

An Empirical Study of the Impact of China's Export Tax Rebates on RMB Appreciation

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While the issue of RMB (*Renminbi*, Chinese *Yuan*) revaluation became the focus of world attention in 2003, the reform of the RMB exchange rate regime in 2005 didn't fundamentally solve the RMB appreciation problem, and even in 2008 the global financial crisis made RMB appreciation face new challenges and risks. It appears that the rise in RMB value is caused by supply exceeding demand in China's foreign exchange market; however, intrinsically it is due to the asymmetry in RMB exchange rate formation mechanism. The export tax rebates policy implemented by Chinese government is one of the leading causes of the asymmetry. This study constructs a transmission model between export tax rebates and foreign exchange rates, and applies the Granger Test to validate the causality between kernel variables based on correlative data from 1994-2011, and uses the error correction method to analyze the quantified relations of kernel variables, and finally gets the contribution rate of export tax rebates to RMB appreciation.

Keywords: Chinese Yuan, RMB, Export tax rebate, Exchange rate, Asymmetry
JEL Classification: E58, F31, O24, P33

I. Introduction

Since 2003 China's RMB (*Renminbi*, Chinese *Yuan*) exchange rate became the focus of attention at home and abroad. With considerations on basic national conditions, Chinese government in July 2005 introduced a new exchange rate regime, in which China moved into a managed floating exchange system based on market demand and supply with reference to a basket of currencies, rather than pegging to a single currency - the US dollar. But the RMB exchange rate

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remained virtually pegged again to the US dollar from the beginning of the global financial crisis until June 2010.

After the outbreak of the global financial crisis of 2008, China's exports fell sharply; China then slowed down the pace of RMB appreciation in order to increase exports. Meanwhile, Chinese leaders may have been afraid that RMB appreciation would also seriously drive down the value of China's vast foreign exchange reserves. As such, the issue of RMB appreciation seems to have a profound and far-reaching impact on China's foreign trade, internal and external balances, foreign-exchange reserves, etc.

As for the cause of RMB exchange rate appreciation, a lot of research has conducted in-depth studies from the perspectives of Chinese foreign exchange market non-equilibrium conditions, external political pressures from other nations, prices movement of non-traded to traded goods, etc. But most of those studies have failed to pay due attention to an important factor in the current RMB exchange rate formation mechanism - the asymmetry that is associated with export tax rebates, export subsidies, peculiar features of processing trade, various (direct and indirect) policies to attract foreign investment, low wages, a mandatory system for the settlement and sale of foreign exchange¹, etc. (Lee and Ma, 2004).

Export tax rebates being in accordance with a country's national tax law and provisions, generally refer to the tax refund that is paid back to exporting companies for the turnover tax or indirect tax including domestic VAT or consumption tax they already paid in the production and distribution processes of the goods which were already declared for export and departed from the country. The export tax rebate policy is usually used as a means to help export goods enter foreign markets with prices not including tax, so as to promote the country's exports and to regulate and control its economic operation.

Using the case of China's export tax rebates, this paper is intended to conduct an empirical analysis of the asymmetry in RMB exchange rate formation mechanism, with focusing on whether or not and how export tax rebates lead to the pressure² of RMB appreciation. The assumption that export tax rebates

¹ China introduced the said mandatory system in 1994, asking that except for some foreign-invested companies to retain their own foreign exchange accounts, domestic firms must sell their foreign currency earnings that exceed their quotas to designated foreign exchange banks. However, China's State Administration of Foreign Exchange issued a notice on Jan. 1, 2011 specifying that domestic exporters can keep their foreign currency earnings offshore from then on, which put an end to the mandatory system for foreign exchange settlement and sales. Refer to He (2011).

would have an impact on RMB appreciation is simply based on the principle of supply and demand in foreign exchange market. For export tax rebates can promote export price competitiveness to increase exports, contributing to the formation of trade balance surpluses, which, in turn, might produce an excess supply in the foreign exchange market.

The structure of this paper is as follows. The next section makes an overview of literature related to the causes of RMB appreciation and the relationship between exchange rate revaluation and export tax rebates, and briefly puts forward our own perspective. Section 3 addresses the transmission mechanism between export tax rebates and RMB appreciation, and derives an empirical analysis model consisting of simultaneous equations; then conducts data analyses of relevant variables of the comparison between export tax rebates and RMB exchange rate, and uses the Granger causality test to prove the causal relationship of main variables in the RMB exchange rate transmission mechanism, and finally using an error-correction model to estimate the contribution rate of export tax rebates on the exchange rate. Section 4 concludes the paper with relevant implications as well as interpreting findings and results of the empirical analysis.

II. Literature Review

Mundell (2003) refuted the logic for RMB appreciation, and maintained that there is no inevitable link between the trade account surplus and the appreciation of RMB. Luo and Wang (2004) analyzed the sources of the RMB appreciation pressure from domestic and external sides, stating that external pressure was mainly due to international economic recession, several countries put pressure on RMB exchange rate in order to divert attention; domestic pressure mainly occurred due to China's strict control of the capital and financial account and the central bank's strong intervention in the foreign-exchange market which entailed the narrow RMB/USD fluctuation limit, with the valuation of RMB pegged to USD, so that it caused discontent in other countries, who then one after another asked China to appreciate its currency. Yao (2005) also insisted that the appreciation pressure assumed by RMB came mainly from the continued economic downturn of developed countries and China's current foreign-exchange rate system and monetary policy; the appreciation would produce

² In this paper, the excess demand for RMB due to the BOP (balance of payments) surpluses is defined as the direct pressure of RMB appreciation, and the increments of foreign-exchange reserves as the indirect pressure.

adverse impact on Chinese trade exports, foreign investment, employment situation, etc.; China should accordingly adopt several countermeasures such as reducing export tax rebates, relaxing capital outflow restriction, and improving the RMB exchange rate formation mechanism, so as to reduce the pressure of RMB appreciation.

As for the relation between export tax rebates and foreign-exchange rate, Chinese academic community has done quite a lot of research, which mainly forms three perspectives as follows:

Firstly, the impact of export tax rebates on foreign-exchange rate is neutral. In other words, the impact is effective only in the short term, but in the long run export tax rebates don't resolve the fundamental problem of RMB appreciation pressure. Xu (2005) notes that reducing export tax rebate rate is a non-forex means to adjust the pressure of RMB appreciation, so that the pressure of international community on RMB appreciation can be alleviated to some extent in the short run; but in the long run export tax rebate policy needs to be operated in coordination with foreign-exchange policy, so as to achieve a dynamic balance in foreign exchange revenue and expenditure. Yang (2006) states that reducing export tax rebate rate in the short-term plays a certain role in diminishing trade surplus under the current account, so as to ease the pressure of RMB appreciation, but since the pressure on China's exchange rate appreciation is mainly derived from the system itself and the capital account surplus, it is unrealistic to thoroughly address the exchange rate problem via export tax rebate rate policy alone.

Secondly, the impact of export tax rebates on foreign-exchange rate is ineffective. In other words, the fundamental reason of RMB exchange rate appreciation is due to the exchange rate regime itself in China; therefore, the approach for adjusting export tax rebate rate to ease the pressure of RMB appreciation is not feasible. Yang and Huang (2006) note that RMB exchange rate is not determined by the supply and demand of foreign exchange market, but by changes in the exchange rate of US dollar movements; therefore, the policy for adjusting export tax rebate rate to affect the import and export, thereby affecting the supply and demand of foreign exchange market cannot produce an effective impact on RMB exchange rate. Jin (2002) claims that the policy of currency devaluation, compared to the export tax rebate, is not only more suitable for China's economic situation at home and abroad, but also more effective for China to achieve policy goals in the face of adverse situation of global economic slowdown and uncertainties after WTO accession; in the next

period of time, compared to the policy of export tax rebate, the policy of RMB devaluation should be preferred so as to cope with the recession and to promote exports. He maintains that both exchange rate and export tax rebates are just tools for trade adjustment, and that the international experience generally shows the feasibility of using exchange rate to adjust exports, but using export tax rebates to stabilize exchange rate, on the contrary, is not feasible.

Thirdly, the impact of export tax rebates on foreign-exchange rate is effective. That is, under a situation of being unable to revalue RMB notwithstanding the pressure of appreciation, lowering export tax rebate rate can effectively control trade exports and reduce trade surplus under the current account, so as to diminish the growth of foreign exchange reserves, so easing the pressure of RMB appreciation. Chen (2005) maintains that reducing export tax rebate rate can effectively relieve the pressure of current account surplus, making real effective exchange rate of RMB decrease with nominal exchange rate and export cost in terms of foreign exchange remaining unchanged, that is equivalent to the increase in value of RMB or its appreciation, and then producing the effect of exports control which is similar to an effect of RMB appreciation. Pei and Zheng (2010) state that in the context of economic globalization, Chinese trade surplus is a result of joint action by a series of comprehensive factors like economic structures and stages of development differences and the international division of labor between China and foreign countries,³ which lead to a lasting large current account surplus and drastic increase in foreign exchange reserves; therefore, China needs to lower the export tax rebate rate to hedge the increase in the current account surplus and foreign exchange reserves, to ease the pressure of RMB exchange rate appreciation.

Outwardly, it seems that the fluctuation of RMB revaluation or change in the exchange rate under the China's (quasi) fixed exchange rate regime is so limited that the effect of export tax rebates on RMB appreciation can't be significant. Inwardly, however, China's quasi-fixed exchange rate system has been implemented by the central bank's intervention in foreign exchange market, and the intervention not only stabilizes the exchange rate, but also leads to an increase in foreign exchange reserves. As Lardy (2012) notes, the central bank has kept the currency undervalued by intervening massively in the foreign

³ Pei and Zheng (2010)'s research is based on the trade balance, foreign exchange reserves and the real effective exchange rate data of the world's leading 46 economies, from 1975 to 2005, using Granger causality test as the basic means to conduct long-term and short-term combination test of the large samples.

exchange market, ultimately buying up more than \$3 trillion in foreign exchange since 2003; to prevent the resulting expansion of the domestic money supply from leading to high inflation the central bank has engaged in large-scale and sustained sterilization operations. As such, the increments of foreign exchange reserves has functioned as an indirect pressure of RMB appreciation, and thus the influence of export tax rebates on RMB appreciation is largely transformed into an indirect pressure upon the appreciation - the impact of rising foreign reserves.

So, among the three perspectives described above, this paper is more inclined to the third one to recognize that the downward adjustment of export tax rebate can alleviate the pressure of RMB appreciation to some extent. Existing research is largely confined to the theoretical analysis of the relationship between export tax rebates and exchange rate. There is little existing research to explore the empirical aspects of the relationship, and even more deficient is a systematic empirical study of the two factors under the framework of asymmetry in the RMB exchange rate mechanism, which is the main theme of this paper.

III. Empirical Analysis

1. The Transmission Mechanism in RMB Appreciation

There is an important feature in the current process of RMB appreciation. There exists an asymmetry in the RMB exchange rate formation mechanism. There are some factors, such as export tax rebates or export subsidies, that distort the mechanism of supply and demand in the foreign exchange market, and so they are termed the ‘asymmetry’ factor (Ma *et al.* 2010). This paper focuses on analysis of the asymmetry existing in the transmission mechanism to RMB appreciation, in which we need to distinguish the difference between theoretical and actual appreciation rates; and the difference margin obtained empirically in this paper is 29.906% which is the result of theoretical appreciation rate 49.539% minus the actual appreciation rate 19.633% during the period from July 2005 to December 2010⁴.

In the case of export tax rebate rate, its rise would cause export firms to reduce cost and increase profits on micro level, so that it might improve the international price competitiveness of product and encourage exports; then

⁴ Refer to the section IV (Conclusion) for further explanation.

exports increase on macro level would result in growth of the current account surplus in the case of imports to remain unchanged or increase less than exports. If the central bank does not intervene in the foreign exchange market, then an increase in current account surplus would form the direct pressure of RMB appreciation, based on the relationship between supply and demand in the foreign exchange market; but in the case of central bank's intervention, an increase in current account surplus would be converted into foreign exchange reserves increase, so that direct pressure of RMB appreciation would be converted into indirect pressure.

2. Empirical Model

Based on the above mentioned transmission mechanism of export tax rebates to foreign exchange rate, this paper builds up a set of simultaneous equations and conducts an empirical analysis of the relationship between export tax rebates and exchange rate. The entire empirical analysis model consists of the following four main equations:

1) The Export Tax Rebate and Net Exports Regression Model

Based on the studies by Arize (2000) and Chowdhury (1993), the regression model of export tax rebates and exports is extended as follows:

$$X_t = \theta_0 + \theta_1 TR_t + \theta_2 ER_t^* + \theta_3 V_t + \varepsilon_{t1}, \quad (1)$$

where X_t is the total exports at time t , TR_t is the total export tax rebates at time t , ER_t^* is the bilateral exchange rate of RMB and USD at time t , V_t is the volatility of exchange rate, ε_{t1} is the residuals at time t .

2) The Regression Equation of Imports and Exports on Current Account

In China the proportion of imports and exports in the current account is very large. Based on the relationship between trade and current account, we can show the following regression equation:

$$CA_t = r_0 + r_1 X_t + r_2 M_t + \varepsilon_{t2}, \quad (2)$$

where CA_t is the total current account at time t , X_t is the total exports at time t , M_t is the total imports at time t , ε_{t2} is the residuals at time t .

3) The Regression of Current, Capital and Financial Account on Foreign Exchange Reserves

In China the central bank (PBC) has had an impact on RMB exchange rate by intervening in foreign exchange market directly as well as indirectly. This paper focuses on the way of direct intervention, that is central bank's direct entering and transaction in the foreign exchange market, thus transforming original relationship of foreign exchange supply and demand, to result in the change in exchange rate. Central bank intervention such as spot foreign exchange transactions, repurchase transactions, etc. is bound to affect the current account, capital and financial account balance. Therefore, we can have the following regression function:

$$\Delta FR_t = \beta_0 + \beta_1 CA_t + \beta_2 KA_t + \beta_3 OR_t + \varepsilon_{t3}, \quad (3)$$

where ΔFR_t is the total foreign exchange reserves at time t , CA_t is the total current account at time t , KA_t is the total capital and financial accounts at time t , OR_t is the total errors and omissions at time t , ε_{t3} is the residuals at time t .

4) The Regression between Foreign exchange Reserves and Exchange Rates

The increment of foreign exchange reserves is used in this paper to measure the indirect pressure of RMB appreciation; therefore, the increment acts as the endogenous variable in the regression model as follows:

$$\Delta ER_t = \partial_0 + \partial_1 \Delta FR_t + \varepsilon_{t4}, \quad (4)$$

where ΔER_t indicates the nominal exchange rate movements at time t , ΔFR_t is the increment of foreign exchange reserves at time t , ε_{t4} is the residuals at time t .

The above (1), (2), (3), (4) regression equations are then unified into a set of simultaneous equations, established as the regression model of the export tax rebate on exchange rate in the following way:

$$\left\{ \begin{array}{l} X_t = \theta_0 + \theta_1 TR_t + \theta_2 ER_t^* + \theta_3 V_t + \varepsilon_{t1} \\ CA_t = r_0 + r_1 X_t + r_2 M_t + \varepsilon_{t2} \\ \Delta FR_t = \beta_0 + \beta_1 CA_t + \beta_2 KA_t + \beta_3 OR_t + \varepsilon_{t3} \\ \Delta ER_t = \delta_0 + \delta_1 \Delta FR_t + \varepsilon_{t4} \end{array} \right. \quad \begin{array}{l} (1) \\ (2) \\ (3) \\ (4) \end{array}$$

3. Empirical Testing of Export Tax Rebates and Foreign Exchange Reserves

1) Data Sources

The impact of the export tax rebate on RMB exchange rates has been transmitted through foreign exchange reserves, and therefore our empirical analysis starts directly from the relationship of export tax rebates and foreign exchange reserves. This paper selected quarterly data from 1994 to 2011. Sample points of the variables amount to 78.⁵ The raw data is sourced from *China Statistical Yearbook*, China's State Administration of Taxation and State Administration of Foreign Exchange.

2) Testing Time Series Stationarity

Seen by the above regression model, *TR* and *FR* denote export tax rebates and foreign exchange reserves respectively. At first, taking the natural logarithm of *FR* and *TR*, we get two sequences of *LFR* and *LTR*; that is, $LFR = \log(FR)$, $LTR = \log(TR)$. Then, taking the differential sequences of the two natural log sequences, we get *DLFR* and *DLTR*. And using EViews tools, we get the two sequences whose time series are stationary, so as to directly conduct a Granger causality test. The results of the stationarity test and Granger causality test of the export tax rebates and foreign exchange reserves are as follows:

⁵ The minimum sample size requirement in econometrics is in accordance with the principles of least squares and maximum likelihood, based on the central limit theorem. The sample size must not be less than the number of explanatory variables in the model. As a rule of thumb, at least 50 or more samples are needed to meet the basic requirements for doing an empirical analysis and estimation. This paper takes at least 78 samples, so complying with the requirement of sample size.

Table 1. Unit Root Testing

Variables	ADF t-statistic	1% significance level	5% significance level	10% significance level
<i>DLFR*</i>	-3.574200	-5.026425	-3.834394	-3.346031
<i>DLTR*</i>	-3.731629	-4.586826	-3.798975	-3.412824

Note: *DLFR* denotes first-order differential of the natural logarithm of foreign exchange reserves; *DLTR* indicates first-order differential of the natural logarithm of export tax rebates.

After processing the two time series data of the export tax rebate (*TR*) and foreign exchange reserves (*FR*), or after processing the natural logarithm and first-order differential of the time series data, both *TR* and *FR* now reject the null hypothesis of unit root existence at the 10% significance level. So, the processed data is stationary at the 10% significance level.

3) Testing for Granger Causality

Table 2. Testing for Granger Causality between *DLTR* and *DLFR*

Null Hypothesis:	Obs.	F-Statistic	Prob.
Foreign exchange reserves do not Granger cause export tax rebates.	78	4.91326	0.0408
Export tax rebates do not Granger cause foreign exchange reserves.	78	0.56639	0.7927

The results show that *DLTR* Granger causes *DLFR*. Or conversely, *DLFR* does not Granger cause *DLTR*. Therefore, we can conclude that the impact of the export tax rebate on the foreign exchange reserve is significant, so that the export tax rebate finally can affect RMB exchange rate via foreign exchange reserves.

4) Testing for Co-integration between *TR* and *FR*

First of all, setting the residual at time t to be μ_t , we conduct a linear regression analysis to examine the relationship between the export tax rebate and foreign exchange reserves. Table 3 reports the result.

Table 3. The Result of a Linear Regression Analysis

Variable	Coefficient	Std. Error	T-stat.	P-value
C	-648000000	2217.817	2.784224	0.0165
TR_t	105000	1.20E-06	7.888470	0.0000

And then, we do ADF unit root test for the residual series μ_t of the regression relationship between the export tax rebate (TR_t) and foreign exchange reserves (FR_t), whose results are shown in Table 4.

Table 4. The Result of Unit Root Test of μ_t

Variable	ADF t-statistic	1% significance level	5% significance level	10% significance level
μ_t	-3.691382	-2.452997	-1.87696	-1.403693

The results show that the residuals reject the null hypothesis of unit root existence in the time series data at the 1% significance level. So, the residual series is stationary at the 1% significance level.

Finally, we establish an ECM (error correction model)⁶ for ΔTR_t and ΔFR_t .⁷ The results are as follows:

Table 5. The Result of the Error Correction Model

Variable	Coefficient	Std. Error	T-stat.	P-value
C	-72.472	1403.975	2.453523	0.0341
ΔTR_t	26000	2.22E-06	1.107402	0.0875
μ_{t-1}	-18245.62	0.401583	1.817953	0.0713
		$R^2=0.8654$		

⁶ In doing empirical analysis between variables, the long-run equilibrium problem of non-stationary time series, which cannot be solved through differencing, can be addressed by ECM (error correction models) which regards the error term from cointegrating regression as the equilibrium error. ECM is a commonly used method in econometric analysis.

⁷ As for the equations (1) and (2), this paper does not conduct empirical data testing. So, Table 5 shows the main result of the empirical analysis of the export tax rebate and foreign exchange reserves, and Table 10 is the empirical estimation for the relationship between the foreign exchange reserves and exchange rates.

Based on the above results, we can draw the ECM (error correction model) for ΔTR_t and ΔFR_t , as follows:

$$\Delta FR_t = -72.472 + 26000\Delta TR_t - 18245.62\mu_{t-1} \quad (5)$$

4. Empirical Testing of Foreign Exchange Reserves and Exchange Rates

1) Data Sources

Here we now conduct another empirical testing for the relationship between foreign exchange reserves and exchange rates⁸, so as to check whether foreign exchange reserves can finally make any impact on exchange rates, and thus test whether the last link in the transmission mechanism is valid or not. We selected monthly data from January 1994 to December 2011. Sample points of the foreign exchange reserves and exchange rates amount to 216 respectively, or 432 in total sample size. The raw data is sourced from *China Statistical Yearbook*, China's State Administration of Foreign Exchange.

2) Testing Time Series Stationarity

Seen by the above regression model, FR and ER denote foreign exchange reserves and exchange rates respectively. At first, taking the natural logarithm of FR and ER , we get two sequences of LFR and LER ; that is, $LFR = \log(FR)$, $LER = \log(ER)$. Then, taking the differential sequences of the two natural log sequences, we get $DLFR$ and $DLER$. And using EViews tools, we get the two sequences whose time series are stationary, so as to directly conduct a Granger causality test. The results of the stationarity test and Granger causality test of the foreign exchange reserve and exchange rates are as follows:

Table 6. Unit Root Testing

Variables	ADF t-statistic	1% significance level	5% significance level	10% significance level
$DLFR^*$	-5.382544	-4.463067	-3.877325	-3.875825
$DLER^*$	-6.203265	-4.875752	-3.865292	-3.463067

Note: $DLFR$ denotes first-order differential of the natural logarithm of foreign exchange reserves; $DLER$ indicates first-order differential of the natural logarithm of foreign exchange rates.

⁸ This paper uses the real effective exchange rate.

After processing the two time series data of the export tax rebate (*FR*) and foreign exchange rates (*ER*), or after processing the natural logarithm and first-order differential of the time series data, both *FR* and *ER* now reject the null hypothesis of unit root existence at the 1% significance level. So, the processed data is stationary at the 1% significance level.

3) Testing for Granger Causality

Table 7. Testing for Granger Causality between *DLFR* and *DLER*

Null Hypothesis:	Obs.	F-Statistic	Prob.
Foreign exchange reserves do not Granger cause exchange rates.	216	1.95383	0.24137
Foreign exchange rates do not Granger cause foreign exchange reserves.	216	0.84891	0.39461

The results show that, comparatively speaking, *DLFR* Granger causes *DLER*, but *DLER* does not Granger cause *DLFR*. Therefore, we can conclude that the impact of the foreign exchange reserves on the exchange rate is significant. To sum up, the export tax rebate impacts the foreign exchange reserve, and then the foreign reserve significantly impacts the exchange rate, so that the transmission process is valid.

4) Testing for Co-integration between *FR* and *ER*

First of all, setting the residual at time *t* to be ϵ_t , we conduct a linear regression analysis to examine the relationship between the foreign exchange reserve and exchange rates. Table 8 reports the result.

Table 8. The Result of a Linear Regression Analysis

Variable	Coefficient	Std. Error	T-stat.	P-value
C	89.472605	0.011407	703.4133	0.0000
<i>FR</i>	-6.02E-05	2.03E-06	-62.85621	0.0000

And then, we do ADF unit root test for the residual series ϵ_t of the regression relationship between the foreign exchange reserve (*FR_t*) and exchange rates (*ER_t*), whose results are shown in Table 9.

Table 9. The Result of Unit Root Test of ε_t

Variable	ADF t-statistic	1% significance level	5% significance level	10% significance level
ε_t	-2.624285	-3.665225	-2.962598	-2.452421

The results show that the residuals reject the null hypothesis of unit root existence in the time series data at the 10% significance level. So, the residual series is stationary at the 10% significance level.

Finally, we establish an ECM (error correction model) for ΔFR_t and ΔER_t . The results are as follows:

Table 10. The Result of the Error Correction Model

Variable	Coefficient	Std. Error	T-stat.	P-value
C	-0.004221	0.002930	-2.324116	0.0149
ΔFR_t	0.0001032	6.12E-06	3.421057	0.0002
ε_{t-1}	-0.031319	0.020595	-1.841126	0.0452
$R^2 = 0.073619$				

Based on the above results, we can draw the ECM (error correction model) for ΔFR_t and ΔER_t . as follows:

$$\Delta ER_t = - 0.004221 + 0.0001032 \Delta FR_t - 0.031319 \varepsilon_{t-1} \quad (6)$$

Combining the equations (5) and (6) simultaneously, we can draw the converted equation:

$$\Delta ER_t = - 0.006762 + 0.7024 \Delta TR_t - 0.539725 \mu_{t-1} \quad (7)$$

Finally, we can use the equation (7) to figure out what happens to the foreign exchange rate if the export tax rebate changes.⁹ For example, when the unit of ΔTR_t is measured in RMB 10 billion *yuan*, and when a change in ΔTR_t amounts to 7.024 billion *yuan*, ΔER_t moves 1% to the same direction.

⁹ Since the export tax rebate (*TR*) indicates the amount of rebates, decrease in *TR* does not always reflect the decline in the rebate rate. Even if the rebate rate is unchanged, increase in exports could make *TR* rise, and decrease in exports could let *TR* decline. However, this paper assumes that changes in the export tax rebate amount are caused by the change of the rebate rate.

Based on the empirical results analyzing the above error correction model, we can estimate that an increase (decrease) of 7.024 billion *yuan* in the export tax rebate would result in 1% appreciation (depreciation) in RMB.

IV. Conclusion

In sum, this study constructs a RMB exchange rate transmission mechanism starting from the export tax rebate, and uses the Granger causality test to prove the causal relationship of kernel variables in the transmission mechanism, based on the relevant data from 1994 to 2011; and finally using an error-correction model to figure out the contribution rate of export tax rebate on the exchange rate.

Based on the empirical results, this study can draw several relevant implications as follows:

First of all, the pressure of RMB appreciation can be divided into direct pressure and indirect pressure. The former is formed by the excess demand for RMB due to the BOP (balance of payments) surpluses, and the latter is caused by the increments of foreign exchange reserves held by the central bank of China (PBC).

Secondly, it seems that the rise in RMB value is caused by the supply exceeding demand in China's foreign exchange market; however, actually it is because of the asymmetry of the RMB exchange rate formation mechanism. The export tax rebate policy implemented by the Chinese government is just one of the asymmetry factors in the exchange rate mechanism. The empirical results of this study show that an increase of 7.024 billion *yuan* in the export tax rebate would result in 1% appreciation in RMB.

Thirdly, our empirical results, analyzing the transmission mechanism to appreciation, show that the RMB exchange rate should have appreciated 49.539%, but actually appreciated 19.633% only during the period from July 2005¹⁰ to December 2010. That is due to the central bank (PBC)'s intervention in the foreign exchange market, so as to convert some direct pressure of RMB appreciation into the indirect pressure. In other words, some excess demand for RMB (29.906%) due to the BOP surpluses was converted to a huge increase (USD 2,114.605 billion¹¹) in China's foreign exchange reserves.

¹⁰ In July 2005 China introduced a new exchange rate regime, moving into a managed floating exchange system with reference to a basket of currencies, rather than pegging to the US dollar.

¹¹ In other words, the increase in the foreign exchange reserves held by the central bank of China amounts to USD 2, 114.605 during the period from July 2005 to December 2010.

Lastly, in the case of no major changes in China's internal and external economic fundamentals¹², or in the case of other factors affecting exchange rates being unchanged, China needs to reduce or even eliminate the asymmetry in the RMB exchange rate formation mechanism by taking some effective initiatives such as lowering or even eliminating export tax rebates, so as to ease the pressure of RMB appreciation.

References

- Arize, A. C., T. Osang and D. J. Slottje. 2000. "Exchange-rate Volatility and Foreign Trade: Evidence from Thirteen LCD's." *Journal of Business and Economic Statistics*, vol. 18, no. 1, pp. 10-17.
- Chen, B. 2005. "Discussion on the Influence of the New Export Tax- reimbursement on the Exchange Rate of RMB." *Sci-Tech Information Development & Economy*, no. 9, pp. 140-141. (in Chinese)
- Chowdhury, A. R. 1993. "Does Exchange Rate Volatility Depress Trade Flows? Evidence from Error-correction Models." *The Review of Economics and Statistics*, vol. 75, no. 4, pp. 700-706.
- He, L. 2011. "China should keep sufficient foreign exchange reserves." *People's Daily Online*, October 9, <http://english.peopledaily.com.cn/90780/7612542.html> (Accessed April 20, 2012).
- Jin, X. 2002. "A Comparative Study between RMB Depreciation Policy and Export Tax Rebate Rate Adjustment." *Finance and Trade Research*, no. 2, pp. 73-76.
- Lardy, N. R. 2012. *Sustaining China's Economic Growth - After the Global Financial Crisis*. Washington: Peterson Institute for International Economics.
- Lee, T. and D. Ma. 2004. "New Explanation on the Mechanism of RMB's Exchange Rate: Governmental Activity and the Non-symmetric Property." *Journal of Sichuan University (Social Science Edition)*, no. 2, pp. 10-14. (in Chinese)
- Luo, K. and J. Wang. 2004. "The Pressure of the Appreciation of RMB: Causes and Alleviating Methods." *Nankai Journal*, no. 2, pp. 56-63. (in Chinese).
- Ma, D., D. Zang and Z. Kang. 2010. "The Analysis on the Non-symmetry in the Pressure of RMB Appreciation." *Shanghai Finance*, no. 8, pp. 70-75.
- Mundell, R. 2003. "China Should Maintain Exchange Rates for Yuan." *Xinhua New Agency*, September 15.
- National Bureau of Statistics of China, *China Statistical Yearbooks*, 2004-2011.
- Pei, C. and W. Zheng. 2010. "Relationship between RMB Exchange Rate and Trade Balance: China's Perspective." *Chinese Review of Financial Studies*, no. 1, pp.

¹² Internal economic fundamentals in China mainly refers to the productivity of domestic products, economic structure, etc.; external ones to global economic recovery, global effective demand, etc.

- 21-36. (in Chinese)
- Xu, N. 2005. "The Empirical Analysis of Effectiveness to Foreign Trade and Exchange Rate by Export Duty Rebate Policy Adjustment." *Journal of Changsha University*, no. 1, pp. 24-28. (in Chinese)
- Yang, S. and W. Huang. 2006. "An Empirical Analysis of the Impacts of Export Tax Rebate Policy on RMB Exchange Rate." *Journal of Hunan Business College*, no. 2, pp. 66-72. (in Chinese)
- Yang, Y. 2006. "A Study of the Effect Mechanism of Export Tax Rebate on RMB Exchange Rate." *Journal of Social Science of Hunan Medical University*, no. 1, pp. 73-76. (in Chinese)
- Yao, X. 2005. "Analysis on the Causes of the Upvaluation Pressure of RMB and Countermeasures." *Sci-Tech Information Development & Economy*, no. 5, pp. 100-101. (in Chinese)
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