International Business and Management
Vol. **2**, No. **2**, **2011**, pp. 62-65
www.cscanada.net

ISSN 1923-841X [PRINT]
ISSN 1923-8428 [ONLINE]
www.cscanada.org

Forecasting of China Resident's Consumption Level Based on ARMA Model

ZHANG Hui[1]

LIU Meng[2]

Abstract: This paper is based on the data of China resident's consumption of 1978-2009, and an ARMA model about China resident's consumption level has also been set up in this paper. It shows that ARMA model is a good forecaster to forecast the value of China resident's future consumption; it can not only estimate and forecast China resident's future consumption level, but also provide a good reference for other economic variables to forecast China's economy.
Key words: Consumption level; Unit root test; ARMA; White noise; Forecasting

1. INTRODUCTION

Consumption level means the degree of consumers' satisfaction about the products and service they consumed. With the rapid development of economy, China's consumption level has been greatly improved. As the data released by National Bureau of Statistics, China's consumption level was only 184 yuan in 1987, while the number has increased to 9098 yuan in the year of 2009. With the growth of the economy, people's consumption demand has become diversity. As one of the three main driving forces which stimulate the development of national economy, consumption plays an important role, so it has a great significance on the research of consumption level. The residents' consumption is not only related to the current income, but also related to residents' personal views of consumption and his or her past consumption habits. To solve the problem, we set up an ARMA model to forecast China's consumption level in this paper.

2. OUTLINE OF ARMA MODEL

ARMA model is the most commonly used model to describe stationary random series. Box and Jenkins had created the famous B-J method, which can instruct practitioners to analyze or forecast time series. ARMA model also has a comprehensive, formal, structured modeling method, and it has a series of statistical theories, such as integrity and solidity.

ARMA model has the three following basic forms: auto regression model (AR), moving average model (MA) and ARMA model. ARMA model consists of auto regression model (AR) and moving average model (MA), and it is usually written as ARMA (p, q), where p and q mean the orders of auto regression and moving average respectively. The general expression of ARMA model is

$$x_t = c + \phi_1 x_{t-1} + \phi_2 x_{t-2} + \cdots + \phi_p x_{t-p} + \mu_t + \theta_1 \mu_{t-1} + \theta_2 \mu_{t-2} + \cdots \theta_q \mu_{t-q}$$

[1] Lecturer, mainly engaged in development economics research. College of Economics, Hebei University, China. E-mail: jjxyzh@163.com
[2] College of Economics, Hebei University, China.
*Received 16 March 2011; accepted 4 May 2011

Or

$$(1-\phi_1 L-\phi_2 L^2-\cdots\phi_p L^p)x_t=(1+\theta_1 L+\theta_2 L^2+\cdots+\theta_q L^q)\mu_t,$$

$$\Phi(L)x_t=\Theta(L)\mu_t$$

Where $\Phi(L)x_t$ and $\Theta(L)\mu$ are functions of p and q respectively.

This model concludes a progress of auto regression AR (p) and a progress of moving average MA (q), where $\phi_1,\phi_2,\ldots\phi_p$ are coefficients of auto regression, and $\theta_1,\theta_2,\ldots\theta_q$ are coefficients of moving average, all of these are the parameters to be estimated. While u_t is a white noise series, namely, it is a steady series. The stability of the ARMA depends on the AR part, and its reversibility depends on the MA part.

3. UNIT ROOT TEST OF CHINA'S CONSUMPTION LEVEL

This paper is based on the data of China resident's consumption between the year 1978 and 2009. In order to eliminate the series' heterosckedasticity, first we can take the nature log of China's per consumption level, and get the series LC. The series LC is more likely to be a stationary series, and it will not change the nature of the series, nor the results. Most of the economic and social variables are non-stationary time series, if we make direct analysis on non-stationary time series, we may get false return, and the results may be invalid. As to ARMA model is based on stationary series, we should take the unit root test on China's consumption level to test its stability. Here we use ADF test to check its stability. If it isn't a stationary series, we should test its difference series as far as we find a stationary one. Here we choose Eviews5.0 to carry out this process as following.

Table 1: Unit Root Test of China's Consumption Level

variable	ADF value	model	1% value	5% value	10% value	conclusion
LC	-2.09390	(C , T , 4)	-4.29673	-3.56838	-3.21838	non-stationary
ΔLC	-2.64165	(C , 0 , 1)	-3.67017	-2.96397	-2.62101	non-stationary
$\Delta^2 LC$	-4.05522	(0 , 0 , 1)	-2.692358	-1.960171	-1.607051	stationary

As can be seen from Table 1, LC and its fist difference series are non-stationary, but LC's second difference series is stationary, that is to say China's consumption level is a second-order stationary series.

4. ARMA MODEL OF CONSUMPTION LEVEL

4.1 Identification of Orders

According to autocorrelation and partial autocorrelation of series, we can identify and decide orders of the ARMA model. As is calculated, the LC series' second-order difference series $\Delta^2 LC$ turns to be a stationary series. From correlation graph and partial correlation graph of the $\Delta^2 LC$ series, we can clearly see that: the value of p can be 2 or 3, so we can choose model AR(2) or AR(3); the value of q can be 2 or 3. General considering, all the possible combinations of (p, q) are (2, 2), (2, 3), (3, 2) and (3, 3). The test results can be shown as Table 2:

Table 2: The Test Results of ARMA (p, q)

(p , q)	Adjusted R-squared	AIC	SC	S.E. of regression
(2 , 2)	0.58298	-3.61713	-3.37824	0.03660
(2 , 3)	0.21059	-2.95200	-2.66652	0.05036
(3 , 2)	0.17962	-2.87314	-2.58517	0.05223
(3 , 3)	0.17650	-2.84405	-2.50809	0.05233

In Table 2, Adjusted R-squared、AIC and SC are important criterions to select the model. Usually, the bigger the Adjusted R-squared is, and the smaller IC and SC are, the more superior ARMA model is. From Table 2, the model of ARMA (2, 2) is more superior than the other combinations, so we can set up an ARMA (2, 2) model.

4.2 Estimation of Model Parameters

Let $y_t = \Delta^2 LC$， and here, we will fit the model with ARMA (2, 2) which has constants:

$$y_t = c + \phi_1 y_{t-1} + \phi_2 y_{t-2} + u_t + \theta_1 u_{t-1} + \theta_2 u_{t-2}$$

Then we use Eviewer5.0 to fit the model, and get the estimation of regression coefficients. After finishing, the ARMA (2, 2) model is as following:

$$y_t = 0.00371 - 0.13339 y_{t-1} + 0.20839 y_{t-2} + u_t - 0.46298 u_{t-1} - 1.60432 u_{t-2}$$

4.3 Model Checking

After estimating the model's parameters, we will deal the residual series of ARMA model with white noise test. White noise process is a stationary random process, the mean is zero, the variance is a fixed value, the random variables are non-related, and the mean and variance will not change over time. If the residual series of the model is not white noise series, there is useful information in the residual series which has not been extracted, and then we should improve the model further. The commonly used method is the residual series test; its null hypothesis is that the residuals are independent. We can get the value of Q and probability of χ^2 from the residual series' autocorrelation - partial correlation graph, and all probabilities are greater than 0.05, indicating that Q values are less than the marginal values of χ^2 test when the test level is 0.05. So we can draw the conclusion that the model's random error series is a white noise series, and the model passes the test.

4.4 Forecasting

Now we use the ARMA (2, 2) model to forecast the consumption level of 2009, we can get the prediction: 9271.643, compared to the actual value 9098, the error is only 1.91%, which indicates that the fitting effect is satisfying. We can also predict that the level of consumption in 2010 is 9526.729. From the predicted value, we can clearly see that the level of consumption in China has been improving, and the result can also provides a good reference for other economic variables to forecast China's economy.

5. CONCLUSIONS AND RECOMMENDATIONS

(1) In this paper, we have forecasted China's consumption level using the ARMA model based on the data between 1978 and 2009. As the original series of consumption level is not steady, we calculate the second-order difference first and turn it to steady series, then fit and forecast the series using the ARMA model. The result shows that the ARMA model is a good predictor to forecast the value of China resident's future consumption; it not only can estimate and forecast China resident's future consumption level, but also provides a good reference for other economic variables to forecast China's economy.

(2) From the forecasted results of 2009, we know the fitting error in the ARMA model we have created is only 1.91%, which indicates that the fitting effect is satisfying. So the related departments can forecast China's consumption level in the future, and take specific measures in other economic activities considering the possible values.

(3) In the end, we have forecasted China's consumption level. Through the recent years' actual data and predictive value, we can find that China's consumption level is continuously increasing with a higher speed. All departments should put a high attention to the consumption of our residents, and all enterprises should have a clearly understanding of what consumers really want and try to meet their diverse demands. At the

same time the Government should take positive measures to promote consumption in order to stimulate economic growth.

REFERENCES

DENG Jun, YANG Xuan. (2010). The Forecasting of Stock Price Based on ARMA Model. *Theory perspective*.

GAO Shuangshuang, SUN Ling. (2010). The Forecasting of China's CPI Based on ARMA Model. *Academic research.*

HOU Chengqi, XU xusong. (2010). Econometric Time Series Analysis Methods. *Technical Economy.*

WENG Dongdong. (2010). The Forecasting of China's CPI _Based on ARMA Model. *Science Technology and Industry.*