Analysis of the RMB Exchange Rate Formation Mechanism
Based on the Currency Basket

HUI Xiao-feng，XING Liang

School of Management, Harbin Institute of Technology, Harbin 150001, P.R.China

Abstract: In this paper, we study the RMB exchange rate formation mechanism based on the weights of each currency in the currency basket. To figure out the composition of the currency basket of RMB exchange rate and construct the weight model of the currency basket in empirical study, we use the monthly data of the import and export among China and USA, euro area, Japan, South Korea during the period of January 2006 to December 2012. Since 2005, the People's Bank of China claimed that RMB exchange rate system will be reformed transferring from the actual pegged to the currency basket system. However, Compared with the proportion of U.S. dollar, euro, yen and won in the basket currency, we find that, at this stage, our exchange rate system is still pegged to the U.S. dollar, which will do harm to the economic development in a long term. It is essential and helpful for the formation of exchange rate to study on the composition of the currency basket in such a situation. Finally, some conclusions are get about the RMB exchange rate formation mechanism.

Keywords: currency basket, economic impact, exchange rate system, trade weight

1 Introduction

Since its accession to the WTO in December 2001，China has begun to open its market gradually, which makes it more significant for China to establish a suitable RMB exchange rate mechanism to fulfill development needs of economic[1]. In July 21, 2005, the People's Bank of China, which is also called Central Bank of China, reformed the RMB exchange rate formation mechanism. Announced to start implementing a managed floating exchange rate system, in reference to a basket of currencies, on the basis of market supply. The RMB exchange rate was no longer pegged to the US dollar, but a reference to a basket of currencies, which made the Chinese exchange rate regime more flexible and provided protection for the smooth development of China's economy. Compared with the old formation of RMB exchange rate ,an obvious difference of the new is

the abolition of the U.S. dollar peg-style policies and to introduce the currency basket to make China's exchange rate regime more flexible after the reforming the formation of RMB exchange rate[2].Meanwhile, the Central Bank decided to expand the daily range of rate volatility of the nominal exchange rate of RMB to U.S. dollar, and the nominal exchange rate would be changed from the original three per thousand into the current five per thousand.

As a result of the impact of the economic crisis in 2008, the RMB exchange rate backed to US dollar peg-type from the second half of 2008 to the first half of 2010. Nevertheless, with weakening of the financial crisis, the Central Bank decided to continue to implement the basket currency policy[3], based on considering the domestic and international economic situation and China's circumstances. During several years implemented the basket currency, the RMB exchange rate was stable at a reasonable exchange rate and fluctuated around the equilibrium exchange rate. Therefore, the Central Bank decided to formally end the exchange rate policy pegged to U.S. dollar. Besides, in April 2012, in order to further improve the exchange rate system of the basket currency, the Central Bank has decided to relax the fluctuation range of the RMB against the U.S. dollar that changes from the original five per thousand to one percent in the foreign exchange market[4].

2 Literature review

In July 2005, China Central Bank carried out the reform of the RMB exchange rate regime, which brought China's exchange rate regime into a new stage. But according to Goldstein and Lardy's (2006) study of RMB exchange rate policy, the RMB exchange rate is still pegged to the U.S. dollar. And other currencies do not have great impact on China's exchange rate, even none[5]. On Chinese exchange rate market, the Central Bank still occupies the driving position and manipulates the RMB exchange rate level[6].

However, some scholars hold different views. Yamazaki (2006) used weight estimation method to study the exchange rate level. He found that the U.S. dollar's

proportion of the currency basket began to reduce, while the proportion of the euro, yen and won began to increase[7]. Eichengreen's research (2006) demonstrated that the proportion of the U.S. dollar did not reduce in the Chinese currency basket under a long-term trend, and the RMB exchange rate was still pegged to the U.S. dollar. China is a great power in the world, so that the reform of China's exchange rate system will have a huge influence on the whole world economy and will provide a good opportunity for other countries to solve their economic problems. For instance, if the RMB exchange rate continues to appreciate, after a long-term effect, China's trade surplus status will be changed, so that some changes will occur in the pattern of world trade[8]. Frankel and Wei (2007) used weight estimation method to analyze the data within six months after the reform of the RMB exchange rate regime. The study found that, at the beginning, the U.S. dollar has a large proportion of the currency basket, more than the summation of proportion of euro, yen and won. So, from which we cannot simply affirm what policies, basket currency policy or U.S. dollar pegged policy, China executes. However, as time goes on, the circumstances have changed. Although the U.S. dollar, the euro, the yen and the won still occupy a big share of the weight, the US dollar's position in the basket currency has occurred loose. The flexibility feature of basket currency policy has become prominent gradually[9]. They insist on that the RMB exchange rate is not controlled artificially.

Unlike the foreign scholars, some domestic scholars did not focus on the exchange rate mechanism itself, they believe the financial risk is the decisive factor that affects China's exchange rate. Yang Li and Weibin Yu (2005) hold the view that maintaining the stability of the RMB exchange rate should treat as fundamental and reforming the RMB exchange rate regime should treat as primary task, as well as paying attention to the risk of currencies, when reforming the RMB exchange rate[10]. He Fan (2005) considers that China should intensify the management of hot money and prevent hot money from flowing into the market to shock the Chinese economy. Besides accelerating the research of tools and methods that can avoid and reduce foreign exchange risk, then establishing the market mechanism determined by the exchange rate [11].

However, some economic scientists mainly study on the internal part of the exchange rate mechanism, the structure and application of the currency basket. Zhihao Wang (2005) and other economists hold the view that our existing exchange rate system has been reformed, but the new exchange rate regime is not suitable for China's economic development. Compared with the pegged U.S. dollar, in a short period, there are still many drawbacks and problems of the currency basket[12]. He insists on that the RMB exchange rate regime will turn to "basket, block and crawling" form, which is also known as the "BBC" rule[13].Zhizhong Yao(2005) compared the reference to the currency basket with pegged to the currency basket, and he drew the conclusion that China

should peg to a basket of currencies in the short-term, while reference to a basket of currencies regime should be implemented in the long-term. Because the range of exchange rate fluctuations in the short term will not change. If the exchange rate wants to change, it just follows weights which are announced in the currency basket. Nevertheless, range of floating rate often changes in long term, thus we should fix on it [14].

Since 2009, some scholars began to estimate the currency basket by using econometrics. Yuliu Peng(2009) finds that the RMB exchange rate regime pegged to the U.S. dollar is a similar type of system-soft pegged exchange rate regime[15]by analyzing the RMB exchange rate regime and using an econometric model. Man Jia, Zhifeng Zheng and Huifen Nie(2009)estimate and evaluate elements of the currency basket. Through using daily exchange rate data, they find that the basket currency is mainly constructed by four currencies, which include U.S. dollar, euro, yen and won. As time goes on, the proportion of the U.S. dollar in the currency basket has decreased[16], which shows that the trend of marketization of RMB exchange rate cannot be prevented. Yaocheng Liu (2010) put forward that it is necessary to reduce the Central Bank's control of the RMB exchange rate for China to create the perfect RMB exchange rate formation mechanism to promote economic development. Only follow this way, could China reach the target for the reformation of exchange rate[17].

3 The model

3.1 Building model

Although at this stage, we are not very clear that which specific currency China's basket currency will choose. Xiaochuan Zhou who is the governor of the central bank at that time once said, a basket of currencies focused on the weight of trade in goods and services, therefore, dollar, euro, yen and the won would be surely considered to choose, in August 10, 2005[18]. This paper chooses swing franc, which not belongs to basket currency, as an intermediate standard of measurement[19]. According to the method of estimating the basket currency Frankel put forward, the fluctuation of basket currency to the Swiss franc can be presented by the fluctuations of RMB to the Swiss franc, we can establish a model[20].

The model is as following:

$$\Delta_{CNY/CHF} = \alpha_0 + \alpha_1\Delta_{USD/CHF} + \alpha_2\Delta_{EUR/CHF} + \alpha_3\Delta_{JPY/CHF}$$

$$+ \alpha_4\Delta_{KER/CHF} \tag{1}$$

In which, $\Delta_{CNY/CHF}$ stands for logarithm of CNY-CHF on the difference form. $\Delta_{USD/CHF}$ means logarithm of USD-CHF on the difference form. $\Delta_{EUR/CHF}$ represents logarithm of EUR-CHF on the difference form. $\Delta_{JPY/CHF}$ means logarithm of

JPY-CHF on the difference form. $\Delta_{KER/CHF}$ stands for logarithm of KER-CHF on the difference form. α_i means currency weights of the RMB currency basket, i=0,1,2…

3.2 Model refinement

Frankel's method, the basket currency estimation, just simply estimated from the angle of currency, not considered the international trade, thus the result may be ex parte[21]. With the development of our national economy, international trade is playing a more and more important role[22]. Therefore, we put the trade weight into the model coefficient.

According to Chinese foreign trade situation from 2006 to 2012, we choose USD, EUR, JPY and KER as the main international currencies(United States, Europe zone, Japan and Korea are our main trade partners.) We use trade-weighted method to calculate the weight of the effective exchange rate. The currency weight of i(trading partners) which comes from the effective exchange rate of the j (domestic) acts as the trade coefficient in the currency basket, it must include the competition of import and export. Therefore, equations are as following:

Weights of import: $w_i^m = m_j^i / m_j$ (2)

Weights of export: $w_i^x = x_j^i / x_j$ (3)

Final weights: $w_i = \left(\dfrac{m_j}{x_j + m_j} \right) w_i^m + \left(\dfrac{m_j}{x_j + m_j} \right) w_i^x$ (4)

In which, x_j^i and m_j^i stand for the export and import of j to i, x_j represents total exports of j, and m_j means j's total import.

According to trade data of each month from 2006 to 2012, calculate the weights.

$$\frac{x_j}{x_j + m_j} = 0.53709033, \quad \frac{m_j}{x_j + m_j} = 0.46290967$$

Therefore, results are as following in Tab.1.

Tab.1 Weights of RMB effective exchange rate index

Country	Final weight of basket currency
US	0.134105104
EA	0.160074226
JP	0.103495984
KER	0.072144669

Data sources: Wind databases, use Excel software to process the data.

Then the model turns to

$$\Delta_{CNY/CHF} = \alpha_0 + 0.134105104\alpha_1\Delta_{USD/CHF}$$
$$+ 0.160074226\alpha_2\Delta_{EUR/CHF} + 0.10349598\alpha_3\Delta_{JPY/CHF}$$
$$+ 0.072144669\alpha_4\Delta_{KER/CHF} \quad (5)$$

3.3 Empirical analysis

Test data

The unit root test on the won the opening price of RMB, U.S. dollar, Euro, Japanese yen to Swiss Franc should be carried on. In order to make sure the test results, we need the logarithm of variables. The results of unit root test are as following in Tab.2.

Tab.2 Results of unit root test of CNY-CHF

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.16684	0.21914
Test critical values:	1% level	-3.453997	
	5% level	-2.871845	
	10% level	-2.572334	

According to the test results, the P value is too high. It is not satisfied with the unit root test, so that we make once difference, then it passes the test. The results are as following in Tab.3.

Tab.3 Results of unit root test of CNY-CHF after the first difference

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-19.06933	0.0000
Test critical values:	1% level	-3.453997	
	5% level	-2.871845	
	10% level	-2.572334	

Data sources: Wind databases, use Eviews software to process the data

As the same, carry on the unit root test on other variables, the results are as following (Tab.4, Tab.5, Tab.6, Tab.7).

Tab.4 Results of unit root test of USD-CHF after the first difference

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.132381	0.00000
Test critical values:	1% level	-3.433779	
	5% level	-2.862941	
	10% level	-2.567563	

Tab.5 Results of unit root test of EUR-CHF after the first difference

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.808122	0.00000
Test critical values:	1% level	-3.433779	
	5% level	-2.862941	
	10% level	-2.567563	

Tab.6 Results of unit root test of JPY-CHF after the first difference

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.672936	0.00000
Test critical values:	1% level	-3.433779	
	5% level	-2.862941	
	10% level	-2.567563	

Tab.7 Results of unit root test of KER-CHF after the first difference

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-19.48788	0.00000
Test critical values:	1% level	-3.433953	
	5% level	-2.863018	
	10% level	-2.567604	

Data sources: Wind databases, use Eviews software to process the data

Through the unit root test, we find that all the variables of ADF test are significant at the level of 1% after first order difference. It shows all sequences become stationary sequence after first order difference, which is the premise to continue estimate the model.

3.4 Analysis of the results

In order to facilitate the research, this paper segments handling data from 2006 to 2012, and divides overall sample into four sub samples. 2006 is the first year for the beginning to execute the new exchange rate policy, therefore, we consider it separately. 2007 should be more obvious to the new exchange rate policy after the new exchange rate policy, and the basket currency policy has executed for one year, thus we should also consider it separately. The fluctuations of RMB exchange rate is not so obvious during 2008 to 2010, especially during 2009 to 2010, therefore, we can put the three years together to research them. RMB exchange rate has begun to appreciate obviously during 2011 to 2012, so we put these two years' data together to study. The result of model can be presented in tab.8.

From the estimation results of the overall sample's model, the statistics of each currency is very significant, therefore, the estimation results of model is effective. In which, the coefficient of USD is 0.782, while the coefficient of EUR,JPY and KER are 0.202、0.003 and 0.013, the dollar's coefficient is far greater than the sum of euro, yen and the won. This situation indirectly shows that China's RMB exchange rate is a basket of currencies at the present stage, but the estimation results of the model demonstrate that the other basket currencies accounts for a small percentage, even we can neglect them, except U.S. dollars. Therefore, results from model estimation can be seen, it is proper to say the current RMB exchange rate system is the pegged US dollar regimes.

From the estimation results of the overall sample's model, the statistics of each currency is very significant, therefore, the estimation results of model is effective. In which, the coefficient of USD is 0.782,while the coefficient of EUR,JPY and KER are 0.202、0.003 and 0.013, the dollar's coefficient is far greater than the sum of euro, yen and the won. This situation indirectly shows that China's RMB exchange rate is a basket of currencies at the present stage, but the estimation results of the model demonstrate that the other basket currencies accounts for a small percentage, even we can neglect them, except U.S. dollars. Therefore, results from model estimation can be seen, it is proper to say the current RMB exchange rate system is the pegged US dollar regimes.

From the results of the sub samples' model estimation, coefficients of USD are all greater than 0.7,while the coefficients of EUR, JPY and KER are very small, even the dollar's coefficient is far greater than the sum of euro, yen and the won, except the second sample which is the result of model estimation in 2007. It is the same to the result of overall sample. To a certain degree, this fact shows the current RMB exchange rate system is pegged U.S. dollar regime. From the result of model estimation of 2007, the dollar's coefficient is 0.294, the coefficient of euro is 0.276, the coefficient of yen is 0.061 and the coefficient of won is 0.369. It is amazing

Tab.8 Estimation results of weights about RMB basket currency

	USD	EUR	JPY	KER	R^2	W-D
2006.01-2012.12	0.782	0.202	0.003	0.013	0.961	2.893
	(2033)	(2.73)	(6.73)	(46.22)		
2006.01-2006.12	0.715	0.216	0.065	0.004	0.973	2.041
	(-3.63)	(0.973)	(7.61)	(0.53)		
2007.01-2007.12	0.294	0.276	0.061	0.369	0.994	1.942
	(8.852)	(5.39)	(6.09)	(11.12)		
2008.01-2010.12	0.772	0.209	0.003	0.016	0.932	2.484
	(348.7)	(2.37)	(3.44)	(4.67)		
2011.01-2012.12	0.746	0.237	0.009	0.008	0.973	2.393
	(100.7)	(3.92)	(3.17)	(2.43)		

Data sources: Wind databases, use Eviews software to process the data.

that the biggest coefficient is the won in that year. Comparing with the results of these years' model estimation vertically, we can find out that the coefficient of won in 2007 is the biggest during 2006 to 2012, and the coefficients of EUR and JPY both have increased, but this growth is not obvious. It shows that the proportion of the euro and yen in basket currency has also raised. China's exchange rate system might indeed execute the currency basket policy in that year. However, results from the model estimation of 2008 can be seen, the currency basket policy hasn't carried out through to the end. In fact, the RMB exchange rate regime executed the policy of the pegged U.S. dollar after the financial crisis in 2008.

4 Conclusion

Although the authority declares that RMB exchange rate formation mechanism is the currency basket system, it is actually pegged U.S. dollar policy through the result of the model, which collects the data during the period of January 2006 to December 2012 and uses the method of the trade weights instead of the usual to estimate the currency basket. The U.S. dollar still occupies 78.2 percent of the currency basket, which means that RMB will be impacted as long as the price of the U.S. dollar causes fluctuation. With the development of our national economy, China has many trade partners and the main trade partner is not just USA. RMB should be influenced by multiple currency together. In this situation, it can be effective to avoid the impacted of a single currency. Therefore the currency basket policy should be insisted, and in the currency basket, the share of U.S. dollar is supposed to be reduced and the kinds of currencies had better be enriched.

References

[1]Wei Zhou. Chinese formation mechanism of the reform of RMB exchange rate [D]. 2011. (in Chinese)

[2]Taro E. De facto exchange rate regimes and currency crises: Are pegged regimes with capital account liberalization really more prone to speculative attacks? [J]. Journal of Banking & Finance, 2010(6): 1109-1128

[3]Shinji T, Thi H, Anh P. Responding to the global financial crisis: Vietnamese exchange rate policy, 2008-2009 [J]. Journal of Asian Economics Economics, 2011(12): 507-517.

[4]Osamah M. Al-Khazali, Chong S P, Daewon K. Are exchange rate movements predictable in Asia-Pacific markets? Evidence of random walk and martingale difference processes [J].International Review of Economics & Finance, 2012(1): 221-231.

[5]Goldstein M, Lardy N. China's exchange rate policy dilemma [J]. American Economic Review, 2006, 96: 422-426.

[6]Goldstein M, Lardy N. The future of China's exchange rate policy [M]. US: The Peterson Institute for International Economics, 2009.

[7]Yamazaki K. Inside the currency basket [N]. Working Paper, Columbia University and Mitsubishi UFJ Trust and Banking Corp, 2006(12).

[8]Eichengreen B. China's exchange rate regime: The long and short of it [N]. Paper for conference on Chinese Money and Finance, Columbia University, New York, 2006.

[9]Frankel J, Wei S. Assessing China's exchange rate regime [N]. NBER Working Paper, No.13100, 2007: 1-79.

[10]Yang Li, Yu Weibin. The reform of RMB exchange rate system: Return to a managed floating mechanism [J]. Economic Research, 2005(8): 23-26. (in Chinese)

[11]Fan He. How to adjust RMB exchange rate policy [J]. Modern Commercial Bank, 2005(6): 11-13.

[12]Wang Zhihao. How to how to observe Chinese economy, if official data has problems? [C]// 2012 CMRC Observation of Chinese Observation in Summer, 2012(30): 27-39. (in Chinese)

[13]Wang Zhihao. The exchange rate of the RMB will shift to "basket, areas, crawl" [J]. The New Finance, 2005(4): 12-13. (in Chinese)

[14]Yao Zhizhong. Pegging to a basket of currencies and reference to a basket of currencies [N]. 21st Economic Daily, 2007. (in Chinese)

[15]Peng Yuliu. Analysis of the RMB exchange rate system after "reformation of exchange rate" [J]. Contemporary Finance, 2009(1): 23-25. (in Chinese)

[16]Jia Nan, Zheng Zhifeng, Nie Huifen. After the formation mechanism of the reform of RMB exchange rate: Estimation based on weight of exchange rate about a basket of currencies exchange rate [J]. The World Economy, 2009(5): 62-64. (in Chinese)

[17]Liu Raocheng. Fluctuation characteristics and policy choice of RMB exchange rate after "the reformation of exchange rate" [J]. Shanghai Economic Research, 2010(1):13-14. (in Chinese)

[18]Wang Jianjun. Zhou Xiaochuan. Remove a cover from a basket of currencies [N]. Outlook Weekly Magazine, 2005(8): 32-33. (in Chinese)

[19]Frankel W. Yen bloc or dollar bloc? Exchange rate policies of the East Asian economies. Ito T, Krueger A O. (eds.). Macroeconomic Linkages: Savings, Exchange Rates and Capital Flows. Chicago: University of Chicago Press, 1994.

[20]Alice Y Ouyang, Ramkishen S Rajan, Alice Y Ouyang, Ramkishen S Rajan. Real exchange rate fluctuations and the relative importance of nontradables [J]. Journal of International Money and Finance, 2013(2): 844-855.

[21]Lee Hsiu-Chuan, Chang Shu-Lien. Spillovers of currency carry trade returns, market risk sentiment, and U.S. market returns [J]. The North American Journal of Economics and Finance, 2013(12): 197-216.

[22]Sabrina Dorn, Peter H Egger. Fixed currency regimes and the time pattern of trade effects [J]. Economics Letters, 2013(5): 120-123.