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**A Retrospection of the Chinese Exchange Rate Regime after Reform:
Stylized Facts in the Five Years**

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Abstract

In this paper, we estimate the *de facto* RMB exchange rate regime, currency basket, floating band and foreign exchange market pressure before and after the reform of the Chinese exchange rate regime in 2005. The stylized facts indicate that the value of RMB became more stable; the weight of US Dollar keep high in the basket, but other currencies become statistically significant; the flexibility band gradually increased to 10% in the first three years but greatly narrowed since the late summer of 2008 under the assumption of yearly resetting interval. We found that the foreign exchange market pressure became higher after the reform till 2008. The reason for it might be the weight of US Dollar in the basket is lower than the share of US Dollar in total transaction on the Chinese foreign exchange market. Since RMB tightened its peg to US Dollar in 2009, the foreign exchange market pressure became lower.

1. Introduction

China had established its inter-bank foreign exchange market and the initial exchange rate determination mechanism by market transaction in 1994, and further realized current account liberalization in 1996. However, the stable exchange rate policy of the Chinese government since the Asian financial crisis gradually evolved into a *de facto* dollar-peg system. In 2005, Chinese authority announced the RMB will switch to a basket peg regime, and later disclosed a list of 11 currencies those were important to the basket in light of their trade share in China's total trade relation.

Empirical studies of the new Chinese exchange rate regime began shortly after the reform. Shah, Zeileis and Patnaik (2005) use daily data of 68 observations after July 26, 2005 to examine the new Chinese exchange rate regime. They find RMB has remained peg to dollar, rather than a basket, and has extremely limited currency flexibility. Ogawa and Sakane (2006) found that the Chinese government had a statistically significant, but small change in exchange rate policy during their sample period from January 3, 2005 to January 25, 2006. Moosa (2008) try to verify the new Chinese exchange rate regime based on daily data from July 21, 2005 to May 24, 2007, and show that while a regime of simply and strict dollar peg has indeed been abandoned. Their evidence does not support the proposition that the current exchange rate regime is a basket peg, but some sort of discretionary crawling peg against U.S. dollar. Frankel (2009) estimate RMB basket with daily exchange rate data from August 2005 to November 2008 and find the basket had switched a substantial part of the dollar's weight onto the euro. Hence, the appreciation of the RMB against the dollar during his sample period was due to the appreciation of the euro against the dollar.

The paper will focus on the three issues as follows: what is the *de facto* RMB exchange rate regime? How about the basket composition? Are there some changes in terms of the foreign exchange market pressure? And finally, based on those finds, how to evaluate the RMB exchange rate regime?

2. The *de facto* RMB Exchange Rate Regime

Three key steps are needed in verifying the *de facto* RMB exchange rate regime if RMB follow variants of Band-Basket-Crawl¹. The first is the classification of the *de facto* exchange rate regime of RMB, the second is the estimation of the currency basket, and the last is the inferring flexibility band.

2.1 The Estimate for the *de facto* RMB Exchange Rate Regime

Applying the methodology of Levy-Yeyati and Sturzenegger (2003), we try to demonstrate characteristics of the exchange rate of RMB against US Dollar by the exchange rate volatility of RMB against US Dollar (the average of the absolute monthly percentage changes in the nominal exchange rate during a calendar year, δ_e), the volatility of exchange rate changes (the standard deviation of the monthly percentage changes in the exchange rate, $\delta_{\Delta e}$), and the volatility of reserves (δ_r)². Using the monthly data by calendar year interval, we can have four groups from July 2005 to June 2009. We collect data from July 2001 to June 2005 in four groups also for the aim of comparative analysis. Since the China's exchange rate regime is widely known as dollar peg before the reform and was announced as basket peg after the reform, we measured two set of exchange rate data, RMB against US Dollar and RMB against Swiss franc to make sure if the shift is really made respectively³. Exchange rate of RMB against US Dollar and exchange rate of RMB against Swiss franc were obtained from the Pacific Exchange rate Service of the Sander School of Business, the University of British Columbia (UBC database). Data which needed in calculation of δ_r were obtained from International Financial Statistics (IFS). Table 1 presents the results of the exchange rate data of RMB against US Dollar, and the results of the exchange rate data of RMB against Swiss franc presents in the bracket.

Table 1 *de Facto* Exchange Rate Regime of RMB before and after July 2005

	δ_e	$\delta_{\Delta e}$	δ_r
2001.7 - 2002.6	0.00352 (1.88953)	0.00369 (1.46521)	1.72223
2002.7 - 2003.6	0.00493 (1.92854)	0.00397 (1.84215)	1.32144
2003.7 - 2004.6	0.00664 (2.08954)	0.00316 (1.45928)	1.29872
2004.7 - 2005.6	0.00483 (2.00783)	0.00313 (1.47689)	2.95689
2001 – 2005 Average	0.05981 (1.97886)	0.00357 (1.56088)	1.82482
2005.7 – 2006.6	0.27498 (1.73282)	0.44236 (1.31887)	2.65754
2006.7 – 2007.6	0.40403 (1.26565)	0.19728 (0.83575)	3.37697
2007.7 – 2008.6	0.83359 (1.79160)	0.45662 (1.76058)	4.08693

¹ There are five keys elements in BBC regime according to Williamson (1999). They are the choice of peg basket, the choice of intervention currency, the choice of parity, the choice of band width and the choice of rate of crawl.

² In order to estimate as closely as possible the change in reserve that reflects intervention, Levy-Yeyati and Sturzenegger (2003) subtracted government deposits t the central bank from the central bank's net foreign assets as: $R_t = \frac{\text{Foreign Asset} - \text{Foreign Liabilities} - \text{Central Government Deposits}}{e_t}$. Hence, the monthly intervention on foreign

market (r_t) is defined as $r_t = \frac{R_t - R_{t-1}}{\text{Monetary Base}_{t-1} \cdot e_t}$.

³ For countries that report a fixed exchange rate regime, Levy-Yeyati and Sturzenegger (2003) use the legal peg currency as reference or the currency against which their exchange rate exhibits the lowest volatility. For countries that pegged their currency to a basket, they eliminated from the sample unless the central peg parity or the basket weight were known. Here we report volatility characteristics of the exchange rate of RMB against Swiss franc to verify if the shift from dollar peg to basket peg is really made, even though US Dollar still significant in the basket.

2008.7 – 2009.6	0.15778 (2.59143)	0.28005 (1.64426)	2.27301
2005 – 2009 Average	0.41760 (1.84538)	0.34408 (1.38987)	3.09861

Source: calculated by the author based on data from UBC database.

Table 1 shows there are some changes happened in the *de facto* RMB exchange rate regime. First, the exchange rate of RMB against US Dollar significantly became float after July 2005. In the meantime, the exchange rate of RMB against Swiss franc became a little bit stable. The high percentage change of exchange rate of RMB against US Dollar suggest a deviate from dollar peg, and the low percentage change of the exchange rate of RMB against Swiss franc indicate the stabilizing effect of a basket peg on RMB value since the reform. Second, the volatility of the exchange rate of RMB against US Dollar is higher than the volatility of the exchange rate of RMB against Swiss franc. It suggests the same conclusions above. Third, the volatility of reserves that reflect central bank intervention on foreign exchange market became more intensive obviously. According to the *de facto* exchange rate regime classification of Levy-Yeyati and Sturzenegger (2003), those changes indicate the exchange rate of RMB against US Dollar presents features of dirty float or discretionary crawling peg as the conclusion of Moosa (2008), the exchange rate of RMB against Swiss franc presents features of fixed regime⁴. If we can find the exchange rate of RMB is really basket pegged, the stable value of RMB, measured by Swiss franc as numeraire, will be one of the expected goals of a basket peg regime.

2.2 The Estimate for RMB Currency Basket

We can make sure that if the exchange rate of RMB is really pegged to a currency basket by the estimation of currency basket composition that RMB is actually pegged to. In other words, if the inferred currency basket is statistically significant, the result can be a verification of the existence of the basket itself and a verification of the *de facto* RMB basket peg regime simultaneously.

The initial method of uncovering weights of constituent currency in a *de facto* basket by ordinary least squares (OLS) regression was established by Frankel and Wei (1994), further developed by Mckinnon and Schnabl (2003), Schnabl (2006), and was widely used in research. However, there are differences in technical details.

The first issue is the choice of numeraire, or the measurement of the value of a currency. In order to measure the value of a currency, Frankel and Wei (1994) was the first to express in terms of a remote currency, the Swiss franc exclusively⁵. The numeraire was soon widely accepted by other researchers of the time. From Frankel and Wei (2007), they began to use SDR as the numeraire because they believe a weighted index such as the SDR or a trade-weighted measure is probably more appropriate⁶. The reason they put forward is authority's intervene depends on the magnitude of the deviation from their reference basket, usually a weighted average of major

⁴ Comparing the changes of δ_e , $\delta_{\Delta e}$ and δ_r before and after July 21, 2005, the exchange rate of RMB against US DOLLAR became high-high-high, and the exchange rate of RMB against Swiss franc became low-low-high. Follow the classification standard of Levy-Yeyati and Sturzenegger (2003), we can make the judgment in the context.

⁵ In Frankel (1992), he initially chooses the inverse of domestic CPI as the numeraire, so as to interpret changes in the value of a currency as the changes in its purchasing power. However, the CPI data are only available on a monthly basis rather than daily or weekly data which are often used in exchange rate analysis.

⁶ In fact, Frankel and Wei (1994) have tried the same test using the SDR as the numeraire for several countries, and find very similar results.

currencies rather than a remote currency like the Swiss franc. If a similar measure is used in the equation, it should help minimize the possibility of correlation between the error term and the numeraire. The fact is true on one hand. On the other hand, since the main currencies in SDR already included in the equation as candidate currencies of the basket, applying the exchange rate of currencies against Swiss franc for regression result will be more clearly demonstrate the volatility of and the correlation among the value of those currencies than applying the exchange rate of currencies against SDR. In fact, a merit of a remote currency, like Swiss franc, is its lower correlation with US dollar, Euro and Japanese yen than the SDR's. In this paper, we will use Swiss franc as numeraire to measure the value of candidate currencies.

The second issue is the choice of the regression period. Frankel and Wei (1994) made their first regression estimation by all available data in one period. Later researchers divided their available data into several periods, like yearly, quarterly or monthly, rolling regression is also applied, in order to estimate the basket changes during different periods. Obviously, if there are no structural change happened, extending the regression period as long as possible could decrease the effect of white noise on regression results, and make more exact overall estimate for the currency basket. Considering the fact that composition and weights of the currency basket may be changed over time, the choice of regression period might be necessary. However, the regression period should be approximately close to the possible basket resetting interval. Apparently, monthly period might be too short as Frankel and Wei (2009) in their estimation of RMB basket, and yearly period might be appropriate. The final choice should be made by the rationality of the regression result. Enchengreen (2006) use rolling regression, moving-window width is fixed at 30 observations, to estimate the consecutive change of RMB basket. From the perspective of regression estimation, rolling regression could take structural change into consideration. From the perspective of policy implication, rolling regression could made more exact estimation for the continuously basket resetting under discretionary crawling peg regime or dirty float.

In this paper, we use Swiss franc as numeraire, take US dollars, Euro, Japanese yen, Korean won, Singapore dollars, British pounds, Malaysian ringgit, Russian rubles, Australian dollars, Thai baht and Canadian dollars as the candidates, make estimation of RMB currency basket with daily data from July 21, 2005 to March 3, 2010. Since the reform of RMB exchange rate regime began in July 21, 2005, the Chinese economy experienced the shock of global financial turmoil from September 2008, but there are no critical change in the basket was found⁷. The estimate equation is as follow:

$$d(\log(CNY))=a_1d(\log(USD))+a_2d(\log(EURO))+a_3d(\log(JPY))+a_4d(\log(KRW))+a_5d(\log(SGD))+a_6d(\log(GBP))+a_7d(\log(MYR))+a_8d(\log(RUB))+a_9d(\log(AUD))+a_{10}d(\log(THB))+a_{11}d(\log(CAD)) \quad (1)$$

We applied two-step method of cointegration test to the estimate equation. We conduct unit root test to all variables and found no unit root exist in first difference, and then conduct unit root test to the residual and found no unit root exist also. We delete currencies that are statistically insignificant and finally get the reasonable estimation as below:

⁷ We estimate separately for the period from July 21, 2005 to July 20, 2008, and from July 21, 2008 to march 3, 2010, the two key currency in RMB basket, the US DOLLAR and SINGAPORE DOLLAR keep unchanged, even though some candidates currency and their weights changed slightly.

Table 2 **The Estimation of RMB Basket** (from July 21, 2005 to March 3, 2010)

	coefficient	Standard Error	T-value	P-value
USD	0.884666	0.009964	88.7825	0.0000
Euro	-0.02428	0.012784	-1.8994	0.0578
JPY	0.012909	0.005214	2.4758	0.0134
KRW	-0.01213	0.003504	-3.4612	0.0006
SGD	0.133674	0.013157	10.1596	0.0000
GBP	0.010119	0.006091	1.6615	0.0969
R²	0.977864	---	D.W.	1.89

Source: calculated by the author based on data from UBC database.

We can find from table 1 that the weight of US Dollar in RMB currency basket after July 21, 2005 is still significant, but the exchange rate of RMB had deviated from hard peg to US Dollar regime. Compare with the estimate results based on two year data after reform of other researchers, like Shah, Zeileis and Patnaik (2005) and Ogawa and Sakane (2006), the weight of US Dollar in the basket in table 2 decreased to an average level of 88%⁸.

It should be mentioned here that the estimation under the assumption of 12 month basket resetting interval shows other currencies that statistically significant in RMB basket varied, and the more important finding is even the weight of US Dollar is high and significant in the four intervals after reform, it also varied in different period from 79% to 96%. The weight of US Dollar in RMB basket presents a significant decrease to 79% in the first year, rebound to about 90% in the second and third year, but peg to dollar again from the July 2008 when the impact of global financial turmoil became intensive⁹.

Chinese central bank governor Zhou Xiaochuan said in a press briefing at March 6, 2010 that the current dollar peg of RMB is only temporary special yuan policy, and the nation will be very cautious about the timing of normalizing the policies, including RMB exchange rate policy, to end pegging currency to US dollar. The speech testified the policy preference and basket adjustment of the central bank.

2.3 The Estimation for the Band of RMB Basket Peg

It is impossible to have the market exchange rate peg to the benchmark level that determined by currency basket exactly at all time in the operation of basket peg regime. Hence, BBC regime is a typical practice of basket peg system. One of the keys in BBC or basket peg regime is the band of floating around its benchmark.

There might be some ways in estimating the floating band of basket peg system. Frankel and Wei (2009) believe if a currency followed a tight basket peg, the standard error of the regression of every candidate currency in the basket should be zero, and R-square should equal 100%.

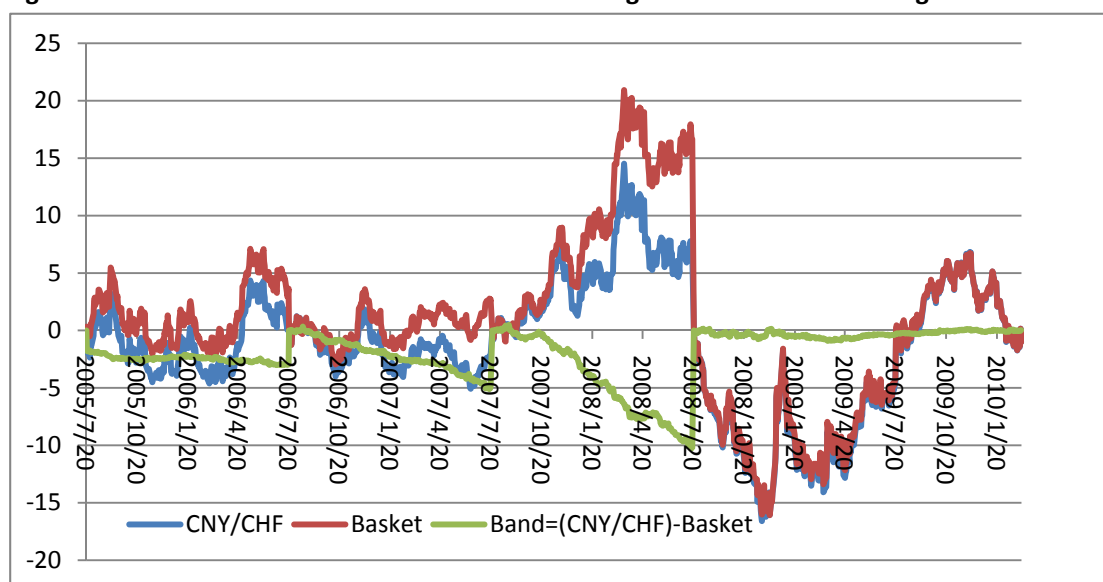
⁸ We use the same regression equation to estimate the basket during the period from January 2001 to June, 2005 and find the weight of US Dollar is as high as 99%. The estimation of Ogawa and Sakane (2006)、Moosa (2008) and Frankel (2009) are varied from 95% to 98%.

⁹ The estimation for currencies in the basket during the periods from July 2005 to July 2008 and from August 2008 to March 2010 present statistically significant changes, but the most two significant currencies, the US Dollar and Singapore Dollar, keep unchanged. However, the weight of US Dollar in the basket increased from 84.2% to 88.2%, and Singapore Dollar decreased from 16.6% to 8.4% in the meantime.

Statistically, both are ways of estimate for the floating band. But we can only estimate for the floating band of every candidate currency to the basket by standard error, or the overall degrees of freedom of the regression in the whole sample period by R-square. Here, we prefer a simply way to illustrate directly the difference between RMB market exchange rate and the basket benchmark level at every observation.

Based on the estimation for the composition currencies and their weights in basket for the whole period after reform in table 2, and given the market exchange rate and the basket benchmark level equal 100 at July 20, 2005, we can calculate the differences between them at every observation. It should be mentioned here that the result in figure 1 is made under the assumption that the composition currencies and their weights in RMB basket is kept unchanged during the whole sample period. However, we assume that there are yearly crawling adjustments considering the Balassa-Samuelson effect with the background of rapid growth of the Chinese economy, and the basket benchmark level (equal 100) will also be adjusted at yearly interval before July 2008. Figure 1 graphically presents the estimation of the floating band of RMB basket peg regime.

Figure 1 The Estimation for the Floating Band of RMB Basket Peg



Source: calculated by the author.

We can find three interesting phenomena from figure 1. First, under the assumption of yearly crawling peg, the floating band became wider and wider in the first three resetting intervals, increased from 3% to 5%, and finally to 10%, indicating that the exchange rate of RMB is more and more flexible to the basket. Second, the estimated floating band, or the inferred flexibility are all pointed to appreciation against the benchmark level of the currency basket. Third, since the autumn of 2008, the exchange rate of RMB is highly correlated with the benchmark level of the currency basket with floating band less than 1%, the weight of the US Dollar in the basket must be very high, or approximately hard peg to dollar again.

3. Exchange Market Pressure of RMB and Central Bank Intervention

The exchange market pressure could be served as a key indicator of the durability of an

exchange rate regime. Girton and Roper(1977) made the initial research on exchange market pressure within the framework of monetary approach to exchange rate determination. The surplus of money supply must be compensated by the change in exchange rate under free float regime, while must be compensated by the change in foreign reserves under fixed regime. For the intermediate regime or soft peg system that is widely existed in the world, the surplus of money supply must be compensated both by the change in exchange rate and the change in foreign reserves. Within the framework in mind, Girton and Roper(1977) believe that the difference between the relative changes of foreign reserves to money supply and the relative changes in exchange rate to money supply can indicate the level of exchange market pressure. Hence, most economists refer the central bank intervention on foreign exchange market as the indicator of exchange market pressure.

Roper and Turnovsky (1980) use a stochastic small open-economy IS-LM model to modify the original exchange market pressure analysis. They assume that the excess demand is absorbed through changes in the exchange rate, in foreign reserves or in domestic credit, than introduce a policy reaction function that describes foreign reserves or intervention as a function of the observed deviation of the exchange rate from its long run equilibrium level. The excess demand for domestic currency is equal to an unequally weighted liner combination of changes in the exchange rate and in the money base/foreign reserves. Weymark (1998) further construct an exchange market pressure index by introducing expectation generated by the exchange rate policy actually implemented, so the actual magnitude of external imbalance is captured in the changes of observed variables. Those indexes are derived from highly restrictive structural monetary models in estimate parameters of changes in the exchange rate and changes in foreign reserves, and are called as model-dependent exchange market pressure index.

The study of exchange market pressure index became popular after the British pound crisis in 1992, especially after Asian financial crisis, as a key leading indicator of currency crises. Eichengreen et al. (1995) argue that model-dependent is not desirable characteristic of an operational index because empirical model linking macroeconomic variables to the exchange rate have little explanatory power at short and intermediate horizons. They constructed a simpler and model-independent EMP measure that EMP is a linear combination of a relevant interest rate differential, the percentage change in foreign reserves and in the bilateral exchange rate. Contrary to model-dependent index, the weight is calculated from the standard deviation of difference between components difference in the analyzed country and the reference country, rather than estimate by any model. Taking an inspiration from Sachs et al. (1996), in order to avoid the EMP index being driven by the most volatile component and abandon the relation between foreign reserve and money in home and reference country, Stavarek (2007) changed the weighting scheme. Here, we calculate the EMP in short and intermediate horizons, so apply model-independent EMP index with the formula as him:

$$EMP_t = \left(\frac{1/\sigma_e}{\left(\frac{1}{\sigma_e}\right) + \left(\frac{1}{\sigma_{rm}}\right) + \left(\frac{1}{\sigma_i}\right)} \right) \frac{\Delta e_t}{e_{t-1}} - \left(\frac{1/\sigma_{rm}}{\left(\frac{1}{\sigma_e}\right) + \left(\frac{1}{\sigma_{rm}}\right) + \left(\frac{1}{\sigma_i}\right)} \right) \left(\frac{\Delta rm_t}{rm_{t-1}} - \frac{\Delta rm_t^*}{rm_t^*} \right) + \left(\frac{\frac{1}{\sigma_i}}{\left(\frac{1}{\sigma_e}\right) + \left(\frac{1}{\sigma_{rm}}\right) + \left(\frac{1}{\sigma_i}\right)} \right) (\Delta(i_t - i_t^*)) \quad (2)$$

where δe is the standard deviation of the rate of change in the real exchange rate $\left(\frac{\Delta e_t}{e_{t-1}}\right)$, δrm is the standard deviation of the difference between the relative changes in the ratio of foreign reserves and money (money base) in the analyzed country and the reference country

$(\frac{\Delta rm_t}{rm_{t-1}} - \frac{\Delta rm_t^*}{rm_t^*})$, δi is the standard deviation of the nominal interest rate differential in the analyzed country and the reference country $\Delta(i_t - i_t^*)$, rm is the ratio of reserves to money base, and * indicate the data of the reference country.

In this paper, we will focus on the measure of EMP between RMB and US Dollar since the transaction on the foreign exchange market in China is dominated by US Dollar. In order to illustrate the change of EMP before and after the reform, we will calculate EMP during the period from January 2002 to June 2005, and the period from July 2005 to December 2008¹⁰ respectively for comparison. We also estimate the EMP index in 2009, even sample data is only 12, to demonstrate the impact of the global financial turmoil on RMB exchange market when the exchange rate of RMB tightened its peg to US Dollar. We estimate by two kinds of data sources.

One of the data source is from *International Financial Statistics* of IMF. For the data of the United States, foreign reserves are from net foreign Asset in the column of central bank, money is from money base, and interest rate is from federal fund rate. For the data of China¹¹, foreign reserves are calculated by the formula in Levy-Yeyati and Sturzenegger (2003) where government deposits at the central bank are subtracted from the central bank's net foreign assets to approximate as closely as possible the change in reserves that reflects intervention on foreign exchange market, money is from reserve money in the column of central bank, interest rate is from bank rate (discount rate). Exchange rate is real exchange rate here. CPI data (change over previous period) of the US is from IFS, and CPI data (change over previous period) of China is from China Economic Information Network (CEI). The benchmark periods are set on January 2002 for CPI data of the US and China.

The other data source is from the website of government departments where the data is originally released. The exchange rate of RMB against US Dollar is from the people's bank of China, CPI data (change over previous period) of China is from China Economic Information Network (CEI), CPI data (change over previous period) of the US is from the Department of Labor. Foreign reserves are from State Administration of Foreign Exchange of China (SAFE) and Department of the Treasury of the US¹². Interest rate of China is from the overnight weighted average interest rate on national interbank market from the people's bank of China, interest rate of the US is from the overnight federal fund rate from the Federal Reserve.

Table 3 Exchange Market Pressure of RMB against US DOLLAR

		EMP(IFS)	EMP(original)	EMP(FW)
2002.1-2005.6	Mean	-0.119527	-0.020807	-0.191462
	Median	-0.123804	-0.027696	-0.183231
	Maximum	0.041461	0.090312	0.319596
	Minimum	-0.317918	-0.137408	-0.487704

¹⁰ The end of the second period is a little bit late than the impact of the global financial turmoil became intensive in the autumn of 2008. However, the easing monetary policy of China is came in at the end of 2008. Both of the two periods include 42 month.

¹¹ In IFS database, data of China is not based on standardized report forms (SRFs). There are no net foreign asset in the central bank column.

¹² Foreign reserves released in the Department of the Treasury of the US are weekly data. Since we conduct monthly analysis, we collect weekly data of the end of the month, but there may exist little error.

	Std. Dev.	0.070864	0.054404	0.130265
2005.7-2008.12	Mean	-0.164104	-0.047506	-0.271381
	Median	-0.240852	-0.053326	-0.273221
	Maximum	1.163940	0.122967	0.123403
	Minimum	-0.515287	-0.277632	-0.505606
	Std. Dev.	0.303572	0.091407	0.126934
2009.1-2009.12	Mean	-0.081146	0.017376	-0.194515
	Median	-0.062177	0.011144	-0.227841
	Maximum	-0.033501	0.196305	0.183978
	Minimum	-0.139117	-0.109689	-0.411978
	Std. Dev.	0.043020	0.108691	0.158413

Source: calculated by the author.

Frankel and Wei (2007) computed the variances of data on exchange rate variability and reserve variability for 15 countries (including basket peg, free float and hard peg regime) within the period from 1980 to 2007 by seven-year interval. The final result shows that intervention, exchange market pressure (EMP), can be computed by the subtracting imputed interest earnings from reported change in reserves, and change reserves are expressed as a percent of the monetary base. They offer a new synthesis estimate approach of implicit *de facto* weight-inference of a basket peg regime and the *de facto* degree of exchange rate flexibility-inference by simply adding a variable of EMP in the conventional regression equation he put forward in 1994 as follows:

$$\Delta \log H(t) = \sum w(j)(\Delta \log X(j,t)) + \beta (\Delta \log EMP(t)) + \mu (t) \quad (3)$$

Since the percentage change in exchange market pressure, that is, increase in international demand for the home currency, which may show up either in its price or its quantity, depending on the policy of the monetary authorities. Frankel and Wei (2009) further clearly define the percentage change in total exchange market pressure, simply with the ration of foreign reserve to monetary base without consideration of interest rate, and then by

$$\Delta EMP_t = \Delta H_t + \Delta Res_t/MB_t \quad (4)$$

where $Res \equiv$ foreign exchange reserves and $MB \equiv$ Monetary Base. The $w(j)$ coefficients capture the *de facto* weights on the constituent currencies. The coefficients β captures the *de facto* degree of exchange rate flexibility. $\beta = 1$ means free floats and $\beta = 0$ means fix regime of the analyzed currency in the regression estimate. H is defined as the value of the analyzed currency.

According to the general rationale of the monetary approach to exchange rate determination and the equation (2), we use an equation as below to estimate the foreign exchange market pressure within the framework put forward by Frankel and Wei (2007):

$$\Delta EMP_t = \Delta H_t - \Delta Res_t/MB_t \quad (5)^{13}$$

Comparing with the estimate equation (2), we can use equation (4) to estimate the overall exchange market pressure of a currency, rather than the foreign exchange market pressure of a currency to a reference currency, like US Dollar.

We can find from table 3 that in term of the foreign exchange market pressure of RMB against US Dollar, RMB appreciation pressure calculated by IFS data is much higher than the

¹³ The original equation showed in Frankel and Wei (2009) is $\Delta EMP_t = \Delta \log H_t + \Delta Res_t/MB_t$.

result calculated by data from original source. However, both results show that the foreign market pressure of RMB against US Dollar became higher after the RMB exchange rate regime reform in July 21, 2005. To some surprise, in facing with impact of the global financial turmoil, when RMB tightened its peg to US Dollar, the foreign market pressure towards appreciation between RMB and US Dollar became apparently lower, and the foreign market pressure calculated by data from original source even shows pressure towards depreciation rather than appreciation.

The overall foreign exchange market pressure estimated by equation (5) based on Frankel and Wei (2007), calculated by data from originally source, shows even higher pressure towards appreciation in contrast to the results estimated by equation (2) in the sample period, presents the same change as mentioned above before and after the reform, as well as before and after the impact of the global financial turmoil¹⁴.

It is interesting to find that the increase of the foreign exchange market pressure after the reform. However, the decrease of the foreign exchange market pressure after RMB tightened its peg to US Dollar in 2009 is beyond all expectations. There might be some reasons for it, and we would like to focus on the foreign exchange market in the next section.

4. Peg to Basket or Peg to Dollar?

If peg to dollar can be regarded as a corn solution of basket peg regime where the dollar is the only one constituent currency in the basket, the issue of peg to basket or peg to dollar is an issue of the choice of basket, or the choice of the constituent currency in the basket.

The choice of basket for developing economies will mainly determined by their trade pattern since current account volume, especially the volume of goods trade is the main part in the total volume of their international payments, and the volume of financial account is often associated with trade. The final goal of basket peg regime is to stabilize foreign trade¹⁵ by stabilizing the effective exchange rate of their currencies (Ogawa, and Ito, 2000).

No one could deny the fact that exchange rate level is directly determined by the transaction on the market. To what currency (like US dollar) or a basket that a currency will finally float with or peg to, is also determined by currency components of the market transaction. Obviously, the currency components of the market transaction are determined by the nation's currency components of the international payments. In China, the currency components of the market transaction is more closely related to China's international payments, because foreign exchange speculators are hard to made transaction on China's foreign exchange market under the membership qualification required by the regulator¹⁶.

There are two features on China's international payments in recent years. First, the trade volume under the current account transaction is two times higher than the trade volume under the financial account transaction, and the more important fact is that the in term of trade balance which is more crucial to the determination of RMB exchange rate level, the trade balance under current account transaction is as high as 25 times than the trade balance under capital

¹⁴ The reason that the pressure towards appreciation estimated by equation (5) is higher than the results estimated by equation (2) might be Frankel and Wei (2007) neglect the interest rate.

¹⁵ The choice is a little bit complicated for China since the huge volume of foreign reserves can be an influential factor in the choice optimal currency basket, in order to keep the market value of foreign reserves stable.

¹⁶ According to the membership regulation of the interbank foreign exchange market participants, most transactions are made by banks for their clients whose demand or supply are from foreign trade need under the current account liberalization.

account transaction; Second, goods trade account for 80% in total volume and balance under the current account transaction. The two features suggest that the RMB exchange rate will mainly determined by China's foreign trade pattern. Table 4 shows China's top six trade partners.

Table 4 China's Main Trade Partner in 2004-2008

2004	2005	2006	2007	2008	2004-2008
U.S.(14.7)	U.S.(14.9)	U.S.(14.9)	U.S.(13.9)	U.S.(13.1)	U.S.(14.1)
Japan(14.5)	Japan(12.9)	Euro Zone(12.2)	Euro Zone(12.7)	Euro Zone(12.8)	Euro Zone(12.5)
Euro Zone(12.2)	Euro Zone(12.2)	Japan(11.8)	Japan(11.8)	Japan(10.4)	Japan(11.7)
H.K. SAR(9.8)	H.K. SAR (9.6)	H.K. SAR (9.4)	H.K. SAR (9.4)	H.K. SAR (8.0)	H.K. SAR (9.0)
R.O.Korea(7.8)	R.O.Korea (7.9)	R.O.Korea (7.6)	R.O.Korea (7.6)	R.O.Korea (7.3)	R.O.Korea (7.5)
Singapore(2.3)	Singapore(2.3)	Singapore(2.3)	Russia(2.3)	Australia(2.3)	Australia (2.2)

Source: calculated by the author based on data from *Direction of Trade*, IFS.

In regards to the data in table 4, we need to take two more things into consideration. First, because the HK Dollar is hard pegged to US Dollar under the linked exchange rate system, the effect of the transaction of between RMB and HK Dollar will be similar to the transaction of between RMB and US Dollar on exchange rate determination; Second, US Dollar is widely used as invoicing currency in foreign trade, especially in the trade between China and countries whose currency are not the major currency on international market under the global dollar standard. Even for the trade with developed country like Japan, Ito et al. (2009) found that the ratio of yen as invoicing currency account for only 40% in total Japanese export, 20% in total Japanese import during the period from 1980 -2008. The research suggests that US Dollar should also be widely used as invoicing currency in the trade between China and rest of the world. The China Foreign Exchange Trade Center does not release data of currency component of total transaction on the market, but we can find some information from some market survey by insiders. Zhao (2009) pointed out that the most of the foreign exchange transaction on China's interbank market are transaction between RMB and US Dollar, and transaction between RMB and HK Dollar or yen account for only 9%. In other word, transaction between RMB and US Dollar accounts for 91% in total volume of foreign exchange transaction on China's interbank market, approximately 200 million in term of US Dollar a day.

Given the membership regulation and foreign trade pattern, as well as the global dollar standard, transaction between RMB and US Dollar dominate on China foreign exchange market is a natural result. Hence, the RMB exchange rate presents as tight peg to US Dollar is also a natural result of market transactions. We may find reasons for the fact of the weight of US Dollar in RMB currency basket decreased from 99% to an average level of 88% before and after the reform. On the one hand, RMB should shift from hard dollar peg to a basket regime to accommodate its currency component of total transaction on foreign exchange market. On the other hand, the weight of US Dollar in RMB currency basket should also approximately accommodate to the component of US Dollar in total market transaction. From this perspective, the 88% average level of the weight of US Dollar in RMB currency basket is a little bit lower than actual 91% average level of the component of US Dollar in total market transaction. It might be the reason that the foreign exchange market pressure in term of RMB and US Dollar became higher since the reform,

as well as the foreign exchange market pressure in term of RMB and US Dollar became lower since the tightened peg to US dollar¹⁷.

5. Conclusions

In this paper, we estimate the *de facto* RMB exchange rate regime, currency basket, floating band and foreign exchange market pressure before and after Chinese exchange rate regime reform in 2005.

The stylized facts we find include:

First, according to the *de facto* exchange rate regime classification of Levy-Yeyati and Sturzenegger (2003), the exchange rate of RMB against US Dollar presents features of dirty float or discretionary crawling peg, and the value of RMB, measured by the exchange rate of RMB against Swiss franc, presents features of fixed regime.

Second, according to Frankal and Wei (1994), the weight of US Dollar in the basket is still high, the weight of Singapore Dollar increased, and Euro, Japanese yen, Korean won and British pound are statistically significant in the basket since the reform. The weight of US Dollar in the basket decreased sharply at the beginning and became gradually rebound during the following period. However, RMB tightened its peg to US Dollar in 2009

Third, the floating band gradually increased to 10% towards appreciation in the first three years but greatly narrowed since the late summer of 2008 under the assumption of yearly resetting interval.

Fourth, the foreign exchange market pressure index, based on Stavarek (2007), became higher after the reform till 2008. Since RMB tightened its peg to US Dollar in 2009, the foreign exchange market pressure became lower.

From the stylized facts listed above, we can reach the conclusions as follows:

First, the Chinese exchange rate regime has obviously shifted from hard dollar peg to a basket peg since July 2005, even though the weight of US Dollar is still high in the basket. As a result, the value of RMB, measured by Swiss franc, became stable than before.

Second, RMB became more flexibility in the period from July 2005 to the end of 2008 in terms of the floating band and diversification of the constituent currency in the basket. However, in facing with the impact of global financial turmoil, RMB tightened its peg to US Dollar again.

Finally, it is very important to know that the RMB exchange rate keep on pegging to US Dollar is a natural result of the Chinese foreign exchange market transactions, in which the share of the US Dollar is dominated. That is why the foreign exchange market pressure became higher after the reform when RMB shifted from hard dollar peg, and why the foreign exchange market pressure became lower since RMB tightened its peg to US Dollar from 2009.

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¹⁷ The foreign exchange market pressure index we applied here is based on monetary approach to exchange rate determination, but later we explain the EMP index change by the currency component on foreign exchange market which is based on foreign trade. The later perspectives can be turned into the former one since the increase of foreign reserve gained from trade surplus will be sterilized by central bank and finally become excessive domestic money supply.

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