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Survival and Distinct Exit Routes of New Firms

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Survival and Distinct Exit Routes of New Firms

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Abstract: This paper explores how the determinants of new-firm duration vary according to exit route: bankruptcy, voluntary liquidation, or merger. Using a sample of new firms in Japan, we provide evidence that the effects of entrepreneur-, firm-, and industry-specific characteristics on new-firm duration are significantly different across exit routes. In particular, the determinants of bankruptcy are fairly different from those of merger. While firms with highly educated entrepreneurs are less likely to go bankrupt, such firms tend to dissolve their businesses voluntarily or be merged by other firms. Our findings suggest that while industry-specific characteristics, such as industry growth and R&D intensity, play a significant role in determining bankruptcy, they do not affect exit through merger.

Keywords: New firm, Survival, Exit, Bankruptcy, Voluntary liquidation, Merger.

JEL Classifications: M13, L26, O25.

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1. Introduction

Many new firms leave the market some years after founding their businesses. Some firms are forced into bankruptcy because of business failures, and others disappear because of mergers, which may not always be due to business failures. In addition, entrepreneurs sometimes voluntarily dissolve their businesses. Since new firms exit the market in such different ways, these distinct exit routes should be regarded as heterogeneous. As Parker (2009) pointed out, entrepreneurs close businesses for a variety of reasons, and there are economic differences between exit routes. Ignoring heterogeneity between exit routes would yield incorrect interpretations. By distinguishing between exit routes—bankruptcy, voluntary liquidation, and merger—this paper contributes to a better understanding of what factors affect the survival and exit of new firms.

New firms not only promote innovation but also create opportunities for employment (e.g., Acs and Audretsch 1990, Audretsch 2002). In addition, they are expected to intensify vigorous competition in industries, which will stimulate economic growth. In this respect, promoting new-firm entry is fairly important from the perspective of economic policy. In contrast, new firms tend to face difficulties and disappear quickly because of fewer resources and inexperience, although only a few survive longer and grow faster. When considering support policies for new businesses, it is vital for policy makers to understand which firms are more likely to survive and have growth potential. For these reasons, this paper would provide some important clues in enforcing economic policies for new businesses.

Research that focuses on Japan may be of interest to scholars and practitioners. According to Global Entrepreneurship Monitor (GEM) reports, Japan consistently

exhibits fairly low rates of perceived entrepreneurial opportunities and capabilities. Indeed, in Japan, the start-up ratio has been fairly low and even lower than the closure ratio for decades. In contrast, since the Japanese economy has faced low economic growth since the 1990s, promoting entrepreneurship is a fairly important policy issue to economic growth. Scholars and practitioners may want to know what types of factors determine the success of entrepreneurs in Japan. Evidence derived from Japan may provide clues on how we support entrepreneurs, and include some important suggestions to other countries with "limited entrepreneurship."

In this paper, we explore the effects of entrepreneur-, firm-, and industry-specific characteristics on new-firm duration according to exit route, using a sample of approximately 15,000 new firms in Japan. By estimating a competing-risks discrete-time duration model, we provide evidence that factors affecting new-firm duration vary significantly across exit routes. In particular, our findings suggest that factors driving the occurrence of bankruptcy are fairly different from those driving the occurrence of merger. In this paper, we argue that taking into account distinct exit routes, which tend to be treated as homogeneous in the existing literature, is fairly important in such lines of studies.

The remainder of the paper is organized as follows. In Section 2, we describe the background and related literature. Section 3 explains the data and methods employed in the analyses. The determinants of new-firm duration are discussed in Section 4. The empirical results and their discussions are presented in Section 5. The final section concludes.

2. Background and related literature

In the field of industrial organization, including entrepreneurship research, scholars have argued that entry and exit play an essential role in industry dynamics.[1] Because new firms are expected to contribute to the development of industries through competition, it is beneficial to promote the creation of new firms, particularly high-growth firms (called "Gazelles"). In contrast, some firms are forced to exit in a short period just after entry under competitive pressure. Entry and exit are essential for the development of industries through competition, and they play a key role in maintaining the natural selection mechanism in the economy.

Until now, the post-entry performance of new firms has been examined in a rich stream of literature. In particular, a large number of empirical studies have examined the survival and exit of firms during the start-up period. Audretsch (1991), for example, estimated the determinants of 10-year survival rates for new establishments, using a logit model. Wagner (1994) also examined the survival of new firms and the duration of survival in years, using probit and tobit models. Audretsch and Mahmood (1991, 1995) applied a proportional hazards model proposed by Cox (1972) (PH model, henceforth) to analyze the survival and exit of new establishments and firms. The PH model has several advantages over binary choice models such as the logit and probit models, because the PH model takes into account the duration of firm survival and censoring of observations. Mata and Portugal (1994) and Mata et al. (1995) used the PH model to estimate the determinants of survival of new firms and plants in Portugal. Honjo (2000a) also investigated the determinants of business failure of new

[1] For a survey of evidence on entry and exit, see, for example, Siegfried and Evans (1994), Carree (2006), and Santarelli and Vivarelli (2007). For more discussions on entry and exit, see also Geroski (1995) and Caves (1998).

firms in Japan, using the PH model.[2] Although these studies have paid attention to the duration of firm survival, they have treated exit as homogeneous.

In contrast, as summarized in Table 1, several studies examined the survival and exit of firms by distinguishing between exit routes. These studies have revealed that factors affecting firm survival vary according to exit route. For example, Harhoff et al. (1998) examined the determinants of firm survival, distinguishing between bankruptcy and voluntary liquidation. In a similar study, Esteve-Perez et al. (2010) distinguished between liquidation and acquisition in the Spanish manufacturing industry.[3]

However, there are still several points that have not been addressed in these previous studies.[4] Although the previous studies in Table 1 have focused on large established firms, evidence on new firms has been quite limited until now. Generally, new firms tend to have fewer resources and lack experience, and they have limited access to external finance mainly because of no track record. New firms are essentially different from large established firms, in terms of not only firm size but also structure and behavior (e.g., Storey and Greene 2010).[5] In this respect, evidence from

[2]Using Japanese data, Doi (1999) examined the determinants of firm exit at the industry level. Harada (2007) also examined the determinants of small-firm exit in Japan, by distinguishing between economic-forced and non-economic-forced exits.

[3]Further, some studies have examined entrepreneurial exit from self-employment. These studies have estimated the determinants of entrepreneurs' self-employment duration by distinguishing between failure and a transition to alternative employment (e.g., Taylor 1999, Van Praag 2003, Cueto and Mato 2006). These results are obtained from data on entrepreneurs' employment, and therefore, they are not identical to the studies on new-firm duration. In the research on self-employment duration, both voluntary liquidation and merger may be regarded as a transition to alternative employment.

[4]In addition, unlike the previous studies, it should be noted that we can avoid the left-truncation problem, because we can observe the timing of entry for all the firms in the sample. For example, while Esteve-Pérez et al. (2010) estimated the determinants of firm survival according to exit route, they could not observe the timing of entry for some firms in their sample. They emphasized that the presence of left-truncated observations—firms that started operations before the beginning of the observation period—is not a problem. However, if the determinants of firm survival depend on firm age, left truncation is problematic. In this respect, the data used in our analysis, which will be explained in Section 3, has an advantage over the previous studies, including Esteve-Pérez et al. (2010).

[5]As an exception, Grilli et al. (2010) examined the determinants of survival and exit of new firms by distinguishing between closure and acquisition, but they focused on firm size and age as the determinants.

research on the duration of new firms will advance our understanding of post-entry performance.

In addition, it has been argued that entrepreneurs' human capital is a valuable resource for new firms, and plays a critical role in firms' performance. Presumably, entrepreneurs' human capital relates to firms' decisions—especially during the start-up period. In practice, a number of studies have provided evidence that entrepreneurs' human capital significantly affects the post-entry performance of firms (e.g., Bates 1990, Colombo and Grilli 2005).[6] While these previous studies revealed that entrepreneur-specific characteristics significantly affect firm survival, they did not provide any evidence on how these characteristics affecting the duration of new firms vary according to exit route.

Moreover, it is considered that the determinants of new-firm duration depend on exit routes. While bankruptcy results from business failure, voluntary liquidation occurs for a variety of reasons. Some entrepreneurs quit their businesses voluntarily when they are approaching retirement age or find another job with higher wages.[7] In this regard, voluntary liquidation should be regarded as a distinct exit route from bankruptcy. In contrast, exit through merger may be due, in part, to business success, rather than failure, since firms with growth potential or valuable resources are often targeted. In this respect, exit through merger should be considered a fairly different economic event from the other exit routes.

In addition, because the resources of merged firms are often reallocated to merging firms, merger should be distinguished from bankruptcy and voluntary liquidation,

[6]For a survey of evidence on the effects of entrepreneurs' human capital on post-entry performance, see, for example, Kato et al. (2013).

[7]For a survey of the evidence on the reasons for quitting businesses, see, for example, Storey and Greene (2010).

in terms of resource allocation. Therefore, we can say that distinguishing between bankruptcy, voluntary liquidation, and merger is quite important for understanding survival and exit from the economic perspective. In fact, whereas exit routes are distinguished between "liquidation and merger/acquisition" or "bankruptcy and voluntary liquidation" in the previous studies, there are few studies that distinguished between bankruptcy, voluntary liquidation, and merger simultaneously.[8]

To address these unresolved issues, we examine the determinants of new-firm duration by distinguishing between bankruptcy, voluntary liquidation, and merger. Following this, we provide evidence on how the effects of entrepreneur-, firm-, and industry-specific characteristics vary across the distinct exit routes.

3. Data and methods

3.1. Data

The data set employed in this paper comes from the *TSR Data Bank* compiled by Tokyo Shoko Research (TSR), which is one of the major credit investigation companies in Japan.[9] The data set consists of manufacturing firms founded between 1997 and 2004, and includes information on the survival and exit of these firms from the years of entry to 2009. The data provides information not only on whether the firm exits but also on the type of exit route.

Regarding industry-specific characteristics, data on capital intensity were ob-

[8] As an exception, Schary (1991) tried to distinguish between bankruptcy, voluntary liquidation, and merger. However, she yielded few significant results, and did not focus on the survival and exit of new firms.

[9] As a public data source, for example, the *Establishment and Enterprise Census* reports the number of entries and exits, based on establishments, in each industry or region. However, it is quite difficult to obtain individual data from public data sources, and in general, we cannot identify which establishment (or firm) is active or extinct even with these sources. In addition, when these sources are used, there is the possibility that the relocation of an establishment to another region is regarded as an exit even though the establishment remains in the market. Consequently, when using these sources, we face difficulties identifying whether or not the firm actually exited the market.

tained at the three-digit Standard Industrial Classification (SIC) level from the *Report by Industry*, *Census of Manufactures* compiled by the Ministry of Economy, Trade, and Industry (METI). Further, data on industry growth is obtained from Japan's Industrial Productivity (JIP) Database by Research Institute for Economy, Trade and Industry (RIETI). In addition, data on research and development (R&D) intensity at roughly the three-digit SIC level is taken from the *Results of Basic Survey of Japanese Business Structure and Activities* by METI. Moreover, data on the employment share of small and medium-sized enterprises (SMEs) to total employment at the three-digit SIC level is obtained from the *Establishment and Enterprise Census* published by the Ministry of Internal Affairs and Communications (MIC). Furthermore, the annual unemployment rate in each prefecture comes from the Labor Force Survey of MIC.

While industrial classifications changed considerably for some industries during the observation period, we made every effort to construct a balanced panel of industry-level data at the three-digit SIC level for each data source throughout the observation period 1997–2009. However, for several industries, we could not match the classifications at the three-digit SIC level between the periods before and after the changes in SIC. In this case, we used the values at the two-digit SIC level, instead of the values at the three-digit SIC level. Further, when data were not obtainable for a year at the three-digit SIC level because of confidentiality, we used the values for these industries in the previous year during the observation period instead.

As a result, we obtained a sample of 15,097 manufacturing firms founded in Japan during 1997–2004, and we observe the duration of the sample firms from the

year of entry to 2009.[10]

3.2. Distinct exit routes

As explained above, we classify exit into three routes—bankruptcy, voluntary liquidation, and merger—using the classifications in the *TSR Data Bank*. Bankruptcy indicates the situation in which firms cannot repay their debts and thus cease operations, and includes the firms applying for court protection under the Bankruptcy Law, as well as those applying for it under the Corporate Rehabilitation Law, and the Civil Rehabilitation Law enacted in Japan in April 2000. In addition, firms whose bills payable are no longer honored by banks are regarded as bankrupt even if they are not necessarily judged as bankrupt by a court. That is, bankruptcy, in this paper, includes not only firms legally declared as bankrupt but also firms that are inactive from an economic viewpoint.

In contrast, voluntary liquidation indicates the situation in which firms voluntarily dissolve their businesses without insolvency. There may be a number of reasons for voluntary liquidation, although it can be difficult to precisely define these reasons. Some entrepreneurs may dissolve their businesses before facing insolvency, because they recognize that their businesses are no longer going well. In addition, those who have the opportunity to receive higher wages as an employee may tend to voluntarily dissolve their businesses. Other entrepreneurs may be forced to close their businesses because they are approaching retirement age and cannot find any successors.

Finally, merger indicates the situation in which a firm disappears because of a merger with another firm.[11] Merger does not indicate business failure because it is

[10] While we dropped 784 firms with 100 or more employees from the sample, the results are generally similar to those without dropping these firms from the sample. Moreover, the results generally held even when we tried alternative cut-off points.

[11] As mentioned above, in this paper, merged firms are regarded to have exited, but merging firms,

not necessarily caused by poor performance. Rather, merged firms may be more likely to have superior capabilities or valuable resources since firms with growth potential or valuable resources are often targeted for a merger.

However, a problem arises when we identify the routes and timing of exit, using the *TSR Data Bank*, as the month and year of exit for voluntary liquidation and merger cannot be identified in the data source. In addition, the month and year of exit for a few bankruptcies—firms with a total deficit of less than 10 million yen—cannot be identified, although the month and year of exit for most bankruptcies are available in the data source. According to TSR, the researchers of TSR collect information on firms by telephone, postal questionnaire, and field surveys several times a year. If a firm is found to exit, the information is no longer updated. Therefore, using information on the accounting period when the last statement of accounts before exit was reported, we identify the exit year of voluntary liquidation and merger, along with the exit year of some bankruptcies that entail a total deficit of less than 10 million yen. For these firms, the next year after the final statement of account was reported is regarded as the exit year.[12]

Table 2 presents summary statistics for three exit routes by year. An important, although not surprising, fact is that new firms indeed exit the market in different ways. As shown in Table 2, 709 (4.7%) of the 15,097 firms in the sample exited the market through bankruptcies, 1,240 firms (8.2%) voluntarily closed their businesses, and 336 firms (2.2%) disappeared because of mergers. The total number of exited

that is, firms that absorb merged firms, are not regarded to have exited, because these firms still exist in the market.

[12]However, this conjecture of the exit year may still have a bias. Therefore, we predicted the exit year for all exit routes, including firms with a total deficit greater than or equal to 10 million yen, based on the year of the last reported statement of account and estimated the determinants of exit. As a result, we did not find large changes in our estimation results, regardless of the prediction method for the exit year.

firms in the sample is 2,285 (15.1%).

3.3. Methods

Our interest is to estimate the probability that a new firm exits and to identify the factors determining its exit route. However, some firms do not exit during the observation period; that is, their duration to exit is right censored. For this reason, previous literature has applied the PH model to the survival and exit of new establishments or firms over time (e.g., Audretsch and Mahmood 1991, 1995, Mata et al. 1995, Honjo 2000a). As already mentioned, the PH model has advantages because it can accommodate the right-censored observations.

In this paper, the post-entry performance of new firms is divided into survival, and as discussed above, three exit routes: bankruptcy, voluntary liquidation, and merger. Although her analysis did not focus on new firms, Schary (1991) assumed that the exit routes are inherently ordered as follows: survival, merger, non-failure, and failure. However, it cannot be reasonably assumed that this order holds for all situations. In addition, because there are three exit routes in our data set, the occurrence of one of the routes precludes us from observing another route of exit. For this purpose, a competing-risks proportional hazards model (CPH model, hereafter) has been used to deal with the presence of competing events that impede the event of interest. Further, we use a discrete-time duration model to examine what factors affect the duration of new firms and how they vary according to the exit route.[13]

As discussed above, we consider three exit routes—bankruptcy, voluntary liqui-

[13]While some previous studies have used a continuous-time duration model to examine the duration of firms, other studies have used the discrete-time duration model instead (e.g., Fontana and Nesta 2009, Cefis and Marsili 2011, 2012). Because survival and exit are observable only by year, we use the discrete-time duration model, following Fontana and Nesta (2009) and Cefis and Marsili (2011, 2012).

dation, and merger. That is, the number of exit routes, m, is set to three ($m = 3$) in this paper. Let x_{ij} denote a vector of covariates affecting the hazard of exit of firm i for exit route $j(= 1, \ldots, m)$. To model the transition from survival to exit through bankruptcy, voluntary liquidation, or merger, we define the discrete hazard rate. For firm i, the hazard rate into route j (j=1, 2, 3) in period t, $h_{ij}(t)$, is the conditional probability of a transition to route j in this period when firm i has survived until t. In this paper, it should be noted that t corresponds to calendar years, and the baseline hazard controls for the risks to all firms in each year.[14]

Following previous studies, we use a complementary log-log model (cloglog model, hereafter) to estimate the discrete hazard rate (e.g., Jenkins 2005). The hazard rate for the cloglog model can be expressed as follows:

$$h_{ij}(t) = 1 - \exp\Big\{-\exp\Big(h_{0j}(t) + x_{ij}\beta_j\Big)\Big\}, \tag{1}$$

where $h_{0j}(t)$ is the baseline hazard function at the tth interval with spell duration, x_{ij} is a vector of covariates (some of which are time-varying) that affect the survival and exit of new firms, and β_j denotes the parameters to be estimated.

An important assumption in this model is that competing risks (distinct exit routes) are independent of one another, and adding or deleting alternative exit routes does not affect the odds among the remaining alternatives. However, there is a possibility that this assumption is violated. Therefore, we test if the independence of irrelevant alternatives (IIA) assumption holds for competing risks, and as shown in the Appendix, it is found that the IIA assumption holds in our estimation.

[14]Therefore, this formula implies that the baseline hazard is determined by macroeconomic conditions.

4. Determinants of new-firm duration

4.1. Entrepreneur-specific characteristics

With respect to entrepreneur-specific characteristics, some studies have emphasized that entrepreneurs' human capital plays an important role in firm survival.[15] In these studies, educational background has often been used as a proxy of entrepreneurs' human capital. Highly educated entrepreneurs are likely to have more knowledge and skills for managing their firms and developing new products. As suggested by Colombo and Grilli (2005), the knowledge and skills of entrepreneurs are related to the "capability" of their firms. In addition, because of information asymmetries under the capital market imperfection, educational background may act as a signal of entrepreneurs' capability to external providers of finance, which affects the investment and performance of their firms. According to the theory of capability and signaling, we can say that firms with highly educated entrepreneurs are more likely to outperform other firms.

In contrast, firms with highly educated entrepreneurs tend to become the target of merger, since these firms may have higher capabilities. Therefore, it is plausible that the effects of educational background on new-firm duration vary according to exit route. More precisely, we hypothesize that while firms with highly educated entrepreneurs are less likely to go bankrupt (business failure), these firms are more likely to disappear via merger, compared to other firms.

In addition, according to occupational choice models, highly educated entrepreneurs are more likely to ensure better employment opportunities (e.g., Evans and Jovanovic 1989, Gimeno et al. 1997, Taylor 1999). Since such entrepreneurs can find an em-

[15] Bates (1990) found that entrepreneurs' human capital inputs affect small business longevity, and Cressy (1996) argued that human capital is the true determinant of firm survival.

ployment opportunity with higher wages than their income, they are likely to be employed and to quit their current businesses. Further, because of their superior capability, if highly educated entrepreneurs are more able to forecast whether their businesses will be successful in the future, they will be more likely to close their businesses before reaching insolvency. In these respects, it is hypothesized that highly educated entrepreneurs are more likely to liquidate their businesses voluntarily (not compulsorily) than others. A dummy for entrepreneurs who had university education is used as a proxy for educational background.[16]

The effect of entrepreneur's age when the entrepreneur started the business is examined in the model. When some entrepreneurs are approaching retirement age and cannot find their successors, they may be more likely to close their companies voluntarily, even if their businesses are going well at that time. In fact, Harada (2007) found that some self-employed entrepreneurs close businesses because of their age. We hypothesize that elderly entrepreneurs are more likely to voluntarily close their businesses than young entrepreneurs.

We also pay attention to gender differences among entrepreneurs. Several studies have examined the role of gender differences in post-entry performance among firms (e.g., Kalleberg and Leicht 1991, Carter et al. 1997, Harada 2003).[17] Until now, however, little is known about the effects of an entrepreneur's gender on new-firm duration, and therefore, we examine these effects according to the exit route.

[16]Because the entrepreneur's educational background is unknown for some observations in our data set, a dummy variable for such firms is also included in the model.

[17]Fairlie and Robb (2009) suggest that female-owned businesses have lower survival rates, because they have less startup capital. They also conclude that female business owners may have different preferences as goals of their businesses.

4.2. Firm-specific characteristics

With respect to firm-specific characteristics, we examine the effect of firm size on the survival and exit of new firms.[18] A large number of studies have provided evidence that the probability of survival increases with firm size (e.g., Audretsch 1991, Audretsch and Mahmood 1991, Audretsch and Mahmood 1995, Honjo 2000a, 2000b).[19] In contrast, the effect of this variable may vary between distinct exit routes. Harhoff et al. (1998) suggest that because the exit mechanism of insolvency is not profitable for firms below some minimum size and the insolvency procedure involves high transaction costs, debtors and creditors may prefer less formal agreements, such as voluntary liquidation. Smaller firms may tend to exit through voluntary liquidation rather than through bankruptcy. In contrast, larger firms have higher exit barriers than smaller firms, since the bankruptcy of larger firms, which often causes large-scale unemployment, has an impact on many stakeholders. Therefore, if a larger firm faces financial difficulties, the firm may prefer to find a rescuer who can buy the firm rather than to liquidate itself.[20] In this paper, firm size is measured by the number of employees.

We also examine the effect of firm age on the survival and exit of new firms. As Evans (1987) indicated, the survival and exit of firms depend heavily on firm age, and the performance of firms with a longer history is likely to differ from that of

[18] It should be noted that data on the number of employees are not measured at the year of entry, because the *TSR Data Bank* provides only the latest information on the number of employees.

[19] Audretsch and Mahmood (1995) argued that larger firms may be more likely to be closer to the minimum efficient scale to operate efficiently in a market, and are therefore less likely to be vulnerable than smaller firms that operate further up the cost curve. Fazzari et al. (1988) argued that large and small firms have different access to funds, and small firms have more limited access to external finance than do large firms. Geroski et al. (2010) also pointed out that larger firms may be more efficient than smaller firms, not because they operate at a different point on the cost curve, but because they may have different managerial capabilities. That is, firm size may be a consequence of its capabilities.

[20] We also used data on paid-up capital as a measure of firm size. Compared with total assets, paid-up capital does not include liabilities or retained profits. While total assets may be more suitable to represent the firm's asset size, total assets include liabilities and large liabilities increase the probability of bankruptcy. However, as paid-up capital is closely correlated to other variables, such as the dummy for joint-stock companies, we do not report the results for paid-up capital.

newer firms. Older firms may have lower probability of business failure because of some advantages, such as learning and scale, but such firms would be more likely to become the target of merger. As firms get older, their entrepreneurs will also be older and thus they are more likely to close businesses without insolvency. The variables for firm age and its quadratic term are included in the model.

Further, the variable for joint-stock companies with limited liability is included to control for differences in legal forms across new firms. In general, as discussed by Harhoff et al. (1998), there are some differences between corporate and non-corporate firms. While the entrepreneurs of corporate firms with limited liability are protected in bankruptcies, those of non-corporate firms are fully liable with their personal assets. In addition, because joint-stock companies can be freely traded in the market and others cannot be, they may be more likely to be the target of mergers and acquisitions. For these reasons, it is predicted that joint-stock companies, compared to the other types of companies, are more likely to exit through bankruptcy or merger.

4.3. Industry-specific characteristics

As for industry-specific characteristics, we examine the effect of capital intensity on new-firm duration. As is often argued, capital intensity is likely to be associated with sunk costs (e.g., Cabral 1995).[21] If new firms are required to establish and operate plants and machines specific to an industry, they are more likely to face larger exit barriers because such plants and machines tend to be sunk. In capital-intensive industries, if capital investment is sunk, new firms are less likely to exit the market.[22]

[21] Large amounts of capital indicate sufficient capacity and size, and new firms are required to establish and operate large-sized plants in, for example, processing industries.

[22] In addition, capital intensity is closely associated with scale economies, which increase the cost disadvantage, and therefore, the exposure to risk confronting a new establishment (Audretsch and Mahmood 1995).

However, firms in capital-intensive industries may have more salable resources, such as physical facilities and real estate, compared to those in labor-intensive industries. In this respect, new firms in capital-intensive industries may have lower barriers to exit. More specifically, if the resources are largely sunk in capital-intensive industries, new firms are more likely to go bankrupt in those industries than in industries with less capital. On the contrary, if not, new firms may be likely to be liquidated voluntarily in capital-intensive industries because resources can be reallocated for resale.

We expect research and development (R&D) intensity to be fairly important in determining survival and exit. Esteve-Pérez et al. (2010) argued that new firms entering the market in R&D-intensive industries usually enjoy high technological opportunities but also face higher uncertainty regarding both the technological characteristics of new products and their demand. Lin and Huang (2008) argued that a higher R&D intensity implies greater innovation opportunities for the industry, and provides better conditions for the entry and survival of new firms. In practice, Lin and Huang (2008) found that the probability of survival tends to be higher in R&D-intensive industries than in less-R&D-intensive industries.[23] In addition, Shapiro and Khemani (1987) found that high research intensity associated with sunk costs deters exit, although it does not deter entry. We hypothesize that while R&D intensity has a negative effect on the occurrence of bankruptcy, as it entails a large part of the firm's resources being sunk, it has no effect on exit through merger because of less sunk costs.

Industry growth may also affect the duration of new-firm survival. Higher industry growth is expected to give a better environment in which new firms can survive

[23]Siegfried and Evans (1994, p. 140) argue that R&D intensity may function as a structural barrier to entry because, when R&D is important, potential entrants may not be able to afford the high initial capitalization required for successful entry.

and grow. Industry growth may enable firms to expand their businesses. In contrast, a higher growth may lead to further investment or new entry, and thereby intensify competition. In this respect, the possibility remains that the risk of exit is as high as the chance of success.

Furthermore, the duration of new firms may depend on the extent of the presence of small firms in each industry. While individual entrepreneurs play an important role in some industries (known as Schumpeter Mark I industries), large firms play a major role in other industries (Schumpeter Mark II industries). In the former industries, new firms may have more opportunities to survive in the market, partly because the economies of scale are not so important. In this respect, the higher the employment share of SMEs, the lower is the probability of exit of new firms.[24] Therefore, the variable for the employment share of SMEs to total employment is included in the model.

4.4. Others

The effect of unemployment rate by prefecture is examined to control for regional economic conditions. Unemployment rate has often been used as a measure of economic distress in regions (e.g., Storey 1994, Acs et al. 2007). The unemployment rate would negatively affect the performance of region-specific businesses, and thus new firms in regions with higher unemployment rates may be more likely to be forced into bankruptcy. On the contrary, because entrepreneurs may not be able to find alter-

[24]We used Hershman-Herfindahl Index (HHI) to measure competition intensity in each industry. Because we did not find any significant coefficient, we do not report the results with HHI. In addition, we examined the effects of entry rates by industry. As is well known, however, entry rate is positively correlated with exit rate (e.g., Geroski 1995). Further, the entry rate is considered to be positively correlated with industry growth, because industry growth induces further entry. To avoid the reverse causality and multicollinearity, we did not include the variable for entry rates, although this variable had positive effects on each exit route.

native employment in economically distressed regions, they are less likely to dissolve their new firms voluntarily.

Following previous studies, the covariate for the time dimension is included in the model as the logarithm of the spell duration (Log (time)) in parametric form (e.g., Cefis and Marsili 2012). It is assumed that the baseline hazard varies monotonically with time.

The definition and descriptive statistics of these covariates are shown in Table 3. While industry-specific covariates and unemployment rate are time-varying, entrepreneur- and firm-specific characteristics (except for firm age) are time-invariant. The former covariates take one-year lag to avoid reverse causality. Using these covariates, we explore the determinants of new-firm duration according to exit route—bankruptcy, voluntary liquidation, or merger.

5. Empirical results

5.1. Basic results

Using the cloglog model, we estimate the determinants of new-firm duration according to exit route. As already explained, our sample consists of 15,097 manufacturing firms founded in Japan during 1997–2004, with data until 2009. We show the estimation results for pooled exit (i.e., together for all three exit routes) in Equation (i) of Table 4 and the results for each exit route in Equations (ii)–(iv) of Table 4. We present both estimated coefficients and computed marginal effects ($\mathrm{d}F/\mathrm{d}x$).

Regarding entrepreneur-specific characteristics, while university education (EDU_UNIV) has a positively significant effect on the probability of pooled exit in Equation (i), the signs of the coefficients of university education are different across Equations (ii)–(iv).

Although the effect of this variable on the probability of bankruptcy is negative in Equation (ii), the effects on the probabilities of voluntary liquidation and merger are positive in Equations (iii) and (iv), respectively. The results indicate that firms with highly educated entrepreneurs are less likely to go bankrupt, and are more likely to exit the market via voluntary liquidation and merger. These findings are consistent with our hypothesis discussed in Section 4. In this respect, the findings support the notion that firms with highly educated entrepreneurs are more likely to outperform other firms, based on the theory of capability and signaling.

Entrepreneur's age has no significant effect on bankruptcy and merger, as shown in Equations (ii) and (iv), while only AGE_50 and AGE_60 have positive and significant effects on voluntary liquidation in Equation (iii). It is also found that the marginal effects increase with the entrepreneur's age. This suggests that elderly entrepreneurs are more likely to voluntarily close their businesses than younger entrepreneurs, which is consistent with our hypothesis and some previous studies, including Harhoff et al. (1998). The variable for male entrepreneurs ($MALE$) has a significant effect only on the probability of merger in Equation (iv), suggesting that male-owned firms tend to be merged more than female-owned ones.

With respect to firm-specific characteristics, both firm size ($SIZE$) and its quadratic term ($SIZE^2$) are not significant for pooled exit, as shown in Equation (i). As for the results according to exit route, $SIZE$ and $SIZE^2$ have positive and negative effects on bankruptcy and merger in Equations (ii) and (iv), respectively. On the contrary, the signs of $SIZE$ and $SIZE^2$ are negative and positive for voluntary liquidation in Equation (iii), respectively. These results indicate that the probabilities of bankruptcy and merger increase with firm size up to a certain point and then

decline, but the probability of voluntary liquidation decreases and then increases with firm size.[25] As discussed, these findings are consistent with the argument of Harhoff et al. (1998).

The effects of firm age ($FAGE$) and its quadratic term ($FAGE^2$) are positive and negative, respectively, on the three exit routes and the pooled exit, as shown in Table 4. This means that the probability of exit increases and then decreases with firm age. The probability of exit peaked at 7.0 years (pooled exit), 8.4 years (bankruptcy), 6.4 years (voluntary liquidation), and 6.4 years (merger).[26] Further, the effects of joint-stock companies ($JSTOCK$) on the probability of exit, are positive and significant in Equations (i), (ii), and (iv); note,though, that this variable is included as a control variable. It may be quite natural that joint-stock companies are more likely to go bankrupt than the other types of companies because the firm's owners and stakeholders have limited liability unlike partnership and sole proprietorship. Because joint-stock companies can be traded in the market, the probability of merger is significantly high.

As for industry-specific characteristics, the variable for capital intensity (CAP), as shown in Equation (ii), has a negative and significant effect on the probability of bankruptcy. This result indicates that new firms are less likely to go bankrupt in capital-intensive industries. In contrast, Equation (iii) indicates that CAP has a significantly positive effect on voluntary liquidation, suggesting that new firms are more likely to voluntarily liquidate their businesses in industries characterized by a

[25] In these cases, the peaked size, measured by the number of employees, is about 30, 46, and 60 for bankruptcy, voluntary liquidation, and merger, respectively.

[26] While our findings indicate that the probability of exit decreases with firm age 6–8 years after commencing operations, many previous studies, including Dunne et al. (1989), found that age has a negative effect on the probability of exit. However, these studies did not use the data of the start-up period, and therefore, our findings do not necessarily contradict theirs.

large amount of capital. These results suggest that firms in capital-intensive industries tend to avoid going bankrupt, since their resources are likely to become firm-specific or relation-specific assets, and therefore, they dissolve their businesses voluntarily before going bankrupt.

Industry growth (IG) has a significantly negative effect on bankruptcy and pooled exit, whereas we do not find any significant effect on voluntary liquidation and merger. These results suggest that higher industry growth gives new firms more opportunities to expand their businesses, and therefore, new firms are more likely to survive in high-growth industries. R&D intensity (RD) too has a negative and significant effect on the probability of bankruptcy in Equation (ii). This is consistent with the finding of Lin and Huang (2008).[27] This may imply that sunk costs associated with R&D investment deter exit, which is consistent with the argument of some previous studies, including Shapiro and Khemani (1987). In contrast, RD has no significant effect on exit through voluntary liquidation and merger, as shown in Equations (iii) and (iv).

The variable for the employment share of SMEs to total employment ($SMESH$) has a negative effect on bankruptcy and voluntary liquidation in Equations (ii) and (iii), respectively, and on pooled exit in Equation (i). This suggests that while new firms are more likely to survive in "entrepreneur-friendly" industries (Schumpeter Mark I industries), they are less likely to be successful in industries where large firms dominate (Schumpeter Mark II industries).[28] As shown in Equation (iv) of Table 4, however, exit through merger is not affected by this covariate. Unemployment rate by

[27]Sarkar et al. (2006) also found that innovative environments promote entrant survival because of more innovation opportunities and mitigation of scale disadvantages for small entrants.

[28]For a detailed discussion on Schumpeter Mark I and II industries, see, for example, Storey and Greene (2010).

prefecture ($UNEMP$) has a significantly positive effect on bankruptcy in Equation (ii). As predicted, the result suggests that new firms are more likely to be forced into bankruptcy in economically distressed regions.

5.2. Alternative estimations

We have estimated the determinants of new-firm duration, using the cloglog model. However, there may be some unobserved heterogeneity (frailty) among firms, which affects the duration of new firms, such as firm-specific management abilities and skills or culture. Such unobserved heterogeneity affects the probability of exit in a particular way, which induces a significant correlation between the exit routes. Neglecting the existence of unobserved heterogeneity (when it is relevant) would bias the estimated-duration dependence of the hazard rate and may attenuate the proportionate response of the hazard variation in each regressor at any survival time (Jenkins 1995).

In order to take into account unobserved heterogeneity, we estimate a random-effects cloglog model for the determinants of new-firm duration according to exit route. We also apply a likelihood-ratio (LR) test to verify whether or not the panel-level variance component is not important and whether or not the panel estimator is not different from the pooled estimator (cloglog).[29] The estimation results are shown in Equations (i)–(iv) of Table 5. It is found that the values and signs of the coefficients are fairly similar to those in Table 4, except for pooled exit. In fact, as shown in Table 5, the LR tests indicate that the panel estimator is not different from the pooled estimator for the three distinct exit routes, although the tests reject the null hypothesis that the panel estimator is not different from the pooled estimator for pooled exit.

[29] For more details, see the *Stata Manual*.

Further, we estimate a multinomial logit model to check the robustness of our findings. As shown in Equation (v) of Table 5, the values and signs of the coefficients are similar to those in the cloglog and random-effects cloglog models.

5.3. Discussion

As shown in the previous subsections, our findings show that there are large differences in the determinants of new-firm duration across the exit routes. We can say that heterogeneity among exit routes should be taken into account to understand the factors affecting the survival and exit of new firms.

Our findings have some important implications regarding the determinants of new-firm duration. As for entrepreneurs' educational background, our findings suggest that firms with highly educated entrepreneurs are less likely to go bankrupt, and are more likely to dissolve voluntarily or be merged. We can take this to imply that the allocation of talent is efficient in the economy. The results for bankruptcy imply that firms with talented human resources are less likely to go bankrupt, and those for exit through merger indicate that the resources of merged firms are reallocated to other firms. However, we cannot conclude the implications from the results for voluntary liquidation, because voluntary liquidation is caused not only by economic but also by non-economic forces. Moreover, the results for the effects of entrepreneurs' age on voluntary liquidation may point out the problem of business succession in the context of the decreasing birthrate and aging population of Japan.

With respect to firm size, our findings suggest that smaller firms tend to exit through voluntary liquidation rather than bankruptcy, partly because debtors and creditors prefer less-formal agreements to the procedure of bankruptcy that entails a large cost and much time. The Civil Rehabilitation Law, which we mentioned

earlier, was passed with an aim to reconstruct failed small firms. The number of bankruptcies tended to increase over time after this law came into effect (Small and Medium Enterprise Agency 2008). However, even now, it is not easy for entrepreneurs to revive their businesses under the law, because the entrepreneurs of small firms usually have to compensate for the debt that is left over by their personal assets to creditors. We take this to imply a potential barrier to entry for future entrepreneurs, especially for "serial entrepreneurs." As already mentioned, in Japan, the start-up ratio has been fairly low and even lower than the closure ratio for decades. Policy makers might have to reconsider how to promote the entry and survival of new firms with growth potential.

Moreover, an interesting finding is that industry-specific characteristics explain the probability of bankruptcy very well, as compared to the other exit routes. All the industry-level covariates used in the analysis are significant for bankruptcy, and the impact of R&D intensity is particularly remarkable among the covariates, suggesting that innovation opportunities are fairly important for survival. In addition, unemployment rate by prefecture has a significant influence only on bankruptcy, suggesting that regional economic conditions force new firms to go bankrupt. These findings imply that bankruptcy is caused by business environments in industries but voluntary liquidation and merger are less likely to be affected by them. More importantly, this suggests that the findings from previous studies, which treated various exit routes as homogeneous, are likely to lead to misleading interpretations, and that taking into account distinct exit routes is fairly important when researching the duration of new firms.

6. Conclusions

This paper explored how the determinants of new-firm duration vary according to exit route: bankruptcy, voluntary liquidation, and merger. Using a sample of new firms in Japan, we provided evidence that the effects of entrepreneur-, firm-, and industry-specific characteristics on new-firm duration are significantly different across exit routes, and in particular, the determinants of bankruptcy are fairly different from those of merger. While firms with highly educated entrepreneurs are less likely to go bankrupt, such firms tend to dissolve their businesses voluntarily or be merged by other firms. The findings suggest that while industry-specific characteristics, such as industry growth and R&D intensity, play a significant role in determining bankruptcy, they do not necessarily affect exit through merger.

However, this paper has some limitations. Although we classified exit into three distinct routes, there might still be some heterogeneity among the exit routes. In fact, while merger occurs as a successful outcome of merged firms, it may be driven by poor performance. In addition, although voluntary liquidation occurs for a variety of reasons, we could not classify it into more detailed routes. Moreover, while we examined the determinants of new-firm duration, we could not include some variables, especially those associated with financial conditions. In fact, Fotopoulos and Louri (2000) and Huynh et al. (2010) provide evidence that initial financial conditions are important factors in determining the exit of new firms. In addition, as Buddelmeyer et al. (2010) and Wagner and Cockburn (2010) found, intangible resources, such as patents and trademarks, may have an impact on firm duration. Furthermore, it would be interesting to extend this research to other industries because, for example, service industries have recently attracted the attention of entrepreneurs, rather than

manufacturing industries.

Despite the limitations of this study, we revealed heterogeneity in the determinants of exit across bankruptcy, voluntary liquidation, and merger among new firms; this has not been examined in previous literature. Entry and exit are essential to industry dynamics, and further investigation on this topic is warranted.

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Appendix A: Tests for the Independence of Irrelevant Alternatives (IIA)

In our empirical model, it is assumed that competing risks (distinct exit routes) are independent. Following previous studies, we tested for the independence of irrelevant alternatives (IIA) assumption in the estimations of multinomial logit specifications, in order to check if the three exit routes can be treated as independent (e.g., Fontana and Nesta 2009, Millan et al. 2012). As shown in Table A1, we performed the Hausman and Small Hsiao tests for IIA assumption, and the Wald and LR tests for combining alternatives. In these tests, it was confirmed that the three exit routes can be treated as independent in our model. All these tests were estimated in STATA 11.

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Table 1: Previous studies on the determinants of survival and of the distinct exit routes at the firm level.

Author(s)	Exit routes	Major determinants	Sample	Estimation method
Balcaen et al. (2012)	B, V, M	*Firm* (cash flow, leverage, debt, age), *Industry* (dummies)	6118 firms (firms less than 5 years old excluded), 1998–2000, Belgium	Binomial nested logit
Buehler et al. (2006)	B, M (S)	*Firm* (size, age), *Region* (dummies), *Industry* (dummies)	54750 firms (13.6 employees), 1995–2000, Switzerland	Continuous-time duration
Cefis and Marsili (2011)	C, M (S)	*Firm* (size, group affiliation, patent applications, entrepreneurial-firm dummy), *Industry* (low- or high-tech dummy)	3203 firms (firms less than 5 years old: 8%), 1996–2003, the Netherlands	Discrete-time duration (ML)
Cefis and Marsili (2012)	C, M (S)	*Firm* (product and process innovation, age, size), *Industry* (Pavitt's categories)	3275 firms (118.2 employees, 28.7 years), 1996–2003, the Netherlands	Discrete-time duration (ML and cloglog)
Esteve-Perez et al. (2010)	C, M (S)	*Firm* (size, age, labor productivity, price-cost margins, R&D, advertising), *Industry* (low-, medium-, or high-tech dummy)	2998 firms (257.5 employees, 23.9 years), 1990–2000, Spain	Continuous-time duration
Fontana and Nesta (2009)	C, M (S)	*Firm* (technology frontier, R&D intensity, size, age)	121 firms (470–480 employees), 1990–2005, worldwide LAN switching industry	Discrete-time duration (ML and cloglog)
Grilli et al. (2010)	C, M (S)	*Firm* (size, age), *Industry* (dummies)	13574 firms (1–2 employees, up to 13 years), 1983–2006, Italy	Continuous- and discrete-time duration (cloglog)
Harhoff et al. (1998)	B, V (S)	*Firm* (size, ownership, diversification, legal status), *Industry* (dummies)	10902 firms (276 employees, 19 years), 1989–1994, West Germany	Continuous-time duration
Mata et al. (2007)	B, V (S)	*Firm* (size, age, debt, bank relationship, foreign ownership, workers' wages, workers' schooling), *Industry* (dummies)	413586 observations (14.8 years), 1995–2000, Portugal	ML
Schary (1991)	B, V, M (S)	*Firm* (debt, cash flow, other financial characteristics)	61 firms, 1924–1940, New England textile industry	Ordered logit and ML
Wagner and Cockburn (2010)	D, M (S)	*Firm* (age at IPO, size, total assets, patent applications, patent citations), *Industry* (dummies)	356 firms, (5.9 years), 1998-2005, US Internet-related industries.	Continuous-time duration

Note:

1. B: bankruptcy, V: voluntary liquidation, M: mergers and acquisitions, C: closure, D: divestiture, S: survival.
2. S in parentheses—(S)—means that the base outcome of the estimated model is "survival."
3. *Firm*, *Industry* and *Region* indicate firm-, industry-, and region-specific variables, respectively.
4. In the fourth column ('Sample'), the sample average in firm size (number of employees) and/or firm age (years after foundation) are presented in parentheses.

Table 2: Figures for pooled exit and the three distinct exit routes over the observation period.

		exit routes				
Period	Pooled exit	Bankruptcy	Voluntary liquidation	Merger	"At risk"	New entry
1997–1998	3	3	0	0	2244	2244
1998–1999	35	11	21	3	4434	2193
1999–2000	86	25	45	16	6403	2004
2000–2001	123	38	70	15	8521	2204
2001–2002	209	58	126	25	10241	1843
2002–2003	240	72	139	29	11562	1530
2003–2004	239	67	134	38	12870	1548
2004–2005	269	59	173	37	14162	1531
2005–2006	252	58	154	40	13893	—
2006–2007	309	98	160	51	13641	—
2007–2008	328	123	160	45	13332	—
2008–2009	192	97	58	37	13004	—
Total	2285	709	1240	336	124307	15097

Table 3: Definitions and summary statistics of independent variables.

Variable	Definition	Mean	S.D.	Min.	Max.
Entrepreneur-specific characteristics					
EDU_UNIV	Dummy variable: 1 if the entrepreneur's educational background is university level, 0 otherwise.	0.261	0.439	0	1
EDU_X	Dummy variable: 1 if the entrepreneur's educational background is unknown, 0 otherwise.	0.453	0.498	0	1
$MAGE\_30$	Dummy variable: 1 if the entrepreneur's age is between 30 and 39, 0 otherwise.	0.161	0.368	0	1
$MAGE\_40$	Dummy variable: 1 if the entrepreneur's age is between 40 and 49, 0 otherwise.	0.237	0.425	0	1
$MAGE\_50$	Dummy variable: 1 if the entrepreneur's age is between 50 and 59, 0 otherwise.	0.262	0.440	0	1
$MAGE\_60$	Dummy variable: 1 if the entrepreneur's age is 60 and more, 0 otherwise.	0.081	0.273	0	1
$MAGE\_X$	Dummy variable: 1 if the entrepreneur's age is unknown, 0 otherwise.	0.223	0.416	0	1
$MALE$	Dummy variable: 1 if the entrepreneur is male, 0 otherwise.	0.943	0.232	0	1
Firm-specific characteristics					
$SIZE$	Number of employees in the firm.	11.399	14.992	1	99
$SIZE^2$	$SIZE \times SIZE$	354.692	1060.587	1	9801
$FAGE$	Years after the foundation of the firm.	5.022	2.922	1	12
$FAGE^2$	$FAGE \times FAGE$	33.758	34.158	1	144
$STOCK$	Dummy variable if the firm is a stock company, 0 otherwise.	0.503	0.500	0	1
Industry-specific characteristics					
$CAPINT$	Industry's value of physical fixed assets, divided by the value of shipments.	0.229	0.083	0.002	2.334
$GROW$	Differences in industry's value of shipments between t and $t-1$, divided by the value of shipments at $t-1$ (converted from nominal values to actual values).	-0.003	0.067	-0.242	0.432
$RDINT$	Industry's R&D expenditure divided by sales.	0.029	0.020	0.001	0.151
$SMESH$	Share of employment in SMEs (1–99 employees) relative to industry's total employment.	0.637	0.202	0.012	1.000
Other characteristics					
$UNEMP$	Unemployment rate in each prefecture (in percent).	4.435	1.123	1.700	8.400

Table 4: Estimated results: cloglog model

			Exit routes					
	(i) Pooled exit		(ii) Bankruptcy		(iii) Voluntary		(iv) Merger	
Variable	Coefficient	dF/dx	Coefficient	dF/dx	Coefficient	dF/dx	Coefficient	dF/dx
EDU_UNIV	0.139**	0.0024	-0.182*	-0.0009	0.294***	0.0027	0.419**	0.0007
	(0.059)	(0.0010)	(0.100)	(0.0005)	(0.083)	(0.0008)	(0.166)	(0.0003)
EDU_X	0.098*	0.0016	-0.281***	-0.0014	0.217***	0.0019	0.597***	0.0009
	(0.059)	(0.0010)	(0.102)	(0.0005)	(0.081)	(0.0007)	(0.176)	(0.0003)
$MAGE\_30$	-0.031	-0.0005	-0.025	-0.0001	-0.010	-0.0001	-0.103	-0.0001
	(0.145)	(0.0024)	(0.218)	(0.0011)	(0.218)	(0.0019)	(0.424)	(0.0006)
$MAGE\_40$	0.211	0.0037	0.055	0.0003	0.270	0.0025	0.471	0.0008
	(0.138)	(0.0026)	(0.210)	(0.0011)	(0.207)	(0.0021)	(0.396)	(0.0007)
$MAGE\_50$	0.453***	0.0084	0.050	0.0002	0.695***	0.0072	0.604	0.0010
	(0.136)	(0.0028)	(0.210)	(0.0011)	(0.203)	(0.0025)	(0.391)	(0.0008)
$MAGE\_60$	0.746***	0.0172	0.230	0.0012	1.118***	0.0160	0.482	0.0008
	(0.144)	(0.0045)	(0.231)	(0.0014)	(0.211)	(0.0047)	(0.431)	(0.0009)
$MAGE\_X$	0.471***	0.0090	0.107	0.0005	0.663***	0.0070	0.637	0.0011
	(0.140)	(0.0031)	(0.222)	(0.0012)	(0.208)	(0.0026)	(0.400)	(0.0008)
$MALE$	0.010	0.0002	-0.068	-0.0003	-0.131	-0.0012	2.015***	0.0014
	(0.092)	(0.0015)	(0.160)	(0.0008)	(0.114)	(0.0011)	(0.710)	(0.0002)
$SIZE$	-0.133	-0.0022	2.010***	0.0098	-3.908***	-0.0336	6.054***	0.0086
	(0.379)	(0.0063)	(0.747)	(0.0036)	(0.578)	(0.0049)	(0.805)	(0.0013)
$SIZE^2$	0.452	0.0075	-3.323***	-0.0162	4.281***	0.0368	-5.044***	-0.0072
	(0.495)	(0.0082)	(1.162)	(0.0056)	(0.729)	(0.0062)	(0.997)	(0.0015)
$FAGE$	0.476***	0.0079	0.521***	0.0025	0.488***	0.0042	0.460***	0.0007
	(0.037)	(0.0006)	(0.067)	(0.0003)	(0.050)	(0.0004)	(0.097)	(0.0001)
$FAGE^2$	-0.034***	-0.0006	-0.031***	-0.0001	-0.038***	-0.0003	-0.036***	-0.0001
	(0.003)	(0.0001)	(0.005)	(0.0000)	(0.004)	(0.0000)	(0.008)	(0.0000)
$STOCK$	0.165***	0.0027	0.177**	0.0009	-0.001	0.0000	1.182***	0.0018
	(0.048)	(0.0008)	(0.085)	(0.0004)	(0.064)	(0.0006)	(0.166)	(0.0003)
$CAPINT$	-0.076	-0.0013	-1.983***	-0.0097	0.668**	0.0057	-0.067	-0.0001
	(0.271)	(0.0045)	(0.563)	(0.0027)	(0.303)	(0.0026)	(0.685)	(0.0010)
$GROW$	-0.951***	-0.0158	-2.542***	-0.0124	-0.031	-0.0003	-1.123	-0.0016
	(0.349)	(0.0058)	(0.648)	(0.0031)	(0.466)	(0.0040)	(0.893)	(0.0013)
$RDINT$	-1.029	-0.0171	-5.161**	-0.0252	0.474	0.0041	-0.864	-0.0012
	(1.285)	(0.0213)	(2.432)	(0.0118)	(1.710)	(0.0147)	(3.121)	(0.0045)
$SMESH$	-0.476***	-0.0079	-0.690***	-0.0034	-0.423**	-0.0036	-0.326	-0.0005
	(0.135)	(0.0022)	(0.242)	(0.0012)	(0.182)	(0.0016)	(0.340)	(0.0005)
$UNEMP$	0.007	0.0001	0.076**	0.0004	-0.033	-0.0003	0.012	0.0000
	(0.020)	(0.0003)	(0.034)	(0.0002)	(0.027)	(0.0002)	(0.051)	(0.0001)
Log (time)	-0.096	-0.0016	-0.190	-0.0009	-0.140	-0.0012	0.221	0.0003
	(0.067)	(0.0011)	(0.130)	(0.0006)	(0.087)	(0.0008)	(0.185)	(0.0003)
Constant term	-5.336***		-5.861***		-5.631***		-11.711***	
	(0.258)		(0.458)		(0.346)		(0.983)	
N of observations	124,307		124,307		124,307		124,307	
N of zero outcomes	122,022		123,598		123,067		123,971	
N of nonzero outcomes	2,285		709		1240		336	
Log likelihood	-11,192.133		-4,272.615		-6,775.914		-2,129.193	

Notes:

1. Base outcome (reference) is "survival."
2. $SIZE$ is multiplied by 10^{-2} for significant decimal points.
3. Standard errors are in parentheses.
4. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 5: Estimated results: Random-effects cloglog and multinomial logit models

	Random-effects cloglog model				Multinomial logit model		
		Exit routes			Exit routes		
	(i)	(ii)	(iii)	(iv)	(v)		
Variable	Pooled exit	Bankruptcy	Voluntary	Merger	Bankruptcy	Voluntary	Merger
EDU_UNIV	0.181**	-0.182*	0.294***	0.431**	-0.178*	0.295***	0.421**
	(0.080)	(0.100)	(0.083)	(0.174)	(0.100)	(0.083)	(0.167)
EDU_X	0.133*	-0.282***	0.217***	0.620***	-0.278***	0.219***	0.599***
	(0.080)	(0.102)	(0.081)	(0.188)	(0.103)	(0.081)	(0.176)
$MAGE\_30$	-0.024	-0.025	-0.010	-0.123	-0.025	-0.010	-0.104
	(0.187)	(0.218)	(0.218)	(0.438)	(0.219)	(0.218)	(0.425)
$MAGE\_40$	0.281	0.055	0.270	0.469	0.059	0.273	0.473
	(0.181)	(0.211)	(0.207)	(0.407)	(0.211)	(0.208)	(0.397)
$MAGE\_50$	0.616***	0.050	0.695***	0.603	0.058	0.701***	0.610
	(0.182)	(0.210)	(0.203)	(0.403)	(0.210)	(0.204)	(0.392)
$MAGE\_60$	1.022***	0.231	1.119***	0.485	0.244	1.128***	0.495
	(0.202)	(0.232)	(0.211)	(0.443)	(0.232)	(0.212)	(0.431)
$MAGE\_X$	0.648***	0.108	0.663***	0.641	0.116	0.668***	0.644
	(0.188)	(0.223)	(0.208)	(0.412)	(0.223)	(0.208)	(0.400)
$MALE$	0.007	-0.068	-0.131	2.045***	-0.067	-0.129	2.015***
	(0.123)	(0.161)	(0.114)	(0.718)	(0.161)	(0.115)	(0.710)
$SIZE$	-0.208	2.013***	-3.908***	6.352***	2.000***	-3.892***	6.045***
	(0.516)	(0.749)	(0.578)	(1.062)	(0.750)	(0.581)	(0.809)
$SIZE^2$	0.633	-3.327***	4.282***	-5.278***	-3.299***	4.273***	-5.032***
	(0.690)	(1.163)	(0.729)	(1.167)	(1.164)	(0.734)	(1.002)
$FAGE$	0.626***	0.521***	0.488***	0.473***	0.528***	0.495***	0.468***
	(0.065)	(0.067)	(0.050)	(0.104)	(0.068)	(0.051)	(0.097)
$FAGE^2$	-0.038***	-0.031***	-0.038***	-0.036***	-0.031***	-0.039***	-0.036***
	(0.004)	(0.005)	(0.004)	(0.008)	(0.005)	(0.004)	(0.008)
$STOCK$	0.218***	0.178**	-0.001	1.204***	0.180**	0.002	1.184***
	(0.066)	(0.085)	(0.064)	(0.177)	(0.086)	(0.065)	(0.166)
$CAPINT$	0.024	-1.984***	0.668**	-0.023	-1.982***	0.665**	-0.069
	(0.341)	(0.564)	(0.303)	(0.724)	(0.565)	(0.308)	(0.688)
$GROW$	-0.842**	-2.542***	-0.031	-1.079	-2.555***	-0.050	-1.145
	(0.370)	(0.648)	(0.466)	(0.907)	(0.650)	(0.469)	(0.897)
$RDINT$	-1.205	-5.168**	0.474	-1.006	-5.180**	0.459	-0.890
	(1.688)	(2.436)	(1.711)	(3.282)	(2.442)	(1.724)	(3.135)
$SMESH$	-0.567***	-0.690***	-0.423**	-0.337	-0.698***	-0.431**	-0.336
	(0.177)	(0.242)	(0.182)	(0.355)	(0.243)	(0.184)	(0.341)
$UNEMP$	0.018	0.076**	-0.033	0.010	0.076**	-0.033	0.012
	(0.025)	(0.034)	(0.027)	(0.053)	(0.034)	(0.027)	(0.051)
Log (time)	-0.067	-0.191	-0.140	0.240	-0.192	-0.141	0.220
	(0.086)	(0.130)	(0.087)	(0.195)	(0.130)	(0.087)	(0.185)
Constant term	-7.199***	-5.887***	-5.633***	-12.444***	-5.864***	-5.638***	-11.715***
	(0.589)	(0.462)	(0.346)	(1.667)	(0.459)	(0.349)	(0.985)
σ_u	1.714	0.229	0.056	1.080			
	(0.232)	(0.262)	(0.136)	(0.899)			
ρ	0.641	0.031	0.002	0.415			
	(0.062)	(0.068)	(0.009)	(0.404)			
LR test of rho = 0 (χ^2)	9.39***	0.01	0.026	0.19			
N of obs.	124,307	124,307	124,307	124,307		124,307	
Log likelihood	-11,187.439	-4,272.623	-6,775.916	-2,129.097		-13,164.426	
N of groups	15,097	15,097	15,097	15,097			

Notes:

1. Base outcome (reference) is "survival."
2. $SIZE$ is multiplied by 10^{-2} for significant decimal points.
3. Standard errors are in parentheses.
4. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table A1: Specification tests for independence.

Specification test	χ^2 $(p > \chi^2)$
Hausman tests of IIA assumption	
- Ho: Odds (Outcome-J vs. outcome-K) are independent of other alternatives.	
Omitted: 1 (Bankruptcy)	-0.041 (1.00)
Omitted: 2 (Voluntary liquidation)	3.536 (1.00)
Omitted: 3 (Merger)	-0.102 (1.00)
Small-Hsiao tests of IIA assumption	
- Ho: Odds (Outcome-J vs. outcome-K) are independent of other alternatives.	
Omitted: 1 (Bankruptcy)	38.125 (0.555)
Omitted: 2 (Voluntary liquidation)	39.023 (0.514)
Omitted: 3 (Merger)	41.866 (0.390)
Wald tests for combining alternatives	
- Ho: All coefficients except intercepts associated with a given pair of alternatives are 0.	
1 (Bankruptcy) - 2 (Voluntary liquidation):	196.930 (0.00)
1 (Bankruptcy) - 3 (Merger):	197.310 (0.00)
1 (Bankruptcy) - 0 (Survival):	172.441 (0.00)
2 (Voluntary liquidation) - 3 (Merger):	297.311 (0.00)
2 (Voluntary liquidation) - 0 (Survival):	320.416 (0.00)
3 (Merger) - 0 (Survival):	331.379 (0.00)
LR tests for combining alternatives	
- Ho: All coefficients except intercepts associated with a given pair of alternatives are 0.	
1 (Bankruptcy) - 2 (Voluntary liquidation):	199.079 (0.00)
1 (Bankruptcy) - 3 (Merger):	234.799 (0.00)
1 (Bankruptcy) - 0 (Survival):	196.514 (0.00)
2 (Voluntary liquidation) - 3 (Merger):	349.790 (0.00)
2 (Voluntary liquidation) - 0 (Survival):	343.629 (0.00)
3 (Merger) - 0 (Survival):	387.354 (0.00)