



# An Data Analysis on Capital Flow and Real Effective Exchange Rate

Ping Zhang and Yixin Hao(✉)

Shaanxi Normal University, Xi'an, China  
2410122589@qq.com

**Abstract.** In the back ground of internationalization of RMB, this study focuses on the impact of various types of capital flows on real effective exchange rate in the Economic development process of China. Using three major kinds of capital flows Data of China in 1994–2015, through Cointegration Analysis and Granger causality analysis, the empirical study found that foreign direct investment appreciation of the real effective exchange rate relatively weak effect; securities investment in real effective exchange rate appreciation of the significant effect; other investment in real effective exchange rate appreciation of the significant effect; other investment on the appreciation of the real effective exchange rate effect is more significant. Some recommendation proposed on the basis of empirical research.

**Keywords:** Dupont Analysis · Profitability · Serial Substitution Method · Return On Equity

## 1 Introduction

Looking back at China's exchange rate reform in recent decades, from a dual exchange rate system to a single exchange rate system, to a market-based, managed floating exchange rate system adjusted with reference to a basket of currencies, the renminbi's exchange rate flexibility is continuously enhanced. The entry of the RMB into the SDR in 2015 marked the internationalization of the RMB, but the increasing capital liquidity has posed a challenge to maintaining the equilibrium and stability of the real exchange rate. According to Chia-Hsing Huang's [7] research shows that understanding the source of real effective exchange rate fluctuations is very important to adopt effective policies to stabilize macroeconomic fluctuations in open economies.

Among various influencing factors, capital flow is one of the important factors, and studying its influence is of great significance to maintaining the equilibrium and stability of the real effective exchange rate of RMB. Therefore, this paper focuses on capital flow, focusing on its impact on the real effective exchange rate.

## 2 Materials and Methods

In the past, scholars have defined capital flow from different perspectives and paid attention to its relationship with exchange rate-related concepts. Scholars such as Dai

Jinping [4] considered the two-way causal relationship between FDI, exchange rate and trade, and only studied the relationship between FDI, a type of capital, and the real effective exchange rate. Some scholars have expanded the dimension of capital flow.

For example, Zhou Aimin [9], Wang Xuguo and other scholars have analyzed the three types of capital: foreign direct investment, securities investment, and other investments. Scholars such as Zhang Bowei [8] divide capital into foreign direct investment, securities investment, and income streams under the current account. The research results of Wang Xuguo [6], Zhang Bowei [8], Saborowski [5] and other scholars all show that FDI leads to a significant appreciation of the real effective exchange rate.

Scholars such as Dai Jinping and Wang Xiaotian [4] considered the two-way causal relationship between FDI, exchange rate and trade, and believed that a rise in the real exchange rate would promote FDI in the short term, but would lead to a decline in FDI in the long run. The increase in FDI will lead to a small depreciation of the RMB in the short term and an appreciation of the RMB in the long term. However, scholars such as Zhou Aimin and Yuan Yuan [4] came to a different conclusion, that is, foreign direct investment led to the depreciation of the real effective exchange rate; scholars such as Brooks [2] and Chen Shujin [3] believed that the impact of FDI on the real effective exchange rate was not significant. Obvious.

Although their conclusions are not uniform, they strongly demonstrate that different types of capital flows have different effects on the real effective exchange rate. This paper adopts this method, not only focusing on the total capital or a specific classification of capital, but also studying the impact of different types of capital flows on the real effective exchange rate.

Regarding non-FDI capital, the research results of Athukorala and Rojapatirana [1] show that inflow of non-FDI capital in Latin America and China will make the real exchange rate appreciate. For securities investment, scholars such as Wang Xuguo [6] believe that it has a weak negative effect on REER, while scholars such as Zhou Aimin [9] found that securities investment has a weak positive effect on the real exchange rate.

Therefore, this paper proposes the following research hypothesis. Hypothesis 1: FDI flows have a significant appreciation effect on the real effective exchange rate. Hypothesis 2: The flow of portfolio investment has a significant appreciation effect on the real effective exchange rate. Hypothesis 3: The flow of other investments has a significant appreciation effect on the real effective exchange rate. Hypothesis 4: When only three types of capital flows under the financial account are considered, total capital flows have an appreciating effect on the real effective exchange rate.

## 2.1 Variable Selection and Data Interpretation

In order to study capital flow and changes in real effective exchange rate, the real effective exchange rate is selected as the explained variable, and the three types of capital flows examined are used as explanatory variables. In addition, in order to make the empirical research environment fit with the actual conditions, some control variables are also established, such as excess money supply (EXMG), trade openness (OPEN), government consumption level (GOV), terms of trade index (TOT) and so on. The specific variable selection, meaning and data sources are shown in Table 1. The sample period is 1994–2015.

**Table 1.** Variables and Data Sources.

Variable name	Variable definitions
REER	The real effective exchange rate index, with 2000 as the base period.
FDI	Foreign direct investment.
PORT	Stock investment
DEBT	other direct investment
ACF	Total capital
EXMG	excess money supply
OPEN	Trade openness (total exports and imports as a percentage of GDP)
GOV	government consumption level
TOT	terms of trade index

The real effective exchange rate showed a relatively steady upward trend from 1994 to 2015. During 1994–1998, REER showed an increasing trend. After 1998, the international economy did not fluctuate greatly, and China’s real effective exchange rate did not change significantly, but it fell to 84.66 in 2005. In 2008, it increased by 8% from the previous year to 96.37, and in 2013, it increased by 6% from the previous year to 115.58.

During this period, FDI showed a trend of rising first and then falling. From 1994 to 2007, it showed a steady upward trend. Before 2003, it fluctuated between 317 and 495, and the increase was not large. After 2007, the volatility was larger. Due to the global economic downturn caused by the economic crisis. In 2008, foreign investment in China was reduced, and FDI fell from 1,390.95 in 2007 to 871.67 in 2009, and then quickly rose to 2,316.52 in 2011.

Other investments showed a volatile upward trend during 1994–2015. From 1994 to 2006, other investment values fluctuated slightly below 400, and then continued to rise for two consecutive years, reaching 1125.70 in 2008, an increase of about 8 times compared to 2006. Other investments traded falling to 87.33 in 2011. Although there were large fluctuations after that, it generally showed an upward trend.

Portfolio investment accounts for the smallest proportion of investment, and its trend changes are similar to other investments. Before 2005, securities investment was relatively stable. From 2005 to 2006, it surged from 47.10 to 684.17, and then fell to 164.43 in 2007. That is to say, during 2005–2007, securities investment fluctuated violently.

According to the variables selected in this paper, referring to the method of Saborowski (2009) used by Zhang Bowei and other scholars, the basic econometric model set in this paper is as follows:

$$\begin{aligned} \text{Lnreerit} = & \beta_0 + \beta_1 \text{capitalit} + \beta_4 \text{Intotit} + \beta_5 \text{Inopenit} + \beta_6 \text{Ingovit} \\ & + \beta_7 \text{exmgit} + \gamma \text{it} \end{aligned}$$

In the formula, the subscript *i* represents the model, *t* represents the time,  $\beta_0$  represents the constant term, and  $\gamma t$  represents the error term. In order to eliminate the

**Table 2.** Unit root test of variables.

ADF test	No differential processing	First-order differential processing	Second-order differential processing
logreer	−0.844[0]	−2.471[0]	−4.382[0]**
Logfdi	−1.438[0]	−2.124[0]	−5.905[0]***
Logport	−1.456[0]	−6.227[0]***	−9.737[0]***
Logdebt	−2.471[0]	−6.950[0]***	−7.237[0]***
Logacf	−0.140[0]	−6.580[0]***	−9.994[0]***
Logexmg	−3.428[0]*	−6.980[0]***	−7.341[0]***
Loggov	−1.402[0]	−4.473[0]**	−3.893[0]***
Logopen	−1.468[0]	−2.913[0]	−6.231[0]***
logtot	−0.921[0]	−4.792[0]***	−5.458[0]***

Legend:\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001

heteroscedasticity of the data, the logarithm of each variable is taken for empirical research.

## 2.2 Empirical Analysis

First, in order to test the stationarity of the time series data of each variable, the ADF test is used to test each variable. Unit root test. Through the measurement software Eviews7.2, the measurement results shown in Table 2 are obtained: logreer time series, logfdi time series and logopen time series are second-order single integral time series; logport time series, logdebt time series, logacf time series, loggov time series The series and logtot time series are first-order monolithic time series; the logexmg time series are stationary time series.

After determining the lag order, carry out the Granger causality test, and obtain the results of the Granger causality test related to the logreer sequence, as shown in Table 3: there is a one-way causality from logfdi to logreer, one-way causality from logreer to logdebt, one-way causality from logacf to logreer, one-way causality from logreer to logexmg, one-way causality from loggov to logreer, one-way causality from logreer to logopen, one-way causality from logreer to logtot.

The three types of capital flows and total capital flows were brought into the model together with other control variables, and then the EG (Engle-Granger) two-step method was used to conduct cointegration tests on the above 9 single-integrated time series. It can be seen from Table 4 that at the 95% confidence level, there are 3 or more cointegration relationships among the variables, and the end degree of all model regression analysis is very strong.

Regression analysis showed that: FDI was positively correlated with REER but not significant, which did not support Hypothesis 1; PORT was positively correlated with REER, and was highly significant, supporting Hypothesis 2; DEBT was significantly

**Table 3.** Granger causality test.

Null Hypothesis:	obs	F-Statistic	Prob.
LOGFDI does not Granger Cause LOGREER	20	2.88499	0.0871
LOGREER does not Granger Cause LOGFDI		1.12180	0.3515
LOGPORT does not Granger Cause LOGREER	20	0.47861	0.6288
LOGREER does not Granger Cause LOGPORT		0.82340	0.4578
LOGDEBT does not Granger Cause LOGREER	20	0.35567	0.7065
LOGREER does not Granger Cause LOGDEBT		3.16524	0.0713
LOGACF does not Granger Cause LOGREER	20	2.57571	0.1092
LOGREER does not Granger Cause LOGACF		0.48256	0.6265
LOGEXMG does not Granger Cause LOGREER	20	0.53082	0.5988
LOGREER does not Granger Cause LOGEXMG		2.31738	0.1027
LOGGOV does not Granger Cause LOGREER	20	1.94806	0.1020
LOGREER does not Granger Cause LOGGOV		1.21150	0.3253
LOGOPEN does not Granger Cause LOGREER	20	0.82010	0.4592
LOGREER does not Granger Cause LOGOPEN		10.6262	0.0013
LOGTOT does not Granger Cause LOGREER	20	1.31203	0.2985
LOGREER does not Granger Cause LOGTOT		3.15161	0.0720

positively correlated with REER, which supported Hypothesis 3; ACF It is positively correlated with REER and has strong significance, which supports Hypothesis 4; EXMG, GOV, OPEN and TOT are negatively correlated with REER and have strong significance.

Excessive money supply, trade openness, government consumption level and terms of trade are the control variables in this paper. Most of the coefficients of excess money supply are negative, and it is generally believed that excessive growth of money supply will lead to an increase in the price level and an appreciation of the real effective exchange rate. A possible explanation is that the amount of currency in circulation exceeds the actual required amount, causing currency depreciation and a comprehensive and sustained rise in prices, which in turn triggers a depreciation of the real effective exchange rate. Government spending will lead to the depreciation of the real effective exchange rate. The possible explanation is that the proportion of government spending on tradable goods is greater than that on non-tradable goods. When this part of expenditure is converted into an increase in wages, private consumption tends to be more inclined to tradable goods. This in turn causes the real effective exchange rate to fall. The impact of trade openness on the real effective exchange rate is significantly negative. The higher the degree of trade openness, the lower the price of imported commodities, and the closer the price of domestic non-tradable commodities is to the level of the competitive market, thus causing the real effective exchange rate to decline. There is a significant negative correlation between the terms of trade and the real effective exchange rate, indicating that the substitution effect caused by the terms of trade is greater than the income effect,

**Table 4.** Regression Analysis Results.

variable	model 1	model2	model3	model4	model5
logfdi		0.004			
		0.059			
logport			0.052***		
			0.013		
logdebt				0.022*	
				0.010	
logacf					0.120***
					0.030
logexmg	−0.096**	−0.095**	−0.081**	−0.065*	−0.042
	0.031	0.034	0.023	0.031	0.027
loggov	−0.476	−0.456	−0.527**	−0.274	0.205
	0.322	0.426	0.231	0.302	0.292
logopen	−0.547***	−0.547***	−0.504***	−0.475***	−0.387***
	0.082	0.084	0.059	0.080	0.072
logtot	−1.063***	−1.407**	−0.554**	−0.907***	−0.381
	0.221	0.310	0.200	0.209	0.236
C	4.503***	4.436***	3.451***	3.913***	2.015***
	0.341	0.966	0.352	0.401	0.675
R-squared	0.823	0.823	0.915	0.866	0.910

Legend: \*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001

that is, the improvement of the terms of trade will significantly cause the depreciation of the real effective exchange rate.

### 3 Results and Discussion

Based on the relevant data of China from 1994 to 2005, we examine the effect of capital flow on the real effective exchange rate. The study finds that different capitals have different effects on the real effective exchange rate. The effect of FDI on the real effective exchange rate of RMB is not significant. Portfolio investment can significantly improve the real effective exchange rate. Other investments also have a significant improvement effect on the real effective exchange rate. Other control variables: Excessive money supply, government consumption level, trade openness and terms of trade will all lead to the depreciation of the real effective exchange rate. Except for the variable of government consumption level, most of the regression results show that other control variables have a significant effect on the real effective exchange rate.

## 4 Conclusions

The positive correlation between FDI and REER is not significant. Increased FDI inflows into the export-oriented tradables sector, and prolonged trade surpluses have expanded the tradables sector. The expansion of the sector increases the country's real wage level and relative price level by increasing the country's average labor productivity. This would lead to a general rise in the price level of non-tradable goods which would then lead to an appreciation of the real effective exchange rate through the spending effect.

Portfolio investment has a significant positive impact on the real effective exchange rate. Empirical analysis shows that the purpose of China's monetary authorities' intervention in the foreign exchange market may not be to weaken the appreciation effect of portfolio investment on the real effective exchange rate, but to prevent the continuous decline of the real effective exchange rate. As one of the markets with the most frequent capital flows, the securities market is very likely to experience irrational market exuberance, and this kind of non-equilibrium prosperity will also lead to an increase in domestic currency demand and an increase in the real effective exchange rate.

There is a significant positive correlation between other investments and the real effective exchange rate. The short-term liquidity of this type of capital is also great, but unlike the speculative nature that attracts international capital into the securities market, more capital from other investments flows into the real economy. This part of the other investment that flows into the real economy will cause the real effective exchange rate to appreciate.

**Acknowledgments.** First of all, I want to thank my school and teachers for cultivating my scientific research and academic ability. Secondly, I would like to thank the reviewers of this conference for their pertinent comments on this paper.

## References

1. Athukorala and Rojapatirana, Capital Inflows and Real Exchange Rate: A Comparative Study of Asia and Latin America[J] *World Economy*, 2003, Vol.26(4)
2. Brooks R, Edison H, Kumar M S. Exchange Rates and Capital Flows[J]. *European Financial Managements*, 2004, 10(3):511–534
3. Chen Shujin and Chen Liu, The Impact of Capital Flows and Trade Balance on the Real Effective Exchange Rate of RMB, *Journal of Hangzhou Dianzi University (Social Science Edition)* June 2013
4. Dai Jinping, Wang Xiaotian, Analysis of the Dynamic Relationship between China's Trade, Foreign Direct Investment and Real Exchange Rate[J] *Quantitative Economics, Technical and Economic Research*, No. 11, 2005
5. Saborowski C. Can Financial Development Cure the Dutch Disease? [J]. *International Journal of Finance & Economics*, 2011, 16(3):218–236
6. Wang Xuguo, Fan Cong, Dai Feng, An Empirical Study on the Impact of China's Foreign Exchange Capital Flow Structure on the Real Effective Exchange Rate [J] *Financial Research*, No. 4, 2012
7. Xiangcai Meng (Assistant Professor) Chia-Hsing Huang (Professor), Nonlinear models for the sources of real effective exchange rate fluctuations; Evidence from the Republic of Korea[J] *Japan and the World Economy*, December 2016, Vol.40:21–30

8. Zhang Bowei, Zhang Kefei, Capital Flow, Financial Development and Real Exchange Rate Changes in Emerging Economies, Nankai Journal (Philosophy and Social Sciences), No. 3, 2015
9. Zhou Aimin, Yuan Yuan, The Structural Impact of Capital Flows on the Real Effective Exchange Rate[J] World Economic Research, 2015(10):3–12+43+127.

**Open Access** This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

