An Empirical Study on the Early Warning Mechanism of Financial Business Cycle Based on the BP Algorithms

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Abstract. Among the various factors that had an impact on the economy, the influence of financial economic cycle is always better than that of other factors. With the development of the society and times and people's pursuit of economic development, finance has become more and more profound for economic development. The emergence of these new factors directly leads to the continuous improvement on financial influence on the economy. This paper mainly studies the early warning mechanism of financial economic cycle based on the BP algorithm.

1. Introduction
The operation of the economic cycle is affected by the financial system. In the 1980s, the research proposed by Bernanke et al. criticize the neutral rounds of money and securities, which led to the development of the theory of financial and economic cycle[1].Financial economic theory is a relatively new concept, which means that under the influence of internal and external factors of financial and economic activities, the fluctuations and changes formed by the financial system.

2. Research Ideas
China’s financial and economic development process has obvious cyclical characteristics. The development of financial economy is cyclical. The financial economic cycle is divided into four stages and the economic growth rate indicators of different stages are distinguished. The different stages are cod, the BP network is trained in historical data and the cycle early warning model is established. The model input data is established by using time series to identify the future financial fluctuation cycled stages, which constitute the financial economic early warning mechanism cycle based on BP algorithm. Empirical research shows that in the first quarter of 2019, China’s financial and economic cycle is still in the stage of expansion.

3. Selection of Indicators
3.1. Indicator input.
Generally speaking, we understand financial volatility as some specific financial variables. For example, changes in the money supply, stock price index, interest rates and exchange rates. These indicators are seen as a manifestation of financial cyclically [2]. Among the data that can be queried, we select the broad currency balance, narrow currency balance, cash balance in circulation, RMB current deposit benchmark interest rate, RMB to US dollar exchange rate, Shanghai Composite Index monthly yield, deposit balance, loan balance and other financial variables as the impact indicators of China’s financial and economic cycle, as shown in the table.
| Category | Variable | Symbol |
|----------|----------|--------|
| Money supply | Cash balance in circulation | Y0 |
|          | Narrow currency balance | Y1 |
|          | Broad currency balance | Y2 |
| Stock market index | Shanghai Composite Index quarterly rate of return | R1 |
| RMB Credit Revenue and Expenditure | Deposit balance | K1 |
|          | Loan balance | K2 |
| Interest rate and exchange rate | Benchmark Interest Rate of RMB Current Deposit | I1 |
|          | Exchange Rate of RMB to US Dollar | I2 |

### 3.2. Index output

Choosing cycle identification index is the key to early warning of financial and economic cycle by using BP network. Reflecting the relationship between financial factors and economic fluctuations and the extent to which the economic cycle is affected by financial variables is the actual role of the financial economic cycle. As one of the most important indicators to measure the development of national economy, GDP is the most concerned macroeconomic statistics. So as an index to identify China’s financial and economic cycle, this paper chooses the economic growth rate obtained by comparing the final period with the period GNP as this index.

### 4. Financial Economic Cycle

The Group of Experts on the French Central Bank defines the financial economic cycle as follows [3][4]. It measures the substantial and sustained fluctuations of the economy by financial variables closely related to the level of long-term economic equilibrium. Therefore, the financial economic cycle actually reflects the relationship between economic fluctuation and financial factors, and reflects the important influence of financial variables on the real economic cycle.

Based on the theoretical results of economic cycle, this paper argues that expansion, contraction, recession and recovery constitute a complete financial and economic cycle, as shown in the figure.

In order to correctly distinguish different stages and integrate them with reality, the following judgment principles are set: the economic growth rate increases annually, and (>9.2%) is in the stage of expansion, and < 9.2% is in the stage of recession; the economic growth rate decreases annually, and (>9.2%) is in the stage of contraction, and < 9.2% is in the stage of recession.
5. Empirical Research

5.1. Preprocessing data

In the searchable data, we choose 17 groups of quarterly data related to China’s financial and economic cycle since 2014. The former 16 groups of data are system samples, and the last group is testing samples. In order to eliminate the influence of different index dimensions for direct analysis, we preprocess standardized data according to the following formulas [5].

\[ N_i = \frac{x_i - \bar{x_i}}{S_i} \]

In this formula, \( \bar{x_i} \) is the average of the first index, and \( S_i \) is standard deviation.

5.2. Identifying the Development Stage of Financial Business Cycle

We choose the year-on-year economic growth rates as an indicator to identify the stage of development of the financial and economic cycle in order to eliminate the impact of seasonal changes.

| Year / quarter   | Y0   | Y1   | Y2   | R1   | K1   | K2   | I1   | I2   |
|------------------|------|------|------|------|------|------|------|------|
| 2014 The 1 quarter of the year | -1.549 | -1.409 | -1.307 | 0.1342 | -1.287 | -1.269 | 0.6872 | 1.5795 |
| 2015 The 1 quarter of the year | -0.706 | -0.816 | -0.791 | 0.4376 | -0.818 | -0.783 | 0.6872 | 0.9551 |
| 2016 The 1 quarter of the year | -0.051 | -0.172 | -0.223 | -1.799 | -0.227 | -0.265 | 0.6872 | -0.445 |
| 2017 The 1 quarter of the year | 0.6619 | 0.5473 | 0.8141 | 0.9156 | 0.8017 | 0.8258 | -1.344 | -0.953 |
| 2018 The 1 quarter of the year | 1.8096 | 2.0286 | 1.9646 | -0.581 | 1.9132 | 1.9413 | -1.344 | -0.971 |

Table 3 Quarterly Economic Growth Rate of China

| Year / quarter   | economic growth Rate (%) |
|------------------|---------------------------|
| 2014 The 1 quarter of the year | 9.4 |
| 2014 The 2 quarter of the year | 10.1 |
| 2014 The 3 quarter of the year | 9.8 |
| 2014 The 4 quarter of the year | 9.9 |
| 2015 The 1 quarter of the year | 10.4 |
| 2015 The 2 quarter of the year | 11.5 |
| 2015 The 3 quarter of the year | 10.6 |
| 2015 The 4 quarter of the year | 10.4 |
| 2016 The 1 quarter of the year | 11.1 |
| 2016 The 2 quarter of the year | 11.9 |
| 2016 The 3 quarter of the year | 11.5 |
| 2016 The 4 quarter of the year | 11.2 |
| 2017 The 1 quarter of the year | 10.6 |
| 2017 The 2 quarter of the year | 10.1 |
| 2017 The 3 quarter of the year | 9 |
| 2017 The 4 quarter of the year | 6.8 |
| 2018 The 1 quarter of the year | 6.2 |
| 2018 The 2 quarter of the year | 7.9 |
| 2018 The 3 quarter of the year | 9.1 |
| 2018 The 4 quarter of the year | 10.7 |
The change of economic growth rate of coordinate system is shown in the figure.

Figure 2 Changes in China’s Economic Growth Rate

Combined with the actual fluctuation of China’s economic growth rate, the development stage of China’s financial economic cycle since 2015 is determined and the cod procedure is completed according to the variation law of financial economic cycle shown in Figure 1.

5.3. BP Network Model

We use a three-layer BP network of a hidden layer. The input layer is 8 nodes, the output layer is 4 nodes, the number of hidden layer nodes is 10 by trial calculation, and the transfer function is

\[ Y(x) = \frac{1}{1 + e^{-x}} \]

5.4. Samples will be trained

The BP network is trained by using the known sample data. The training times are 5000 and the error item E is set to 0.2. By comparing the training results of the actual cod, we can see that the specific training results are shown in Table 4.

The number of scheduled training is 6000. The BP network is trained for the obtained sample data, and the error F is set to stop at 0.2. By comparing the actual cod with the training results, it can be seen that the expected effect of BP network has reached the recognition level of learning samples.

5.5. Verification test sample

Through the time series method, this paper forecasts and analyses the relevant indicators of China’s financial and economic cycle in the first quarter of 2019. After standardizing the indicators, the BP network model is established to get the identification index value of China’s financial and economic cycle in the first quarter of 2019. As shown in the table.

| Year / quarter          | BP network training | Actual coding |
|-------------------------|---------------------|---------------|
|                         | \( O_1 \)           | \( O_2 \)     | \( O_3 \)     | \( O_4 \) |
| 2019 The 1 quarter of the year | 0.0000             | 0.0000        | 0.0017        | 0.9895   |

It can be seen that China’s financial economic cycle is in the stage of expansion in the 1st quarter of 2019, and the actual data is consistent with the predicted results.

6. Conclusions and Recommendations

Through the early warning model of financial economic cycle based on BP network, we first divide the financial economic cycle into four stages and distinguish it by using the economic growth rate. Then we train the BP network to build a suitable model by cod different stages. Finally, we use time series prediction and input BP model to identify the stage of financial and economic fluctuations in a certain
period of our country. This is for the purpose of identifying the stage of financial and economic fluctuations in a certain period of our country. Correctly and scientifically grasping the development trend of China’s financial and economic cycle has played an early warning effect to a certain extent.

References
[1] Song Yuhua, Li Zexiang. New progress of theoretical research on financial economic cycle [J]. Journal of Zhejiang University (Humanities and Social Sciences Edition), 2007, (4): 163-171.
[2] Christopher Viney. Financial Institutions, Financial Instruments and Financial Markets [M]. Beijing: Renmin University Press, 2008Reference to a chapter in an edited book:
[3] Mueller G R, Grean MJ. Brownfields: The Last Opportunity Investment at the End of this Real Estate Cycle[J]. Real Estate Finance, 2002, 19 (3) :12-20.
[4] Kaiser R W.The Long Cycle in Real Estate[J]. Journal of Real Estate Research, 1997, 14 (3) :233-258.
[5] Sohu Finance and Economics. Focus on the first quarter of 2010 economic data [EB/OL]. ht-tp://business.sohu.com/s2010/jsj1003/.