Hindawi
Security and Communication Networks
Volume 2023, Article ID 9823467, 1 page
https://doi.org/10.1155/2023/9823467

Retraction

Retracted: Correlation Analysis of Interbank Money Market Interest Rate and Financial Crisis Based on Neural Network Model

Security and Communication Networks

Received 11 July 2023; Accepted 11 July 2023; Published 12 July 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] X. Zeng, C. Yuan, and C. Liang, "Correlation Analysis of Interbank Money Market Interest Rate and Financial Crisis Based on Neural Network Model," *Security and Communication Networks*, vol. 2022, Article ID 8807215, 11 pages, 2022.

Hindawi
Security and Communication Networks
Volume 2022, Article ID 8807215, 11 pages
https://doi.org/10.1155/2022/8807215

Research Article

Correlation Analysis of Interbank Money Market Interest Rate and Financial Crisis Based on Neural Network Model

Xiaohua Zeng,[1] **Chiping Yuan**,[2] **and Changzhou Liang**[1]

[1]*School of Economics and Trade, Guangzhou Xinhua University, Dongguan 523133, China*
[2]*Lingnan College Sun Yat-Sen Universtiy, Guangzhou 510275, China*

Correspondence should be addressed to Chiping Yuan; yuanchip@sysu.edu.cn and Changzhou Liang; salcz@xhsysu.edu.cn

Received 17 March 2022; Revised 13 April 2022; Accepted 21 April 2022; Published 27 May 2022

Academic Editor: Chin-Ling Chen

This paper combines the neural network model to analyze the correlation between the interbank money market interest rate and the financial crisis, and theoretically analyzes the influence of the characteristics of the banking industry on the transmission of monetary policy interest rates. Moreover, this paper constructs a theoretical model to analyze the influence of banking industry characteristics on the transmission of monetary policy interest rate and examines whether the variables of banking industry characteristics still affect the measurement indicators of monetary policy interest rate transmission after the financial crisis subsides. In addition, this paper combines the neural network model to construct a correlation analysis system between the interbank money market interest rate and the financial crisis. The experimental research shows that the correlation analysis between the interbank money market interest rate and the financial crisis based on the neural network model proposed in this paper can play a certain role.

1. Introduction

Under normal circumstances, the marketization of interest rates will directly affect the risk management ability of commercial banks and improve the pricing ability of commercial banks on deposit and loan interest rates, and there is a relatively low interest rate risk. After the interest rate liberalization, in the short term, the interest rate of bank deposits may rise and the interest spread will narrow. Moreover, it may also lead to large fluctuations in financial asset prices in the short term, intensify competition among banks, and lead to risks such as strengthening the trend of integrated operations of financial institutions. The relationship between interest rate liberalization and macroeconomics is uncertain. Existing research is generally divided into stages of development. In developed countries, interest rate liberalization will help increase macroeconomic output under normal conditions. However, its occurrence in developing countries increases the volatility of macroeconomic output.

Interest rate marketization refers to the fact that the central bank gives the right to determine interest rates to financial institutions, which independently determine interest rates in accordance with the supply and demand of market funds. At the same time, the central bank indirectly regulates interest rates by controlling benchmark interest rates, deposit reserves, re-lending rates, re-discount rates, open market operations, and other means to transmit national policies. Interest rate liberalization is beneficial to the improvement and optimization of the financial environment, and can help improve the efficiency of operating the financial system and play a potential role in economic development. In particular, for developing countries, the microeconomic foundation and macroeconomic environment are weak, and the risk of interest rate liberalization reform is greater and more complicated. Therefore, it is of great significance to explore and prevent financial risks such as liquidity risk, credit risk, and exchange rate risk in the process of interest rate marketization.

Interest rate liberalization increases the autonomy of commercial banks and eliminates the market where commercial banks strictly enforce interest rates prescribed by the People's Bank of China, distort price relations, lower interest rates to optimize financial services, and violate "quality-based pricing" and "risk-reward matching" phenomenon of the principle resource allocation function. Commercial banks may, based on bank operation and management and market interest rates, comprehensively consider their own operating costs, customer risk differences, target returns, industry competition, and the elasticity of interest rate supply and demand, determine the interest rate levels for deposits and loans, and implement differentiated strategies. The liberalization of interest rate has prompted commercial banks to develop intermediary business and carry out product innovation. At present, the ratio of intermediary business to the income of commercial banks is still low. The marketization of interest rate has greatly reduced the interest spread income of commercial banks in deposits and loans, and the profit point of state-owned commercial banks has turned more to the development of intermediary business. The impact of the financial crisis has also brought about an internationalized financial service concept, and the increasingly mature market has an increasing demand for financial services, which greatly expands the profit margins of commercial banks for intermediary business. The liberalization of interest rates enables commercial banks to have more means to actively match assets and liabilities. Usually, commercial banks cannot match assets, liabilities in terms of maturity, and interest rates. However, after the interest rate marketization, commercial banks can reduce or increase interest rates through active negative detection methods to absorb the deposits required by commercial banks and ultimately reduce the risk of mismatch. Also, under the increasingly perfect financial market, commercial banks use financial derivatives to alleviate the risk of asset-liability gap, reduce the possibility of loss of benefits, and better manage assets and liabilities of commercial banks.

Based on the above analysis, this paper combines the neural network model to analyze the correlation between the interbank money market interest rate and the financial crisis, which provides a method for the discovery of the risk factors of the financial crisis and improves the effective response strategy of the financial crisis.

2. Related Work

Literature [1] focuses on the analysis of optimal fiscal policy and monetary policy; Literature [2] studies the optimal monetary policy rules; Literature [3] studies the optimal monetary policy under sticky prices; Literature [4] studies a comprehensive effect assessment of the macro model of monetary policy which is presented. There are more and more macro studies that add financial factors. In recent years, the DSGE model has been widely used in the study of financial crisis. Literature [5] discusses the selection and application of optimal monetary policy rules and establishes an open economy DSGE model with a "financial accelerator," which lays the early foundation for the application of monetary policy rules. Literature [6] constructs a new Keynesian DSGE model from different channels and compares the optimal monetary policy choices of different parameters of economic fluctuations under Taylor's rule; Literature [7] discusses whether monetary policy is a quantitative rule or a price rule, and argues that the interest rate rules will become an important and effective means of monetary policy; Literature [8] adds the banking sector to the general equilibrium model, examines the relationship between bank credit and economic fluctuations, and finds that the impact of banks on economic fluctuations has a strong explanatory power; Literature [9] studied monetary policy options from different perspectives, and they all came to the conclusion that it is necessary to strengthen the coordination and cooperation between policy tools, and it is necessary to use mixed policy tools; and it is necessary to use mixed policy tools; Literature [10] studied the impact of monetary policy on bank risk and believed that monetary policy and macro-prudential policies need to be coordinated with each other; Literature [11] studied the impact of monetary policy on the fluctuation of economic-related variables and believed that the open frame model is the best choice for national interest rate policy. Literature [12] analyzed the effectiveness of monetary policy from different perspectives and methods.

Literature [13] explained the promotion effect of interest rate marketization from the perspective of endogenous growth theory. Interest rate marketization will make savings more effectively allocated to high-yield investment projects. Literature [14] found that the actual average annual economic growth rate of each country will increase by 1%–2% after interest rate liberalization through panel data research on 21 interest rate liberalization countries. However, interest rate liberalization is also a double-edged sword. While bringing benefits, it will also increase risks in the financial sector, aggravate macroeconomic fluctuations, and increase the probability of a financial crisis. Literature [15] analyzed the incomplete statistics of the banking crisis in the interest rate liberalization countries and concluded that the crisis after the interest rate liberalization is not an accidental event, including the developed economies such as the USA and Japan with sound financial infrastructure. It also includes developing countries such as Thailand, Kenya, and Chile with weak financial infrastructure. A large number of studies on banking crises and currency crises show that financial liberalization represented by deregulation of interest rates often leads to problems such as excessive credit, increasing the instability of the financial system, and thus triggering financial crises. Literature [16] used 0/1 dummy variables as proxy variables for interest rate control periods and interest rate relaxation periods. The study found a strong positive relationship between interest rate liberalization and the probability of a subsequent banking crisis. Literature [17] found that banking crises are more likely to occur after the relaxation of interest rate controls and direct credit scale controls. Literature [18] further subdivided financial liberalization into internal financial liberalization represented by interest rate liberalization and external financial liberalization represented by capital account deregulation. Financial liberalization is the main cause of the financial crisis. In general, financial crises are more likely to occur in an open financial system, and the probability of bank crises and currency crises will increase significantly after interest rate liberalization. And the banking crisis has shown a trend following the reform of interest rate liberalization [19].

3. Theoretical Model of the Influence of Banking Sector Characteristics on the Transmission of Monetary Policy Interest Rates

The model assumes that the banking system is an imperfectly competitive market, so banks have the right to set prices in the deposit and loan markets, and can set the loan interest rate i_L and deposit interest rate i_D by themselves, while the government bond interest rate i_B is beyond the control of the bank. The model uses i_B as the monetary policy rate. The assets of commercial bank j include loans issued (L_j), government bonds held (B_j), and reserves (R_j), while liabilities include deposits received (D_j), and there is the following relationship between them:

$$B_j = D_j - L_j - R_j. \tag{1}$$

We assume that the loan demand function and deposit supply function faced by banks are

$$\begin{aligned} L_j &= L\left(i_{Lj} - i_L, i_L\right) = L_0 e \times p - \left[\theta_1\left(i_{Lj} - i_L\right) - \theta_2 i_L\right], \\ D_j &= D\left(i_{Dj} - i_D, i_D\right) = D_0 e \times p\gamma\left[\left(i_{Dj} - i_D\right) + \eta_2 i_D\right]. \end{aligned} \tag{2}$$

Among them, L_0 and D_0 are constants greater than 0, i_L and i_D represent the average loan interest rate and average deposit interest rate in the market, respectively, and i_{Lj} and i_{Dj} are the loan interest rate and deposit interest rate selected by bank j. θ_1 and η_1 are constants greater than 0, representing the semi-elasticity of the bank's loan demand and deposit supply, respectively, with respect to the gap between the bank's loan interest rate and deposit interest rate and the market average. The size of θ_1 is related to the degree of competition in the credit market, and the more intense the market competition, the larger the θ_1. Similarly, θ_2 and η_2 are also constants greater than 0, representing the semi-elasticity of the bank's loan demand and deposit supply with respect to the average loan interest rate and the average deposit interest rate, respectively. If all banks in the market are assumed to be identical, then L_0, D_0 and all semi-elasticities are the same for each bank.

Due to the information asymmetry in the loan market and the existence of contract execution costs (negotiation costs, the cost of investigating the borrower's solvency, and credit history before the transaction, the cost of monitoring the use of the borrower's funds after the transaction), issuing loans has become a high-cost activity. In the case of information asymmetry in the credit market, if the scale of bank loan business exceeds the customer group they trust, the cost of lending will increase significantly. In addition, the larger the loan scale expands, the faster the cost increases; that is, when the credit scale exceeds a certain amount, the bank's loan cost function C_j is a single-increasing convex function, and a quadratic function is used to describe this relationship, namely,

$$C_j = \begin{cases} \gamma_0 L_j, & L_j \le L^*, \\ \gamma_0 L_j + \left(\dfrac{\gamma_1}{2}\right)\left(L_j - L^*\right)^2, & L_j > L^*. \end{cases} \tag{3}$$

L^* represents the maximum loan amount that banks can lend to enterprises with excellent qualifications. If the scale of credit is to be further increased, it can only lend to enterprises with lower credit levels. The model assumes that L^* and γ_0, γ_1 are the same for all banks. The parameter γ_1 plays an important role in the model. The worse the environment in which the bank conducts business (macroeconomic environment, banking competition environment, etc.), the larger the γ_1 will be, and the steeper the cost function will be.

Finally, we assume that banks hold reserves at a fixed ratio, that is, $R_j = \rho D_j$.

The goal of commercial banks is to set the optimal $iL, i\ D$ to maximize their own profits, that is, to solve the following problems under the above assumptions:

$$\begin{aligned} \operatorname{Max}\left(i_{Lj}, i_{Dj}\right) &= i_{Lj} L\left(i_{Lj}, \Lambda\right) + i_B B_j \\ &\quad - c\left[L\left(i_{Lj}, \Lambda\right)\right] - i_{Dj} D\left(i_{Dj}, \Lambda\right) \\ &= i_{Lj} L\left(i_{Lj}, \Lambda\right) + i_B\left[(1-\rho) D\left(i_{Dj}, \Lambda\right) - L\left(L_{Lj}, \Lambda\right)\right] \\ &\quad - c\left[L\left(i_{Lj}, \Lambda\right)\right] - i_{Dj} D\left(i_{Dj}, \Lambda\right). \end{aligned} \tag{4}$$

The first-order conditions for a bank to maximize profits are

$$\begin{aligned} L_j + \left(i_{Lj} - i_B\right) L' - C' L' &= 0, \\ -D_j + \left[i_B(1-\rho) - i_{Dj}\right] D' &= 0. \end{aligned} \tag{5}$$

The optimal loan interest rate is $i_{Lj} = (1/\theta) + \ (i_B + \omega + \gamma_1 L_j)$.

Among them, $\omega = \gamma_0 - \gamma_1 L^*$ is a constant. What we are most concerned about is the effect of the transmission of policy interest rate changes to the loan interest rate, so according to the expression of the optimal loan interest rate, the transmission coefficient $\partial i_{Lj}/\partial i_B$ of the policy interest rate to the loan interest rate is further deduced.

$$0 < \frac{\partial i_{Lj}}{\partial i_B} = \frac{1}{\left(1 + \gamma_1 \theta_1 L_j\right)} < 1. \tag{6}$$

In order to investigate the influencing factors of the transmission coefficient of the policy interest rate to the loan interest rate, the partial derivatives of γ_1 and θ_1 are obtained by using the interest rate transmission coefficient to obtain

$$\begin{aligned} \frac{\partial^2 i_{Lj}}{\partial i_B \partial \gamma_1} &= \frac{-\theta_1 L_j}{\left(1 + \gamma_1 \theta_1 L_j\right)^2} < 0, \\ \frac{\partial^2 i_{Lj}}{\partial i_B \partial \theta_1} &= \frac{-\left(1 - \theta_1 i_L\right) \gamma_1 L_j}{\left(1 + \gamma_1 \theta_1 L_j\right)^2} > 0. \end{aligned} \tag{7}$$

It can be seen that the larger the γ_1 is, the smaller the transmission coefficient of the policy interest rate to the loan interest rate is, and the larger the θ_1 is, the larger the transmission coefficient of the policy interest rate to the loan interest rate is. γ_1 represents the marginal cost of the bank in expanding the scale of credit. A country's macroeconomic environment, financial system environment, and the quality of the banking industry's own assets may all affect the magnitude of this coefficient, and the lower the asset quality of the banking industry. The worse the domestic financial system environment and the larger the γ_1, the weaker the transmission of monetary policy interest rate to loan interest rate. Similarly, we can see from the results that the larger the θ_1, the larger the transmission coefficient from the policy rate to the lending rate. θ_1 represents the semi-elasticity of the loan demand faced by banks with respect to the gap between bank loan interest rates and the market average. When the degree of competition in the banking industry increases, θ_1 increases, and the transmission of policy interest rates to loan interest rates will also increase. To sum up, the transmission effect of monetary policy interest rate to loan interest rate is related to the degree of competition in the banking industry, it is also related to the marginal cost when banks expand the scale of credit, and it is related to the quality of the banking industry's own assets.

In order to study the influence of banking industry characteristics on the transmission effect of monetary policy interest rate to bank loan interest rate, the first problem to be solved is what method to use to measure the transmission effect of monetary policy interest rate to bank loan interest rate. By reviewing previous studies, we found that different scholars have different approaches to this issue. In order to enrich the research content and enhance the credibility of the results, this paper will use the error correction model and the SVAR model to measure the transmission effect of monetary policy interest rates to bank loan interest rates, and the error correction model is used in this section.

An error correction model (ECM) was established for each sample country's monetary policy rate and bank lending rate using the E-G two-step method. The advantage of this approach is that it can separately describe the short-term adjustment relationship and long-term dynamic equilibrium relationship between the two interest rates, and then comprehensively consider the short-term and long-term effects of interest rate transmission. The specific method is to carry out unit root test and cointegration test for the monetary policy interest rate index series $PR_{i,t}$ and bank loan interest rate index series $LR_{i,t}$ of each sample country, and the countries that fail the cointegration test between the two series are deleted from the sample. For each sample country that satisfies the cointegration relationship, a cointegration regression model is established:

$$LR_{i,t} = c_i + \beta_i \cdot PR_{i,t} + \varepsilon_{i,t}. \tag{8}$$

Among them, $LR_{i,t}$ and $PR_{i,t}$ are the bank loan interest rate and the monetary policy interest rate of the sample country i, respectively, and β_i is the long-term transmission coefficient of the change of the monetary policy interest rate in the country to the loan interest rate, which represents the long-term equilibrium relationship between the policy interest rate and the bank loan interest rate. The second step uses the residuals of the first step, the monetary policy interest rate, and the first-order difference term and the lag term of the bank loan interest rate to establish an error correction model, and the short-term parameters are estimated by the following equations.

$$\begin{aligned}\Delta LR_{i,t} = {} & \gamma_i + \alpha_{i1}\Delta LR_{i,-1} + \alpha_{i2}\Delta LR_{i,t-2} + \theta_i \Delta PR_{i,t} \\ & + \theta_{i1}\Delta PR_{i,t-1} + \theta_{i2}\Delta PR_{i,t-2} + \delta_i \widehat{\varepsilon}_{i,t-1} + \mu_{i,t}.\end{aligned} \tag{9}$$

Among them, the current influence coefficient θ_i of monetary policy interest rate change $\triangle PR_{i,t}$ on loan interest rate change $\triangle LR_{i,t}$ is the short-term transmission coefficient of policy interest rate change to loan interest rate. The coefficient δ_i before the error correction term $\widehat{c}_{i,-1}$ represents the adjustment speed when the two interest rates deviate from the long-term equilibrium relationship. By comparing the long-term interest rate transmission coefficient β_i, the short-term interest rate transmission coefficient θ_i, and the adjustment speed δ_i in different countries, we can compare the differences in the transmission effect of monetary policy interest rates to bank lending rates in different countries.

From the two aspects of the competition degree of the banking system and the asset quality of the banking system, the method of multiple regression is used to examine the influence of the characteristics of the banking industry on the estimated coefficient $\beta_i, \theta_i, \delta_i$ in the model. Among them, regarding the degree of competition in the banking system, this paper uses the market concentration index, that is, the proportion of the total assets of the three largest commercial banks in a country to the total assets of the banking industry (CR3) to reflect. This paper introduces per capita GDP and CPI. Finally, in order to control the factors of the institutional environment, this paper selects the regulatory quality (rq) index measured by the World Bank as the control variable. The regulatory quality index aims to reflect the ability of a government to formulate and implement reasonable policies. Therefore, we use the interest rate transmission coefficient index $\beta_i, \theta_i, \delta_i$ as the explained variable, and the various indicators and other variables of the banking industry characteristics as the explanatory variables to establish the following multiple regression model, and focus on examining the sign of the coefficient of the banking industry characteristic variable and its economic significance.

$$\begin{aligned}\beta_i &= \gamma_0 + \gamma_1 CR3_i + \gamma_2 npl_i + \gamma_3 fd_i + \gamma_4 G\ DP_i + \gamma_5 CPI_i + \gamma_6 rq_i + \varepsilon_1, \\ \theta_i &= \rho_0 + \rho_1 CR3_i + \rho_2 npl_i + \rho_3 fd_i + \rho_4 G\ DP_i + \rho_5 CPI_i + \rho_6 rq_i + \varepsilon_2, \\ \delta_i &= \varphi_0 + \varphi_1 CR3_i + \varphi_2 npl_i + \varphi_3 fd_i + \varphi_4 G\ DP_i + \varphi_5 CPI_i + \varphi_6 rq_i + \varepsilon_3.\end{aligned} \tag{10}$$

The SVAR model is a measurement method that introduces the structural relationship between variables based on economic and financial theory on the basis of the traditional VAR model. The model adds the contemporaneous influence relationship between variables, so as to fully

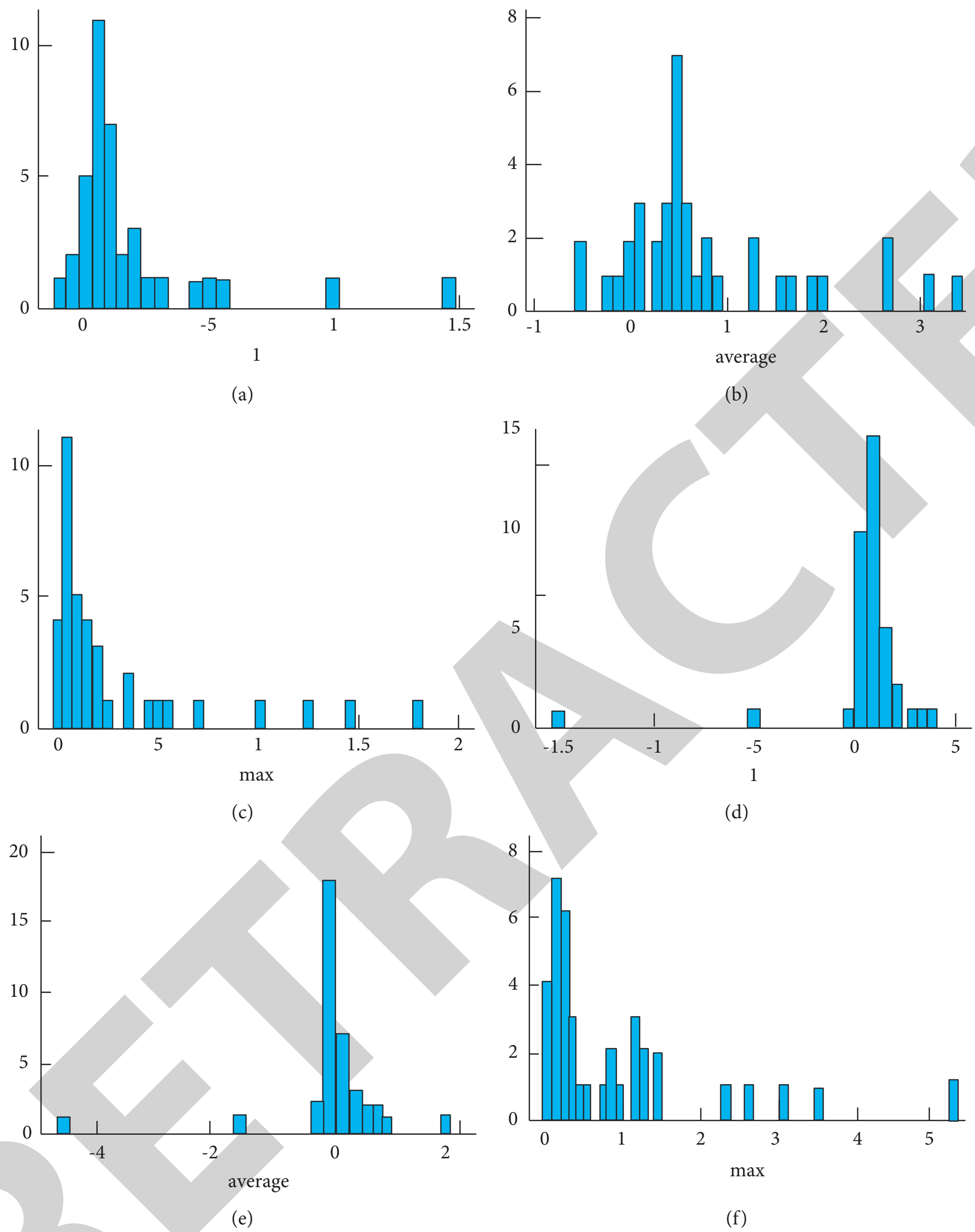
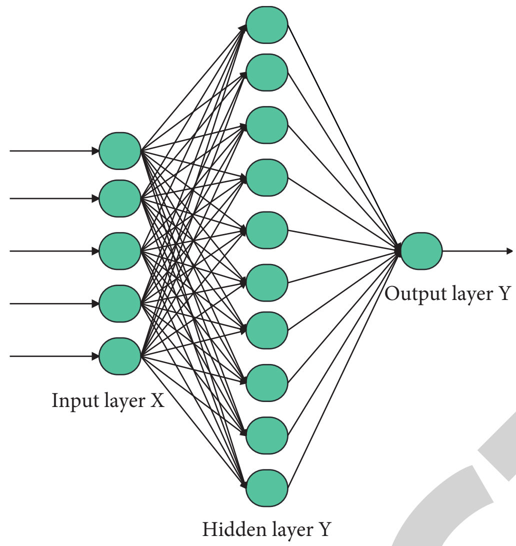


Figure 1: Frequency distribution histogram. (a) Histogram of the frequency distribution of re_1 before the financial crisis. (b) Histogram of the frequency distribution of re_average before the financial crisis. (c) Histogram of the frequency distribution of re_max before the financial crisis. (d) Histogram of the frequency distribution of re_1 after the financial crisis. (e) Histogram of the frequency distribution of re_average before the financial crisis. (f) Histogram of the frequency distribution of re_max before the financial crisis.

consider the influence of its own lag item and other variables and their lag items in the current period. The advantage is that it can capture the immediate structural relationship of variables in the system, which is more in line with the actual situation of economic operation.

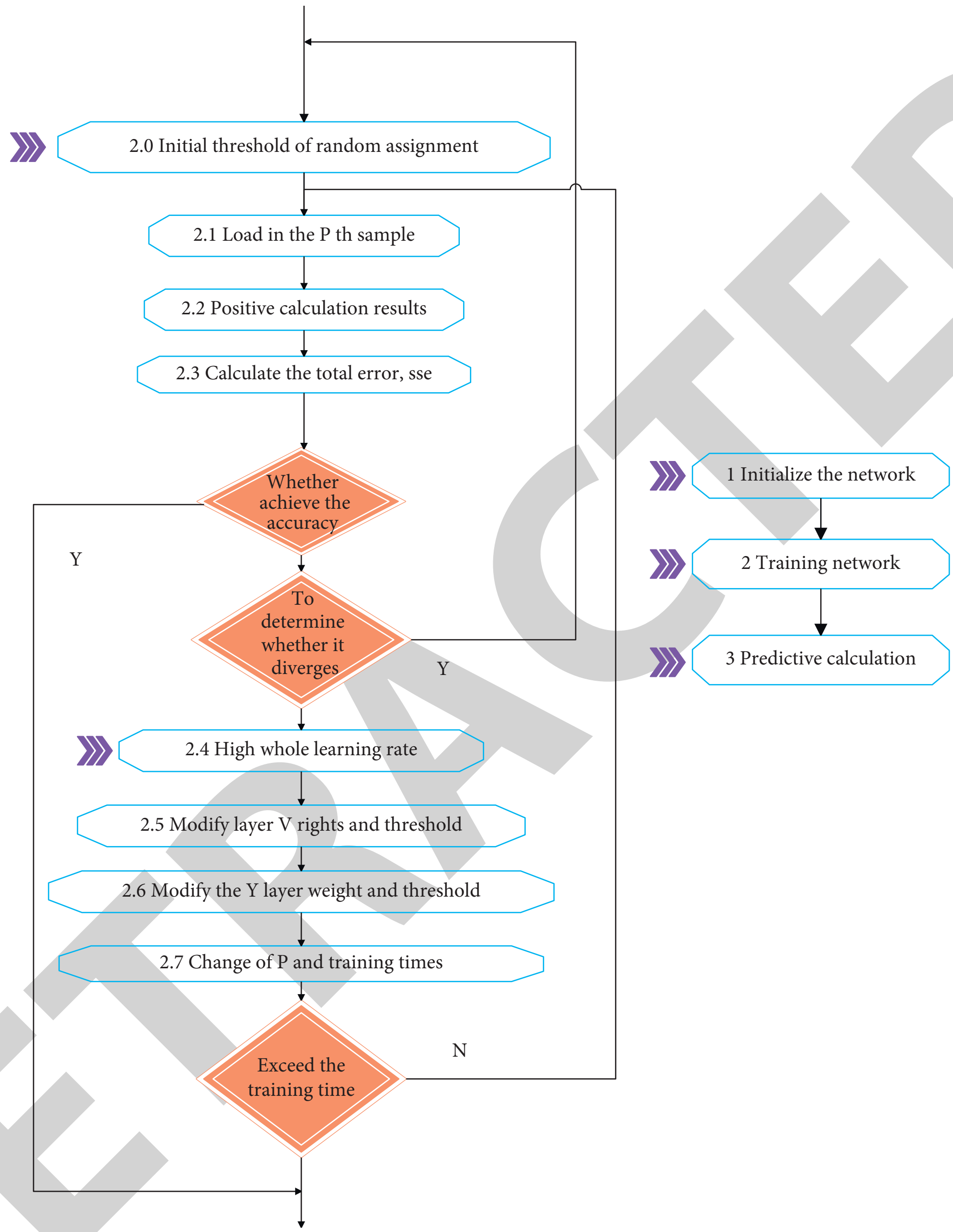
We build the following q-order SVAR model for each country in the sample:

$$\begin{pmatrix} 1 & a_{12} \\ a_{21} & 1 \end{pmatrix}\begin{pmatrix} PR_{i,t} \\ LR_{i,t} \end{pmatrix} = \begin{pmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{pmatrix}\begin{pmatrix} PR_{i,t-1} \\ LR_{i,t-1} \end{pmatrix} + \Lambda + \begin{pmatrix} \rho_{11} & \rho_{12} \\ \rho_{21} & \rho_{22} \end{pmatrix}\begin{pmatrix} PR_{i,t-q} \\ LR_{i,t-q} \end{pmatrix} + \begin{pmatrix} \varepsilon_{i,1t} \\ \varepsilon_{i,2t} \end{pmatrix}. \tag{11}$$



(a)

Figure 2: Continued.



(b)

Figure 2: BP neural network model structure and training process. (a) Topological diagram of BP neural network. (b) Flowchart of the BP network training algorithm program.

Among them, $LR_{i,t}$ and $PR_{i,t}$ are the bank loan interest rate and the monetary policy interest rate of the sample country i, respectively. When y represents $(PR, LR)^T$, the above formula can be written more concisely as

$$A y_{i,t} = \Gamma_1 y_{i,t-1} + \Lambda + \Gamma_p y_{i,t-p} + \varepsilon_{i,t}. \qquad (12)$$

If the matrix A is assumed to be nondegenerate, the corresponding simplified VAR can be obtained by multiplying both sides of the equation by A^{-1}:

$$y_{i,t} = A^{-1}\Gamma_1 y_{i,t-1} + \Lambda + A^{-1}\Gamma_p y_{i,t-p} + A^{-1}\varepsilon_t. \qquad (13)$$

The disturbance term $\mu_t = A^{-1}\varepsilon_t$ of the simplified disturbance term is a linear combination of the structural VAR disturbance term.

This model is the "AB model" of SVAR. It is assumed that $A\mu_t = Be_t, \mu_t$ is a simplified disturbance term, e_t is a standard orthogonal random disturbance term, its constituent elements are mutually orthogonal, and the covariance matrix is an identity matrix. The characteristic of the AB model is that the current relationship of each endogenous variable in the system can be clearly established, and the impact of the standard orthogonal random disturbance term on the system can be analyzed intuitively. To identify an A B

Table 1: Correlation between interbank money market interest rate and financial crisis.

Number	Correlation
1	22.20
2	28.46
3	30.87
4	26.70
5	24.35
6	23.42
7	27.88
8	23.32
9	27.55
10	28.40
11	22.73
12	24.13
13	29.41
14	25.30
15	22.68
16	22.38
17	26.14
18	25.60
19	27.16
20	27.06
21	30.78
22	26.75
23	21.01
24	24.41
25	22.35
26	25.07
27	24.56
28	27.47
29	24.63
30	22.02
31	28.08
32	28.94
33	28.21
34	26.93
35	24.56
36	23.19
37	21.36
38	29.70
39	23.08
40	24.67
41	30.98
42	28.07
43	26.43
44	26.48
45	28.41
46	29.62
47	22.37
48	23.37
49	24.03
50	21.23

model with M endogenous variables, at least $[2M^2 - M(M+1)/2]$ constraints need to be imposed on the elements in matrices A and B. In this paper, the "Cholesky constraint" is used to set the matrix A as a lower triangular matrix, the main diagonal elements are all 1, and the matrix B is set as a diagonal matrix. From an economic point of view, such a setting is also in line with the general understanding that the monetary policy interest rate has a current

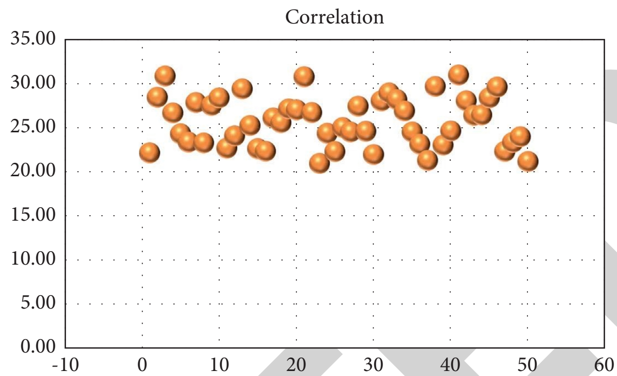


Figure 3: Statistical table of correlation between interbank money market interest rate and financial crisis.

impact on the loan interest rate, while the loan interest rate has no current impact on the monetary policy interest rate.

After the model is established, the dynamic response of the system under shock is analyzed by observing the impulse response function. This article treats giving a shock to the policy rate as the implementation of monetary policy, focusing on the impact of the shock on bank lending rates. According to the above SVAR model, the impulse response function of bank loan interest rate can be obtained when the shock to the policy interest rate occurs. The impulse response value of the first period (re_1), the average impulse response value of the first four periods (re_average), and the maximum impulse response value (re_max) after the shock are selected to reflect the response of bank loan interest rates to changes in monetary policy interest rates. By comparing the impulse response function values of different countries, we can see the difference in the transmission effect of monetary policy interest rate among different countries.

Next, the method of multiple regression is also used to study the influence of banking industry characteristics on the transmission effect of monetary policy interest rate, and the following multiple regression model is established. The explained variable is the impulse response value, and the annual average value of the corresponding sample period is also taken. In order to examine the impact of the financial crisis on the monetary policy transmission channels of various countries, this section also divides the sample into two parts before the financial crisis and after the financial crisis.

$$\begin{aligned} \text{re\_1}_i &= \alpha_0 + \alpha_1 CR3_i + \alpha_2 \text{npl}_i + \alpha_3 fd_i + \alpha_4 \text{GDP}_i \\ &\quad + \alpha_5 \text{CPI}_i + \alpha_6 rq_i + \xi_1, \\ \text{re\_average}_i &= \omega_0 + \omega_1 CR3_i + \omega_2 \text{npl}_i + \omega_3 fd_i \\ &\quad + \omega_4 \text{GDP}_i + \omega_5 \text{CPI}_i + \omega_6 rq_i + \xi_2, \\ \text{re\_max}_i &= \lambda_0 + \lambda_1 CR3_i + \lambda_2 \text{npl}_i + \lambda_3 fd_i \\ &\quad + \lambda_4 \text{GDP}_i + \lambda_5 \text{CPI}_i + \lambda_6 rq_i + \xi_3. \end{aligned} \tag{14}$$

According to the method introduced above, we can obtain the impulse response function of the bank loan interest rate to the monetary policy interest rate in each sample

Table 2: Financial crisis prediction effect.

Number	Prediction effect
1	54.77
2	34.28
3	50.50
4	53.25
5	50.72
6	33.68
7	30.67
8	39.07
9	39.95
10	30.77
11	49.98
12	48.65
13	33.94
14	34.87
15	45.96
16	35.86
17	46.06
18	37.76
19	47.56
20	48.49
21	48.21
22	36.66
23	30.46
24	46.46
25	52.42
26	49.29
27	46.69
28	33.77
29	39.58
30	53.03
31	33.08
32	37.52
33	38.41
34	50.23
35	35.60
36	49.96
37	46.73
38	37.19
39	46.52
40	42.87
41	43.39
42	49.86
43	41.62
44	30.76
45	36.28
46	39.93
47	42.04
48	38.46
49	43.00
50	32.88

country before and after the financial crisis. The impulse response value re_1 of the first period after the shock, the average impulse response value re_average of the first four periods, and the maximum value of the impulse response function re_max are selected to reflect the monetary policy interest rate transmission effect of various countries before and after the financial crisis, as shown in Figure 1.

Figure 1(a)–1(f) shows the frequency distribution histogram of re_1, re_average, and re_max. The first-period

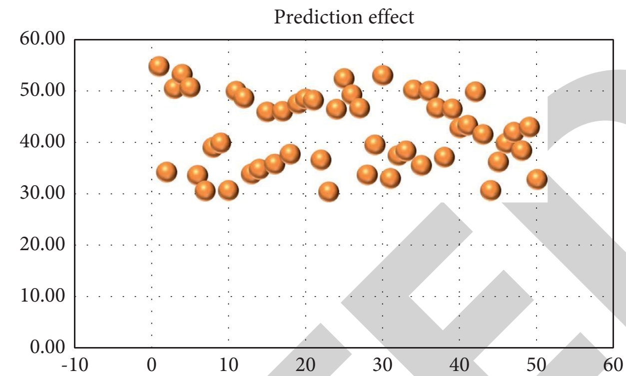


Figure 4: Statistical chart of the prediction effect of the financial crisis.

impulse response value (re_1) after a shock represents how the lending rate responds in the short term after a change in monetary policy. It can be seen from the figure that the re_1 indicators of most countries are positive numbers, indicating that changes in monetary policy interest rates will immediately cause the same direction changes in bank loan interest rates, which is consistent with the usual economic laws. However, comparing Figure 1(a) and 1(d), it can be seen that the re_1 indicator of countries generally decreased after the financial crisis, and the number of countries with this indicator less than 0 increased. Considering that there is a certain lag in the response of loan interest rates after the monetary policy interest rate changes in some countries, only using the impulse response value of the first period cannot fully explain the transmission effect of the policy interest rate to the bank loan interest rate. In this paper, the average impulse response value (re_average) and the maximum impulse response function (re_max) of the first four periods are also selected. Observing the frequency distribution histogram of these two indicators, it can be seen that these two indicators are positive numbers in most countries; that is, monetary policy has played a role in guiding bank loan interest rates to change in the same direction. However, after the financial crisis, the two indicators of re_average and re_max in various countries have generally decreased, which may mean that the transmission effect of monetary policy interest rates to bank lending rates has weakened after the financial crisis.

On the basis of the above analysis, this paper combines the neural network model to analyze the correlation between the interbank money market interest rate and the financial crisis. The BP neural network topology diagram and the BP network training algorithm program flowchart are shown in Figure 2.

In view of the shortcomings of traditional BP network, this paper improves it. First, the momentum term α ($0< \alpha <1$) is added when modifying the weights and thresholds, which plays an optimization role. Second, theoretically speaking, there can be infinitely many hidden layers in BP network, but generally only one layer is used in practical application. The improvement of network accuracy can be achieved by increasing the number of neurons. If we use the financial interest rate index of the previous n months to predict the financial interest rate index of the n+1st month, and so on, then only n ($n > 5$) node input layers and 1 node output layer are needed. As for the selection of the number of hidden layer nodes, the "trial and error method" is used in this BP network program, and it is found that the convergence is better when the number of nodes is 2n.

On the basis of the above research, the effect of the model proposed in this paper is verified. Moreover, this paper verifies the analysis effect of this model on the correlation between the interbank money market interest rate and the financial crisis through multiple sets of simulation data, and obtains the results shown in Table 1 and Figure 3.

From the above research, we can see that the model proposed in this paper can play a certain role in the correlation statistics between interbank money market interest rate and financial crisis. On this basis, this paper evaluates the prediction effect of the financial crisis and obtains the results shown in Table 2 and Figure 4.

From the above research, it can be seen that the correlation analysis between the interbank money market interest rate and the financial crisis based on the neural network model proposed in this paper can play a certain role.

4. Conclusion

From the analysis of the long-term and short-term effects, the marketization of interest rates will increase the risk of macroeconomic operation in the short term, but it will contribute to the increase of macroeconomic output in the long run. Interest rate liberalization may also deepen finance based on savings effect, income effect, channel effect, etc., which forces commercial banks to accelerate financial innovation and change their business methods. Moreover, the profits of commercial banks may shift to intermediary business, which will lead to substantial adjustment of the financial system and have a negative impact on the operation of the macro economy. However, most scholars believe that as long as the reform of interest rate liberalization does not cause a one-time large fluctuation in interest rates, the impact on the macro economy can still be controlled. This paper combines the neural network model to analyze the correlation between the interbank money market interest rate and the financial crisis. The experimental research shows that the correlation analysis between the interbank money market interest rate and the financial crisis based on the neural network model proposed in this paper can play a certain role.

Data Availability

The labeled dataset used to support the findings of this study is available from the corresponding author upon request.

Conflicts of Interest

The authors declare no competing interests.

Acknowledgments

This work was supported by 2016 Guangdong Distinctive Key Disciplines "public Administration" (F2017STSZD01).

References

[1] S. Barde, "Back to the future: Economic self-organisation and maximum entropy prediction," *Computational Economics*, vol. 45, no. 2, pp. 337–358, 2015.

[2] D. Bhattacharya, J. Mukhoti, and A. Konar, "Learning regularity in an economic time-series for structure prediction," *Applied Soft Computing*, vol. 76, no. 2, pp. 31–44, 2019.

[3] A. Ferramosca, D. Limon, and E. F. Camacho, "Economic MPC for a changing economic criterion for linear systems," *IEEE Transactions on Automatic Control*, vol. 59, no. 10, pp. 2657–2667, 2014.

[4] Y. Geng, Z. Wei, H. Zhang, and M. Maimaituerxun, "Analysis and prediction of the coupling coordination relationship between tourism and air environment: Yangtze river economic zone in China as example," *Discrete Dynamics in Nature and Society*, vol. 2020, no. 10, 15 pages, Article ID 1406978, 2020.

[5] P. Karanikić, I. Mladenović, S. Sokolov-Mladenović, and M. Alizamir, "Retraction Note: Prediction of economic growth by extreme learning approach based on science and technology transfer," *Quality and Quantity*, vol. 53, no. 2, pp. 1095-1096, 2019.

[6] K. Ataka, "Prediction of election result and economic indicator," *Resuscitation*, vol. 96, no. 6, p. 84, 2014.

[7] S. Nagy and J Pipek, "An economic prediction of the finer resolution level wavelet coefficients in electronic structure calculations," *Phys.chem.chem.phys*, vol. 17, no. 47, pp. 31558–31565, 2015.

[8] J. Pipek and S. Nagy, "An economic prediction of refinement coefficients in wavelet-based adaptive methods for electron structure calculations," *Journal of Computational Chemistry*, vol. 34, no. 6, pp. 460–465, 2013.

[9] H. L. Vu, K. T. W. Ng, and D. Bolingbroke, "Time-lagged effects of weekly climatic and socio-economic factors on ANN municipal yard waste prediction models," *Waste Management*, vol. 84, no. 2, pp. 129–140, 2019.

[10] W. Yu and W. Huafeng, "Quantitative analysis of regional economic indicators prediction based on grey relevance degree and fuzzy mathematical model," *Journal of Intelligent and Fuzzy Systems*, vol. 37, no. 2, pp. 1–14, 2019.

[11] L. Zhou, K. K. Lai, and J. Yen, "Bankruptcy prediction using SVM models with a new approach to combine features selection and parameter optimisation," *International Journal of Systems Science*, vol. 45, no. 3, pp. 241–253, 2014.

[12] C. Teljeur, M. O"'Neill, L. Murphy et al., "Using prediction intervals from random-effects meta-analyses in an economic model," *International Journal of Technology Assessment in Health Care*, vol. 30, no. 1, pp. 44–49, 2014.

[13] P. Rajsic, A. Weersink, A. Navabi, and K. P. Pauls, "Economics of genomic selection: The role of prediction accuracy and relative genotyping costs," *Euphytica*, vol. 210, no. 2, pp. 1–18, 2016.

[14] F. Jahedpari, T. Rahwan, S. Hashemi et al., "Online prediction via continuous artificial prediction markets," *IEEE Intelligent Systems*, vol. 32, no. 1, pp. 61–68, 2017.

[15] V. Daksiya, H. T. Su, Y. H. Chang, and E. Y. M. Lo, "Incorporating socio-economic effects and uncertain rainfall in

flood mitigation decision using MCDA," *Natural Hazards*, vol. 87, no. 1, pp. 515–531, 2017.
[16] S. Lahmiri, "A variational mode decompoisition approach for analysis and forecasting of economic and financial time series," *Expert Systems with Applications*, vol. 55, no. 8, pp. 268–273, 2016.
[17] N. Gordini, "A genetic algorithm approach for SMEs bankruptcy prediction: E," *Expert Systems with Applications*, vol. 41, no. 14, pp. 6433–6445, 2014.
[18] A. Ferramosca, A. H. González, and D. Limon, "Offset-free multi-model economic model predictive control for changing economic criterion," *Journal of Process Control*, vol. 54, no. 3, pp. 1–13, 2017.
[19] C. J. Jane, "A hybrid model combined grey prediction and autoregressive integrated moving average model for talent prediction," *Journal of Grey System*, vol. 21, no. 2, pp. 91–102, 2018.