Analysis of Influencing Factors of RMB Exchange Rate Trend Based on Least Square Method

Lin Li¹, Fuchen Pan²* and Chaobo Wang³

¹ Department of Technology, Dalian Radio and TV University, Dalian, Liaoning, 116021, China
² College of Science, Dalian Ocean University, Dalian, Liaoning, 116021, China
³ Department of Mathematics, Dalian Maritime University, Dalian, Liaoning, 116026, China

*Corresponding author’s e-mail: fuchenpan@163.com

Abstract. The exchange rate is the currency ratio between countries, which determines what standard is equitable for the distribution of the benefits of economic transactions between countries. There are many factors affecting the change of RMB exchange rate, such as inflation rate differential, commodity price, economic growth rate differential, foreign exchange reserve and international balance of payments. In this paper, the least square method is used to analyze the exchange rate’s influencing factors. The results show that the balance of payments, commodity prices and the dollar against the RMB exchange rate has a negative correlation. Inflation, gross domestic product, foreign exchange reserves and the dollar against the RMB Exchange rate has a positive correlation.

1. Introduction

Exchange rate represents the national currency exchange rate which marks the standard of fair distribution of economic transactions among countries. The exchange rate adjustment can change a country's foreign trade ability and affect the country's economic development level. Since the reform and opening up, with the development of the global economy and China's active participation in the world financial circle, the demand for domestic and foreign market resources has become an important driving force for the growth of China's domestic economy. The economy of China and the world has formed an interdependent relationship.

The study of exchange rate determination theory includes two aspects: the decisive factor and the trend of exchange rate change. The exchange rate determines the direction and development of the exchange rate. Exchange rate determinants influence the trend and development of exchange rate. There are many factors influencing the change of the RMB exchange rate, which determines the trend of the RMB exchange rate. Fundamentally, the main factors influencing exchange rate changes include: inflation rate differential, commodity price, economic growth rate differential, foreign exchange reserve, the international balance of payments, etc. Zhang yuxi simply used the method of econometrics analyzing the impact of the RMB exchange rate from gross domestic product (GDP) and consumer price index (CPI)[1]; Shao mingji used EViews software analyzing the general influencing factors of exchange rate and found out the main influencing factors of exchange rate, which led to better prediction of exchange rate and macro-control, so that the RMB could better meet the need of market development and better play its function of resource allocation and adjustment[2]; Taking the
change of RMB exchange rate as the explanatory variable, Liao zizhen analyzed the significance of GDP growth, RMB against US interest rate differential, inflation rate, foreign exchange reserve and other factors on the exchange rate by establishing a multivariate linear regression model and concluded that foreign exchange reserve had a significant impact on the fluctuation of RMB exchange rate. Then this paper proposed suggestions on how to maintain exchange rate stability and promote the internationalization of RMB[3]; By analyzing the exchange rate overshooting model, li yanfeng believed that the main factors influencing the fluctuation of RMB exchange rate were the monetary policy of US dollar interest rate increasing, the expectation of market depreciation, the segmentation of RMB exchange rate market and the RMB crawling peg exchange rate system [4].

2. Analysis on determinants of RMB exchange rate

Based on the research of exchange rate determination theory and the analysis of relevant factors of exchange rate, the empirical analysis of the determinants of exchange rate between RMB and US dollar is carried out by collecting and collating relevant data. Then we can further explore the influencing factors of China's RMB exchange rate market and the relationship between various factors and the RMB exchange rate.

2.1. Data selection processing

2.1.1. Data selection. According to the exchange rate determination theory and the domestic and foreign studies on the influencing factors of RMB exchange rate, this paper selects the international balance of payments, commodity prices, inflation rate differentials(INFL), economic growth rate differentials, foreign exchange reserves as the influencing factors of RMB exchange rate. The statistics of import and export balance, household consumption index, crude oil import volume, gross domestic product and China's foreign exchange reserves are respectively used for research. The relationship between explanatory variables and explained variables is constructed as follows:

$$y = ax_1 + bx_2 + cx_3 + dx_4 + ex_5 + f$$  (1)

In (1), $y$ represents the exchange rate of RMB, $x_1$ represents balance of imports and exports, $x_2$ represents household consumption index, $x_3$ represents crude oil import volume, $x_4$ represents gross domestic product, $x_5$ represents China's foreign exchange reserves, $f$ represents interference from other factors.

2.1.2. Data processing. Among the factors influencing the selection of RMB exchange rate, because the statistical cycles of each factor are different (such as daily data, monthly data, quarterly data and annual data), the statistical cycles of all influencing factors are unified into annual data. In this paper the normal distribution test is used to obtain the data of influencing factors within the interval from 1996 to 2015. A two-stage least-squares method (TSSLS) is used to conduct an empirical study of the decision factors of RMB exchange rate with the data of 1990-2010.

In this paper, SPSS statistical analysis software is used to process all samples. The sample data of this paper mainly come from China statistical yearbook and national bureau of statistics network.

2.2. Modeling

We first check whether each variable satisfies the normal distribution when we study the relationship between multiple variables. The data corresponding to each variable is depicted in Cartesian coordinate system. This linear equation can be used if they are found in the vicinity of a straight line. In order to establish the linear regression equation we need to use the least square method to minimize the sum of the total error squares, so as to determine the coefficients in the regression equation. The associated regression can't all pass through each regression data point in the process of regression. To determine the correlation we can calculate the correlation of the "R", the statistical "F", the remaining
standard deviation "S". The closer "R" is to 1, the better result; The bigger "F" is, the better result, the closer "S" is to 0, the better result[6].

2.3. Analysis of statistical characteristics of each influencing factor
Based on the analysis of SPSS statistical software the statistical characteristic values of each factor are obtained as shown in table 1.

| Factor                        | Valid | Missing | Mean value       | SE mean          | Mid-value         | Standard deviation | Variance              | Measure of skewness | SE skewness | kurtosis | SE kurtosis | Minimal value | Maximal value |
|-------------------------------|-------|---------|------------------|------------------|-------------------|--------------------|----------------------|--------------------|-------------|----------|-------------|---------------|---------------|
| Foreign exchange reserve     | 20    | 0       | 15157.65000      | 3168.745815      | 9426.00000        | 14171.062090       | 200819000.766        | .509               | .512        | -1.465    | .992        | 1050.000       | 38430.000     |
| GDP                           | 20    | 0       | 283798.00000     | 46577.806578     | 203380.00000      | 208302.283501      | 43389841311.5        | .755               | .512        | -.860     | .992        | 71810.000      | 689050.000    |
| Balance of payment            | 20    | 0       | 10605.85000      | 2140.388749      | 9226.50000        | 9572.109481        | 91625279.924         | 1.158              | .512        | 1.324     | .992        | 1019.000       | 36831.000     |
| Inflation rate                | 20    | 0       | 102.245000       | .561552          | 101.90000         | 2.511337           | 6.307                | .673               | .512        | .304      | .992        | 98.600         | 108.300       |
| Commodity price               | 20    | 0       | 2366.680000      | 380.143090       | 2085.00000        | 1700.051579        | 2890175.371          | .368               | .512        | -1.361    | .992        | 396.900        | 5361.700      |

2.4. Regression analysis based on two-stage least square method.

2.4.1 Correlation analysis and normal distribution test: The normal distribution test and correlation analysis of related variables are conducted before performing the regression analysis, as shown in table 2 and table 3.

| null hypothesis | test | Sig. | Decision makers |
|-----------------|------|------|-----------------|
| Normal distribution for foreign exchange reserve | one-sample test | 0.475 | retain null hypothesis |
| Normal distribution for GDP | one-sample test | 0.548 | retain null hypothesis |
| Normal distribution for balance of payments | one-sample test | 0.298 | retain null hypothesis |
| Normal distribution for inflation rate | one-sample test | 0.962 | retain null hypothesis |
| Normal distribution for commodity price | one-sample test | 0.667 | retain null hypothesis |
### Table 3 correlation coefficient between variables

| GDP          | GDP 1.00 | foreign exchange reserve | inflation rate | balance of payments | commodity price | RMB exchange rate |
|--------------|----------|--------------------------|----------------|---------------------|----------------|------------------|
| foreign exchange reserve | 0.13     | 1.00                     |                |                     |                |                  |
| inflation rate | 0.58     | -0.21                    | 1.00           |                     |                |                  |
| balance of payments | 0.22     | 0.03                     | 0.30           | 1.00                |                |                  |
| commodity price | 0.31     | 0.53                     | 0.27           | 0.32                | 1.00           |                  |
| RMB exchange rate | 0.03     | 0.51                     | 0.15           | 0.55                | 0.20           | 1.00             |

All factors affecting the exchange rate of RMB obey normal distribution that can be seen from table 2. Table 3 shows the highest correlation between the foreign exchange reserves and the international payments rate. The correlation coefficients are 0.51 and 0.55 respectively. The correlation coefficient between inflation rate and commodity prices against RMB exchange rate is relatively low with correlation coefficients of 0.15 and 0.20 respectively. The correlation coefficient between GDP and RMB exchange rate is the lowest with correlation coefficient of 0.03.

#### 2.4.2 Regression equation:

The regression equation of each influencing factor on RMB exchange rate is obtained by least square method:

\[ y = -0.5413x_1 + 0.1221x_2 - 0.2433x_3 + 0.013x_4 + 0.4736x_5 - 6.3465 \]

The following conclusions can be drawn from the regression equation:

- The balance of payments is negatively correlated with the exchange rate of the US dollar against the RMB, that is the larger the international import and export gap, the nominal interest rate of the US dollar against the RMB decreases, in turn the nominal exchange rate of the RMB against the US dollar increases.
- The inflation rate has a positive correlation with the exchange rate of the US dollar against the RMB, that is, the higher the inflation rate, the lower the nominal exchange rate of the RMB against the US dollar.
- Foreign exchange reserves have a positive correlation with the exchange rate of the US dollar against the RMB. In other words, if foreign exchange reserves are increased, the exchange rate of the US dollar against the RMB will rise. Otherwise the exchange rate of the RMB against the US dollar will fall.
- There is a negative correlation between commodity prices and the exchange rate of the US dollar against the RMB. When commodity prices fall, the exchange rate of the RMB against the US dollar also falls, at this time the RMB devalues.
- There is a positive correlation between the GDP and the US dollar. We can see that with the growth of GDP in China the RMB has fallen against the US dollar, which means our economy has not adjusted to the level of the exchange rate.

### 3. Conclusion

Under the situation of fluctuant international economic the change of RMB exchange rate has a great influence on the development of China's economy. Through the analysis we know that the factors
affecting the exchange rate of RMB against US dollar are as follows: balance of payment, inflation rate, commodity price, foreign exchange reserve and GDP. When the RMB exchange rate fluctuates greatly, what we should do first is to found out the root cause of currency fluctuation of RMB from the above factors. Then we take some efficient measures to solve the problem. For example, we should take macroeconomic policies to adjust the exchange rate of RMB. Meanwhile we can improve China's national strength. Then we can effectively control the trend of the RMB exchange rate. As for the real estate bubble and the negative economic problems the state should take effective measures to eliminate these negative factors. We enhance the competitiveness of the international trade market to achieve the expansion of the trade market, so as to ease the continuous depreciation of the RMB exchange rate. We must adjust the product mix on a regular basis and enhance the innovation capability of Chinese enterprises to improve the core competitiveness of the product. We should also keep the disadvantages under control, such as the rising of dollars exchange rate for RMB, foreign capital escape, less domestic investment, shrinking of Chinese income, insufficient domestic demand. Therefore it is particularly important to grasp the fundamental factors of the exchange rate change firmly when the exchange rate changes greatly.

Acknowledgement
This paper is supported by the Fundamental Research Funds for Central Universities(No.3132016306)

References
[1] Zhang, Y.X. (2015) Analysis of influencing factors of RMB exchange rate. J. Chinese Business Theory., 31:85-90.
[2] Shao, M. J. j., Zhang, Y., Guo, T. (2018) Analysis of influencing factors of RMB exchange rate. J. Value Engineering., 37:1-3.
[3] Liao, Z. Zh. (2018) Empirical analysis on the influencing factors of RMB exchange rate change. J. Times Finance., 12:7-12.
[4] Li, Y.F. (2017) Analysis of influencing factors of RMB exchange rate fluctuation--Based on the perspective of exchange rate overshoot model. J. Theory Monthly., 01:122-128.
[5] Obioma, B.K. (2015) The Effect of Industrial Development on Economic Growth (An Empirical Evidence in Nigeria 1973-2013). J. European Journal of Business and Management., 13: 2222-2863.
[6] Yang, D.P., Liu,X.H., Sun., H.T. (2012) Economic forecasting methods and MATLAB implementation. M. China Machine Press, Beijing.