Credit Risk Assessment of POS-Loans in the Big Data Era

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Abstract: Credit risk assessment plays an essential role in bank loan processes. It is difficult for small and micro enterprises (SMEs) to apply for a loan because of their lack of collateral and low credit ratings. In the absence of a guaranty, enterprises can get loans based on the business and operational data from POS machine records. In this position paper, we propose to use POS-loans to address this problem. This paper defines the concept of POS-loans, proposes a credit scoring framework, and discusses the potential influence of POS-loans on bank management.

Keywords: POS-loans, POS data, credit risk assessment, bank risk management, big data mining

1. Introduction

Nowadays, small and micro enterprises (SMEs) play a significant role in the national economy of many developed and developing countries. One of the major hindrances to the development of SMEs is financing. For example, a recent study found that SMEs cannot get support in start-up funding from banks and financial institutions in China [1]. In order to address the financing problem of SMEs, researchers have called for new financial products for assisting SME development [2]. Some companies (e.g., Kabbage) provide working capital to small businesses by using data from business checking accounts, accounting software, payment processors, UPS shipping data, and other online tools.

POS-loans are such a new financial product. Assessing credit risk through transaction records retrieved from POS machines is a challenging problem. The earliest credit risk assessment model, the Z-score model, was proposed by Altman in 1968 [3]. The Z-score model can be used for analyzing financial crisis vigilance of business operations and predicting corporate defaults. The model relies on knowing a few financial ratios in a corporation’s annual report. Altman, Haldeman and Narayannan improved the Z-score model in 1977 [4]. The second-generation model, the ZETA model, incorporates several additional financial ratios. This model is not only suitable for manufacturing but also effective for the retail industry. These two models, the Z-score model and the ZETA model, made a profound impact on credit risk assessment and are used by many banks and financial institutions even today.

Martin applied a logistic regression method to analyze financial warnings and predict corporate loan default [5]. Besides financial ratios, Martin’s approach also considered different risk preference of users. The results were better than the Z-score model and the ZETA model. Ohlson used the multi logistic regression method to predict bankruptcy and found that financial difficulties of companies had close relationships between firm size, capital structure, performance, and current liquidity [6]. So far, such multivariate nonlinear regression models are regarded as the most widely used method in the international financial industry and academia.

The neural network approach is most often adopted to assess the credit risks of SMEs. Tam Kiang compared various prediction models for rating 59 banks based on 19 financial ratios as inputs [7]. The neural network approach achieved the highest accuracy [7]. Using...
the neural network approach, Coats and Fant predicted bank failure [8]. Shen et al. concluded that the soft information of companies is a very important factor in the lending decision [9].

Although previous research on credit risk assessment is fruitful, most of the methods proposed so far rely on knowing crucial financial ratios that are usually retrieved from formal financial reports. However, most SMEs do not have a complete set of formal financial reports and they do not have enough assets as guaranty. Under such circumstances, the popular models such as those described above will not be applicable. In a traditional loan process, banks ask applicants to use certain assets as guaranties for loans, also called collateral. Collateral can help banks reduce default risk to ensure applicants’ solvency. Essentially, analyzing transaction records of applicants can also reflect their solvency. So, to assess credit risk for SMEs, transaction records can be used as a substitute for collateral. This paper aims to find out how transaction records can help assess SMEs’ credit risk.

2. Credit Risk Assessment based on POS Data

2.1 Definition of POS-Loans

A POS-loan refers to getting a loan via transactional records of a POS machine. It is designed for SMEs who use a POS machine and enjoy certain standards of credit to finance a small amount in the short-term. Taking out a loan via POS allows the mortgagor to immediately meet their urgent financing needs. Many banks already allow this new venue for loans to SMEs. POS-loans not only can assist SMEs’ development but also could make profits for banks[10].

Generally speaking, a POS-Loan has the following attributes:

- The loan is offered without a guarantor or collateral.
- The loan amount and term are in appropriate ranges.
- The lending bank provides the POS machine.
- The mortgagor’s enterprise should use the POS machine for a required time and must have certain turnover and enough profit.

2.2 Credit Risk Assessment Process

Figure 1 shows a typical loan approval process. Every applicant (e.g., a SME) must supply basic information, including a business license, legal representative information, organization code certificate, tax certificate, Accounts receivable, total bank borrowings, loan application, and basic bank account information. Banks evaluate this information to determine whether a SME is qualified to apply for a loan.

In addition, the SME must have used a POS machine over a period of time (usually more than one year). The POS machine stores all of a business’s transactional records. As mentioned above, SMEs usually do not have a complete set of formal financial reports. To a certain extent, transaction records can be considered a replacement for cash flow sheets. So banks could use POS data to calculate repayment capability. Collateral is a necessity for applying a conventional corporate loan. But in a POS loan, collateral is optional because most of SMEs lack enough assets to provide a guaranty. Based on the basic information, POS data, and collateral (if any), banks will assess the credit risk of the SME.

![Figure 1. Credit Risk Assessment Process with POS Data](image-url)
2.3 Credit Scoring System

We propose a scoring system for banks to evaluate the credit of loan applicants via POS data (see Figure 2). This system could analyze the recoded data and produce credit scores for each applicant. This score can help banks determine the credit line and loan amount more efficiently. It could provide a supporting platform to study the relationship between POS-loans and credit risk assessment in the absence of asset-based risk measures.

In the credit scoring process, POS data is collected from the machines owned by the SMEs and subsequently input into the credit scoring system. The system will utilize a private cloud service to store POS data for further analysis. After the delicate calculation of the system, credit rating results of the applicants are produced. According to the CreditMetrics model [11], we could use credit rating to evaluate the rating migration. Combining the rating migration with recovery rate, bond valuation, and some other factors, banks can obtain the distribution of values for a single credit and calculate appropriate loan amount.

We will adapt Z-Score model [3] to calculate credit ratings. The original Z-score formula was as follows:

\[ Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 0.999X_5 \]

\( X_1 = \text{Working capital / Total assets.} \)

\( X_2 = \text{Retained earnings / Total assets.} \)

\( X_3 = \text{Earnings before interest and taxes (EBIT)/ Total assets.} \)

\( X_4 = \text{Market value of equity / Book value of total liabilities.} \)

\( X_5 = \text{Sales/ Total Assets.} \)

Decision rules:

<table>
<thead>
<tr>
<th>Z-Score</th>
<th>Failed</th>
<th>Zone of ignorance</th>
<th>Nonfail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z&lt;1.8</td>
<td></td>
<td>1.8≤Z&lt;2.99</td>
<td>Z&gt;2.99</td>
</tr>
</tbody>
</table>

In this formula, the working capital, retained earnings, EBIT and sales can be provided and proven by POS data. Future, we could test and improve the model under POS-loans environment and add POS data factor in to the model.

When building the credit scoring system, credit assessment techniques, credit risk model (e.g., CreditMetrics model [12] and CreditRisk+ model [13]), system dynamic model (dynamic analysis), and some other algorithms are used.

3. Impact of POS-Loans on Bank Management

There is no denying that such a new loan type will affect banks’ risk management. We will study the relationship between POS-loans and bank risk management through empirical research. Typically, bank risk management deals with four types of risks, namely market risk, credit risk, operational risk and performance risk [14]. The changes of these four types of risks could result in changes of bank risk management. We consider the adoption of POS-loan technology as an independent variable and bank risk management as a dependent variable. The research framework is shown in Figure3. A POS-loan can produce positive or
negative effect on the loan process, portfolio risk distribution and market index prediction (e.g., interest rate, market volatilities, equity prices and commodity prices). The changes of loan process, portfolio risk and market index prediction could subsequently affect the operation risk, credit risk and market risk and thereby affect bank risk management.

Figure 3. Research Framework of Influence on Bank Risk Management

The POS loan will change the traditional loan process (see Figure 1), which may increase/decrease the operational risk of a bank. The portfolio credit distribution is another important factor that should be measured when assessing credit risks. POS data can be used to help calculate the portfolio credit distribution. Concerning the market risk, POS data can capture information such as the interest rate, market volatilities and price level. These indexes could be very useful for banks to measure the market risk and make proper predictions.

In order to study the impact of POS-loans on bank risk management, data will be collected from banks in China. The collected data will include application process time, market volatilities, loan amounts, default rates and so on. Historical data of application process time cycle, applicants’ satisfaction, loan amounts and default rates will be used to measure different aspects of efficiency of POS-loan process. Furthermore, the operational risk in the POS-loan process would be measured according to the seven categories of operational risk disaggregated by the Basel Committee on Banking Supervision [15]. We will use CreditRisk+ model [13] to measure credit risk. Data of user portfolio, credit rating (calculated via POS data), recovery rate, equities correlations and etc. will be collected to calculate the portfolio credit distribution. POS machines can provide all the applicants’ profit/loss data and price information of the whole market, which can be used for banks to measure the market risk. Therefore, POS-loans will bring unprecedented changed to various aspects of bank risk management.

With the diffusion of the POS technique, the increasing amount of financial records and data information generated by POS machines require a server with huge capacity that most traditional servers cannot provide. To satisfy the requirement of capacity, a cloud-based structure may be a good choice. In addition, companies in the mobile payment area have started to provide POS services that are deployed cloud and big data scoring company such as Kreditech has been receiving lots of attention recently. To examine the qualification of one SME borrower, the banks need data from the whole industry and the SME market as well as the borrower’s transaction data. The transaction data collected from different SMEs may be in different formats because data heterogeneity is one of the unique characteristics of POS data. Moreover, mining POS data could also help banks monitor cash flow and track loans. Some big data mining algorithms [16] could provide a reference in seeking quick, effective, and responsive data mining methods to search big data.

4. Discussion

In this paper, we give an overview of credit risk assessment. Then we define what a POS-loan is and explain how it can help an SME obtain a loan and how it can assist banks in loan risk assessment. We also design a credit scoring system to calculate credit rating and put forward some concrete suggestions about the transformation of banks’ IT departments under
the influence of big data. This newly emerged loan method brings up a new perspective about how IT affects financial activities. Some research issues explored include transformation of bank risk management, credit risk assessment and its influence on SME development, and management changes. As the POS-loan technology becomes increasingly mature and widely accepted, it will further affect bank loan processes such as approval, supervision, and administration. In the future, we will further refine the preliminary research framework proposed in this paper and conduct empirical studies to evaluate the framework.

References


