Research on Stress Test of Bank Credit Risk in International Trade Based on DEA Model

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Abstract: International trade financing refers to the sum of all kinds of services provided by banks to meet the capital needs of traders around the capital needs and the laws of capital flow, combined with all aspects of international settlement. As an important part of finance, banking has played a great role in promoting economic and social development. Similarly, economic and social development will also promote the progress and development of banking. With the continuous development of the international economic and financial situation, the potential risks of international trade financing are also growing and changing. Studying the application of stress testing in commercial banks can effectively find the shortcomings of stress testing in commercial banks, which has positive theoretical and practical significance for the docking of management concepts and corporate culture and the construction of a comprehensive risk management system. According to the theory of credit portfolio, this paper puts forward a stress test scheme of bank credit risk in international trade based on DEA, so as to strengthen the management and control of credit risk and ensure the long-term healthy and stable development of banks.

1. Introduction

As the main body of modern finance and one of the hubs of economic and social operation, commercial banks have a great impact on the economy, and its important position makes risk management a very important job. At the same time, commercial banks, as an important part of the national economy, are the core of China's economic development[1]. International trade financing refers to the sum of all kinds of services provided by banks to meet the capital needs of traders around the capital needs and the rules of capital flow, combined with all aspects of international settlement[2]. As an important part of finance, banking has played a great role in promoting economic and social development. Similarly, economic and social development will also promote the progress and development of banking[3]. The commercial bank's measurement of the credit risk of enterprise customers can be transformed into the measurement of the financial situation of enterprises. The business of commercial banks is becoming more and more complex, and the risk sources are more diversified. How to effectively improve the risk management ability has become a major issue that domestic banks must solve as soon as possible[4]. As one of the main players in the international financial market, China's financial institutions and real economy are also facing a huge impact. The outbreak of COVID-19 epidemic has aroused people's thinking about the management

theory and methods of banking credit risk, and also put forward newer and stricter requirements for the monitoring, prediction and prevention of future financial risks[5].

As the oldest and most important risk in the financial market, credit risk has always been the key aspect of risk management and control of commercial banks. When credit funds flow into low-credit groups and high-risk areas for a long time, directly or indirectly, the hidden dangers of the crisis are formed[6]. If the risk control measures are improper, once the macro-economy is adjusted and the bubble bursts, it may induce a large-scale default[7]. If the default loss exceeds a certain limit, it will cause a series of chain reactions in the market, all kinds of risk cameras will be induced, and the financial market will fluctuate unceasingly, thus impacting the real economy[8]. The comprehensive credit granting of trade financing is often faced with a complex system composed of many interrelated and mutually restrictive factors, which often lacks quantitative data, so the credit granting risk of trade financing business is large and complicated[9]. However, in the process of introducing credit management into international trade financing, Chinese banks are often influenced by the original credit management thinking mode, and it is difficult to get rid of the deep-rooted thinking inertia. According to the theory of credit portfolio, this paper puts forward a stress test scheme of bank credit risk in international trade based on DEA, so as to strengthen the management and control of credit risk and ensure the long-term healthy and stable development of banks.

2. The Connotation of Commercial Bank Credit Risk and the Necessity of Stress Test

2.1 The Connotation of Credit Risk of Commercial Banks

Banks are special enterprises with operational risks, and the goal of bank management is to maximize profits on the premise of ensuring "survival". This requires banks to have a high level of risk management, which can manage daily risks and prevent extreme risks. The credit risk of a commercial bank refers to the risk that the debtor or counterparty defaults, that is, the bank has positive expected cash flow in the future, and the other party may default due to poor management or other reasons, resulting in the risk that the expected cash flow cannot be fully paid. After a long period of development, commercial banks have developed a relatively mature management system to deal with daily risks, but they still lack effective means to deal with extreme risks. The risk in normal environment and the risk in extreme environment show completely different characteristics, and the risk management methods developed based on normal environment cannot be applied to extreme environment, which requires banks to develop risk management methods for extreme environment.

The risk owned by a commercial bank refers to the situation that the actual income deviates greatly from the expectation because of uncertainty in the operation and management of the bank, which leads to the loss of the bank. This is the most extensive concept of credit risk, which includes all kinds of potential risks that may arise from bank credit activities, but this extra bank income is often ignored in real life. The credit risk of commercial banks mainly comes from the credit risk of loans, the credit risk of counterparties and the credit risk of issuers, and its credit risk is mainly the debtor's default. When the value of derivatives held by banks is unfavorable to the counterparty, the loss of counterparty's default may occur[10]. The credit risk of commercial banks refers to the possibility of asset loss to banks and other financial institutions because of credit default. For commercial banks, the harm of credit risk may lead to the ultimate inability of banks to repay their debts, and the solvency of banks is threatened. If the ratio of bad debts to total assets is too high, it will inevitably reduce the net asset value of banks, thus affecting their future development and competitiveness.

2.2 Necessity of Stress Test of Credit Risk in Commercial Banks

There are various forms of financial market risks, among which credit risk is the most important risk faced by financial activities and even economic society. The existence of credit risk not only has a great impact on economic and social life, but also plays an important role in the decision-making and development of major national projects, and sometimes even threatens the stability and development of the entire global economic system. Credit risk is considered as the risk that the borrower can't repay the principal and interest on time, which will cause losses to the lender. With the development of risk management technology, the possibility of losses caused by the borrower's or the market counterparty's breach of contract includes not only the failure of the counterparty to perform the contract at maturity, but also the possibility of losses caused by the change of the borrower's credit rating and performance ability. Stress testing needs to fully consider the potential changes in the future, because these changes may adversely affect the risk exposure of banks and the evaluation of their ability to resist such changes. According to the requirements of supervision and inspection by regulatory authorities, banks should choose different stress testing methods according to their own conditions. Commercial banks are at an information disadvantage. According to the probability distribution of default risk of all borrowers, it may be found that it is more beneficial for banks to restrict borrowers from borrowing from banks than to allow borrowers to choose their borrowing scale without restriction, which is called adverse selection.

Reliable data is the key to ensure the credit risk stress test results, and the data involved are divided into two levels: internal data and external data. Internal data include the data of assets exposed to credit risk in trading accounts and credit accounts of commercial banks; External data include various risk factors such as interest rate, exchange rate and stock price index. Commercial banks should ensure that accurate internal and external data can be obtained in time for stress testing. This requires commercial banks to have an efficient account information system, which is well connected with the risk management information system. International advanced banks can transmit the information of trading accounts and credit account changes to the risk management system in real time. The credit risk of commercial banks can be attributed to the severity of the loss of the bank's own assets caused by the failure to recover the bank's borrowed funds in time, which is the ratio of bank bad debts to bank assets. The credit risk of a commercial bank refers to the possibility that the borrower of the commercial bank can't perform the prescribed obligations according to the prior agreement, which will cause losses to the bank.

3. DEA-Based Stress Test Method of Bank Credit Risk in International Trade

In the risk management theory of commercial banks, stress testing has been a very important method to measure risks. The purpose of stress testing is not to predict what kind of macroeconomic situation will appear in the next few years, nor to build a risk early warning system for commercial banks, but to build an uncertain economic scenario that will have a great impact on the credit risk of commercial banks in the future, and to simulate the possible extreme events in the macro-economy to measure and evaluate the ability of China's commercial banking system to maintain stability when it encounters a big impact. Enterprises are the most important clients of bank credit, and the default behavior of enterprises is the most direct factor leading to the credit risk of commercial banks. When the macro-economy is in prosperity, the business conditions of enterprises are generally good, and enterprises are full of confidence in the future. Therefore, if loans are increased, the profits of enterprises will be good, and the credit quality will be significantly improved. When the macro-economy is in depression, the business conditions of enterprises will deteriorate, resulting in a significant increase in loan defaults.

The premise of diversification is that the correlation between asset returns is relatively small,

which exists under normal conditions. However, when extreme events occur, the correlation unexpectedly increases, leading to unexpected risk concentration, which makes risk diversification ineffective. In the risk management of financial system, it is not the ultimate goal to estimate the possibility of crisis, but to evaluate the financial system's ability to withstand the crisis. Stress testing evaluates the endurance of the financial system by simulating crisis scenarios. In the stress test of bank credit risk, randomly select two financial items: A and B, and calculate their relative performance values E_{AB} and E_{BA} respectively. The solution process is as follows:

$$E_{AB} = \max \sum_{r=1}^{s} u_r y_{rA} \tag{1}$$

$$\sum_{r=1}^{s} u_r y_{rA} \leq 1 \tag{2}$$

$$\sum_{r=1}^{m} u_r y_{rB} - \sum_{i=1}^{m} v_i x_{iB} \leq 0 \tag{3}$$

$$E_{BA} = \max \sum_{r=1}^{s} u_r y_{rB} \tag{4}$$

$$\sum_{r=1}^{s} u_r y_{rB} \leq 1 \tag{5}$$

$$\sum_{r=1}^{s} u_r y_{rA} - \sum_{i=1}^{m} v_i x_{iA} \leq 0 \tag{6}$$

Among them, x_{iA} represents the i input value of the economic benefit of A financial project; y_{rA} represents the r output value of A financial project economic benefit insurance; x_{iB} represents the i input value of the economic benefit of B financial project; y_{rB} represents the first r output value of the economic benefit of B financial project.

User interface		
Assessment model training	Assessment model management	Assessment model application

Customer data collection → Model extraction → Model calculation → Result adjustment →

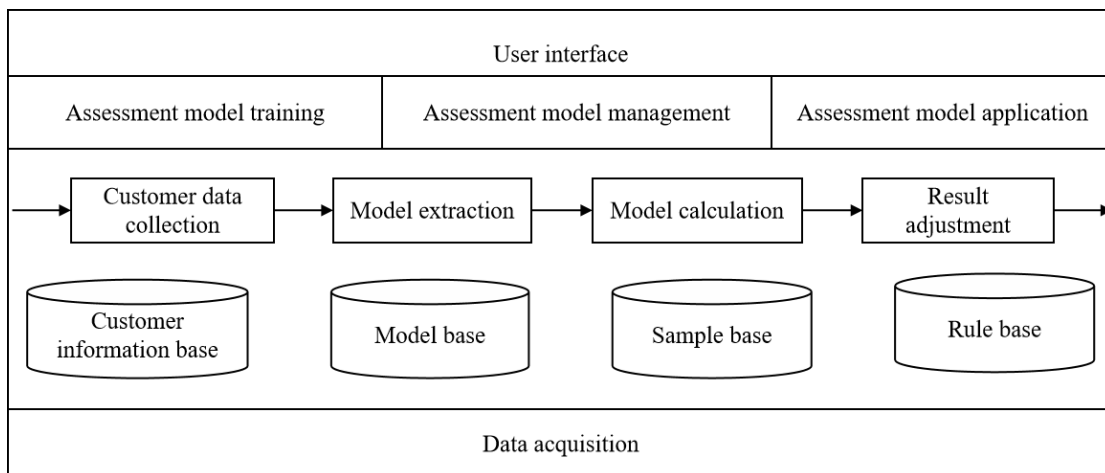| Customer information base	Model base	Sample base	Rule base

| Data acquisition | | | |

Figure 1 Credit Risk Control Model of Commercial Banks

The risk management department of a bank should regularly carry out stress tests on the risk

concentration of the main loans of the bank, and constantly verify the evaluation results in future operations, so as to judge the changes in the economic environment that may adversely affect the bank's operation and make corresponding responses. When a bank operates between several markets, it does not need to pass the test of each market, but it should include most of the loan stress tests. In extreme situations, banks may find that the original risk mitigation measures have limited effect. For example, in a crisis scenario, assets with strong liquidity may become illiquid. And facing the same situation, the risk mitigation measures taken by banks are similar, so many effective risk mitigation measures in normal environment will suddenly lose their effectiveness. As the main body of lending, the behavior of commercial banks will also affect credit risk. In addition to deciding loans according to the operating and financial conditions of individual enterprises, the lending behavior of commercial banks is also affected by the national macroeconomic situation. The credit risk control model of commercial banks is shown in Figure 1.

When the macro-economy is prosperous, banks are full of confidence in the future, so the credit scale will expand, enterprises and residents will make good profits, and the credit quality will be significantly improved. When the macro-economy is depressed, the business conditions of enterprises and residents will deteriorate, and banks will not expand the credit scale, resulting in a significant increase in loan defaults. In extreme environment, the uncertainty and fluctuation of risk factors in extreme environment are greater, and the losses that banks may suffer are also greater. In extreme circumstances, the correlation of many risks with low correlation will increase, while the correlation of some risks with high correlation under normal circumstances may decrease, which makes it more difficult to judge the development direction of things. The structure and specific characteristics of the bank's asset portfolio are the basic basis for determining the risk factors of stress testing. In addition, it is necessary to study the social environment, political environment, economic environment and industry environment to find out the potential stress events.

4. Conclusions

Affected by the financial crisis, global financial markets, including banks, are more prone to fluctuations, and the probability of systemic risks increases. Credit risk is still the biggest risk faced by the banking industry. How to improve the ability of commercial banks to resist risks, especially credit risks, is not only related to the survival and development of banks themselves, but also to the financial security and stability of the country. The stability of the banking system is an important issue related to the national financial security and stability, and the most important risk faced by the banking system is credit risk. According to the theory of credit portfolio, this paper puts forward a stress test scheme of bank credit risk in international trade based on DEA, so as to strengthen the management and control of credit risk and ensure the long-term healthy and stable development of banks. Banks are special enterprises that operate risks. They need to manage both daily risks and extreme risks. As far as scenario setting is concerned, how to select the appropriate stress scenario, ensure the sufficient stress and give the possibility of scenario occurrence as much as possible is still a difficult problem for stress testing. Historical scenario, hypothetical scenario, mixed scenario and other scenario setting methods have their own advantages and disadvantages and applicability. Risk managers should choose different methods according to their own risk status and test objectives.

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