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Business failure of new firms: an empirical analysis using a multiplicative hazards model

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Abstract

This paper investigates business failure of new firms. Using a multiplicative hazards model, we estimate the determinants of business failures among new manufacturing firms in Tokyo during the period 1986 to 1994. It is found that the new firm without sufficient capital or sufficient large size confronts a higher risk of business failure. It is also found that the new firm is more difficult to survive in an industry characterized by a high entry rate. With respect to the timing of entry, the new firm that entered just before or after the collapse of the so-called bubble economy is more likely to fail. Considering the macroeconomic conditions on calendar time, we estimate the regression model based not only on age but also on calendar time. By using the regression model on calendar time, it is also found the firm's age is related to business failure.

Keywords : New firm; Business failure; Multiplicative hazards model

JEL Classification : G33; L11; M13

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I. INTRODUCTION

The emergence of new firms is a big concern in advanced industrial countries which struggle to overcome economic stagnation. New firms are expected to stimulate growth and competition in industries. Several policies have been undertaken by these countries in order to urge entrepreneurs to start new business. Nevertheless, entry of new firms may have become more difficult year by year.[1] New firms often compete against dominant incumbent firms and have to invest a substantial amount of capital to introduce advanced technology. Furthermore, undesirable macroeconomic situations such as depression may be more severe for new firms if it is necessary to have a learning period without profits. As a result, many of the new firms that lack financial strength tend to fail and are forced to go bankrupt.

The purpose of this paper is to investigate business failure of new firms. Business failure in this paper is defined as a situation in which firms cannot meet their liabilities and hence cannot conduct economic activities any more.[2] Bankruptcy through a legal procedure may be the most typical form of business failures. However, in practice, any firm whose bills are no longer honored by banking facilities is regarded as business failure even if it is not yet judged as bankrupt by the court. In fact, most of the failing firms cease operations following suspended business transaction caused by dishonored bills.[3] That is, business failures in this paper include not only those legally claimed

[1] Small and Medium Enterprise Agency (1996) found that the gross entry rate in Japanese manufacturing industries had become less than the gross exit rate since 1989.

[2] The definition is derived from Tokyo Shoko Research (TSR), a leading supplier of relevant statistics on unsuccessful enterprise in Japan. It is similar to the definition by Dun & Bradstreet in the United States.

[3] According to TSR, the above case is about 90% of total business failures in Japan.

as bankrupt but also those regarded as impotent from an economic point of view.

There have been many studies on business failure. Most of these studies attempted to identify whether or not individual firms may fail in the near future.[4] These studies focused on predicting business failures of firms and dealt with firms irrespective of their age: incumbents or new entrants. On the other hand, some of the recent empirical studies have investigated the post-entry performance of new entrants, in particular, exit of new entrants. Audrestch and Mahamood (1994, 1995) investigated the exit of new firms and establishments (manufacturing plants) in the United States. They proposed an analytical framework using the proportional hazards model by Cox (1972) and used the data on new entrants founded in a single common year. Mata *et al.* (1995) applied the analytical framework to the exit of new entrants over different years. They investigated the exit of new establishments founded in Portugal during 1983 – 1989. These studies on the post-entry performance used the time dimension on age of new entrants, that is, the number of years since the new entrants had been founded.

Our interest is also to investigate the post-entry performance of new firms, in particular, business failure of new firms. Following the analytical framework used by Audrestch and Mahmood (1994, 1995), and Mata *et al.* (1995), we estimate the determinants of business failures among new manufacturing firms in Tokyo during 1986 – 1994. While these studies on the post-entry performance dealt with exits, this paper is restricted to business failures which are, we consider, special cases of exits and may correspond to exits without

[4]For example, Altman (1983) developed a model to predict business failures using the financial statements of firms.

solvency. The causes of individual exits seem to be considerably different. For example, one firm exits out of a market while it is still gaining some profits; another firm exits reluctantly such as bankruptcy. Hence, this paper shows the result based on the more identifiable post-entry performance. Furthermore, we use the time dimension not only on age of new firms but also on calendar time.

The paper is organized as follows. In the second section, we explain the multiplicative hazards model that is used to investigate business failure of new firms. In the third section, we explain the data sources. In the forth section, we explain the determinants of business failures and the variables. In the fifth section, we estimate the determinants of business failures among new manufacturing firms founded in Tokyo during 1986 – 1994. We use the regression model based on calendar time as well as on age. In the final section, we summarize our findings with implications.

II. METHODOLOGY

The proportional hazards model proposed by Cox (1972), known as Cox model, is the most widely used regression model for survival data. Andersen and Gill (1982) extended the Cox model by means of the counting process formulation and proposed the multiplicative hazards model as a generalized version of the Cox model.[5] While the original Cox model cannot be applied to the time dimension on calendar time, the multiplicative hazards model can be applied

[5] The original formulation of the counting process was done by Aalen (1978). The counting process and the multiplicative hazards model are described in Fleming and Harrington (1991), and Andersen *et al.* (1993).

to other situations such as multiple events and the time dimension on calendar time.[6]

With respect to applications of the Cox model, Tunali and Pritchett (1997) introduced alternative concepts of time dimensions using an example of the yellow fever epidemic in New Orleans. They proposed to consider three time dimensions: calendar time, age, and duration of residency in New Orleans. They estimated the determinants of yellow fever deaths using the multiplicative hazards model, since the multiplicative hazards model can be applied to the time dimension on calendar time as already explained. Their approach is useful to detect mis-specification of the time dimension.

In this paper the multiplicative hazards model is proposed to estimate the determinants of business failures because there may be cases where business failures of new firms are more related to macroeconomic conditions represented by calendar time than to age.[7] First, we introduce the multiplicative hazards model based on age of new firms. Time t is defined as age of a new firm which is the period since the firm was founded. Consider n firms in a sample and assume that k firms among the n firms have ceased operations due to business failure by the end of the observation period. Let X_i denote a potential failure time of firm i. However, X_i is not observed for all n firms because some firms continue to exist until the end of the observation period without business failure; that is, some data are censored. Here let U_i denote a censored time which indicates the time when we stop observing the business failure of firm i. Let

[6] In this paper we ignore the multiple events. That is, we ignore a case where a firm is re-founded after it has failed. In this case, the firm is regarded as a different firm.

[7] Mata *et al.* (1995) used the regression model based on age, and time-dummy variables are included in their regression model to control for the changes in macroeconomic conditions. The result was that the time-dummy variables had a significant effect on exit. That may indicate that mis-specification of the time dimension matter.

δ_i denote an indicator for censoring, and $\delta_i = I(X_i \leq U_i)$ where $I(\cdot)$ denotes the indicator function. That is, $\delta_i = 0$ if the observation is censored, $\delta_i = 1$ if the observation is uncensored. Let $Y_i(t)$ denote an indicator function for risk at time t, and $Y_i(t)$ is defined as follows.

$$Y_i(t) = I(t \leq \min\{X_i, U_i\}) \tag{1}$$

Now we define the hazard function. The hazard function, $\lambda(t)$, specifies the instantaneous failure rate at time t. Let T denote a non-negative random variable, and $\lambda(t)$ is defined as follows.

$$\lambda(t) = \lim_{\Delta t \to 0+} \frac{\Pr(t \leq T \leq t + \Delta t | t \leq T)}{\Delta t} \tag{2}$$

Our interest is to examine how economic and other variables explain the business failure of new firms. For this purpose, the hazard function proposed by Cox (1972) is most commonly used. Let z_i denote a vector of explanatory variables for firm i. The model assumes that the hazard function is of the form:

$$\lambda(t; z_i) = \lambda_0(t) \exp(z_i' \beta) \tag{3}$$

where β is a vector of regression parameters, and $\lambda_0(t)$ is an unknown baseline hazard function based on age of the new firms. Since it is not necessary that $\lambda_0(t)$ be specified, we can obtain β without mis-specifing $\lambda_0(t)$. If $\delta_i = 1$, then the likelihood L_i that firm i fails rather than the other existing firms at time X_i is as follows.

$$\begin{aligned} L_i &= \frac{\lambda(t; z_i)}{\sum_{j=1}^{n} Y_j(X_i) \lambda(t; z_j)} \\ &= \frac{\exp(z_i' \beta)}{\sum_{j=1}^{n} Y_j(X_i) \exp(z_j' \beta)} \end{aligned} \tag{4}$$

In the multiplicative hazards model we obtain the partial likelihood function on age, L, for n firms as follows.[8]

$$L = \prod_{i=1}^{n} \left[\frac{\exp(z_i'\beta)}{\sum_{j=1}^{n} Y_j(X_i) \exp(z_j'\beta)} \right]^{\delta_i} \tag{5}$$

Then, we propose the multiplicative hazards model based on calendar time. Suppose that calendar time $\tilde{t}$ is used as a time dimension. The baseline hazard function, $\tilde{\lambda}_0(\tilde{t})$, is defined as an unknown baseline hazard function based on calendar time. That implies that the baseline hazard function depends on macroeconomic conditions such as boom and depression. Moreover, let $\tilde{V}_i$ denote a foundation time which indicates the time when firm i was founded. Let $\tilde{Y}_i(\tilde{t})$ denote the indicator function on calendar time, and $\tilde{Y}_i(\tilde{t})$ is defined as follows:

$$\tilde{Y}_i(\tilde{t}) = I\left(\tilde{V}_i \leq \tilde{t} \leq \min\left\{\tilde{X}_i, \tilde{U}_i\right\}\right) \tag{6}$$

where $\tilde{X}_i$ and $\tilde{U}_i$ indicate a potential failure time and a censoring time on calendar time, respectively. If we stop observing business failures on a certain time, then $\tilde{U}_i \cdots = \tilde{U}_n$ for all n firms. In the same way, we get the partial likelihood function on calendar time to estimate the determinants of business failures.

III. DATA

The data on new firms come from the *TSR Data Bank* compiled by Tokyo Shoko Research (TSR). This data source deals with failed firms and existing

[8]This likelihood function ignores business failures at the same time, but the approximated formulations to calculate this likelihood function are established by previous studies. In this paper the Breslow approximation is used (Breslow, 1974). In these approximations each of tied times is treated as though it occurred just before the others.

firms, respectively. The failed firms are defined as those which have ceased operations with total debt more than 10 million yen.[9] The *TSR Data Bank* gives several facts on each firm: for example, the foundation time, the paid-up capital, and the current number of employees.[10] Almost all the firms are classified at the four-digit standard industrial classification (SIC) level; however, a few of the failed firms are classified only at the three-digit SIC level.

The data on industries come from the *Establishments Census of Japan* by the Statistics Bureau of the Management and Coordination and the *Census of Manufactures* (Ministry of International Trade and Industry). The *Establishments Census of Japan* collects the fundamental data on establishments every five years. In order to obtain the data on gross entry, we also use the *Establishment Directory Maintenance Survey of Japan* (*EDMS*) that is published for 1989 and 1994 as a supplemental volume of the *Establishments Census of Japan*. The *EDMS* collects the data on new establishments for three years, and we can obtain the number of new establishments at the three-digit SIC level during 1986 – 1989 and 1991 – 1994, respectively.[11] Since the gross entry rate in this paper is measured by establishments, the gross entry rate includes not only new firms but also the new establishments created by incumbent firms.[12]

The *Census of Manufactures* collects the fundamental data on manufacturing industries such as value of shipments in industries every year. However,

[9]The data on failed firms include the firms that voluntarily compromised with creditors and ceased operations.

[10]Although the data are revised every few years, the latest data are only obtainable. The data on failed firms are the latest data before the firms cease operations.

[11]It is, to our knowledge, the only data on gross entry at the three-digit SIC level in Japanese manufacturing industries.

[12]On the other hand, when the gross entry rate is measured by firms, it excludes new establishments created by incumbent firms but includes new subsidiary firms created by incumbent firms.

the Census usually collects the data on the establishments that employ more than four persons, and the data on the establishments of all sizes are collected only for 1985, 1988, 1990, and 1993 among recent years.

The observation period is 1986 – 1994 as already explained. The data is censored at the end of 1994. Therefore, those firms that have failed after January 1995 are regarded as existing firms; that is, $\delta_i = 0$. With respect to the observation period, Yen appreciated rapidly since the Plaza Accord of 1985. The period 1986 – 1987 was a recession period due to the Yen appreciation. Then, around 1989 – 1990, the so-called bubble economy brought a tremendous business boom. After the collapse of the bubble economy, the economy confronted a great depression.

IV. DETERMINANTS OF BUSINESS FAILURES

Time t is measured by months because the foundation time of the new firms is available only by months. We consider the determinants of business failures, z_i, among new firms. According to the traditional view of entry and exit, the level of expected profits induces entry and exit.[13] With respect to business failure, negative profits over time increase the probability of business failure. Therefore, it is assumed that business failure is determined by the profitability of new firms. However, even if the new firm is potential profitable, it may incur temporary negative profits. If the new firm has sufficient funds, then it can survive the period of the temporary negative profits; otherwise, it may run into the hazard of business failure. In this case, the new firm may bor-

[13]For a more discussion of entry and exit, see Geroski (1991), Geroski and Schwalbach (1991), and Geroski (1995).

row more money from banking facilities. It is, however, impossible for the banking facilities to know the true or the potential profitability of new firms completely. As a result, the banking facilities do not necessary provide finance for the profitable new firms. Therefore, it is assumed that business failure is determined by financial strength and profitability of new firms.

The financial strength is here measured by capital of new firms. The variable, *Capital*, is defined as the logarithm of paid-up capital (in thousand yen).[14] Compared with total assets, paid-up capital does not include liabilities and retained profits. Thus, total assets are more suitable to represent the firm's asset size. However, total assets include liabilities, and a large amount of liabilities increases the probability of business failure. Moreover, total assets are more affected by the fluctuation in the financial markets. Although other variables including total assets are considered as measurement of the financial strength, we cannot obtain any financial data except for paid-up capital from the data sources.[15]

When examining the profitability, we consider variables from two categories: internal and external factors of new firms. As internal factors, capabilities of new firms such as R&D and marketing must play an important role in determining the profitability of the firms. However, we cannot obtain such strategic variables from the data sources. On the other hand, it is argued that new firms start small and are burdened by an inherent size disadvantage (Audrestch and Mahamood, 1995). Even if scale merits are large, new firms may not be able to

[14] We also used the actual number of paid-up capital instead of the logarithm of it. As a result, we obtained similar results.

[15] Subsidiary firms are financially supported by their parent firms. Some of the new firms seem to be subsidiary firms. It may be interesting to ascertain whether or not the ownership style affects business failure of new firms. However, it was difficult to distinguish subsidiary firms in our data source.

enlarge their sizes due to lack of mass-production technology and distribution and marketing channels. Thus, in order to examine the size disadvantage, the size of new firms is included in the regression model. The variable, *Size*, is defined as the number of employees divided by the average of employees of the industry. That is, *Size* represents the relative size in the industry. The average of employees of the industry is calculated by the total number of employees of the industry divided by the number of companies of the industry in Tokyo of 1986 from the data in the *Establishment Census of Japan.*

In addition, we can examine the effect of age of new firms by means of the regression model based on calendar time. The variable, *Age*, is defined as the number of months the new firm has been operation since it was founded. Following several previous studies, we also include a quadratic term in age.

As external factors, the dynamic characteristics of the industry are measured by gross entry rate and industry growth. The industries in this paper are classified at the three-digit SIC level. Since several studies on entry have documented a positive correlation between entry and exit (Geroski, 1995), we expect that the gross entry rate has a positive effect on business failure. The gross entry rate is defined as the ratio of the number of new establishments divided by the total number of incumbent and new establishments of the industry. The variable, *Entry*, is calculated by the average of two discrete periods, 1986 to 1989 and 1991 to 1994 from the data in *EDMS.* The variable of the industry growth, *Growth*, is defined as the percentage change in the added-value of shipments during 1985 – 1993 from the data in the *Census of Manufactures.*

Furthermore, following Audrestch and Mahamood (1995)'s study, the profitability of the industry is included in their regression model. We use the price-cost margin of the industry that is defined as the value of shipments minus labor and material costs, divided by the value of shipments. The variable, PCM, is calculated from the data in *Census of Manufactures* as an average of the price-cost margins in 1985, 1988, 1990, and 1993. We also include an additional variable to inquire whether geographical concentration affects business failure of new firms. Such an inquiry is worth while particularly because some industries, such as printing, concentrate on the Tokyo area. The variable, $CR-TYO$, is defined as the ratio of the number of employees in Tokyo divided by that in the whole country in 1986 from the data in the *Establishment Census of Japan.*

Finally, time-dummy variables are included in the regression model based on age to control for the effects of the different entry timing. That is, the time-dummy variables indicate the foundation year of the new firms. No firm founded in 1993 and 1994 failed by the end of the year; thus, the time-dummy variables for 1993 and 1994 are excluded. Since a constant term is not allowed in the regression model, the time-dummy variable for 1986 is also excluded among the time-dummy variables. The time-dummy variables are represented by $D87 - D92$, and, for example, if the firm is founded in 1987, $D87 = 1$; otherwise, $D87 = 0$.

V. EMPIRICAL RESULTS

Our data consist of 2488 new manufacturing firms founded in Tokyo during 1986 – 1994. All these firms are private companies. Of the total, 120 firms have ceased operations by the end of 1994.

Table 1 shows the results using the multiplicative hazards model based on age.[16] Equation (ii), (iii), and (iv) include the time-dummy variables, $D87 - D92$. Equation (iii) exclude *Capital* because there is a high correlation between *Capital* and *Size*. Equation (iv) include $CR - TYO$ but exclude *Entry* because there is a high correlation between *Entry* and $CR - TYO$.

In Table 1, with respect to the financial strength, *Capital* has a significantly negative effect on business failure, and the coefficient is significant at the 1% level. Since *Capital* is positively related to *Size*, *Capital* may imply the effect of firms' size.[17] However, the financial strength represented by paid-up capital apparently affects business failure of new firms, while the previous studies on exit ignored the financial variables. The result suggests that new firms without sufficient capital confront a higher risk of business failure.

With respect to the internal factors of the profitability, *Size* has a negative effect on business failure, and the coefficient is significant in Equation (iii). It is consistent with the result by Mata *et al.* (1995) who found that the current size had a negative effect on exit of new establishments. The result shows that new firms with relatively small size are more likely to fail. Since *Size* is the current size, it may also indicate a reverse causality that the new firms that continue to exist without business failures enlarge their size. Although the causality is not clear, our result suggests that new firms without sufficient large size confront a higher risk of business failure.[18]

[16] Audrestch and Mahamood (1995), and Mata *et al.* (1995) used time-dependent variables, allowing z_i to vary over time. However, we do not use time-dependent variables except for *Age* because we cannot constantly obtain the data on firms and industries. Moreover, it is difficult to determine the time lags.

[17] The correlation coefficient between *Capital* and *Size* is 0.4697.

[18] Mata *et al.* (1995) found that the initial size had a positive effect on exit.

With respect to the external factors of the profitability, *Entry* has a significantly positive effect on business failure. It is also consistent with the result by Mata *et al.* (1995). The result suggests that new firms confront a higher risk of business failure if they are in an industry where entry occurs actively. Active entry may be an indication of a fierce market competition. However, *Entry* does not include potential entry. Moreover, there may be more severe competition even without new entrants as the Bertrand oligopoly model suggests. Nevertheless, since many previous studies have shown positive correlations between entry rate and proxies of entry barriers (Geroski and Schwalbach, 1991), *Entry* is likely to indicate how low the entry barrier of the industry is. Our result may, therefore, suggest that the survival of a new firm is more difficult in a market characterized by low entry barriers.

On the other hand, *Growth* has a negative effect on business failure, but the coefficient is not significant. Mata *et al* (1995) found that industry growth had a significantly negative effect on exit. Although the result does not show the significant effect of the industry growth, it is similar to the result by Audrestch and Mahamood (1995). While the industry growth decreases the probability of business failure, it may also have a positive effect on business failure. The conditions in the growing industry are unsettled, and the industry growth may give the risk of failure as well as the chance of success.

PCM has a negative effect on business failure, but the coefficient is not significant. The result does not show that the profitability of the industry has a significant effect on business failure. Audrestch and Mahamood (1995) found that exit had a positive effect on exit, but the coefficient was not significant. While the profitability of the industry is positively related to the profitability of the new firms, it may indicate that sunk costs are more required in the industry. That is, the higher profitability of the industry may also increase the probability of business failure due to the sunk costs.

In addition, $CR - TYO$ has a significantly positive effect on business failure. The concentration at the industry level does not have a negative effect on business failures but a significantly positive effect on it.[19] Thus, the result may suggest that new firms in the geographically concentrated industries confront a higher risk of business failure. However, the data on the new firms in the other areas are required to reveal the fact more obviously.

With respect to the time-dummy variables, $D90$ and $D91$ have a significantly positive effect on business failure, and these coefficients are significant at the 1% level. By contrast, the coefficients of $D87 - D89$ and $D92$ are not significant. It is interesting to note that the new firms that entered just before or after the collapse of the bubble economy confront a higher risk of business failure. One explanation for this result is that the sudden depression after the collapse of the bubble economy has more strongly affected the younger firms and hence they have ceased operations with a short life. Another explanation is that easy entry attracted by the bubble economy results in business failure.

Table 2 shows the results using the multiplicative hazards model based on calendar time. Equation (ii), (iii), and (iv) include *Age* and Age^2. The estimated coefficients of the common variables, *Capital*, *Size*, and *Entry*, are not almost changed between Table 1 and Table 2. That is, these results are not changed irrespective of the time dimensions. While the previous studies on exit have used only the time dimension on age without considering the mis-

[19] Using a dummy variable for printing, we also estimated the effect. However, we did not obtain the result that the dummy variable had a significant effect on business failure.

specification of the baseline hazard function, we estimate the determinants of business failures using two time-dimensions: age and calendar time. Therefore, the results we obtained appear more robust.

Furthermore, we examined the effect of age using the regression model based on calendar time. *Age* has a significantly positive effect on business failure, and Age^2 has a significantly negative effect on it. These coefficients are significant at the 1% level. The negative quadratic term begins to dominate about six years when we use Equation (ii) in Table 2. Many previous studies have shown that age has a positive effect on exit of firms. Dunne *et al.* (1989) found a positive correlation between age and survival of firms using the data on manufacturing plants in the United States.[20] The longer firms remain in the market, the more they may acquire experience. If age is regarded as experience, it may have a negative effect on business failure. However, by using an initial endowment, new firms may be able to avoid business failure during a short period. The result shows that the probability of business failure increases with age during a certain period (about six years). After the period, new firms are less likely to fail as time passes. In addition, the observation period is at most nine years. It may be not long enough to show the effect of the firms' experience.

VI. CONCLUSION

In this paper we estimated the determinants of business failures among new manufacturing firms in Tokyo using the multiplicative hazards model. It was

[20] However, this paper is restricted to business failures of new firms. Therefore, our results may not necessarily follow the results of these studies.

found that the new firm without sufficient large size confronted a higher risk of business failure. It was also found that the new firm was more difficult to survive in an industry characterized by high entry rate. Although we investigated not exit but business failure, these findings were consistent with the previous studies on exit. In addition, it was found that the financial strength measured by paid-up capital apparently affected business failure of new firms. Moreover, the new firm that had entered just before or after the collapse of the bubble economy was more likely to fail.

In this paper we proposed the multiplicative hazards model to investigate business failure of new firms. Considering the macroeconomic conditions on calendar time, we estimated the regression model based not only on age but also on calendar time. Using two regression models, we may be able to avoid mis-specification of the baseline hazard function; therefore, we obtained more robust results. Moreover, we examined the effect of age using the regression model based on calendar time. It was also found that age affected business failure. However, the observation period is limited less than nine years.

The result in this paper suggested that the survival of new firms was more difficult in a market characterized by a high entry rate. If business failure is caused only by firms' capabilities or market dynamics due to competition, market mechanism based on economic natural selection may operate properly. On the other hand, it is often argued that new firms are obliged to start business without sufficient capital. According to the questionnaires by the Small and Medium Enterprise Agency (1996), the lack of own resources is the most grave obstacle for new firms when they start business. The result in this paper also suggested that sufficient capital was needed to avoid business failure. Needless to say, we do not deny all types of business failures. However, if almost all new firms need deficit period to learn business, it may be necessary to full up the financial support policies for new firms. Also, if it is necessary that new firms spend a large amount of sunk.costs at the beginning of business, social welfare loss occurs where they fail before gaining profits. For this purpose, more detailed data on attributions of new firms, in particular, capabilities of new firms, would be required for the further investigation.

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Table 1. Empirical results: regression model on age

	(i)	(ii)	(iii)	(iv)
Capital	−0.2593***	−0.2562***		−0.2743***
	(0.0903)	(0.0909)		(0.0835)
Size	−0.0835	−0.0780	−0.1722**	
	(0.0839)	(0.0820)	(0.0851)	
Entry	3.3862*	3.5773*	3.6217*	
	(1.9809)	(1.9828)	(1.9672)	
Growth	−0.0970	−0.1259	−0.0111	−0.1446
	(0.4366)	(0.4384)	(0.4217)	(0.4358)
PCM	−0.2957	−0.3614	−0.8590	−0.4541
	(1.9039)	(1.9284)	(1.8289)	(1.9901)
$CR-TYO$				1.0756*
				(0.5540)
$D87$		0.2143	0.1751	0.2135
		(0.2728)	(0.2725)	(0.2728)
$D88$		0.0148	0.0058	0.0157
		(0.3282)	(0.3281)	(0.3282)
$D89$		0.0878	0.0521	0.0781
		(0.3939)	(0.3937)	(0.3940)
$D90$		1.2184***	1.2363***	1.2074***
		(0.3576)	(0.3574)	(0.3574)
$D91$		1.3364***	1.2843***	1.3373***
		(0.4848)	(0.4845)	(0.4849)
$D92$		0.8924	0.8173	0.9108
		(1.0776)	(1.0773)	(1.0775)
$-2\log L$	1699	1682	1691	1683
LR statistic	19.03***	36.02***	27.81***	35.31***

Note : Standard errors in parentheses. ***, **, and * indicate significant at the 1%, 5%, and 10% level, respectively.

Table 2. Empirical results: regression model on calendar time

	(i)	(ii)	(iii)	(iv)
Capital	−0.2861***	−0.2662***		−0.2828***
	(0.0903)	(0.0900)		(0.0826)
Size	−0.0585	−0.0743	−0.1739**	
	(0.0769)	(0.0818)	(0.0853)	
Age		0.0753***	0.0817***	0.0750***
		(0.0208)	(0.0194)	(0.0208)
Age^2		−0.0005***	−0.0005***	−0.0005***
		(0.0002)	(0.0002)	(0.0002)
Entry	3.5674*	3.4935*	3.5376*	
	(1.9712)	(1.9791)	(1.9654)	
Growth	−0.1599	−0.1243	0.0017	−0.1469
	(0.4383)	(0.4371)	(0.4292)	(0.4348)
PCM	−0.4622	−0.4029	−0.9765	−0.5030
	(1.9403)	(1.9206)	(1.8197)	(1.9815)
$CR-TYO$				1.0519*
				(0.5524)
$-2\log L$	1832	1798	1808	1799
LR statistic	20.65***	53.98***	44.14***	53.36***

Note : Standard errors in parentheses. ***, **, and * indicate significant at the 1%, 5%, and 10% level, respectively.