The Impact of RMB Appreciation on China's Economy

by

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Abstract

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After China reformed the exchange rate policy in 2005, experts and scholars began to pay more attention to study the relationship between RMB exchange rate movements and China's economy. Exchange rates are an important and comprehensive index of a country's participation in international economic activities, and are also the link between domestic and international markets. The change of exchange rate will directly affect a country's operation in an open economy. This paper uses an open macroeconomic model and adopts the ADF and cointergration test to investigate the impact of RMB appreciation on China's economy.

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Chapter 1: Introduction

1.1 Purpose of Study

Since China adopted a floating exchange rate regime, the Renminbi (RMB) exchange rate has been in a rising stage. With the rapid development of China's economy, the pressure from the international community for the RMB appreciation is constant. Different exchange rate regimes will have various effects on the national economy and this paper aims to discuss the impact of RMB appreciation on China's economy.

1.2 Background

1.2.1 RMB exchange rate reform

After joining the World Trade Organization (WTO), the Chinese government, according to the related rules of WTO, gradually opened up China's financial markets to the world and actively promoted the RMB exchange rate reform process. According to the People's Bank of China Announcement No. 16 [2005], the RMB exchange rate is no longer be pegged to the U.S. dollar since July 21, 2005. It reforms to a more flexible RMB exchange rate mechanism, practices on the basis of market supply and demand with reference to a basket of currencies, and performs as a managed floating exchange rate system (The People's Bank of China, 2005).

With the exchange rate reform further deepening, the RMB exchange rate gradually embarked on an appreciation track. Eight years ago, on July 21, 2005,

the RMB exchange rate had appreciated 2.1percent (from 8.2765 RMB/USD to 8.11 RMB/USD). Figure 1.1 shows the movement of RMB exchange rate to US dollar for the past eight years. The central parity rate of RMB/USD on July 19, 2013 was 6.1751, which means that the exchange rate appreciated by 34.03 percent for the past eight years.

Figure 1.1 RMB exchange rates to US dollar from 2005 to 2013

From the data collected by the PBC, in May 2006, the central parity of RMB/USD fell under 8 with the annual increase of 3.35 percent. Since then, the appreciation of RMB against USD began to accelerate. In the whole year of 2007, the exchange rate had an increase of 6.9 percent and a sharply appreciation of 6.5 percent for the first half year of 2008. The exchange rate of RMB/USD fell under 7 on April 10th, 2008, with a rate of 6.9920.

The outbreak of the global financial crisis in 2008 led the RMB exchange rate movements into nearly two year of stability. In order to withstand the

financial crisis, the People's Bank of China decided to promote a “second exchange reform”. On June 19, 2010, the central bank announced to further promote the reform of RMB exchange rate formation mechanism, and enhance the RMB exchange rate flexibility. From June 2010, the RMB exchange rate gave up pegging to the dollar, its movement and the appreciation of the exchange rate has obviously been different. In 2012, the RMB exchange rate against the USD had a trend of first strong and then weak, the annual appreciation rate was only 0.25 percent. For the first half year of 2013, the rate was 1.73 percent.

1.2.2 Reason for the appreciation

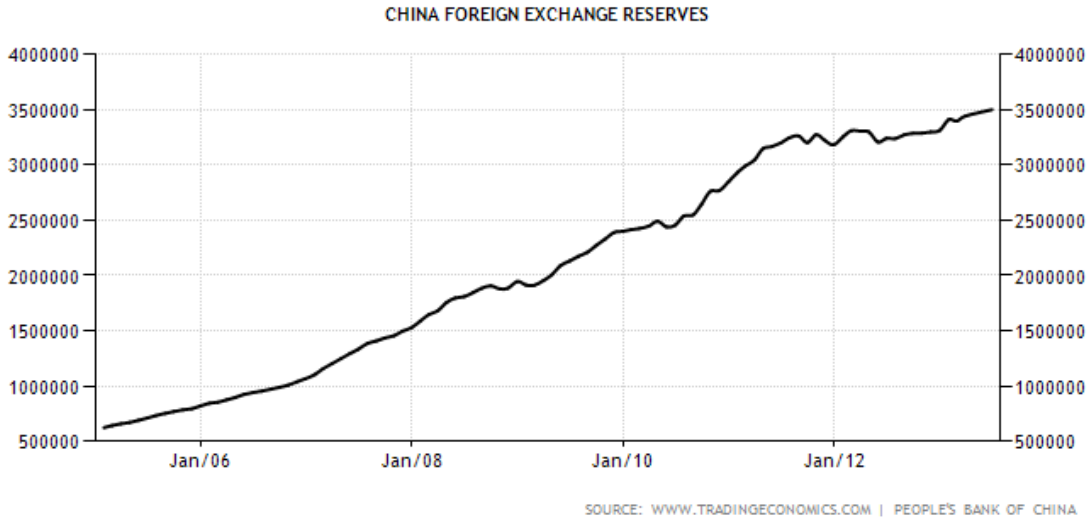
China’s economy has shown remarkable capacity for growth in the past eight years. According to the data form the website of the World Bank, the Gross domestic product (GDP) increased from 2,257 billion USD in 2005 to 8,227 billion USD in 2012. The GDP annual growth rate from 2005 to 2012 was consistently high and had an average 10.56 percent per year. This made China’s purchasing power greatly improve, which led to the appreciation of RMB exchange rate.

At the same time, the developed countries didn’t have such high rapid growth rate. For example, the annual GDP growth rate of the United States in the same period was only 1.32 percent and even negative in 2008 and 2009. The different growth speed made for trade imbalance between China and other countries. Therefore, the United States and Japan put pressure on international public opinion, asked for the RMB to appreciate so that they could increase their

exports and reduce imports to reverse the trade deficit to reverse the deflationary effects of their economy.

Another reason for the appreciation is that the increase of China's foreign exchange reserves. Figure 1.2 shows China foreign exchange reserves from 2005 to 2013.The data collected by PBC show that the foreign exchange reserves were 732,733 million USD in July 2005 while 3,442,649 million USD in March 2013: an increase of 4.7 times.

Figure 1.2 China Foreign exchange reserves from 2005 to 2013



Foreign exchange reserves are an important part of a nation's international solvency, and have great influence on the balance of payments and the maintenance of the stable of exchange rate. The "double surplus" of China's current account and capital account is the key reason for the RMB appreciation.

1.3 Need for Study

This paper will provide a research into RMB exchange rate appreciation, and combined with the actual condition of China's economic development. It will use open macroeconomic model to analyze the relationship among imports, exports, foreign direct investment and RMB real effective exchange rate to China's economy. What's more, the paper will give some recommendations on the future RMB exchange rate appreciation.

1.4 Chapter Organization

This paper has six chapters. This current chapter provides an introduction to RMB appreciation. Chapter 2 is a literature review of previous research while Chapter 3 outlines the methodology of the study. Chapter 4 describes the analysis of the results, and Chapter 5 provides final conclusions with the recommendations in Chapter 6.

Chapter 2: Literature Review

The impact for the movements of exchange rate on a country's economy has always being noticed by economists. With the further opening of China's financial markets, the link between China's economy and the world economy is further deepening. The researches on the appreciation of RMB played an important role on maintain the sustained and healthy development for China's and global economy. This chapter provides the following studies for the scholars on the implementation of China's exchange rate reform.

2.1 The Reason for RMB Appreciation

Much of the literature had argued that the continued trade surplus, huge growth in foreign exchange reserves, short-term inflation, foreign exchange market pressures and the dollar depreciation are the key reasons that have caused the RMB appreciation.

For example, Xiao and Wang (2009) studied the growth of foreign exchange reserves in China arguing that this put pressure to the RMB against some major foreign currency exchange rate. In the short-run, the growth of foreign exchange reserves would cause certain pressure on the RMB appreciation.

Fan (2013) believed that the purchasing power of RMB is extremely low and as China's economy is now in a stage of rapid development, this growth will

increase productivity and produce a current account surplus. At the same time, the growth of FDI in particular has causes the RMB appreciation.

2.2 The Effect of RMB Appreciation

By reviewing the related literature, the RMB appreciation has two aspects of the effects on China's economic stability and development. Some scholars thought that RMB appreciation will benefit China’s economy, be conducive to cheaper imports, enhance the Chinese people's purchasing power, and be favorable for China's industrial structure optimization.

Gao (2010) believed that the RMB appreciation is a benefit to China's industrial restructuring, to guide her from labor-intensive industries to capital and technology-intensive industries. At present, China is famous for its cheap labor and lower profit, which is not good for the country's long-term development. RMB appreciation indeed has had an impact on export enterprises in the short-term, but it may improve foreign trade structure, and promote industrial upgrading in the long-term.

Hu and Du (2013) thought that with the improvement of China’s economy and the living standards, many people choose to go aboard to travel and study. The appreciation will reduce their cost for spending in the world, which helps to increase purchasing power and lead to the development of its economy. It could also reduce the foreign debt and lower the cost of imports.

For the negative aspect, the appreciation may inhibit exports, influence China's foreign direct investment (FDI), and increase employment pressure. For instance, Zhang (2006) provided a study of RMB appreciation for quantitative evaluation of policy scenarios and found that the RMB revaluation had adverse economic impact to the global economy, which would reduce the competitiveness of China's exports and the growth of GDP.

Yang, et al (2012) wrote a paper to discuss the macroeconomic impact of RMB appreciation on the world. The results show that most Chinese macroeconomic indicators, such as real GDP, exports, employment and investment, had negative effects as a result of the RMB appreciation in the short-term. The nominal exchange rate adjustment would not have any impact on the Chinese economy if the real wages were fixed and nominal wages were adjustable.

Yu and Cheng (2010) found that RMB appreciation stimulated China's inflow of FDI in the short-term. It reduced the inflow of resource-seeking FDI while increased that of market-seeking FDI. Additionally, wages had a negative relationship with the inflow of FDI and multinational enterprises may be depressed by RMB appreciation and wage rising. The increase of RMB exchange rate flexibility and the market-oriented reforms of domestic factor pricing should reduce the competitiveness of low-cost goods.

2.3 The Countermeasures of RMB Appreciation

Through the relevant literature, RMB appreciation is an unavoidable problem. China should learn from international experience and according to China's national conditions, establish suitable short-term measures and long-term strategies to take advantage of the positive impact of the appreciation and overcome the negative impact of the appreciation.

As Yin (2007) proposed, to adjust the import and export trade strategy and structure should reduce the adverse effects of the appreciation to export enterprises, change the growth mode of foreign trade, and optimize trade structure of export commodities. Export enterprises would strengthen their capability of independent innovation, and improve the industrial structure and product structure.

Zheng, et al (2006) used scenario analysis to study the impact of RMB appreciation on China’s trade in 2005 and 2006. They found that the growth space for China’s export is still strong, and believed that the China’s exports would not be affected too much by the RMB appreciation, but the risk still exists. Therefore, it is necessary to conduct a follow-up study and to closely monitor the situation of trade development.

Hung (2009) studied the impact of RMB reform on China’s trade competitiveness. The results show that most export prices were affected by the exchange rate changes. In the long-run, China would lose its export advantage and competitiveness if the RMB appreciates too fast. The exporters need to re-think their export pricing strategy and determine how to keep their market

share, while maintaining the competitiveness. The slow appreciation of the RMB has had great benefits for China's overall economic interests and improves export competitiveness and profit margins.

Lv (2008) thought that China need to reduce this current account surplus by reducing exports and increasing imports so that to increase the strategic material reserves and consume the existing foreign exchange reserves. It also needs to improve the ability and level of monetary policy, develop the financial and foreign exchange markets, and improving the RMB exchange rate formation mechanism.

Chapter 3: Methodology

3.1 Open macroeconomic Model

Open macroeconomic models have been an important area of economic research. Their development is mainly manifested by the simple macroeconomic model, Mundell-Fleming model of Keynesian macroeconomics and the Dornbusch model. This chapter mainly outlines the simple macroeconomic model and Mundell-Fleming model.

3.1.1 Simple Macroeconomic Model

According to Auerbach and Kotlikoff, in the open economy system, national income identity can be expressed in Equation 3.1as follows:

$$Y = C + I + G + (X - M), \tag{3.1}$$

where Y denotes GDP, C denotes private consumption, I denotes gross investment, G denotes government expenditure, X denotes exports, M denotes imports, and X-M denotes net exports (1998, pp.122-123).

Bao (2008) wrote in his research paper said that Keynesians believe that a country's exports and domestic investment have the effect of increasing national income. When a country increases its exports, the income received from abroad will increase export enterprises' income and consumption, and this stimulates production and increases the employment rate (p.20).

3.1.2 Mundell-Fleming Model

The model made appropriate modifications within the framework of Keynesian macroeconomics. It focused on the decision of domestic and international payments when commodity markets, monetary market and foreign exchange market achieved equilibrium. The model mainly analyzes the impact on income and balance of payments under different fiscal policy and monetary policy. It could also be used to perform the analysis of the impact of exchange rate movements on the economy. There are three simple expression of markets reaches equilibrium:

1. Commodity market equilibrium-- Investment - Saving (IS) curve

When the commodity market reaches the equilibrium, total supply equals to total demand. We could get the following equation by substituting between variables:

$$i = -\frac{a}{b}Y + \frac{c}{b} + \frac{u}{b}r + \frac{1}{b}G, \tag{3.2}$$

where i, Y, r, G represent interest, output, exchange rate and financial deficit respectively, a, b, c and u are coefficient that all greater than zero. From Equation 3.2, we could deduce that output will reduce when the exchange rate is appreciated, and vice versa. This means that exchange rate movement affects the economy.

2. Monetary market equilibrium-- Liquidity preference - Money Supply (LM) curve

In the monetary market, the money demand depends on the income and interest rates, while the money supply depends on the central bank's monetary

policy. In an open economy, the flexible-price monetary model could obtain by the monetary market equilibrium as follow:

$$\mathrm{i} = \frac{k}{h}Y - \frac{1}{h}M, \tag{3.3}$$

Equation 3.3 reflects relationship between interest (i), income (Y) and real money supply (M) in the monetary market.

3. Foreign exchange market equilibrium—Balance of Payment (BP) curve

According to the balance of international payments, current account balance and capital account balance both depend on the difference between the income and the exchange rate. Foreign exchange market equilibrium could be expressed as:

$$\mathrm{i} = \frac{m}{n}\mathrm{Y} + \frac{\mathrm{d}}{n} - \frac{v}{n}\mathrm{r} + \frac{1}{n}\mathrm{B}, \tag{3.4}$$

where B is the sum of current account balance and capital account balance. When a country's economy turns from closed to open, the expansion of net exports will directly contribute to the growth of its economy. As the exchange rate is the direct factor that affects import and export trade and FDI, it also affects the country's economy indirectly (Pan, 2000, pp.269-273).

3.2 Theoretical Analysis Framework of Exchange Rate Movements Effect

The exchange rate movement first affects the initial change of GDP by influencing net exports and FDI. It also affects the further changes by influencing the interaction between economic variables. One effect is the multiplier effect, another is the feedback effect. The initial changes of GDP will influence imports,

the changes of imports will influence the movement of exchange rate, and the movement will cause further changes of GDP.

3.2.1 Considering Multiplier Effect of Exchange Rate Movements

In an open economy system, national income identity can be expressed as Equation 3.1. From this, we can derive the simple consumption function which is shown as:

$$\mathrm{C} = C_0 + bY, \tag{3.5}$$

where C_0 is autonomous consumption; b is the marginal propensity to consume, $\mathrm{b} = \Delta C/\Delta Y$, and 0<b<1; Y is disposable income.

The import function can be written as:

$$\mathrm{M} = M_0 + mY, \tag{3.6}$$

where M_0 is autonomous import; m is marginal propensity to import, and $\mathrm{m} = \Delta M/\Delta Y$.

By bringing Equation (3.5) and (3.6) into Equation (3.1), we can obtain the following:

$$\mathrm{Y} = \frac{1}{1-b+m}\,(C_0 + \mathrm{I} + \mathrm{G} + \mathrm{X} - M_0)\,, \tag{3.7}$$

The coefficient 1/ (1-b+m) is the foreign trade multiplier of the open economy. The generation of the multiplier makes import and export trade closely linked with national income, and so does FDI. That means the movement of exchange rates will lead to the changes of exports, imports and FDI, and then those influence national income through the foreign trade multiplier.

Taking the derivative of time for the both sides of the above function, we obtain:

$$\Delta \mathrm{Y} = \frac{1}{1-b+m}\left(\Delta \mathrm{C}_o + \Delta \mathrm{I} + \Delta \mathrm{G} + \Delta \mathrm{X} - \Delta \mathrm{M}_0\right), \tag{3.8}$$

where $\Delta \mathrm{Y} = dY/dt$. As FDI is an important part of investment, if one doesn't consider changes on other factors, we can get the influence of exchange rate movement on the national income as follow:

$$\frac{\Delta Y}{Y} = \frac{1}{1-b+m}\left(\frac{\Delta X}{X} * \frac{X}{Y} - \frac{\Delta M_0}{M} * \frac{M}{Y} + \frac{\Delta FDI}{FDI} * \frac{FDI}{Y}\right), \tag{3.9}$$

where $\frac{\Delta \mathrm{Y}}{\mathrm{Y}}$, $\frac{\Delta \mathrm{X}}{\mathrm{X}}$, and $\frac{\Delta \mathrm{FDI}}{\mathrm{FDI}}$ represent the growth rate of national income, exports and FDI respectively; $\frac{\Delta M_0}{\mathrm{M}}$ is the ratio of the autonomous import to total import; $\frac{\mathrm{X}}{\mathrm{Y}}$, $\frac{\mathrm{M}}{\mathrm{Y}}$, and $\frac{\mathrm{FDI}}{\mathrm{Y}}$ are percentage of export, import and FDI in the national income respectively. Equation (3.9) shows the influence between the change in the numbers of above variables and the growth of national income (Lu and Chen, 2007, pp.27-28).

3.2.2 Considering Both Multiplier Effect and Feedback Effect of Exchange Rate Movements

According to the feedback effect, the change of GDP ($\frac{\Delta Y}{Y}$) will lead to the change of imports by $\mathrm{m}\frac{\Delta Y}{Y}$, and the imports changes make reverse changes of exchange rate by $-\mathrm{m}\mu\frac{\Delta Y}{Y}$, where μ is the coefficient of balance of trade on exchange rate. The exchange rate movements further make GDP change again

through the multiplier effect by $\frac{-\mathrm{m}\mu}{1-b+m}\frac{\Delta Y}{Y}$ per time.

After summing all the feedback effect together and putting them into Equation (3.9), we can get the following function:

$$\frac{\Delta \mathrm{Y}'}{\mathrm{Y}} = \frac{1}{1-b+m+m\mu}\left(\frac{\Delta \mathrm{X}}{\mathrm{X}} * \frac{\mathrm{X}}{\mathrm{Y}} - \frac{\Delta M_0}{\mathrm{M}} * \frac{\mathrm{M}}{\mathrm{Y}} + \frac{\Delta \mathrm{FDI}}{\mathrm{FDI}} * \frac{\mathrm{FDI}}{\mathrm{Y}}\right), \qquad (3.10)$$

Equation 3.10 is considering both multiplier effect and feedback effect for the impact of exchange rate movements on GDP (Lu and Chen, 2007, pp.28-29)

3.3 The Empirical Model

3.3.1 Real Effective Exchange Rate (REER) Index

Gao and Fu (2005) wrote in their paper that many theoretical and empirical studied show that the real effective exchange rate is the variable which directly affects the trade balance of payments. Therefore, if we want to judge the rationality of RMB exchange rate, we must make the real effective exchange rate as the objective (p.2).

According to the IMF, the real effective exchange rate (REER) is "an indicator to measure international competitiveness as an index of unit labor costs in a country's manufacturing sector relative to a weighted average of the unit labor costs in competing countries expressed in a common currency". The REER indicator of country i is given by Equation (3.11):

$$REER_i = \prod_{j \neq i} \left[\frac{C_i R_i}{C_j R_j}\right]^{W_{ij}}, \qquad (3.11)$$

where j is an index that runs over country i's trade partners, W_{ij} represents the

competitiveness weight attached by country i to country j, C_i and C_j are normalized unit labor cost measures in countries I and j expressed in local currencies, and R_i and R_j, represent the nominal exchange rate of country i and country j's currencies in U.S. dollars (Alessandro and Dominique, 1997, p.7).

From Equation 3.11, we can determine that the REER is not only related to the bilateral nominal interest rate, but is also associated with other countries' inflation. This paper mainly uses the RMB real effective exchange rate from the International Financial Statistics, with a base year of 2005.

3.3.2 Regression Model

To study the impact of RMB exchange rate movements on China's economy, we need to know the coefficient of $\frac{\Delta Y}{Y}$,$\frac{\Delta X}{X}$, and $\frac{\Delta FDI}{FDI}$. According to the existing research, we can now build the following empirical set of equations:

$$\ln(X)_t = \alpha_0 + \alpha_1 ln(REER)_t + \alpha_2 ln\left(Y_f\right)_t + \varepsilon_{1t}, \quad (3.12)$$

$$\ln(M)_t = \beta_0 + \beta_1 ln(REER)_t + \beta_2 ln(Y)_t + \varepsilon_{2t}, \quad (3.13)$$

$$\ln(FDI)_t = \gamma_0 + \gamma_1 ln(REER)_t + \gamma_2 ln(Y_f)_t + \varepsilon_{3t}, \quad (3.14)$$

where X, M and FDI are exports, imports, and FDI of China, respectively; and Y_f is the GDP of the United States.

3.3.3 Test of Stationarity

One of the important types of data used in empirical analysis is time

series data. The empirical work based on time series data assumes that the underlying time series is stationary. If a time series is nonstationary, we only can study its behavior for the time period under consideration, but can't generalize it to other time periods. Therefore, the nonstationary time series may be have little practical value. Hence, before we do the analysis, we need to make sure that the particular time series is stationary (Gujarati, 2002, p.798).

In order to check whether a regression model is stationary or not, one popular way is to do the unit root test. There are several ways to do the unit root test – Dickey-Fuller (DF) test, augmented Dickey–Fuller (ADF) test and the Phillips–Perron (PP) tests etc. This paper uses ADF test, which is conducted by "augmenting" three different null hypotheses of DF test by adding the lagged values of the dependent variable ΔY_t. The equation is shown as follow:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + \varepsilon_t, \qquad (3.15)$$

where ε_t is a pure white noise error term and $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$, etc (Gujarati, 2002, p.817).

If we find the data is nonstationarity after doing the unit root test, we need to transform these time series to make them stationary to avoid the spurious regression problem. This paper uses difference-stationary processes to do the transformation. We take the first differences of the time series, if the computed value is more negative than the critical value, we can conclude that the first-differenced variables is stationary and expresses as I(0), which means that it

doesn’t obtain unit root.

3.3.4 Test of Cointergration

Cointergration is a regression of a unit root time series on another unit root time series. Economically speaking, if two variables have a long-term relationship between each other, they will be cointegrated. As Granger (1986) notes, “A test for cointegration can be thought of as a pre-test to avoid ‘spurious regression’ situations” (p.226).

There are several methods for testing cointegration, and two comparatively simple methods are the DF or ADF unit root test on the residual estimated term form the cointegrating regression and the cointegrating regression Durbin–Watson (CRDW) test.

The Engle-Granger (EG) test is based on the DF or ADF unit root test. After estimating a regression model, we obtain the residuals and use the ADF tests to test the cointegration. If the computed values of the unit root test for the residuals smaller than the critical values, hence the cointegrating regression is not spurious, even if the two variables are nonstationary individually and the regression model is the long-run function for what we want to obtain (Gujarati, 2002, pp.823-824).

The cointegrating regression Durbin–Watson (CRDW) test is an alternative and quicker method of finding out whether two variables are

cointegrated or not. It uses the Durbin–Watson d value that obtained from the cointegrating regression and compared it with the critical value. If the computed value is above the critical value, we could say that the variables are cointegrated; that is, there is an equilibrium relationship between the variables in the long-term (Gujarati, 2002, pp.824).

3.4 Data Sources

The quarterly data of the RMB real effective exchange rate are found from International Financial Statistics with a base year of 2005. The monthly data of Chinese imports, exports and FDI are found from the website of the Ministry of Commerce of the People's Republic of China and I summed them together to get the needed data.

The quarterly data of China's GDP in RMB are found from the website of the National Bureau of Statistics of China, while the quarterly data of China's GDP in US dollar are found from International Financial Statistics and related period average exchange rate are from China's Statistical Yearbook, 2012.

The United States GDP is found from the Federal Reserve Bank of St. Louis and the data were the seasonally adjusted annual rate for quarterly. All the data were collected from July 1st 2005 to December 31st 2012.

The data for marginal propensity to consume, the marginal propensity to import and foreign trade multiplier were calculated from those in the China's

Statistical Yearbook, 2012 and the Quarterly Report of People's Bank of China.

Chapter 4: Results

4.1 The Unit Root Test

I use an augmented Dickey-Fuller (ADF) test to check the stationarity of the time series for the variables of ln(X), ln (M),ln(FDI), ln(Y) and ln (Y_f). If the ADF statistic is smaller than the test critical values, the time series is stationary. The lag length I used is the Akaike Info Criterion and the intercept is including in test equation. The results of the ADF tests showed as follows (Table 4.1):

Table 4.1: The results of ADF test for unit root in level

Variables	ln(X)	ln(M)	ln(FDI)	ln(Y)	ln(Y_f)
ADF statistic	-0.593727	-0.877459	-1.639352	-1.933246	-0.680401
1% level	-3.737853	-3.699874	-3.711457	-3.737853	-3.689194
5% level	-2.991878	-2.976263	-2.981038	-2.991878	-2.971853
10% level	-2.635542	-2.627420	-2.629906	-2.635542	-2.625121

From the table above, we see that all the series are non-stationary. Then we perform the unit root test for the first order of each variable, the results are shown as follows in Table 4.2:

Table 4.2: The results of ADF test for unit root in first difference

Variables	Δln(X)	Δln(M)	Δln(FDI)	Δln(Y)	Δln(Yf)
ADF statistic	-3.499005	-6.373847	-5.628249	-2.987941	-2.790007
1% level	-3.737853	-3.699871	-3.711457	-3.737853	-3.689194
5% level	-2.991878	-2.976263	-2.981038	-2.991878	-2.971853
10% level	-2.635542	-2.627420	-2.629906	-2.635542	-2.625121

After the first order, Δln(M) and Δln(FDI) are stationary at 1% level, Δln(X) is stationary at 5% level and Δln(Y) and $\Delta\ln(Y_f)$ are stationary at 10% level, therefore, they are all I(1).

4.2 Testing of Cointegration

I use the Engle-Granger test to test the conintegration and run the regression of export, import and FDI according to the Equations of 3.12 - 3.14. The detailed results are in Appendix A. After sorting out, we obtain the result of the exports equation (Equation 3.12), now renumbered 4.1, as follows:

$$\ln(X)_t=-42.91093-0.002244\ln(REER)_t+5.079507\ln(Y_f)_t \quad (4.1)$$

t-Stat (-9.930924) (-0.005518) (8.366490)

R^2=0.901141, Adjusted R^2=0.893818, F-stat=123.0574, D.W. =1.610541

This means that if the Chinese real effective exchange rate rises by 1

percent, the exports will decrease by 0.002 percent. After getting results, I run the unit root test for the residual error and get its ADF statistic of -2.429320. As the value is smaller than the 5% critical value, which is -1.955020, the residuals series is stationary, and the Equation (4.1) is the cointegration equation.

The import equation (Equation 3.13), now renumbered 4.2, results were:

$$\ln(M)_t=2.209628-0.436708\ln(REER)_t+0.782624\ln(Y)_t \quad (4.2)$$

t-Stat (0.882334) (-0.619179) (5.665128)

R^2=0.833545, Adjusted R^2=0.821215, F-stat=67.603, D.W. =1.528631

This means that if the Chinese real effective exchange rate rises by 1 percent, the imports will decrease by 0.44 percent. The result of unit root test for the residual error is that the ADF statistic is -2.972654. As the value is smaller than the 5% critical value, which is -1.955020, the residuals series is stationary, and Equation 4.2 is the cointegration equation.

The results for FDI equation (Equation 3.14), now renumbered 4.3, were:

$$\ln(FDI)_t=-26.31936+0.842597\ln(REER)_t+2.648011\ln(Y_f)_t \quad (4.3)$$

t-Stat (-3.547200) (1.206771) (2.539979)

R^2=0.630607, Adjusted R^2=0.603244, F-stat=23.04641, D.W. =1.385226

This means that if the Chinese real effective exchange rate rises by 1 percent, the imports will increase by 0.84 percent. The result of unit root test for the residual error is that the ADF statistic is -3.822181. As the value is smaller

than the 1% critical value, which is –2.64712, the residuals series is stationary, and equation 4.3 is the cointegration equation.

4.3 Foreign Trade Multipliers

According to the calculations in Appendix B, the average marginal propensity to consume (MPC) from 2005 to 2012 is 46.16%, while the corresponding marginal propensity to import (MPI) is 17.56%. Hence the average foreign trade multiplier could be calculated as 1.8229. Then according to the quarterly data form the third quarter of 2005 to the end of 2012 in Appendix C, the average proportion of export, import and FDI to GDP are 29.72%, 25.11% and 1.93% respectively.

We calculated the degree of the impact on the economy of the RMB REER changes by using Equation 3.9, now renumbered as 4.4, and the results are shown below:

$$\frac{\Delta \mathrm{Y}}{\mathrm{Y}} = \frac{1}{1-b+m}\left(\frac{\Delta \mathrm{X}}{\mathrm{X}} * \frac{\mathrm{X}}{\mathrm{Y}} - \frac{\Delta M_0}{\mathrm{M}} * \frac{\mathrm{M}}{\mathrm{Y}} + \frac{\Delta \mathrm{FDI}}{\mathrm{FDI}} * \frac{\mathrm{FDI}}{\mathrm{Y}}\right) \qquad (4.4)$$

= 1.8229*(-0.002244%*29.73%+0.436708%*25.12%+0.842597%* 1.93%)

≈0.2284%

According to the above calculation, we can predict the impact of RMB exchange rate movements to China's economy by the economic variables of

imports, exports and FDI. A 1% percent increase of RMB real effective exchange rate will lead to China's economy increasing by 0.2284 percent.

Chapter 5: Conclusions

This paper is based on previous studies and Keynesian macroeconomics. According to the data of import and export trade and foreign direct investment from July 2005 to the end of 2012, I build an open general macroeconomic model to analyze the impact of RMB exchange rate movements on the Chinese economy through the multiplier effect.

According to the empirical study, this paper shows that the RMB real effective exchange rate will lead to the inflow of foreign direct investment and a decrease of imports and exports. As imports declined more than exports, the net exports will increase. While both foreign direct investment inflows and export and import trade benefit China’s economic growth, on the whole, the RMB exchange rate appreciation has positive impacts on China's economy.

This paper did not consider the feedback effects and only considered the multiplier effect. What’s more, if the RMB exchange rate saw a significant appreciation, the external economy will not only affecting economic growth through multiplier effects and feedback effects, but also through other channels. These include the impact of international capital, and the instability of financial system, which may jeopardize the continued rapid growth of China's economy.

Therefore, at the current stage, we should focus on the promotion of RMB appreciation on China's economic growth, develop a positive foreign trade development strategy to accelerate the rapid inflow of high quality foreign capital, promote the continued growth of net exports, and maintain the contribution rate of China's current foreign trade and investment in economic growth.

Chapter 6: Recommendations

Currently, the pressure on RMB appreciation is increasing. As was said before in the paper, the small change of RMB appreciation will not affect the Chinese economy too much, but a huge change will do harm for the rapid growth of China's economy and influence the financial and economic stability of China and other countries. However, there is no need to deny that the RMB exchange rate should tend to rise in the long-run. During this RMB appreciation, it will inevitably bring certain impacts to China's economy, so it is necessary to take some measures to reduce or even eliminate these potential negative impacts.

After joining the WTO, China implemented a series of economic development strategies and achieved remarkable economic growth. However, depending too much on foreign trade will increase the risk of economic disruption and the global financial crisis in 2008 is a stark example. Moreover, China depends on lots of cheaper labor-intensive enterprises to increase exports. While this will drive up the domestic economy, this strategy makes China's export structure vulnerable to the forces of global integration and rising wage rates. For the structural change necessary, China needs to look to the innovation of science and technology so it moves up the value chain from low value production.

In order to promote the development of the foreign trade enterprise, enterprises are better to strengthen their risk prevention consciousness, use reasonable hedging tools, adjust their trade structure and implement a diversifying export strategy. As mentioned in the previous paragraph, they also need to enhance technological innovation and increase the product technology content and added value of their products. For the government, it could take some measures to guide enterprises to innovate, and make policy support for the export enterprises that will be seriously damaged due to the RMB appreciation. These include adjusting the related tax policy, improving the level of foreign capital utilization, and reducing the conflict with major trading partners to dissolve the RMB appreciation pressure.

Currently, the performance of China has encouraged capital inflows and restricts capital outflows, and this is not conducive to the long-run development of China's economy. Therefore, it is necessary to actively implement the "going out" strategy, adjust and improve the foreign exchange management policy for overseas investment, and makes effort to keep a balance between foreign investment in China and China's foreign direct investment. The government needs to establish a perfect legal system and necessary financial support for the enterprises to "go out".

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Appendix A: Testing of Cointegration Results

1. Testing of import equation

Dependent Variable: LOG(X)
Method: Least Squares
Date: 08/18/13 Time: 00:02
Sample: 2005Q3 2012Q4
Included observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-42.91093	4.320940	-9.930924	0.0000
LOG(REER)	-0.002244	0.406615	-0.005518	0.9956
LOG(YF)	5.079507	0.607125	8.366490	0.0000

R-squared	0.901141	Mean dependent var	5.839548
Adjusted R-squared	0.893818	S.D. dependent var	0.302375
S.E. of regression	0.098531	Akaike info criterion	-1.702256
Sum squared resid	0.262125	Schwarz criterion	-1.562136
Log likelihood	28.53383	Hannan-Quinn criter.	-1.657430
F-statistic	123.0574	Durbin-Watson stat	1.610541
Prob(F-statistic)	0.000000		

Null Hypothesis: RESID01 has a unit root
Exogenous: None
Lag Length: 4 (Automatic based on SIC, MAXLAG=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.429320	0.0174
Test critical values:	1% level	-2.660720	
	5% level	-1.955020	
	10% level	-1.609070	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID01)
Method: Least Squares
Date: 08/18/13 Time: 17:18
Sample (adjusted): 2006Q4 2012Q4
Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID01(-1)	-0.801459	0.329911	-2.429320	0.0247
D(RESID01(-1))	0.387045	0.331838	1.166367	0.2572
D(RESID01(-2))	0.236706	0.275770	0.858345	0.4009
D(RESID01(-3))	0.041167	0.214542	0.191885	0.8498
D(RESID01(-4))	0.737804	0.193055	3.821738	0.0011

R-squared	0.767619	Mean dependent var	-0.003805
Adjusted R-squared	0.721143	S.D. dependent var	0.123804
S.E. of regression	0.065377	Akaike info criterion	-2.440435
Sum squared resid	0.085483	Schwarz criterion	-2.196660
Log likelihood	35.50544	Hannan-Quinn criter.	-2.372822
Durbin-Watson stat	1.821962		

2. Testing of export equation

Dependent Variable: LOG(M)
Method: Least Squares
Date: 08/18/13 Time: 17:31
Sample: 2005Q3 2012Q4
Included observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.209628	2.504300	0.882334	0.3854
LOG(REER)	-0.436708	0.705302	-0.619179	0.5410
LOG(Y)	0.782624	0.138148	5.665128	0.0000

R-squared	0.833545	Mean dependent var	5.671971
Adjusted R-squared	0.821215	S.D. dependent var	0.333680
S.E. of regression	0.141090	Akaike info criterion	-0.984201
Sum squared resid	0.537471	Schwarz criterion	-0.844081
Log likelihood	17.76301	Hannan-Quinn criter.	-0.939375
F-statistic	67.60300	Durbin-Watson stat	1.528631
Prob(F-statistic)	0.000000		

Null Hypothesis: RESID02 has a unit root
Exogenous: None
Lag Length: 4 (Automatic based on SIC, MAXLAG=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.972654	0.0046
Test critical values:	1% level	-2.660720	
	5% level	-1.955020	
	10% level	-1.609070	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID02)
Method: Least Squares
Date: 08/18/13 Time: 17:44
Sample (adjusted): 2006Q4 2012Q4
Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID02(-1)	-0.715911	0.240832	-2.972654	0.0075
D(RESID02(-1))	0.355574	0.254311	1.398189	0.1774
D(RESID02(-2))	0.208885	0.213986	0.976162	0.3406
D(RESID02(-3))	0.030728	0.183477	0.167478	0.8687
D(RESID02(-4))	0.727283	0.160427	4.533435	0.0002

R-squared	0.771592	Mean dependent var	-0.007785
Adjusted R-squared	0.725910	S.D. dependent var	0.178824
S.E. of regression	0.093621	Akaike info criterion	-1.722271
Sum squared resid	0.175297	Schwarz criterion	-1.478496
Log likelihood	26.52839	Hannan-Quinn criter.	-1.654658
Durbin-Watson stat	1.467025		

3. Testing of FDI equation

Dependent Variable: LOG(FDI)
Method: Least Squares
Date: 08/18/13 Time: 17:47
Sample: 2005Q3 2012Q4
Included observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-26.31936	7.419755	-3.547200	0.0014
LOG(REER)	0.842597	0.698224	1.206771	0.2380
LOG(YF)	2.648011	1.042533	2.539979	0.0172

R-squared	0.630607	Mean dependent var	3.095430
Adjusted R-squared	0.603244	S.D. dependent var	0.268610
S.E. of regression	0.169193	Akaike info criterion	-0.620909
Sum squared resid	0.772913	Schwarz criterion	-0.480790
Log likelihood	12.31364	Hannan-Quinn criter.	-0.576084
F-statistic	23.04641	Durbin-Watson stat	1.385226
Prob(F-statistic)	0.000001		

Null Hypothesis: RESID03 has a unit root
Exogenous: None
Lag Length: 0 (Automatic based on SIC, MAXLAG=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.822181	0.0004
Test critical values:	1% level	-2.647120	
	5% level	-1.952910	
	10% level	-1.610011	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID03)
Method: Least Squares
Date: 08/18/13 Time: 17:47
Sample (adjusted): 2005Q4 2012Q4
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID03(-1)	-0.697184	0.182405	-3.822181	0.0007

R-squared	0.342540	Mean dependent var	-0.004257
Adjusted R-squared	0.342540	S.D. dependent var	0.195497
S.E. of regression	0.158517	Akaike info criterion	-0.812041
Sum squared resid	0.703570	Schwarz criterion	-0.764893
Log likelihood	12.77460	Hannan-Quinn criter.	-0.797275
Durbin-Watson stat	1.949301		

Appendix B: Calculations of China's foreign trade multipliers

The relevant data calculations of China's foreign trade multipliers

Year	GDP (100 million yuan)	Final Consumption Expenditures	Total Imports	marginal propensity to consume	marginal propensity to import	foreign trade multiplier
2005	187,423.50	99,357.50	54,273.70	0.4460	0.2961	1.1763
2006	222,712.50	113,103.80	63,376.90	0.3895	0.2580	1.1515
2007	266,599.20	132,232.90	73,300.10	0.4359	0.2261	1.2654
2008	315,974.60	153,422.50	79,526.50	0.4292	0.1261	1.4348
2009	348,775.10	169,274.80	68,618.40	0.4833	-0.3326	5.4305
2010	402,816.50	194,115.00	94,699.30	0.4597	0.4826	0.9776
2011	465,731.30	228,561.30	113,161.40	0.5475	0.2934	1.3406
2012	527,608.00	259,600.00	116,578.30	0.5016	0.0552	1.8064
Average				0.4616	0.1756	1.8229

Data sources: China Statistical Yearbook 2012 and the website of Ministry of Commerce of the People's Republic of China Comprehensive Department

Appendix C: Calculations of China's exports, imports and FDI in GDP proportion

The relevant data calculations of China's exports, imports and FDI in GDP proportion

Quarter	REER	Export	Import	FDI	GDP	Proportion of Export	Proportion of Import	Proportion of FDI
2005 3rd	101.30	204.05	175.31	14.68	549.60	37.13%	31.90%	2.67%
2005 4th	103.50	215.64	182.12	17.08	721.00	29.91%	25.26%	2.37%
2006 1st	102.20	197.26	173.94	14.25	562.90	35.04%	30.90%	2.53%
2006 2nd	100.60	231.18	193.44	14.18	625.40	36.97%	30.93%	2.27%
2006 3rd	100.90	262.61	213.94	14.16	651.60	40.30%	32.83%	2.17%
2006 4th	102.70	278.03	210.30	20.43	877.00	31.70%	23.98%	2.33%
2007 1st	104.10	252.00	205.67	15.89	705.50	35.72%	29.15%	2.25%
2007 2nd	104.70	294.87	228.82	16.00	797.70	36.97%	28.68%	2.01%
2007 3rd	107.10	331.41	257.87	15.33	847.90	39.09%	30.41%	1.81%
2007 4th	106.40	339.75	263.47	27.55	1153.30	29.46%	22.84%	2.39%
2008 1st	110.20	305.79	265.11	27.41	925.40	33.04%	28.65%	2.96%
2008 2nd	112.40	360.39	303.59	24.97	1066.40	33.80%	28.47%	2.34%
2008 3rd	115.90	407.83	324.57	21.99	1119.10	36.44%	29.00%	1.96%
2008 4th	122.60	354.48	240.17	18.02	1419.60	24.97%	16.92%	1.27%
2009 1st	124.20	245.63	183.12	21.78	1021.10	24.06%	17.93%	2.13%
2009 2nd	121.30	276.10	241.33	21.23	1147.70	24.06%	21.03%	1.85%
2009 3rd	117.10	325.07	285.80	20.76	1216.50	26.72%	23.49%	1.71%
2009 4th	114.20	355.13	293.63	26.27	1605.20	22.12%	18.29%	1.64%
2010 1st	116.60	316.11	301.57	23.44	1210.10	26.12%	24.92%	1.94%
2010 2nd	120.30	389.08	347.84	27.99	1352.20	28.77%	25.72%	2.07%
2010 3rd	119.00	429.81	364.17	22.91	1443.90	29.77%	25.22%	1.59%
2010 4th	118.90	443.46	380.34	31.40	1935.00	22.92%	19.66%	1.62%
2011 1st	119.20	399.67	400.37	30.34	1474.70	27.10%	27.15%	2.06%
2011 2nd	118.70	474.83	428.08	30.55	1671.40	28.41%	25.61%	1.83%
2011 3rd	123.60	518.12	454.36	25.79	1798.80	28.80%	25.26%	1.43%
2011 4th	126.10	506.67	458.60	29.33	2370.80	21.37%	19.34%	1.24%
2012 1st	127.20	430.07	428.92	29.48	1721.00	24.99%	24.92%	1.71%
2012 2nd	129.00	524.59	455.75	29.61	1893.90	27.70%	24.06%	1.56%
2012 3rd	130.60	541.26	461.78	24.33	1991.17	27.18%	23.19%	1.22%
2012 4th	128.70	554.18	470.94	28.29	2623.43	21.12%	17.95%	1.08%
Average						29.73%	25.12%	1.93%

Note: the unit of imports, exports, FDI and GDP are all in US dollars in billion

Data sources: relevent data from China Statistical Yearbook 2012 and the website of Ministry of Commerce of the People's Republic of China Comprehensive Department . REER is from International Financial Statistics