Review

A Systematic Literature Review on the Credit Risk Management of Big Tech Lending

Mu Zhang [1,*] and Cheng Cao [1,2]

[1] School of Big Data Application and Economics, Guizhou University of Finance and Economics, Guiyang (550025), Guizhou, China

[2] Guizhou Institution for Technology Innovation & Entrepreneurship Investment, Guizhou University of Finance and Economics, Guiyang (550025), Guizhou, China

* Correspondence: zhangmu01@163.com; Tel.: +86-0851-88510575

Abstract: This article reviews the relevant research of Big Tech Lending credit risk management in order to promote the research on the theory and method of credit risk management of Big Tech Lending. At present, relevant research results at home and abroad mainly concentrated on internet finance, credit risk analysis and control of digital inclusive finance and financial technology, and large-tech credit risk management framework research. Under the background of financial technology, the research on the theory and method of credit risk management of Big Tech Lending is in its infancy at home and abroad. The explanatory nature of the risk control methods of large-scale technology credit is relatively low, resulting in the fact that government supervision department cannot well identify the stability of such loans, which is a key issue that needs to be solved urgently in the credit risk management of large-scale technology credit. The research directions of Big Tech Lending credit risk management in the future include: Big Tech Lending credit risk perception and its influencing factors, Big Tech Lending credit risk control mechanism research and Big Tech Lending credit risk early warning model research.

Keywords: SMEs; Big Tech Lending; Credit Risk Management; Big Tech Ecosystem; Big Data Risk Control Model; Literature Review

1. Introduction

Small and medium-sized enterprises (SMEs) refer to enterprises established in accordance with the law within the territory of the People's Republic of China with relatively small staff and operating scales, including medium-sized enterprises, small enterprises and micro-enterprises. Private enterprises with small and medium-sized enterprises as the main body have occupied a very important position in the national economy, and their contributions to GDP growth, intellectual property rights and urban employment have exceeded 60%, 70% and 80% respectively. Therefore, whether the "financing difficulties" of small and medium-sized enterprises can be effectively alleviated is not only related to the survival of micro-enterprises, but also affects the development of the macro-economy. There are many reasons for the "financing difficulties" of SMEs (Demirgüç-Kunt and Klapper, 2012), which can be attributed to the difficulties of "acquiring customers" and "risk control" mostly. Most SMEs are small in scale, large in number, and geographically dispersed, which increases the cost of acquiring customers for banks. At the same time, banks usually use three methods to manage corporate credit risk: financial data, mortgage assets, and "relational credit".

However, it is difficult for these methods to be applied to small and medium-sized enterprises on a large scale.

In recent years, the rapid development of internet finance, digital inclusive finance, financial technology, and especially large-scale technology company credit (Big Tech Lending) has brought dawn to the real solution to the problem of "financing difficulties" for SMEs. The so-called Big Tech Lending mainly refers to the use of digital technology to provide loans by some large technology companies (Frost et al., 2019). From the perspective of technological process, service scale and asset quality, Big Tech Lending is likely to be a revolutionary financial innovation. The financial business model of Big Tech Lending originated in China and has been implemented in many countries such as the United States, Argentina, India, and South Korea. According to data from the Bank for International Settlements (BIS), the total credit of global financial technology and large technology companies reached nearly 800 billion US dollars in 2019. China, United States and United Kingdom are the largest markets for financial technology credit (Chen Hua and Li Qingchuan, 2021).

Big Tech Lending has creatively formed an effective credit risk management framework. The two pillars of this framework are the big technology ecosystem based on the big technology platform and the big data risk control model (Huang Yiping and Qiu Han, 2021). The outstanding advantage of the big technology ecosystem is that it can cover most of the activities in the entire process from customer acquisition, loan application, risk assessment, monitoring to repayment management, thereby providing an effective way to reduce information asymmetry and control adverse selection and moral hazard. The massive digital footprint left in the big technology ecosystem is gathered to form big data. On one hand, these big data can be used for real-time monitoring to help the platform quickly adjust business strategies, on the other hand, it can support big data risk control models. This new type of risk control model based on big data and machine learning can not only predict the default rate more accurately and robustly (Huang et al., 2020), but also provide credit services for many SMEs that lack bank credit history. It fully embodies the inclusive characteristics of Big Tech Lending. The new credit risk management framework of Big Tech Lending makes it possible for large-scale, low-cost, high-efficiency and sustainable SMEs loans.

This article will review the current research status at home and abroad of internet finance, digital inclusive finance, financial technology credit risk analysis and control, and Big Tech Lending risk management framework, with a view to promoting the research of Big Tech Lending risk management theories and methods. The research in this article has important theoretical and practical significance for promoting the healthy development of Big Tech Lending business and alleviating the "financing difficulties" of SMEs.

2. Related Research of Internet Finance, Digital Inclusive Finance and Financial Technology

Compared with traditional financial credit risk, internet financial credit risk has three characteristics: credit risk is highly concealed, credit risk of a single platform spreads widely, and credit risk supervision is more difficult (Li Guoyi, 2017). Short loan terms in the internet lending market can easily cause small and micro enterprises to face serious mismatches in investment and financing terms, resulting in higher credit risks (Hu Jinyan and Shui Bingbing, 2020). The main borrowers in the Internet financial market are low-income groups with insufficient credit records, which will bring greater credit risk (Graves, 2003; Dobbie and Skiba, 2013; Li Kemu, 2016), which brings huge risks to financial technology companies. Operational risks may even affect financial

security and social stability. Therefore, performing well in risk control and accurately assessing the credit of borrowers is of great significance for promoting the healthy and orderly development of the Internet financial market (Zhang Yiwei and Gao Weihe, 2020).

Digital inclusive finance provides financial services through the Internet, however, its impact on credit expansion cannot be underestimated due to wide coverage and large amount. In particular, current financial regulatory agencies are unable to accurately monitor the liquidity absorbed by digital finance and incorporate the risks of digital finance into the prudential regulatory framework for systemic risks in the entire financial market, leading to excessive credit expansion (Wei Xiaofeng, 2019). Financing internet platforms have the dual business attributes of "information services-financial services", and there are price transmission mechanisms and systemic risk channels between "money market-information market". Therefore, digital financial supervision should take moral hazard and credit risk as focus.

The extensive use of financial technology has not only improved the convenience and availability of financial services, but also lowered the barriers to entry for customers. It has introduced a large number of high-risk customers with varying qualifications, besides, credit information system, credit reporting system and credit reporting supervision is not perfect in China, financial technology is more likely to induce credit risk (Liu Mengfei, 2020). Although financial technology adopts different technologies, causing credit risk to have many manifestations, its essence is still the risk caused by lack of information disclosure or default of market participants. When the economic situation declines, if there exists a large scale of failure to repay on time or even failure to repay, banks and other financial institutions will be affected, which will lead to large-scale credit problems (Chen Hong and Guo Liang, 2020). Internet banking credit risk presents highly different risk characteristics from traditional banks in that: Loan default rate is small, but potential risks are worthy of attention. The success of big data risk control requires cross-cycle and long-term calibration verification. Post-loan management is difficult (Research Group of Chengdu Branch of the People's Bank of China, 2020). Although FinTech 2.0 has financial attributes, it is dominated by technical attributes. Therefore, the nature of fintech companies is a mixed business of technology companies and financial companies. For financial regulators, it is difficult to define the target of supervision. It is necessary to have a clear boundary between technology and finance, otherwise it will cause regulatory loopholes, duplicate supervision or regulatory mismatch, making it difficult to discover potential financial risks in time (Meng Xiantong, 2020).

3. Related Research of Big Tech Lending

The business model of the American fintech company Nav can be summarized as: Acting as a platform and channel to match service needs of small and micro enterprises with the products and services of credit bureaus and financial institutions to achieve one-stop service (Liu Xinhai, 2019). Born in the Internet Boom, fintech companies in China are in a leading position of the world whether in terms of revenue scale, investment and financing scale, or the strength of individual companies. However, the development of the regulatory field is relatively lagging. The construction of an effective regulatory framework is still in the process of exploration (Sun Fei, 2019). From the involvement of technology companies in the financial field to the online transformation and development of traditional financial institutions, online credit has gradually evolved into two modes of weak-scene finance represented by P2P and strong-scene finance represented by e-commerce and

supply chain financing. A more inclusive, prudent, and appropriate regulatory environment will ensure a deeper integration of finance and technology (ICBC Online Financing Center, 2020).

Frost et al. (2019) proposed the concept of Big Tech Lending, which mainly refers to the use of digital technology to provide loans by some large technology companies. Huang Yiping and Qiu Han (2021) further proposed the concept that big technology companies use the big technology ecosystem and the big data risk control model to provide credit services, innovate the credit risk management framework, and analyze the working mechanism of Big Tech Lending on the credit risk management framework in the field of SME loans. On one hand, the big technology ecosystem based on the big technology platform achieves customer acquisition by connecting hundreds of millions of users, accumulates a large number of digital footprints, supports real-time monitoring and credit risk assessment, and designs corresponding incentive mechanisms to improve repayment management. Gambacorta et al. (2019) found that the higher the importance of the network, the higher the loan amount that users can spend. Huang et al. (2020) also found that the importance of borrowers in the ecological network can help predict their default. On the other hand, big data risk control models based on big data and machine learning have outstanding information advantages and model advantages (Frost et al., 2019; Gambacorta et al., 2019). They can be used to predict defaults more accurately and robustly (Huang et al., 2020), and there will be a heterogeneous impact on different groups (Fuster et al., 2018; Huang et al., 2020). The combination of the two pillars of the big technology ecosystem and the big data risk control model constitutes a new type of credit risk management framework for Big Tech Lending, making large-scale, low-cost, high-efficiency and sustainable SME loans possible.

Big Tech Lending promotes the inclusiveness of finance, but at the same time brings some problems and challenges, which require further research and improvement. For example, the risk control method of Big Tech Lending is low in explanatory, similar to a "black box". The government supervision department cannot well identify the stability of this type of loan. The effectiveness of Big Tech Lending in terms of risk control has not yet been tested by the complete financial cycle. The digital footprint may bring fraud risks and problems such as data privacy and "algorithm discrimination". Big Tech Lending may also increase the "digital divide" of some special groups (such as middle-aged and elderly groups) (Huang Yiping and Qiu Han, 2021).

4. Brief Comment

At present, relevant research results at home and abroad mainly concentrated on internet finance, digital inclusive finance and financial technology credit risk analysis and control, and Big Tech Lending risk management framework research. In summary, in the context of financial technology, research on theories and methods of credit risk management for Big Tech Lending just started.

Although Big Tech Lending has achieved initial success, the maturity and popularization of its business model still requires the joint efforts of Big Tech Lending institutions and government regulatory agencies. At present, the explanatory nature of the risk control method of Big Tech Lending is low, and the government supervision department cannot well identify the stability of this type of loan (Huang Yiping and Qiu Han, 2021), which is a key issue that needs to be solved urgently in the credit risk management of Big Tech Lending. The future research direction of credit risk management of Big Tech Lending includes the following three aspects：

（1）Research on Big Tech Lending Risk Perception and Influencing Factors Based on System Simulation

Perceived credit risk is defined as: the possibility of loan loss for SMEs and its probability distribution that Big Tech Lending institutions can perceive in credit transactions, consisting of basic credit risk and dynamic credit risk. Based on this, the system composed of Big Tech Lending risk perception and its influencing factors is defined as a big-tech credit risk perception system, and the system dynamics characteristics such as complexity, nonlinearity and time-varying characteristics are analyzed. According to the causal relationship among the various influencing factors in the system, a system dynamics model for the perception of credit risk of Big Tech Lending is established. Using the number of credit transactions as the simulation unit, through the Vensim software, we can simulate the change trend of the perceived credit risk rate in the process of N credit transactions, and research the influence of changes in factors such as industry, technology, market, supervision, culture, transaction, Big Tech Lending institutions, and big technology ecological environment on perceived credit risk.

（2）Research on Credit Risk Control Mechanism of Big Tech Lending Based on Differential Game

Big Tech Lending features "small amount, short term, and repayment on demand". Therefore, the differential game can accurately describe the dynamic changes of the decision-making process of Big Tech Lending institutions and SMEs in the process of Big Tech Lending, and describe the differences of interests between the two parties in each stage of the game. A simplified Big Tech Lending system is formed by Big Tech Lending institutions (C) and SMEs (E) based on the big technology ecosystem. SMEs may default in the process of Big Tech Lending transactions. Therefore, SMEs may default institutions need to establish supervision and punishment mechanisms to supervise the transaction process of SMEs in order to reduce the occurrence of defaults and control the number of transaction defaults. SMEs choose the degree of effort to control breach of contract according to existing conditions to maximize their own interests. First, introduce characteristic variables such as the political benefits brought about by SMEs may default institutions' regulatory defaults and the reputation benefits of SMEs in the large technology ecosystem brought about by the performance of SMEs. Under the assumptions of model, the game model is constructed based on the differential game theory of the default supervision behavior of Big Tech Lending institutions and the default control behavior of SMEs in the process of Big Tech Lending transaction. Then, solve different game equilibrium strategies under the situation of independent decision-making between Big Tech Lending institutions and SMEs, the Stackelberg game situation under the incentives of Big Tech Lending institutions, and in the case of consistent decision-making between Big Tech Lending institutions and SMEs, and analyze the degree of default supervision effort of Big Tech Lending institutions and the degree of default control effort of SMEs in the three game situations. Finally, make numerically simulation analysis of the theoretical model.

（3）Research on Credit Risk Warning Model of Big Tech Lending Based on CNN-LSTM Neural Network

Using the good feature extraction ability of convolutional neural network (CNN) and the special memory prediction function of long and short-term memory (LSTM) neural network, a Big Tech Lending risk warning model based on CNN-LSTM neural network is constructed. The first step is to collect SME credit data. The second step is to use nuclear principal component analysis (KPCA) to

extract the principal components of numerical data, and use Word2vec technology to convert text data into word vectors, thereby converting high-dimensional sparsity data into low-dimensional dense data. The third step is to input the extracted principal components and word vectors into CNN, and use CNN's good feature extraction function to find out the potential relationships in the historical data, and then integrate them into effective feature vectors. The fourth step is to input the integrated feature vector into the LSTM neural network, memorize and filter the features, and perform fitting predictions, so as to output the credit risk prediction results through the fully connected layer. The fifth step is to set the early warning threshold to achieve credit risk Early warning.

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