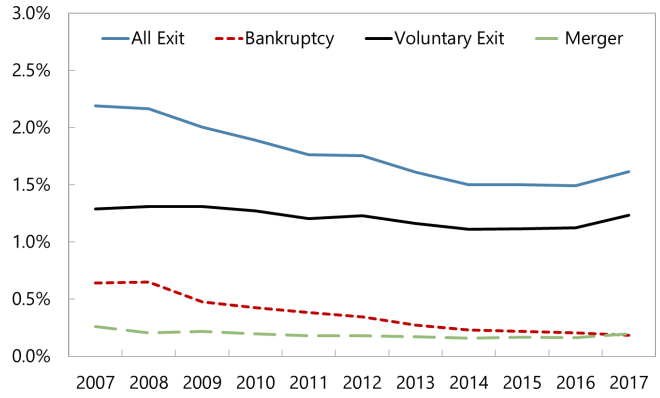
In this section, we document several facts about the changing patterns of firm exits by Japanese firms and how an aging society can help explain these trends.

A. Exit Patterns of Japanese SMEs

It is well-documented that the exit rate of Japanese firms is low compared to other countries (OECD, 2017; Colacelli and Hong, 2019). The SMEA (2019) reports that the firm exit rate in Japan is 4 percent, whereas firm exit rates are close to 10 percent in the United States and the United Kingdom in 2011. In the TSR data, the firm exit rate is around 2 percent in 2017 (Figure 3).[13] This is well below the target of 10 percent under Japan's Revitalization Strategy. Contrary to the policy initiative, we find that firm exit rates have continued to slide since the beginning of the sample, although it began to increase mildly since 2016. We find that this recent upward trend in firm exit rates is driven by an increase in voluntary exits. On the other hand, exits due to bankruptcy have declined steadily since 2008, while exits due to merger have the lowest ratio and remained constant (and close to zero) throughout the sample period.

Figure 3. Evolution of Firm's Exit Rates by Exit Type

Japan: Firm Exit Rates by Exit Type



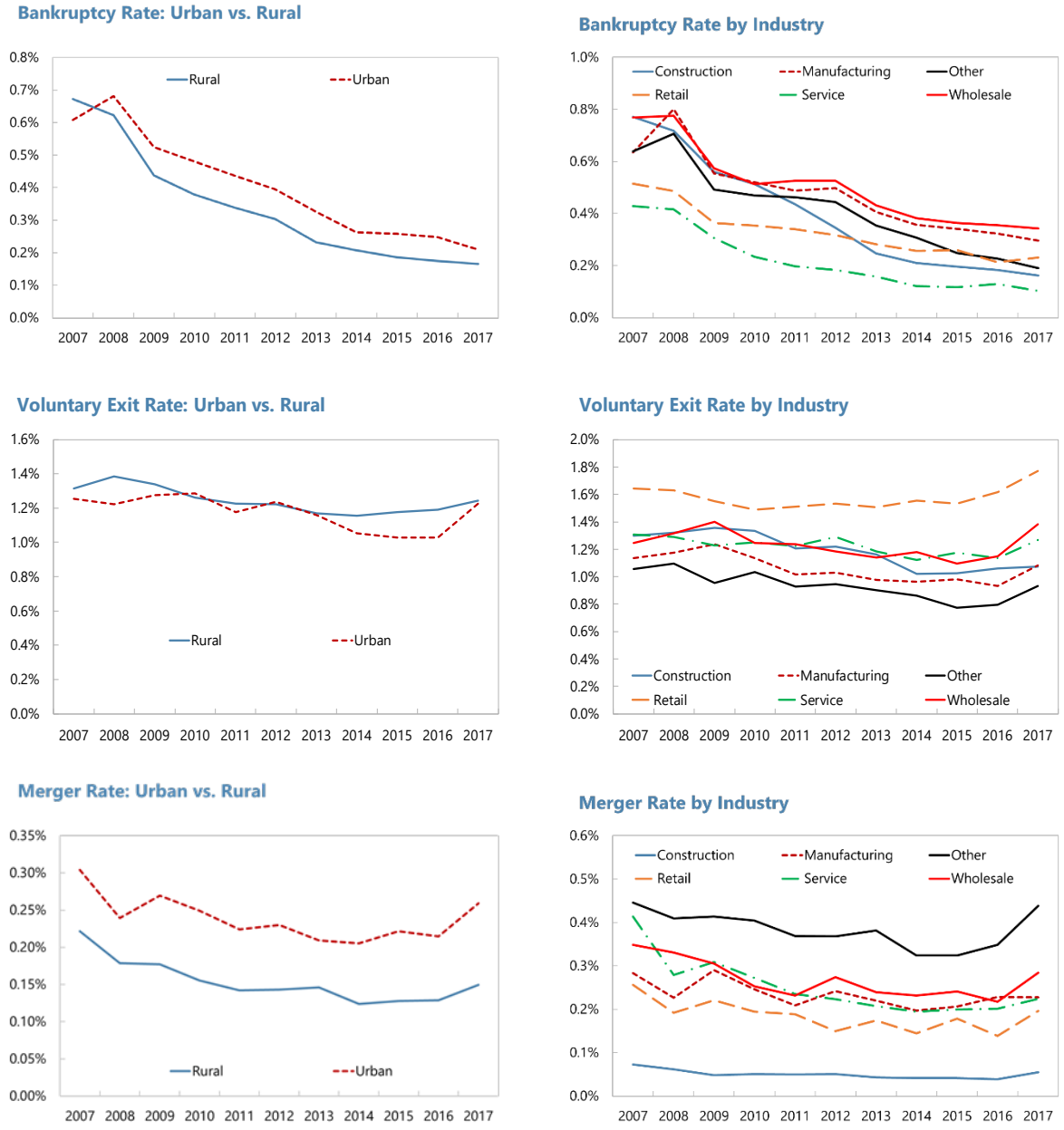
Source: Tokyo Shoko Research, LTD

Note: Each line represents firm's exit rates by exit type for a given year. X-axis represents years. Y-axis represents firm's exit rate in percent.

Figure 4 compares the changes in exit rates over time by region and industry for each type of firm exit. First, the share of firms that exited due to bankruptcy declined steadily for both rural and urban areas and for all sectors. The bankruptcy rate is slightly higher for urban areas than for rural areas, but the difference is marginal.

[13] Firm exit rates are calculated as total number of firms that exited from October (current year) to September (following year) out of total number of firms at the beginning of October for each year.

Figure 4. Exit Types by Region and Industry



Source: Tokyo Shoko Research, LTD

Note: For the left, each line represents exit rates (by type) by urban and rural area. For the right, each line represents exit rates (by type) by industry. For all charts, x-axis represents years and y-axis represents exit rates (by type) in percent.

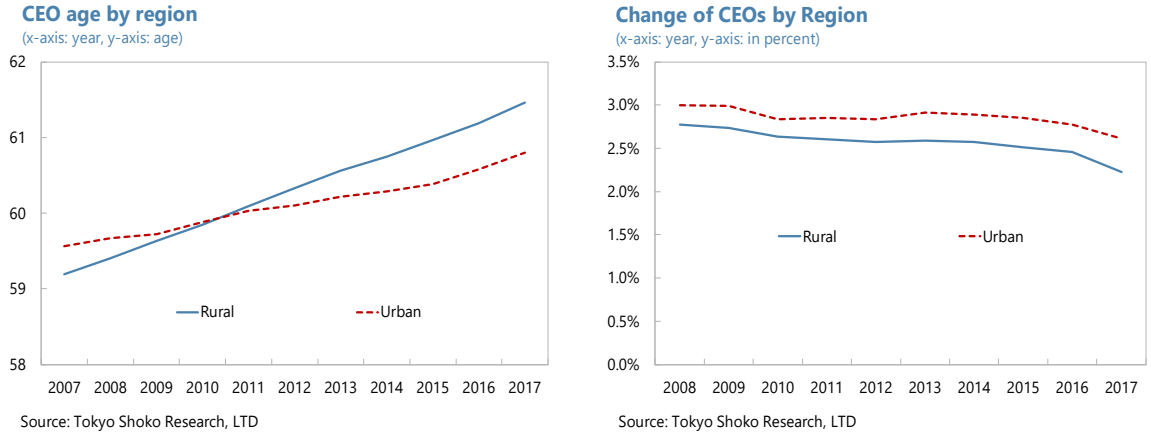
On the other hand, the share of firms that exited due to voluntary exits and merger have increased in recent years for all regions and sectors. Firms in rural areas have an equally high ratio of exiting voluntarily as those in urban areas. Across sectors, firms in all sectors excluding construction industry had higher voluntary exits in 2017 compared to 2016. Firms in retail sectors have the highest ratio of voluntary exits throughout the sample period, while firms in manufacturing sectors exhibit relatively low ratio. In contrast to the patterns observed for voluntary exits, we find that

there is an important regional difference when firms exit through merging. Firms in urban areas have higher share of merging compared to those in rural areas. In particularly, firms in wholesale and retail sectors exhibited a higher ratio of exiting through merging in 2017 compared to 2016, while firms in construction sectors had a very low rate of merger. Despite the recent uptick in merger, the level of firm exits due to merger remains at a very low level.

B. CEO Age, Business Succession and Voluntary Exits

In this subsection, we look at an important proximate factor that could help explain an upward trend in voluntary exits in recent years, namely, the age of CEOs. We observe some regional differences in terms of the evolution of average age of business owners. Until 2010, the average age of CEOs was higher for urban areas when compared to rural areas.[14] Since then, the order has reversed and in 2017, the average age of business owners in rural areas is 61.5 years, compared to 60.8 years for urban areas (Figure 5, left chart). This reversal is consistent with the fact that the population is aging more rapidly in rural areas than in urban areas. In addition to the general demographic trends, we also find that firms in rural areas are less likely to change their business owners, compared to the firms in urban areas (Figure 5, right chart). For both urban and rural areas, Japanese firms show very low rate of change in their CEOs (2.2 percent for rural areas, 2.6 percent for urban areas in 2017). As the change of CEOs often implies a replacement of older business owners with younger managers, the average age of business owners is likely to be negatively correlated with the ratio of changing business owners.

Figure 5. CEO Age and Change of CEOs by Region



Source: Tokyo Shoko Research, LTD

Source: Tokyo Shoko Research, LTD

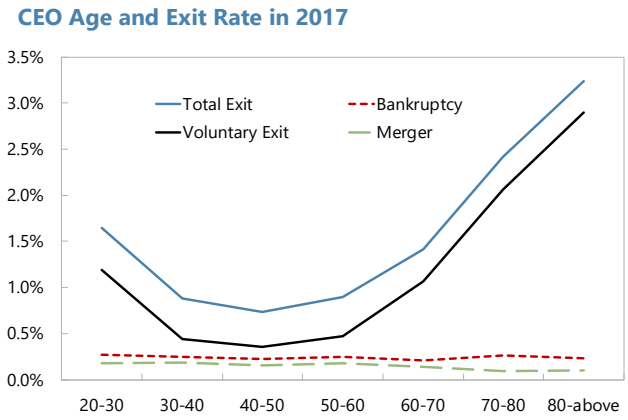
Note: For the left chart, each line represents the average age of CEOs for each year for rural and urban areas. For the right chart, each line represents the percent of firms that changed CEOs by rural and urban area. For both charts, x-axis represents years.

Then, how is the age of CEO related to voluntary exits? Using the information on firm exits and the age of CEOs for each firm in the TSR data, we find a strong and positive correlation between the age of CEOs and voluntary exit rates, with voluntary exits reaching above 2 percent for CEOs aged between 70-80 years and about 2.5 percent for CEOs aged above 80 years old (Figure 6).

[14] Throughout the paper, 'urban' areas include the following prefectures: Tokyo, Kanagawa, Chiba, Saitama, Aichi, Osaka and Kyoto prefectures. All other prefectures are 'rural' in this paper.

Interestingly, this positive correlation between exit rate and age of CEOs is observed only for voluntary exit, and not for other types of exits (such as bankruptcy and merger).

Figure 6. Exit Rate by CEO Age

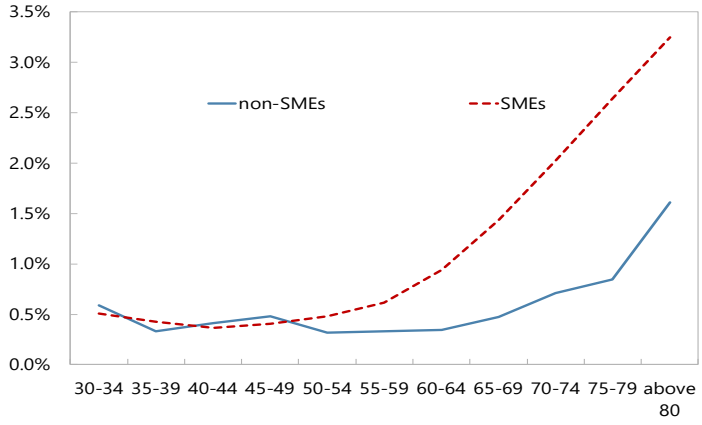


Source: Tokyo Shoko Research, LTD

Note: Each bin in the x-axis represents age group of CEOs. Y-axis represents firm exit rates by exit type for each age group (in percent). The data used is the 2017 sample of the TSR data.

Furthermore, we find that the correlation between the CEO age and voluntary exit ratios is stronger for SMEs than non-SMEs (Figure 7). There does not exist a significant difference between voluntary exit rates for SMEs and those for non-SMEs until below 50 years of age. However, the voluntary exit rate rises more rapidly for SMEs compared to non-SMEs from the age of 50 years. And for each age group above 50 years old, the positive correlation between voluntary exit rate and CEO age is higher for SMEs compared to non-SMEs. In other words, for the same age group, voluntary exit rates are higher for SMEs than for non-SMEs. For non-SMEs, voluntary exit rates rise mildly until above 75 years of age and picks up after that.

Figure 7. CEO Age and Voluntary Exit Rate: SMEs vs. non-SMEs

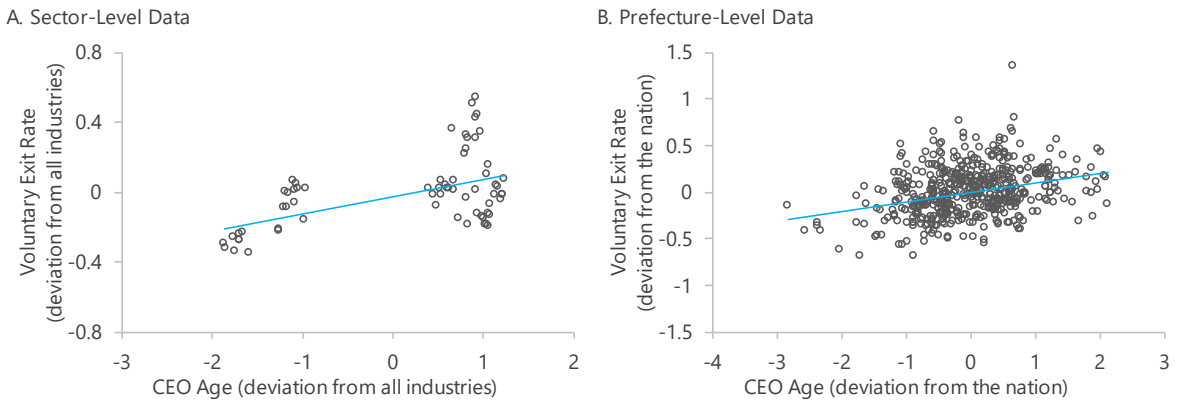


Source: Tokyo Shoko Research, LTD

Note: Each bin in the x-axis represents age group of CEOs. Each line represents voluntary exit rates by SMEs and non-SMEs. Y-axis is in percent. The data used is the 2017 sample of the TSR data.

Positive and strong correlations between the CEO age and voluntary exit rates are also confirmed using sector-level data and prefecture-level data (Figure 8). First, the sectoral-level correlation between the age of CEOs and voluntary exit rates is positive (correlation: 0.52). That is, the sector that has the average CEO age higher than that of all sectors tends to have higher-than-average voluntary exits. We also find a positive correlation at the prefecture-level (correlation: 0.31). Prefectures that have CEOs that are older compared to the average age across prefectures exhibit higher voluntary exit rates than the average rate across Japan.

Figure 8. Voluntary Exit Rate and CEO Age, Sector-Level and Prefecture-Level Data, 2007-17



Source: Tokyo Shoko Research, LTD

Note: For the left, each circle represents industry- and year-specific value. Six industries are considered: construction, manufacturing, wholesale, retail, service and others. Time horizon is from 2007 to 2017. X-axis represents the deviations of average CEO age of a sector from the average CEO age of all industries for a specific year. Y-axis plots the deviation of average voluntary exit rate of a sector from the average voluntary exit rate of all sectors for a specific year. For the right, each circle represents prefecture- and year-specific value. Time horizon is from 2007 to 2017. X-axis represents the deviations of average CEO age of a prefecture from the average CEO age of all prefectures for each year. Y-axis plots the deviation of average voluntary exit rate of a prefecture from the average voluntary exit rate of all prefectures for a specific year.

C. Declining Bankruptcy Rate and Zombie Firms

Here, we focus on firm exits from bankruptcies. A decline in bankruptcy rates over the sample period, in and of itself, does not ensure an improvement of financial conditions of Japanese firms. For instance, a decline in the bankruptcy rate may imply an improvement in the health of Japanese SMEs. If so, this would be reflected in the declining ratio of zombie firms (firms that are unable to cover debt servicing costs from current profits over an extended period). On the other hand, a decline in the bankruptcy rate combined with an increase in the share of zombie firms may imply a deterioration in the cleansing mechanism of the market.[15]

[15] Overly generous credit guarantee schemes provided to the SMEs has been cited as an important reason for low firm exit rates in Japan, creating an inefficient allocation of resources and discouraging investment and job creation (Caballero, Hoshi, and Kashyap 2008; OECD 2017; and IMF 2017, 2018, 2020).

In order to distinguish between the two possibilities, we adopt three different methodologies used in the literature to define a zombie firm: (1) Caballero, Hoshi, and Kashyap (2008, hereafter CHK); (2) Fukuda and Nakamura (2011, hereafter FN); and (3) Imai (2016).[16] CHK defines a zombie firm by creating a proxy for receiving subsidized credit, using estimates for reductions in interest payments. A firm is identified as a zombie firm if the actual interest payment is lower than the minimum required interest payment for a firm. On the other hand, FN adds additional two conditions: profitability and ever-greening. FN defines zombie firms as firms that fulfill the profitability criterion and meet at least one of the financial support criteria of interest payments (CHK) and evergreening. Finally, Imai (2016) follows the idea of FN, but uses a longer period to evaluate firm profitability. This helps to avoid the problems of misidentifying healthy firms as zombie firms if the healthy firms experience temporary profit declines, and misidentifying zombie firms as healthy firms if the zombie firms have temporary profit increase. The minimum required interest payment for each firm is defined as follows:

$$I^*_{i,t} = r^{short}_{t-1} * B^{short}_{i,t-1} + \left(\frac{1}{5}\sum_{j=1}^{5} r^{long}_{t-j}\right) * B^{long}_{i,t-1} + \min(r^{cb}_{t-5}, \dots, r^{cb}_{t-1}) * Bonds_{i,t-1}$$

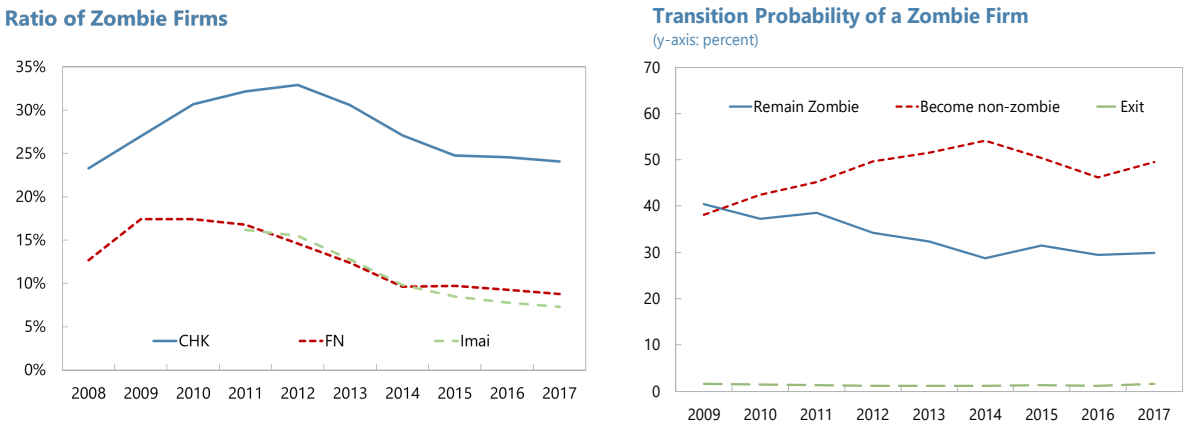
where $I^*_{i,t}$ is the minimum required interest payment for firm *i* in year *t*, r^{short}_t is the short-term prime rate in year *t*, r^{long}_t is the long-term prime rate in year *t*, $\min(r^{cb}_{t-5}, \dots, r^{cb}_{t-1})$ is the minimum coupon rate observed on any convertible corporate bond issued in the last five years before year *t*. $B^{short}_{i,t}$ refers to short-term borrowing from banks for firm *i* at the end of year *t*, $B^{long}_{i,t}$ refers to long-term borrowing from banks for firm *i* at the end of year *t*, and $Bonds_{i,t}$ is total issued amount of corporate bonds for firm *i* at the end of year *t*. CHK defines a firm to be a zombie firm if $I^*_{i,t} > I_{i,t}$, where $I_{i,t}$ is actual interest paid by firm *i* in year *t*. FN defines a firm to be a zombie firm if $I^*_{i,t} > EBIT_{i,t}$ and $(B_{i,t} > B_{i,t-1}\ or\ I_{i,t} < I^*_{i,t})$. $EBIT_{i,t}$ denotes earnings before interest and taxes for firm *i* in year *t* and $B_{i,t}$ the amount of outstanding debt for firm *i* at the end of year *t*. Imai (2016) defines a firm to be a zombie firm if $\sum_{m=0}^{3}\left(EBIT_{i,t-m} - I^*_{i,t-m}\right) < 0$ and $(B_{i,t} > B_{i,t-1}\ or\ I_{i,t} < I^*_{i,t})$.

First, while the exact magnitude of the share of zombie firms depend on which definition we adopt, regardless of the definitions that we use, we observe that the share of zombie firms declined over the years (Figure 9, left figure). CHK zombie ratio peaked in 2012, suggesting the impact from decreasing interest rates since the Abenomics. FN zombie ratio peaked in 2009, suggesting that the ratio of zombie firms increased during the Global Financial Crisis. Given the limited sample period, Imai zombie ratio starts only in 2011, where we observe a continued decline over the years since the first observation. The share of zombie firms ranges from 5 percent (Imai) to 25 percent (CHK) for 2017. The share of zombie firms using CHK is nearly five times higher than those using FN and Imai, as CHK does not impose any filtering of zombie firms based on firm profitability. As a

[16] Adalet McGowan, Andrews, and Millot (2017) defines a zombie firm as a firm where the interest coverage ratio (ICR) has been less than one for at least three consecutive years and if a firm is at least five years old. Banerjee and Hofmann (2018) adds another criterion based on a firm's growth potential by comparing Tobin's q and the median Tobin's q of the sector.

result, the CHK definition generates an upward bias during the low interest environment, as the CHK is more suitable in defining a zombie firm in the context of bank non-performing loan issues and forbearance lending practices in 1990s. As a result, our preferred methodology is FN, as Imai's definition constrains the data coverage. This finding that the share of zombie firms has been declining in recent years supports the view that the health of Japanese SMEs, on average, has improved.[17] Zombie firms which remain a zombie in the next period has been declining over the years, stabilizing at around 30 percent in 2017. On the other hand, more than half of zombie firms became non-zombie firms in the following period (Figure 9, right figure).

Figure 9. Share of Zombie Firms and Transition Probability



Source: Tokyo Shoko Research, LTD

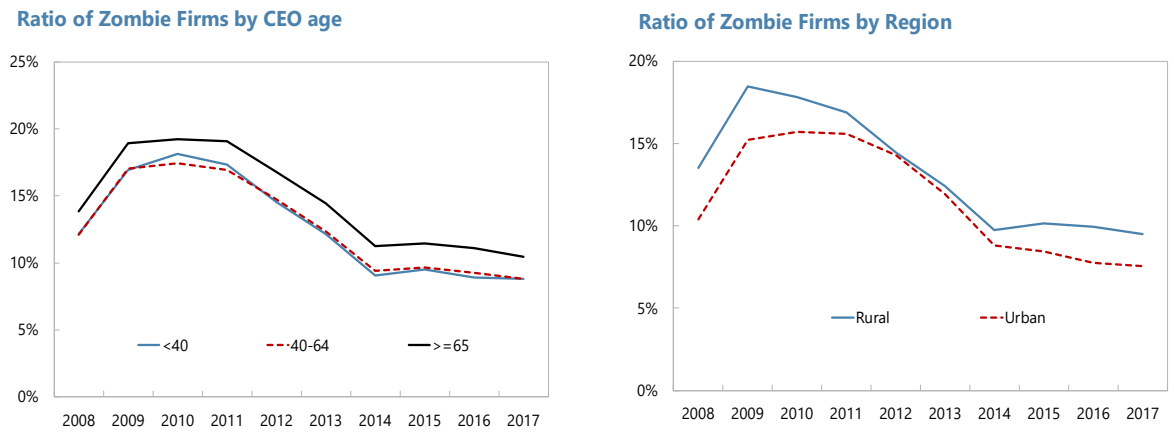
Note: For the left chart, 'CHK' uses the zombie definition by Caballero, Hoshi, and Kashyap (2008), 'FN' uses the definition by Fukuda and Nakamura (2011), and 'Imai' uses the definition by Imai (2016). Y-axis refers to the ratio of zombie firms. For the right chart, y-axis refers to the transition probability at time t, conditional on the fact that a firm was a zombie firm at time t-1. For both charts, x-axis refers to the years.

Interestingly, firms with older CEOs have a higher ratio of zombie firms (Figure 10, left chart). Studies show evidence that older CEOs invest less in productivity-enhancing investment, take less risks when they become older, and such behavior leads to lower firm's productivity growth (Barker and Mueller 2002; Campbell, Jeong, and Graffin 2019). Another feature that could explain this correltion is the sticky relationship between firms and between banks and firms (Hong, Ogura, and Saito 2019) that could often prevent efficient matching between banks and firms. That is, older CEOs who have long-term business relationships with banks may have access to funds based on the relationship, rather than on firms' financial performance.

In addition, we find that the ratio of zombie firms in rural areas has been higher than those in urban areas. This finding is unsurprising considering the fact that population aging is happening more rapidly in rural areas.

[17] Using firm-level data for 14 advanced economies, mostly covering European countries, Banerjee and Hofmann (2018) suggest that low interest rates drove up the share of zombie firms and resulted in low productivity. We do not find support for these findings for Japanese firms.

Figure 10. Ratio of Zombie Firms Using FN: by CEO Age and Region



Source: Tokyo Shoko Research, LTD

Note: The definition of a zombie firm follows Fukuda and Nakamura (2011). X-axis refers to the years. The y-axis of the left chart shows the ratio of zombie firms by age group of CEOs at each year. The y-axis of the right chart is the ratio of zombie firms in rural and urban areas.

V. Business Succession, Voluntary Exits and Spillovers

In this section, we conduct empirical analyses to assess the propagation impact of a firm's exit through inter-firm transaction network. First, we investigate how a firm's exit affects business performances and behaviors for its partner companies, such as sales growth and formation of networks. Second, we explore how a firm's exit affects the likelihood of an exit of its partner companies. Finally, we explore the determinants of each exit type and make a comparison across different exit types.

A. Impact of Firm Exit on Partner Firms' Business Activities

We run an OLS regression to estimate the impact of a firm's exit on business activities for its partner firms. In particular, we are interested in sales growth and network formations, separating upstream linkages from downstream linkages. The regression specification is as follows:

$$Y_{i,r,s,t} = \alpha_s + \alpha_r + \alpha_t + \beta MEANEXIT^h_{i,t-1} + \gamma X_{i,r,s,t} + e_{i,r,s,t}.$$

$Y_{i,r,s,t}$ is a variable of interest for firm i, located in prefecture r, operating in industry s for year t. In this section, we look specifically at sales growth, new supplier connections, and new consumer connections. $MEANEXIT^h_{i,t}$ is a measure of the average exit rate of business connections of firm i for year t. It is defined as:

$$MEANEXIT^h_{i,t} = mean\left(Exit^h_{i,j,t}\right).$$

$Exit^h_{i,j,t}$ is an indicator function that equals one if a partner company j of firm i exits in year t and otherwise equals zero. The type of exit, h, can take three different forms: bankruptcy, merger, and

voluntary exit. A partner company can be either a supplier or a consumer, and we take two cases separately.

$X_{i,r,s,t}$ denotes a control variable. Variables include firm age, CEO age, number of consumer connections, number of supplier connections, number of employment (all in log terms so far), and a dummy variable for the change of CEO. Fixed effects for industry (s), prefecture (r) and year (t) are included.

Table 2 shows the results. We find that exit of a partner company due to bankruptcy or voluntary exit negatively affects sales growth in the following period. The magnitude varies across exit types. A sudden and disruptive bankruptcy has a larger negative impact on sales growth. In column (1), a one-fifth of one percent increase in the variable of exit rate of business connections drops sales in the following period by 0.59 percent (=1/5*-0.0297*100) in the case of supplier bankruptcy and by 0.55 percent (=1/5*-0.0278*100) in the case of consumer bankruptcy. Compared to bankruptcy, voluntary exit leads to a smaller decline in sales growth. A one-fifth of one percent increase in the variable of exit rate of business connections lowers sales in the following period by 0.26 percent (=1/5*-0.0133*100) for supplier voluntary exit and by 0.25 percent (=1/5*-0.0125*100) for consumer exit. Interestingly, when a partner, whether it be supplier or consumer company, exits through merger, sales growth in the following period is positively affected. This could be due to various endogenous factors. For instance, firms whose partners will go through merger may be profitable firms to begin with. Also, given everything else equal, through merger, existing firms can benefit from an expansion in network of 'new' partner.

Table 2. Growth of Sales, Network Creations when a Partner Company Exits

	(1)	(2)	(3)
VARIABLES	dlnsales	indeg_new	outdeg_new
lnage	-0.0220***	-0.305***	-0.253***
	(0.000369)	(0.00771)	(0.0109)
lnage_exe	-0.0467***	0.622***	0.285***
	(0.000964)	(0.0155)	(0.0155)
d_change_exe	-0.0104***	0.328***	0.227***
	(0.00105)	(0.0311)	(0.0322)
lnindeg	-0.00308***	1.453***	0.272***
	(0.000268)	(0.0186)	(0.00696)
lnoutdeg	0.00253***	0.127***	1.185***
	(0.000220)	(0.00794)	(0.0127)
lnemp	0.0146***	0.578***	0.348***
	(0.000208)	(0.00533)	(0.00449)
supplier bankruptcy (t-1)	-0.0297***	0.917***	0.00362
	(0.00727)	(0.0308)	(0.0358)
consumer bankruptcy (t-1)	-0.0278***	0.0454	0.668***
	(0.00630)	(0.0349)	(0.0269)
supplier merger (t-1)	0.00884**	0.569***	-0.0476**
	(0.00388)	(0.0206)	(0.0219)
consumer merger (t-1)	0.0351***	-0.0677	0.171***
	(0.00661)	(0.0672)	(0.0333)
supplier voluntary exit (t-1)	-0.0133**	0.444***	0.110***
	(0.00578)	(0.0254)	(0.0308)
consumer voluntary exit (t-1)	-0.0125**	0.268***	0.846***
	(0.00610)	(0.0334)	(0.0277)
Constant	0.277***	-3.796***	-1.774***
	(0.00494)	(0.0754)	(0.0613)
Observations	2,862,101	3,582,570	3,582,570
R-squared	0.025	0.110	0.094

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. 'lnage', 'lnage_exe', 'lnindeg', 'lnoutdeg' and 'lnemp' indicate age of firms, age of CEOs, number of inbound inter-firm connections (suppliers), number of outbound inter-firm connections (consumers) and total employment of the firm, respectively, all in natural logs. 'd_change_exe' is a dummy variable which takes value 1 if the firm changed CEOs for time t, and 0 otherwise. Left-hand side variables include 'dlnsales', 'lnindeg_new' and 'lnoutdeg_new', indicating sales growth, natural log of *new* inbound firm-connections (suppliers) and *new* outbound firm-connections (consumers), respectively. Fixed effects for industry, prefecture and year are included.

An exit of a partner company is associated with building new connections, for all exit types. In fact, a clear pattern emerges that an exit of a supplier leads to finding new suppliers and not consumers. Finally, we observe that sales growth and new network creation are negatively correlated with the age of CEO and firm age. Perhaps, relatedly, the change of CEOs (d_change_exe) is positively correlated with both 'lnindeg_new' and 'lnoutdeg_new,' suggesting that new CEOs (who are likely to be younger than the CEO he/she replaced) search for new connections.

B. Impact of Firm Exit on Partner Firm's Exit

Now, we assess the spillover effects of an exit of a firm on its partner firms' exits through inter-firm transaction network. To do so, we use a probit regression to estimate the likelihood of an exit of its business connection when a firm exits. Specifically, we consider the following regression model:

$$Exit_{i,r,s,t} = \Phi\left(\alpha_s + \alpha_r + \alpha_t + \beta MEANEXIT^{h}_{i,t-1} + \gamma X_{i,r,s,t} + \varepsilon_{i,r,s,t}\right).$$

$Exit_{i,r,s,t}$ denotes an indicator function that equals one if firm *i*, located in prefecture *r*, operating in industry *s* exits in year *t* and equals zero otherwise. We also explore the effects of business connections exits on a firm exit through bankruptcy, voluntary exit, and merger to see if propagation characteristics differ by exit type. To this end, we run probit regressions with the dependent variable of $Exit_{i,r,s,t}$ separately for bankruptcy, voluntary exit, and merger. $MEANEXIT^{h}_{i,t-1}$ is a measure of an exit rate of business connections of firm *i,* defined in the same way as in the previous section. Control variables, $X_{i,r,s,t}$, include firm age, CEO age, number of consumer connections, number of supplier connections, number of employment (all in log terms so far), sales growth, and a dummy variable for the change of CEO. Fixed effects for industry (*s*), prefecture (*r*) and year (*t*) are included.

We report our findings in Table 3. Table 3 shows that regardless of the industry, firm exits are negatively correlated with the CEO age, implying that firms with older CEOs have a higher likelihood of exits. Looking at individual exit type, we find that bankruptcy of a partner company, whether it be supplier or consumer company, increases the likelihood of a firm's exit, as shown by positive and significant coefficients on supplier bankruptcy and consumer bankruptcy. On the other hand, voluntary exits are positively associated with partner firms' exits only when suppliers exit, while voluntary exits of a consumer company do not have spillover effects. We find this result to hold for both manufacturing and non-manufacturing sectors. Finally, as a firm exiting through merger does not result in additional exits of partner companies, as exiting through merger, unlike other types of exits, is not a real exit in the sense that firms do not disappear from the market. Therefore, the exit by merger does not have any impact on the exit probability of its partners.

Table 3. Manufacturing vs. Non-manufacturing

	(1)	(2)	(3)
VARIABLES		Exit Dummy	
Industries	ALL	Manufacturing	Non-Manufacturing
lnage	-0.0602***	-0.0657***	-0.0582***
	(0.00340)	(0.00720)	(0.00389)
lnage_exe	0.600***	0.589***	0.603***
	(0.0111)	(0.0232)	(0.0127)
d_change_exe	0.169***	0.156***	0.173***
	(0.0102)	(0.0216)	(0.0117)
lnindeg	0.0202***	0.0184***	0.0222***
	(0.00279)	(0.00665)	(0.00309)
lnoutdeg	-0.0466***	-0.0709***	-0.0400***
	(0.00249)	(0.00581)	(0.00278)
lnemp	-0.100***	-0.0934***	-0.101***
	(0.00212)	(0.00433)	(0.00246)
dlnsales	-0.266***	-0.378***	-0.246***
	(0.00537)	(0.0136)	(0.00590)
supplier bankruptcy (t-1)	0.362***	0.233*	0.404***
	(0.0553)	(0.120)	(0.0623)
consumer bankruptcy (t-1)	0.288***	0.316***	0.283***
	(0.0499)	(0.116)	(0.0554)
supplier merger (t-1)	-0.0128	-0.0508	-0.0128
	(0.0430)	(0.124)	(0.0462)
consumer merger (t-1)	0.0636	0.127	0.0392
	(0.0483)	(0.0941)	(0.0569)
supplier voluntary exit (t-1)	0.240***	0.309***	0.215***
	(0.0521)	(0.106)	(0.0603)
consumer voluntary exit (t-1)	0.0897*	0.158	0.0750
	(0.0545)	(0.118)	(0.0616)
Constant	-4.536***	-4.382***	-4.555***
	(0.0561)	(0.129)	(0.0616)
Observations	3,393,380	766,646	2,616,115

Note: Standard errors in parentheses.: *** p<0.01, ** p<0.05, * p<0.1. See note in Table 2 for detailed description of the variables. Fixed effects for industry, year and prefectures are included.

Table 4 shows the results for the same regression as in Table 3, but for different sub-sectors of the non-manufacturing sector. Bankruptcy of a supplier company increases the likelihood of firm exits in the retail, wholesale, and construction sectors, while bankruptcy of a consumer company increases the likelihood of a partner company's exit for firms in the wholesale and construction sectors, but not for firms in the retail sector. As for voluntary exits, a company's exit is affected differently across different sectors depending on the supply chain relationship. For instance, a company in the retail sector has a higher probability of exiting if its consumer company exits voluntarily. On the other hand, a company in the wholesale sector has a higher probability of exiting if its supplier company exits voluntarily.

Table 4. Spillover from Partner Company Exit to Own Exit: Non-manufacturing Sectors

	(1)	(2)	(3)	(4)
VARIABLES		Exit Dummy		
Industries	Non-Manufacturing	Retail	Wholesale	Construction
lnage	-0.0582***	-0.0824***	-0.0625***	0.00217
	(0.00389)	(0.0127)	(0.00757)	(0.00672)
lnage_exe	0.603***	0.612***	0.646***	0.660***
	(0.0127)	(0.0464)	(0.0248)	(0.0197)
d_change_exe	0.173***	0.218***	0.177***	0.140***
	(0.0117)	(0.0453)	(0.0231)	(0.0202)
lnindeg	0.0222***	-0.0290**	-0.0402***	0.0603***
	(0.00309)	(0.0120)	(0.00645)	(0.00466)
lnoutdeg	-0.0400***	-0.0201**	0.00607	-0.0537***
	(0.00278)	(0.00989)	(0.00533)	(0.00480)
lnemp	-0.101***	-0.0515***	-0.110***	-0.153***
	(0.00246)	(0.00789)	(0.00500)	(0.00473)
dlnsales	-0.246***	-0.341***	-0.345***	-0.218***
	(0.00590)	(0.0310)	(0.0141)	(0.00834)
supplier bankruptcy (t-1)	0.404***	0.921***	0.355***	0.385***
	(0.0623)	(0.211)	(0.129)	(0.0906)
consumer bankruptcy (t-1)	0.283***	0.0567	0.286**	0.178**
	(0.0554)	(0.239)	(0.122)	(0.0764)
supplier merger (t-1)	-0.0128	0.163	-0.0329	-0.0545
	(0.0462)	(0.111)	(0.0939)	(0.0998)
consumer merger (t-1)	0.0392	0.366**	0.128	-0.0797
	(0.0569)	(0.171)	(0.114)	(0.104)
supplier voluntary exit (t-1)	0.215***	-0.0893	0.500***	0.139
	(0.0603)	(0.319)	(0.115)	(0.0855)
consumer voluntary exit (t-1)	0.0750	0.394**	-0.171	-0.0242
	(0.0616)	(0.188)	(0.128)	(0.0966)
Constant	-4.555***	-4.404***	-4.526***	-4.921***
	(0.0616)	(0.209)	(0.117)	(0.0858)
Observations	2,616,115	178,258	627,899	1,180,238

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. See note in Table 2 for detailed description of the variables. Fixed effects for industry, year and prefectures are included.

Results in Table 5 show a correlation between a partner company's exits and the likelihood of a company's exit through bankruptcy, for both manufacturing and non-manufacturing sectors. First, we find that bankruptcy has spillover effects in the sense that a partner company's bankruptcy is highly correlated with firm's exit through bankruptcy. This positive and significant correlation is observed bankruptcies of both supplier firms and consumer firms and the finding is true for both manufacturing and non-manufacturing firms. What is interesting is that voluntary exits of supplier firms in the network are also positively correlated with the bankruptcy of a firm. This is true for non-manufacturing companies only, as we find that a voluntary exit of a supplier company leads to a higher likelihood of bankruptcy.

Table 5. Spillover Effects from Partner Company Exit to Bankruptcy: Manufacturing vs. Non-manufacturing

	(1)	(2)	(3)
VARIABLES	Exit from Bankruptcy		
Industries	All	Manufacturing	Non-Manufacturing
lnage	-0.0558***	-0.0806***	-0.0498***
	(0.00502)	(0.0104)	(0.00577)
lnage_exe	0.135***	0.190***	0.116***
	(0.0157)	(0.0327)	(0.0180)
d_change_exe	-0.102***	-0.117***	-0.0961***
	(0.0177)	(0.0378)	(0.0202)
lnindeg	0.0777***	-0.00226	0.0937***
	(0.00411)	(0.00986)	(0.00455)
lnoutdeg	0.00478	0.0543***	-0.00187
	(0.00367)	(0.00875)	(0.00408)
lnemp	-0.0805***	-0.0796***	-0.0774***
	(0.00324)	(0.00657)	(0.00376)
dlnsales	-0.189***	-0.267***	-0.175***
	(0.00817)	(0.0204)	(0.00901)
supplier bankruptcy (t-1)	0.587***	0.483***	0.612***
	(0.0701)	(0.149)	(0.0798)
consumer bankruptcy (t-1)	0.503***	0.551***	0.493***
	(0.0633)	(0.152)	(0.0699)
supplier merger (t-1)	-0.0454	-0.272	-0.0214
	(0.0685)	(0.209)	(0.0731)
consumer merger (t-1)	0.0504	0.100	0.0436
	(0.0744)	(0.150)	(0.0865)
supplier voluntary exit (t-1)	0.244***	0.0956	0.272***
	(0.0782)	(0.172)	(0.0886)
consumer voluntary exit (t-1)	0.0184	0.110	0.00889
	(0.0865)	(0.190)	(0.0972)
Constant	-3.443***	-3.590***	-3.407***
	(0.0862)	(0.225)	(0.0936)
Observations	3,393,380	766,646	2,616,115

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. See note in Table 2 for detailed description of the variables. Fixed effects for industry, prefecture and year are included.

Table 6 shows the results obtained from performing the same regression analysis as in Table 7, but for different sub-sectors of non-manufacturing companies. Bankruptcy of suppliers increases the probability of a firm's bankruptcy in a statistically significant way for all types of non-manufacturing companies. The impact is largest for the firms in the retail sector, while smallest for the firms in the wholesale sector. On the other hand, bankruptcy of consumer increases the likelihood of a firm's bankruptcy for wholesale and construction sectors, but not for the retail sector. However, we also find evidence that voluntary exits to have propagation effects, as we find that voluntary exits of suppliers increase the likelihood of bankruptcy for companies in the wholesale and construction sector.

Table 6. Spillovers from Partner Company Exit to Bankruptcy: Non-manufacturing Sectors

	(1)	(2)	(3)	(4)
VARIABLES	Exit from Bankruptcy			
Industries	Non-Manufacturing	Retail	Wholesale	Construction
lnage	-0.0498***	-0.0294	-0.0606***	-0.0473***
	(0.00577)	(0.0212)	(0.0114)	(0.00911)
lnage_exe	0.116***	0.0720	0.210***	0.121***
	(0.0180)	(0.0730)	(0.0364)	(0.0261)
d_change_exe	-0.0961***	-0.0951	-0.149***	-0.0327
	(0.0202)	(0.0904)	(0.0441)	(0.0283)
lnindeg	0.0937***	0.0528***	0.0239**	0.136***
	(0.00455)	(0.0199)	(0.00993)	(0.00647)
lnoutdeg	-0.00187	0.000738	0.00563	0.00324
	(0.00408)	(0.0157)	(0.00809)	(0.00658)
lnemp	-0.0774***	-0.0605***	-0.0825***	-0.0597***
	(0.00376)	(0.0132)	(0.00759)	(0.00660)
dlnsales	-0.175***	-0.353***	-0.249***	-0.140***
	(0.00901)	(0.0465)	(0.0212)	(0.0126)
supplier bankruptcy (t-1)	0.612***	1.180***	0.492***	0.615***
	(0.0798)	(0.276)	(0.180)	(0.110)
consumer bankruptcy (t-1)	0.493***	-0.0153	0.451***	0.370***
	(0.0699)	(0.402)	(0.168)	(0.0943)
supplier merger (t-1)	-0.0214	-0.0358	-0.153	0.00429
	(0.0731)	(0.209)	(0.158)	(0.145)
consumer merger (t-1)	0.0436	0.0474	0.282*	-0.0763
	(0.0865)	(0.336)	(0.158)	(0.149)
supplier voluntary exit (t-1)	0.272***	-0.463	0.700***	0.221*
	(0.0886)	(0.664)	(0.156)	(0.122)
consumer voluntary exit (t-1)	0.00889	0.283	-0.208	0.0856
	(0.0972)	(0.316)	(0.207)	(0.132)
Constant	-3.407***	-2.907***	-3.481***	-3.344***
	(0.0936)	(0.324)	(0.177)	(0.113)
Observations	2,616,115	178,258	627,899	1,180,238

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 See note in Table 2 for detailed description of the variables. Fixed effects for industry, prefecture and year are included.

Table 7 uses voluntary exits as the dependent variable. It shows that an increase in supplier bankruptcy leads to a higher likelihood of voluntary exit, for non-manufacturing companies. A positive and strong correlation is observed between voluntary exits and suppliers' voluntary exits. Such positive correlation is observed for both manufacturing and non-manufacturing companies. For non-manufacturing companies, the propagation of voluntary exits leading to voluntary exits of firms in the same network is observed for retail companies (consumers) and for wholesalers (supplier) (see Table 10).

Table 7. Spillover from Partner Company Exit: Manufacturing vs. Non-manufacturing

	(1)	(2)	(3)
VARIABLES	Voluntary Exit		
Industries	All	Manufacturing	Non-Manufacturing
lnage	0.0472***	0.0819***	0.0378***
	(0.00498)	(0.0109)	(0.00565)
lnage_exe	1.004***	0.932***	1.031***
	(0.0162)	(0.0338)	(0.0186)
d_change_exe	0.154***	0.133***	0.162***
	(0.0170)	(0.0372)	(0.0192)
lnindeg	-0.0678***	-0.0684***	-0.0652***
	(0.00399)	(0.00942)	(0.00444)
lnoutdeg	-0.0910***	-0.126***	-0.0826***
	(0.00365)	(0.00837)	(0.00408)
lnemp	-0.257***	-0.232***	-0.266***
	(0.00320)	(0.00625)	(0.00375)
dlnsales	-0.277***	-0.405***	-0.255***
	(0.00655)	(0.0166)	(0.00720)
supplier bankruptcy (t-1)	0.145*	0.0136	0.189**
	(0.0781)	(0.171)	(0.0877)
consumer bankruptcy (t-1)	0.0991	0.172	0.0836
	(0.0694)	(0.154)	(0.0781)
supplier merger (t-1)	-0.0589	-0.0267	-0.0625
	(0.0569)	(0.158)	(0.0613)
consumer merger (t-1)	0.0168	0.156	-0.0464
	(0.0660)	(0.121)	(0.0800)
supplier voluntary exit (t-1)	0.210***	0.386***	0.147*
	(0.0653)	(0.126)	(0.0772)
consumer voluntary exit (t-1)	0.0734	0.141	0.0530
	(0.0688)	(0.145)	(0.0784)
Constant	-6.219***	-5.879***	-6.294***
	(0.0788)	(0.175)	(0.0873)
Observations	3,393,380	766,646	2,616,115

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. See note in Table 2 for detailed description of the variables. Fixed effects for industry, prefecture and year are included.

Table 8. Spillover from Partner Company Exit: Non-manufacturing Sectors

	(1)	(2)	(3)	(4)
VARIABLES	Voluntary Exit			
Industries	Non-Manufacturing	Retail	Wholesale	Construction
lnage	0.0378***	0.0162	0.0669***	0.0812***
	(0.00565)	(0.0179)	(0.0112)	(0.00935)
lnage_exe	1.031***	0.968***	1.064***	1.135***
	(0.0186)	(0.0646)	(0.0365)	(0.0286)
d_change_exe	0.162***	0.103	0.103**	0.196***
	(0.0192)	(0.0819)	(0.0419)	(0.0300)
lnindeg	-0.0652***	-0.106***	-0.0741***	-0.0630***
	(0.00444)	(0.0170)	(0.00901)	(0.00651)
lnoutdeg	-0.0826***	-0.0416***	-0.0590***	-0.0943***
	(0.00408)	(0.0152)	(0.00762)	(0.00661)
lnemp	-0.266***	-0.255***	-0.296***	-0.298***
	(0.00375)	(0.0131)	(0.00761)	(0.00648)
dlnsales	-0.255***	-0.318***	-0.346***	-0.237***
	(0.00720)	(0.0370)	(0.0168)	(0.0102)
supplier bankruptcy (t-1)	0.189**	0.679**	0.344**	0.0235
	(0.0877)	(0.269)	(0.166)	(0.136)
consumer bankruptcy (t-1)	0.0836	0.00566	0.121	0.00142
	(0.0781)	(0.308)	(0.162)	(0.109)
supplier merger (t-1)	-0.0625	0.0326	-0.121	-0.0542
	(0.0613)	(0.145)	(0.125)	(0.124)
consumer merger (t-1)	-0.0464	0.417*	-0.0234	-0.265*
	(0.0800)	(0.222)	(0.157)	(0.154)
supplier voluntary exit (t-1)	0.147*	-0.0229	0.370**	0.0274
	(0.0772)	(0.378)	(0.150)	(0.110)
consumer voluntary exit (t-1)	0.0530	0.510**	-0.171	-0.101
	(0.0784)	(0.220)	(0.159)	(0.127)
Constant	-6.294***	-5.929***	-6.324***	-6.868***
	(0.0873)	(0.292)	(0.168)	(0.124)
Observations	2,616,115	178,258	627,899	1,180,238

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1'. See note in Table 2 for detailed description of the variables. Fixed effects for industry, prefecture and year are included.

Finally, Table 9 and Table 10 show how different types of partner firms' exits are correlated with a company's exit through merger. Unlike bankruptcy or voluntary exit where a bankruptcy in some cases can lead to a higher likelihood of voluntary exit and vice versa (Table 5-8), partner companies' exit from bankruptcy or voluntary exit does not affect the likelihood of merger. Instead, it is only when business partners exit through merger that a firm is likely to be merged as well. This fact holds for both supplier and consumer exit in nonmanufacturing (Table 9), suppliers exit in retail and wholesale, and consumers exit in construction (Table 10).

Table 9. Spillover from Partner Company Exit: Manufacturing vs. Non-manufacturing

	(1)	(2)	(1)
VARIABLES	Exit from Merger		
Industries	All	Manufacturing	Non-Manufacturing
lnage	-0.213***	-0.257***	-0.196***
	(0.00618)	(0.0123)	(0.00721)
lnage_exe	0.110***	0.100**	0.101***
	(0.0231)	(0.0485)	(0.0265)
d_change_exe	0.314***	0.284***	0.319***
	(0.0145)	(0.0300)	(0.0167)
lnindeg	0.00181	0.0565***	-0.00761
	(0.00559)	(0.0136)	(0.00622)
lnoutdeg	-0.0324***	-0.130***	-0.00894*
	(0.00466)	(0.0109)	(0.00521)
lnemp	0.146***	0.177***	0.136***
	(0.00396)	(0.00892)	(0.00446)
dlnsales	-0.145***	-0.163***	-0.139***
	(0.0128)	(0.0314)	(0.0142)
supplier bankruptcy (t-1)	-0.114	-0.123	-0.0930
	(0.166)	(0.345)	(0.189)
consumer bankruptcy (t-1)	-0.137	-0.339	-0.0778
	(0.159)	(0.395)	(0.174)
supplier merger (t-1)	0.192**	0.287	0.167*
	(0.0833)	(0.243)	(0.0902)
consumer merger (t-1)	0.178*	0.0602	0.211**
	(0.0925)	(0.200)	(0.105)
supplier voluntary exit (t-1)	0.112	0.117	0.129
	(0.134)	(0.292)	(0.151)
consumer voluntary exit (t-1)	0.171	0.178	0.172
	(0.124)	(0.275)	(0.140)
Constant	-3.237***	-3.048***	-3.238***
	(0.120)	(0.267)	(0.132)
Observations	3,393,380	766,646	2,616,115

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. See note in Table 2 for detailed description of the variables. Fixed effects for industry, prefecture and year are included.

Table 10. Spillover from Partner Company Exit: Non-manufacturing Sectors

	(1)	(2)	(3)	(4)
VARIABLES	Exit from Merger			
Industries	Non-Manufacturing	Retail	Wholesale	Construction
lnage	-0.196***	-0.236***	-0.234***	-0.178***
	(0.00721)	(0.0221)	(0.0128)	(0.0181)
lnage_exe	0.101***	0.0810	0.0615	0.126**
	(0.0265)	(0.0907)	(0.0471)	(0.0588)
d_change_exe	0.319***	0.329***	0.315***	0.301***
	(0.0167)	(0.0593)	(0.0303)	(0.0408)
lnindeg	-0.00761	-0.0926***	-0.115***	0.0790***
	(0.00622)	(0.0206)	(0.0119)	(0.0137)
lnoutdeg	-0.00894*	-0.00814	0.0884***	-0.102***
	(0.00521)	(0.0158)	(0.00990)	(0.0140)
lnemp	0.136***	0.213***	0.158***	0.170***
	(0.00446)	(0.0139)	(0.00913)	(0.0134)
dlnsales	-0.139***	-0.0851	-0.168***	-0.129***
	(0.0142)	(0.0699)	(0.0299)	(0.0286)
supplier bankruptcy (t-1)	-0.0930	-0.175	-0.699	0.245
	(0.189)	(0.740)	(0.444)	(0.325)
consumer bankruptcy (t-1)	-0.0778	0.428	0.229	-0.322
	(0.174)	(0.436)	(0.295)	(0.361)
supplier merger (t-1)	0.167*	0.591***	0.354**	-0.100
	(0.0902)	(0.183)	(0.161)	(0.363)
consumer merger (t-1)	0.211**	0.390	0.194	0.494**
	(0.105)	(0.294)	(0.238)	(0.208)
supplier voluntary exit (t-1)	0.129	-0.0421	-0.0347	0.413*
	(0.151)	(0.696)	(0.300)	(0.246)
consumer voluntary exit (t-1)	0.172	-0.509	0.0724	-0.213
	(0.140)	(0.695)	(0.287)	(0.380)
Constant	-3.238***	-2.981***	-2.838***	-3.817***
	(0.132)	(0.408)	(0.218)	(0.266)
Observations	2,616,115	178,258	627,899	1,180,238

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1'. See note in Table 2 for detailed description of the variables. Fixed effects for industry, prefecture and year are included.

C. Determinants of Firm Exits

Finally, we apply the same probit regression analysis for all industries to understand the potential factors that are correlated with each exit type. Table 11 reports the results. We look at firm characteristics and CEO characteristics to explain the likelihood of firm exits by each firm exit

type. As for firm age, we find that younger firms are likely to go bankrupt or to be merged compared to older firms. However, for voluntary exits, the relationship is the opposite – older firms are more likely to exit voluntarily. As for the change of CEO, a firm is less likely to go bankrupt if the firm changed the CEO, but the opposite is true for merger and voluntary exits. As for firm connections, having more network connections tends to decrease the probability of voluntary exits, indicating firms that are more connected are less likely to exit voluntarily. The same mechanism applies for merger that firms are less likely to merge with more consumers. On the other hand, having more suppliers increase the likelihood of bankruptcies. Despite these differences, there are some common determinants as well: for all types of exits, firms that are large, with higher sales growth and with younger CEOs tend to have lower probability of exits.

Table 11. Determinants of Exits by Exit Type

VARIABLES	All Exit	Bankruptcy	Merger	Voluntary Exit
Firm Age	-0.0602***	-0.0558***	-0.213***	0.0472***
	(0.00340)	(0.00502)	(0.00618)	(0.00498)
CEO Age	0.600***	0.135***	0.110***	1.004***
	(0.0111)	(0.0157)	(0.0231)	(0.0162)
Change of CEO	0.169***	-0.102***	0.314***	0.154***
	(0.0102)	(0.0177)	(0.0145)	(0.0170)
Number of Suppliers	0.0202***	0.0777***	0.00181	-0.0678***
	(0.00279)	(0.00411)	(0.00559)	(0.00399)
Number of Consumers	-0.0466***	0.00478	-0.0324***	-0.0910***
	(0.00249)	(0.00367)	(0.00466)	(0.00365)
Employment	-0.100***	-0.0805***	0.146***	-0.257***
	(0.00212)	(0.00324)	(0.00396)	(0.00320)
Sales Growth	-0.266***	-0.189***	-0.145***	-0.277***
	(0.00537)	(0.00817)	(0.0128)	(0.00655)
Supplier Bankruptcy (t-1)	0.362***	0.587***	-0.114	0.145*
	(0.0553)	(0.0701)	(0.166)	(0.0781)
Consumer Bankruptcy (t-1)	0.288***	0.503***	-0.137	0.0991
	(0.0499)	(0.0633)	(0.159)	(0.0694)
Supplier Merger (t-1)	-0.0128	-0.0454	0.192**	-0.0589
	(0.0430)	(0.0685)	(0.0833)	(0.0569)
Consumer Merger (t-1)	0.0636	0.0504	0.178*	0.0168
	(0.0483)	(0.0744)	(0.0925)	(0.0660)
Supplier Voluntary Exit (t-1)	0.240***	0.244***	0.112	0.210***
	(0.0521)	(0.0782)	(0.134)	(0.0653)
Consumer Voluntary Exit (t-1)	0.0897*	0.0184	0.171	0.0734
	(0.0545)	(0.0865)	(0.124)	(0.0688)
Constant	-4.536***	-3.443***	-3.237***	-6.219***
	(0.0561)	(0.0862)	(0.120)	(0.0788)
Fixed-Effects	Y	Y	Y	Y
Observations	3,393,380	3,393,380	3,393,380	3,393,380

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. See note in Table 2 for detailed description of the variables. Fixed effects for industry, prefecture and year are included.

VI. POLICY IMPLICATIONS

In this paper, using a rich firm-level data set that contains information on individual firm exits, we have documented the changing exit patterns of Japanese firms, highlighting a recent increase in voluntary exits. We argue that such increase in voluntary exits is inarguably associated with demographic trends, as older CEOs nearing or beyond their retirement ages are not able to identify their business successors. Lower bankruptcy rates and the declining share of zombie firms suggest that the overall health of Japanese firms has improved.

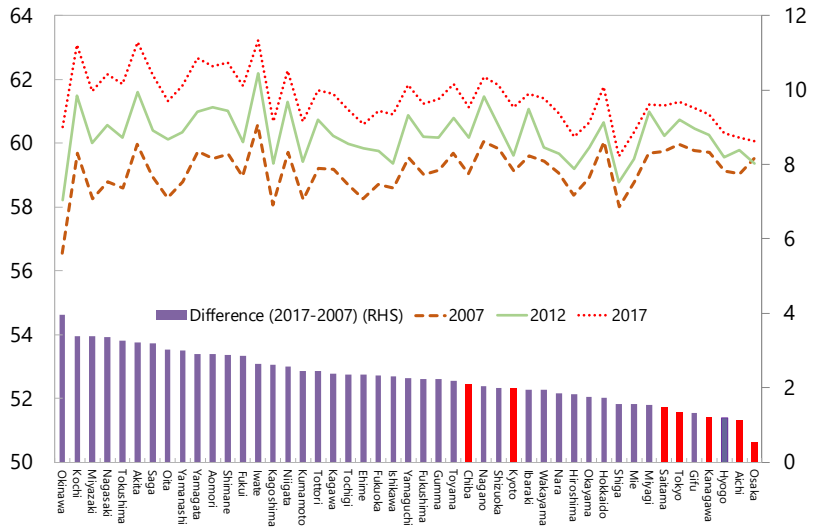
An increase in voluntary exits due to business succession issues raises concerns and requires a new way of thinking about how to improve the efficiency of resource allocations in a way that is different from firm exits through bankruptcies. In the years to come, population aging in Japan will accelerate and an increasing number of CEOs nearing their retirement ages will face the issue of business succession. As a result, voluntary firm exits will likely rise. In addition, the fact that the economic impact of a firm exit is likely to be amplified through highly connected inter-firm supply chain networks among Japanese firms makes this issue economically important. We show empirically that this is indeed the case, where firm exits, including voluntary exits, increase the probability of exits of other firms that are connected through firm network.

In recent years, policies have been introduced to address these issues. In 2017, the Small and Medium Enterprise Agency formulated a 'Five-Year Plan for Business Succession,' to support business owners and SMEs to pass over their businesses to the next generation CEOs. For business owners who have already identified business successors, the support has been mostly through tax measures, either deduction of tax rates or deferral of taxes. For instance, for the FY2018 and FY2019 tax reforms, the government introduced a system of 100 percent deferral of payment of inheritance tax and gift tax concerning the succession of land, buildings, machinery and equipment. For business owners who have not identified business successors, the government's support to find the right successor for retiring business owners has increased. This includes: (i) increasing awareness of the importance of business succession by sending financial institutions and professional experts to business owners; (ii) establishment of public centers for supporting business succession; (iii) establishment of special measures for SMEs which are funded by the business succession fund of the Organization for Small and Medium Enterprises and Regional Innovations (FY2019 tax reform); and (iv) reduction or exempt of registration license tax for M&A and real estate acquisition tax to support business succession to non-family members (FY2018 tax reform).[18] In December 2019, the Ministry of Economy, Trade and Industry published a package of policy-related measures to enlarge business successions from aged business owners to those who are not their relatives or employees working at their companies. Examples include permission of access to information held by public centers for supporting business succession by private financial institutions and M&A companies, enhancement of cooperation between these centers and regional financial institutions to link business owners to potential new owners and raising subsidies for business succession. The government aims that 600,000 business owners can turn over their businesses to new owners in the coming decade through these measures. Finally, as a part of fiscal

[18] The Small and Medium Enterprise Agency (2017, 2018, 2019) discuss motivations behind these measures introduced and plans going forward.

package to support firms in the face of the COVID-19 shock, the first supplementary budget of FY2020 included measures to support SME business succession, amounting to 10 billion Japanese Yen, including subsidizing costs (legal, due diligence) associated with SME's succession to a third-party.

Figure 11. CEO Age by Prefectures (2007 vs. 2012 vs. 2017)



Note: Highlighted red bars indicate regions defined as 'urban' area in our analysis. 'Urban' areas cover the following prefectures: Tokyo, Kanagawa, Chiba, Saitama, Aichi, Osaka, and Kyoto. All other prefectures are defined as 'rural.' Left-hand axis represents the average age of CEOs. Right-hand axis represents the difference of the average age of CEOs in 2007 and 2017.

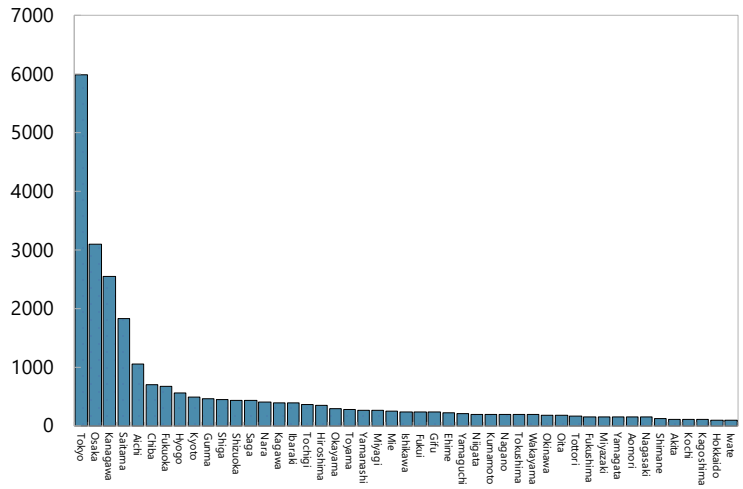
Our analysis provides some implications for policies, suggesting that a greater support for firms' succession challenges in rural areas is warranted for the following reasons.

First, population aging in Japan has been advancing at a more rapid pace in rural areas compared to urban areas. Figure 11 compares the average age of CEOs by prefecture in 2007, 2012 and 2017. CEOs are aging in every prefecture, as we see an upward shift of lines from 2007 to 2017 for all prefectures. In 2017, Iwate, Kochi and Akita are the prefectures where the average age of CEOs is higher than other prefectures, with the average age exceeding 63 years. Prefectures with the youngest CEOs as of 2017 are Shiga, Osaka and Aichi prefectures, where the average of age of CEOs is around 60 years.[19] In addition, from the chart, we can observe that the CEOs in rural prefectures are aging faster than those in urban areas. The purple and red bars indicate the difference of average age of CEOs by prefecture, taking the difference between 2007 and 2017, where purple bars indicate rural areas and red bars indicate urban areas. The top 25 prefectures

[19] The average age of CEOs in Tokyo is about 61 years old, which is about the median of all the prefectures in Japan.

with the largest increase in the average of CEO age are rural areas. Okinawa prefecture shows the largest difference and Osaka and Aichi prefectures show the smallest difference.

Figure 12. Prefecture-Level Firm Density in 2017



Source: Tokyo Shoko Research, LTD

Note: Y-axis denotes the average number of firms per ten square kilometers by prefecture in 2017.

Second, Japanese firms are much less densely populated in rural areas compared to urban areas. Using the Grid Square Statistics from the Statistics Bureau of Japan with the information on latitude and longitude, we look at the 'density of firms' in a given area as the total number of firms that exist within ten square kilometers.[20] We find that firms are much more populated in urban areas than in rural areas, with the average number of firms in ten square kilometers in urban areas nearly seven times higher than in rural areas. For 2017, there are on average 1,343 firms in ten square kilometers in urban areas, but only 205 firms in rural areas. Furthermore, among urban areas, it is Tokyo and Osaka cities that exhibit an extreme concentration of firms, with Tokyo having close to 6,000 firms and Osaka close to 3,000 firms per ten square kilometers (Figure 12). For about 40 out of 47 prefectures in Japan aside from these large metropolitan areas, the average number of firms per ten square kilometers is less than 500. For firm exits, such unevenness in firm concentration across regions implies difficulties in finding alternative partners to replace or to start new business relationships in rural areas—if a firm loses business partner(s) in the same production network, whether it be due to bankruptcy or voluntary exits, it is more difficult to find alternative business partners. This is due to the importance of geographical proximity in inter-firm network formation for Japanese firms, as shown in Section 3.4.

Finally, institutions or mechanisms that can reduce search frictions in matching retiring CEOs and business successors could reduce welfare losses from the voluntary exit of potentially productive and profitable firms. Raising awareness of the importance of finding business successors and

[20] We use the second digit mesh data. https://www.stat.go.jp/english/data/mesh/01.html

encouraging early preparation could also increase the likelihood of successful matching, although search costs should still be reduced to ensure efficient matching. Policies to support business succession such as raising awareness, incentivizing and encouraging non-family succession, and helping to improve the matching between firms and potential successors are steps in the right direction. Our analysis shows that more efforts are needed to target firms in rural areas, given the aforementioned structural barriers.

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Annex 1. Average Age of CEOs

		Region		Industry					
Year	Total	Rural	Urban	Construction	Manufacturing	Retail	Services	Wholesale	Other
2007	59.4	59.2	59.6	58.4	60.4	60.0	59.8	60.2	58.1
2008	59.5	59.4	59.7	58.5	60.6	60.4	60.0	60.5	58.3
2009	59.7	59.6	59.7	58.6	60.8	60.5	60.2	60.7	58.1
2010	59.9	59.8	59.9	58.8	60.9	60.7	60.4	61.0	58.2
2011	60.1	60.1	60.0	59.0	61.1	60.9	60.6	61.2	58.4
2012	60.2	60.3	60.1	59.1	61.3	61.1	60.8	61.4	58.5
2013	60.4	60.6	60.2	59.2	61.4	61.4	61.0	61.6	58.6
2014	60.6	60.7	60.3	59.3	61.5	61.5	61.2	61.8	58.9
2015	60.7	61.0	60.4	59.5	61.7	61.6	61.4	61.9	59.0
2016	60.9	61.2	60.6	59.8	61.8	61.8	61.6	62.1	59.1
2017	61.2	61.5	60.8	60.2	61.9	62.1	61.8	62.3	59.3

Source: Tokyo Shoko Research, LTD.

Annex 2. Summary Statistics

year	Total Number of Firms	non-SME	SME
2007	1,034,221	32,124	1,002,097
2008	1,055,557	36,854	1,018,703
2009	1,104,151	53,577	1,050,574
2010	1,158,362	70,153	1,088,209
2011	1,192,175	82,027	1,110,148
2012	1,240,063	92,951	1,147,112
2013	1,271,667	90,256	1,181,411
2014	1,264,155	88,684	1,175,471
2015	1,256,867	94,781	1,162,086
2016	1,281,440	100,869	1,180,571
2017	1,292,421	103,800	1,188,621

Source: Tokyo Shoko Research, LTD.

Note: See footnotes 9 and 10 for the definition of an SME adopted in our analysis.