

The Safety of Japanese Shinkin Bank Management and Z-score^{*}

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Abstract

The safety of financial institutions is an essential condition for expediting financial transactions and a benchmark suggesting for the safety is needed. In this article, we try to test whether Z-score can be used as a proxy for the survival probability of Shinkin Banks (SBs) or not, by the method of survival analysis and the data of the Financial Statements for National Shinkin Banks (FSNSB). From the result of our analysis, we can get two implications as follows: Z-score could be a strong candidate for the benchmark for safety of a SB; Differences in scale and regionality should be controlled at the analysis of SBs' safety.

JEL Classification Codes : C41, G21

Key Words : Shinkin Banks, Z-score, survival analysis

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1. Introduction

Japanese Shinkin Banks (SBs) are classified into cooperative and regional banks and an important part of Japanese regional financial system. Their businesses have two features: regulatory limitations on business area and on customers. They can accept all kind of deposits in their business area, which is almost smaller than prefectures, but their lending practice customers are limited only to small /medium-sized enterprises (SMEs) and individuals, which must have a special relationship, it's called "Membership", with SBs. And a SB's Membership SMEs must be located in that bank's business area. On the other hand, for households (depositors), whether a bank office is located in their neighborhood or not is important to their satisfaction with financial service.¹ Customers of SBs are nearby SMEs and households.

Japanese business enterprises largely depend on borrowings from their nearby deposit institutions, as for their external source of business funds. Especially, SMEs strongly have that tendency². So, a SB's destabilization might interrupt financing of regional small businesses within that bank's business area. And that destabilization may cause "Deposit flights", which is my coined words from the phrase "Capital flights". This destabilization may have a potential to trigger the crisis of regional economy and financial system.

In other words, the safety of SB management is very important problem for regional economy governance and micro-level prudence policy. Once the financial health of a bank begin to worse, it would become very hard to turn around that ailing bank. So, the best way what we can think for keeping stability³ of a bank management would be to make preemptive moves to serious ail of a bank. For this preemptive action, the benchmark for bank management is needed. In fact, several benchmarks have used for that object (e.g. BIS capital ratio). But to seek a more appropriate benchmark has been sustained. In this article, we show that "Z-score" is a strong candidate for the benchmark for safety of SBs with the results of our empirical analysis using data of the *Financial Statements for National Shinkin Banks (FSNSB)*⁴. From our survival analysis, we get two imprecations as follows: Z-score could be used as a proxy for survival probability of a SB; Regionality and Scale of banks are important factors for the safety of SBs.

The rest of this article proceeds as follows: In Section2, we describe past benchmarks; In Section3, we discuss about Z-score; In Section4, we illustrate methodology, data, and result of our empirical analysis; Section5 concludes this article.

¹ Some surveys, for example by Postal Services Research Institute or by Kinzai Institute for Financial Affairs, Inc., show that crucial important factors are closeness and safety of those banks when depositors choice their own deposit-taking ones.

² Tawada and Yamori (2005, 2008) show that, in Tokai area and Kinki area, SMEs have choiced nearby financial institutions as their main-banks. And Degryse and Ongena (2004) shows that same tendency has been found in Europe and USA.

³ Of course, this stability is satisfied together with the safety of management.

⁴ By Kinyu- Consultant Inc. Only in Japanese (Japanese Name: *Zenkoku- Shinyou- Kinko- Zaimu- Shohyo*).

2. Benchmarks of safety of financial institution management

2.1. Critiques for evaluation of the benchmark of safety

Minimum requirement for a deposit institution's existence is an enough solvency for a repayment on demand. There is no one who deposits his money in the bank with a suspected solvency. Of course, this is a crucial and fatal situation for all kind of deposit institutions. For a deposit institution, the social confidence for his solvency is most basic requirement. This confidence would be a basis of safety of the financial institutions.

We think that there are three points for evaluation of the benchmark of safety for financial institutions. The first one is the view-point on future risks for their holding assets. Commonly, agreement dates are different from settlement ones at financial transactions. They contain an incompleteness based on uncertainty. So a financial institution's solvency should be evaluated by not only current but also future risks for their assets. The second one is the view-point of past performance. The confidence for a bank cannot be established instantly. It depends on whether the bank can have achieved stable performance for a certain level of period or not. Hence, information for past performance should be included in the benchmark of safety based on social confidence. Finally, the third one is the view-point of transparency. If the benchmark shows high performance, no bank would hesitate to make that benchmark public. But, once the financial health of a bank become worse and benchmark reflects this bad situation, the bank might conceal or fabricate the bad benchmark for fear of falling confidence by the publication. Therefore, to reflect a bank's status precisely is one of important requirements to fulfill for the benchmark. And simultaneously, it's also the important requirement that preciseness of the benchmark is clear to all. One of ways to fulfill this requirement is to ensure the ease of making, which means a kind of reproducibility, for the benchmark.

From these disuccsion, we think the benchmark for safety of financial institutions needs three requirements as follows: To contain information for solvency reflecting futre risks; To contain information for past performance; To ensure transparency and ease for making. In the rest of this section, we discuss validity of several benchmarks for safety from the perspective of our three requirements.

2.2. Gearing Ratio

In 1986, the gearing ratio, which is a ratio of own capital account to total asset, was introduced into Japanese banks as the index of solvency (in other words, as the benchmark of banks' safety) by the instruction of MOF. The gearing ratio is easily calculable by a bank's basic financial data, and so easily available to everyone. In that sense, the gearing ratio can be called a very pragmatic benchmark. However, this ratio does not contain the evaluation of future risks contained in banks'

owned assets⁵, so that ratio is not enough to a benchmark of future solvency. But almost settlements of financial transactions would not be real time ones and those transactions always contain a risk of defaults. And, therefore, it's doubtful to deal with the gearing ratio, which does not contain information for a bank's future solvency, as an only benchmark of safety.

2.3. BIS capital ratio

As everyone knows, since the mid 1980s, the Financial Deregulation has progressed worldwide. That deregulation has caused higher financial market risks by an evaluation and diversification of financial assets and related technologies. In other words, the progress of deregulation would have brought not only the increase of a profit earning opportunity but also the financial destabilization. This recognition led to the introduction of BIS Capital Accord (In 1988, Basel I; In 2004, Basel II). The method of this accord is Asset-Specific Approach; a financial institution is obligated to show the capital-to-asset ratio (that capital must be calculated by the weighted average method using weights varying by category of holding assets) as the measure of his own solvency, and maintain above a certain level of that ratio. This ratio is based on the instantaneous portfolio like the gearing ratio, but evaluates the solvency with factoring that institution's future risks, unlike the gearing ratio.

But, actual use of BIS capital ratio as that benchmark would remain to have several problems. BIS capital ratio suggests the concept of "whether or not a financial institution sets his capital or reserves enough to cover future risks". This means that the ratio contains time view of present and future. And in other words, BIS capital ratio does not contain the evaluation of a bank's safety based on past management, especially information for stability.

Also, there are some practical problems to use the ratio as the benchmark. From the business aspect, it would be like putting the cart before the horse to concentrate on making the benchmark, instead of main business. Therefore, it should be needed to be easy of making for the benchmark. And as mentioned above, information for a bank's safety is needed by not only insiders of the bank but also outsiders (the benchmark should have a transparency required for improving asymmetry of information).

But, as well known, to calculate and accumulate with categorizing risk assets is needed for making BIS capital ratio. This task should be difficult even for insiders, who have detail bank-inside information. Of course, for outsiders, it's impossible to reproduce the ratio only by published basic financial data. Though this ratio is published in banks' financial data recently (since 1996, SBs have been publishing), outsiders cannot check preciseness of that ratio. And to verify past management by this ratio is impossible. From these points of view, BIS capital ratio would have some difficulties for actual using.

⁵ However, reserves for bad loans are contained.

3. Z-score

In preceding section, we mentioned conceptual and actual difficulties to use BIS capital ratio as the benchmark of a financial institution's safety. Now, we shall propose to use Z-score as the benchmark instead of BIS capital ratio. Z-score, which has been already suggested as the benchmark of stability of corporate management (or the risk of a corporate bankruptcy) in 1960s by Altman (1968), is not a novelty concept. Altman's Z-score is defined as follows (1). This (1) would show that the higher Z-score of that company is, the lower risk of a bankruptcy (and the more stable that company's management).

$$\text{Altman's Z-score} = 1.2 X_1 + 1.4 X_2 + 3.3 X_3 + 0.6 X_4 + 0.999 X_5 \quad (1)$$

X_1 : Working Capital / Total Assets

X_2 : Retained Earnings / Total Assets

X_3 : Earnings before Interest and Taxes / Total Assets

X_4 : Market Value of Equity / Book Value of Total Liabilities

X_5 : Sales / Total Assets

Even in recent years, Altman's Z-score has been used as the benchmark of the corporate management stability; for example, "The bankruptcy risk ranking of Japanese firms based on their Z-scores" was published in 2008/10/4 issue of *Diamond Weekly* (In Japanese)⁶. Z-score has been used in not only business field but also academic field. Table 1 shows recent related studies⁷ and that there are small differences among these studies. The definitions of their Z-scores aren't same as Altman's one. In this section, we shall reference these earlier formulations to devise our own formulation of Z-score, which can be used as the benchmark of SBs' safety.

Table 1. Definitions of Z-score in earlier studies

Studies	Formulations of Z-Scores
1 Lorn et al. (2000)	[Ave of CAR (for 2 periods) + Ave of ROA (for 2 periods)] / SD of ROA
2 Inaba and Hattori (2006)	[Ave of CAR (for 5 years) + Ave of ROA (for 5 years)] / SD of ROA (for 5 years)
3 Laeven and Levine (2006)	(CAR + ROA) / SD of ROA (for 4 years)
4 Maechler et al. (2007)	[Ave of CAR (for 3 years) + Ave of ROA (for 3 years)] / SD of ROA (for 3 years)
5 Inaba and Hattori (2007)	[Ave of CAR (for 5 years) + Ave of ROA (for 5 years)] / SD of ROA (for 10 years)
6 CihAk and Hesse (2007)	(CAR + Ave of ROA) / SD of ROA

CAR : Capital-to-Asset Ratio
ROA : Return on Assets
Ave : Average
SD : Standard Division

Table 1 shows that a sum (or sum of averages) of capital-to-asset ratio and return on assets (ROA) is the numerator and a standard deviation of ROA is the denominator of all formulations of Z-scores.

⁶ In *Diamond Weekly*, this ranking has been published infrequently.

⁷ Laeven, L. and R. Levine (2006) "Corporate Governance, Regulation and Bank Risk Taking," World Bank, Washington. It's unpublished, but there is a description about their Z-score in CihAk and Hesse (2007).

Inaba and Hattori (2007) describes that Z-score shows the possibility for famine of expected returns and capital by the negative return (=loss). The numerator of Z-score would suggest scale of buffer, which represent solvency reflecting future risks because of containing capital-to-assets ratio. Hence, Z-score satisfies our first requirement; To contain information for solvency reflecting future risks. And the denominator would imply volatility of returns. Few people deny that this volatility reflects past performance of management. Z-score satisfies our second requirement; To contain information for past performance.

In short, Z-score presents how a bank's buffer can cover volatility of his return⁸. This is the reason for using Z-score as the benchmark of companies' stability. And, the fact that the denominator of Z-score is a standard deviation of ROA means that the result of evaluation by Z-score would be sometimes different with the one by BIS capital ratio. If two banks have similar level capital-to-assets ratio and ROA, there would be little difference between evaluations by BIS capital ratio. On the other hand, evaluations by Z-score indicate that the bank whose volatility of returns is smaller (= S.D. of ROA is smaller) is better⁹.

In this article, we adopt the formulation (2) based on several formulations in Table 1 as our Z-score for SBs. And as the capital, we use the members' account, which is one of the items of SB accounts and equals the sum of stake, legal reserve, retirement-payment reserve, other reserves, and current unappropriated surplus¹⁰. This score can be calculated easily from a SB's basic financial data. It means that everyone can calculate our Z-score with using the data from the FSNSB. From this FSNSB, everyone can get yearly data of ROA, members' account, and total assets. In other words, this score satisfies our third requirement, which is to ensure transparency and ease for making¹¹.

$$\text{Our Z-score} = (X_1 + X_2) / X_3 \quad (2)$$

X_1 : current members account / total assets

X_2 : current ROA

X_3 : standard deviation of ROA (for 10years)

But, for our Z-score, most important point is to function successfully for the benchmark of safety. Nonfunctional Z-score has no mean even if our three requirements are satisfied. In next section, we

⁸ Some studies assume the normality on ROA or capital-to-assets ratio and presume Z-score as the probability of bankruptcies. But Lorn et al. (2000) and Inaba and Hattori (2007) says that this assumption is too strong.

⁹ In CihAk and Hesse (2007), they thought the reason why cooperative banks could be important part of financial systems in spite of lower response capabilities to market risk and lower ROA than commercial banks, particularly in European countries, was the stability of cooperative banks' management, which might be observable from low variance of their ROA, and tested it by Z-score. They concluded that the high Z-score would show the stability of European cooperative banks and that high stability had enhanced their presence in European countries' financial systems.

¹⁰ The members account corresponds to a Shinkin Bank's capital, and shows this bank's solvency.

¹¹ Our Z-score can use BIS capital ratio instead of members' account-to-assets ratio. But according to our above discussion, this score cannot ensure transparency and ease for making.

will examine empirically whether our Z-score (2) can be used as the benchmark or not.

4. Empirical Analysis

4.1. Methodology

In this section, we analyze empirically the relationship between SBs' Z-scores calculated in accordance with the formulation (2) and safety of SBs. More precisely, we perform the survival analysis about the relationship between SBs' Z-scores and their duration. Though the survival analysis has mainly evolved in the field of medical statistics, since Lane et al. (1986), this method has been adopted in many empirical studies about corporate bankruptcy or duration.

According to Kitamura (2009), in the survival analysis, duration of an analyzing object is thought as follows. T represents timing when an event (a vanishment of a SB, in this article) occurs. The cumulative distribution function $F(t)$ shows probability of occurring the event that a SB is vanished at time t , when is before T . The survival function $S(t)$ presents probability of never occurring the event by time t . These functions are written as,

$$\begin{aligned} F(t) &= \int_0^t f(s) ds \\ S(t) &= 1 - F(t) \end{aligned} \tag{3}$$

where $f(t)$ is $F(t)$'s stochastic distribution function. And the hazard function $\lambda(t)$ indicates probability of surviving by time t and occurring event at next period.

$$\lambda(t) = f(t)/S(t) = -S'(t)/S(t) \tag{4}$$

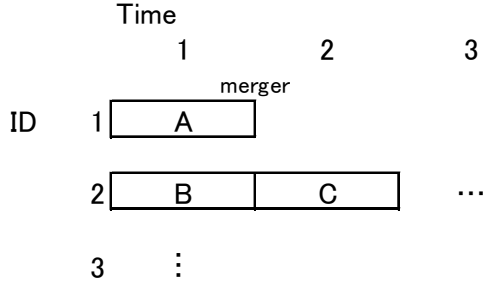
One of the main purposes of the survival analysis is to estimate this hazard function. By this estimation result, the relationship between duration and covariates (SBs' survival time and Z-scores, in this article) would be able to be considered.

4.2. Data

Our analyzing period is from 1999 to 2006. At the end of 1998, there were 393 SBs. But at the end of 2006, there were only 287 banks because of bankruptcies or mergers (during this period, no SB had been established newly). This fact means that our data set is an unbalanced panel data. Commonly, in the corporate panel data, merged firms and surviving firm are treated as independent ones. But, in this article, because mergers during our analyzing period are almost relief ones and our

method is the survival analysis, we think that an accepting bank equals the surviving bank¹². Figure 1 shows our treatment for mergers.

Figure 1. Treatment for mergers in our data set



where A is an absorbed and extinct bank, B is an accepting bank, and C is a surviving bank. At the merger, A becomes extinct. B and C are continuous ones.

Table 2. Basic statistics (2,603obs)

variables		mean	Std. Dev	min	25%	50%	75%	max
Z-score		30.63	22.97	-7.98	12.58	26.90	42.80	196.40
Total Assets (real, billion yen)		349.0	448.0	14.1	101.0	191.0	401.0	3,680.0
variables		0	1					
Area dummies	Hokkaido	2388	215					
	Tohoku	2326	277					
	Kanto	2301	302					
	Tokyo	2367	236					
	Hokuriku	2289	314					
	Tokai	2258	345					
	Kinki	2297	306					
	Chugoku	2376	227					
	Shikoku	2508	95					
	Kita-Kyushu	2468	135					
	Minami-Kyushu	2452	151					

Table 2 presents basic statistics of our Z-score, which is calculated by the formulation (2), and other variables using in our estimation. And, the data source of these variables is the *FSNSB*. Total assets are deflated by the CPI. Area dummies are belonging area association dummies¹³, more precisely.

4.3 Survival analysis I : Kaplan-Meier Method

We classify all SBs to 4 groups by calculated Z-scores of 1998 and estimate survival probabilities

¹² In most these relief mergers, the local major shinkin bank played a role as White Knight. To split factual-continuous bank data would be fatal to the survival analysis.

¹³ Though both Okinawa Shinkin Bank and Goza Shinkin bank are belonging to Tokyo area association, we emphasize their location and treat them as belonging to Minami-Kyushu area.

for each group by Kaplan-Meier Method, which is one method of the survival analysis. Kaplan-Meier Method is a non-parametric method of estimating, and estimating survival function is written as,

$$\hat{S}(t) = \left(1 - \frac{d_1}{n_1}\right) \times \left(1 - \frac{d_2}{n_2}\right) \times \cdots = \prod_{i=1}^t \left(1 - \frac{d_i}{n_i}\right) \quad (5)$$

where d_t presents the number of extinct banks at time t , n_t shows the number of surviving banks by just before time t .

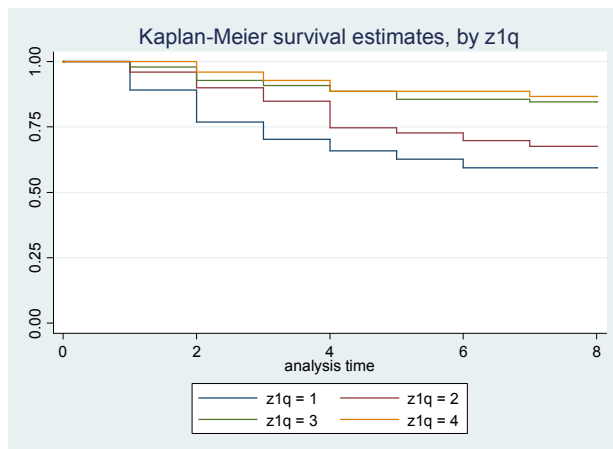
In 1998, there were 393 SBs in Japan. Table 3 shows basic statistics of calculated Z-scores in 1998. Group1 has lowest Z-score and group4 has highest one. We classify this banks into 4 groups based on quartile points in that table.

Table 3. Our Z-score in 1998

obs.	min	25%	50%	75%	max	mean	S.D.
393	-6.12%	37.28%	52.83%	70.87%	217.82%	56.8%	28.7%
Group 1	under 37.28						
Group 2	under 52.83 & over 37.28						
Group 3	under 70.87 & over 52.83						
Group 4	over 70.87						

We estimate survival probability by each group for 8 years (1999~2006) using by Kaplan-Meier method. And Figure 2 indicates Kaplan-Meier survival curves of these groups.

Figure 2. Survival probability of SBs (by Kaplan-Meier Method)



Notes: Z1q=1:Group1, Z1q=2:Group2, Z1q=3:Group3, Z1q=4:Group4

Figure1 shows two facts as follows: Survival probability becomes larger in order of group number; There is a large distance between Group2's survival probability and Group3's one.

And, we try to do the log-rank test and Wilcoxon test in order to assess the significance of difference among each groups' survival probabilities. Both tests' null-hypotheses are same one: $H_0 : S_{gp1}(t) = S_{gp2}(t) = S_{gp3}(t) = S_{gp4}(t)$.

Table 4. Results of Log-Rank test and Wilcoxon test

	Test-statistics	P-value
Log-Rank test	22.94	(0.00)
Wilcoxon test	23.83	(0.00)

Table4 reports the results of these tests. Both p-values are 0.00, so null-hypotheses are rejected at the 1% level. Therefore, the differences among Group1~4's survival probabilities are significant. This fact shows that our Z-score would be correlated with Sinkin bank's survival probability significantly. It means that our Z-score could be a proxy for Sinkin bank's survival probability.

4.3 Survival analysis II : Cox Proportional Hazard Model

Our analysis by the method of Kaplan-Meier shows the possibility that our Z-score can be a benchmark of SB's safety. But Kitamura (2009) said that if analyzing objects are affected by heterogeneity and independent variables cannot control it, a hazard function couldn't be estimated efficiently. For SBs, many studies have pointed out the existence of economies of scale (e.g. Horie (2008)). Differences in the scale of SBs may generate heterogeneity among SBs. And as we mentioned above, SBs have regulatory limitations on business area. It means that all SBs don't face on same business conditions. Differences in the regional business conditions also may generate heterogeneity among SBs.

At the estimation for the hazard function, though these differences in the scale or regionality have to be controlled by added independent variables, Kaplan-Meier is not a multivariate analysis. So, we try to use the Cox Proportional Hazard Model, which can operate multi-independent variables as covariates. This model estimates the effects of covariates for the hazard function, which is called "baseline hazard"¹⁴. In this article, we choice total assets and area dummies, which are proxies for scale and regionaily of SBs, as covariates. Total assets are deflated by CPI and logarithmic. Area dummies are defined by belonging regional associations (in Japan, there are 11 regional associations of SBs).

The Cox Proportional Hazard Model is basically written as,

$$\lambda(t) = \lambda_0(t) \exp(\beta_1 x_1 + \dots + \beta_k x_k) \quad (6)$$

¹⁴ The Cox Proportional Hazard Model dosen't directly estimate the baseline hazard itself.

where $\lambda_0(t)$ is the baseline hazard, x_1, \dots, x_k are covariates, β_1, \dots, β_k are estimating parameters.

Commonly, in the Cox Proportional Hazard Model, covariates, x_1, \dots, x_k , are constant against time (e.g. gender gap, past history of illness and medication, and so on). But, total assets, which is one of our covariates, is a time variant variable. So, based on Cameron and Trivedi (2005) which expand the Cox Proportional Hazard Model to the one allowing time variant covariates, we rewrite (6) as,

$$\lambda(t) = \lambda_0(t) \exp(\beta' \mathbf{x} + \gamma' \mathbf{z}(t)) \quad (6)'$$

where \mathbf{x} is a vector of time invariant covariates, \mathbf{z} is a vector of time variant covariates, and β and γ are vectors of parameters.

In this article, we use this extended Cox Proportional Hazard Model, (6)'. In our earlier analysis by Kaplan-Meier method, Z-scores are constant (we use only 1998's Z-scores). However, in this sub-section, we operate Z-scores as a time variant covariate.

Table 5. Estimation results by Cox Proportional Hazard Model

	Corf.	Std. Err.	Haz. Ratio
Z-score	-0.060 ***	0.009	0.942
Total Assets (real, log)	-0.977 ***	0.134	0.376
Area dummies ¹			
Hokkaido	0.439	0.550	1.551
Tohoku	-0.928	0.682	0.395
Kanto	1.095 **	0.475	2.989
Tokyo	1.851 ***	0.476	6.365
Hokuriku	0.663	0.491	1.941
Tokai	0.844	0.531	2.327
Kinki	1.693 ***	0.469	5.436
Chugoku	0.247	0.529	1.280
Shikoku	0.642	0.621	1.901
Kita-Kyushu	0.056	0.545	1.058
joint significance of area dummies	38.79 ***		
Log likelihood	-481.58		
obs.	2,603		

Respectively, *, **, *** indicate significance at the 10, 5, 1% levels.

1: base = Minami-Kyushu

Table 5 reports our estimation results by the extended Cox Proportional Hazard Model.

By not only simple univariate analysis but also multivariate analysis controlling differences in scale and regionality, we can confirm that Z-score has significant influence on SB's duration. And, Z-score's parameter is negative, so we can see that the higher Z-score has possibility of the longer duration. This fact means, as well as the result of our earlier analysis by Kaplan-Meier method, that our Z-score could be treated as a proxy for safety of a SB.

Also, the parameter of real total assets is significantly negative. It means that a larger scale Sinkin Bank has higher survival probability. And the result of joint significance test for area dummies is significant, so it implies that differences in regionality have impacts on SBs management. The fact

that estimation results for these covariates are significant shows a need for controlling two factors, scale and regionality of SB, at the analysis by SBs' micro data.

5. Conclusion

For the smooth regional finance, a benchmark, which contains information for safety of SBs and provides a transparency, would be needed. In this article, we try to test whether Z-score can be used as a proxy for SB's survival probability or not, by the method of survival analysis and data of the *FSNSB*. From the result of our analysis, which are univariate one and multivariate one, we can get two implications as follows: Z-score could be a strong candidate for the benchmark for safety of a SB; Differences in scale and regionality should be controlled at the analysis of SBs' safety.

But our analysis is very simple. We have many subjects which have been clear yet. For example, the relationship between scale and safety of SBs is one of those subjects. Cost? Portfolio of assets? We have to analysis from a lot of view-points. And, what is the "regionality"? More exactly, what factors do influence on SBs' management? This question is also one of our further major subjects.

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