

The Empirical Test of Consumption-Real Exchange Rate Anomaly in China

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Introduction

Consumption-Real Exchange Rate Anomaly is one of the well known puzzles in international finance. Most international business cycle models predict that, under the assumption of perfect financial markets along with supply disturbances, consumption should be higher in the country where its price, converted into a common currency, is lower. But empirical studies show that the consumption differentials across countries do not correspond in any systematic pattern with its relative price (i.e. the real exchange rate)¹. Furthermore, consumption in countries with lower real exchange rate does not go up. Quite often than not it goes down². With regard to the current situation in China, on the one hand, there is the criticism from western countries that RMB³ exchange rate is undervalued⁴; on the other, the final consumption rate has been very low with a continued downward trend. It has dropped to 52.1% in 2005 from 66.36% in 1985. Especially, there has been a drastic decrease in resident consumption rate, from 48.8% in 1991 to 38.2% in 2005⁵. However, according to statistics of the World Bank, the average consumption of the world stays between 77% and 79%. For example, the average consumption

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¹ The foreign exchange quotations are either described as direct or indirect. The direct quotation is a home currency price of a unit of foreign currency, and an indirect quotation is a foreign currency price of a unit of home currency. Under direct quotation of exchange rate, the ascending of real exchange rate means the depreciation of home currency and the descending, the appreciation of home currency. For example, ¥7.5200/\$ is under the direct foreign exchange quotation for the *yuan*, the currency of People's Republic of China.

² International real business cycle models based on complete financial markets predict a unitary correlation between the real exchange rate and the ratio of home to foreign consumption when subjected to supply-side shocks. In the data, this correlation is usually small and often negative. Gianluca Benigno and Christoph Thoenissen, 'On the consumption-real exchange rate anomaly', Bank of England Working Paper No. 254, 2005.

³ RMB is the abbreviation of the currency of People's Republic of China.

⁴ For example, Morris Goldstein argues that RMB is undervalued about 15 to 25 percent (see Morris Goldstein, 'Adjusting China's Exchange Rate Policies', Institute for International Economics, Working Paper 2004); Jeffrey A. Frankel says that "the yuan was undervalued by approximately 35% in 2000, and is by at least as much today" (see 'On The Renminbi: The Choice Between Adjustment Under A Fixed Exchange Rate And Adjustment Under A Flexible Rate', NBER Working Paper 11274).

⁵Li Jian, Lan Ying, 'The main reasons for persisting descending of consumption rate in China: imbalance in national income distribution', www.frchina.net.

rate of the world in 2002 was 81%, and the figure for low income countries was 80.7%, middle income countries, 73.2%, high income countries, 81%. But the rate in China was only 58.2%.

Is there a significant relationship between resident consumption rate and RMB real exchange rate? Does the persistent decreasing resident consumption affect the real exchange rate in China? These are undoubtedly subjects worth studying thoroughly.

Related Literature

Backus and Smith are the first to document the lack of correlation between relative consumption levels and the real exchange rate. By introducing the non-traded goods, their research demonstrates that the correlation between the growth rate of relative consumption and the growth rate of the real exchange rate, averaged across eight OECD countries, is only 0.045, with the biggest value of 0.17⁶. Calculations done by Corsetti, Dedola and Leduc show that the cross-correlations obtained from Hodrick-Prescott filtered as well as first-difference filtered data for a selection of OECD countries appear to be small and often negative. The median is between -0.30 and -0.2. The data for consumption and real exchange rates are annual series from the OECD Main Economic Indicators dataset from 1973 to 2001⁷. Most recent studies question the premise of complete financial market and take the incomplete financial market as the necessary premise, but the empirical conclusions about the cross correlation between relative consumption and the real exchange rate for the incomplete market case is the same as in the complete market case. So, Chari et al come to the conclusion that '*The most widely used forms of asset market incompleteness does not eliminate - or even shrink- the anomaly*'⁸. Further studies find that, by introducing other frictions along with asset market incompleteness, the research conclusions are able to get closer to the empirical facts, but the anomaly still holds. Corsetti et al highlight the role of distributive trade along with market incompleteness⁹. Their VAR analysis suggests that a positive productivity shock will improve the terms of trade, appreciate the real exchange rate and increase domestic consumption relative to the rest of the world. Another related contribution is a recent work by Ghironi and Melitz. In their work a non-traded sector arises endogenously because less productive firms decide not to export their products. They find that the Balassa-Samuelson effect and the real exchange rate appreciation are generated by aggregate productivity shocks rather than sector specific ones to the traded sector¹⁰. Benigno and

⁶ Backus, D K and Smith, G W, 'Consumption and real exchange rates in dynamic economies with non-traded goods', *Journal of International Economics*, Vol. 35, 1993, pages 297-316.

⁷ Corsetti, G, Dedola, L and Leduc, S, 'International risk sharing and the transmission of productivity shocks', European Central Bank working paper series, No. 308, 2004.

⁸ Chari, V V, Kehoe, P J and McGrattan, E R, 'Can sticky price models generate volatile and persistent real exchange rates?' *Review of Economic Studies*, Vol 69, 2002, pages 633-63.

⁹ The same as footnote 6.

¹⁰ Ghironi, F and Melitz, M J, 'International trade and macroeconomic dynamics with heterogeneous firms', mimeo,

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Thoenissen explores the extent to which the introduction of non-traded goods, along with a limited international financial market structure, might account for the aforementioned anomaly. Their results suggest that the combination of these two factors is a promising avenue for understanding the behavior of consumption across countries as well as the real exchange rate, even though they find that the correlation between real consumption and real exchange rate is -0.09, and the so called anomaly still holds¹¹. In particular, following a positive shock to the traded goods sector in the home economy, home consumption increases in relation to consumption abroad. On the other hand, the real exchange rate appreciates if the effect coming from the relative price of non-traded to traded goods (the so-called Balassa-Samuelson effect) outweighs the terms of trade effect that would imply a depreciation of the real exchange rate¹². More generally, the structure of the disturbance and the specification of consumption preferences determine the overall cross-correlation between real exchange rate and relative consumption. The recent research about consumption and real exchange rate is finished by Hoffmann and Nitschka¹³. Basing their data on 13 industrialized countries and resorting to an international version of the consumption capital asset pricing model (CCAPM), they find that idiosyncratic consumption risk measured by the cross-sectional variance of real consumption growth explains more than 60 percent of the cross-sectional variation in exchange rates in a standard consumption CAPM adjusted for heterogeneous consumers, which bears out the holding of the consumption-real exchange rates anomaly to some degree.

Empirical Analysis

This paper will testify whether the Consumption-Real Exchange Anomaly holds in China by constructing an equilibrium exchange rate model, and at the same time, figure out how much is the strength of the Balassa-Samuelson effect and the terms of trade effect in the test. It must be mentioned that this paper does not estimate the cross-correlation between relative consumption and real exchange rate across countries, but the correlation of these two variables in China.

Constructing Equilibrium Exchange Rate Model

Since the equilibrium exchange rate is a kind of medium and long term real exchange rate, which is consistent with the external and internal macroeconomic balance, and is determined by

Boston College and Harvard University, 2004.

¹¹ Benigno, G. and Thoenissen, C., 'On the consumption-real exchange rate anomaly', Bank of England, Working Paper no. 254. 2005

¹² The Balassa-Samuelson effect will be stronger the more dominant the shocks to the traded goods sector relative to the non-traded goods sector, while the terms of trade effect will be stronger the higher the degree of home bias in preferences.

¹³ Hoffmann, M and Nitschka, T, 'The Consumption - Real Exchange Rate Anomaly: an Asset Pricing Perspective', Institute for Empirical Research in Economics, University of Zurich, Working Paper No. 331.

the macroeconomic fundamentals and not influenced by short term factors¹⁴, most researches of the effective exchange rate of RMB are accomplished by the method of estimating equilibrium exchange rate in recent years. There are mainly two methods to estimate equilibrium exchange rate: Purchasing Power Parity(PPP) and equilibrium exchange rate model. The latter is more often used in estimating equilibrium exchange rate of RMB in recent years. The essential of the theories of equilibrium exchange rate is to analyze the effects of macroeconomic fundamentals on the equilibrium exchange rate and to calculate the equilibrium exchange rate by using correlations among these factors. In general, there are mainly four kinds of equilibrium exchange rate models: Fundamental Equilibrium Exchange Rate model (FEER), Behavioral Equilibrium Exchange Rate model (BEER), Natural Equilibrium Exchange Rate model (NATREX) and Real Equilibrium Exchange Rate model (REER), with the last one developed specially for developing countries. Due to the lack of data in developing countries, application of FEER and NATREX in such countries often runs into many difficulties, so most studies of RMB exchange rate use BEER, ERER or other small general equilibrium models.

Certain premises are necessary to estimate the equilibrium exchange rate. This paper, following the practice of Benigno & Thoenissen¹⁵ and others, also takes the incomplete financial market as the necessary assumption and introduces non-traded goods into the model.

Given the current situation of China, one cannot simply take simultaneous realization of external balance and internal balance as the premise for estimating the equilibrium exchange rate. Still at the primary stage of the socialist market economy, China should take the continued economy growth as its long term strategy. The writer, therefore, agrees with Jiang¹⁶ that the realization of sustainable economic growth should be taken as the first consideration in defining the equilibrium exchange rate. This does not mean that the external balance is not important. It only means that the realization of internal balance (full employment, persistent economic growth and so on) is of paramount importance and external balance should be focused on sustainable balance of the current account rather than the capital account which, in this case, should be put in a second place.

The influence of resident consumption on RMB equilibrium exchange rate, which is very important undoubtedly, is based on the intertemporal substitution effect. Generally speaking, the increase of resident consumption is in favor of the economic growth and the economic growth of one country often leads to the appreciation of its currency. But the reality is that the resident

14 According to this definition, equilibrium exchange rate is equilibrium real exchange rate in fact and the terms of equilibrium exchange rate in this paper all refer to real exchange rate.

15 Benigno, G. and Thoenissen, C., 'On the consumption-real exchange rate anomaly', Bank of England, Working Paper no. 254. 2005

16 Jiang, Boke argues that internal balance is the most important condition and yardstick for equilibrium exchange rate and that equilibrium exchange rate should be the necessary condition for sustainable economic growth and not the one for balance of international payments. See Jiang Boke, 'New frame of theory and policy of equilibrium exchange rate', Chinese Social Science, 2006, 1

consumption in China, which is evoked by many factors, is decreasing ceaselessly during the last two decades. The most important reason behind it is that due to the low income compared to developed countries and the unsound social security system, the residents of China still have a strong inclination to save for a rainy day. Another important factor is that there is a great change in the age structure of the people and the ageing of the population stands out step by step. All of these factors lead to the persistent decrease of domestic demand, which in turn makes foreign demand a necessity for domestic economic growth and brings a large and long term surplus to the current account. The decreasing domestic demand pulls down domestic commodity prices. With other factors fixed, domestic currency depreciates, and export and national income increases. As a result, the decrease of resident consumption is often accompanied by the depreciation of the real exchange rate.

The mechanism that economic growth can result in the appreciation of domestic currency can be interpreted by the Balassa-Samuelson(BS) effect. BS effect can be stated as: Differences between countries in relative productivity in their traded versus non-traded products sectors give rise to distortions in Purchasing Power Parity. These differences in relative productivity may arise as countries develop, open itself to international trade, and catch up with advanced countries technologically. As a result, productivity in the traded sector tends to rise faster than in the non-traded sector. Accordingly, wages in the traded sector tend to rise in line with the increase in productivity, which in turn drives up wages in the non-traded sector. Non-traded wages rise faster than productivity in that sector, resulting in an increase in non-traded relative to traded product prices. Consequently, domestic prices tend to rise faster than prices in the rest of the world, leading to an appreciation of the real exchange rate. This paper also intends to figure out the relative strength of the BS effect and the effect of terms of trade.

Based on the current situation of China, the equilibrium exchange rate model of RMB is constructed as follows:

The domestic aggregate output consists of tradable and non-tradable

$$y = y_T(e, a) + y_N(e, a) \quad (1)$$

Where y is the aggregate domestic output, y_T is traded goods and y_N , non-traded goods, all of which are mainly affected by real exchange rate (the ratio of home tradable divided by home non-tradable) e and productivity a .

The domestic demand, which is from two departments: resident and government, is composed of the demand for domestic traded goods, non-trade goods and imported goods.

$$c = c_T + c_N + c_M \quad (2)$$

$$g = g_T + g_N + g_M \quad (3)$$

Where c is resident consumption and g is government consumption. C_T , C_N and C_M stand for the consumption of domestic tradable, non-tradable and import respectively. The composition of government consumption is the same as resident consumption.

$$y_N(e, a) = c_N + g_N \quad (4)$$

$$\frac{dy_N}{de} < 0, \quad \frac{dy_N}{da} < 0$$

Formula (4) shows that domestic output is totally consumed by domestic residents and government. The internal balance can be defined as the equilibrium of non-traded goods market under the conditions of full employment, low inflation rate and persistent economic growth. If the price of export goes up, more resources will flow to traded goods department and the output of non-traded will go down, so $\frac{dy_N}{de} < 0$; the improvement of productivity in the department of traded goods also attracts more resources to this department, therefore $\frac{dy_N}{da} < 0$. If the economy is of internal balance at the beginning, the increase of domestic expenditure will boost the demand for non-traded products, hence the need to raise the price of non-traded goods to appreciate real exchange rate and keep internal balance.

Defining the external balance as the balance of the current account which can bring the persisting economic growth, we get the following equation:

$$nfa = tb + r^* nfa \quad (5)$$

Where nfa is the stock of foreign net asset, tb , the balance of the current account, r^* , the return of foreign asset and $r^* nfa$ stands for the transfer income of current account;

Because trade balance equals to export minus import, namely $tb = X - M$ because,

$$X = y_T - (c_T + g_T), M = c_M + g_M$$

Thus,

$$tb = y_T(e, a) - (c_T + g_T) - (c_M + g_M) \quad (6)$$

$$\frac{dy_T}{de} > 0, \quad \frac{dy_T}{da} > 0$$

Where real exchange rate depreciates (e goes up), output of traded goods increases, so $\frac{dy_T}{de} > 0$; The improvement of the productivity of traded goods sector also contributes to the output growth,

so $\frac{dy_T}{da} > 0$.

Substituting formula (6) into (5), together with all formulas above, we can solve the equilibrium exchange rate by the following equation,

$$e^* = e^*(c, g, a, nfa) \quad (7)$$

If productivity a rises, y_T will increase and surplus in balance of payments go up too. So, in order to keep the external balance in the long run, it is necessary to let the currency appreciate.

According to the analysis above, decreasing resident and government consumption will build up a surplus in balance of payments, making it necessary to appreciate domestic currency to restore balance in the economy. According to the definition given by the National Bureau of Statistics of China, final consumption refers to the expenditure of the resident units of a country on goods and services from home and abroad and does not include the expenditure of non-resident units in the economic territory of the country. Because government consumption only amounts to one fifth of the total final consumption, this paper abandons the variable of government consumption and only focuses on the effect of resident consumption on equilibrium exchange rate.

Because of the relatively rigorous capital control in China (although China has made a great effort to open its capital account,) the interest rate spread between home and abroad is not the main reason of capital flow, so we overlook the effect of foreign interest rate on the equilibrium exchange rate. However, the net foreign asset should be taken as the very important factor, which is not only based on the model of balance of payments¹⁷, but also supported by the intertemporal equilibrium exchange rate model¹⁸. The increase of net foreign asset will appreciate the currency in the medium and long term.

The researchers can not come to consensus with regard to the effect of terms of trade on equilibrium exchange rate. Many argue that such effect is positive and the betterment of terms of trade will necessitate the appreciation of equilibrium exchange rate¹⁹. In fact, the effect of the betterment or deterioration of terms of trade on the equilibrium exchange rate is not yet certain. There are two effects²⁰, namely income effect and substitution effect, for the betterment or deterioration of terms of trade. Under the income effect, the increase of the price of export means the improvement of real income, so the household consumption will rise and the greater demand for non-traded goods will boost its price and further push up the domestic price. On the contrary,

¹⁷ Shi, Jianhuai and Yu, Haifeng, 'RMB equilibrium exchange rate and misalignment: 1991-2004' *Journal of Economy Studies*, 2005, 4.

¹⁸ Obstfeld, M. and Rogoff, K., 'Foundations of International Economics', MIT Press, Cambridge, MA, 1996.

¹⁹ Zhang, Xiaopu (2001), 'Study of RMB equilibrium exchange rate', China Finance Press.

²⁰ The same as footnote 17.

the substitution effect will pull down the domestic price. So the effect of term of trade depends on the relative strength of these two effects.

In addition, Trade Openness (OPEN), which is expressed by the ratio of the total amount of trade to GDP in this paper as well as other similar documents, is also indispensable to estimate equilibrium exchange rate usually. Based on the consideration of objectivity, this paper takes REER Index publicized by IMF as the data resource of the variable of equilibrium exchange rate. So we have the theoretical model of equilibrium exchange rate:

$$REER = REER (GDP, NFA, RC, OPEN, TOT)$$

Taking the form of linear logarithm, we can get the econometric model for empirical analyzing:

$$LREER_t = \alpha_0 + \alpha_1 LGDP_t + \alpha_2 LNFA_t + \alpha_3 LRC_t + \alpha_4 LOPEN_t + \alpha_5 LTOT_t \varepsilon_t \quad (8)$$

where ε_t is error

The sample uses quarterly data, from 1994Q1 to 2005Q2²¹. The data of Real Effective Exchange Rate (REER), Growth Rate of Real GDP, Net Foreign Asset (NFA) and OPEN are directly or indirectly from IFS. TOT is from the World Bank and Ratio of Resident Consumption (RC), is acquired from Statistic Yearbook of China of every year and the Statistics Bureau of China. REER is based on the indirect pricing and the increase means the appreciation of domestic currency.

3.2 Empirical analysis by VAR model and Johansen Cointegration Test

To seek the long term relationship between the equilibrium exchange rate and macroeconomic fundamentals, we use the Vector Autoregression (VAR) model²² to make empirical analysis and try to find a long term cointegration equation by the Johansen Cointegration Test²³. Before cointegration analysis, it is necessary to test for presence of unit

²¹ Making 1994 as the beginning is based on two points, firstly, 1994 is the critical point of the marketization reform of RMB exchange rate; secondly, the state of the current account and capital account of balance of payments has always been surplus (except the capita account of 1998) since 1994.

²² Vector autoregression (VAR) is an econometric model used to capture the evolution and the interdependencies between multiple time series. All the variables in a VAR are treated symmetrically by including for each variable an equation explaining its evolution based on its own lags and the lags of all the other variables in the model. Based on this feature, Christopher Sims advocates the use of VAR models as a theory-free method to estimate economic relationships, thus being an alternative to the "incredible identification restrictions" in structural models. See Christopher A. Sims, "Macroeconomics and Reality", *Econometrica*, 1980, 48.

²³ The purpose of the cointegration test is to determine whether a group of non-stationary series are cointegrated or not. VAR-based cointegration tests uses the methodology developed by Søren Johansen. See Johansen, Søren. "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models," *Econometrica*, 1991, 59, 1551–1580;

Johansen, Søren. *Likelihood-based Inference in Cointegrated Vector Autoregressive Models*,

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roots in the time series to avoid spurious regression. We use the Augmented Dickey-Fuller (ADF) test²⁴ to determine whether the variables of the model are stationary in first difference. The result of the stationarity test (shown by table 1) indicates that all of them are non-stationary integrated, I(1), variables, where stationarity is obtained by taking first differences.

Given all variables are I(1) series, we next test whether they have cointegration relationship. First, considering sensitivity of VAR model to the number of lags of the variables, the optimal lags of the variables of the model must be determined. In this work, we use Akaike Information Criterion (AIC) and Schwarz Information (SC)²⁵. Based on these statistics, we choose lag 3 in the VAR model. Additionally, we believe that there is linear deterministic trend in cointegration vectors and intercept in cointegration equation should be reasonable.

Table 1: Results of ADF unit root test

Variables	ADF Statistics	Test critical values: (1%)	Test critical values (5%)
LREER	-2.79 (c,0, 1)	-3.57	-2.92
D(LREER)	-4.49(c,0, 0)	-3.57	-2.92
LGDP	-2.29(c,0, 0)	-3.57	-2.92
D(LGDP)	-7.41(c, 0,0)	-3.57	-2.92
LF	-1.33(c,0, 2)	-4.16	-3.51
D(LF)	-8.31(c,0, 0)	-4.16	-3.51
LPC	-1.80((c,0, 0)	-3.57	-2.92
D(LPC)	-8.91(c, 0,0)	-3.57	-2.92
LOPEN	-0.71(c, 0, 4)	-3.58	-2.93
D(LOPEN)	-2.96(0, 0, 3)	-2.62	-1.95
LTOT	-0.08(c, 0, 0)	-3.56	-2.92
D(LTOT)	-8.12(c,0, 0)	-3.57	-2.92

Note: Of the three terms in parentheses of ADF statistics, firstly, c in the first term denotes that intercept is included and 0, intercept not included; Secondly, all of the second terms are equal to 0, denoting time trend is not included; thirdly, the figures in the third term represent the lag length.

Oxford: Oxford University Press, 1995.

²⁴ In statistics and econometrics, an augmented Dickey-Fuller test (ADF) is a test for a unit root in a time series sample. It is an augmented version of the Dickey-Fuller test to accommodate some forms of serial correlation.

²⁵ Akaike Information Criterion (AIC) and Schwarz criterion (SC) are often used as a guide in model selection. In VAR model, AIC and SC are used to determine the lag length of the variables. The formula for AIC and SC are as follows: $AIC = -2l/n + 2k/n$, $SC = -2l/n + k \log n/n$, Where, n = the number of observations, or equivalently, the sample size; k = the number of free parameters to be estimated; L = the maximized value of the likelihood function for the estimated model.

The value of AIC and SC is up to l and k . In general, we take the lag length of the variables when AIC and SC get to the smallest value.

Table2: Results of unrestricted Cointegration Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5% Critical Value	1% Critical Value
None *	0.718830	134.7108	103.8473	113.4194
At most 1	0.432679	75.07740	76.97277	85.33651
At most 2	0.307547	48.43641	54.07904	61.26692
At most 3	0.259496	31.16319	35.19275	41.19504
At most 4	0.182926	17.04325	20.26184	25.07811
At most 5	0.148365	7.548064	9.164546	12.76076

Table2: Results of unrestricted Cointegration Test (continued)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5% Critical Value	1% Critical Value
None *	0.718830	59.63336	40.95680	46.74582
At most 1	0.432679	26.64099	34.80587	40.29526
At most 2	0.307547	17.27322	28.58808	33.73292
At most 3	0.259496	14.11994	22.29962	27.06783
At most 4	0.182926	9.495187	15.89210	20.16121
At most 5	0.148365	7.548064	9.164546	12.76076

Note: * denotes rejection of the hypothesis at the 0.05 or 0.01 level.

Table2 presents the trace and maximum Eigenvalue statistics for the VAR model. From the above results, only one cointegration relationship exists, the standardized cointegration vector is shown by table 3.

Table 3: Normalized cointegrating coefficients Adjustment coefficients

Variable	LREER	LGDP	LF	LPC	LOPEN	LTOT	C
Coefficient	1.00	-0.885523 (0.17246)	-0.434819 (0.05351)	-5.212518 (0.85682)	0.539437 (0.09274)	0.506700 (0.45705)	-6.99283 (2.39227)
First difference	D(LREER)	D(LGDP)	D(LF)	D(LPC)	D(LOPEN2)	D(LTOT)	
Adjustment coefficient	-0.024630 (0.04891)	0.235484 (0.14473)	-0.451638 (0.08531)	0.028021 (0.02718)	-1.015202 (0.29190)	0.027967 (0.03003)	

Note: standard error in parentheses

From Table 3 we obtain the following cointegration equation:

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$$LREER = 6.9922383 + 0.885523LGDP + 0.434819LF + 5.212518LHC - 0.539437LOPEN - 0.5067LTOT$$

Since all coefficients don't equal to zero significantly, all economic fundamentals have significant effect on RMB equilibrium exchange rate. And it also can be seen from the equation that all coefficients conform to the economic theory. Firstly, what impresses us most is that Consumption-Real Exchange Anomaly also holds in China. The coefficient of resident consumption is 5.2, which indicates that a 1% decrease in resident consumption causes a 5.2% depreciation in RMB real exchange rate. The continuously decreasing of resident consumption restrains domestic demand, which pulls down the domestic price and eventually forces the currency to depreciate. Secondly, the elasticity coefficient of Balassa-Samuelson effect is 0.89, which means that a 1% rise in the grow rate of real GDP will bring real exchange rate to appreciate 0.89%. Furthermore, the coefficient of terms of trade is -0.51, which indicates that, for each 1% betterment in terms of trade, RMB real exchange rate will depreciate 0.51%. It should be mentioned that the Balassa-Samuelson effect is larger than terms of trade effect. So, if resident consumption is constant, the increase of productivity will make the currency to appreciate in the long run, but the elasticity coefficient of resident consumption is so big that the decreasing of resident consumption eventually will make the home currency to depreciate, so Consumption-Real Exchange Anomaly holds in China.

Because RMB exchange rate has the co-integration relationship with economic fundamentals, there exists a vector error-correction (VEC) model describing the adjustment mechanism of the exchange rate from short-term to long term. From table 3 we find that adjustment coefficient ($-0.02463 < 0$) is negative, which means that if the real exchange revalues, it will be adjusted downward, and vice versa. The dynamics of the error correction model would force it back toward the long-run equilibrium. The larger the absolute value of adjustment coefficient, the faster is the adjustment speed. According to the model, if the RMB real effective exchange rate drops below the equilibrium rate, it would revalue at the rate of 2.5% per quarter, until it reaches the equilibrium rate. In the short term, the real effective exchange rate is also influenced by the fundamental economic factors; money supply and the foreign exchange reserve also have distinct influence on the fluctuation of the exchange rate. It appears that both short term and long-term variables have a unidirectional effect on the equilibrium exchange rate. Therefore, the rise in the GDP, the increase in foreign exchange reserve, and the decrease in the money supply would lead to the appreciation of the real effective exchange rate.

Empirical Test Based on Binary Model

Having got the equilibrium exchange rate equation, we now focus on estimating the value of RMB equilibrium exchange rate. Taking the actual values of the fundamental variables (GDP, RC, FA, TOT, OPEN), we can estimate the current actual equilibrium exchange rate of RMB. To abstract from the short, random disturbances in ERER, we use the H-P filter technique²⁶ (see

²⁶ The Hodrick-Prescott (H-P) filter is a mathematical tool used in macroeconomics, especially in real business cycle theory. It is used to obtain a smoothed non-linear representation of a time series, one that is more sensitive to

Clark & MacDonald, 2000), then we obtain the stable and permanent EREER value (ERER_P, shown in Fig.1). Compared with actual REER, at last, we can figure out the series of misalignment of RMB real exchange rate, which is denoted by MISA_P(shown in Fig.2). From Fig.1 and Fig.2, we can observe that, during most of the time 1994–2005, RMB effective exchange rate is undervalued.

Taking MISA-P as dependent variable and RC (Resident Consumption) as independent variable, we can use the Binary model to further certify whether or not Consumption-Real Exchange Rate Anomaly holds in China. According to the requirement of Binary model that the dependent variable can only be two status values, we let all of the numerical values of undervalued RMB exchange rate equal to 1 and the numerical value of overvalued RMB exchange rate equal to 0, and adopt the Probit model²⁷. Eventually, we get the results shown by table 4. With this equation, we can conduct a forecast and figure out the probability value of all the misalignment of RMB exchange rate (Fig.3). What impresses us most is that all probability values are positive, even when RMB real exchange rate is undervalued, and the values are nearly equal 1 in recent years. From Fig.3 we can see clearly that resident consumption and RMB real exchange rate are moving in opposite directions: the decreasing of household consumption is accompanied by depreciation of RMB real exchange rate.

So, with the Binary model, we certify the holding of Consumption—Real Exchange Rate Anomaly in China again.

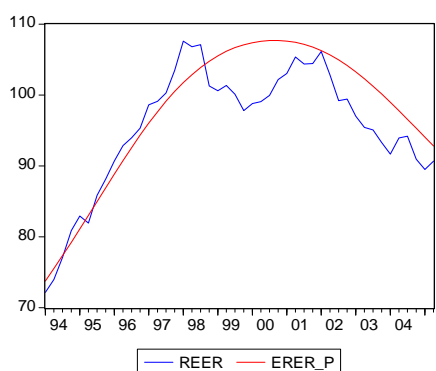


Fig. 1: RMB REER and REER_P

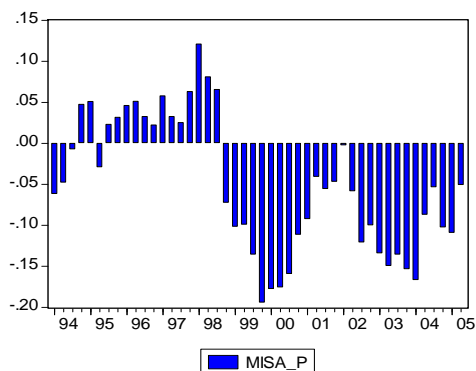


Fig. 2: Misalignment of RMB exchange rate

long-term than to short-term fluctuations.

²⁷The Probit model is one of the mostly used style of the binary model, which mainly contains the Probit model. the Logit model and the Extreme-value model.

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Table 4: Results of Empirical Test by Binary Model

Dependent Variable: MISA

Method: ML - Binary Probit (Quadratic hill climbing)

Sample: 1994Q1 2005Q2

Included observations: 46

Convergence achieved after 7 iterations

Covariance matrix computed using second derivatives

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	29.21793	10.66719	2.739046	0.0062
PC	-63.76329	23.49204	-2.714251	0.0066
Mean dependent var	0.673913	S.D. dependent var		0.473960
S.E. of regression	0.424261	Akaike info criterion		1.083910
Sum squared resid	7.919875	Schwarz criterion		1.163416
Log likelihood	-22.92993	Hannan-Quinn criter.		1.113693
Restr. log likelihood	-29.04315	Avg. log likelihood		-0.498477
LR statistic (1 df)	12.22644	McFadden R-squared		0.210488
Probability(LR stat)	0.000471			
Obs with Dep=0	15	Total obs		46
Obs with Dep=1	31			

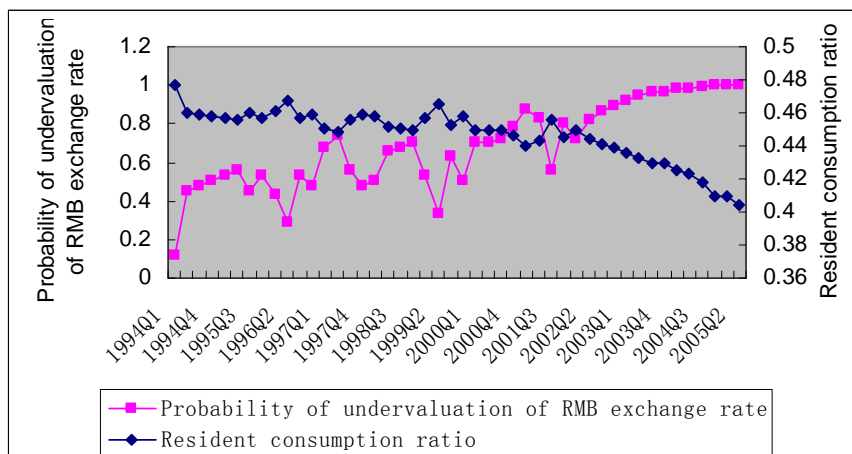


Fig. 3: Probability of undervaluation of RMB exchange rate and resident consumption ratio

Conclusion and Suggestions

By equilibrium exchange rate model and Binary model, this paper certifies that Consumption-Real Exchange Rate Anomaly holds in China significantly. During most of the time from 1994, the beginning of the reform of RMB exchange rate marketization, to 2005, the reform of RMB exchange rate formation regime restarted in July of that year, especially from the end of 1998, there has been persisting undervaluation in RMB real exchange rate and continuous decrease in resident consumption at the same time. The author believes that the decreasing of resident consumption has an effect of pulling down RMB real exchange rate. The mechanism is that the descending of resident consumption restrains domestic demand, and deficiency of domestic demand pulls down domestic price and eventually forces the currency to depreciate, which in turn makes foreign demand a relatively important factor in promoting economic growth. Although Balassa-Samuelson effect can cause the real exchange rate to appreciate in the long run, the strength of the pulling-down effect of the descending resident consumption is so strong that it causes RMB exchange rate depreciation eventually.

The true reason for this situation, in the writer's opinion, lies in the unreasonable income distribution system. Resident income, which accounts for a relative low percentage in the whole national income, is decreasing year by year. Since the 1990s, the growth rate of fiscal revenue has far exceeded that of disposable personal income. To be more specific, the ratio of fiscal revenue to GDP, which grew to 17.29% in 2005 from 10.83% in 1994, has maintained an upward trend. Plus government revenue outside budget and land transfer fees, the financial resources controlled by the government is over 30% of GDP. Additionally, most of the large amounts of profit held by state-owned enterprises and listed companies are not redistributed. However, the ratio of disposable personal income to GDP is declining year by year during the same period, from 55.36% in 1990 to 45.47% in 2005. The descending of disposable personal income, together with the unsound social security system, restrains resident consumption and the decrease in resident consumption pulls down the real exchange rate eventually.

In the writer's opinion, keeping RMB exchange rate undervalued and resident consumption lower is unfavorable to the healthy development of China's economy and the steady improvement of people's livelihood. To build a harmonious socialist society and promote the healthy development of China's economy in terms of both internal and external balance, the following strategies should be implemented: Firstly, trying our best to improve the people's welfare and living standard. To do that, reform of the national revenue distribution system must be carried out immediately, the concrete policies of which may include, among others, improving workers' wage and increasing transfer income of residents. Consumption demand increases only if resident income has ascended. Then the domestic demand can rise and become the main force to boost economic growth and the outdated economic growth pattern, which heavily relies on foreign demand, should be abandoned eventually. Secondly, further promoting reform of RMB exchange rate regime and steadily pushing forward the appreciation of RMB. Thirdly, speeding up the upgrading of foreign trade industry. The export-oriented foreign trade policy should be

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changed and the foreign trade industry, which was and is still labor and resources intensive, should be transformed to be knowledge intensive as soon as possible.