

# The Value of Financial and Non-Financial Information in Japanese Small and Medium-sized Enterprises Risk Assessment

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**Abstract:** The purpose of this study is to investigate indicators needed for credit risk measurement for Japanese Small and medium-sized enterprises (SMEs), using financial information, as well as corporate information of a large SMEs database. Since this data include non-financial information with categorical data, the author applies a multinomial logit regression analysis to develop the model. The analyses in this study show that not only financial information but non-financial information is the valuable source for a SMEs risk assessment. Sales (log), internal reserves to total assets ratio, ROA, interest coverage ratio, debt to equity ratio, and operating profit to sales ratio are statistically positive and significant financial ratio. Firms which do not own real estates are statistically significantly positive.

**Key words:** credit risk assessment; SMEs; multinomial logistic regression mode; financial information; non-financial information

**JEL code:** G31

## 1. Introduction

More than 99% of all businesses in Japan are small or medium-sized enterprises (SMEs); they also employ a majority of the working population and account for a large proportion of economic output (METI, 2014). Altman and Sabato (2007) found that small and medium sized enterprises of the US are significantly different from large corporates from a credit risk point of view. Especially, SMEs rarely provide reliable financial data so that they are informationally opaque. SMEs often depend on financial institutions for external funding, since they simply do not have access to public capital markets (Berger & Udell, 2002). Thus, commitment to credit risk management is an essential component of a comprehensive technique to risk management and critical to the long-term success to all banking institutions. The recent literature on small and medium-sized enterprises (SMEs) lending emphasizes that commercial lenders can draw on alternative lending technologies in extending credit to SMEs based on soft information and hard information (Berger & Udell, 2002, 2005).

In this paper, the author analyzes the nature and effects of financial and non-financial data in credit risk modeling, using a large SMEs database in Japan. This paper is organized as follows. Following the introduction on Section 1, Section 2 presents literature review on SMEs credit risk assessment. Section 3 describes the data and variables. Section 4 presents analytical method. Section 5 presents the result of analysis. Finally, summary of

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research results and future study are discussed in Section 6.

## 2. Literature Review

Using data from the Federal Reserve Board's 1993, 1998 and 2003 Surveys of Small Business Finances (SSBFs), the issue of availability of credit to small business has been studied. Petersen and Rajan (1994) analyze credit availability using data from 1987 SSBF, and found firms with stronger relationships with their prospective lenders are more likely to receive credit, and close ties with creditors lead to greater availability of credit at lower rates of interest. Also using 1987 SSBF data, Berger and Udell (1995) find loan rates are lower when firms have longer pre-existing relationships. Cole (1998) finds the length of the firm-lender relationship that affects the likelihood a lender will extend credit through the 1993 SSBF. Chakraborty and Hu (2006) also use the 1993 SSBF data to analyze how relationships affect lender's decision to secure lines of credit and other types of loans.

The importance of bank relationships to small businesses in terms of both credit availability and credit terms such as loan interest rates and collateral requirements have been supported by several empirical studies (e.g., Petersen & Rajan, 1994, 1995; Berger & Udell, 1995; Cole, 1998; Elsas & Krahnen, 1998; Harhoff & Körting, 1998a). Kirschenmann (2011) study credit rationing in small business bank relationships in one Bulgarian bank by using a data set of matched loan application and loan contract information, and find that credit rationing is considerable and most pronounced for opaque borrowers in the beginning of bank relationships, but is resolved with decreasing informational asymmetries over the bank relationship.

In a study of bank-borrower relationship for SMEs in Japan, Kano et al. (2011) suggest that relationship strength matters most when firms are less transparent (i.e., do not have audited financial statements), which implies that relationship lending and financial statement lending are distinct lending technologies for Japanese SMEs. Using a postal survey data conducted in the small business district area in Japan by the local government office in August 1998, Kutsuna and Cowling (2003) find that probability of loan approval is positively associated with employment size of small businesses, loan requests made to governmental financial institutions for small businesses, and for investment in fixed assets. Hatsumi et al. (2011) use datasets from firm surveys conducted by the Research Institute of Economy, Trade, and Industry (RIETI) during 2008-2009, to examine the ex-post performance of SMEs that obtained small business credit scoring (SBCS) loans. They find that the ex-post probability of default after the SBCS loan was provided significantly increased for SMEs that obtained an SBCS loan from a transactional lender. They also find that the lending attitude of relationship lenders in the midst of the recent global financial crisis became much more severe if a transactional lender had extended an SBCS loan to a firm. These findings suggest that SBCS loans by a transactional lender are detrimental to a relationship lender's incentive to monitor SMEs and maintain relationships.

Miyamoto (2014) investigates indicators needed for credit risk measurement for a small bank, using both financial and non-financial dataset consists of nearly 4,955 loans to individual entrepreneurs and small enterprises extended by one bank located in the provincial city of Japan over the period 2002 to 2004. The results show both financial information and non-financial information are valuable sources for credit risk assessment for both small enterprises and individual entrepreneurs which are majority of the small bank are lending customers.

## 3. Data

In this paper, the author analyzes credit risk assessment by using both financial and non-financial dataset

consists of nearly 135,000 Japanese SMEs collected by credit guarantee corporations, as well as government-affiliated and private financial institutions involving SMEs business in 2010. Definitions of SMEs varies among different countries. SMEs in Japan are defined under Article 2, Paragraph 1 of the Small and Medium-sized Enterprise Basic Act, and the term “small enterprises” is defined under Article 2, Paragraph 5 of said act. According to these definitions, most companies in this research are considered as SMEs. The data provides information on each firm’s balance sheet and income statement; its default information; the firm’s characteristics, including industrial classification, and demographic characteristics of each firm’s primary owner, including age, real estate ownership, whether he/she has a successor or not. Table 1 shows description of variables in this study.

**Table 1 Description of Variables**

	N	Minimum	Maximum	Mean	Std. Deviation
Years since established	134,552	1	145	14.78	16.532
Real estate owned	135,743	0	1	0.79	0.408
CEO	135,743	59	80	60.70	4.058
Default	135,743	0	1	0.05	0.209
Sales (log)	135,525	-1.20	2.08	1.5869	0.11879
Internal reserves to total assets ratio	135,743	-8.58	2.03	-0.0338	0.69853
ROA	135,743	-2.57	2.99	0.5569	0.74041
The cash equivalent total assets ratio	135,743	-1.09	1.00	0.7929	0.12958
Net profit margin	135,525	-10.81	1.98	-0.0273	0.68464
Interest coverage ratio	129,020	-16.14	18.45	0.0144	1.49797
Debt to equity ratio	135,743	0.00	14.04	1.0026	0.08500
Ratio of current expense to current income (log)	135,547	-2.75	2.63	0.0388	0.14454
Operating profit to asset ratio	135,743	-8.97	1.65	-0.0568	0.74208
Operating profit to sales ratio	135,536	-12.64	11.85	-0.0396	0.80279
Fixed long term conforming rate	135,708	0.00	8.65	0.8767	0.14589
Quick assets to liquid assets ratio	135,732	-2.33	3.63	1.8713	0.50842
Mining and quarrying	135,743	0	1	0.00	0.039
Manufacturing	135,743	0	1	0.00	0.028
Electricity gas steam and air conditioning supply	135,743	0	1	0.00	0.044
Water supply sewerage waste management and remediation activities	135,743	0	1	0.19	0.039
Construction	135,743	0	1	0.19	0.039
Wholesale and retail trade; repair of motor vehicles and motorcycles	135,743	0	1	0.00	0.032
Transportation and storage	135,743	0	1	0.05	0.215
Accommodation and food service activities	135,743	0	1	0.01	0.108
Information and communication	135,743	0	1	0.31	0.462
Real estate activities	135,743	0	1	0.03	0.173
Professional scientific and technical activities	135,743	0	1	0.04	0.189
Administrative and support service activities	135,743	0	1	0.02	0.132
Public administration and defence; compulsory social security	135,743	0	1	0.01	0.075
Education	135,743	0	1	0.00	0.003
Human health and social work activities	135,743	0	1	0.16	0.365

#### 4. Multinomial Logistic Regression Model

The purpose of this paper is to analyze a set of financial ratios and non-financial information linked to SMEs to find out which are the most predictive variables affecting an entities’ credit worthiness. Since this data include

non-financial information with categorical data, the author applies a multinomial logit regression analysis to develop the model. As for financial ratios, the author extensively analyzes a selected number of relevant financial measures suggested by previous literatures (Edmister, 1972; Altman & Hotchkiss, 2006; Altman & Sabato, 2007) in order to select the most predictive ones. Then, these variables, along with non-financial variables, are used as predictors of the default event.

Multiple discriminant analysis and logit regression are the traditionally preferred statistical techniques for credit risk modeling, and logistic regression can be extended to handle responses that are polytomous, i.e., taking more than two categories. Multinomial logistic regression is used to predict categorical placement in or the probability of category membership on a dependent variable based on multiple independent variables. The independent variables can be either dichotomous (i.e., binary) or continuous (i.e., interval or ratio in scale). Like binary logistic regression, multinomial logistic regression uses maximum likelihood estimation to evaluate the probability of categorical membership. The simplest form of the multinomial logistic regression model involves one categorical dependent variable  $Y$  (e.g., three levels of behavioral risk) and one explanatory variable,  $X$  (e.g., default risk). Let  $p_1$  = the probability of high behavioral risk ( $Y = 3$ ),  $p_2$  = the probability of medium behavioral risk ( $Y = 2$ ), and  $p_3$  = the probability of low behavioral risk ( $Y = 1$ ). The simplistic multinomial logistic regression model relates the log of odds (or logit) of  $Y$  to the explanatory variable,  $X$ , in a linear form, as follows:

$$\log \frac{Pr(Y=j)}{Pr(Y=j')} = \alpha + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k \quad (1)$$

Where  $j$  is the identified behavioral risk and  $j'$  is the reference behavioral risk

## 5. Results

The results of analyses are shown in Table 2.

As for financial variables, sales (log), internal reserves to total assets ratio, ROA, interest coverage ratio, debt to equity ratio, and operating profit to sales ratio are statistically positive and significant. Other financial ratios are negative and significant. As for non-financial variables, years since established for 12, 13, over 115 years are negative, while other years are positive; however, none of them are statistically significant. Firms which do not own real estates are statistically significantly positive. Ages of CEO are negative, but statistically not significant. Any corporations do not have successors are statistically positive and significant. Among industries, manufacturing, electricity gas steam and air conditioning supply, water supply, transportation and storage, accommodation and food service activities, information and communication, professional scientific and technical activities are positive and significant.

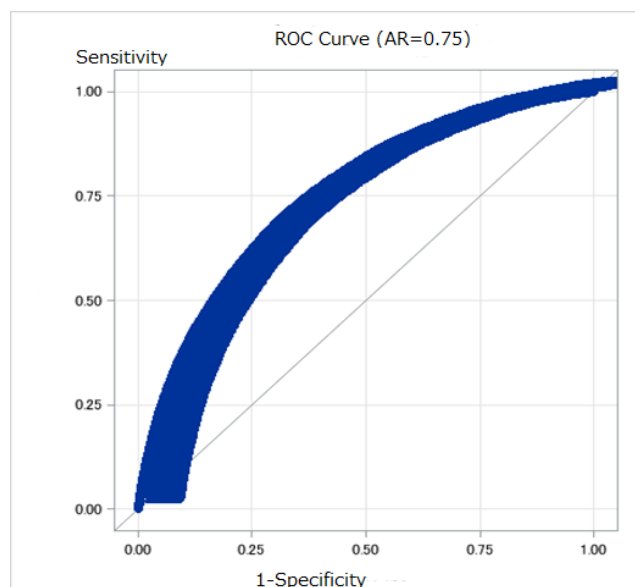
**Table 2 The Results of Analyses (Dependent Variable = Default)**

Variables	Parameter estimate	Odds ratio	95% conf. interval
Intercept	-10.3288		
Sales (log)	1.5041***	4.5	3.297~6.143
Internal reserves to total assets ratio	1.6453***	5.183	3.673~7.313
ROA	0.3094***	1.363	1.235~1.504
The cash equivalent total assets ratio	-3.4064***	0.033	0.027~0.04
Net profit margin	-2.5005***	0.082	0.058~0.115
Interest coverage ratio	0.0853***	1.089	1.045~1.135
Debt to equity ratio	3.1678***	23.754	15.406~36.626
Ratio of current expense to current income	0.3587***	1.432	1.192~1.719

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Operating profit to asset ratio		-0.2449***	0.783	0.713~0.859
Operating profit to sales ratio		0.2747***	1.316	1.234~1.404
Fixed long term conformity rate		-0.5203***	0.594	0.47~0.752
Quick assets to liquid assets ratio		-0.3095***	0.734	0.685~0.786
Years since established	1	4.1722	64.86	<0.001~>999.999
Years since established	2	4.0229	55.86	<0.001~>999.999
Years since established	3	4.1535	63.658	<0.001~>999.999
Years since established	4	4.1266	61.967	<0.001~>999.999
Years since established	5	4.1403	62.822	<0.001~>999.999
Years since established	6	4.1823	65.513	<0.001~>999.999
Years since established	7	4.0729	58.724	<0.001~>999.999
Years since established	8	4.7416	114.618	<0.001~>999.999
Years since established	9	3.8793	48.391	<0.001~>999.999
Years since established	11	4.6741	107.133	<0.001~>999.999
Years since established	12	-4.4372	0.012	<0.001~>999.999
Years since established	13	-4.4104	0.012	<0.001~>999.999
Years since established	15	4.2022	66.831	<0.001~>999.999
Years since established	25	4.1048	60.628	<0.001~>999.999
Years since established	35	4.1925	66.189	<0.001~>999.999
Years since established	45	4.1075	60.797	<0.001~>999.999
Years since established	55	4.0993	60.297	<0.001~>999.999
Years since established	65	4.2399	69.4	<0.001~>999.999
Years since established	75	4.0069	54.976	<0.001~>999.999
Years since established	85	4.334	76.25	<0.001~>999.999
Years since established	95	3.8208	45.639	<0.001~>999.999
Years since established	115	-4.4579	0.012	<0.001~>999.999
Years since established	125	-4.6902	0.009	<0.001~>999.999
Years since established	135	-4.4265	0.012	<0.001~>999.999
Real estate owned	No	0.2633***	1.301	1.22~1.388
Age of CEO	Under 59	-0.0512	0.95	0.773~1.168
Age of CEO	60~69	-0.00573	0.994	0.807~1.226
Age of CEO	70~79	-0.0296	0.971	0.778~1.211
Have a successor	No	0.2397***	1.271	1.2~1.346
Mining and quarrying		0.187	1.206	0.372~3.909
Manufacturing		1.032*	2.807	0.985~7.999
Electricity gas steam and air conditioning supply		0.8376*	2.311	0.872~6.124
Water supply sewerage waste management and remediation activities		1.0031***	2.727	1.28~5.809
Construction		0.6928*	1.999	0.938~4.263
Wholesale and retail trade; repair of motor vehicles and motorcycles		-0.7288	0.482	0.058~4.018
Transportation and storage		0.8481**	2.335	1.088~5.011
Accommodation and food service activities		0.9323**	2.54	1.153~5.595
Information and communication		0.6719*	1.958	0.92~4.169
Real estate activities		0.4321	1.54	0.711~3.336
Professional scientific and technical activities		0.7675**	2.154	1.004~4.625
Administrative and support service activities		-0.1885	0.828	0.362~1.895
Public administration and defence; compulsory social security		0.4204	1.523	0.653~3.548
Education		-9.2569	< 0.001	< 0.001~> 999.999
Human health and social work activities		0.6022	1.826	0.856~3.895

Note: \*Significant at 0.10, \*\*Significant at 0.50, \*\*\*Significant at 0.01



**Figure 1 ROC Curve**

In order to evaluate credit risk model, ROC (Receiver Operating Characteristic) analyses are used (Irwin & Irwin, 2012). ROC curve is at the left end and the closer the ROC curve's position is to the point (0, 1). Similarly, the model is the better the larger the area under the ROC curve is (BCBS 2005). The ROC curve for Japanese SMEs in this study is shown in Figure 1.

Accuracy Ratio (AR; exactly equivalent to the Gini coefficient) measures the trade-off between the selection rates of "Goods" and that of "Bads". If the score model is random, at any given cut-off, the proportion of goods passing the cutoff will be the same as the proportion of bads. This would give an AR of 0%. On the other hand, with a perfect scorecard, it would be possible to select all of the goods (100%) and none of the bads (0%).

The resulting AR would be 100%. Practical experience shows that the Accuracy Ratio (AR) has tendency to take values in the range of 50% and 80%. AR for this analysis is 0.75.

## 6. Conclusions and Further Study

The purpose of this study is to investigate indicators needed for credit risk measurement for the SMEs in Japan, using financial information, as well as corporate information by using a multinomial logistic regression model. The analyses in this study show that not only financial information but non-financial information is the valuable source for a SMEs risk assessment. This data contain limited non-financial information, and what kind of non-financial data would be suitable to estimate credit risk assessment will be sought in a future study.

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## References

Altman E. I. and Hotchkiss E. (2006). *Corporate Financial Distress & Bankruptcy* (3rd ed.), John Wiley, Hoboken, NJ.

- Altman E. I. and Sabato G. (2007). "Modeling credit risk for SMEs: Evidence from the US market", *Abacus*, Vol. 43, No. 3, pp. 332-357.
- Basel Committee on Banking Supervision (May 2005). "Studies on the validation of internal rating systems", BIS Working Paper No. 14, Basel, Switzerland: Bank for International Settlements.
- Berger A. and Udell G. (1995). "Relationship lending and lines of credit in small firm finance", *Journal of Business*, Vol. 68, pp. 351-381.
- Berger A. and Udell G. (2002). "Small business credit availability and relationship lending: The importance of bank organizational structure", *Royal Economic Society*, Vol. 112, pp. 32-53.
- Berger A. and Udell G. (2005). "A more complete conceptual framework for SME finance", mimeo, Federal Reserve Board and Indiana University.
- Chakraborty A. and Hu C. (2006). "Lending relationships in line-of-credit and non-line-of-credit loans: Evidence from collateral use in small business", *Journal of Financial Intermediation*, Vol. 15, No. 1, pp. 86-107.
- Cole R. A. (1998). "The importance of relationships to the availability of credit", *Journal of Banking and Finance*, Vol. 22, pp. 959-977.
- Edmister R. (1972). "An empirical test of financial ratio analysis for small business failure prediction", *Journal of Financial and Quantitative Analysis*, Vol. 7, No. 2, pp. 1477-1493.
- Elsas R. and Krahnen J. (1998). "Is relationship lending special? Evidence from credit-file data in Germany", *Journal of Banking and Finance*, Vol. 22, pp. 1283-1316.
- Harhoff D. and Körting T. (1998). "Lending relationships in Germany: Empirical results from survey data", *Journal of Banking and Finance*, Vol. 22, pp. 1317-1354.
- Hatsumi R., Hirata H. and Ono A. (2011). "Differentiated use of small business credit scoring by relationship lenders and transactional lenders: Evidence from firm-bank matched data in Japan", *RIETI Discussion Paper Series* 11-E-070.
- Irwin J. R. and Irwin C. T. (2012). "Appraising credit ratings: Does the CAP fit better than the ROC?", IMF Working paper 12/122, accessed February 27, 2014, available online at: <http://www.imf.org/external/pubs/ft/wp/2012/wp12122.pdf>.
- Kano M., Uchida H., Udell G. F. and Watanabe W. (2011). "Information verifiability, bank organization, bank competition and bank-borrower relationships", *Journal of Banking and Finance*, Vol. 35, No. 4, pp. 935-954.
- Kutsuna K. and Cowling M. (2003). "Determinants of small business loan approval: Evidence from Japanese survey data", mimeo.
- Kirschenmann K. (2011). "Credit rationing in small business bank relationships", Aalto University School of Economics, working papers series.
- Ministry of Economy, Trade and Industry and Japan Small Business Research Institute (2014). *2014 White Paper on Small and Medium Enterprises in Japan*, June 13.
- Miyamoto M. (2014). "Credit risk assessment for a small bank by using a multinomial logistic regression model", *International Journal of Finance and Accounting*, Vol. 3, No. 5, pp. 327-334, doi: 10.5923/j.ijfa.20140305.07.
- Petersen M. and Rajan R. (1994). "The benefits of firm-creditor relationships: Evidence from small business data", *Journal of Finance*, Vol. 49, pp. 3-37.
- Petersen M. and Rajan R. (1995). "The effect of credit market competition on lending relationships", *Quarterly Journal of Economics*, Vol. 110, pp. 407-443.