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A Study on Chinese Real Exchange Rate

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Abstract. Purchasing power parity theory is often used as an important basis for exchange rate policy, and also the most widely used in the theory of exchange rate decision. Since July 21, 2005, the exchange rate system of China is relatively stable, and also the economic development is the same. Therefore, this paper took the nominal exchange rate of RMB against the Dollar and the consumer's price index of China and US in the past 10 years as a sample, used unit root test and co integration test for purchasing power parity checking. The results show that the purchasing power parity is not applicable to the real exchange rate of RMB.

Introduction

Since Cassell (1918) [1] proposed the theory of purchasing power parity (PPP), purchasing power parity has always been a hot and key issue in the research of international finance theory and policy. Chinese scholars have a dispute on the theory of purchasing power parity, which cannot be fully supported by empirical evidence. With China's accelerated marketing economic, the process of internationalization, the exchange rate is required by rules of market, which requires a solid theoretical basis. The starting point for studying the exchange rate is the long-term basis of the exchange rate decision, which is the purchasing power parity. Therefore, taking the international advanced experience, combining with the latest data and new analytical methods, to re test the purchasing power parity of RMB is very necessary at present.

Purchasing Power Parity and Its Test

Purchasing Power Parity

Purchasing power parity theory explains the reason why people are willing to buy foreign currency; it is due to the foreign currency to have the purchasing power of goods and services in the foreign country, and the domestic currency to have purchasing power of goods and services in the domestic country. As a result, the exchange rate of the two currencies depends on the purchasing power of the two currencies in the two countries. When the two currencies are in inflation condition, the real exchange rate will be equal to the nominal exchange rate multiplied by the ratio of the two countries' inflation rate (commodity price level). Although there may be a departure from the real exchange rate, but the fluctuating trend of exchange rate is always the ratio of purchasing power of the two countries. Therefore, we must put the exchange rate calculated in the above manner as the new parity between the two currencies, which is purchasing power parity. The formula is expressed as:

$$REX = NEX \times \frac{CPIDOMESTIC}{CPIFOREIGN} \tag{1}$$

Where, REX for the real exchange rate, NEX for the nominal exchange rate, CPIDOMESTIC for the commodity price level of domestic country, and CPIFOREIGN for the commodity price level of foreign country.

Taking the natural logarithm on both sides of the above equation gets:

$$q_t = e_t + p_t^* - p_t \tag{2}$$

Where, q for the natural logarithm of REX, e for the natural logarithm of NEX under the direct quotation method, p for the natural logarithm of CPIDOMESTIC, p^* for the natural logarithm of CPIFOREIGN, t for the corresponding time. This is the purchasing power parity equation which is to be tested in this paper.

The Methods of Test

The implications of purchase power parity is that real exchange rate is a equilibrium exchange rate between two countries, when the exchange rate is at the equilibrium level means that commodity markets must be clearing. Due to the assumption of the sticky price monetary model, the adjustment speeds of product market and money market are different, commodity market prices are sticky, the adjustment is gradual, and the adjustment of monetary market is rapid, real exchange rate requires a certain period of time to reach equilibrium level, so the purchasing power parity is not establish in the short term, and may establish only in the long term.

Generally, two ways are often used in test of the purchasing power parity equation. One way is to test the stability of the real exchange rate time series. According to Culver and Papell (1999) [2], if the real exchange rate time series data showed non stationary, it means the data does not support the purchasing power parity; if it is stationary, we can consider that the real exchange rate convergences a fixed value in the long term, that is convergences the long-run equilibrium value of the exchange rate or purchasing power parity.

The other way is to test the co integration relationship between the variables that constitute the real exchange rate, that is, to test whether there is a co integration relationship between the nominal exchange rate, the foreign price index and the domestic price index sequence. According to Chen (1995) [3], the sufficient and necessary condition which purchasing power parity holds is the natural logarithm of the nominal exchange rate, the natural logarithm of the commodity price level of foreign country and the natural logarithm of the commodity price level of domestic country should co integration with a co integration vector [1, - 1, 1], otherwise means that purchasing power parity does not hold.

The Results of Former Test

The test results of the purchasing power parity from scholars are not consistent, some support for the establishment of purchasing power parity, and others don't support for the establishment of purchasing power parity. For example, in which Kim (1990)[4] used Granger - Engle two step method and the exchange rate data of five industrialized countries during 1900 to 1987 for test purchasing power parity, the results do not fully support the purchasing power parity. Grilli and Kaminsky (1991) [5] used the annual data during 1885-1986 and wholesale price index for study the real exchange rate of the Dollar against the Pound, the results support the purchasing power parity. Similarly, there are a lot of literatures about the study of purchasing power parity of RMB, which mainly use the above methods to study. In their conclusions, some support for purchasing power parity, such as Chou and Shih (1998) [6], Liu Jinquan (2006) [7], etc. (2006), and others don't not supported the purchasing power parity, such as Yi Gang (1997) [8], Zhang Xiaopu (2000) [9], etc.

Empirical Tests

The Selection of Data

Empirical observations of the time period was selected from August 2005 to April 2015, a total of 117 monthly data. The data based on monthly frequency is mainly because the consumer price index (CPI) data which the empirical need to use is monthly. In addition, the monthly data is the frequency that most exchange rate theory empirical research observation value takes.

The nominal exchange rate (NEX) of RMB used the exchange rate of RMB, the price for the end of the month, and the data was chosen from International Financial Statistics (IFS) of the

International Monetary Fund (IMF).

The data of China's CPI was a ring data which was chosen from the website of National Bureau of Statistics, the data of the United States CPI was the fixed base data which was taken from the Economic Cooperation Organization (OECD). CPI is usually an important data for the academic or government to measure the level of commodity prices or inflation.

The Processing of Data

The Calculation of Monthly Real Exchange Rate. According to the definition of the natural logarithm of RMB real exchange rate in the model, $q_t = e_t + p_t^* - p_t$, Where, q_t for the natural logarithm of REX, e_t for the natural logarithm of NEX under the direct quotation method, p_t for the natural logarithm of China's CPI, p_t^* for the natural logarithm of the United States CPI. There are a variety of indicators which reflects the level of commodity price, this paper referring to the approach of Kanas Angelos (2005), using the consumer price index (CPI) said the price level. So, the monthly real exchange rate was calculated as the natural logarithm of the RMB exchange rate combines with the natural logarithm of the United States CPI, and then subtracts the natural logarithm of China's CPI.

The Calculation of Monthly CPI. Because of this paper was to study the purchasing power parity of RMB after 2005, the CPI data of China and US all were adjusted to fixed base data in January 2005, and then calculated the month on month CPI data for each time period by the fixed base CPI data.

The Test of Unit Root

Although the chart of real exchange rate of RMB had been initially showed that the real exchange rate of RMB had the characteristics of non stationary, see figure 1. The following was still a further test on its stability of the unit root.

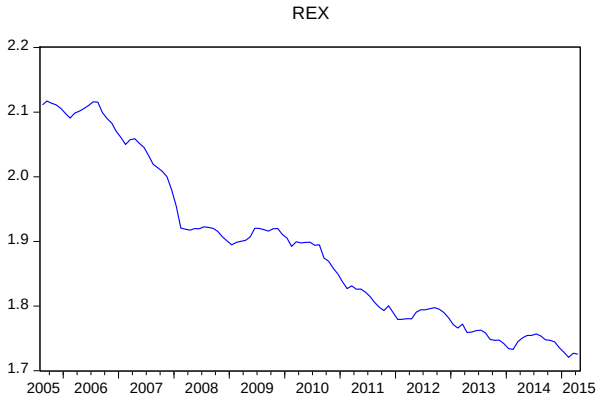

Fig. 1 The real exchange rate of RMB (REX)

Table 1 Unit root test of RMB real exchange rate series

Variable	Intercept	Trend	ADF	1%	5%	10%
REX	have	Have	-1.7830 (0.7068)	-4.0398	-3.4494	-3.1499

Note: For ADF test, intercept and trend were decided by the graph of the time series; the optimal lag order were determined by the computer according to the principle of minimum AIC and SC; data in bracket is the p value that accompany probability for statistics.

From table 1, we can know that the absolute value of the ADF statistical value of real exchange rate of RMB time series is less than the absolute value of the critical value of 10%, so the time series is a non stationary time series. Therefore, a preliminary judgment of the real exchange rate of RMB does not support the purchasing power parity. The following will be the test of Co integration relationship of three variables which constitute the real exchange rate of RMB to examine whether the real exchange rate of RMB to support the purchasing power parity.

The Test of Co Integration

Before the co integration test, the test of stationary of three time series is need; they are the natural logarithm of the nominal exchange rate (LNNEX), the natural logarithm of the US price level (LNCPIUS), and the natural logarithm of the price level of China (LNCPICN).

Table 2 The test of unit root of LNNEX, LNCPIUS, LNCPICN and the differential series of them

Variable	Intercept	Trend	ADF	1%	5%	10%
LNNEX	have	have	-1.8566 (0.6703)	-4.0413	-3.4501	-3.1503
LNCPIUS	have	have	-2.6261 (0.2698)	-4.0398	-3.4494	-3.1499
LNCPICN	have	have	-2.3597 (0.3986)	-4.0398	-3.4494	-3.1499
DLNNEX	have	have	-4.8101 (0.0008)	-4.0405	-3.4497	-3.1501
DLNCPIUS	have	have	-7.0863 (0.0000)	-4.0398	-3.4494	-3.1499
DLNCPICN	have	have	-8.4652 (0.0000)	-4.0398	-3.4494	-3.1499

Note: For ADF test, D represents the first order differential; intercept and trend were decided by the graph of the time series; the optimal lag order were determined by the computer according to the principle of minimum AIC and SC; data in bracket is the p value that accompany probability for statistics.

From table 2, we know the absolute value of ADF statistics of three time series LNNEX, LNCPIUS LNCPICN were less than the absolute values of critical level of 10%, so the three series are non-stationary time series. But after the first order difference, the three series all reject the original hypothesis of existing unit root of 1%. Therefore, the first order difference of the three variables are stationary time series, which is the same as the first order single integer series I (1), and satisfy the condition of co integration test. The results of the test of Johansen co integration of the three variables are as follows.

Table 3 The results of co integration test of LNNEX, LNCPIUS, and LNCPICN (Trace)

Null Hypothesis	Eigenvalue	Trace Statistic	5% Critical Value	Prob.**
None*	0.2733	42.985	29.797	0.0009
At most 1	0.0603	7.2370	15.495	0.5503
At most 2	0.0024	0.2710	3.8415	0.6027

Note: * indicates rejecting the original hypothesis of 0.05%.
* * * indicates MacKinnon-Haug-Michelis (1999) p-values

Table 4 The results of co integration test of LNNEX, LNCPIUS, and LNCPICN (Maximum Eigenvalue)

Null Hypothesis	Eigenvalue	Statistic	5% Critical Value	Prob.**
None*	0.2733	35.748	21.132	0.0002
At most 1	0.00603	6.9660	14.265	0.4932
At most 2	0.0024	0.2710	3.8415	0.6027

Note: * indicates rejecting the original hypothesis of 0.05%.
* * * indicates MacKinnon-Haug-Michelis (1999) p-values

From table 3 and table 4, we know existing co integration relationship of LNNEX, LNCPIUS and LNCPICN series.

Table 5 The standard co integration coefficient of co integration equation

LNCPICN	LNNEX	LNCPIUS	likelihood ratio
1.0000	-0.0222 (0.0645)	-1.6564 (0.1064)	1425

Note: The data in brackets is the standard deviation.

Conclusions

From table 3, 4 and 5, although there is a co integration relationship between LNCPICN, LNNEX and LNCPIUS, but exist a large gap compare to co integration relationship with a co integration vector [1, - 1, 1]. Therefore, it can be said that the real exchange rate of RMB does not support the purchasing power parity.

From the previous results of empirical studies both at home and abroad about purchasing power parity, generally the possibility of purchasing power parity establish is larger during decades of period, and in short term are generally not establish, it is consistent with the premise hypothesis of the sticky price monetary theory that purchasing power parity does not hold on short-term.

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References

[1] Cassel, G. Foreign Investments Lectures of the Harris Foundation [M]. Chicago: University of Chicago Press, 1928.

[2] Sarah E Culver, David H Papell. Long-run purchasing power parity with short-run data: evidence with a null hypothesis of stationary [J]. Journal of International Money and Finance, 1999, 18(5), p751-768.

[3] Baizhu Chen. Long-Run Purchasing Power Parity: Evidence form some European Monetary System Countries [J], Applied Economics, 1995(27), p377-383.

[4] Kim, Yoonbai. Purchasing Power Parity in the Long Run: A Co-integration Approach [J]. Journal of Money, Credit, and Banking, 1990, (22), p491-503.

[5] Grilli, V. and Kaminsky, G. Nominal Exchange Rate Regimes and the Real Exchange Rate: Evidence from the United States and Britain, 1885-1986 [J]. Journal of Monetary Economics, 1991, No. 27, p191-212.

[6] Chou, Shih, Y. C. The Equilibrium Exchange Rate of Chinese Renminbi [J]. Journal of Comparative Economics, 1998, (26), p165-174.

[7] Liu Jinquan, et al. Measurement and test of the purchasing power parity of RMB exchange rate [J]. Management world, 2006, (3) , p57-62(in Chinese).

[8] Yi Gang, fan min. Determinants and trend analysis of RMB exchange rate [J]. Economic Research, 1997, (10), p26-35(in Chinese).

[9] Zhang Xiaopu. The latest development of purchasing power parity theory and its application in RMB exchange rate [J]. World Economy, 2000, (9), p10-18(in Chinese).