

Could traditional financial indicators predict the default of small and medium-sized enterprises?

--Evidence from Chinese Small and Medium-sized enterprises

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Abstract—Whether an enterprise could pay up its loan largely depends on its financial situation. Thus, former researches mainly focus on identifying and recognizing potential risk of default by financial analysis. However, we believe that though analysis of traditional financial indicators has been proved effective for prediction of large companies' financial crisis, it might not be so useful in predicting the default of small and medium-sized enterprises (SMEs) owing to their special features which are different from the larger ones ominously. In order to certify our opinion, we take samples from the credit database of SMEs in Beijing, China. By comparing the fitness of models with different candidate indicators and the order of variables picked up according to the improvement of likelihood ratio with Binary logistic regression, we find the qualitative indicators, which reflect the features of enterprises and their owners, turn out to be more effective in default forecasting of SMEs than traditional financial indicators. As a result, searching useful qualitative variables and other special financial indicators should be focused on risk management of banks.

Keywords—financial indicator; small and medium-sized enterprise; default

I. INTRODUCTION

Small and medium-sized enterprises (SMEs) have been playing increasingly important roles in economy for employment, and thus become to be attractive for scholars and practitioners. As the competition among financial institutions turns out to be fiercer than ever before, SMEs gradually become the aim clients of commercial banks. According to Basel II, if commercial banks want to account loans for SMEs to save economic capital, they should develop an inner ranking system of risk management first (Altman and Sabato, 2007). So it is important to check out which indicators would be useful to predict the default of SMEs.

For the main source of payment of loan is the cash flow created by enterprises, so the former researches mainly focus on the correlation between financial performance and default behavior. In this frame, a system of traditional financial indicators, which includes the indicators on the liquidity, profitability, growth, operating ability and debt-paying ability, has been established. Having built up the system of indicators, many scholars transfer their area to optimizing

models, such as multivariate discriminant analysis (MDA) (Beaver, 1966), Z-score model (Altman, 1968), mortality rate model (Altman, 1988/1989) and aging approach (Asquith, Mullins and Wolff, 1989).

As to Chinese SMEs, they have distinct accounting rules from OECD countries, and the majority are not state owned enterprises, so models developed based on the data of OECD large companies might not be appropriate to be implemented on Chinese SMEs. For the difference between SMEs and large companies is too remarkable to be neglected, we doubt whether traditional financial indicators, which appear to be useful in predicting default of large companies, could predict the default of SMEs effectively. In order to testify our suspicion, this paper is arranged as following. Section 2 reviews the literature on prediction of default for commercial loans and other relevant topics; Section 3 elaborates the data resource and the hypotheses of our empirical research. Section 4 shows the empirical results of different models and tests. In Section 5, we draw some conclusions to sum up.

II. LITERATURE REVIEW

A. Default prediction methodologies for SMEs

Although credit risk models have been usually used in the underwriting of consumer loans, this technology has only recently been applied to small commercial credits. We review the extant study on SMEs' credit risk models from two aspects including the prediction methodologies and the factors considered into SMEs' credit risk management.

1) Default prediction technologies for SMEs

The extant credit risk models specifically for SMEs has been only touched upon mainly depended on statistic model, such as Z-score models originated from MDA and logistic technology. The structural models and reduced-form models based on capital market information are unavailable to small firms owing to their information opacity and unattainability. The only study which was aware of that focused on modeling credit risk specifically for SMEs was a fairly distant article by Edmister (1972). He analyzed 19 financial ratios using multivariate discriminant analysis and developed a model to predict small business defaults. Altman and Sabato (2007) applied a logistic regression analysis to develop the model and select the most predictive five financial ratios for the predictors of the default event. They

also compared their logistic regression analysis with Z-Score model and MDA, and showed that the specific SME model depended on logistic regression was almost 30% higher than the Z-Score model, and MDA default prediction models were likely to have a lower ability to discriminate between defaulted and non-defaulted clients than logistic models when the same variables were used as predictors.

2) *Default prediction factors for SMEs — Comparison between the quantitative and qualitative indicators*

Although the analysis technologies are limited, the authors widely made research on selecting the important factors influencing the SMEs credit risk. In our opinions, it maybe three stages for important variables selection. Before credit risk models application, the significant factors used to SMEs credit risk assessment are qualitative and “soft” information for the relationship based approach loan. And then the researchers pay attention to quantitative information with relationship loan declining and credit scoring models application broadly, especially financial ratios. Subsequently, once again, the authors find the qualitative factors including small firms and their owners play important part on SMEs credit risk models’ accuracy and applicability.

Small firms seek out local bank lenders whose geographic proximity allowed them to observe and accumulate the “soft”, non-quantitative information necessary to assess these firms’ creditworthiness according to relationship based approach (Meyer, 1998). But the geographic distance between small business borrowers and their commercial bank lenders began to increase and some banks began using credit scoring models and “hard” quantitative information to assess small business loan applications, especially financial ratios. Altman (1968)’s Z-Score based on five financial ratios were applied on SMEs credit risk management. Edmister (1972) analyzed 19 financial ratios to predict small business defaults. Mester (1997) showed the personal information used in SBCS models may include the owner’s monthly income, outstanding debt, financial assets, employment tenure, home ownership, firm size, foundation times and previous loan defaults or delinquencies. Hol (2007) analyzed the incremental benefit of employing macroeconomic data to predict bankruptcy on a sample of Norwegian unlisted firms.

Meanwhile, many literatures have highlighted the utility of qualitative variables. Many authors complemented the traditional statistic models based only on financial ratios adding some qualitative factors of firms and their owners into the MDA and logistic analysis. Von Stein and Ziegler (1984) examined the impact of managerial behavior on failure. Cooper (1991) found that educational levels of managers, experience, capital gained were all the cooperation’s resource. Lussier (2001) confirmed that the capital, managerial level, the cycle of economy and production, owner’s age should be considered in the predicting models. It was necessary to combine the age, type of business and industrial sector etc. with financial ratios (Grunet et al, 2004). However, this study did not focus on SMEs clients and a very limited amount of qualitative information was analyzed and used for modeling purposes.

Basel II (2004) requested the financial data of firms must be audited by reliable auditing institutions, and consider the qualitative data of the enterprise, such as its management, internal processes and human capital base, of which the relationship with the financial institution is important. Liberti (2005) suggested a top quality auditor bring an additional impact on the financial information used, and concluded that qualitative and soft information was more reasonable than the financial information without quality auditor. As to the importance of qualitative and quantitative data for SMEs credit risk assessment, Liberti (2005) concluded that soft information was more important for loans approved or denied at the local branch, while hard information was more important for loans approved or denied by loan officers located further away. Edward I. Altman, Gabriele Sabato and Nicholas Wilson (2008) used available non-financial and “event” data to supplement the limited accounting data, and found that qualitative data relating to such variables as legal action by creditors to recover unpaid debts, company filing histories, comprehensive audit report/opinion data and firm specific characteristics made a significant contribution to increasing the default prediction power of risk models built specifically for SMEs.

B. *Research Background of Chinese SMEs credit risk measurement*

Research on SMEs credit risk prediction is still at the beginning stage in China, simulating the western default prediction methodologies. Wang Chunfeng (1998), Wu Shinong (2001) found the traditional model, including four financial ratios. Zhang Ling (2000) developed a 4 variables discriminant model out of 11 ratios and found it had a predictive ability of up to four years prior to default. Zeng Yi (2007) combined financial ratios and non-financial information into credit risk models using Logistic and found the model was more accuracy than the models only having financial ratios or non-financial information.

To be noticed, the situation in China is quite different from that of OECD countries, especially in accounting and audit regulation for SMEs, due diligence, equity structure, and the factors that affect the performance of firms. Most Chinese small corporations were not required to disclose cash flow information that is very important for the classification of failed and non-failed firms, which restricted the use of quantitative information in Chinese small firms’ evaluation. Meanwhile, Unlike Moody’s or Standard & Poor’s databases, which have tens of thousands of healthy and unhealthy firms over the past 30 years, data about Chinese firms is limited, especially the distressed firms. Comparing with the qualitative variables, it is important to test whether the traditional financial information is significant for Chinese SMEs credit risk evaluation based on the above situation.

III. DATA AND HYPOTHESES

A. *Data resource and sampling*

The sample used in this study, with the interval from 2004 to 2007, was selected from the credit database of SMEs

offered by Mintai Institute of Finance and Banking, Central University of Finance and Economics. Specifically, the sampling process is comprised of two parts. The first one is picking up experimental set of samples, and the other was for test set. In order to keep the proportion of default observations steady, we designed the following sampling procedures. Firstly, we randomly selected 20 default companies, and then selected 50 companies without any default record randomly to construct an experimental set of samples which meet the ratio of default observations to good ones hitting on 1:2.5. Subsequently, we randomly selected 35 default companies with missing qualitative data about the information of the owners from the database. Then we pick up 88 well performed enterprises from the same database according to the ratio of 1:2.5 for test sample set, which guarantees the robust of our conclusions. In summary, this empirical study samples consisted of 193 enterprises in total and the sample indicators did not only include qualitative financial indicators, but also the qualitative indicators related to the characteristics of firms and their owners.

B. Hypotheses

We believe that SMEs are distinct from the large ones in operating style, firm structure and decision making procedure, thus the stability of business and reliability of financial indicators might be weak and cannot reflect the financial situation of SMEs timely and accurately. Although traditional financial indicators play remarkable roles in models predicting financial crisis of large companies, they might not be proper to estimate whether a SME is going to be default. Based on this doubt, we set hypotheses as follows.

Hypothesis 1: If traditional financial indicators could not predict the default of SMEs, then the coefficients of these indicators do not pass the test of significant in the logistic regression model.

Hypothesis 2: If traditional financial indicators could not predict the default of SMEs, then they will enter logistic regression model later than other variables even if the coefficients of those indicators pass the test of significant in the logistic regression model.

Inspired by Altman and Sabato(2006)and Altman, Ling Zhang and Yen (2007), we select eight financial indicators according to five traditional categories, liquidity, profitability, growth, debt-paying ability, asset management capability to reflect financial characteristics of enterprises. The indicators include current ratio(CR), return on equity (ROE), annual growth rate of sales (AGS) and retained earnings/total assets (RETA), interest cover (IC) and asset-liability ratio (ALR), account receivable turnover (ART) and total capital turnover (TCT), respectively. We select financial indicators from annual financial data prior to the point of default or maturation of loan. Although these quantitative financial indicators are quite effective to analyze large scale enterprises' operational state, some researches (Mester, 1997), (Greunet et al, 2004) pointed out that certain qualitative factors such as entrepreneurs' age, nature of the enterprises, characteristics of the industry also played important parts in assessing the default of the enterprises.

Therefore, we pick up qualitative factors related to the features of the SMEs and their owners, including owner gender(OG), owner age(OA), staff number(SN), firm's age (FA), cooperation duration with banks (CD) as well (see Table I).

TABLE I. VARIABLES AND DEFINITION TABLE

	Variables	Short form	Category	Stands for
Dependent variable	Default	DEF	-	-
Independent variable	Current ratio	CR	Traditional financial indicator	Liquidity
	Return on equity	ROE	Traditional financial indicator	Profitability
	Annual growth rate of sales	AGS	Traditional financial indicator	Growth
	Retained earnings/Total assets	RETA	Traditional financial indicator	Growth
	Interest cover	IC	Traditional financial indicator	debt-paying ability
	Assets/liability ratio	ALR	Traditional financial indicator	debt-paying ability
	Account receivable turnover	ART	Traditional financial indicator	Operation ability
	Total assets turnover	TAT	Traditional financial indicator	Operation ability
Owner's gender	OG	Qualitative variable	Features of owner	
Owner's age	OA	Qualitative variable	Features of owner	
Staff number	SN	Qualitative variable	Scale	
Firm's age	FA	Qualitative variable	Growth	
Cooperation duration	CD	Qualitative variable	Relationship	

Binary logistic regression could be implied in predicting default with both traditional financial indicators and other qualitative variables, especially effective with scale variables. Forward Stepwise method has been chosen to check out whether traditional financial indicators would be allowed to put into the models and they are introduced in the models later than other factors.

IV. EMPIRICAL RESULT

A. The analysis result of traditional financial indicators' attribution

In order to certify traditional financial indicators' attribution to the default prediction models for SMEs by

checking out whether they could be selected into the models tested by the improvement of likelihood ratio, we make use of 70 observations with traditional financial indicators and other qualitative variables about the features of enterprises and their owners to establish three binary logistic models. After ruling out useless candidate variables, we get the list which shows the variables introduced in the models and their order of entrance into the equations. (See table II).

TABLE II. TEST RESULT OF LOGISTIC REGRESSION

variables	Model 1 ^a		Model 2 ^b		Model 3 ^c	
	Selecte d or not	Order	Selecte d or not	Order	Selecte d or not	Order
Current ratio	No	-	-	-	Yes	4
Return on equity	No	-	-	-	No	-
Annual growth rate of sales	No	-	-	-	No	-
Retained earnings/Tot al assets	No	-	-	-	Yes	5
Interest cover	No	-	-	-	No	-
Assets/liabili ty ratio	No	-	-	-	No	-
Account receivable turnover	No	-	-	-	No	-
Total assets turnover	No	-	-	-	No	-
Owner's gender	-	-	Yes	3	No	-
Owner's age	-	-	Yes	2	Yes	3
Staff number	-	-	No	-	Yes	2
Firm's age	-	-	No	-	No	-
Cooperation duration	-	-	Yes	1	Yes	1

a. Model 1 is the model which only have traditional financial indicator as candidate variables;
b. Model 2 is the model which only have qualitative variables about firm and its owners' as candidate variables;
c. Model 3 is the model which include all the variables mentioned above.

The result demonstrates that, if there are only traditional financial indicators available, then no traditional financial indicators could be added into the model. However, the variables indicating the features of enterprise and its owner, such as "cooperation duration", "owner's gender" and "owner's age", could be selected as only qualitative variables available. Moreover, when traditional financial indicators and qualitative variables are all chosen as candidate variables, current ratio and retained earnings/total assets (RETA) turn to be significant adopted by the model, while they have less contribution in improving it.

From the aspect of fitness of model (see Table III), we recognize that the model with combination of qualitative variables and traditional financial indicators perform much more well than the model merely with qualitative variables which reflect the characteristics of enterprises and their owners. It means that traditional financial indicators have

their own part in default estimate on SMEs, they could enhance the accuracy of logistic regression model when other qualitative variables are taken into account as well. This finding had been presented by Altman, Sabato and Wilson (2008) as well.

TABLE III. TABLE 3 TEST RESULT OF LOGISTIC REGRESSION

	Hosmer and Lemeshow test			Fitness of Model			
	χ^2	df	Sig.	-2log	Cox and Snell R ²	Nagelkerke R ²	Accuracy
Model1	-	-	-	-	-	-	-
Model 2	1.57	8	0.99	26.29	0.56	0.80	88.6%
Model 3	0	7	1	0	0.70	1	100%

B. The result of robust test

To be noticed that, as a result of less samples with default, the empirical results maybe not robust influenced by sampling. In the purpose of verifying the above empirical results, we make a test group according to the experimental group's sampling progress. Considering that the default companies are selected before the well performed ones, the test set's default samples are compound by the default firms with lots of qualitative data missing to avoid the sameness with the experimental ones.

TABLE IV. TEST RESULT OF LOGISTIC REGRESSION FOR ROBUST TEST

Variables	Model 1		Model 2		Model 3	
	Selected or not	Order	Selected or not	Order	Selected or not	Order
Current ratio	No	-	-	-	No	-
Return on equity	No	-	-	-	No	-
Annual growth rate of sales	No	-	-	-	No	-
Retained earnings/Tot al assets	No	-	-	-	No	-
Interest cover	No	-	-	-	No	-
Assets/liabili ty ratio	No	-	-	-	No	-
Account receivable turnover	No	-	-	-	No	-
Total assets turnover	No	-	-	-	No	-
Owner's gender	-	-	-	-	-	-
Owner's age	-	-	-	-	-	-
Staff number	-	-	No	-	No	-
Firm's age	-	-	No	-	No	-
Cooperation duration	-	-	Yes	1	Yes	1

As is showed in the logistic regression results of test set (see table IV), the models introducing the qualitative data

associated with the firms' characteristics still perform better than the models with only the traditional financial information in spite of the qualitative data missing in the selected samples, such as gender and age. Especially, the cooperation duration between banks and companies is a key variable related to default probability.

It is worthy to mention that the traditional financial data are still not be employed in the models when the qualitative information and traditional financial information are both treated as the candidate variables, although test group are lack of much qualitative data. It can be concluded that the contribution of traditional financial information into default predicting necessarily based on the combination with the qualitative classification data reflecting the features of enterprises and their owners.

To sum up, as depicted by the empirical analyses results, traditional financial indicators might not be effective and significant to predict the default of SMEs. It means traditional financial indicators play less crucial role when they are implied to analyze SMEs than to the large ones. On the contrary, qualitative variables about soft information have closer and more significant correlation with default of SMEs.

V. CONCLUSION

In order to verify the efficiency of the traditional financial variables for predicting the SMEs' default, the paper uses the Logistic regression model with Forward Stepwise method, tested by likelihood ratio. Through observing whether the traditional financial indicators could be adopted by the models and the order of the traditional financial indicators that are adopted by the model, we find that the traditional financial indicators which just reflect the profitability, growth, liquidity, solvency and operational capacity of the business cannot predict the default of SMEs effectively. In contrast, the qualitative classification information which reflects the main features of the enterprise, such as duration of cooperation with banks, is significant for the default predicting of SMEs. However, after introducing qualitative classification indicators, the traditional financial indicators significantly improve the fitness of the models.

Considering the results might be impacted by sampling, the paper uses test set of sample to verify the robustness of these conclusions. We re-extract samples of SMEs without characteristic variables of owners, and repeat the preceding operation on the test set of samples. The results show that the traditional financial indicator still cannot be introduced in the model separately. Additionally, in the absence of the qualitative variables which reflect the features of SMEs' owners, it cannot improve model effectively even if we use the traditional financial indicators as alternative indicators.

Overall, the empirical results show that the traditional financial indicators which are important for predicting the default of larger enterprises cannot predict the default of the SMEs effectively owing to the special nature of SMEs. If we do not recognize the special characteristics of SMEs, the credit risk models mainly based on the traditional financial information can hardly identify and predict the default of

SMEs effectively. So it is important for scholars and practitioners to find other useful financial indicators and valuable qualitative variables to monitor the credit risk of loans to SMEs.

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