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De Facto Currency Baskets of China and East Asian Economies: The Rising Weights

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Abstract

We employ Bayesian method to estimate a time-varying coefficient version of the de facto currency basket model of Frankel and Wei (2007) for the RMB of China, using daily data from February 2005 to July 2011. We estimate jointly the implicit time-varying weights of all 11 currencies in the reference basket announced by the Chinese government. We find the dollar weight has been reduced and sometimes significantly smaller than one, but there is no evidence of systematic operation of a currency basket with discernable pattern of significant weights on other currencies. During specific periods, the reduced dollar weight has not been switched to other major international currencies, but to some East Asian currencies, which is hard to explain by trade importance to or trade competition with China. We examine currency baskets of these East Asian Economies, including major international currencies and the RMB in their baskets. We find an evident tendency of Malaysia and Singapore to increase the weights of RMB in their own currency baskets, and a steadily and significantly positive weight of RMB in the basket of Thailand. These evidences suggest that, the positive weights of some East Asian currencies in RMB currency basket during specific periods largely reflect the fact that these East Asia economies have been systematically placing greater weights on RMB under the new regime of RMB exchange rate.

Keywords: RMB currency basket, time-varying regressions, East Asia, China, US

JEL Classification: F31, F41, C11

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1 Introduction

One of the central economic issues in the past decade is global imbalance, which features substantial US deficits and Chinese surpluses. Much of the related concern is on China's exchange rate regime. The international consensus and pressure are for China's currency yuan, the RMB, to appreciate, but there is no easy answer concerning the proper extent of appreciation. While the Chinese government has allowed the RMB to float within a narrow band since July 2005, the pace of adjustment is slow and the mechanism is lack of transparency. Discovering the mechanism behind and understanding the significance of the changing regime are of great importance to international society. This paper sheds lights on these issues following a brief review of the background and related research.

The remarkable economic boom of China has been one of the most important economic phenomena in the world economy during the past three decades. In 1978 when China launched economic reform, the total volume of China's foreign trade was a mere of $21 billion but increased to $1.1 trillion in 2004 (Branstetter and Lardy, 2008), equivalent to an average annual growth rate of 15% for more than two decades. To date, China has become the second largest economy in terms of GDP, trade volume and the volume of foreign direct investment, respectively. In the meantime, however, China continued to stick to a dollar-pegged exchange rate regime for a long time even after a great success of opening to foreign trade and investment. For example, the USD/CNY exchange rate was almost fixed around 8.3 during the period from 1995 to the summer of 2005. A rigid exchange rate regime has been blamed for the huge amount of accumulated current account surplus with respect to the US, which is a central issue in global imbalance. Since 2003, China has received intense pressure to appreciate the RMB.

On July 21, 2005, China's monetary authority announced to establish a managed floating exchange rate regime, shifting from a dollar-pegged regime to the one referring to a basket of several currencies to determine the value of RMB. About half a month later, Mr. Xiaochuan Zhou, the governor of People's Bank of China, claimed on August 9 that the basket would consider 11 currencies which includes the US dollar (USD), the Japanese yen (JPY), the Euro (EUR), the South Korean won (KRW), the Australian dollar (AUD), the Canadian dollar (CAD), the British pound

(GBP), the Malaysia ringgit (MYR), the Russian ruble (RUB), the Singapore dollar (SGD) and the Thailand baht (THB). And particularly, the governor emphasized that the first four currencies would play more important roles in determining the value of RMB. In addition, the daily floating band of the exchange rates was set between $\pm 0.3\%$ around the central parity. This band was lifted to $\pm 0.5\%$ on May 21, 2007. Figure 1 shows the level and log difference of the USD/RMB exchange rate daily data from February 2005 to July 2011. The figure reveals different stages of the exchange rate dynamics resulting from hidden policy operations.

[**Figure 1. Level and Log-difference of RMB/USD Exchange Rate**]

The aforementioned policy change has attracted heated attention on assessing China's de facto exchange rate regime. For example, Shah and Patnaik (2005) found no evidence to support a basket peg by using daily Chinese exchange rates from July to October in 2005. When the data coverage was extended to January 2006, Ogawa and Sakane (2006) found a statistically significant but small change in China's policy for RMB/USD exchange rate, while the currency basket system was not explored in their paper. Frankel and Wei (2007) is the first paper to assess China's de facto exchange rate regime and identify the implicit weights of other currencies in the basket to determine the value of RMB. By regressing the changes in the logarithm value of the RMB on the changes in the logarithm values of the candidate currencies, Frankel and Wei (2007) showed that, from July 2005 to the end of 2006, the weight on USD was still fairly heavy, although some Asian currencies load significantly positve in the subsamples of the first half of 2006. Furthermore, they found some empirical evidence that the implicit weight on USD was related to the pressure from the bi-annual US Treasury reports. Extending the examination period to 2007, Frankel and Wei (2008) found that a simple dollar peg regime was dominating during most of the period. Frankel (2009) found evidence that, during the period from July 2005 to 2008, the RMB basket started to switch a substantial weight from USD onto EUR, KRW or JPY, when only four major currencies were included in the regression; however, when other currencies were also included in the regression, the MYR became the most influential other than the USD. Finally, Fidrmuc (2010) estimated the implicit time-varying weights of three international currencies in the RMB basket by Maximum

Likelihood estimation (MLE) with Kalman filter for the daily exchange rates in levels from March 2005 to January 2009, and found evidence of flexibility in between but reversal to a dollar peg since 2008.

The previous literature indicates that the currency weights of the RMB basket is time-changing and the sample periods and currency choices play important roles in the results. In this paper, we employ the random coefficient model to identify the time-varying de facto weights of RMB's currency basket using the daily exchange rate data from February 2005 to July 2011. Although the USD weight was overwhelmingly heavy during most of the sample period, we find evidence that the USD weight has been reduced and was significantly below one in some specific periods. In particular, we find that the reduced weights on USD largely switched to the increased weights on some Asian currencies rather than on major international currencies such as EUR, JPY or GBP.

The significant Asian currency weights found in our study echoes some sets of results in Frankel and Wei (2007) in that only weights of USD and MRY were significant in their sample between 2005 and 2007. But the explanation on the significance of MRY weight is not convincing in the paper. In our paper, we look at this issue from the side of East Asian economies in the potential adjustment on their own currency basket weights under the backdrop of China's changing exchange rate regime, and find firm evidence that the RMB has become increasingly important in determining the Asian currency values. We find an evident tendency of Malaysia and Singapore to increase the weights of RMB in their own currency baskets, and a steadily and significantly positive weight of RMB in the basket of Thailand. The results explain the positive coefficients in a bilateral regression when RMB currency value is the dependent variable and the Asian currency values are explanatory variables. Despited the little transparency in the currency basket of China, these Asian economies have swiftly prepared themselves for a more flexible RMB.

Compared to the existing literature, our paper contributes in the following three aspects. Firstly, the random coefficient model adopted in the paper can not only efficiently utilize the whole sample information but also accommodate the time-varying features. While learning the evolution of the China's de facto exchange rate regime is of capital importance in this literature, most existing studies estimated the time-varying weights by using sub-samples and rolling regression, which

are subject to information inefficiency of short sample and biased estimates due to uncertainty in subsample division. In a transition from fixed exchange rate to a more flexible regime, both smoothed change and abrupted breaks can happen in the process such that the constant coefficient model is subject to biased estimator. For example, Cai, Chen and Fang (2012) detected some structural breaks in the daily log return of Chinese exchange rate. The random coefficient model used in this paper is not only capable of capturing smoothed change in parameters, but also can detect sudden breaks effectively, by fully utilizing the whole sample information.

Secondly, by including all eleven currencies in the officially announced currency basket of RMB and using Bayesian method of sampling, our paper avoids potential problems of Fidrmuc (2010), where only three international currencies are included in the time-varying regression using Maximum Likelihood Estimation (MLE) with Kalman filter. Excluding relevant currencies in the basket may lead to problem of omitted variables. The MLE using Kalman filter encounters numerical difficulty to handel high dimension optimization, when a large set of latent variables, i.e. currency weights, are involved.

Last, our paper echoes the debate in the literature about whether and why some Asian currencies substitute the reduced weight on the USD, even though they are not strategically as important as major international currencies both in terms of trade and capital flows. We attribute the phenomenon of increasing weights on these Asian currencies to the tendency of these Asian emerging markets to lift the weight of the RMB in their own currency baskets. The results bring us insights on the influence and consequence of the changing regime of China's exchange rate.

The rest of the paper is organized as follows. Section 2 presents the time-varying coefficient regression for currency basket with a model on the RMB currency basket and a model of currency basket for Asian economies. Estimation procedure will be discussed. Section 3 describes data. Section 4 discusses estimation results. Section 5 concludes.

2 Time-varying Coefficient Regressions for Currency Basket

2.1 Model of RMB Currency Basket

2.1.1 Linear Model with Constant Coefficients

To discover the opaque currency basket weights of RMB, Frankel and Wei (2007, 2008) and Frankel (2009) regressed the change in RMB exchange rate with respect to a numeraire on changes in exchange rates of the basket currencies with respect to the same numeraire. The candidate numeraire currency is the SDR. To allow for the likelihood of a trend appreciation, a constant term is included in the regression.

$$\begin{aligned} \Delta \log RMB_t &= c + \sum w_j \left[\Delta \log X_{j,t}\right] \\ &= c + \alpha \Delta \log USD_t + \beta_1 \Delta \log EUR_t + \beta_2 \Delta \log GBP_t + \beta_3 ... + u_t \end{aligned} \tag{1}$$

where α, β_1, $\beta_2 ... \beta_n$ are the currency weights. Frankel and Wei (2008) have a detailed discussion on this setting. When there is no clear information on the composition of the basket available, usually major international currencies are included as regressors.

Under the specific assumption that explanatory variables contain all currencies in the basket, the weights should sum up to one, such that $\alpha = 1 - \beta_1 - \beta_2 ... - \beta_n$ holds as a constraint, under which the above equation can be transformed to the following OLS regression by subtracting $\Delta \log USD_t$ on both sides

$$\begin{aligned} & \Delta \log RMB_t - \Delta \log USD_t \\ = \; & c + \beta_1 \left[\Delta \log EUR_t - \Delta \log USD_t\right] + \beta_2 \left[\Delta \log GBP_t - \Delta \log USD_t\right] + \beta_3 ... + u_t. \end{aligned} \tag{2}$$

In this transformed equation, the left hand side is the change in RMB/USD exchange rate, and the right hand side involves the changes in exchange rates of other currencies with respect to the USD. Frankel and Wei (2008) found similar results of the unconstrained and constrained regressions.

Frankel and Wei (2007) and Frankel (2009) estimated the weights for several subsamples to uncover the dynamic patterns of the changing weights of RMB currency basket. However, the results are dependent on the choice of sample division and subject to influence of sudden events included in the subsamples.

2.1.2 Time-varying Coefficient Model

To overcome the problems of subsample OLS regressions and efficiently utilize the information available in the whole sample, we employ time-varying coefficient regression to model the dynamic weights of the basket currencies

$$\Delta \log RMB_t = c_t + \alpha_t \Delta \log USD_t + \beta_{1t} \Delta \log EUR_t + \beta_{2t} \Delta \log GBP_t + \beta_{3t} ... + u_t. \quad (3)$$

Since we assume that, for China, the equation includes all relevant currencies in the basket such that sum of weights equal to 1, such that $\alpha_t = 1 - \beta_{1t} - \beta_{2t} ... - \beta_{nt}$, by rearrangement, we then have the following time-varying coefficient model

$$\begin{aligned} & \Delta \log RMB_t - \Delta \log USD_t \\ = \; & c_t + \beta_{1t} \left[\Delta \log EUR_t - \Delta \log USD_t \right] + \beta_{2t} \left[\Delta \log GBP_t - \Delta \log USD_t \right] + \beta_{3t} ... + u_t. \end{aligned} \quad (4)$$

We assume the time-varying parameters of currency weights follow the random walk process

$$\beta_{jt} = \beta_{jt-1} + \varepsilon_{jt} \quad (5)$$

with $\text{var}(\varepsilon_{jt}) = \sigma^2_{\varepsilon j}$. The random walk is appropriate to model dynamics with possible structural changes or nonstationary trend, which are highly likely in a transition from pegged exchange rate with US dollar to managed floating with respect to a currency basket.

As for the intercept c_t, which reflects adjustment speeds when the RMB value trended steadily, we use a dummy variable to incorporate the characteristics of two visible regime trends of the RMB/USD exchange rate. As shown in Figure 1, there are two types of periods. Type one: periods of modest appreciation at roughly constant speed, from July 10, 2005 to July 10, 2008, and from June 22, 2010 onwards; type two, periods of zero trend, namely before July 10, 2005 and between July 11, 2008 to June 21, 2010, which is a suspicious fixed exchange rate regime. Thus we introduce a dummy d_t such that $c_t = \alpha_1 + \alpha_2 d_t$, with $d_t = 1$ for the first type of trending periods, and $d_t = 0$ for the second type of periods of zero trend. If we do not introduce the dummy d_t, $c_t = \alpha_1$ comes back to the constant term case as in Frankel and Wei (2007)[1].

[1]In fact, whether introducing dummy for the intercept c or keeping it constant result in fairly similar results to the time-varying weights. This indicates that once we allow currency weights to be time-varying, the adjustment speed of change in exchange rate has been incorporated in the changes in weights. We will report the results of both cases.

2.2 Currency Basket Model for Asian economies

We will use the unconstraint representation to study how the Asian currency values target on international currencies and the RMB since July 2005, when RMB became more flexible with respect to the dollar. This exercise will help us to understand the "puzzling" result of currency weights in the officially announced RMB basket, as noticed by Frankel and Wei (2007). In these regressions, we explain the change in the value of an Asian currency value by weighted changes in the values of international currencies of USD, EUR, JPY and GBP, plus the RMB.

Taking Korea Won as an example, the regression equation is

$$\begin{aligned}\Delta \log KRW_t &= c + \beta_{1t}\Delta \log USD_t + \beta_{2t}\Delta \log EUR_t + \beta_{3t}\Delta \log JPY_t + \beta_{4t}\Delta \log GBP_t \\ &\quad + \beta_{5t}\Delta \log CNY_t + u_t. \end{aligned} \tag{6}$$

This unrestricted setting is more appropriate than the constraint one, when we do not have information on the exact basket currencies. Again we model the time-varying weights as random walk processes. Since we do not have particular information on the possible trends of exchange rate changes in these economies, we keep c constant.

2.3 Estimation of the Time-varying Coefficient Model of Currency Baskets

With the dynamics of weights, equations (4) and (5) fit naturally into the state-space framework. The states here are the time-varying weights evolving as random walks. The time-varying latent states can be estimated by Kalman filter in a traditional Maximum Likelihood estimation (MLE). However, due to the high dimensionality of this system where a total of eleven state variables need to be filtered out, MLE is subject to enormous difficulty in the numerical computation to find global optimum. To overcome this problem, we utilize Bayesian inference with a Gibbs sampler to elicit posterior distributions of the parameters and latent variables under proper prior assumption and data information.

We choose normal-gamma distribution for the prior distribution of α_1 and α_2, i.e., $\alpha_i \sim N(\bar{\mu}_i, \sigma^2_{\alpha_i})$ and $\sigma^2_{\alpha_i} \sim Gamma(n, \bar{\sigma}^2_i)$ for $i = 1, 2$. The posterior distribution will also be normal-gamma. We set prior distributions of variance parameters of σ^2_u and σ^2_ε as Gamma distributions, which produce

posterior Gamma distributions. These parameters can be taken as random draws directly. A Kalman filter step for filtering the latent states is embedded in the Gibbs sampler, and we use the algorithm of DeJong and Shephard (1995) to draw from the posterior distributions of time-varying weights. The hyperparameters of prior distributions for the time-varying latent weights are set at relatively large values, which allow them to vary substantively over time.

3 Data

The currency basket of China's yuan (RMB) includes US dollar (USD), the Japanese yen (JPY), the Euro (EUR), the South Korean won (KRW), the Australian dollar (AUD), the Canadian dollar (CAD), the British pound (GBP), the Malaysia ringgit (MYR), the Russian ruble (RUB), the Singapore dollar (SGD) and the Thailand baht (THB). We take the Special Drawing Rights (SDR) as the reference currency. Daily data of the exchange rates from February 7th, 2005 to July 29th, 2011 are downloaded from Bloomberg. Table 1 provides the descriptive statistics for the log-differences of the selected exchange rates.

We test the stationarity using ADF as well as KPSS test, and test the cointegration using Johansen test under the null of a constant term. Table 2 presents the results for unit root and stationarity tests, and table 3 reports cointegration test results. The ADF and KPSS test statistics indicate that all the exchange rate levels are unit root processes, while the log returns of the exchange rates are stationary. Results of the Johansen test show that there exists a single cointegration relation among these currencies. These test statistics are reassuring for the econometric models we choose to estimate.

Table 1. Descriptive Statistics

	Mean	Median	Min	Max	Std.Dev	Skewness	Kurtosis	JB-stat	Q(12)
CNY	0.00012	0.00009	-0.0241	0.0213	0.0032	-0.0008	7.7559	1588.51	14.6085
USD	-0.00003	-0.00007	-0.0247	0.0220	0.0033	-0.0858	7.1646	1220.40	10.9489
EUR	-0.00010	-0.00010	-0.0265	0.0341	0.0066	0.1907	4.9637	281.60	18.9490
JPY	0.00014	-0.00015	-0.0574	0.0401	0.0073	0.0687	8.4538	2089.85	62.7586
KRW	-0.00004	-0.00001	-0.0737	0.0780	0.0091	0.1542	19.2006	18419.90	47.1339
GBP	-0.00021	-0.00011	-0.0481	0.0251	0.0065	-0.2630	5.7852	564.76	14.3560
SGD	0.00015	0.00014	-0.0235	0.0179	0.0036	-0.1884	6.2023	730.65	125.6082
MYR	0.00011	0.00017	-0.0273	0.0204	0.0039	-0.2117	6.8058	1030.19	24.3198
RUB	-0.00001	0.00014	-0.0558	0.0233	0.0051	-1.5611	17.1860	14802.46	17.4158
AUD	-0.00005	0.00020	-0.0699	0.0815	0.0099	-0.2205	12.5231	6378.00	52.9898
THB	0.00012	0.00007	-0.0704	0.0347	0.0057	-1.7358	29.9488	51785.76	72.1931
CAD	0.00013	0.00024	-0.0299	0.0345	0.0072	-0.1244	4.7444	218.61	47.3491

[Note: The table provides the descriptive statistics for the returns of the exchange rates. We calculate daily log returns for exchange rate as $log(E_t/E_{t-1})$. The sample period is from February 7th, 2005 to July 29th, 2011 with a total of 1665 observations. JB-stat denotes the Jarque-Bera test statistics. Q(12) denotes the Ljung-Box test statistics with 12 lags.]

Table 2. Results of Unit Root and Stationarity Tests

	ADF		KPSS	
	return	price	return	price
CNY	-11.4618	-2.3162	0.0797	14.2056
USD	-11.3142	-2.4877	0.0705	6.1507
EUR	-12.2398	-2.3521	0.2939	5.8104
JPY	-12.8711	-1.9382	0.3154	12.5985
KRW	-12.7853	-1.3465	0.1449	10.9758
GBP	-12.8546	-1.5983	0.2045	4.7074
SGD	-13.4465	-0.7625	0.1779	14.1497
MYR	-12.7845	-2.4505	0.0826	7.0441
RUB	-11.2386	-1.6752	0.1865	8.5431
AUD	-12.1014	-2.1051	0.1294	6.5345
THB	-11.8904	-2.1930	0.0654	13.2922
CAD	-13.0081	-2.3616	0.0676	4.4359
Critical values:				
10%	-3.12		0.347	
5%	-3.41		0.463	
1%	-3.96		0.739	

[Note: ADF is the augmented Dicky-Fuller statistics under the null hypothesis that the return/price series has a unit root. KPSS is the Kwiatkowski-Phillips-Schmidt-Shin statistics under the null hypothesis that the return/price series is stationary. The critical value for ADF and KPSS are provided below the test statistics. The test statistics show that all the return series are stationary, and all the series of exchange rates in level are unit root processes.]

Table 3: Results of Johansen's Cointegration Test

Trace	$r <= 0$	$r <= 1$	$r <= 2$	$r <= 3$	$r <= 4$
Stat.	76.5577	28.0651	15.2524	6.1760	0.0034
Critical values:					
10%	65.8202	44.4929	27.0669	13.4294	2.7055
5%	69.8189	47.8545	29.7961	15.4943	3.8415
1%	77.8202	54.6815	35.4628	19.9349	6.6349
Max	$r = 0$	$r = 1$	$r = 2$	$r = 3$	$r = 4$
Stat.	48.4926	12.8127	9.0764	6.1726	0.0034
Critical values:					
10%	31.2379	25.1236	18.8928	12.2971	2.7055
5%	33.8777	27.5858	21.1314	14.2639	3.8415
1%	39.3693	32.7172	25.8650	18.5200	6.6349

[Note: This table provides Johansen's cointegration test for all the twelve series of exchange rate values with respect to the SDR. The null hypothesis is constant deterministic term plus linear time-trend. Test statistics of $r <= 0$ to $r <= 4$, for both λ_{max} and λ_{Trace}, are provided respectively. The results show there is only one cointegrating relationship among the 11 exchange rates.]

4 Results

In our estimation, we have set the total number of draws to be 6000, with the first 1000 draws as burn-ins to be discarded in order to reduce the effects of intial values in the Gibbs sampler. The prior and posterior parameter values are given in Table 4 for two specifications with or without regime dummy.

Table 4: Prior and Posterior Distributions of Parameters

	Prior	Posterior			
		TVCM		TVCM (Dummy)	
α_1	$\bar{\mu}_1 = 0, \bar{\sigma}^2_{\alpha_1} = 0.01$	1.6148		1.6589	
		(0.9254)		(0.9080)	
σ^2_u	$\bar{v}_u = 0; \bar{s}_u = 0.01$	[0.0080	0.0095]	[0.0080	0.0096]
$\sigma^2_{\varepsilon_{EUR}}$		[0.0898	0.1024]	[0.0896	0.1026]
$\sigma^2_{\varepsilon_{JPY}}$		[0.0759	0.0851]	[0.0759	0.0850]
$\sigma^2_{\varepsilon_{KRW}}$		[0.0802	0.0905]	[0.0803	0.0908]
$\sigma^2_{\varepsilon_{GBP}}$		[0.0808	0.0912]	[0.0809	0.0914]
$\sigma^2_{\varepsilon_{SGD}}$	$\bar{v}_\varepsilon = I_{k\times 1};$	[0.1226	0.1448]	[0.1225	0.1456]
$\sigma^2_{\varepsilon_{MYR}}$	$\bar{s}_\varepsilon = 0.1 * I_{k\times 1}$	[0.1076	0.1274]	[0.1078	0.1280]
$\sigma^2_{\varepsilon_{AUD}}$		[0.1157	0.1364]	[0.1154	0.1367]
$\sigma^2_{\varepsilon_{RUB}}$		[0.0758	0.0849]	[0.0758	0.0848]
$\sigma^2_{\varepsilon_{THB}}$		[0.0944	0.1088]	[0.0944	0.1088]
$\sigma^2_{\varepsilon_{CAD}}$		[0.0766	0.0857]	[0.0764	0.0858]
α_2	$\bar{\mu}_2 = 0, \bar{\sigma}^2_{\alpha_1} = 0.01$	-		0.0001	
		-		(0.0019)	

[Note: Standard deviations are given in "( )", and the 95% confidence intervals are given in "[ ]". The posterior 95% probability intervals for σ^2_ε must be multiplied by 10^{-3}. The posterior parameter values pass Geweke's convergence diagnostics.]

In our time-varying coefficient model, the intercept term c_t is insignificant in both cases, and the coefficient of dummy α_2 is very small and also insignificant. These indicates that our time-varying coefficient model and our empirical results are not sensitive to the changes in the regimes of the appreciation trend in the RMB/USD exchange rate dynamics. The appreciation speed of the exchange rate has been incorporated into the changes in weights.

4.1 Estimated Weights in the RMB Currency Basket

To visualize the time-varying weights intuitively, we plot the median estimates along time together with the 95% probability interval.

We first present in Figure 2 the time-varying weight on the US dollar. It is still dominant over other currencies, on average accounting for 85% of the value change in RMB, which is a confirmation on the impression from the dynamics of RMB/USD exchange rate in Figure 1. There are three major periods when the weight is significantly below one: (1) July 2005, when Chinese authority announced to switch to the new currency regime; (2) December 2008, when the sub-prime crisis broke out; (3) late 2010 and early 2011, when China's growth figure and economic indicators seemed to excel under the dismal backdrop of the world economy, and China is again under acute pressure from the U.S. to accelerate the RMB appreciation process.

[Figure 2. Time-Varying Weight of the US Dollar]

Figure 3 plots the estimated time-varying weights on five major international currencies other than the USD in the basket, i.e. Euro (EUR), British pound (GBP), Japanese yen (JPY), the Australian dollar (AUD) and Canadian dollar (CAD), respectively. Although the first three international currencies were announced as major currencies in the basket together with the US dollar, the weight of yen is significantly positive only in July 2005 when the new exchange rate regime was introduced, and the weight of pound is once significant at the end of 2008 in the crisis, while the euro weight never turns positive significantly. As for the other two international currencies, the weight on AUD is flat around zero during the whole sample period, and the CAD only significantly drops to negative at the end of 2008, reflecting its position closely tied to the US dollar.

[Figure 3. Time-Varying Weights of Five International Currencies]

Figure 4 plots weights of Asian currencies in the announced basket other than the Japanese yen. The Korean won (KRW) is significant only around July 2005, then tends to be negative at the end of 2008, but stays around zero at large. The Russian ruble (RUB) was significantly positive

at the end of 2008. The other three East Asian currencies exhibit significantly positive weights in multiple occasions. The Malaysia ringgit (MYR) becomes significantly positive during the first half of 2008, then tends to be positive in 2010 and 2011, and the median weight stays positive most of the time. The Singapore dollar (SGD) has large swings to the positive side in 2005 and stays for sometime positive with significance in the beginning of 2011. The Thailand baht (THB) becomes significantly positive every time when the US dollar drops significantly below one.

[Figure 4. Time-Varying Weights of Asian Currencies Other than the Japanese Yen]

The above results echo the findings in Frankel and Wei (2007) and Frankel (2009) in that:

1) The RMB did relax its peg to the US dollar since July 2005, although a rigid peg was resumed during the financial crisis, and the weight has been constantly below one with high probability, and significantly below one during some periods.

2) Besides the relaxation to the dollar peg, there is no systematic patterns of currency weights discovered on the claimed currency basket.

3) When the dollar weight decreases, it's not that the weights of the other major international currencies get higher, but the weights of some East Asian currencies increase.

While the first two points are intuitive and in line with what the market observes, the last point is not obvious without a close examination, neither is the explanation straight forward.

Concerning the significant weight of Malaysia ringgit from linear regression with 2005-2007 data, Frankel and Wei (2007) suggest the possible reason of the Chinese government to preserve trade competitiveness against other Asian rivals. But the explanation is not fully justified in terms of the importance of bilateral trade with Malaysia or trade competition with Malaysia, when other trade partners, especially some other important East Asian economies, are also present in the regression. In what follows, we will offer an explanation through a mutual regression by regressing the exchang rate change of the Asian economies on RMB exchang rate variation, controlling for major international currencies.

4.2 Weights of RMB in the de Facto Currency Baskets of East Asian Economies

In a bilateral relationship between a dependent and an explanatory variables, say y and x, the regression coefficient in a linear model always closely reflects the covariation ($x'y$) between the two variables. When we see the puzzling phenomenon of the increasing weights of some East Asian economies on RMB's value, it means, other things being equal, the covariation between them increases. Then an interesting point is to look at the opposite direction: under the new regime of RMB exchange rate, has its influence on these East Asian economies change? How have these East Asian economies adjust their currency values with respect to a more flexible RMB? This is a very sensitive question as China is a very important trade partner with economies in East Asia. When China changes the exchange rate policy with respect to the US, it has significant impact on the trade relationships within the region. Thus it is crucial for East Asian currencies to react accordingly.

To verify this hypothesis, we run regression of equation (6) to discover the weights of international currencies together with the RMB for Korean won. We assume that its currency basket includes the four major international currencies of USD, EUR, JYP and GBP, plus the RMB. The reference currency is SDR. Although RMB and USD are highly correlated, the fact that it is not strictly pegging after July 2005 renders independent variation of the RMB value with respect to the US dollar, which enables the feasibility of the estimation. We run the regression also with other East Asian currencies – RUB, MYR, SGD and THB – to elicit weights in the currency basket of each.

Figure 5 to 9 plot the results of the de facto currency baskets for these five Asian economies in turn. Each figure presents the regression coefficients of all five weights of USD, EUR, JYP, GBP and RMB in the basket.

We have shown in Figure 4 that the KRW and RUB actually do not show significant weights in multiple occasions. In Figure 5, the results of the regression of KRW on RMB as one of the basket currencies also show no evident relationship between them. Though in Figure 6, the RMB does starts to load positively on the RUB at the end of the sample, i.e. in 2011.

[Figure 5. Time-Varying Weights of the de Facto Currency Basket of Korea Won]

[Figure 6. Time-Varying Weights of the de Facto Currency Basket of Russia Ruble]

Figure 7 shows the de facto basket weights of Malaysia ringgit (MYR), where the RMB weight tends to strongly pick up since 2008. In Figure 8 for Singapore dollar (SGD), the RMB weight starts being significantly positive already in 2005 and 2006, although it decreases somewhat in the following years, it is with a high probability of being positive. Then since 2010 it increases again with an average of 0.5. Figure 9 shows that since 2005 the RMB weight for Thailand baht (THB) remains significantly positive with an average of 0.3-0.4 most of the time.

[Figure 7. Time-Varying Weights of the de Facto Currency Basket of Malaysia Ringgit]

[Figure 8. Time-Varying Weights of the de Facto Currency Basket of Singapore Dollar]

[Figure 9. Time-Varying Weights of the de Facto Currency Basket of Thailand Baht]

The above results demonstrate that some East Asian economies, whose weights tend to pick up in the de facto RMB currency basket, have a strong tendency to increase the RMB weights in their own currency baskets. Higher weights of the RMB in the currency baskets of these East Asian currencies result in higher weights of Asian currencies in the de facto RMB currency basket when US weight drops, as the relationship is bilateral in the two way regression.

These evidences suggest that these East Asia economies have been placing greater weights on the RMB systematically. On the contrary, the currency basket of RMB is more of a technical construction rather than systematic policy operation, as we have not seen evident patterns of weights, or changes in weights, for currencies other than the US dollar.

5 Conclusions

We employ Bayesian method to assess the time-varying weights of China's de facto currency basket using daily data between February 2005 to July 2011. By putting all the 11 currencies announced by the Chinese authority in the regression, we confirm the general impression of markets and previous literature that the US dollar still dominates other currencies in determining the value of China's RMB, although under the new regime of limited flexibility the weight has been below one during some periods. There seems not yet to exist a systematic weighting scheme from the Chinese authority, with little evidence of increasing importance of other major international currencies. The occasionally increasing weights of some East Asian currencies in the RMB basket can be explained largely by the greater importance of a more flexible RMB in determining the currency values of these economies.

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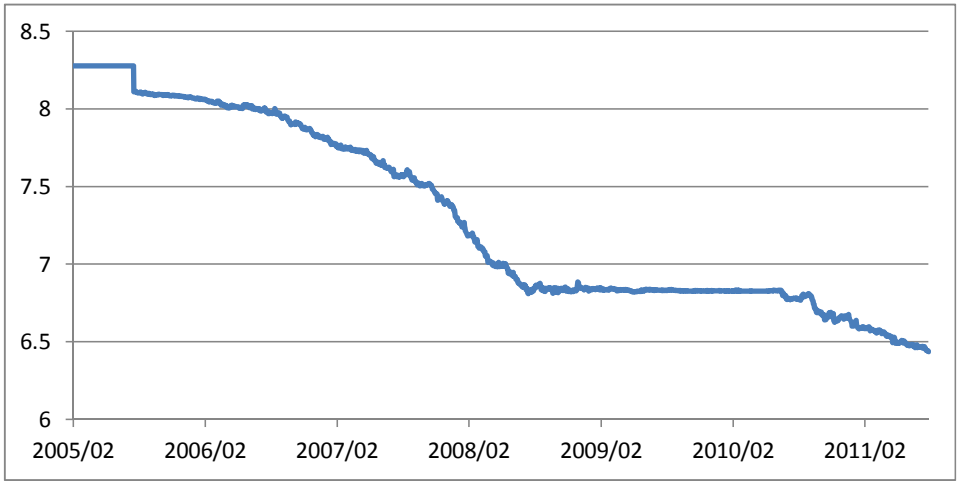
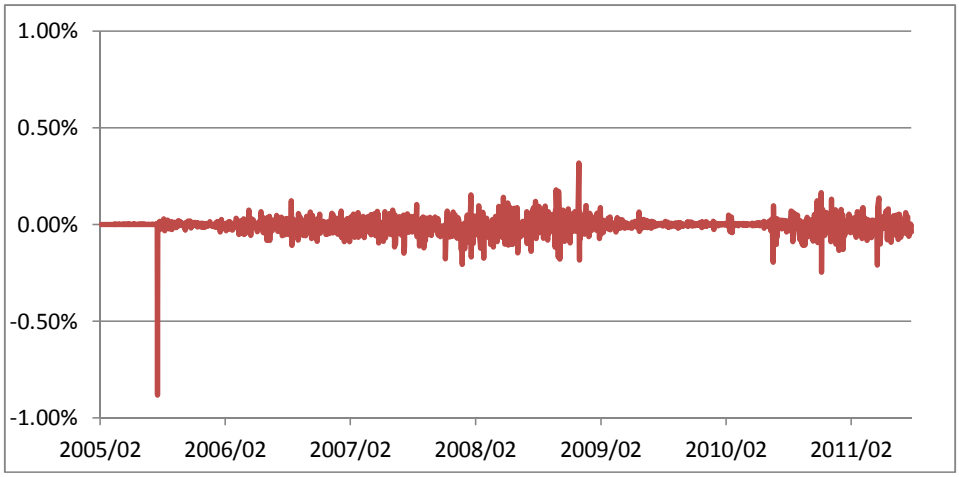
Figure 1: Level and Log-Difference of RMB/USD Exchange Rate

Panel A: Level of RMB/USD exchange rate

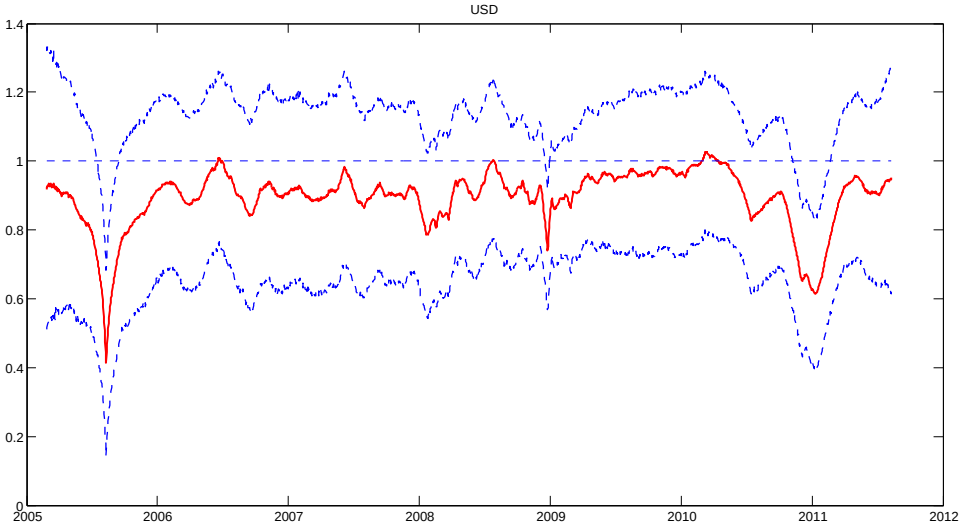


Panel B: Daily log changes of RMB/USD exchange rate



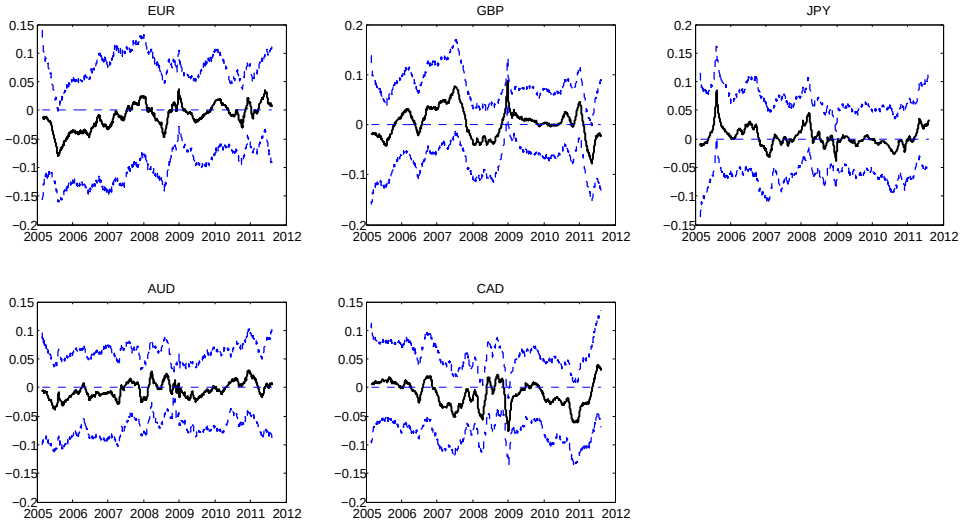
Note: Panel A plots the level of the RMB/USD exchange rate, and Panel B plots the daily log difference of the RMB/USD exchange rate. The sample period is from 2005.2 to 2011.7.

Figure 2: Time-Varying Weight of the US Dollar



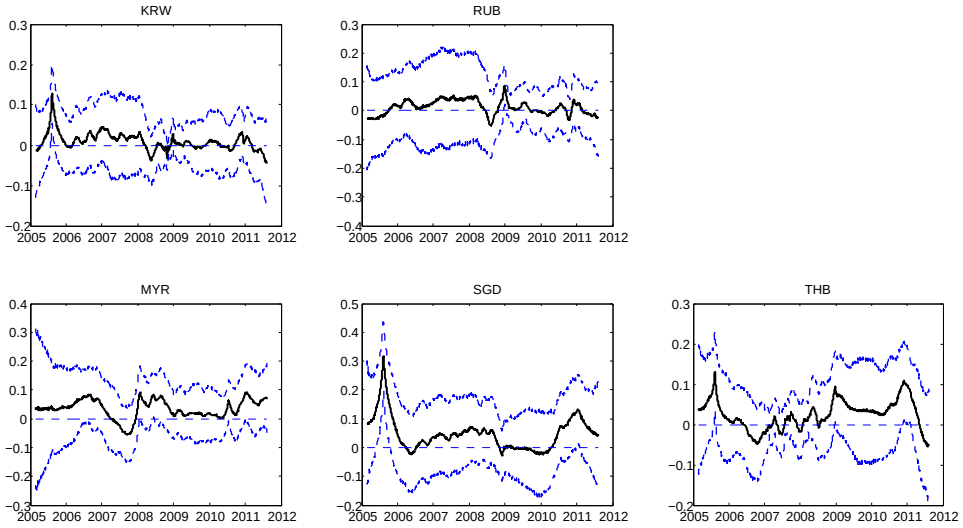
Note: This figure plot the time-varying weight of US dollar in RMB's currency basket. The solid line is the estimated weights and the dashed lines are the 95% confidence intervals.

Figure 3: Time-Varying Weights of Five International Currencies



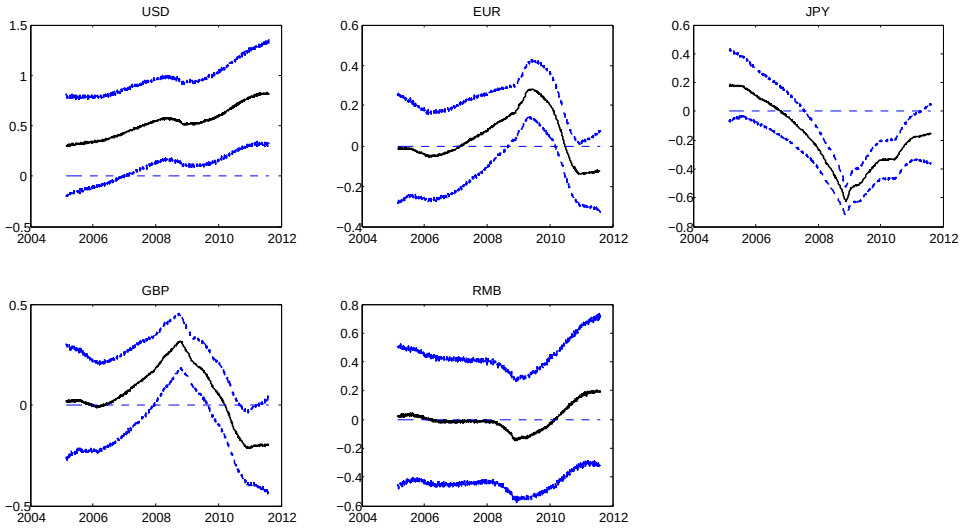
Note: This figure plot the estimated time-varying weight of Euro (EUR), British pound (GBP)), Japanese yen (JPY), the Australian dollar (AUD) and Canadian dollar (CAD), respectively. The solid line is the estimated weights and the dashed lines are the 95% confidence intervals.

Figure 4: Time-Varying Weights of Asian Currencies Other than the Japanese Yen



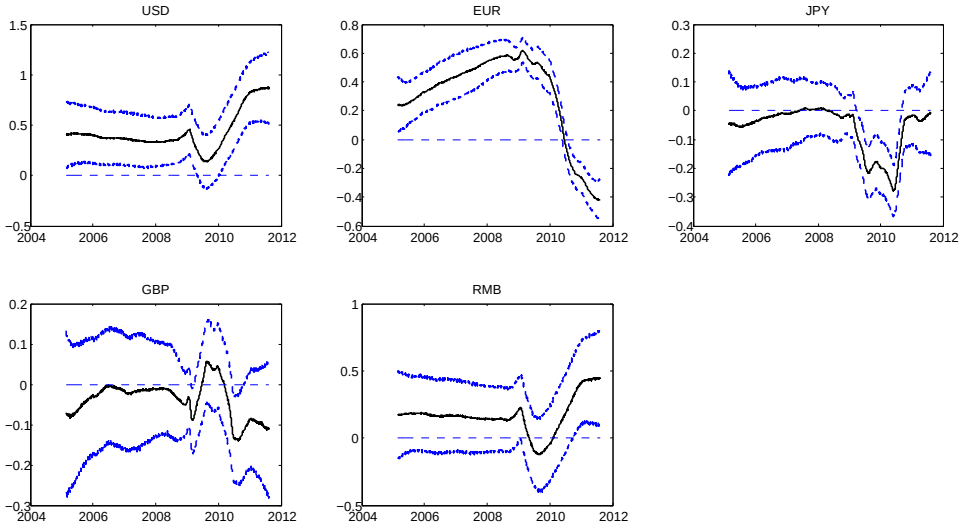
Note: This figure plot the estimated time-varying weights of Korea Won (KRW), Russian ruble (RUB), Malaysia ringgit (MYR), Singapore dollar (SGD) and Thailand baht (THB). The solid line is the estimated weights and the dashed lines are the 95% confidence intervals.

Figure 5: Time-Varying Weights of the de Facto Currency Basket of Korea Won



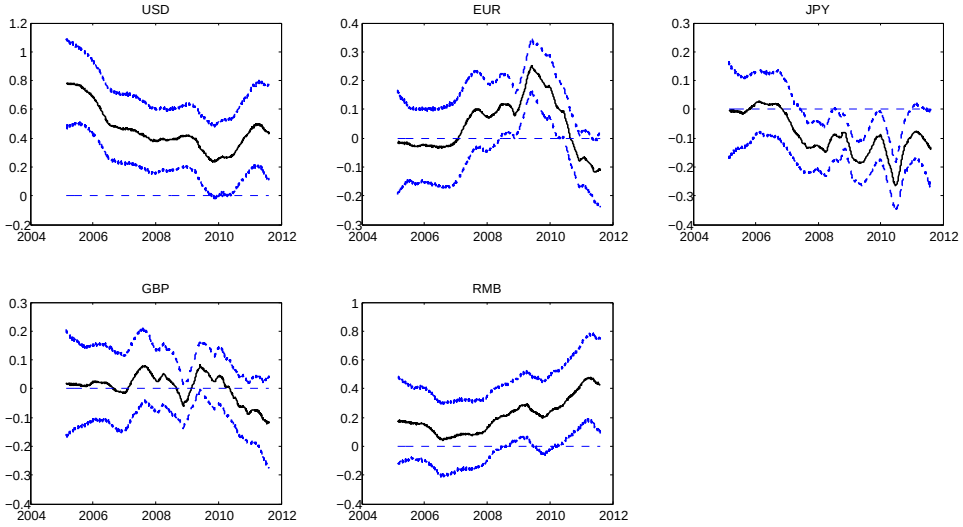
Note: Using time-varying coefficient model, we regress Asian currencies (returns) on 5 major currencies (returns): USD, EUR, JPY, GBP and RMB. This figure plot the time-varying coefficients for Korea Won. The solid line is the estimated weights and the dashed lines are the 95% confidence intervals.

Figure 6: Time-Varying Weights of the de Facto Currency Basket of Russia Ruble



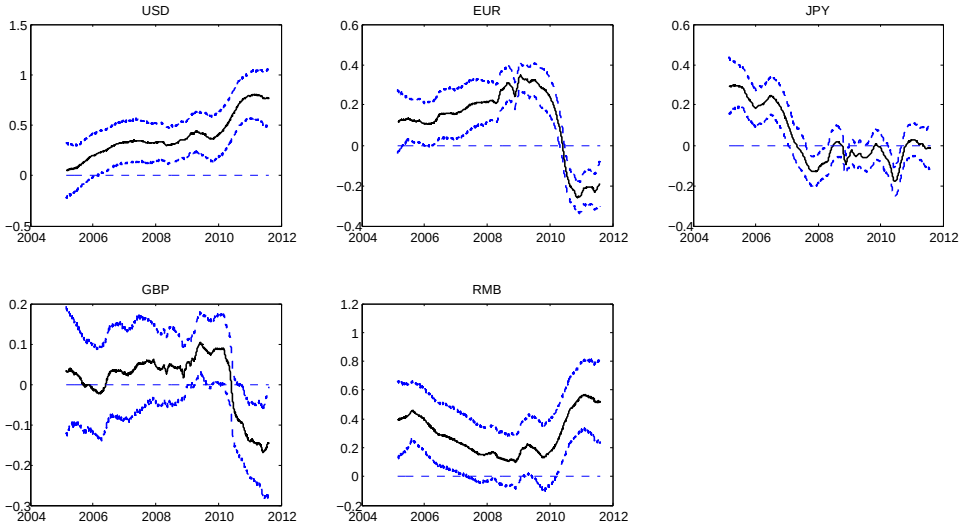
Note: Using time-varying coefficient model, we regress the currencies (returns) on 5 major currencies (returns): USD, EUR, JPY, GBP and RMB. This figure plot the time-varying coefficients for Russia Ruble. The solid line is the estimated weights and the dashed lines are the 95% confidence intervals.

Figure 7: Time-Varying Weights of the de Facto Currency Basket of Malaysia Ringgit



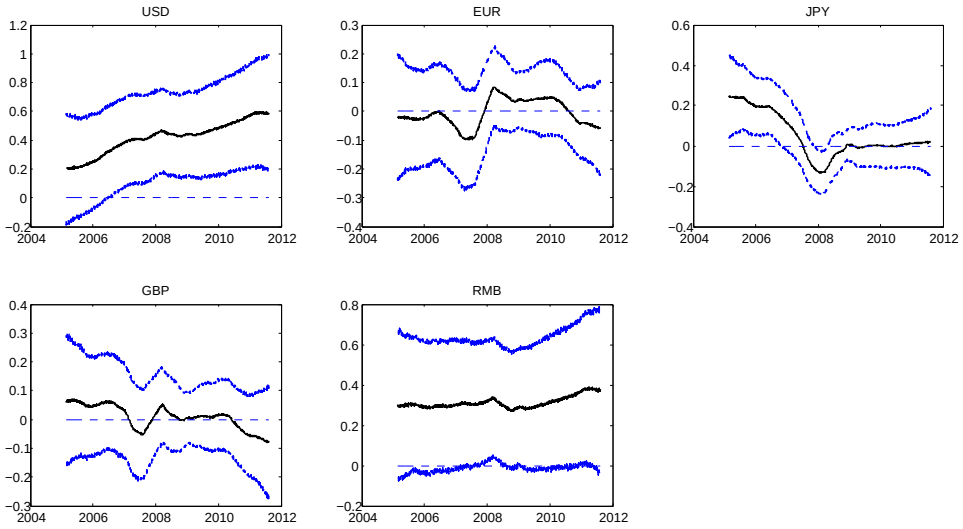
Note: Using time-varying coefficient model, we regress Asian currencies (returns) on 5 major currencies (returns): USD, EUR, JPY, GBP and RMB. This figure plot the time-varying coefficients for Malaysia Ringgit. The solid line is the estimated weights and the dashed lines are the 95% confidence intervals.

Figure 8: Time-Varying Weights of the de Facto Currency Basket of Singapore Dollar



Note: Using time-varying coefficient model, we regress Asian currencies (returns) on 5 major currencies (returns): USD, EUR, JPY, GBP and RMB. This figure plot the time-varying coefficients for Singapore dollar. The solid line is the estimated weights and the dashed lines are the 95% confidence intervals.

Figure 9: Time-Varying Weights of the de Facto Currency Basket of Thailand Baht



Note: Using time-varying coefficient model, we regress Asian currencies (returns) on 5 major currencies (returns): USD, EUR, JPY, GBP and RMB. This figure plot the time-varying coefficients for Thailand Baht. The solid line is the estimated weights and the dashed lines are the 95% confidence intervals.

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