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Analyzing the Impact of Economic Variables on RMB Exchange Rate: A Multiple Regression Study

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Abstract: In recent times, the exchange rate of the Renminbi (RMB) has been a persistent focus for scholars, business professionals, and policymakers. Amid China's swift economic development and the significant increase in its foreign exchange reserves, there have been persistent international demands for the appreciation of the RMB. Numerous theoretical and empirical studies have demonstrated that fluctuations in a nation's exchange rate can exert a profound and enduring influence on its economy. This paper compiles various data from 2000 to 2015 and conducts multiple regression analysis on six economic variables that impact the RMB exchange rate.

Keywords:RMB exchange rate,influencing factors, foreign exchange reserve.

1. Correlation Theory

1.1. Overview of Exchange Rates

Exchange rate, which is the price comparison between two different currencies. RMB exchange rate, that is, the relative price comparison between China's RMB and other countries' currencies under the economic conditions [1].

The exchange rate can be expressed by direct pricing method and indirect pricing method. The direct pricing method refers to the fixed foreign currency and the value of the foreign currency expressed in the domestic currency, which is used by the vast majority of countries in the international market, including China. For example, on April 24,2017, the intermediate price of the RMB exchange rate was 6.8673 yuan to the RMB against the US dollar. Indirect pricing method refers to the amount of food fixed in the domestic currency, and the price of this fixed amount of domestic currency is expressed in foreign currency, and a few developed countries adopt indirect pricing method, such as the United Kingdom and the United States. As an example above, for our country The bid-adding method means that the exchange rate of the dollar is not 6.8673 yuan equal to one dollar.

Exchange rate system refers to the systematic provisions made by countries or the international community on the principles, methods, methods and institutions for determining, maintaining, adjusting and managing exchange rates. At present, the fixed exchange rate system and floating exchange rate system are typical representatives. Fixed exchange rate system refers to a fixed exchange rate system based on a reference, between the national currency and that reference. The advantages of the fixed exchange rate system are as follows: first, it is conducive to economic development and stability; second, it is conducive to international trade and investment activities; and third, preventing foreign exchange speculation is conducive to stabilizing foreign exchange markets. The disadvantages can be summed up as: first, the balance of payments can not be adjusted; second, to maintain the fixed exchange rate system balance may destroy the domestic balance. Floating exchange rate system refers to the exchange rate system, which is completely determined by the supply and demand of the market, and the government does not intervene in any way. The advantages of the floating exchange rate system are: first, to prevent a large loss of

foreign exchange; second, to avoid the impact of international inflation; and third, to maintain the autonomy of a central bank in implementing monetary policy. The disadvantages can be summarized as follows: first, international coordination is more difficult and disadvantageous for developing countries; second, a Government may abuse the exchange rate regime for its own benefit.

1.2. Domestic and Foreign Research Trends on Exchange Rate Determinants

1.2.1 Foreign Literature Review

Based on the reform of exchange rate formation system, foreign scholars focus on exchange rate determination theory and influencing factors. Ehrmann M, Fratzscher M (2005) focus on the impact of economic factors on the exchange rate, and groundbreaking information as an economic factor to study its relationship with exchange rate fluctuations, the results show that monetary policy and macroeconomic have a certain impact on exchange rate fluctuations. Annika Alexius (2005) from the basic variables, the relationship between the exchange rate and the exchange rate level is studied, and the results show that there is a long-term equilibrium relationship between the two, and the long-term fluctuation of the exchange rate is largely due to the impact of relative production capacity. Dominguez K M E, Panthaki F (2006) It is mainly from the point of view of uniqueness that attempts to prove the uniqueness of the influence of traditional macro variables on exchange rate changes, but the results of the study show that there is no uniqueness, and the influence of non-fundamental information and other factors needs to be considered synthetically. Bertrand Candelon etal (2007) take the exchange rate of the eight new EU member countries to the euro as a sample, and use the panel data to conduct an empirical study on the influencing factors of the exchange rate. The empirical results show that the openness is negatively correlated with the real exchange rate, while the production level is positively correlated with the real exchange rate level. With the development of China's economy, China has more and more voice in the world, so the international community has also begun to discuss the issue of RMB exchange rate. Most scholars, such as Morgan Stanley's Barton Biggs、 Fred Bergsten, John Williamson and Nicholas Lardy of the American Institute of International Economics, are critical of the currency's exchange rate, arguing that the renminbi is grossly undervalued and that as China's position in the world grows more important, it will also be in the world economy imbalance has a direct effect. So far, the United States is still putting pressure on the Chinese government on the basis of the undervaluation of the renminbi, and foreign exchange rate theory researchers have also pointed out the phenomenon of undervalued renminbi from a theoretical point of view. Cheung, Chinn and Fujii (2007) used pre-2004 data to study fluctuations in the renminbi's exchange rate, and the results showed that the renminbi's exchange rate misaligned more than 50% by the end of 2004. Elekdag and Lall (2008) re-measured the real effective exchange rate of the renminbi in terms of per capita income in 2008, using data from a new set of commodity price standards of the International Comparison Project team. The results show that the renminbi exchange rate was underestimated by about 10 per cent in 2007. It can be seen that choosing different commodity groups or hypothetical conditions will bring great difference to the empirical results of exchange rate.

To sum up, most of the foreign literature focuses on the exchange rate determinants, among which the study of RMB exchange rate is more to discuss the problem of RMB undervaluation. But because of the different assumptions and methods of use, the empirical results will be quite different; in addition, many foreign scholars seldom consider the actual economic situation of China when using the traditional exchange rate to determine the theoretical model, but directly copy the theory, which also has a great impact on the accuracy of the empirical results.

1.2.2 Domestic Literature Review

On the basis of western exchange rate determination theory, Chinese scholars study the exchange rate of RMB by using different economic indicators and research methods under different restrictive conditions from the national conditions of our country. Zhang and Jie (2005) used factor analysis method to analyze the influencing factors of RMB exchange rate data from 1991 to 2002. The research conclusion shows that foreign direct investment, economic growth rate, inflation level and relative productivity have a great influence on the exchange rate fluctuation of RMB. Li Hong, Lu Jianming (2008) used regression analysis to analyze the data from 1980 to

2007, and concluded that the factors such as GDP, money supply, total consumption, foreign exchange reserves and so on play a decisive role in the fluctuation of RMB exchange rate. Gu yu, high-speed mai, fu xuewen (2008) selected the annual data from 1997 to 2007 and used error correction (VEC) model to study the exchange rate changes of rmb. the results showed that the level of productivity development, the degree of opening to the outside world, the amount of actual use of foreign direct investment, the terms of trade and so on had a great impact on the exchange rate fluctuation of rmb in the short term. Wu Shihui (2009) selected the quarterly data from 2002 to the first quarter of 2008 to analyze the relationship between RMB exchange rate, China's real GDP and the real GDP of the United States from the perspective of cointegration. The results show that compared with the difference of GDP between China and the United States, the national economy of the United States has a greater impact on the RMB exchange rate [2]. Li Guojun (2009) mainly studied the effect of GDP on the effective exchange rate of RMB. The empirical results show that sustained, high-speed economic growth has a greater impact on the appreciation of our people[3].Zhang Kun (2010) made an empirical study using the data since the exchange reform on July 25,2005, and the results showed that in the long run, the impact of the Sino-US trade balance on the RMB exchange rate was very small and not significant[4].Ding Jianping and Zhou Jianfang (2010) proved by empirical evidence that the large increase in China's trade surplus since 2005 is not entirely due to the increased competitiveness of Chinese commodities in the international market, but because of the influx of "hot money" caused by the strong expectation of RMB appreciation after the reform in 2005, which eventually led to the rise of domestic inflation level and the rise of prices. Zhang Li (2010) based on the transmission mechanism of spread to exchange rate in international economic theory, constructed the corresponding transmission path simultaneous equation, and applied the path analysis method in statistics to test the monthly data of RMB to US dollar exchange rate intermediate price from January 1994 to September 2008. There are obvious differences between the posterior conduction mode and the magnitude of the conduction effect. Pei Changhong, Zheng Wen (2010) used the data of trade balance, foreign exchange reserve, real effective exchange rate and other variables of the world's 46 major economies from 1975 to 2005 as a sample, using Granger causality test. The results show that the trade balance can not determine the exchange rate level alone, and point out that under the current exchange rate system of our country, we can not copy the use of western equilibrium exchange rate empirical evidence, which needs to be combined with the actual situation of our country. From the above analysis, we can see that domestic scholars have carried out a lot of research on the influencing factors of RMB exchange rate changes from different angles. Using different analytical methods: early scholars used Regression analysis method, to error correction model, and then use Granger causality test, data interval selection is also divided into years, quarterly, monthly data, selected economic variables are also more concentrated on macroeconomic variables, such as GDP, money supply, foreign exchange reserves, foreign direct investment and so on. But because the time interval of the data sample and the selected economic variables are different, the scholars draw different conclusions. Based on the previous analysis of the influencing factors of exchange rate, this paper will study the exchange rate of RMB under the current exchange rate system, based on the theory of exchange rate determination and combined with the actual situation of our country.

1.3. Main Factors Affecting the RMB Exchange Rate

1.3.1 Rate of Economic Growth

Growth in a country's gross domestic product (GDP) usually results in increases in national income and total expenditure. China's GDP has been growing rapidly in recent years, and the resulting increase in national income has increased people's purchasing power of imported products, and the demand for imported products has also increased, which has led to the increasing domestic demand for foreign exchange and the appreciation of foreign currencies and the depreciation of the renminbi. Similarly, with economic growth, the increase of enterprises' expanded reproduction capital will increase the technological innovation of enterprises, and then the competitiveness of domestic products in the international market will continue to improve, and the export of products will increase, thus the RMB will appreciate. It can be seen that RMB exchange rate fluctuations affected by China's economic growth, and its impact is two-way, both the impact of appreciation and

depreciation [5].

1.3.2 Rate of Inflation

Inflation means higher prices for goods and services and lower purchasing power of money. Inflation causes domestic prices to rise, leading to higher production costs and lower product competitiveness, thus affecting trade, lower exports and increased imports, higher foreign exchange demand, while the currency depreciates, the currency as a disguised commodity, the currency of the country in exchange for foreign exchange increases, the country's currency depreciates and the exchange rate decreases. In terms of international project exchange, the decline in the internal value of a country's currency will inevitably affect its external value, weaken the credit position of the country's currency in the international market, lower the expected value of the country's currency, and change its holdings from the foreign currency.

1.3.3 Currency Reserves

The foreign exchange reserve of the country is composed of a huge trade surplus, a net inflow of foreign direct investment, foreign loans and international hot money, and its change is mainly affected by the balance of payments. China's long-term balance-of-payments surplus has allowed foreign exchange reserves to expand. Because of the existence of China's controlled capital projects and compulsory foreign exchange settlement and sale system, the large size of foreign exchange reserves represents more basic currency investment. The money supply increases and the RMB depreciates internally. But in the foreign exchange market, because of the large influx of foreign exchange, the supply of foreign exchange exceeds the demand, which makes the foreign exchange depreciate and the local currency appreciate, that is, the RMB appreciates abroad [6]. It follows that the relationship between foreign exchange reserves and exchange rates should be negative.

1.3.4 Money Supply(M2)

Money supply is the primary factor that determines the value of money and the purchasing power of money. If the money supply increases, the excess money will be expressed in the form of inflation, which will cause domestic price increases to lead to a decrease in exports and a decrease in foreign demand for the domestic currency, which will lead to the devaluation of the domestic currency. At the same time, the domestic demand for foreign goods will increase, and the inflow of foreign currency will lead to a rise in the foreign exchange rate. If the money supply decreases and the domestic currency appreciates, there should be a negative correlation between the domestic money supply and the exchange rate [7].

1.3.5 Consumer Price Index (CPI)

The PPP theory holds that any unit of currency should be able to buy equal quantities of goods in all countries. Many economists believe that PPP describes the determinants of exchange rates in the long run. The meaning of PPP theory is that the nominal exchange rate between the two countries depends on the price level between the two countries. According to the theory of purchasing power parity, it can be concluded that the nominal exchange rate between the two countries' currencies is equal to the ratio of the foreign price level to the domestic price level. That is, the ratio of nominal exchange rate to domestic price level should be negative correlation based on purchasing power parity theory.

Relative Interest Rate

The effect of interest rate on RMB exchange rate is also obvious. For example, when China's interest rate is high in the economic boom, Chinese investors will invest more in their own capital markets than in foreign capital markets, and foreign investors will also exchange their currency for RMB to invest in our capital markets. At this time, the demand for RMB in the foreign exchange market will increase the RMB rises; and vice versa.

1.4. Exchange Rate Research Methodology

1.4.1 Correlation Coefficient Method

The correlation coefficient is the most intuitive method to measure the relationship between exchange rate fluctuation and its influencing factors. It is only a rough estimate of exchange rate and its influencing factors, which can not accurately measure the effect of exchange rate and its influencing factors.

1.4.2 One-way Regression Estimation Method

In one-way regression estimates, the influencing factors of exchange rates change by 1 per cent and the percentage of changes in exchange rate fluctuations. The fluctuation of exchange rate is a dynamic process, while the one-way estimation method reflects the relationship between variables from a static point of view.

1.4.3 Event Research

The practice research method is through the research related event produces the influence to the market the size to show through the price, and carries on the forecast analysis according to the price change range.

Table 1. Data collection control table

Time	RMB exchange rate (average annual price)	GDP increase rate (%)	currency reserves (100 billion US dollars)	CPI	M2 (trillion yuan)	Inflation rate (%)	Sino-US spreads (%)
2000	8.27	10.73	1.66	100.4	8.15	0.40	-3.35
2001	8.27	10.55	2.12	100.7	9.84	0.70	-1.05
2002	8.27	9.79	2.86	99.2	11.41	-0.80	0.61
2003	8.27	12.90	4.03	101.2	13.71	1.20	1.21
2004	8.27	17.77	6.10	103.9	15.81	3.90	1.28
2005	8.19	15.74	8.19	101.8	19.15	1.80	-0.62
2006	7.97	17.15	10.66	101.5	21.95	1.50	-2.15
2007	7.60	23.15	15.28	104.8	25.09	4.80	-0.85
2008	6.94	18.24	19.46	105.9	30.89	5.90	2.11
2009	6.83	9.25	23.99	99.3	38.88	-0.70	3.95
2010	6.76	18.32	28.47	103.3	45.92	3.30	2.31
2011	6.45	18.47	31.81	105.4	56.17	5.40	2.81
2012	6.31	10.44	33.12	102.6	66.55	2.60	3.06
2013	6.19	10.16	38.21	102.6	76.92	3.20	3.06
2014	6.14	8.19	38.43	102	88.03	1.50	1.81
2015	6.22	7.00	33.30	101.4	99.13	1.40	1.81

1.4.4 Multiple Linear Regression Analysis

including two or more independent variables in the regression analysis, and the linear relationship between the dependent variable and the independent variable is called multivariate linear regression analysis.

2. Empirical Analysis

2.1. Data Collection

2.1.1 Sub-section Headings

All the data used in this paper are from the Statistical Yearbook of the National Bureau of Statistics of China, the data period is 2000~2015.The annual RMB exchange rate (annual average price), China-US spread (%), GDP increase rate (%), foreign exchange reserves (100 billion US dollars), CPI, inflation rate (%), money supply M2 (trillion yuan), See table 1.

Table 2. Meaning of dependent and independent variables respectively

Time	RMB exchange rate (average annual price)	GDP increase rate (%)	currency reserves (100 billion US dollars)	CPI	M2 (trillion yuan)	Inflation rate (%)	Sino-US spreads (%)
Y	X1	X2	X3	X4	X5	X6	X7

2.2. Date Analyse

EVIEWS9.0 multivariate linear regression function is carried out with independent variables and dependent variables represented in Table 2, and the output results are as follows:

Sample: 2000 2015
Included observations: 16

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	23.08654	20.58296	1.121634	0.2911
X1	0.038530	0.021306	1.808406	0.1040
X2	-0.067990	0.012236	-5.556423	0.0004
X3	-0.150773	0.206402	-0.730485	0.4837
X4	0.005030	0.005681	0.885412	0.3990
X5	0.083722	0.200382	0.417812	0.6859
X6	-0.006424	0.030713	-0.209171	0.8390

R-squared	0.982667	Mean dependent var	7.309375
Adjusted R-squared	0.971112	S.D. dependent var	0.898996
S.E. of regression	0.152798	Akaike info criterion	-0.619767
Sum squared resid	0.210124	Schwarz criterion	-0.281760
Log likelihood	11.95814	Hannan-Quinn criter.	-0.602458
F-statistic	85.04082	Durbin-Watson stat	1.131602
Prob(F-statistic)	0.000000		

Figure 1. Data analysis results

The regression results W-D the test value is 1.132, and there is no autocorrelation in the model; the modified R2 value is 0.983, and the F test value is 85.041, which indicates that the model fitting degree and predictability are very good. The final multiple linear regression equations are as follows:

Y=23.087+0.038*X1-0.068*X2-0.151*X3+0.005*X4+0.084*X5-0.006*X6

It can be seen from the results of the model analysis that:

(1) GDP growth rate

The coefficient of GDP growth rate (X1) is 0.0386, indicating that the exchange rate under indirect pricing method is proportional to the GDP growth rate. GDP the higher the growth rate, the higher the exchange rate under the indirect pricing method, the stronger the RMB. If the GDP growth rate increases by 1% and other conditions remain unchanged, the RMB 100 to US
$0.038 will increase.

(2) Currency reserves

A country's foreign exchange reserves (X2) are negatively correlated with that country's exchange rate. The economic significance is: when the other conditions are unchanged, the foreign exchange reserve increases by one thousand dollars, and the RMB exchange rate rises by 0.068 units, that is, the depreciation rate is 0.068%.

(3) Consumer Price Index (CPI)

the coefficient of the consumer price index (CPI)(x3) is -0.151, which indicates that the exchange rate under the indirect pricing method is inversely proportional to the interest rate difference between china and the united states. the greater the interest rate difference between china and the united states, the higher the exchange rate under the indirect pricing method, the stronger the renminbi, and vice versa. Should the interest rate difference between China and the United States increase by 1% and other conditions remain unchanged, the 100 RMB exchange rate will be reduced by 0.151×1=0.151 dollars.

(4) M2

Overall upward trend. Combined with reality, before 2008, China implemented a prudent monetary policy, and in 2008, due to the impact of the financial crisis, monetary policy was tight, this stage of the RMB exchange rate quickly fell from eight words to about seven; after that, in order to alleviate the impact of the financial crisis, a two-year policy of moderate easing, which saw the exchange rate stable at about 6.2 yuan / dollar, and then returned to a sound monetary policy by 2015, and the exchange rate began to fall all the way to about 6.1 yuan / dollar.

(5) Rate of inflation

A coefficient of 0.0834 for inflation rate (X5) indicates that the exchange rate under the indirect pricing method is proportional to the inflation rate level. The higher the level of inflation, the higher the exchange rate under the indirect pricing method, the stronger the RMB, and vice versa. If the inflation rate level increases by $1 and other conditions remain unchanged, the RMB exchange rate will increase by $0.0834.

(6) Sino-US spreads

China-US spread (X6) has a positive correlation with the exchange rate. The X6 correlation coefficient is -0.006. If the other variables remain the same, net exports will decrease by 0.006 yuan per dollar for every 1 percentage point increase in net exports. China's interest rates have been higher than those of the United States in terms of data, with the renminbi rising in 2000- 2015, a general downward trend against the dollar. Between 2006 and 2011, the spread between China and the United States stabilized between 0.30 and 0.70 percentage points, The spread reached its highest level in 2012, at 1.10 percentage points, and stabilized at around 0.7 percentage points after 2012. Since the spread between China and the United States is less relevant than the money supply and the exchange rate, the impact of the spread between China and the United States on the exchange rate is not as significant as the money supply.

3. Countermeasure and Advice

3.1. To enhance Economic Strength

If the exchange rate rises and the RMB appreciates abroad, the country will have greater purchase demand for foreign goods, and the total domestic demand will also rise. The increase in total domestic demand may lead to a shortage of demand, so the government must promote the progress of various industries in order to fundamentally solve the negative impact of exchange rate appreciation.

3.2. The Expansion of Domestic Demand

Stable exchange rate internal aggregate demand and external aggregate demand jointly affect exchange rate fluctuations, when the internal aggregate demand increases, it will cause an increase in external aggregate demand. If aggregate demand depends entirely on external supply, it is an unscientific and undesirable method. It is necessary to expand the demand of the Chinese market itself and ensure that the internal aggregate demand meets the total supply as far as possible, thus reducing the result of the increase of external demand. Because of China's large population, this condition can be used to expand China's internal market to increase domestic demand, ease the exchange rate fluctuations caused by changes in demand, and then stabilize the exchange rate.

3.3. Regional Planning Economy

Strengthening Economic Strength and Promoting Regional Economic Development through Great Western Development. With the advantage of low labor cost in the west, increasing the production of products, Chinese products can occupy a strong position in the world market. The low-cost advantage of the western region can be used to transfer the low-value-added industries in the eastern region to the western region, to increase the added value of products through the value of labor innovation in the western region, to solve the problem of rising export costs caused by the rising exchange rate, and thus to expand the industrial scale in the eastern region, and the excess labor force can also be reasonably improved by using the development of the western region.

3.4. Open the Market

Exchange rate stability should be based on market opening. Because the current development of the financial industry lags behind the developed countries, through the open market business, adjust the market liquidity, use the market to adjust the exchange rate, so that the RMB exchange rate gradually marketization.

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