Construction of Interest Rate Index of Supply Chain Finance

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Abstract:

The market-based reform of interest rates has facilitated the advent and development of supply chain finance. The latter then provides solutions toward the difficult and costly financing problems faced by micro-, small- and medium-sized enterprises. Interest rate, a critical means of economic regulation and control, is of certain sensitivity and thus can reflect rapidly the changes in economic development. However, there are relatively few researches on the interest rate concerning supply chain finance at present. First of all, synthetic control method and MI-TVP-SV-VAR model are adopted to calculate the selected variables of supply chain finance based on the overall monitoring goals of supply chain. Then, velocity area principle is quoted to construct the interest rate index of supply chain finance. Furthermore, the functions and application of interest rate index of supply chain finance is prospected.

Keywords: *Interest rate liberalization, Supply chain finance, Interest rate index, Risk control and MI-TVP-SV-VAR model.*

I. INTRODUCTION

During recent years, the socialized production mode in China has tended to be diversified. For example, credit sales becomes the dominant transaction mode; the financing proportion and loan growth rate of micro-, small- and medium-sized enterprises are much higher than those of large enterprises. By the end of 2020, there had been 55 million standing micro-, small- and medium-sized enterprises in China, accounting for 98.5% of total number of our enterprises. They have constituted an indispensable part of our break-and-mortar economy and stood as a crucial factor in boosting high-quality economic development. However, due to their small economic scale and weak qualifications, micro-, small- and medium-sized enterprises are suffering from the difficult and costly financing problems caused by their low credit grade and difficult credit evaluation[1]. The market-based reform of interest rates and the development in supply chain finance have provided solutions toward this problem.

The market-based reform of interest rates and the supply chain finance have been implemented for a long time abroad[2,3]. Therefore, relevant financial institutions have no strict control over their own interest rates. However, most of the supply chain finance service providers in China are banks or large financial network companies who gain their control over the interest rate of supply chain finance[4]. As

regulation strength intensifies and the capital amount on the market increases, the competition among financial institutions keeps growing fierce. They are gradually subject to the influence from interest rate liberalization upon supply chain finance. Supply chain finance creates a relatively stable environment for interest rate liberalization to play its role. In the supply chain ecosystem, interest rate can be set upon greater autonomy, which facilitates commercial banks to expand their business modes and boosts a rapid development in economy[5-7]. However, while facilitating micro-, small- and medium-sized enterprises in their financing, supply chain finance poses greater risks and management challenges to financial institutions, core enterprises and even macro financial sector[8,9].

II. DOMESTIC AND FOREIGN RESEARH STATUS

Although there are fewer researches on supply chain finance as a new financing method in the early stage, it has now not only become one of the key points of industrial practice but also a gradual hot spot for academic research as the economy develops in leaps and bounds[10,11].

When it comes to the functions of supply chain finance, Chinese experts and scholars generally hold that it has played a positive role in enterprises and banks. The financing via supply chain finance comes under the background of a limited credit capacity among small- and medium-sized enterprises and the credit tight of commercial banks. Against such a backdrop, Yan Guangle argued that it was supply chain finance that was able to point out a new path for the financing by small- and medium-sized enterprises[12]. Li Fei had affirmed the positive role of supply chain finance in resolving the financial problems among small- and medium-sized enterprises[13]. Foreign scholars have acknowledged the role of supply chain finance, too. According to their analyses on global enterprises that adopted supply chain finance solutions in 2013, Kelly and Susan found that supply chain finance had already became a critical tool for business circle to balance the demand for cash between themselves and their suppliers[14].

The research on financial index in China starts later that that in foreign countries. Therefore, there are fewer existing researches by now. Some specialists pointed out that the credit index of supply chain finance comprised two parts, namely the credit index of core enterprises during supply chain finance activities and the pledge rate index[15-17]. They emphasized the crucial role of core enterprises during the operation of supply chain finance. Later on, some scholars took the standard deviation of market interest rate of supply chain finance as the risk index and came up with the China Supply Chain Finance Index, so as to measure the scale and development degree and to evaluate the risk and macroeconomic development of the supply chain finance market in China[18-20]. The financial index has been researched for a relatively long time abroad due to their high level of market-based economy. The UK and some European and American countries began to research and apply the theories on price index in the 18th century. This index has now been adopted to reflect the changes in stock price since then. Purchasing Managers' Index (PMI) was proposed in the 1930s, of which each indicator reflects the realistic situation in commercial activities, and whose composite index reflects the overall growth or recession in a sector. PMI is of great significance to governmental departments, financial institutions, investment companies and general enterprises in the aspect of economic projection and business analysis. Proposed by Sharpe W. F. in 1996,

Sharpe Index was designed to measure the performance of financial assets and to reflect the degree to which the growth rate of unit venture capital exceeded the risk-free rate of return. The construction of supply chain finance model and index system is valued by researchers in general. Nevertheless, it is quite necessary to explore a quantitative analysis model based on the principle that data prevail. That is because the information on market is often incomplete, and the basic hypotheses and parameters mostly come from qualitative analysis. They may cause the deviation in calculation.

Currently, there are many financial indexes on the economic front but few researches on interest rate of supply chain finance. That is because banks and large financial network enterprises pay close attention to controlling their own risks, and haven't conducted the risk assessment, prevention and control from the perspective of interest rate system of supply chain finance across China yet. Besides, the above researches were mainly theoretical according to literature review; the parameters of those models constructed were set through qualitative analysis, which brought artificial errors into the measurement. Most of those models did not taken into account the influence from interest rate, either. As a result, in this paper, the interest rate index of supply chain finance is constructed through data mining and analysis with the interest rate as entry point, and then applied into the scale forecasting, risk measurement and control and other aspects of supply chain finance.

III. CONSTRUCTION OF INTEREST RATE INDEX OF SUPPLY CHAIN FINANCE

3.1 Data Selection and Index System Establishment

As for data selection, the data herein are mainly acquired from the People's Bank of China, the Open data of China Banking Regulatory Commission, Wind database, Almanac of China's Finance and Banking, etc. The following variables from 2013 to 2021 are adopted as indicators in view of the characteristics of supply chain finance and the types of enterprises involved. They are credit rate of supply chain finance, supply and demand of credit money of supply chain finance, collateral value, asset and credit level, operating cost, real trade background of supply chain, information efficiency, risk control measures, institutional competition, policy environment, third-party regulation capacity, maturity time, etc.

Credit rate of supply chain finance. The main clients of supply chain finance services are micro-, small- and medium-sized enterprises. However, the huge number and the corporate secrets concerning those enterprises make it impossible to acquire all credit rates of supply chain finance. Therefore, the synthetic control method is adopted herein to calculate the data on interest rates from some large supply chain finance credit platforms. In this way, an universal interest rate can be obtained in the field of supply chain finance.

Supply and demand of credit money of supply chain finance. The changes in money supply, a key indicator for financial authorities to intervene in economic development, can reflect the social and economic development to a certain extent. Therefore, the credit money supply of supply chain finance is selected as one of the indicators to observe the development in supply chain economy.

Collateral value, asset and credit level and operating cost. These three indicators fully display the loan solvency and the operating status of enterprises engaging in supply chain finance. Therefore, the data on above three indicators are summarized through credit transactions of supply chain finance disclosed via various channels.

Real trade background of supply chain, information efficiency, risk control measures, institutional competition, policy environment, third-party regulation capacity and maturity time. The above indicators reflect the risk profile of supply chain finance to a certain extent and simultaneously influence the formulation of interest rate of supply chain finance. Therefore, the above indicators selected are able to reflect the risk profile of supply chain finance.

When it comes to the establishment of index system, first of all, the ADF method is adopted to conduct the unit root test for index system sequence. Each indicator rejects the null hypothesis at least at a level of 5%. It indicates that estimated sequences of all sequences involved are stationary time sequences. Therefore, they can be adopted to build the MI-TVP-SV-VAR model. Then, a lag order of 2 is selected to conduct the Granger causality test. All of the tests between indicators and supply chain finance development reject the null hypothesis at least a level of 5%, indicating that all of them have a two-way Granger causality. It fully shows that each indicator can serve as Granger cause of supply chain finance development and that it's rational to use them to construct the interest rate index of supply chain finance.

3.2 MI-TVP-SV-VAR Model

The precondition to apply a classical linear model is that the relations among economic variables and the external fluctuations remain unchanged. However, the rapid economic development and the sea change in economic environment in China makes it impossible to maintain somehow definite relationship among economic variables and external fluctuations. Therefore, the MI-TVP-SV-VAR model is quoted to reduce the subjectivity and randomness during the model establishment. The impulse response function value of each indicator is calculated, which lays a foundation for the construction of interest rate index of supply chain finance.

Measurement Equation of MI-TVP-SV-VAR Model

$$y_t = Z_t X_t + \mu_t \tag{1}$$

Where y_t is the vector of n*1 and n is the number of variables explained.

Z_t is a matrix consisting of explanatory variables with n* K dimensions. It includes lagged values and intercept items of all variables explained and its total number is k.

X_t is an unobservable state vector of k*1. It represents the coefficient of VAR, and determines that the evolution mode of VAR model coefficient term is flexible

and dynamic.

μ_t is an independent random vector that conforms to a normal distribution of N (0, H).

(2) State Equation of MI-TVP-SV-VAR Model

$$X_t = X_{t-1} + K_{1t}\nu_t \tag{2}$$

$$h_t = h_{t-1} + K_{2t}\xi_t \tag{3}$$

$$\alpha_t = \alpha_{t-1} + K_{3t}\varsigma_t \tag{4}$$

Among them, K_{it} is a mixed innovation term and can only be taken as 0 and 1, thus determining that the evolution mode of each relational term concerning the VAR model is flexible and dynamic.

h_t is an unobservable vector, namely, the logarithmic fluctuation term of VAR model.

α_t is the state equation of unobservable vector, namely, the concurrent relational term of VAR model.

$\nu_t, \varsigma_t, \varsigma_t$ is an independent error term that conforms to the entire distribution.

3.3 Interest Rate Index Model of Supply Chain Finance and its Measurement Method

Firstly, the supply chain interest rate index model is constructed as below with reference to the thoughts and principle of velocity area method.

$$SPCIRI_t = \beta_{IR_t} \sum_i^n \omega_{it} nT\Phi_{it} \tag{5}$$

$$\omega_{it} = \frac{\sum_{j=1}^M \Phi_{ijt}}{\sum_{it} \left| \sum_{j=1}^M \Phi_{ijt} \right|} \tag{6}$$

Where β_{IR_t} is the supply chain finance interest rate at phase t calculated with Stata through synthetic control method.

ω_{it} is the weight coefficient of the ith indicator at phase t.

n is the number of supply chain finance indicators involved in index model calculation.

T is the maturity time of supply chain financial credit.

Φ_{it} is the impulse response value of the ith indicator at phase t.

Secondly, a flexible and dynamic measurement method for supply chain interest rate index. First, data

on each indicator are selected for standardized processing; second, Eviews is adopted for unit root test and Granger causality test for data on each indicator; qualified indicators are adopted to form the index system; third, MI-TVP-SV-VAR model is adopted to calculate each flexible dynamic impulse response function value; fourth, the ratio of cumulative value of flexible dynamic impulse function of each indicator to the total cumulative value is adopted to calculate the flexible dynamic weight of each state variable; fifth, the flexible dynamic weight is substituted into Equation (5) to work out the credit rate index of supply chain finance.

The prospect applications of findings herein are mainly reflected in three aspects as below. First of all, the indicators selected herein concern the whole field and each participant in supply chain finance. Therefore, the interest rate index of supply chain finance can measure and control the market scale and risks and forecast the development trend of supply chain finance. Second, the interest rate of supply chain finance is formulated upon discussion among its participants. The interest rate index of supply chain finance can serve as the reference index for interest rates formulated within the field of supply chain finance. Besides, it also provides a theoretical basis for business adjustment and strategy formulation by supply chain enterprises. Third, interest rate index of supply chain finance reflects to some extent the scale, development and risk profile of macro financial market because macroeconomic market consist of supply chains. Therefore, the index can serve as a basis for governmental departments to formulate policies and to engage in the control over economic development.

IV. SUMMARY AND PROSPECT

The role of interest rate and the characteristics of supply chain finance are taken into full account. On this basis, 12 variables in supply chain finance are taken as indicators, such as credit rate of supply chain finance, supply and demand of credit money of supply chain finance, asset and credit level and real trade background of supply chain; the principle of velocity area method is quoted, expanded and transformed so as to construct the interest rate index of supply chain finance. In this way, the interest rate of supply chain financial can fully play its role as a "barometer" of economic dynamics. That is, the credit rate index of supply chain finance can be adopted to forecast the overall development trend of supply chain in a better way and to prevent and control the risks in supply chain finance.

Interest rate index of supply chain finance can reflect not only the situation of supply chain but also the financing scale and cost on the supply chain market. As compared with PMI, which only reflects the situation in production and circulation sectors, this index is better because it reflects situations in both the production and circulation sectors and the financial sector simultaneously. Therefore, it can work with PMI and other indexes to jointly reflect the macroeconomic performance. In this regard, it helps various industries to scientifically forecast the macroeconomic boom and development trend; it facilitates the government to formulate the policies for macro control; it assists regulators in formulating regulation measures, policies and planning for supply chain finance sector.

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