Analysis of Macroeconomic Prosperity Index with ARMA Model

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Abstract. Macroeconomic climate index can play the role of the monitoring and early warning. For quantitative analysis, this paper used Eviews software to establish the ARMA model for the early warning index in the macroeconomic prosperity index. This model predicts the prosperity index in the coming period and reduces the barriers of traditional models. It also better reflects the fluctuation of economic development and forecasts the future economy.

Many economists and mathematicians use ARMA model made a lot of effort in forecasting stock prices, but for macro-economic climate index, analysis is very few, so this study choose the monthly data from Sina Finance between January 2009 and December 2016 to analyze the macroeconomic climate index (warning index), which reflects the fluctuation of economic development and economic forecast for the future. Here is a brief introduction of the indicators and the relevant background.

The macro-economic climate index includes: early warning index, consistency index, the index of leading indicators and lagging. Consistent index is the basic trend, which reflects the current economic situation composed of industrial production, employment, social demand (investment, consumption, foreign trade) and social income (national tax, corporate profits, income). Leading index is composed of a set of leading indicators ahead of the consistent index, used to forecast the economic trend of the future. Lag index was synthesized from lagging indicator behind the consistent index, it is mainly used to be a confirmation in the economic cycle peak and valley. And early warning index divides economic status into five levels: "red light" said economic overheating, "yellow light" said economic heat, "green light" said normal economic operation, "light blue lamp" said economic slants cold, "blue light" said economic too cold.

In general, using the index analysis basically has the following advantages:

First, business index is comprehensive. Business index method is a comprehensive climate measurement method, which can avoid the one-sidedness of the monitor, and comprehensively cover the main information of macroeconomic overall running state. Second, business index has continuity. Generally speaking, the sentiment index system structure is relatively stable in a relatively long period of time, basically will not occur on a large scale continuous changes and information with the higher continuity creates the basic conditions for analyzing the macroeconomic situation or judgement macroeconomic trend. Third, the prosperity index has dynamic comparability. The dynamic comparability of the business index allows the indices between different periods and regions to be compared vertically or horizontally. Fourth, the business index is timely. At present, the composition index of the synthetic business index is almost always the monthly data index, so the measure of the change of the climate is more timely, which is beneficial to reduce the delay effect of the regulation and greatly improve the effect of macro regulation.

Since the early 1970s, the economic boom monitoring and early warning system itself has been initially shaped and has begun to show an international trend. The macroeconomic early warning system has been paid more and more attention in the process of modern economic development. This paper analyzes the early warning index in the macroeconomic prosperity index to reflect the fluctuation of economic development and forecast the future economy.
Variable Construction and Data Processing

In this paper, we use the ARMA model to analyze the early warning index. First, the logarithm of the original data is observed to observe the smoothness of the original data. It is found that it is a stationary sequence, so it is processed by differential processing. Then the model is identified and ordered and the parameters are estimated. Finally, the model is predicted.

The original data is plotted as a line graph, which is written as sequence w1. It is found by the graph that the sequence is descending from the obvious first and then declining trend. The natural data is processed by the natural data, and the w2 sequence is obtained. The sequence is still not smooth.

On the stability of w2 test. From the unit root test results can be obtained at the significance level of 0.05, the existence of a unit root of the original hypothesis, verify the w2 sequence is non-stationary sequence. So the first-order difference on w2 for ADF test. Firstly, the first order differential sequence of w2 is judged and the first order difference sequence is obtained without the trend feature, and it has no nonzero mean value. Therefore, we choose the model with no constant term and no trend item. As a result of the test, it can be seen that at the significance level of 0.05, the null hypothesis of the unit root is rejected, indicating that the first order differential sequence of sequence w2 is a stationary sequence, so \(d = 1\). The sequence after the new first-order difference is defined as the x-sequence.

Empirical Model

The number of lag orders is 12 for the x sequence, and the autocorrelation and partial autocorrelation functions are made. From the autocorrelation function graph and the partial autocorrelation function graph of the x-sequence, it can be seen that the autocorrelation function 1 ~ 3 of x is significant, and the descending from the fourth order is very large and the value is not significant. The initial set q value of 3, x partial self-correlation function 1 to 3 are very significant, starting from the fourth order down a lot, so the initial set p value of 3, so for the sequence x, the initial establishment of the ARMA (3,3) model.

The autoregression of ARMA (3, 3) was followed by observing its significance, and the AIC value was obtained at the same time. Then, the values of p and q were changed by the same method. The results were as follows:

Table 1. The amount of AIC information of the p and q values for the x-sequence ARMA model.

<table>
<thead>
<tr>
<th>q</th>
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<td>p</td>
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<td>3</td>
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From the AIC results, select \(p = 2\), \(q = 2\), so the final model for x is ARMA (2,2); the results are shown by regression. As a result, the least squares estimation of the model is:

\[
\hat{X}_t = -0.00664 + 1.681103X_{t-1} - 0.739119X_{t-2} - 1.684275a_{t-1} + 0.694979 a_{t-2} \tag{1}
\]

Model Prediction

Dynamic and static methods are used to predict the exponential. The dynamic prediction is based on the selected estimation interval. The multi-step forward prediction is carried out. Each step is to use the previous forecast value to calculate the new forecast value outside the sample (2017.1 and later). The static prediction is a rolling forward prediction, that is, every prediction, with the real value instead of the forecast, added to the estimated interval, and then further forward forecast for the sample forecast (2009.1-2016.12)
The static prediction is first performed. The intra-sample estimates are used to estimate the X from January 2009 to December 2016 and the sequence estimates and the static prediction sequences are opened in groups. Predictive samples within the sample and the sample sequence within the sample, as shown in Figure 1:

![Figure 1](image1.png)

Figure 1. Intra-sample prediction and group sequence graphic within the sample of static model.

It can be seen from the intra-sample prediction that the predicted volatility of this method is large, and the decrease of the variance ratio also shows that the simulation of the actual sequence is better, the Theil unequal coefficient is 0.537969, the covariance ratio is 0.723560, indicating that the prediction results of the model are ideal. By group sequence graphic within the sample of static model can be observed, prediction model with the estimated value fluctuates up and down, and the original data fitting degree is higher, predicted results are ideal.

And then the sample is estimated, estimated from 2016 to 2017, and the sequence estimates x and static prediction sequence are opened in the form of groups, static forecast predicted respectively diagram and the sequence of graphics as shown in Figure 2:

![Figure 2](image2.png)

Figure 2. Sample extrapolated and out-of-sample sequences of static model.

It can be seen that the predictive value volatility of this method is very small, there is no change, Theil unequal coefficient is 0.810939, the covariance ratio is 0.2194459, which indicates that the prediction result of the model is ideal.
Then, the dynamic model is used to predict the first, then the intra-sample prediction of the dynamic model is carried out, and then the sequence estimation value \( x \) and the dynamic prediction sequence are opened in groups. The group sequence graph is drawn and the following results are obtained:

![Figure 3. Dynamic model intra-sample prediction and intra-group sequence diagram.](image)

It can be seen that the predicted volatility of this method is smaller than that of the static model, Theil unequal coefficient is 0.567487 and the covariance ratio is 0.702405. Compared with the static model, the prediction result of this model is not ideal.

The graph of the dynamic model can be seen from the group chart. The pattern of the dynamic model does not change from the beginning of 2010, and the horizontal state is basically presented. Compared with the static model, the degree of fitting with the \( x \) value is not ideal. Therefore, in the sample prediction, select the static model to predict. Then, the extrinsic prediction of the dynamic model is carried out, and the sequence estimation value \( x \) and the dynamic prediction sequence are opened in groups, and the group sequence pattern is drawn.

![Figure 4. Dynamic model out-of-sample and out-of-sample sequences.](image)

It can be seen that the Theil unequal coefficient obtained by this method is 0.863042 and the covariance ratio is 0.260387. Compared with the static model, the prediction result of this model is not ideal. Therefore, in the sample prediction part of the choice of static model than the choice of dynamic model to be more ideal.
In summary, it is more desirable to choose a static model than to select a dynamic model in the sample and in the sample prediction section.

Conclusion
In this paper, the ARMA model is used to predict the future multi-period value, and the trend of the business index is obtained for a certain period of time, which reduces the drawbacks of the traditional economic business index forecasting model. However, due to the limited sample data and the uncertainty of the climate index, it is impossible to predict the infinite multi-period value at the time of prediction, and the length of time is limited. And then because of different characteristics of different indices, so the forecasting method does not necessarily apply to any group of economic index data, but also in the future experiments to further explore its characteristics and methods.

References