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The Sovereign Risk of Official Intervention： The Volatility Relationship between EUD and RMB

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Abstract

We provide new evidence regarding the shock effects of the PBC intervention in the FX market by comparing the volatility of exchange rate of Euro dollar (EUD) and Chinese Ranminbi (RMB) against the US dollar (USD) and showing policy interference of Chinese the exchange rate system. Firstly we model the ARMAX-GJR-GARCH equation to re-examine interest parity theory and find the structure break of the exchange rate of the RMB then we set up our new Copula-ARMAX-GJR-GARCH model by using daily exchange rate of EUD and RMB against USD during the period from January 2005 to March 2010. The result provides the very important information that we prove the sovereign risk of official intervention and political influence economy. Our new research also contributes to examine a discrepancy between the exchange rate system of EU and China for risk managers in financial institutions.

Introduction

China has taken communism, the government controls the means of production and economic condition as well as the exchange rate system, which varies differently with capitalism. The country has still a conventional fixed-peg exchange rate system and has been accompanied by frequent official interventions when it has already become one of the largest exporters in the world. Our research focus on comparision to profile the sovereign risk of official intervention in communism country by analysis of volatility between Euro dollar (EUD) and Chinese Ranminbi (RMB).

The monetary authorities firmly believe that his intervention helps reducing market volatility (Neely, 2006). Humala et al. (2009) uses time series models to study currency volatility, they assess consistency of the empirical evidence with the goal of reducing exchange rate volatility and find the foreign exchange gap with respect to its trend also induce foreign exchange intervention. Suardi (2008) assesses the effectiveness of foreign exchange intervention using an exchange rate model that accommodates regime dependence in both its conditional mean and variance. Using a double threshold GARCH model of the Japanese Yen-US dollar exchange rates, results showed that interventions of the Bank of Japan and the Federal Reserve are more effective in changing the direction of the exchange rate movements and reducing its volatility level in a regime when the exchange rates are severely misaligned. Our research find the reality of intervention could increased the volatility of RMB exchange rate in the short run and produce sovereign risk, which hasn't the characteristic of volatility cluster.

Many academic and business researchers focus on interest rate parity theory to illustrate exchange rate. For example, Suliman (2005) and Hsing (2007) study the relationship between exchange rate and interest rate differential. Wee et al. (2000) shows the existence of a fairly robust long run relationship between the real exchange rate and the real interest rate differential. Hoffmann et al. (2009) re-examined the real exchange rate - real interest rate (RERI) relationship using data for six US dollar bilateral exchange rates. In addition, most researchers have found exchange rates to display nonlinear behavior and the subsequent literature (see also Herwartz and Reimers, 2002; Tsui and Ho, 2004; and Kim and Sheen, 2006) on exchange rate volatility. In this paper, we model two original equations to expose the nonlinear dynamic relationship between exchange rate and interest rate differential of EUD and RMB against USD. We further to discuss the sovereign risk due to the fact of official intervention exchange rate.[1]

We use ARMAX-GJR-GARCH model and the panel data of Reuters from Jan. 1, 2005 to Mar. 31, 2010. We successfully re-examined two equations based on interest rate parity theory and clarified the exchange rate puzzle of fluctuations and policy of China between EUD and RMB, using the Copula-ARMAX-GJR-GARCH model. We find that the structure break changed and shock effects emerged when the value of RMB appreciated by the People's Bank of China's (PBC, central bank of PRC).

Empirically, statistics analysis on the volatility of exchange rates shows the presence of structure-break for RMB on July 21, 2005. The appreciation of RMB exchange rate is once up to 2.1% the day. Is it true that the PBC adjusted RMB exchange rate from pegging to USD ?[2] We proved that it is false because the adjustment only existed during July 21, 2005 to Dec 29, 2008. We suggest the PBC adopt flexible exchange rate system in the future. We also use the Copula functions in our methodology to calculate the correlation of both equations in ARMAX-GJR -GARCH model. We find that the RMB exchange rate to EUD has been inflexible since Dec 29, 2008. The result shows that interventions tend to increase exchange rate volatility in the short run.

Our results show a discrepancy between the exchange rate system of EU and China. This model combined the structural model forecast and the random walk forecasting. We develop the Copula-ARMAX-GJR-GARCH model together with interest rate parity theory to capture the prominent relationship between the above mentioned fitting models. Our research shows that the volatility of RMB is different from that of the EUD dollars in the long run. Table 4 displays negative causality on panel A before July 21, 2005 and on panel C after December 30, 2010, while there is on panel B positive relationship between EUD and RMB during from July 21, 2005 to December 29, 2010. We provide new evidence regarding the shock effects of the PBC intervention in the FX market by comparing the volatility of the EUD and RMB exchange rate against USD and find policy interference in the exchange rate system of China.

The remainder of the paper is as follows. Section 2 is a brief introduction to the theorem of interest rate adjustments called interest rate parity theory. Section 3 introduces the methodologies, such as Copula functions and Copula-ARMAX -GJR-GARCH model. Section 4 is the data description and empirical result, followed by the conclusions for the reference of the governments, investors and researcher.

[1] The sovereign risk mean that a foreign central bank will alter its foreign-exchange regulations thereby significantly reducing or completely nulling the value of foreign-exchange contracts.

[2] Crawling peg is an exchange rate regime usually seen as a part of fixed exchange rate regimes which allows depreciation or appreciation in an exchange rate gradually.

Theoretical Model

Research studies on exchange rates stem from the equilibrium theory of supply and demand. In the 1960s the theory of optimum currency introduced by Fleming (1962) and Mundell (1963) based on the control over exchange rates and various hypotheses of elasticity of capital mobility became the mainstream of thought for theories governing exchange rate determination of that time. The interest rate parity approach is one of the theorems of exchange rate determination. It is developed after balance of payments approach and purchasing power parity approach. (Balassa, 1964) reliance, emphasizes that the foreign exchange rate is depends on the level of interest rates indicator. To sum up, interest rate differentials between any two nations are important determinants of international investment flows and exchange rates.[3] In fact, many well- known exchange rate models highlight the role of the real interest rate differential as a key determinant of real exchange rates. As we mentioned in introducing, Dornbusch (2004) and Mussa (1984) posed sticky price models. Grilli et al. (1992) and Obstfeld et al. (1996) provided optimization to emphasize the effect of liquidity impulses on real interest rates and consequently the real exchange–real interest rate (RERI) relationship. In particular, McCauley & McGuire (2009) and Melvin & Taylor (2009) report exacerbating any crisis-related depreciation of the affected currencies. Kohler (2010) show that interest rate differentials played a much larger role in determining exchange rates in financial crisis than in previous episodes. He also represent that interest differentials played a less consistent role in the appreciation of exchange rates after the crisis than in their depreciation during these episodes.

Methodology

Theoretical Models

Thomas (2006) illustrated that the interest policy condition is based on the simple notion that in a world of capital mobility, expected returns on assets equalize across countries. In equilibrium, interest rates and exchange rates align so that traders cannot expect to profit by switching currencies.

$$\frac{e_{t+1}^{RMB} - e_t^{RMB}}{e_t^{RMB}} = i_{usa} - i_{china} \tag{1}$$

for China FX market

$$\frac{e_{t+1}^{EUD} - e_t^{EUD}}{e_t^{EUD}} = i_{usa} - i_{EU} \tag{2}$$

for EU FX market

Where base on the interest rate parity theory, i_{usa} is the USA interest rate, i_{china} is the China interest rate. The function of interest parity also could be transformed with a natural logarithm.

Copula-ARMAX-GJR-GARCH Model

Because of the observed negative skewness, we decided to filter the returns with the semi-parametric method. In specifying the bivariate model we must specify the two models for the marginal variables and the model for the conditional copula. The models for the univariate variables must take into account the characteristics of the variables. Return series have been successfully modeled by ARMAX-GJR-GARCH (1,1) model assuming Gaussian residuals.[4]

Assume two return series $r_{1,t}$, $r_{2,t}$,..., follow a ARMAX (1,0,0)-GJR-GARCH (1,1)

$$r_{i,t} = c + sr_{i,t-N} + \phi X_{i,t} + \varepsilon_{i,t}, \; i=1,2;$$

$$N=1,2,..t;\; t=1,2,..,T \tag{3a}$$

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[3] The exchange rate is defined as the value of Renminbi (RMB) per USD.

[4] Based on the Log-likelihood test and min: AIC (Akaike information criterion), we set optimal order of ARMAX (1, 0, 0)-GJR-GARCH (1, 1).This specification is able to solve both the autocorrelation and heteroscedasticity and asymmetric problems.

$$\varepsilon_{i,t} = \sqrt{h}_{i,t} z_{i,t}, \; z_{i,t} \sim N(0,1) \tag{3b}$$

$$h_{i,t} = \sigma_{i,t}^2 = \omega + \alpha\varepsilon_{i,t-1}^2 + \beta h_{i,t-1} + \gamma\varepsilon_{i,t-1}^2 d_{i,t-1} \tag{3c}$$

where

$$d_{i,t} = \begin{cases} 1, if & \varepsilon_{i,t} < 0 \\ 0, if & \varepsilon_{i,t} \geq 0 \end{cases} \tag{3d}$$

$$(z_{1t}, z_{2t}) \sim C_t(F(z_{1t}), F(z_{2t})) \tag{3e}$$

$R_{i,t}$ is the return of EUD/USD and RMB/USD, respectively.

$X_{i,t}$ is an explanatory regression matrix.[5] $z_{i,t} = \varepsilon_{i,t} / \sqrt{h_{i,t}}$ is the conditional distribution of standardized innovations. In this study, we set i=1, 2. The distribution of the innovation vector $z_t = (z_{1t}, z_{2t})$ is modeled by copula C_t (……,.). Here, C was modeled by Normal, student-t, Gumbel copula and time varying copula normal copula respectively.[6]

In recent years, copula function was widely used in financial econometrics and risk management. For example, Palaro and Hotta (2006) used conditional copula to estimate VaR. Junker et al. (2006) discussed the nonlinear term structure dependence and risk implication based on copula function. Hu (2006) proposed a mixed copula model that it can capture various patterns of dependence structures. Rodriguez (2007) modeled dependence with switching-parameter copulas to study financial contagion. Chiou and Tsay (2008) addressed a copula-based approach to option pricing and risk assessment. Hsu et al. (2008) proposed copula-based GARCH models for the estimation of the futures optimal hedge ratio. Manner et al. (2009) used copula models with time-varying dependence structure. We will take a brief review of copula function. For a complete introduction to copulas see Joe (1997) and Nelsen. (1999). Let's consider the bivariate stochastic process $\{X_{it}\}_{t=1}^{T}$ with $X_t = (X_{1t}, X_{2t})'$. Let F (X_{1t}, X_{2t}) be the joint distribution, and F_i denote the marginal distribution for i=1, 2. Then by sklar's theorem [7](1959), there exists a copula function $C(\cdot,\cdot)$: $[0,\ 1]^2 \to [0,1]$ mapping the marginal distributions of X_{1t} and X_{2t} to their joint distribution through[8]

$$F(X_{1t}, X_{2t}) = C(F_1(X_{1t}), F_2(X_{2t})) \tag{4}$$

We assume that the marginal can be modeled parametrically, thus the probability transform is given by $u_{it} = F_i(X_{it}; \phi_i)$, where ϕ_i is the vector of parameters completely describing the individual behavior of the series.

Normal copula is the copula of multivariate normal distribution. It is defined as follows: Assuming $X = (X_1, X_2, ..., X_n)$ is multivariate normal, if and only if (a) its margins $F_1, ..., F_n$ are normally distribution, and (b) a unique copula function exists,[9] such that

$$C_R^N(u_1,...,u_n) = \Phi_R(\phi^{-1}(u_1),...,\phi^{-1}(u_n)) \tag{5}$$

where Φ_R denotes the standard multivariate normal distribution with correlation matrix R and ϕ^{-1} is the inverse function of standard univariate normal distribution. When n=2, $\rho \in (-1,1)$ is the correlation coefficient, we can obtain the 2-dimension normal copula function as follows:

5 In the model, we consider the interest rates differential (European vs. US and PRC vs. US) in money market..

6 To save space, the normal copula, student t copula and Gumbel copula functions will not be shown here. The books of Joe (1997) and Nelsen (1999) presented a good introduction to the copula theory.

7 Sklar's Theorem is the most important theorem regarding to copula functions since it is used in many practical applications.

8 This class of function is very important because it permits to define the dependence structure between the margins of a multivariate distribution. Hence, different multivariate marginal distribution will be considered, for example, Gaussian copula (normal copula), Student copula, Archimedean copulas (like Clayton-Copula).

9 i.e. the normal Copula.

$$C\ (u,v,\rho)=\frac{1}{\sqrt{1-\rho^2}}\exp(-\frac{\Phi^{-1}(u)^2+\Phi^{-1}(v)^2-2\rho\Phi^{-1}(u)\Phi^{-1}(v)}{2(1-\rho^2)}) \quad (6)$$
$$\exp(-\frac{\Phi^{-1}(u)^2\Phi^{-1}(v)^2}{2})$$

By the same concept, t-copula is the copula function of multivariate Student's t distribution. Assuming $X=(X_1,X_2,...,X_n)$ is t-student copula with v degree of freedom; it can be analytically represented in the following equation:

$$C^t_{v,R}(u_1,...,u_n)=t_{v,\rho}(t_v^{-1}(u_1),...,t_v^{-1}(u_n)) \quad (7)$$

For n=2, the t-Student copula has the following analytic form:

$$C^t_{v,\rho}(u,v)=\rho^{-(1/2)}\frac{\Gamma(\frac{v+2}{v})\Gamma(\frac{v}{2})}{[\Gamma(\frac{v+1}{v})]^2}\cdot\frac{[1+\frac{\zeta_1^2+\zeta_2^2-2\rho\zeta_1\zeta_2}{v(1-\rho^2)}]^{-\frac{v+2}{2}}}{\prod_{i=1}^{2}(1+\frac{\zeta_i^2}{v})^{-\frac{v+2}{2}}} \quad (8)$$

Where $\rho\in(-1,1)$ is the correlation coefficient; Γ_v^{-1} is an inverse of t distribution with v freedom of degree; $\zeta_1=\Gamma_v^{-1}(u)$, $\zeta_2=\Gamma_v^{-1}(v)$

Another important class of copulas is known as Archimedean copulas. These copulas find a wide range of applications. An n-dimension copula function,

$$C\ (x_1,\cdots x_n)=\Psi^{-1}\left(\sum_{i=1}^{n}\Psi\left(F_i\left(x_i\right)\right)\right) \quad (9)$$

where Ψ: generator function and satisfies ; $\lim_{x\to 0}\Psi(x)=\infty$; $\Psi'(x)<0$; $\Psi''(x)>0$; In this study, we apply Gumbel-Copula as equation (10), when n=2, and the parameter $\alpha>1$, then

$$C\ (u_1,\ldots,u_n)=\exp\left[-\left(\sum_{i=1}^{n}(-\ln u_i)^{\alpha}\right)^{1/\alpha}\right] \quad (10)$$

The time varying normal copula tau function is given:

$$\rho_{1,2,t}=\tilde{L}[\omega_\rho+\beta_\rho\rho_{1,2,t-1}+\alpha_\rho\frac{1}{10}\sum_{j=1}^{10}\Phi^{-1}(u_{t-j}).\Phi^{-1}(v_{t-j})] \quad (11)$$

Where ρ is normal Kendall's tau. $\tilde{L}(x)=\frac{1-e^{-x}}{1+e^{-x}}$, the modified logistic function; Φ^{-1} is the inverse of the standard normal CDF.

We further use the Kendall tau (τ) coefficient to calculate the rank correlation coefficient of operation events-pair. It is a non-parametric statistic used to measure the association or statistical dependence between two measured quantities. For a pair (u, v), we can construct a two-dimension copula C and obtain the Kendall's tau as equation (13),

$$\tau=4\iint C(u,v)\,dC(u,v)-1 \quad (12)$$

Data and Empirical Results

Data Description

Our empirical analysis is based on the Reuters database to retrieve the exchange rate of EUD and RMB against USD as well as the interest rates differential of EU vs. US and PRC vs. US from Jan. 1, 2005 to Mar. 31, 2010. We selected the daily data of the exchange rates and interest rates differential. There are l367 observations, two part and the two key variables including the exchange rate (EUD/USD and RMB/USD) and interest rates differential (EU vs. US and PRC vs. US) in the data set.

Empirical Result

We apply Chow test (1960) to formally test the structural change of RMB exchange rate during the period from January 1, 2005 to March 31, 2010. The results of chow test show that the trend of volatility of RMB exchange rate significantly existed structure-break which peak on July 21, 2005. It represents significant at 5% significance level through Chow test on Table 1. Especially the presence of structure-break for RMB(also see the bottom of Figure 1), which the adjustment of RMB exchange rate is once time up to 2.1% on July 21, 2005 to lead to a huge volatility.[10] During the U.S. subprime mortgage, the PBC fixed the RMB exchange rate fluctuation within a small band and secure the stability of China's economy.

On the other hand, the volatility of EUD exchange rate showed the presence of stochastic properties in European FX market. The amplitude of volatility of EUD and RMB are quite different from each other, indicating the PBC has a strong intervention mechanism.

Figure 1: The return of EUD and RMB exchange rate

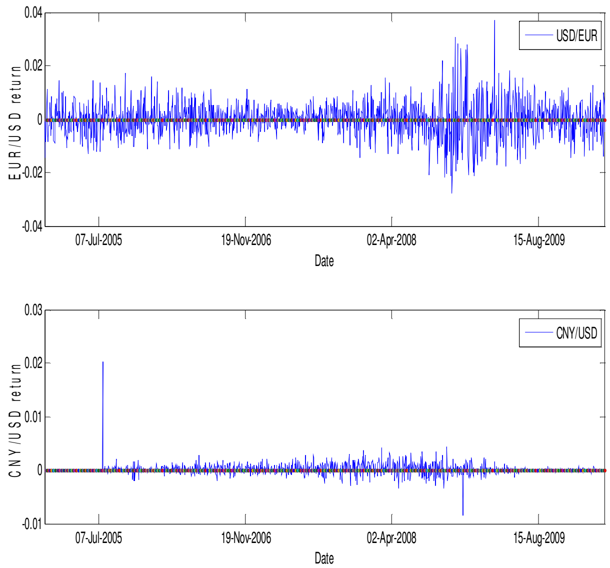

Table 1: The results of Chow test

Breakpoint: July 20,2005, RMB=8.2765		
Chow statistics	**367.2925**	**P-value**
F(0.90,2,1362)	2.3065	0.0000**
F(0.95,2,1362)	3.0023	
F(0.99.,2,1362)	4.6208	
Breakpoint: Dec. 30, 2008, RMB=6.8295		
Chow statistics	**383.6424**	**P-value**
F(0.90,2,1362)	2.3065	0.0000**
F(0.95,2,1362)	3.0023	
F(0.99.,2,1362)	4.6208	

Note: ** represent significant at 5% significance level.

We re-examine interest rate parity theory by ARMAX-GJR-GARCH (1,1) model to set up two equations, using data for the EUD against USD bilateral exchange rates relative to interest rate differential of EUD/USD and the RMB against USD bilateral exchange rates relative to interest rate

[10] Chinese PBC ends pegging the RMB to the USD and revaluated the Yuan by 2.1% against the USD. Together with this revaluation, it announced it would shift its exchange rate system from traditional dollar peg to a loose currency basket system.

differential of EU/US over the period January 1, 2005 to March 31, 2010. Our research find the structure break point then we split three subsamples, including Panel A from Jan. 4, 2005 to July 20, 2005, Panel B from July 21, 2005 to Dec. 29, 2008, Panel C from Dec. 30, 2009 to March 31, 2010. The parameters of rateEUD and rateRMB in conditional mean equation are all significant at 1% significance level. That is to say, we successfully re-examine both of equations based on interest rate parity theory to show as EUD ARMAX–GJR-GARCH (1,1) model on Table 2 and RMB on Table 3.

The dependence of residuals (or innovations) expresses the spillover effect or contagion of volatility between the two markets. Table 4 reports the dependence of EUD and RMB standardized innovations in different periods for ARMAX-GJR-GARCH model. The ranks of the Table include four copula Kendall's tau and three criteria, log-likelihood value (LL), Akaike information criterion (AIC) and Bayesian information criterion (BIC), respectively. We can see that there is a negative dependence between the two series. Panel A is stronger than panel B and panel C. The result is reasonable. During the period, the RMB pegged to the USD and the USD appreciation, whereas the EUR against USD depreciation. In addition, the time varying normal copula in Figure 2 shows that the dynamic dependence of panel B is smooth than other panels. This expresses that the RMB is allowed to fluctuate against the currency basket and toward a more appropriate exchange rate. The results are also shown in the left panel of Figure 4. For comparison purpose, Table 5 reports the dependence of EUD and RMB price in different periods. We can see that only there is a negative dependence in panel A while positive dependence regardless of panel B or Panel C. Figure 3 also shows that the dynamic dependence of panel B is smooth than other panels. It is clear to see in the right panel of Figure 4.

Table 2: Results from the ARMAX –GJR-GARCH (1, 1) model- EUD

	Panel A	**Panel B**	**Panel C**
Conditional mean equation ARMAX(1,0,0)			
C	1.2375*** (-343.2623)	-1.0667*** (-571.2520)	-1.0569*** (-250.2390)
rateEUD	-0.084185*** (-7.3467)	-0.25247*** (-103.5147)	-0.24725*** (-41.1394)
Conditional variance equation GARCH(1,1)			
ω	0.00030017*** (3.0491)	0.00026637*** (4.8429)	0.00037671*** (2.9969)
α	0	0.11983*** (3.1723)	0
β	0.93473*** (2.4321)	0.85888 *** (4.2182)	0.92933** (2.1099)
γ	0.13054 (0.2261)	0.042566 (0.1889)	0.11628 (0.2188)
LL	-37.1601	-1.9858	-0.6346

Note:
1. The estimated parameters correspond to equations (3a) and (3c). LL corresponds to the log - likelihood function value.
2. The t values are in the parenthesis.
3. rateEUD is the interest rates differential of European vs. US in money market.
4. ***,** denotes significant at 1%, 5% significance level, respectively.
5. Model states as (3a), (3b), (3c), (3d), (3e)
6. Panel A: Jan. 4, 2005~July 20, 2005; Panel B: July 21, 2005~Dec. 29, 2008; Panel C: Dec. 30, 2008~March 31, 2010.

Table 3: Results from the ARMAX –GJR-GARCH (1, 1) model- RMB

	Panel A	**Panel B**	**Panel C**
Conditional mean equation ARMAX(1,0,0)			
C	3.5921e-009*** Inf	0.0003431*** (9.5207)	-2.1977e-005*** (-1.2197)

Table 3: Results from the ARMAX –GJR-GARCH (1, 1) model- RMB - continued

rateRMB	-8.573e-009*** –Inf	-0.0001295*** (-8.5557)	-2.9317e-005*** (-1.7342)
Conditional variance equation GARCH(1,1)			
Ω	0.0003001*** (3.0491)	0.0002663*** (4.8429)	0.0003767*** (2.9969)
α	0	0.11983*** (3.1723)	0
β	0.93473*** (2.4321)	0.85888 *** (4.2182)	0.92933** (2.1099)
γ	0.13054 (0.2261)	0.042566 (0.1889)	0.11628 (0.2188)
LLF	-37.1601	-1.9858	-0.6346

Note: 1. rateRMB is the interest rates differential of PRC vs. US in money market.
2. Other notes are same with Table 2.

Figure 2: Time varying normal copula Kendall's tau-standardize innovations

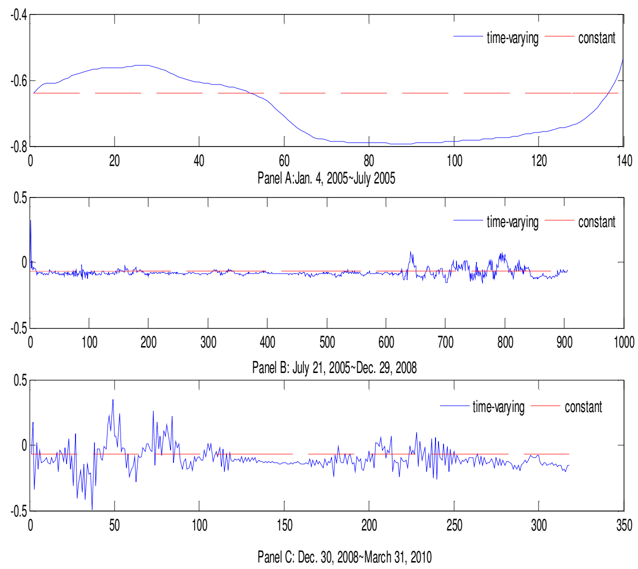

Figure 3: Time varying normal copula Kendall's tau -EUD and RMB exchange rate

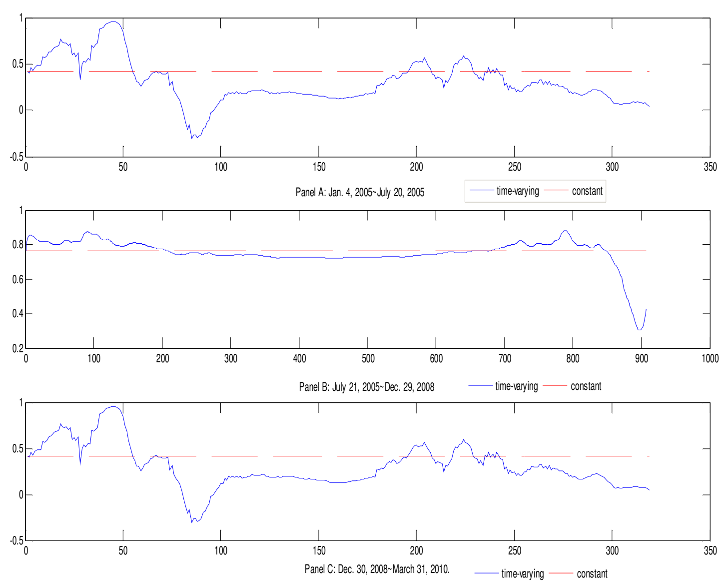

Figure 4: The scatter plot of two series (Left panel: standardize innovation; right panel: EUD and RMB price)

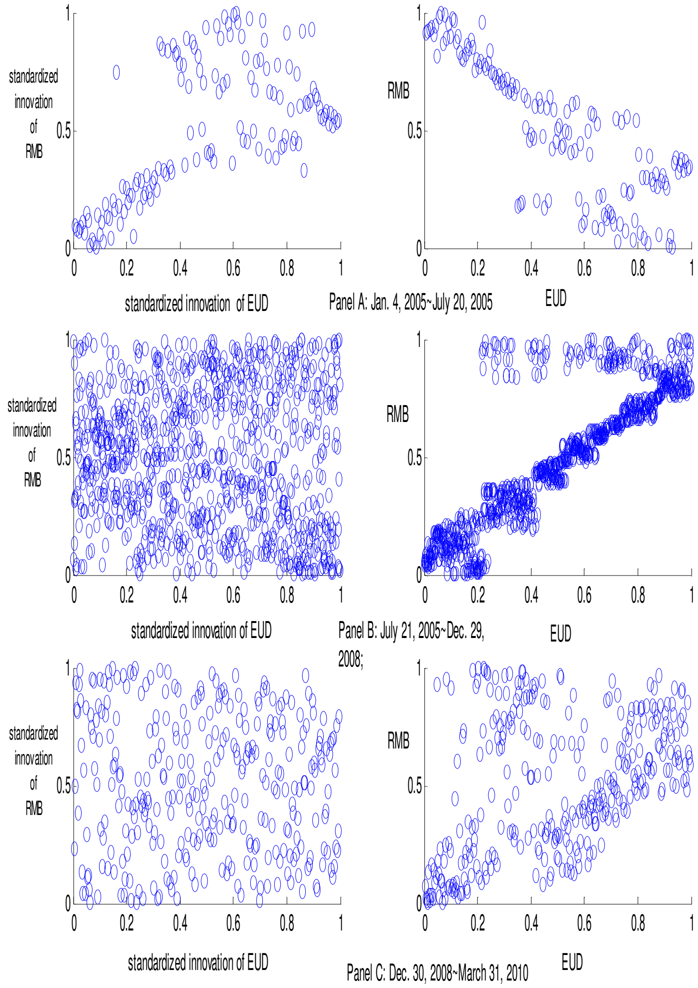

Table 4: The Kendall's tau of copula functions-innovations between EU and RMB

	Normal Copula	Student Copula	Gumbel Copula	Normal-DCC Copula
Panel A: EUD-RMB (Jan. 4, 2005~July 20, 2005)				
Kendall tau	-0.4436	-0.4620	-0.6143	-0.6916
LL	-37.1601	-37.3196	-32.3569	-47.8399
AIC	-74.3294	-74.6485	-64.7049	-95.6897
BIC	-74.3428	-74.6624	-64.6920	-95.7042
Panel B: EUD-RMB (July 21, 2005~Dec. 29, 2008)				
Kendall's taut	-0.0421	-0.0449	-0.0536	-0.0787
LL	-1.9858	-7.9005	-1.8053	-2.9982
AIC	-3.9717	-15.8012	-1.4981	-5.9966
BIC	-3.9720	-15.8016	-1.4983	-5.9970
Panel C: EUD-RMB (Dec. 30, 2009~March 31, 2010)				
Kendall's taut	-0.0402	-0.0414	-0.0673	-0.1025
LL	-0.6346	-0.6559	-3.3011	-4.0060
AIC	-1.2697	-1.3121	-6.5964	-8.0126
BIC	-1.2704	-1.3129	-6.5854	-8.0138

Note: LL is the log-likelihood value of copula estimation. AIC (Akaike, 1973) which is defined as $AIC(M) = 2\,LL + 2T$; where T is the number of parameters being estimated and hat denotes the maximum likelihood estimates. BIC is Bayesian information criterion (Schwarz, 1978)

Table 5: The Kendall's tau of copula functions- between EUD and RMB exchange rate

	Normal Copula	**Student Copula**	**Gumbel Copula**	**Normal-DCC Copula**
Panel A: EUD-RMB (Jan. 4, 2005~July 20, 2005)				
Kendall tau	-0.5628	-0.5803	-0.6762	-0.7979
LL	-64.2608	-64.8302	-40.8389	-66.3841
AIC	-128.5325	-129.6716	-81.6694	-132.7795
BIC	-128.5487	-129.6881	-81.6569	-132.7961
Panel B: EUD-RMB (July 21, 2005~Dec. 29, 2008)				
Kendall tau	0.5546	0.6034	0.5386	0.7525
LL	-399.2369	-433.8636	-343.5747	-421.5511
AIC	-798.4722	-867.7253	-687.1446 -	-843.1005
BIC	-798.4681	-867.7210	-687.1331	-843.0965
Panel C: EUD-RMB (Dec. 30, 2009~March 31, 2010)				
Kendall tau	0.2758	0.2891	0.2180	0.3030
LL	-30.9278	-34.8094	-15.0168	-60.3901
AIC	-61.8530	-69.6160	-30.0255	-120.7783
BIC	-61.8481	-69.6109	-30.0104	-120.7747

Note: LL is the log-likelihood value of copula estimation. AIC (Akaike, 1973) which is defined as *AIC* (*M*) = 2 LL + 2T*;* where T is the number of parameters being estimated and hat denotes the maximum likelihood estimates. BIC is Bayesian information criterion (Schwarz, 1978)

Conclusions

We re-examined the exchange rate system against USD in EU and China FX markets, as well as the exchange rate of EUD by ARMAX-GJR-GARCH model was based on interest rate parity to verify the real world. All EU countries have trade liberalization and completely market deregulation, FX market system in EU took fully floating exchange rate due to the market volatility is time-varying from July 21, 2005 to Dec. 29, 2008. Our research find the reality of intervention could increased the volatility of RMB exchange rate in the short run and produce sovereign risk, which hasn't the characteristic of volatility cluster when we successfully implemented the comparison of different exchange rate systems between EU and PRC.

The lower dependence demonstrates that China took international spillovers slowly during the financial crisis from July 21, 2005 to Dec. 29, 2008. We construct the copula based on ARMAX-GJR-GARCH model to re-examine the temporal causality relationship between exchange rate of EUD and that of RMB in full period. According to the empirical results, we find that Chinese investors could gather useful information to know more intervention of exchange rate and produce the sovereign risk for RMB in short run. We also suggest that the PBC deregulate the FX market and even to amend the law relative to exchange rate.

With acknowledge of the exchange rate policy interventions of the PBC in communism country significantly affect macroeconomic as well as exchange rate. As a result, "politics influences economy" is real. FX market in China will be down if incorporating the government intervention as an impact movement. It is the official intervention of the sovereign risk to assist risk managers could clearly identified this risk.

Finally, we conclude the appreciation of the RMB over 2005 to 2008 went along with the depreciation of the USD, and the effective exchange indicator was stable at that time, while the European debt crisis was still very risky. If the USD appreciates due to the market hedge, the RMB should be volatile for a short period of time. In order to add extra academic value, we suggest further research for exchange rate regarding contrast between the EUD and the RMB based on other famous theories or different model be conducted.

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