The Impact of Big Data Credit Technology

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As the main force in boosting national economic development, micro and small enterprises (MSEs) play an irreplaceable role in stabilizing economic growth, narrowing the income gap, improving labor productivity, and promoting market competition. Compared with large and medium-sized enterprises, MSEs are numerous and widely distributed, which creates a broad job market for the labor force in both developing and developed countries. However, credit rationing hindered the effective use of credit resources and weakened MSEs' incentive to engage in technological innovation and alleviate employment pressure.

Keywords: micro and small enterprises ; credit rationing ; big data ; evolutionary game

1. Introduction

According to the credit rationing theory developed by Stiglitz and Weiss (1981), due to adverse selection and moral hazard caused by information asymmetry in the credit market, there is no monotonic linear relationship between the expected return on bank loans and the interest rate. When borrowers'demand for loans is greater than banks' supply of loans, banks will implement restrictions on borrowers through non-price instruments rather than raising interest rates to clear the market; as a result, for undifferentiated borrowers, some can obtain loans while others cannot, and borrowers who could not obtain loans still have no access to loans even if they are willing to pay higher interest rates or provide more collaterals [1]. Enterprise size is considered to be one of the most important indicators in determining the financing barriers of borrowers. Macmillan (1931) [2] suggested that enterprise size affects the financing accessibility of enterprises: the smaller the enterprise, the higher the probability of suffering from credit rationing [3]. Even if micro and small enterprises (MSEs) have growth potential, it is difficult for them to obtain credit support. "Financing is difficult and expensive" has been a major problem faced by MSEs [4][5].

2. The Causes of the Credit Rationing of Micro and Small Enterprises

Regarding the causes of the credit rationing of MSEs, scholars generally conclude that specific characteristics of the credit demand side and credit supply side, as well as the economic policy regime, affect credit transaction costs and credit risks, making it more difficult for MSEs to obtain loans than large and medium-sized enterprises. Demand-side factors mainly include entrepreneur characteristics [6], enterprise size or age [7][8], ownership type and legal form [9], geographic location [10], industry affiliation [11], and asset structure [12]. The literature shows that a deterioration in an enterprise's own view of its credit history, economic outlook, and capital should reduce its access to finance [13][14][15]. In addition, Beyhaghi et al. (2020) suggest that decreased profits increase the probability of an enterprise being rationed [16].

The mechanism that leads to the credit rationing of MSEs from the credit supply side lies in that, owing to information asymmetry, evaluating the credit risk of small enterprises is difficult for lenders [17]. To maximize profitability, lenders may apply stricter selection criteria and credit discrimination on MSEs [18]. Masiak et al. (2019) and De Jonghe et al. (2020) revealed that, due to increased screening costs, smaller enterprises find it more difficult to access finance from banks [19] [20]. The research of Sun et al. (2013) affirmed the existence of "the discrimination of scale" in the process of SME financing, and showed that the bank lending policies using fixed assets as collateral exacerbate the plight of small business financing [21].

Economic policy regimes contribute to the credit rationing of MSEs as evidenced by the fact that financial institutions may restrict credit or charge risk premiums for enterprises that operate opaquely in economies where legal regimes do not adequately protect property rights, institutions operate inefficiently, and the regulatory system is imperfect [22][23][24]. European evidence suggests that unique structural features combined with strict governance rules make MSEs less attractive to external financiers, and, as a result, this results in difficulties in accessing credit for them [25]. Based on the African context, Simba et al. (2023) suggest that, due to vast institutional voids, unco-ordinated domestic policies and the

widespread application of derivative accounting practices in financial markets, the availability of financial resources for small enterprises can be dangerously low [26].

Although scholars have explained the causes of the credit rationing of MSEs based on different perspectives and contexts, however, most studies did not make a clear distinction between MSEs and small and medium-sized enterprises (SMEs); the research on the credit rationing of MSEs is not systematic and in-depth. The concept of MSEs is derived from SMEs, and the explicit definition of MSEs is relevant to the understanding of the country's economic structure and development, as well as to the allocation of resources and the identification of targets for government support. This research is different from the previous study. Focusing on the specificities of MSEs, researchers explain the persistence of credit rationing for MSEs under the traditional credit mode through an evolutionary game model. And researchers found that the credit strategies evolutionary trajectory of banks and MSEs under the traditional mode is extremely unstable and cannot reach equilibrium.

3. Countermeasures to Alleviate the Credit Rationing of Micro and Small Enterprises

In order to alleviate the credit rationing of MSEs, scholars have put forward numerous countermeasures mainly for banks, governments, and MSEs. Policy recommendations for banks mainly include innovating credit technologies and providing loans to MSEs by large banks. Ferri et al. (2019) showed that transactional lending technologies increased enterprises' credit rationing, whereas soft information mitigated asymmetric information problems and improved enterprises' access to credit; when soft information was incorporated into transactional lending technologies, small enterprises' credit rationing significantly reduced [27]. Vera and Onji (2010) argued that large banks can provide differentiated financial services and credit support to MSEs at different stages of development, and they have information technology advantages, network advantages, and the advantage of sharing information costs across time, which is more conducive to establishing long-term and stable co-operative relationships with MSEs and providing them with services [28]. However, large banks may face Williamson-type organizational diseconomies.

Government intervention can reduce the investigation cost of banks to MSEs, make banks' deposit liquidity management more flexible, and improve the allocation efficiency of credit resources [29]. Government interventions for MSEs are categorized into indirect and direct interventions. Indirect interventions include taking measures to reduce transaction costs or increase the supply of funds, while direct interventions mainly include credit subsidies and loan guarantees [30]. Dai et al. (2020) showed that tax incentives from the government motivate enterprises to invest in short-term development opportunities with high returns rather than in long-term projects with high returns and high risks; tax incentives save capital expenditures for MSEs, and indirectly reduce the financing costs of MSEs [31]. Beck and Demirgü-Kunt (2010) point out that, as a form of risk sharing, government subsidies can help to increase the cash flow of MSEs and mitigate the negative impacts of co-ordination failures among guarantee agencies or the over-concentration of credit resources provided by collaborating banks [32]. Arping et al. (2010) examined the functioning mechanism of government credit guarantees on enterprise financing, noting that government subsidies for credit guarantees are more effective than other interventions [33].

Credit rationing has restricted the development of MSEs, and MSEs need to enhance their capabilities and utilize the environment to create appropriate financing opportunities to solve the problem [34]. Policy recommendations for MSEs mainly include borrowing from small and medium-sized financial institutions, utilizing informal finance, and engaging in relationship lending. For example, Lehmann et al. (2003) point out that it is easy to form long-term relationships between small and medium-sized financial institutions and MSEs, which can help to reduce collateral requirements for MSEs and information asymmetry, thus alleviating the credit rationing of MSEs [35]. Isaksson's (2002) study showed that, although the amount of each loan received by small enterprises from informal finance is small, they lend more often to informal finance and have a higher utilization of credit funds [36]. Cucculelli et al. (2019) argue that, by establishing soft-information-based and durable lending relationships with banks, the likelihood of small enterprises experiencing credit rationing is significantly reduced [37]. In addition, Olufunso and Francis (2011) advised the owners of MSEs to improve their management capacity by attending seminars and training programs to prepare them for access to finance [38]. Ogawa et al. (2013) showed that trade credit is an important source of finance for young and small enterprises that have difficulty in obtaining bank loans [39].

Overall, although scholars have provided many policy recommendations based on different perspectives to alleviate the credit rationing of MSEs, and these policy recommendations have also played a certain role, however, on the whole, the credit rationing of MSEs has not been thoroughly reduced in many countries, especially in developing countries. Therefore, further research is needed on countermeasures against the credit rationing of MSEs. This research is different

from existing research, since researchers believe that the credit rationing of MSEs is a kind of market mechanism defect. As a major player in the market, banks are the main external financing channels for MSEs; to alleviate the credit rationing of MSEs, banks desperately need tools to obtain the risk information of MSEs, and big data credit technology provides an opportunity for achieving this.

4. The Role of Big Data in the Credit Market

Improvements in socialization and the emergence of social networking platforms such as Facebook, Twitter, and Pinterest, as well as the tendency for data and programs to be accessed and stored over the Internet rather than on computer hard drives, have contributed to the era of big data [40]. "Big data" refers to massive data sets that are difficult to extract, store, search, share, analyze, and process with existing software tools, which require greater storage space and time, as well as sophisticated methods and technologies for managing and analyzing the [41]. Volume, Variety, and Velocity ("3V") is a common framework for describing big data [42]. In addition to the "3V" characteristics of big data, in recent years, Veracity, Variability, and Value have become new dimensions of big data characteristics, and are even more challenging [43]. Reduced storage costs and the widespread availability of cloud solutions from well-known providers such as Amazon, Google, and Microsoft have had a positive impact on the adoption of big data technologies and methodologies [44]. Cloud computing solutions can be used for big data management, and provide opportunities for enterprises, especially small enterprises, which are often constrained by a lack of financial and organizational resources [45].

Financial sectors can highly benefit from big data. They can access massive amounts of transaction data which can be processed to gain competitive advantages over their peers, enhancing the customer banking experience, risk analysis and mitigation, and operation and optimization [46]. The use of big data technology can break through the traditional mode of banks in dealing with information asymmetry. When big data technology is applied to the credit business, there is no human or subjective judgment factor; instead, through the analysis of the historical data that actually occurred, it can improve the amount of information and accuracy of the credit of borrowers to a certain extent. Jin et al. (2022) pointed out that the application of big data technology in credit evaluation facilitates the provision of unsecured credit based on industrial chain credit [47].

For the financing of MSEs, the value of big data lies in their ability to alleviate the information asymmetry between banks and enterprises, enabling banks to discover more high-quality MSEs with low risks instead of making credit decisions based on the qualitative characteristics of loan applicants, thereby expanding banks' credit allocation for the MSE group, effectively alleviating the problem of credit rationing for MSEs, and, at the same time, maximizing the banks' own profits. The research of Kshetri (2016) shows that the main reason why low-income households or microenterprises in emerging economies lack access to financial services is not because they lack creditworthiness but merely because banks lack data, information, and capabilities to access the creditworthiness of and effectively provide financial services to this financially disadvantaged group [48]. Tencent's Weizhong Bank has launched the "Microparticle Loan" product for its target customer groups, which is a microcredit product based on big data credit technology, and the speed of issuance of the product can be as fast as 45 s, and the slowest speed can be 90 s, which enables customers to enjoy a safer, faster, and more convenient service.

In summary, the existing literature provides many useful insights into the role of big data technology in the credit market, and the existing literature demonstrates that big data credit technology can reduce the information asymmetry between borrowers and lenders, thereby lowering the transaction costs of banks, and making the size of the enterprise no longer a constraint on the access to credit for MSEs. However, existing studies did not intensively consider the mechanisms by which banks' use of big data credit technology affects the credit rationing of MSEs. By comparing the evolutionary trajectories of bank–enterprise credit strategies under big data credit technology and the traditional mode through an evolutionary game model, and comparing the extent to which big data credit technology alleviates the credit rationing of MSEs with different credit levels through simulation experiments, researchers demonstrate that big data credit technology can effectively alleviate the credit rationing of MSEs.

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