RMB Bloc in East Asia: Too early to talk about it?

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Abstract

This paper investigates whether the Chinese RMB has become more influential (than the US dollar) in determining the exchange rates of East Asian currencies in recent years. We employ a regression method with time varying coefficients in order to trace changes in coefficients over time. The empirical results show that the RMB's effects on East Asian currencies were near zero before 2008, but since then have significantly increased and took over the role of the US dollar in some countries (Indonesia, Malaysia, and the Philippines). In Singapore and Thailand, the RMB is still a non-factor. South Korea shows an interesting pattern, in that the role of the RMB swings over time with an increase in the past couple of years. We conjecture that the trade share with China has a positive influence on the role of the RMB. In conclusion, given the small absolute value of the regression coefficient on the RMB, even though the RMB has attained a more significant status in the currency market, it is too early to talk about the creation of an RMB bloc in East Asia.

JEL Classification: F4

Key Words: RMB bloc, exchange rate, Chinese RMB, US dollar, East Asia.

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1. Introduction

China has been increasingly influential in East Asia, in both trade and financial fronts. However, the status of the renminbi (RMB) has not been commensurate with the country's economic prowess. Although the RMB has been included in the SDR (Special Drawing Rights) basket as a fifth currency since October 1, 2016, along with the US dollar (USD), euro (EUR), Japanese yen (JPY), and pound sterling (GBP), international use of the RMB is still limited. As described in terms of Chinese preference for "crossing the river by feeling the stones beneath one's feet," China's approach toward RMB internationalization has been cautious and gradual (Eichengreen, 2015). It requires considerable progress and time to reform domestic financial markets and institutions before removing the residual restrictions on capital account that limit the international use of the RMB (Wang, 2017).

Exchange rate regimes in most East Asian countries had been a dollar peg until the currency crisis in 1997 when many countries switched to free floating. Since then, some countries (Indonesia, South Korea, and Thailand) have significantly increased the degree of exchange rate flexibility, while others (Hong Kong, Malaysia and Singapore) have not. For the exchange rate policies of the East Asian countries, it is no longer easy to paint all of them with one color. As argued in Frankel (1999), certainly, no single arrangement is right for all times and places. Although the US dollar still remains the most widely used in trade, investment, and financial transactions among the East Asian countries, exchange rate movements of these countries show different patterns against the US dollar and other Asian currencies.

Given a rapid increase of China's economic influence in East Asia, this paper examines whether the role of the RMB has increased in exchange rate determination in East Asian currencies. This issue has already been explored in the literature, as by Frankel and Wei (1994), Kawai and Pontines (2014, 2016), Ito (2016), and others. Our contribution is that we carefully control for a numeraire currency and multi-collinearity issues and adopt an up-to-date regression method with time varying coefficients to analyze how the role of the RMB has changed over time. This paper focuses on differences in regression coefficients over time and over different countries, while examining how and why the RMB has become more influential in some countries and not in other countries. Throughout this exercise, we aim to draw meaningful implications for exchange rate policies in East Asia.

Frankel and Wei (1994) provided the basic empirical methodology used in the literature. They ran a regression of exchange rates of East Asian currencies in terms of Swiss franc (CHF) on USD, JPY and other key currencies in order to investigate the relative role of USD and JPY in determining exchange rates in East Asia. Some later papers modified the Frankel-Wei regression by including the Chinese RMB on the right hand side of the regression equation to see whether the role of the RMB has become more important in exchange rate determination in the region. Much of this previous research has concluded that the coefficient of the

Chinese RMB is quite significant and large in many countries, and sometimes larger than the role of the US dollar.[1]

However, Kawai and Pontines (2014, 2016) argued that the Frankel-Wei regression has a multi-collinearity problem. They proposed a two-step regression to control for the effects of the US dollar on the Chinese RMB in the regression. They showed that the role of the RMB becomes insignificant in most regressions (using the data up to 2013) after controlling for multi-collinearity among explanatory variables. They also proposed using New Zealand dollar (NZD) instead of the Swiss franc as numeraire, because the Swiss franc has recently followed a fixed exchange rate regime for some times. Using expanded data up to 2016, Ito (2016) also showed the importance of a numeraire currency. He used NZD as a numeraire currency and showed that the role of the RMB has become significant in exchange rate determination in recent years. However, he did not correct the multicollinearity issue, so the apparent importance of the RMB may result from multicollinearity problems in the regression.

This paper refines the methodology of Ito (2016) by employing a two-step regression and that of Kawai and Pontines (2016) by adding data up to 2016. We also provide regression results with time-varying coefficients. Our regression results show that the role of the Chinese RMB has become more significant with time, especially since 2014. These results are different from those of Kawai and Pontines (2016), who reported that the RMB becomes insignificant using the data up to 2013. Regression results with time-varying coefficients reveal that the coefficient for RBM in most countries was near zero before the 2008 global financial crisis, but since then countries have followed different patterns. For Thai Baht, the Singapore dollar, and the Hong Kong dollar, the role of the RMB stays insignificant. However, for the Indonesian Rupiah, Malaysian Ringgit, and Philippines Peso, the role of the RMB significantly increased. Korean won showed a mixed pattern, in that the coefficient for RMB decreased between 2010 and 2014, but has increased since then. These different patterns can partly be explained by trade share with China. A high trade share with China means that the central bank should focus more on stabilizing the exchange rate with the RMB, therefore increasing the role of the RMB in exchange rate determination.

The rest of the paper is as follows. We first provide an overview of the exchange regimes in China and other East Asian countries, and then explain the regression method with time-varying coefficients. After we provide regression results, we provide explanations for the differences in coefficients by using the trade share with China.

2. Exchange Regime in China

Until 1994, the People's Republic of China (PRC) had a dual exchange rate system, where

[1] For example, see Ho et al. (2005), Balasubramaniam et al. (2011), Chow (2011), Henning (2012), Subramanian and Kessler (2013) and Fratzscher and Mehl (2014).

the official exchange rate was set much higher than the market rate. In early 1994, these rates were unified by devaluing the official rate by about 30% from CNY 5.8 per USD to CNY 8.48 per USD. Thereafter, the exchange rate appreciated slightly to 8.28 and stayed there until July 2005.

On July 21, 2005, the PRC authorities announced that they would revalue the RMB against the USD by 2.1% from 8.28 to 8.11. At the same time, the PRC shifted its exchange rate system from a conventional US dollar peg to a crawling peg regime. Crawling pegs are often used to provide a degree of exchange rate stability between trading partners by allowing for incremental adjustments within a pre-announced narrow band, instead of choosing one-time large devaluation or revaluation under the hard-peg regime. Under this soft-peg regime, the daily trading price of the USD against the RMB in the inter-bank foreign exchange market was allowed to float within a narrow band of 0.3% around the central parity announced by the People's Bank of China (PBOC). The band was extended to 0.5% on May 18, 2007. On April 14, 2012, the band was extended again to 1.0%. On March 17, 2014, the band was once again extended to 2%.

Starting in July 2005, the PRC authorities allowed the RMB to appreciate gradually, partly to tighten monetary policy, given the domestic economic overheating and partly to respond to the criticism by the United States and IMF that the PRC had maintained an undervalued currency, which led to rising current account surpluses and a huge amount of foreign exchange reserves. The pace of appreciation was slow and well controlled but persistent until the summer of 2008. The nominal RMB against the US dollar appreciated by 17.5% and the RMB reached a peak (Kawai and Pontines, 2014).

In the summer of 2008, the PRC authorities decelerated the pace of RMB appreciation and restored a US dollar peg system before the global financial markets were severely hit by the collapse of the Lehman Brothers in September 2008. The PRC government officials were seriously concerned about the erosion of the PRC's export competitiveness caused by RMB appreciation in the midst of the global demand contraction. Their decision to stabilize the RMB exchange rate appreciated the RMB value in real effective exchange rate terms, because many of its export competitors in the region began to suffer from sharp depreciation of their currencies. The RMB exchange rate was set at CNY 6.83 per USD until May 2010. In June 2010 the PRC abandoned the peg once again, allowing RMB appreciation against the US dollar to resume.

On August 11, 2015, the PBOC announced changes to the daily fixing arrangements for the RMB. In practical terms, the new policy represented further liberalization of the exchange rate regime, which was in line with the Chinese government's desire for RMB internationalization. Under the previous arrangement, the PBOC set the daily reference rate each morning, and the RMB was permitted to trade each day within a +/-2% band. The reference rate was determined by the PBOC, but the market spot rate often varied significantly from the official rate. Under the new arrangement, the reference rate was set at

the previous day's closing value, while the trading band remained unchanged. This new arrangement initially led to a 1.9% fall in the RMB (the largest daily depreciation since the adoption of the crawling peg in 2005), as the RMB had closed the previous day close to the bottom of the permissible range. Although the decision was explained by the PBOC as a 'one-off' move to establish parity between the reference and spot rates, the PBOC was forced to set the reference rate on August 12 again at the lower end of a new lower range, resulting in a further 1.6% depreciation. The reference rate was set a further 1.1% lower on August 13.

This new exchange rate arrangement and the ensuing depreciation of the RMB raised speculation that China would embark on a currency war to boost the country's exports and growth. However, many others interpreted that move as the government's effort to allow the RMB to float more freely on the international market. Indeed, the PRC's move towards a more flexible exchange rate regime has been cautiously welcomed by both the IMF and the US Treasury. The PBOC also emphasized its official position by saying that the RMB would be determined by "demand and supply conditions in the foreign exchange markets and the movement of major currencies."

Nonetheless, China has not yet set a timetable for allowing its currency to float freely against others. Furthermore, as clearly pointed out in the US Treasury's report on 'foreign exchange policies of major trading partners of the United States,' China's excessive foreign exchange intervention has been regarded as evidence of currency manipulation. Treasury estimates that from August 2015 through February 2017, China sold around $800 billion in foreign currency assets to prevent rapid RMB depreciation (US Treasury, 2017). By welcoming China's recent efforts to prevent sharp depreciation of the RMB, the US Treasury also strongly asserted that China will need to demonstrate its durable policy shift by letting the RMB rise with market forces once appreciation pressures resume. In short, the RMB has long been expected to eventually become a freely floating currency. The highly managed exchange rate is inconsistent with Beijing's other moves toward capital account liberalization and RMB internationalization.

3. Exchange and Monetary Regimes in East Asian Countries

This section provides a brief explanation of the exchange rate and monetary regimes in East Asia. Since the exchange rate system is closely linked to monetary policy, both exchange and monetary regimes are often considered simultaneously. The IMF Annual Report on Exchange Arrangements and Exchange Restrictions (2016) show the following exchange rate classifications:

China: other managed arrangement and monetary aggregate targeting
Indonesia: floating and inflation targeting
Korea: floating and inflation targeting
Malaysia: other managed arrangement and other monetary policy framework

Philippines: floating and inflation targeting
Singapore: stabilized arrangement (composite exchange rate anchor)
Thailand: floating and inflation targeting

A floating exchange rate regime, as adopted in Indonesia, Korea, the Philippines, and Thailand, means a largely market-determined regime without a predictable path for the rate. In particular, an exchange rate that satisfies the statistical criteria for a stabilized or a crawl-like arrangement will be classified as such unless it is clear that the stability of the exchange rate is not the result of official actions. Foreign exchange market intervention may be either direct or indirect, and such intervention moderates the rate of change and prevents undue fluctuations in the exchange rate, but policies targeting a specific level of the exchange rate are incompatible with floating. Indicators for managing the rate are broadly judgmental (e.g., balance of payments position, international reserves, and parallel market developments). Floating arrangements may exhibit more or less exchange rate volatility, depending on the size of the shocks affecting the economy.

Stabilized arrangement as in Singapore entails a spot market exchange rate that remains within a margin of 2% for six months or more (with the exception of a specified number of outliers or step adjustments) and is not floating. The required margin of stability can be met with either a single currency or a basket of currencies, where the anchor currency or the basket is confirmed using statistical techniques. Classification as a stabilized arrangement requires that the statistical criteria are met and that the exchange rate remains stable as a result of official action (including structural market rigidities). The classification does not imply a policy commitment on the part of the country authorities.

The category of other managed arrangement, as in China and Malaysia, is used when the exchange rate arrangement does not meet the criteria for any of the other categories. Arrangements characterized by frequent shifts in policies may fall into this category.

Inflation-targeting, adopted in Indonesia, Korea, the Philippines, and Thailand, involves a public announcement of numerical targets for inflation, with an institutional commitment by the monetary authority to achieve these targets, typically over a medium-term horizon. Additional key features normally include increased communication with the public and the markets about the plans and objectives of monetary policymakers and increased accountability of the central bank for achieving its inflation objectives. Monetary policy decisions are often guided by the deviation of forecasts of future inflation from the announced inflation target, with the inflation forecast acting (implicitly or explicitly) as the intermediate target of monetary policy.

China has a monetary aggregate target where the monetary authority uses its instruments to achieve a target growth rate for a monetary aggregate, such as reserve money, M1, or M2, and the targeted aggregate becomes the nominal anchor or intermediate target of monetary policy. Singapore has a composite exchange rate anchor for its monetary policy regime.

Malaysia has no explicitly stated nominal anchor, but rather monitors various indicators in conducting monetary policy. This category is also used when no relevant information on the country is available.

4. Empirical Estimation

The basic equation, first developed by Frankel and Wei (1994) and used in many subsequent papers, to estimate the influence of major international currencies in determining individual currencies is as follows:

$$\Delta \log\left(\frac{i}{N}\right)_t = \beta_0 + \beta_1 \Delta log\left(\frac{USD}{N}\right)_t + \beta_2 \Delta log\left(\frac{EUR}{N}\right)_t + \beta_3 \Delta log\left(\frac{JPY}{N}\right)_t + \beta_4 \Delta log\left(\frac{CNY}{N}\right)_t + \epsilon_t, \quad (1)$$

where $\left(\frac{i}{N}\right)$ is the number of units of currency i per unit of currency N and Δ is the first-difference operator. One can put a different combination of key currencies on the right hand side depending on which currencies to focus on. Currency N is the numeraire currency and many papers used either the Swiss franc or the New Zealand dollar. We use a version of this equation as a starting point.

The data source for exchange rates is Bloomberg and we use closing price data after dropping missing values. Following Ito (2016), we use the following estimation periods when China maintained a floating exchange rate regime.

(Period 1) July 20, 2005 – June 18, 2008: Crawling peg
(Period 2) June 16, 2010 – June 24, 2016: Flexible Crawling peg (Managed float)
(Period 2-1) June 16, 2010 – January 14, 2014
(Period 2-2) January 15, 2014 – June 24, 2016[2]

Note that (Jan 2001 – June 2005) and (July 2008 – June 2010) were fixed exchange rate regime in China and so were removed from our analysis. Period 2 (2010-2016) is further divided into period 2-1 (an appreciation phase) and period 2-2 (a gradual and accelerating depreciation phase). There are two potential problems in the regression, namely, a numeraire currency issue and a multicollinearity issue among explanatory variables. We investigate these issues one by one.

[2] Note that Ito (2016) defined period 1 as period 2 and period 2 as period 4 in his paper.

(1) Numeraire currency issue

Since exchange rate is a relative price, one needs to decide which currency should be a numeraire (or reference) currency. A numeraire currency should not have high volatility or be highly correlated with the currency of interest. The original Frankel-Wei regression used the Swiss franc as a numeraire currency. However, because the Swiss franc has been pegged to the euro since September 2011, it may not be an ideal anchor currency. Kawai and Pontines (2016) pointed out that the Swiss monetary authority introduced the ceiling of CHF 1.2 per EUR from September 9, 2011 to December 18, 2014. The rate was at or near the ceiling for a long time, which means the CHF/EUR exchange rate stayed almost unchanged. Hence, the Frankel-Wei regressions, especially the coefficients on euro, are unreliable. Kawai and Pontines (2016) proposed to have the New Zealand Dollar (NZD) as a numeraire.

We run the regression (1) using both CHF and NZD as numeraire and investigate how much differences the choice of a numeraire currency makes in terms of the regression results. Table 1 shows that even within the same period, choice of a numeraire currency makes dramatic differences in results. In period 1 (07/20/2005 ~ 7/18/2008), regression results with CHF and NZD are similar to each other, but in period 2 (06/16/2010 ~ 6/24/2016), the choice of numeraire makes a big difference. Moreover, the differences are larger in Period 2-2 (01/15/2014 ~ 6/24/2016) than in Period 2-1 (06/16/2010 ~ 1/14/2014). One noticeable observation is that when using CHF as a numeraire currency, there are significant differences in coefficients over sample periods. Moreover, coefficients on RMB sometimes become larger than one, which observation is hard to interpret economically.[3] Therefore, we use NZD as numeraire for the rest of the paper.

(2) Multicollinearity issue

If the Chinese RMB is heavily influenced by other currencies such as the US dollar, then the regression equation (1) can be misleading, as USD and CNY are both used as explanatory variables at the same time—which is the multicollinearity problem. Following, Kawai and Pontines (2016), we control for multicollinearity by adopting a two-step regression as follows:

[1st step]

$$\Delta \log\left(\frac{\mathrm{CNY}}{\mathrm{NZD}}\right)_t = \alpha_0 + \alpha_1 \Delta log\left(\frac{USD}{NZD}\right)_t + \alpha_2 \Delta log\left(\frac{EUR}{NZD}\right)_t + \alpha_3 \Delta log\left(\frac{JPY}{NZD}\right)_t + \alpha_4 \Delta log\left(\frac{GBP}{NZD}\right)_t + \epsilon_t$$

[3] Ito (2016) also performed a similar exercise. He showed that the coefficient on RMB becomes more significant when NZD is used than when CHF is used, in particular in period 1.

(2)

[2nd step]

$$\Delta\log\left(\frac{i}{NZD}\right)_t = \beta_0 + \beta_1\Delta log\left(\frac{USD}{NZD}\right)_t + \beta_2\Delta log\left(\frac{EUR}{NZD}\right)_t + \beta_3\Delta log\left(\frac{JPY}{NZD}\right)_t + \beta_4\Delta log\left(\frac{GBP}{NZD}\right)_t + \beta_5\widehat{\omega_t} + \varepsilon_t, \quad (3)$$

where $\widehat{\omega_t} = \Delta\log\left(\frac{\mathrm{CNY}}{\mathrm{NZD}}\right)_t - \{\widehat{\alpha_0} + \widehat{\alpha_1}\Delta log\left(\frac{USD}{NZD}\right)_t + \widehat{\alpha_2}\Delta log\left(\frac{EUR}{NZD}\right)_t + \widehat{\alpha_3}\Delta log\left(\frac{JPY}{NZD}\right)_t + \widehat{\alpha_4}\Delta log\left(\frac{GBP}{NZD}\right)_t\}$.

Note that the coefficients are restricted to sum up to 1: $(\beta_0 + \beta_1 + \beta_2 + \beta_3 + \beta_4 + \beta_5 = 1)$.

Ito (2016) ran the regression without correcting for multi-collinearity. He found that the coefficients on CNY is quite high (above 0.7) for all sample countries in both periods, while the coefficient on USD is almost zero or minus. The coefficient on CNY becomes higher in period 2 (above 0.9) for three countries. However, when the multicollinearity issues are corrected by the two-step regression, these results change. Kawai and Pontines (2016) reported that the coefficient on CNY becomes insignificant in most countries and stays near zero in many countries.

Table 2 shows that the coefficients for CNY are significant in almost all cases. Note that the CNY coefficient is not significant in 4 out of 6 countries in period 1, when the multicollinearity was not controlled in Table 1. Using a two-step regression makes the role of CNY more significant in all periods. In terms of the size of coefficients, controlling for the multicollinearity does not change the coefficients in only one direction. In Indonesia and the Philippines, the coefficients slightly increase after the control, but in the other four countries, the coefficients decrease after the control. This result is different from that of Kawai and Pontines (2016) where the coefficients on CNY decrease after the control in most cases.

In general, the CNY coefficient is larger in period 2 than in period 1. The only exception is Thailand. The absolute sizes of the coefficients, however, are quite small ranging from 0.08 to 0.18 in period 1 and from 0.12 to 0.48 in period 2. Coefficients on USD are quite high in most countries, ranging from 0.62 to 0.92 in period 1 and from 0.37 to 0.75 in period 2. Coefficients on USD are higher than those on CNY in all countries in period 1 but in only three countries (Thailand, Singapore and Korea) in period 2. Regression coefficients close to 1 indicate that, even though these countries adopt floating exchange rate regimes, the de facto exchange rate system can be considered to be a US dollar bloc. These results indicate that

before the global financial crisis, these countries were close to a US dollar bloc (especially Indonesia, Korea, Malaysia and the Philippines), but since then, the trend has changed and the role of the US dollar became weaker in general in East Asia. This does not mean that these East Asian countries moved closer to an RMB bloc. The regression coefficient on the RMB is still too small to be considered as evidence for an RMB bloc.

Comparing the periods 2-1 and 2-2, the CNY coefficient becomes larger in period 2-2 in all cases, which indicates that the role of the Chinese RMB has increased in the past couple of years. In Malaysia, Indonesia and the Philippines, the coefficients on the RMB becomes larger than 0.5. In order to further analyze the CNY coefficient in period 2-2, we run the regression with data for year 2014, 2015 and 2016 respectively (full sample). Compared to year 2014, the CNY coefficient has increased in all countries in 2015. However, from 2015 to 2016, the CNY coefficient increased only in Korea and Singapore, but it decreased in the other four countries. The next step is to see how coefficients changed over time in detail.

(3) Regression with time-varying coefficients

In this section, we introduce a time varying coefficients in the two-step regression to capture how the regression coefficients change over time. We use the following steps:

[1st step]

$$\Delta\log\left(\frac{\mathrm{CNY}}{\mathrm{NZD}}\right)_t = \alpha_0 + \alpha_1\Delta log\left(\frac{USD}{NZD}\right)_t + \alpha_2\Delta log\left(\frac{EUR}{NZD}\right)_t + \alpha_3\Delta log\left(\frac{JPY}{NZD}\right)_t + \alpha_4\Delta log\left(\frac{GBP}{NZD}\right)_t + \epsilon_t \quad (4)$$

[2nd step]

$$\Delta\log\left(\frac{i}{NZD}\right)_t = \beta_0 + \beta_1(t)\Delta log\left(\frac{USD}{NZD}\right)_t + \beta_2\Delta log\left(\frac{EUR}{NZD}\right)_t + \beta_3\Delta log\left(\frac{JPY}{NZD}\right)_t + \beta_4\Delta log\left(\frac{GBP}{NZD}\right)_t + \beta_5(t)\widehat{\omega_t} + \varepsilon_t, \quad (5)$$

where $\widehat{\omega_t} = \Delta\log\left(\frac{\mathrm{CNY}}{\mathrm{NZD}}\right)_t - \{\widehat{\alpha_0} + \widehat{\alpha_1}\Delta log\left(\frac{USD}{NZD}\right)_t + \widehat{\alpha_2}\Delta log\left(\frac{EUR}{NZD}\right)_t + \widehat{\alpha_3}\Delta log\left(\frac{JPY}{NZD}\right)_t + \widehat{\alpha_4}\Delta log\left(\frac{GBP}{NZD}\right)_t\}$ and

$\beta_1(\text{coefficients of } \Delta\log\left(\frac{USD}{NZD}\right))$ and $\beta_5(\text{coefficients of } \widehat{\omega_t})$ are time varying.

We specify a time-varying coefficient $\beta(t)$ with optimal (p, q) such that

$$\beta(t) = \gamma_0 + \gamma_1 \cdot t + \gamma_2 \cdot t^2 + \cdots + \gamma_p \cdot t^p + (\delta_1 \cos 2\pi t + \delta_2 \sin 2\pi t) + (\delta_3 \cos 4\pi t + \delta_4 \sin 4\pi t) + \cdots + (\delta_{2q-1} \cos 2q \cdot \pi t + \delta_{2q} \sin 2q \cdot \pi t),$$

and the coefficients are restricted to sum up to 1: $(\beta_0 + \beta_1(t) + \beta_2 + \beta_3 + \beta_4 + \beta_5(t) = 1)$.

Time-varying coefficients can capture the time-changing properties of elasticities and properly reflect the long term relationship of variables, and are therefore popular in forecasting literature. Suppose there is an econometric model with fixed coefficients (fixed elasticities) as follows:

$$y_t = \alpha + \beta x_t + u_t. \quad (6)$$

This type of model cannot reflect changes in elasticities over time and does not have a good forecasting power. A time-varying coefficient model can compensate for these shortcomings by using series estimation, by which a function can be expressed as a combination of several basis functions under certain assumptions. We allow for the Fourier flexible form functions which include polynomial and trigonometric functions for the approximation of time-varying coefficient as:

$$y_t = \alpha + \beta_t x_t + u_t,$$

where $\beta_t = \beta\left(\frac{t}{T}\right) = \gamma_0 + \gamma_1 \cdot \frac{t}{T} + \gamma_2 \cdot \frac{t}{T}^2 + \cdots + \gamma_p \cdot \frac{t}{T}^p + (\delta_1 \cos 2\pi \frac{t}{T} + \delta_2 \sin 2\pi \frac{t}{T}) + (\delta_3 \cos 4\pi \frac{t}{T} + \delta_4 \sin 4\pi \frac{t}{T}) + \cdots + (\delta_{2q-1} \cos 2q \cdot \pi \frac{t}{T} + \delta_{2q} \sin 2q \cdot \pi \frac{t}{T})$, (7)

and T denotes the number of observations, and β_t is a smooth function defined in the space of [0, 1]. If β_t is sufficiently smooth and T is large enough, then β_t can be approximated into a sum of linear and trigonometric functions. For example, the following equation estimates a time–varying coefficient using a second-order trend function (p=2) and a trigonometric function with T (q=1):

$$y_t = \alpha + \gamma_0 x_t + \gamma_1 \cdot (\frac{t}{T}) x_t + \gamma_2 \cdot (\frac{t}{T})^2 x_t + \delta_1 \cos\left(2\pi \frac{t}{T}\right) x_t + \delta_2 \sin(2\pi \frac{t}{T}) x_t + u_t. \quad (8)$$

We can use the estimates of $\gamma_0, \gamma_1, \gamma_2, \delta_1, \delta_2$ and calculate the time varying coefficient β_t as follows:

$$\widehat{\beta_t} = \widehat{\gamma_0} + \widehat{\gamma_1} \cdot \left(\frac{t}{T}\right) + \widehat{\gamma_2} \cdot \left(\frac{t}{T}\right)^2 + \widehat{\delta_1} \cos\left(2\pi \frac{t}{T}\right) + \widehat{\delta_2} \sin(2\pi \frac{t}{T}). \quad (9)$$

The estimation results for time-varying coefficients for the US dollar and the Chinese RMB are reported in Figure 1. The sample period is set at 06/03/2002 ~ 03/28/2017 for all figures. We also show the estimates of the fixed coefficients from the two-step estimation during the two periods when CNY was floating (in a dotted line), as in Kawai and Pontines (2016).

In all sample countries, the coefficient for CNY was near zero before the 2008 global financial crisis. However, the changes in coefficients differ since then. We can categorize the sample countries into three groups: (1) insignificant role of CNY throughout the whole sample period, (2) increased role of CNY, (3) mixed pattern.

Group (1) includes three countries. For Thai Baht (THB) and the Singapore dollar (SGD), the coefficient for CNY does not increase much. Since the Hong Kong dollar (HKD) is still pegged to the US dollar, the coefficient for CNY stayed at zero throughout the whole period.

Group (2) includes three countries: the Indonesian Rupiah (IDR), the Malaysian Ringgit (MYR), and the Philippines Peso (PHP). All three currencies show that the CNY coefficient has continuously increased since 2008, while the coefficient for the US dollar has continuously decreased. In all three countries, the CNY coefficient becomes larger than that of the US dollar around 2013 and stayed that way until now. In Indonesia, the CNY coefficient has slightly decreased since 2016.

The mixed pattern (3) is observed in Korea. For the Korean won (KRW), the coefficient for CNY temporarily increased between 2008 and 2010, and then decreased until 2014. After 2014, however, the coefficient for CNY significantly increased until recently. This time varying nature of the coefficients cannot be analyzed by using a regression with fixed coefficients as in Kawai and Pontines (2016).

(4) Potential explanation using trade share with China

According to Frankel and Wei (1994), one reason for a country to assign weight to a particular currency in determining its exchange rate is that a more stable bilateral exchange rate would help promote bilateral trade with the partner in question. They also pointed out that this was a major motivation for exchange rate stabilization in Europe.

Along this line of argument, we investigate the trade volume with China to explain why the role of the RMB is weaker than that of the US dollar in some countries and not in others. A higher share of trade with China means that stabilizing the exchange rate against the Chinese RMB, rather than against other currencies such as the US dollar, is beneficial for the country. Therefore, a higher share of trade with China may indicate a need for the central bank to focus more on stabilizing exchange rates against the RMB.

Table 3 shows the trade volume (export + import) with China (as a percentage of total trade) of seven East Asian countries. The table shows that the trade share with China is much smaller for Singapore and Thailand than for other countries. Lower trade volume with China may explain why the role of the RMB is still weak in these countries. The central banks of these countries do not necessarily need to stabilize exchange rates against the RMB, because their trade volume with China is still small. For Hong Kong, even though the trade volume with China is high, the fixed exchange rate regime against the US dollar explains the low coefficient for the RMB.

On the other hand, Korea, Indonesia and the Philippines show a high trade share with China around 30 - 40%, implying that the high volume of trade with China may explain the significant role of the RMB in exchange rate determination. Indonesia is considered as an exception where the role of trade with China is small but the role of the RMB is significant in exchange rate determination.

One weakness of this approach is that we only indirectly measure the role of the RMB in trade. In trade among Asian countries, the US dollar is still most widely used as a main trading currency, not the RMB. Hence, stabilizing exchange rate with the RMB does not necessarily help hedging exchange rate risks in trade. However, an increasing amount of trade among Asian countries uses the RMB as a contract invoicing currency. Therefore, our analysis can provide some connection between trade volume and exchange rate influence.[4]

Another possible explanation is to use the data on how much the RMB is used in international financial transactions in private and public sectors as documented in BIS data. A large volume of capital flows with China (possibly using the RMB as settlement currency) indicates that exchange rate movement can be governed by the RMB. Ito (2016) provides a detailed explanation in this direction.

5. Conclusion

In the early 1990s, there was a heated discussion on the possibility of a yen bloc. A simple version of the currency bloc hypothesis proposed by Frankel and Wei (1994) suggests that the US dollar had dominant influence in the western hemisphere, the Japanese yen in East Asia and the Deutsch mark in Europe. Their empirical results, however, denied any special role of the Japanese yen. East Asian countries were more properly classified as a dollar bloc than a yen bloc.[5]

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[4] Note that it is hard to find the data on the relative composition of invoicing currencies in international trade.

[5] According to Kwan (2001), several impediments hinder the Japanese yen from expanding its role up to the level of Japan's economic importance in East Asia. One is the prolonged stagnation of the Japanese economy and the other is historical background of East Asian countries suffering from Japanese invasions.

Now, turning to the current economic situation in East Asia, a similar discussion is gaining attention. Only this time, the Chinese RMB replaces the Japanese yen in the discussion. This paper tries to provide up-to-date empirical evidence on the debate over whether East Asia can be considered as a RMB bloc.

Empirical results based on two-step regressions with time-varying coefficients suggest that, in general, the RMB gained influence in exchange rate determination in East Asia, especially since the global financial crisis in 2008. However, there are some country differences. The role of the RMB has become more significant in the past couple of years in Malaysia, Indonesia, Korea and the Philippines, but not in Thailand or Singapore where the US dollar still plays a major role in exchange rate determination.

Moreover, even for those currencies on which the RMB has a significant influence, the absolute values of the coefficients on the RMB are still quite small, ranging from 0.32 to 0.67. The regression coefficient on the US dollar before the global financial crisis was around 0.9 in most countries in the region, implying a de facto US dollar bloc. These results indicate that it is too early to talk about the creation of an RMB bloc in this region. Looking ahead, the RMB will be unlikely to replace the role of the US dollar anytime soon. Nonetheless, the RMB may gradually serve as a regional settlement currency in trade and financial transactions between China and China's trading partners in East Asia as China becomes a leading trading partner with many East Asian countries.

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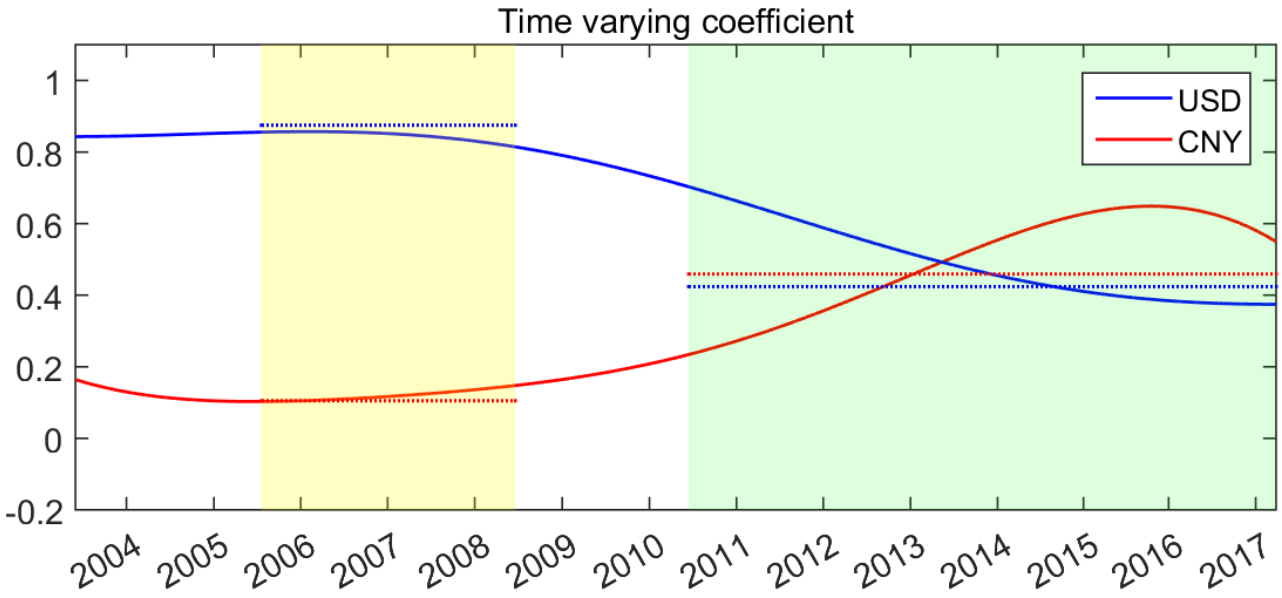
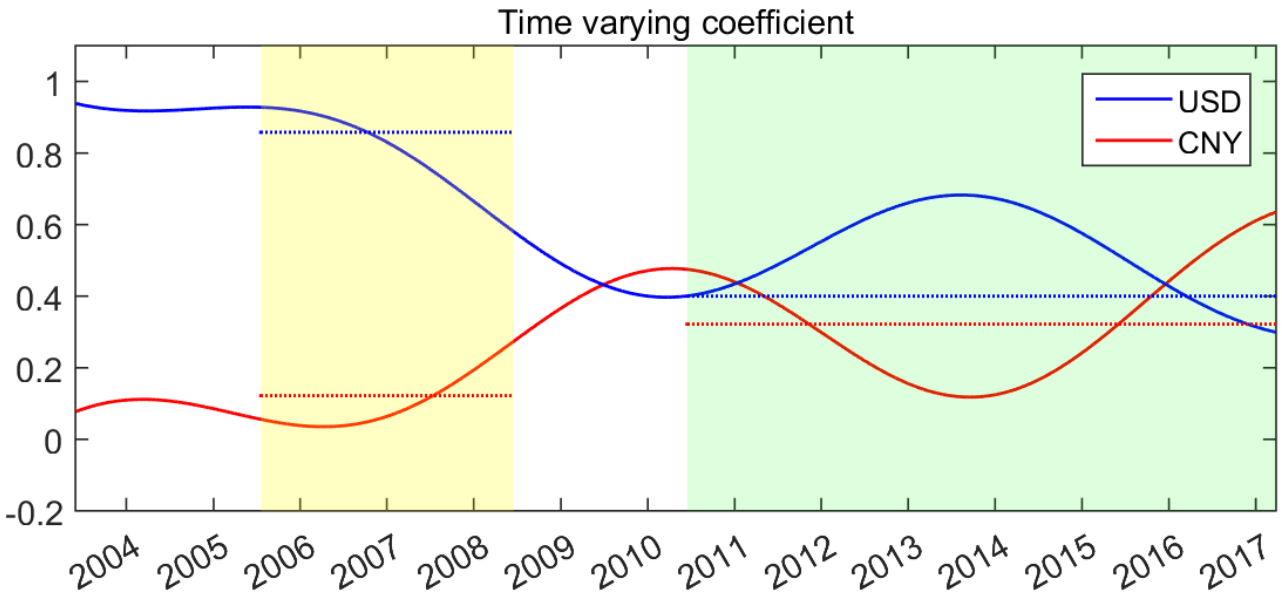
Figure 1. Regression results with time-varying coefficients

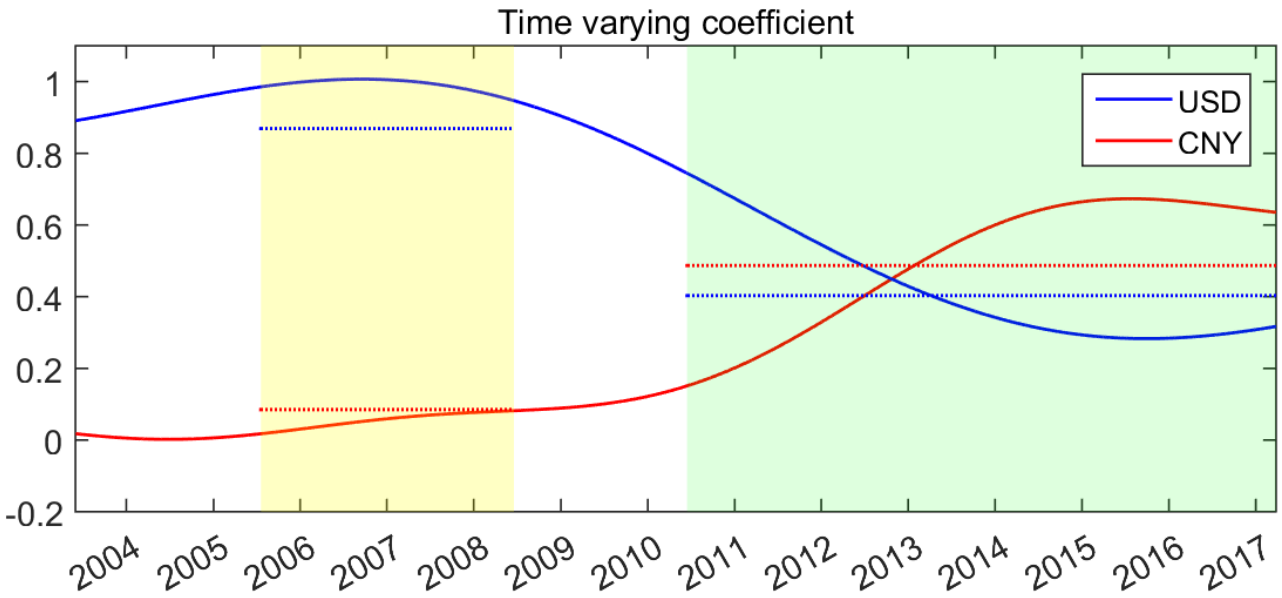
IDR (Indonesian rupiah) --- USD : (p, q) = (1, 1), CNY : (p, q) = (3, 1)



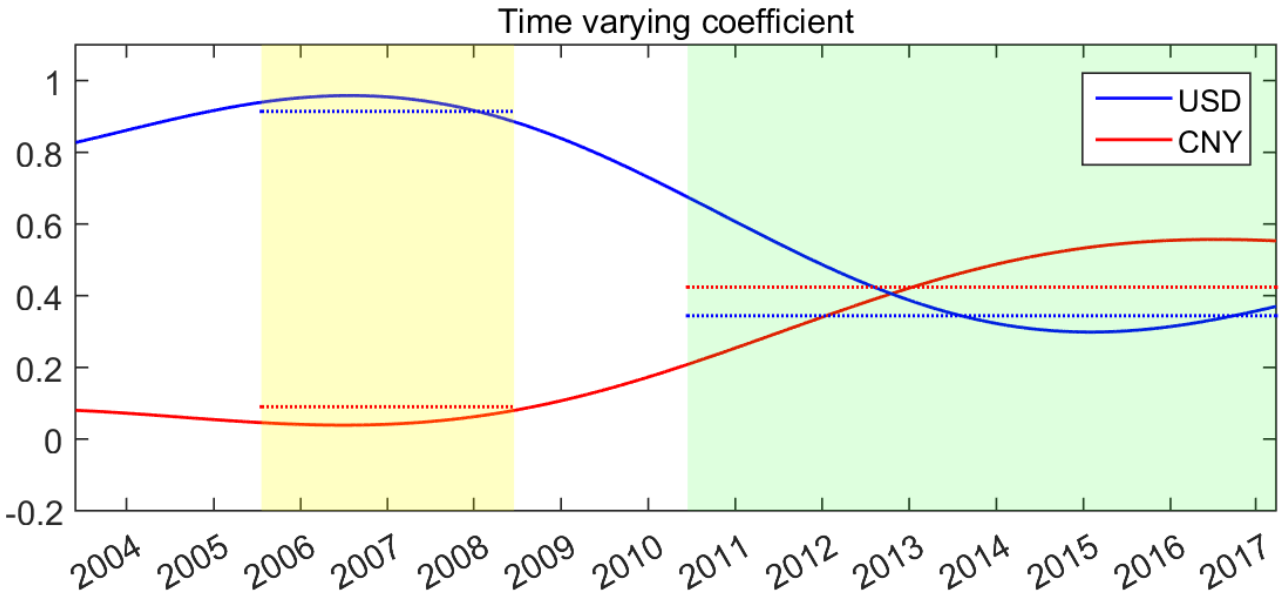
KRW (Korean won) --- USD : (p, q) = (1, 2), CNY : (p, q) = (1, 2)



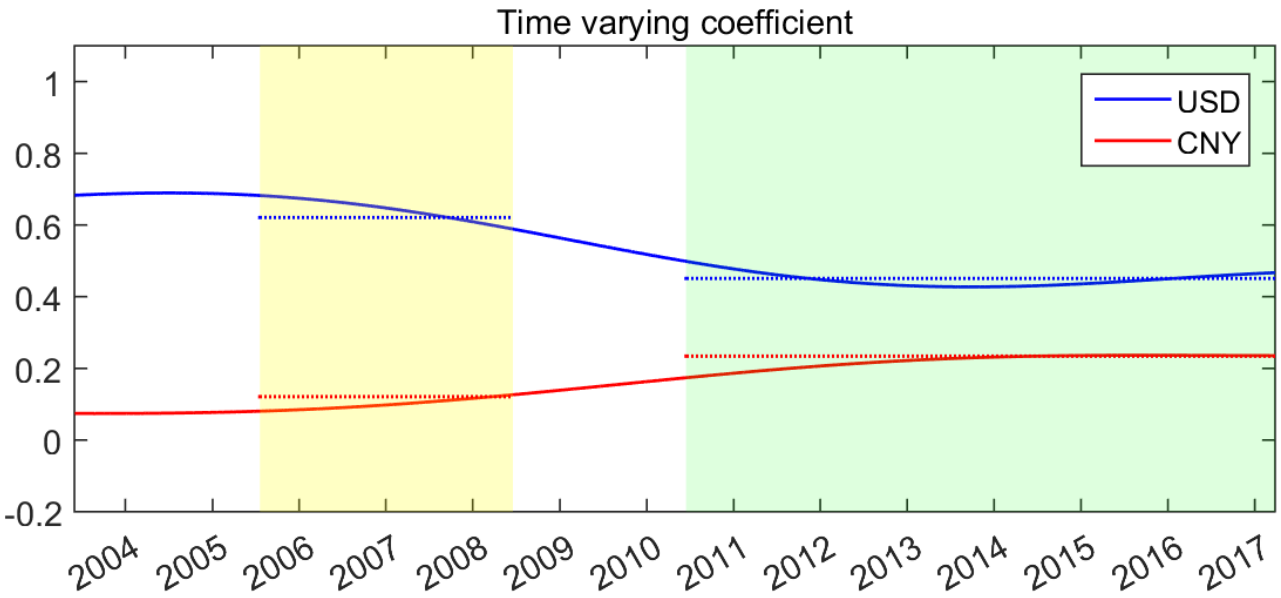
MYR (Malaysian ringgit) --- USD : (p, q) = (1, 2), CNY : (p, q) = (1, 1)



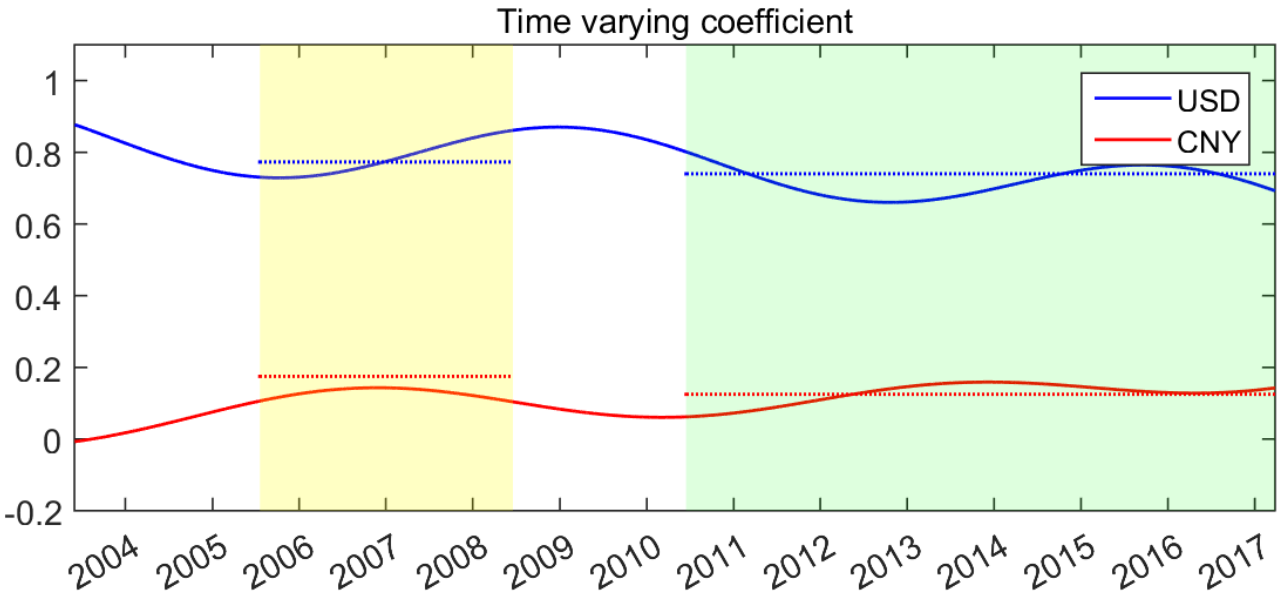
PHP (Philippin peso) --- USD : (p, q) = (1, 1), CNY : (p, q) = (1, 1)



SGD (Singapore dollar) --- USD : (p, q) = (1, 1), CNY : (p, q) = (1, 1)



THB (Thai baht) --- USD : (p, q) = (1, 2), CNY : (p, q) = (1, 2)



HKD (Hong Kong dollar) --- USD : (p, q) = (1, 1), CNY : (p, q) = (1, 1)

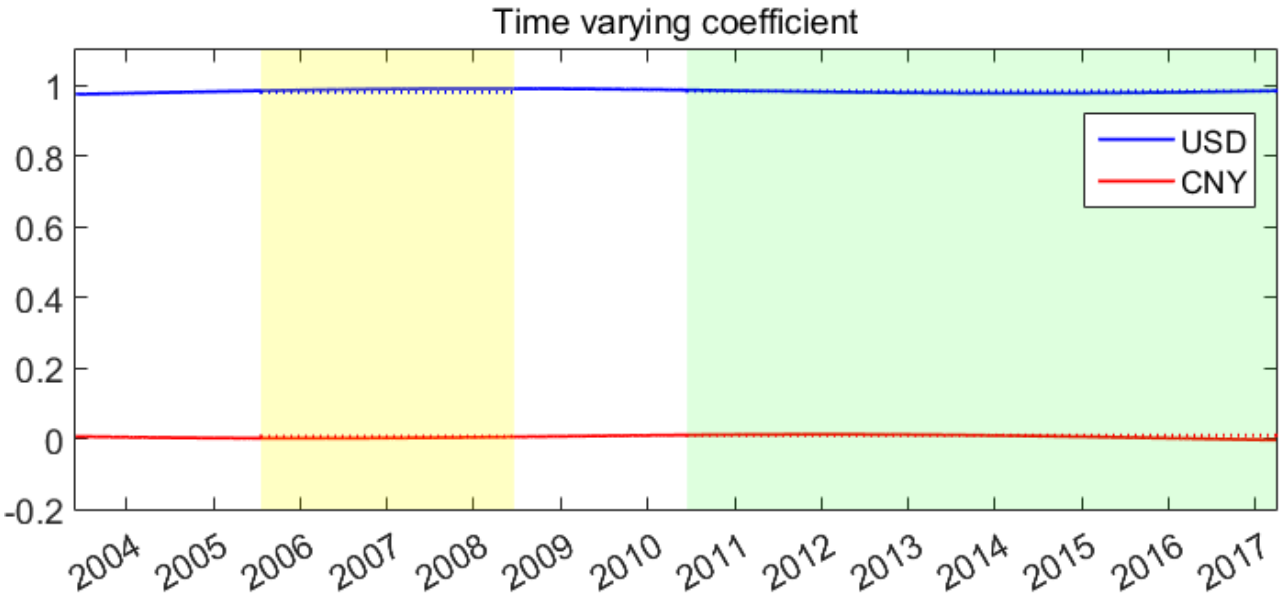


Table 1. Comparison of the reference currency

CHF based

07/20/2005 ~ 7/18/2008

	Indonesia	Korea	Malaysia	Philippines	Singapore	Thailand
USD	0.889***	0.773***	0.802***	0.872***	0.536***	0.160
	(0.076)	(0.169)	(0.067)	(0.053)	(0.111)	(0.099)
EURO	0.230***	0.158***	0.144***	0.181***	0.279***	0.077
	(0.048)	(0.037)	(0.025)	(0.039)	(0.021)	(0.066)
RMB	**0.058**	**0.166**	**0.123***	**0.066**	**0.162**	**0.703*****
	(0.066)	**(0.159)**	**(0.065)**	**(0.046)**	**(0.108)**	**(0.088)**
YEN	-0.177***	-0.098**	-0.070***	-0.119***	0.023	0.060
	(0.037)	(0.042)	(0.023)	(0.037)	(0.021)	(0.076)
Observations	783	783	783	780	783	783
R-squared	0.618	0.683	0.826	0.700	0.864	0.340

NZD based

	Indonesia	Korea	Malaysia	Philippines	Singapore	Thailand
USD	0.868***	0.767***	0.790***	0.855***	0.530***	0.238**
	(0.082)	(0.174)	(0.070)	(0.058)	(0.116)	(0.111)
EURO	0.237***	0.157***	0.152***	0.183***	0.285***	0.112*
	(0.047)	(0.037)	(0.024)	(0.038)	(0.022)	(0.065)
RMB	**0.071**	**0.170**	**0.134***	**0.079**	**0.161**	**0.634*****
	(0.072)	**(0.164)**	**(0.069)**	**(0.052)**	**(0.112)**	**(0.103)**
YEN	-0.176***	-0.095**	-0.076***	-0.117***	0.025	0.016
	(0.036)	(0.042)	(0.023)	(0.037)	(0.022)	(0.069)
Observations	783	783	783	780	783	783
R-squared	0.615	0.682	0.827	0.701	0.856	0.361

06/16/2010 ~ 6/24/2016

VARIABLES	Indonesia	Korea	Malaysia	Philippines	Singapore	Thailand
USD	-0.591	0.333***	-1.428*	-1.266	0.422***	0.727***
	(0.867)	(0.097)	(0.778)	(0.787)	(0.073)	(0.064)
EURO	0.436***	0.363***	0.446***	0.499***	0.362***	0.157***
	(0.034)	(0.028)	(0.045)	(0.045)	(0.017)	(0.013)
RMB	**1.106**	**0.306*****	**1.900****	**1.652****	**0.167****	**0.092**
	(0.855)	**(0.090)**	**(0.755)**	**(0.762)**	**(0.070)**	**(0.060)**
YEN	0.049	-0.001	0.083**	0.115***	0.048***	0.024*
	(0.043)	(0.029)	(0.039)	(0.040)	(0.014)	(0.013)
Observations	1,557	1,573	1,573	1,573	1,573	1,573
R-squared	0.354	0.578	0.417	0.419	0.772	0.803

VARIABLES	Indonesia	Korea	Malaysia	Philippines	Singapore	Thailand
USD	0.401***	0.026	0.126	0.340***	0.236***	0.551***
	(0.121)	(0.096)	(0.120)	(0.107)	(0.057)	(0.044)
EURO	0.326***	0.367***	0.314***	0.364***	0.361***	0.159***
	(0.035)	(0.028)	(0.035)	(0.031)	(0.017)	(0.013)
RMB	**0.207***	**0.600*****	**0.500*****	**0.205***	**0.351*****	**0.262*****
	(0.118)	**(0.093)**	**(0.120)**	**(0.106)**	**(0.057)**	**(0.042)**
YEN	0.066*	0.007	0.060	0.092***	0.051***	0.027**
	(0.038)	(0.028)	(0.039)	(0.034)	(0.014)	(0.013)
Observations	1,563	1,573	1,573	1,569	1,573	1,573
R-squared	0.355	0.585	0.397	0.418	0.778	0.803

06/16/2010 ~ 1/14/2014

VARIABLES	Indonesia	Korea	Malaysia	Philippines	Singapore	Thailand
USD	0.833***	0.126	0.402***	0.389***	0.289***	0.529***
	(0.131)	(0.145)	(0.129)	(0.111)	(0.069)	(0.073)
EURO	0.380***	0.383***	0.361***	0.445***	0.402***	0.183***
	(0.035)	(0.034)	(0.033)	(0.030)	(0.023)	(0.017)
RMB	**-0.227***	**0.530*****	**0.206**	**0.085**	**0.256*****	**0.276*****
	(0.127)	**(0.138)**	**(0.133)**	**(0.111)**	**(0.070)**	**(0.073)**
YEN	0.014	-0.040	0.031	0.081**	0.053***	0.012
	(0.045)	(0.029)	(0.031)	(0.033)	(0.015)	(0.017)
Observations	933	935	935	935	935	935
R-squared	0.451	0.619	0.555	0.578	0.802	0.811

VARIABLES	Indonesia	Korea	Malaysia	Philippines	Singapore	Thailand
USD	0.805***	0.119	0.435***	0.418***	0.342***	0.556***
	(0.151)	(0.139)	(0.134)	(0.129)	(0.065)	(0.070)
EURO	0.293***	0.385***	0.259***	0.343***	0.407***	0.183***
	(0.035)	(0.034)	(0.030)	(0.029)	(0.023)	(0.017)
RMB	**-0.135**	**0.528*****	**0.295****	**0.178**	**0.204*****	**0.250*****
	(0.148)	**(0.134)**	**(0.134)**	**(0.126)**	**(0.064)**	**(0.069)**
YEN	0.038	-0.033	0.011	0.061*	0.048***	0.011
	(0.040)	(0.029)	(0.033)	(0.035)	(0.016)	(0.017)
Observations	935	935	935	935	935	935
R-squared	0.413	0.615	0.528	0.521	0.800	0.808

01/15/2014 ~ 6/24/2016

VARIABLES	Indonesia	Korea	Malaysia	Philippines	Singapore	Thailand
USD	-1.197	0.366***	-2.010**	-1.766*	0.487***	0.786***
	(1.099)	(0.110)	(0.900)	(0.923)	(0.086)	(0.069)
EURO	0.543***	0.309***	0.581***	0.588***	0.296***	0.107***
	(0.067)	(0.059)	(0.104)	(0.110)	(0.028)	(0.022)
RMB	**1.587**	**0.246****	**2.317*****	**2.049****	**0.158****	**0.049**
	(1.070)	**(0.099)**	**(0.862)**	**(0.879)**	**(0.079)**	**(0.062)**
YEN	0.067	0.080	0.111	0.129	0.058*	0.059**
	(0.082)	(0.071)	(0.091)	(0.098)	(0.030)	(0.023)
Observations	624	638	638	638	638	638
R-squared	0.324	0.505	0.411	0.394	0.726	0.795

VARIABLES	Indonesia	Korea	Malaysia	Philippines	Singapore	Thailand
USD	0.078	-0.058	-0.144	0.259	0.171**	0.547***
	(0.168)	(0.128)	(0.177)	(0.161)	(0.077)	(0.055)
EURO	0.370***	0.321***	0.384***	0.385***	0.286***	0.113***
	(0.072)	(0.054)	(0.074)	(0.066)	(0.026)	(0.019)
RMB	**0.452*****	**0.654*****	**0.639*****	**0.220**	**0.469*****	**0.275*****
	(0.161)	**(0.127)**	**(0.177)**	**(0.160)**	**(0.076)**	**(0.052)**
YEN	0.100	0.083	0.121	0.136*	0.074***	0.065***
	(0.075)	(0.066)	(0.089)	(0.071)	(0.028)	(0.020)
Observations	628	638	638	634	638	638
R-squared	0.285	0.531	0.267	0.295	0.747	0.798

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2. Two-stage regression results

07/20/2005 ~ 7/18/2008

VARIABLES	China(1st stage)	Indonesia	Korea	Malaysia	Philippines	Singapore	Thailand
USD	0.965***	0.875***	0.858***	0.869***	0.914***	0.621***	0.773***
	(0.024)	(0.052)	(0.049)	(0.023)	(0.035)	(0.025)	(0.058)
EURO	0.007	0.109*	0.006	0.042	0.144***	0.147***	-0.045
	(0.034)	(0.059)	(0.067)	(0.034)	(0.049)	(0.036)	(0.083)
YEN	0.038	-0.121***	-0.029	-0.029	-0.073**	0.090***	0.119*
	(0.028)	(0.035)	(0.049)	(0.022)	(0.034)	(0.027)	(0.066)
POUND	-0.029	0.032	0.043	0.033	-0.076	0.021	-0.022
	(0.023)	(0.051)	(0.056)	(0.032)	(0.046)	(0.025)	(0.076)
RMB		**0.105*** **	**0.122*** **	**0.085*** **	**0.090*** **	**0.121*** **	**0.175*** **
		(0.029)	**(0.032)**	**(0.015)**	**(0.024)**	**(0.020)**	**(0.053)**
Constant	-0.000***	-0.000	-0.000	-0.000*	-0.000*	-0.000***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	783	783	783	783	780	783	783
R-squared	0.925	0.640	0.735	0.873	0.754	0.918	0.447

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

06/16/2010 ~ 6/24/2016

VARIABLES	China(1st stage)	Indonesia	Korea	Malaysia	Philippines	Singapore	Thailand
USD	0.953***	0.448***	0.432***	0.410***	0.374***	0.462***	0.746***
	(0.012)	(0.045)	(0.031)	(0.046)	(0.040)	(0.018)	(0.017)
EURO	-0.011	0.041	0.107***	-0.025	0.075**	0.180***	0.065***
	(0.010)	(0.041)	(0.027)	(0.040)	(0.036)	(0.016)	(0.015)
YEN	0.002	0.033	-0.009	0.028	0.061**	0.037***	0.020
	(0.008)	(0.032)	(0.024)	(0.032)	(0.030)	(0.011)	(0.012)
POUND	0.031**	0.023	0.168***	0.109***	0.067	0.087***	0.046***
	(0.015)	(0.041)	(0.027)	(0.035)	(0.042)	(0.016)	(0.016)
RMB		**0.455*** **	**0.301*** **	**0.479*** **	**0.422*** **	**0.233*** **	**0.124*** **
		(0.031)	**(0.022)**	**(0.033)**	**(0.026)**	**(0.012)**	**(0.011)**
Constant	-0.000	0.000	-0.000	0.000	-0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	1,573	1,563	1,573	1,573	1,569	1,573	1,573
R-squared	0.954	0.274	0.545	0.301	0.357	0.822	0.856

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

06/16/2010 ~ 1/14/2014

VARIABLES	China(1st stage)	Indonesia	Korea	Malaysia	Philippines	Singapore	Thailand
USD	0.979***	0.599***	0.517***	0.608***	0.483***	0.452***	0.753***
	(0.011)	(0.054)	(0.039)	(0.047)	(0.042)	(0.026)	(0.025)
EURO	0.007	0.059	0.135***	-0.013	0.071**	0.215***	0.085***
	(0.009)	(0.044)	(0.035)	(0.036)	(0.035)	(0.022)	(0.021)
YEN	0.001	0.018	-0.057**	-0.014	0.037	0.030**	0.001
	(0.006)	(0.038)	(0.028)	(0.030)	(0.032)	(0.014)	(0.016)
POUND	0.005	-0.040	0.121***	0.077*	0.052	0.083***	0.051*
	(0.012)	(0.058)	(0.043)	(0.044)	(0.044)	(0.025)	(0.026)
RMB		**0.363*** **	**0.283*** **	**0.341*** **	**0.357*** **	**0.219*** **	**0.109*** **
		(0.037)	**(0.028)**	**(0.029)**	**(0.027)**	**(0.016)**	**(0.015)**
Constant	-0.000***	0.000*	-0.000	0.000	0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	935	935	935	935	935	935	935
R-squared	0.968	0.364	0.540	0.493	0.474	0.820	0.849

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

01/15/2014 ~ 6/24/2016

VARIABLES	China(1st stage)	Indonesia	Korea	Malaysia	Philippines	Singapore	Thailand
USD	0.919***	0.241***	0.307***	0.133*	0.224***	0.468***	0.726***
	(0.023)	(0.075)	(0.048)	(0.079)	(0.074)	(0.027)	(0.024)
EURO	-0.026	0.076	0.049	0.015	0.109	0.127***	0.025
	(0.018)	(0.074)	(0.039)	(0.073)	(0.069)	(0.025)	(0.022)
YEN	0.008	0.031	0.092**	0.055	0.075	0.062***	0.059***
	(0.017)	(0.064)	(0.043)	(0.070)	(0.065)	(0.021)	(0.020)
POUND	0.050***	0.064	0.235***	0.131**	0.079	0.099***	0.055***
	(0.019)	(0.076)	(0.037)	(0.065)	(0.074)	(0.020)	(0.019)
RMB		**0.588*** **	**0.317*** **	**0.665*** **	**0.513*** **	**0.244*** **	**0.135*** **
		(0.048)	**(0.033)**	**(0.057)**	**(0.047)**	**(0.019)**	**(0.016)**
Constant	0.000*	-0.000	-0.000	0.000	-0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	638	628	638	638	634	638	638
R-squared	0.933	0.160	0.571	0.109	0.225	0.828	0.869

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

1/15/2014 ~ 12/31/2014

VARIABLES	China(1st stage)	Indonesia	Korea	Malaysia	Philippines	Singapore	Thailand
USD	1.000***	0.078	0.354***	0.023	0.114	0.525***	0.730***
	(0.024)	(0.106)	(0.094)	(0.105)	(0.113)	(0.037)	(0.045)
EURO	-0.032	0.244**	-0.005	0.169	0.306***	0.069*	0.009
	(0.031)	(0.121)	(0.079)	(0.104)	(0.114)	(0.040)	(0.045)
YEN	0.026	-0.060	0.211**	0.135*	-0.018	0.142***	0.078**
	(0.018)	(0.084)	[(0.091)]	(0.078)	(0.089)	(0.029)	(0.034)
POUND	-0.008	0.159	0.202**	0.102	0.097	0.096***	0.059
	(0.026)	(0.127)	(0.082)	(0.102)	(0.110)	(0.033)	(0.051)
RMB		**0.578*** **	**0.237*** **	**0.572*** **	**0.502*** **	**0.169*** **	**0.124*** **
		(0.076)	**(0.057)**	**(0.075)**	**(0.077)**	**(0.025)**	**(0.027)**
Constant	0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	251	247	251	251	251	251	251
R-squared	0.947	0.129	0.560	0.163	0.196	0.878	0.819

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

01/01/2015 ~ 12/31/2015

VARIABLES	China(1st stage)	Indonesia	Korea	Malaysia	Philippines	Singapore	Thailand
USD	0.947***	0.251*	0.323***	0.103	0.163	0.466***	0.691***
	(0.037)	(0.129)	(0.070)	(0.139)	(0.115)	(0.047)	(0.043)
EURO	-0.018	-0.013	0.051	-0.077	0.014	0.127***	0.001
	(0.024)	(0.099)	(0.051)	(0.094)	(0.090)	(0.034)	(0.030)
YEN	0.013	-0.009	0.173**	0.025	0.097	0.040	0.078*
	(0.029)	(0.131)	(0.071)	(0.164)	(0.130)	(0.037)	(0.041)
POUND	0.022	0.171	0.169**	0.272**	0.217**	0.136***	0.087**
	(0.025)	(0.109)	(0.066)	(0.109)	(0.099)	(0.043)	(0.040)
RMB		**0.599*** **	**0.284*** **	**0.677*** **	**0.510*** **	**0.232*** **	**0.143*** **
		(0.069)	**(0.044)**	**(0.083)**	**(0.066)**	**(0.027)**	**(0.024)**
Constant	0.000	0.000	0.000	0.000	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	261	255	261	261	261	261	261
R-squared	0.936	0.174	0.629	0.112	0.251	0.830	0.879

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

01/01/2016 ~ 12/30/2016

VARIABLES	China(1st stage)	Indonesia	Korea	Malaysia	Philippines	Singapore	Thailand
USD	0.786***	0.194*	0.262***	0.172	0.170*	0.424***	0.711***
	(0.035)	(0.102)	(0.061)	(0.105)	(0.102)	(0.033)	(0.028)
EURO	0.054	0.295**	0.239***	0.320**	0.259*	0.222***	0.138***
	(0.042)	(0.129)	(0.083)	(0.132)	(0.132)	(0.044)	(0.037)
YEN	0.027	0.015	-0.060	-0.091	0.068	0.032	0.020
	(0.020)	(0.071)	(0.047)	(0.076)	(0.074)	(0.025)	(0.021)
POUND	0.052***	-0.012	0.083	-0.052	0.033	0.036	0.002
	(0.017)	(0.076)	(0.055)	(0.076)	(0.085)	(0.023)	(0.024)
RMB		**0.509*** **	**0.476*** **	**0.651*** **	**0.469*** **	**0.287*** **	**0.129*** **
		(0.063)	**(0.056)**	**(0.066)**	**(0.065)**	**(0.031)**	**(0.026)**
Constant	0.000*	-0.000	0.000	0.000	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	261	261	261	261	255	261	261
R-squared	0.922	0.218	0.388	0.141	0.223	0.814	0.886

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3. Trade volume with China (percentage of total trade)

	Hong Kong	Indonesia	Korea	Malaysia	Philippines	Singapore	Thailand
2005	26.4%	11.5%	20.8%	12.3%	28.1%	7.6%	10.1%
2006	28.8%	11.6%	21.2%	13.0%	24.1%	7.3%	11.4%
2007	31.1%	13.4%	21.9%	14.8%	38.5%	7.6%	12.6%
2008	29.8%	13.1%	21.8%	15.4%	32.5%	7.4%	12.4%
2009	28.2%	14.6%	23.0%	18.9%	28.5%	8.3%	14.0%
2010	29.8%	15.9%	23.5%	22.1%	30.7%	7.7%	14.7%
2011	32.1%	17.4%	21.5%	23.4%	33.3%	7.9%	15.0%
2012	35.7%	18.1%	22.1%	24.9%	32.6%	8.5%	15.3%
2013	38.5%	19.1%	23.8%	28.4%	35.7%	9.3%	16.7%
2014	35.4%	18.5%	25.5%	26.8%	38.0%	9.9%	16.7%
2015	33.8%	19.1%	28.6%	30.1%	41.7%	11.9%	18.8%

Data Source: World Integrated Trade Solution (WITS)