Empirical Analysis on RMB Exchange Rate Determinants

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ABSTRACT

Within open economy system, the exchange rate is the ratio of converting the domestic currency with the foreign currency, which is manifesting the foreign value of the currency. The change of the exchange rate is mainly decided by the economic development situation of our country. This paper carries on the empirical analysis to the relation of the favorable balance of payments, the monetary aggregates (M2), the RMB deposit interest rate, the commodity retail price index and the RMB nominal exchange rate. By choosing the time series data of each variable time from 1985 to 2012, the paper uses some methods of econometrics to return the data and pass the examination. Then, it draws a conclusion that the favorable balance of payments and the commodity retail price index has a reasonable explanation for the changes on the RMB nominal exchange rate and gets the quantities relation between them.

KEYWORDS

RMB Exchange Rate; Exchange Rate Pass-through, Asset Prices;Commodity retail price index; Empirical Analysis

1 INTRODUCTION

In recent years, the RMB has been taken the pressure of the appreciation from developed countries. by 2009, Obama, the USA President visit china in November,told Reuters in an interview that "We will discussed exchange rate for a series of problems." The problem of RMB exchange rate issued its importance.
Since China's reform and opening up, the RMB exchange rate system has experienced from a single official exchange rate to the official exchange rate. To January 1, 1994, the RMB exchange rate and foreign exchange swap market exchange rates began to implement based on market supply and demand. A unified foreign exchange market was established, the market managed single and floating exchange rate system, and its aim is to carry out foreign exchange transaction.
By the end of 2001, with China's accession to the WTO formally, the government gradually relaxed and abolition part foreign exchange controls of capital account , so that to create conditions for the ultimate realization of the full RMB convertibility and the marketization of RMB exchange rate.
Since July 21, 2005, the RMB exchange rate is no longer pegged to the dollar, but began to implement based on market supply and demand, establish the managed floating exchange rate system reference to a basket of currencies. As the link between the domestic and foreign economy, RMB exchange rate plays an important role in China's economic activities.Therefore, an empirical study of the determinants of exchange rate also becomes more important and urgent.

2 CURRENT STUDY

In China, more mature model of exchange rate determination has not been produced. Most scholars analyze the determinants of exchange rate by means of purchasing power parity theory or cointegration theory . In recent years, there were more papers on the domestic equilibrium real exchange rate of RMB , earlier research results include: Chinese University of Hong Kong, Chou and Shi (1997) with annual data prior to 1997 model estimates used purchasing power parity to calculate equilibrium exchange rate of RMB; Yi Gang (1997) from three aspects of the decision

factors (absolute purchasing power parity, relative purchasing power parity, and interest rate parity)to study the RMB exchange rate , in order to estimate the purchasing power parity of the RMB, but he did not draw conclusions on the equilibrium exchange rate. Zhang Xiao Pu (1999) first introduced the equilibrium exchange rate theories system and equilibrium exchange rate models, based on the behavior of equilibrium real exchange rate and the basic elements of the theory,he put forward the theory of equilibrium real exchange rate, with the actual situation of our country, raised a theoretical framework of RMB equilibrium real exchange rate. He use cointegration analysis and error correction model to estimates RMB equilibrium real exchange rate from 1980 to1999, and make an assessment of the RMB exchange rate misalignment and exchange rate policies since 1980. But because of the sample interval limitations, research results is still limited to the RMB imbalance of East Asian currency crisis. Lin Boqiang (2002) analyst RMB real exchange rate of situation based on theoretical analysis of equilibrium real exchange rate in developing countries from 1952 to 1997, so that the sample contained a variety of exchange rate regime; However, due to China's exchange rate system since the early 1980s was gradually determined by the market, the exchange rate was essentially just a tool of the Government's plan in early time , but it did not reflect market supply and demand, however the data or the results, its credibility nature is questionable; Shi Jian Huai, Yu Haifeng (2005) calculated the degree of disorder of the equilibrium real exchange rate of RMB and the real exchange rate with model of behavioral equilibrium exchange rate framework, by using the quarterly data of period from 1991 to 2004, then drew a conclusion : during the fourth quarter of the second quarter of 1992 to 1994, the real exchange rate of RMB was undervalued ; during the second quarter of quarter of 1995 to 1999, the real exchange rate of RMB was overvalued ;the third quarter of 1999,to the third quarter of 2004, the RMB real exchange rate undervalued. The main drawback is that these methods require strict accordance with the basic assumption of the theory of exchange rate determination as a prerequisite, the basic economic model parameters were estimated by macroeconomic variables, so the result depends heavily on data,not necessarily with the actual economic factors and current economic system.

This paper studies practical factors of RMB exchange rate determined,with econometrics to establish multiple linear regression model, analyze the size of the role of quantitative of the determinants of exchange rate changes.

3 EMPIRICAL ANALYSIS ON THE DETERMINANTS OF RMB NOMINAL EXCHANGE RATE

3.1 Analysis of ideas

Because the influence factors of RMB nominal exchange rate changes lie in many aspects, including economic factors, political factors and psychological factors. All the factors are interrelated and interact on each other. According to the related theory of exchange rate, combined with the actual situation, there is a quantify relationship between the RMB nominal exchange rate level and some quantify variable, such as balance of payments, broad money supply, interest rate, commodity retail price index. This paper analysis the economic relationship between the amount of data1985 - 2007. It focuses on the analysis of the factors of exchange rate changes after implementation of a managed floating exchange rate system.Meanwhile,using econometric models to analyze the stage shows more of practical significance.

3.2 Empirical Analysis

3.2.1 Model Construction

Now we take the international balance of payments surplus, the broad money supply (M2), RMB benchmark deposit interest rates, commodity retail price index as the explanatory variables, take RMB nominal exchange rate as the explanatory variable, then make empirical analysis by using econometric methods for quantitative analysis.Here we set relation model for their relationship:

$$Y_t = C + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t} + \beta_4 X_{4t} + \mu_t$$

Y:Dependent variable - the RMB's nominal exchange rate;

X_1: International balance of payments surplus;

X_2 : Broad money supply;

X_3 : RMB benchmark deposit rate;

X_4 : Commodity retail price index;

Among them, μ_t refers to the random disturbance term,it is on behalf of those affected but not included in the Y model. C, β_4 β_3 β_1 β_2 stand for the coefficients need to be estimated.

3.2.2 Data Selection

This data take from "China Statistical Yearbook" 1985 - 2008, the State Administration of Foreign Exchange, arranged by year.

$\hat{Y}_i = -1.559312 - 0.058233X_1 + 0.004119X_2 + 2.58799X_3 + 2.231885X_4$

(67.74116) (0.042469) (0.005410) (7.091009) (0.193611)

T=(-0.023019) (-1.371192) (0.761362) (0.364968) (11.52766)

R^2 =0.949661 F =84.8931 DF = 1.8

3.2.3 Model Checking

(1)Statistical test and economics test

Regression results: coefficient of determination R^2 = 0.949661, shows that the model fit the sample well.

$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ a given significant level: $\alpha = 0.05$, the F distribution tables found in degrees of freedom for the k-1 = 4 and n-k = 18 threshold.

F=84.8931> $F_{0.05}(4,18)$=2.93,

That the whole model and the nominal exchange rate of RMB to explain a significant linear relationship between variables 。 However , $\alpha = 0.05$,

$t_{\alpha/2}(n-k) = t_{0.025}(23-5) = 2.01$

We can see the coefficients of X_1， X_2， X_3 of the T test was not significant, which suggesting that it may be a serious multicollinearity.

(2)Econometric test

Here is Multicollinearity test

Table1 Correlation matrix

Variable	X1	X2	X3	X4
X1	1.000000	0.917279	-0.456077	0.509056
X2	0.917279	1.000000	-0.717674	0.689476
X3	-0.456077	-0.717674	1.000000	-0.552307
X4	0.509056	0.689476	-0.552307	1.000000

From the correlation coefficient matrix in Table 1,we can see the correlation coefficient between the explanatory variables are higher, which confirm the existence of serious multicollinearity.

(3) Multicollinearity Correction

With stepwise regression , examine and resolve the problem of multicollinearity. Do Y on X_1 , X_2 , X_3 , X_4 separately a regression, the results shown in Table 2.

Table 2 Regression Results

Variable	X1	X2	X3	X4
Parameter estimates	0.073659	0.010414	-32.09120	2.194104
t statistic	1.943630	3.453351	-2.864969	17.17340
R^2	0.152464	0.362199	0.281020	0.933529
$\overline{R}^2$	0.112105	0.331828	0.246783	0.930363

$\overline{R}^2$ of equation which added X_4 is 0.930363,this coefficient is higher than that of several other coefficient.Based on this way,adding other variables and regression in turn, the results shown in Table 3.

Table 3 Results to Add a new variable regression（1）

Variable	X1	X2	X3	X4	$\overline{R}^2$
X4、X1	-0.025814 (-2.296764)			2.352294 (17.38586)	0.942142
X4、X2		-0.002122 (-1.641244)		2.386116 (14.06232)	0.935561
X4、X3			0.306742 (0.073281)	2.200459 (14.01378)	0.926901

By comparison, new entrants of X_1 to the equation and $\overline{R}^2$ = 0.942142, is the most improved, and the parameters of the t-test is significant, chosen to retain, then add other new variable regression, the results shown in Table 4.

Table 4 results to add a new variable regression（2）

Variable	X1	X2	X3	X4	$\overline{R}^2$
X4 X1 X2	-0.046488 (-1.717083)	0.002481 (0.840657)		2.254499 (12.58116)	0.941281
X4 X1 X3	-0.027205 (-2.302062)		-1.890692 (-0.482857)	2.321646 (15.28710)	0.939835

Based on the accession of X_1 、 X_4 , added X_2 、 X_3 ,not only $\overline{R}^2$ fall, but also the parameters of the t-test was not significant. This shows serious multicollinearity , and the multicollinearity should be removed.

Finally, correction of serious multicollinearity affect the regression results ;

$$\hat{Y}_i = 2.860463 - 0.025814X_1 + 2.352294X_4$$

t = (0.076456) (-2.296764) (17.38586)

$R^2 = 0.947402$ $\overline{R}^2 = 0.942142$

DW=1.550173 F=180.1206

(3). Heteroscedasticity Test

Due to the time series, so follow with the ARCH test, select the lag phases of 1, the inspection process of ARCH is：

$\delta_t^2 = \alpha_0 + \alpha_1\delta_{t-1}^2 + \alpha_2\delta_{t-2}^2 + \nu_t$, $\alpha_0 > 0$,

$\alpha_j >= 0$,（j=1,2）; Vt is Random error.

Hypothesized：$H_0: \alpha_1 = \alpha_2 = 0$; $H_1: \alpha_j$ （j=1,2）

At least one non-zero. Return obtained using Eviews 6.0 to calculate，

$(n-p)R^2 = (23-1)*0.01832 = 0.40304$ ，Given significant level = 0.05，Degrees of freedom = 1，Check the χ^2 distribution table，get $\chi^2_{0.05}(1) = 3.84146$ ，since $(n-p)R^2 = 0.40304 < \chi^2_{0.05}(1) = 3.84146$ ，So accept the hypothesis $H_0: \alpha_1 = \alpha_2 = 0$, Reject the alternative hypothesis $H_1: \alpha_j$ （j=1,2）At least one non-zero，It indicates that the model does not exist heteroscedasticity.

(4).Autocorrelation Test

According to the results in Table 3-4(2)，DW= 1.550173，given significant level a=0.05,check the Durbin-Watson table，n=23,k=2,got the lower threshold d_l =1.168,higher threshold d_u =1.543，d_u <DW<4- d_u . According to the results in Table 3-4，DW= 1.550173，given significant level=0.05,check the Durbin-Watson table，n=23,k=2,got the lower threshold $d_l = 1.168$, higher threshold $d_u = 1.543$, $d_u < \mathrm{DW} < 4 - d_u$ ，It showed that the model without autocorrelation。

(5). Unit root tests and cointegration analysis

Because the data used in this paper is the time-series data, we should make smooth test to the confirm the series smooth or not, as it is annual data, lag order was chosen 1. Test results of the Augmented Dickey-Fuller was in Table5, the test results showed that the three indicators: the RMB's nominal exchange rate (Y), it is no unit root difference sequence, is a smooth sequence. The Y sequence is a single full-order, that is Y~I(1)；the sequence of the Balance of payments surplus amount (X_1)is a single second-order, that is X_1 ~I(2) ； the sequence of the Retail Price Index (X_4)is a first-order single whole, that is, X_4 ~I(2).

Table5 Unit Root Test Results

Variable	(C,t,q)*	T- statistic	Threshold (1%)	Threshold (5%)	Threshold (10%)
Y	(C,0,1)	-1.838409	-3.7856	-3.0114	-2.6457
△Y	(C,0,1)	-2.761633	-3.8067	-3.0199	-2.6502
X1	(C,0,1)	4.114726	-3.7856	-3.0114	-2.6457
△X1	(C,0,1)	-5.012318	-3.8304	-3.0294	-2.6552
X4	(C,0,1)	-2.010748	-3.7856	-3.0114	-2.6457
△X4	(C,0,1)	-2.922788	-3.8067	-3.0199	-2.6502

Note: * C stands for the constant term; t stands for the trend term; q stands for lags of the order.

Using Engle-Granger two-step method, we do the co-integration test between the relationship of the RMB's nominal exchange rate and the balance of payments surplus and the retail price index of the amount of. First of all, we do the static regression, the results showed the variables in the regression equation are more significant.

Secondly, the results of ADF test for unit root to the static regression residuals RESID, shown in Table 6. in the case of Lag phases of 1 ,the residuals of the ADF test statistic t is -3.326649, at the 5% significance level is significant. The test results show that there is no unit root, residuals RESID is a stationary sequence.

Table 6 Residuals of the ADF Test Results

ADF Test Statistic	-3.326649	1% Critical Value*	-3.7856
		5% Critical Value	-3.0114
		10% Critical Value	-2.6457
*MacKinnon critical values for rejection of hypothesis of a unit root.			

Therefore, there were co-integration relationship between the nominal exchange rate of RMB (Y) and the amount of balance of payments surplus (X_1), the retail price index (X_4), the co-integration equation is:

$$Y = 2.860463 - 0.025814X_1 + 2.352294X_4$$

t = (0.076456) (-2.296764) (17.38586)

$R^2 = 0.947402$ $\overline{R}^2 = 0.942142$

F=180.1206 DW=1.550173

3.3 Conclusion

After the inspection and correction of the model, we get the formula of the relationship between the RMB's nominal exchange rate and balance of payments surplus and the amount of the retail price index:

$$Y = 2.860463 - 0.025814X_1 + 2.352294X_4$$

t = (0.076456) (-2.296764) (17.38586)

$R^2 = 0.947402$ $\overline{R}^2 = 0.942142$ F=180.1206

DW=1.550173

The results showed the model fitting is very good, in the case of other variables constant, the balance of payments surplus amount for each additional $ 100 million, USD 100 corresponding to the amount of RMB 0.025814 yuan will reduce; retail price index for every point $ 100 corresponding to the amount of the increase of RMB 2.352294 yuan. Model shows that factors that determine the exchange rate are mainly international balance of payments surplus and the retail price index.

4. RELEVANT POLICY SUGGESTION

Based on the above analysis, we have the policy recommendations following:

4.1 Price stability

According to the model,we can concluded that the price level made the RMB exchange rate changes and was a main factors of long-term regularity, and the RMB exchange rate changes into the reverse relationship. In the longer-term of economic development, due to a certain degree of inflation every year, the RMB was in the long run depreciation .

According to the model, we can draw the conclusion: the price level is a long-term ,regular,important and major factor of the influence of RMB exchange rate changes. From the a long-term economic development , due to a certain degree of inflation each year, RMB face the great pressure from the long term long-term external devaluation. However, as shown in table 3-1, the price level in China has decreased since 2005, thus make RMB in the state of appreciation. However, excessive RMB appreciation will make Chinese economy bring a series of effects, such as reducing export, reducing output, reducing the rate of economic development. Therefore, in order to maintain the relative stability of the exchange rate of RMB, effective measures shall be taken to prevent the moderate price stability, inflation or deflation, so more conducive to China long-term sustainable economic development.

4.2 Appropriately reduce the balance of payments surplus

According to the model, expanding the international balance of payments surplus contributes RMB appreciation pressure, but its influence is not as good as the retail price index. The greater international balance of payments surplus is , the greater the pressure of RMB appreciation gets. Nowadays, China exists in huge balance of payment surplus and the very strong appreciation pressure of RMB.Any attempt to increase the flexibility of the RMB exchange rate will lead to the rapid appreciation of the RMB, and play adverse effects on the domestic economic stability. Therefore, under the financial crisis, how to reduce the international balance of payments surplus is more important and urgent than considering the reform of RMB exchange rate system itself. How to reduce the international balance of payments surplus, we should consider reducing the current account and the capital

financial account to start, to realize the balance between the goal of international balance of payments depends on Trade and capital flows policy adjustment.

4.2.1 As soon as possible to change human driven pattern of trade surplus,take the overall balance of international payments as the basic policy objectives of external economy. We should adjust over prevailing measurements on the enterprises export as soon as possible (such as to reduce the export tax rebate rate), and completely change the government export quantity basis performance evaluation, gradually reduce the current account surplus. At the same time also need appropriate incentives continue to maintain the domestic investment and consumption, so as to reduce the demand for external (trade surplus) dependence, to create conditions to gradually reduce the trade surplus.

4.2.2 We should continue to prudential approach to capital account liberalization, to prevent the excessive accumulation of capital account surplus. Many countries of emerging market in the 1990s, due to rapidly promotion capital account liberalization, resulting in excessive inflows of foreign capital, excessive accumulation of capital account, the international balance of payments surplus, and bringing heavy pressure to appreciate its currency. In order to prevent the occurrence of similar situations, in a longer period in the future, China should avoid excessive advancing capital account convertibility, continue to impose capital controls to a certain extent. From the current international balance of payments, in the next 2-3 years, China especially needs to maintain effective control of the capital inflow, stop to launch any new inflows of capital liberalization measures, some measures have been introduced (such as QFII) should be careful implementation. Of particular note is, for foreign direct investment, we should reduce or even completely cancel all unnecessary preferential policies as soon as possible, at the same time, completely change the inappropriate practice of local government performance evaluation which act capital as its basis.

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