Changing anchor of the renminbi: A Bayesian learning approach to the decade-long transition

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Abstract

China's exchange rate reform, initiated in 2005, had the goal of switching from a fixed U.S. dollar (USD) peg to a floating mechanism with reference to a trade-weighted currency basket. Over a decade of gradual transition, the renminbi (RMB) has gained importance in the international monetary system and has shown higher flexibility in its dollar value. However, previous studies have demonstrated the inertia of the RMB in maintaining a de facto dollar peg, with little evidence of the up-to-date effectiveness of the official currency basket. We present a Bayesian time-varying coefficient regression on the currency peg or basket weight suitable for studying transition process. We show that the "8.11" reform in 2015 triggered an eventual anchor switching, driving down the dollar weight from 1 to around 0.3. Since 2016, the weight of the official basket has been double that of the USD. SVAR and TVP-VAR analysis, controlling for endogeneity, provide consistent evidence of this regime change, which has important implications for China and the global economy.

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1 Introduction

Given the growing share of Chinese trade in the global economy and the increasing importance of its currency, the renminbi (RMB), the transition of China's exchange rate regime from the US Dollar (USD) peg to managed floating around the official currency basket from July 2005 onwards is of immense interest to the global market and policy-makers. China's trade volume surged from 6.7% of the world total in 2005 to 13.1% of the world total in 2020 according to the United Nations Conference on Trade Statistics. In particular, its global share of manufacturing exports reached 20% in 2020. The inclusion of the RMB in the Special Drawing Right (SDR) index of the International Monetary Fund (IMF) in November 2015 marked a milestone in its internationalization, demonstrating its increasing importance and greater flexibility. A more flexible currency regime might be helpful for reducing real misalignment (Holtemöller and Mallick, 2013) and for alleviating international critiques of China's currency manipulation for causing real misalignment (Korhonen and Ritola, 2011). However, the global status of the USD may be challenged if the decoupling of the RMB from the USD interacts with the weakening of the U.S. economy under a negative shock, and one possible outcome is that multiple regional currencies might emerge (Mukhin, 2022). Against this backdrop, the reform of the exchange rate regime has significant implications for both China and the world.

During the transition from the longstanding USD peg to a managed-floating mechanism, the RMB/USD exchange rate deviated from its past fixed rate of around 8.28 and steadily appreciated for 8 years before demonstrating a two-way fluctuation. However, the managed-floating process has remained within a strongly controlled band of fluctuation around a central parity rate determined by opaque rules that have been poorly communicated with the market; this reflects the tradition of gradualism in Chinese economic reform, which operates on a trade-off between the long-term reform goal and short-term priority of stabilisation. Consequently, China's exchange rate regime has long been regarded as a de facto dollar peg (Frankel and Wei, 2007, 2008; Fidrmuc, 2010; Ma and McCauley, 2011; Fang et al., 2012; Fidrmuc and Siddiqui, 2015; Kunkler, 2021). Despite the announcement of an RMB index based on a concrete currency basket with a detailed composition in December 2015 and its updates by the China Foreign Exchange Trade System (CFETS), evidence for its effectiveness is either weak or mixed (Cheung et al., 2018b; Das, 2019; Su and Qian, 2021).

This paper studies the evolution of the RMB exchange rate regime with new evidence using a Bayesian learning technique well-suited to the study of smooth structural changes. Our results indicate that, after a decade of transition, the RMB indeed switched its anchor from a dollar peg to the officially announced CFETS currency basket; the reform announced on August 11, 2015 (the “8.11” reform) aimed at further market orientation was a critical trigger for this transition, although it did not receive enough attention and recognition due to subsequent policy actions to mitigate the fluctuations in the RMB/USD exchange rate that it induced.

The remainder of the paper is organised as follows. Section 2 briefly discusses China’s exchange rate reform, with its relevant characteristics and the resulting perception of a de facto dollar peg. Section 3 reviews the related literature on China’s exchange rate regime. Section 4 describes the methodology of the Bayesian time-varying Frankel-Wei regressions used to assess competing specifications of the evolving RMB exchange rate regime and discusses alternative methods used to validate the regime change. Section 5 presents the empirical results of our main regressions and some alternative methods. Section 6 concludes the study.

2 Exchange rate reform with Chinese characteristics

In keeping with its tradition of gradualism in economic reform and prioritisation of stabilising economic activity, China has committed to a progressive path of moving away from the dollar peg. The transition was so slow that market participants sensed a huge gap between the publicly announced reform goal and actual day-to-day market operations. Figure 1 illustrates this contrast by plotting the daily closing price of the RMB/USD exchange rate, its day-to-day log difference and the daily log difference between the RMB/USD closing rate and the central parity rate announced by the CFETS. It can be seen that the exchange rate indeed floated away from the initial level of around 8.28 before July 2005 and increased to about 6.06 in February 2014, appreciating by 36.7% before demonstrating two-way fluctuations. However, the trajectory has been over-smoothed and does not clearly show tiny daily variations. The first year experienced only a dozen days when the rate changed by more than 0.1%. The first 2 years had only 9 days when the rate change exceeded 0.2 %. During the financial crisis, the rate was pegged at around 6.83, with variations well within 0.1% between October 2008 and June 2010. The tight daily control signalled a local dollar peg, even though there was substantial floating over a long time period from a global viewpoint.

[Figure 1. (a) RMB/USD. (b) Log-difference between RMB/USD and lagged RMB/USD. (c) Log-difference between RMB/USD and central parity rate with policy bands on the deviation (dashed line).]

The Chinese government has been reticent in communicating with market participants on the actual mechanisms and policy changes underlying its cautious trials. There has been obscurity around the key policy tools used to meet the goal of regime transition from the dollar peg to a referenced currency basket.

The first policy tool was the central parity rate of RMB/USD, announced at the beginning of each trading day by the CFETS. In practice, the setting of the central parity rate has been an impediment to effective communication with the market. From January 2006 onwards, the rate had been set daily before market opening based on market dealers' quotes, which were widely believed to be highly regulated and to not necessarily reflect market forces. On 11 August 2015, 10 years after the initial reform, the monetary authority announced a reform plan aimed at market orientation, which included more reliance on a currency basket to determine the central parity rate based on market forces, i.e., they aimed to set the central parity rate to the closing rate of the previous trading day. The policy change of this "8.11" reform triggered global responses and a sharp revaluation of the RMB (Yu, 2018), leading to a cumulative depreciation of 4.4% over the next 3 trading days. To reduce exchange rate fluctuations, the Chinese authority announced in February 2016 that the central parity rate would be set around the previous closing rate in combination with the change in the CEFTS RMB index released in December 2015; however, they did not reveal the combination method that would be used. In May 2017, the central parity formation was further complicated by the introduction of a "counter-cyclical factor" to resist exchange rate volatility; this made it harder for the market to comprehend the mechanism.

The second policy tool was the control band on the exchange rate fluctuation. As can be seen from Figure 1(c), although the officially announced floating band was ±0.3% around the central parity rate starting on 21 July 2005, ±0.5% on 21 May 2007, ±1% on 16 April 2012 and ±2 % on 17 March 2014, the actual fluctuation was tightly controlled within much narrower ranges during most periods and without allowing the rate to float fully within the nominal policy bands. Thus, the government appeared to have inferred the band to represent maximum tolerance to the exchange rate risk and granted it strong protection to facilitate benevolent stabilisation for risk-averse market participants. However, given the vaguely set central parity rate, the market may have regarded the band as an untrue and useless guide to the expected exchange rate movement.

The third policy tool was the currency basket, which was the goal of the transition. An initial basket of 11 currencies, without the weights revealed, was briefly mentioned in August 2005 by Xiaochuan Zhou, governor of the People's Bank of China. The weights were not specified for 10 years, until the detailed composition was finally announced for a renewed basket by the CFETS on 11 December 2015. This was followed by three subsequent revisions, as shown in Table 1. In fact, the currency weight in the basket was almost a mirror image of the weight of China's bilateral trade with its trading partners in the preceding year, as shown in Figure 2. [1] This setting of currency weight, which reflects fundamental trade linkages, is

[1]The only outlier that fell significantly below the regression line was the Hong Kong dollar (HKD). Due

consistent with the finding that the optimal exchange regime selected by a country depends on its trade structure (Devereux and Engel, 2003). As stated by Xiaochuan Zhou in an interview on 14 February 2016, referring to the currency basket for RMB valuation and keeping the exchange rate reasonably stable will be a key goal of the Chinese government. However, the market did not positively receive the CFETS basket as a benchmark to evaluate changes in RMB value, and instead focused on the dynamics of the RMB/USD exchange rate.

Interestingly, the CFETS publishes its own RMB currency basket index alongside two supplementary RMB indices: one based on the Bank of International Settlement (BIS) basket, which contains 40 currencies, and one based on the IMF SDR currency basket, which contains the USD, euro (EUR), Japanese yen (JPY) and British pound sterling (GBP). The dynamics of these three indices are highly correlated, as shown in Figure 3. Although these international indices may lend some support to the CFETS basket as a proper valuation benchmark, it is difficult to determine which basket is more relevant for evaluating the RMB value and whether any of the baskets has been credibly used by the Chinese authority to determine the RMB value.

The RMB/USD has evolved in a dynamic manner since its initial de-pegging in July 2005. It has reached a clear two-way fluctuation stage with increasing flexibility compared to its restricted movement a decade ago. It is necessary to continuously assess the de facto exchange rate regime using suitable methods to identify the latest transition stages.

[Table 1. CFETS basket: composition and weights.]

[Figure 2. Trade weight and currency weight in the CFETS basket.]

[Figure 3. The CFETS, SDR and BIS RMB indices.]

3 Related literature

Against the backdrop of policy evolution on the RMB exchange rate, much attention has been paid to the use of historical data to assess the de facto RMB exchange rate regime . Following Frankel and Wei (2007, 2008) and Frankel (2009), who measured currency weight using price elasticity, various studies have investigated the RMB exchange rate regime and identified either a hard or soft peg to the USD, but no references to a currency basket, as announced by the government (Fidrmuc, 2010; Ma and McCauley, 2011; Fidrmuc and

to Hong Kong's special role in mediating China's trade with the rest of the world and its fixed peg to the USD, it is reasonable to deduct its currency share from the CFETS basket to avoid double counting.

Siddiqui, 2015; Kunkler, 2021). In the tradition of binary classification methods used to judge exchange rate regimes (Reinhart and Rogoff, 2004; Shambaugh, 2004), Ilzetzki et al. (2019) have identified China as belonging to the dollar bloc. Compared to the classification method, the Frankel-Wei method provides a better understanding of the extent to which a regime falls behind the currency valuation.

With respect to the reform of the Chinese exchange rate regime, one strand of literature has focused on opaque reform tools such as the mechanism of setting the central parity rate (Clark, 2017; Cheung et al., 2018a,b; Jermann et al., 2019; McCauley and Shu, 2019; Su and Qian, 2021) or the determination of exchange rate volatility (Liu and Pauwels, 2012; Chen et al., 2020). When RMB value indeed started exhibiting a high degree of flexibility, various studies investigated spillover effects to other economies (Whalley and Wang, 2011; Fang et al., 2012; Fratzscher and Mehl, 2014; Hooy et al., 2015; Kawai and Pontines, 2016).

Concerning the effectiveness of the official CFETS basket, most studies examine its role in explaining the RMB/USD exchange rate movement, in particular the central parity rate of RMB/USD, rather than evaluating its impact on RMB value determination with respect to a numéraire following the methodology used in the Frankel-Wei type regression. For example, Cheung et al. (2018b) found a weak effect of the CFETS in shaping the central parity rate of the RMB versus the USD in their study period between August 2015 and December 2016. Das (2019) recognised the possible anchoring effect of the CFETS basket from mid-2016 to end-2017, but found that the introduction of the counter-cyclical factor in May 2017 resisted the depreciation pressure of the RMB versus the USD and blurred the role of the CFETS basket as a guide to RMB exchange rate formation. Further evidence on the weak effect of the currency basket in explaining the central parity of RMB/USD was provided by Su and Qian (2021), although their study used the SDR basket as a benchmark.

To date, 6 years after the first release of the official CFETS currency basket, its credibility has not been formally assessed and confirmed using suitable methods. As the flexibility of the RMB increases in terms of two-way fluctuations with respect to the USD, the importance of the RMB in international trade and financial markets increases (Batten and Szilagyi, 2016; Guo and Zhou, 2021). Increasing uncertainty in the global economy makes it crucial for market participants and policy makers to understand the current status and evolution of the RMB exchange rate regime. In this regard, we employ a comprehensive set of methodologies to examine the evolution of the RMB exchange rate regime with a long-term view and thus, contribute to the literature in the following aspects.

Technically, our paper is the first to use the Bayesian time-varying Frankel-Wei regression and validating methods that control for the endogeneity problem of the regression and to demonstrate the credibility of the official CFETS currency basket. Although the Frankel-Wei approach has clear advantages in interpreting parameters such as the weight of the currency basket (Frankel and Wei, 2007, 2008), its linear regression form assumes constant parameters and cannot reflect the evolving characteristics of the RMB exchange rate regime. Therefore, we adopt a time-varying coefficient specification, similar to that adopted by Fidrmuc (2010), Fang et al. (2012) and Fidrmuc and Siddiqui (2015), which not only efficiently uses the whole sample information, but also better accommodates the time-varying features of the transition compared to a rolling regression based on subsample information. Instead of a Maximum Likelihood Estimation (MLE), as in Fidrmuc (2010) and Fidrmuc and Siddiqui (2015), we use a Bayesian learning technique to assist our inferences with respect to confidence intervals, convergence checks and model comparisons (Fang et al., 2012). Furthermore, to deal with the potential endogeneity problem of the Frankel-Wei regression, we examine the RMB responses to orthogonal currency/basket shocks identified in the structural vector autoregressive model (SVAR) or time-varying parameter vector autoregressive model (TVP-VAR) by incorporating all of the variables in the Frankel-Wei regression into a VAR system. The impulse responses from both the SVAR sub-samples and the TVP-VAR analysis strengthen our findings obtained using the Bayesian time-varying Frankel-Wei regression.

Empirically, our results help understand the turning point in the regime transition brought about by the "8.11" reform introduced in August 2015. Since then, the dollar weight estimated either from the dollar peg model or a currency basket with free weights has declined substantially to as low as 0.2, which is close to the dollar weight of the official CFETS basket. In terms of posterior information criteria, models of currency baskets with pre-determined weights are better supported by data than the dollar-peg model. Of the alternative currency baskets, the CFETS basket is the best; its weight is about 0.6 in the sample starting from 2016. The impulse responses of the RMB value react most strongly to the CFETS shock in a SVAR or TVP-VAR setting.

4 Empirical Methodology

In this section, we first explain our main empirical method of the Bayesian time-varying Frankel-Wei regressions used to assess competing specifications of the evolving RMB exchange rate regime. We then discuss alternative validating methods used to examine the regime transition evidence obtained from time-changing VAR analysis including TVP-VAR and SVAR analysis with subsample comparison.

4.1 Bayesian time-varying Frankel-Wei Regression

Following the currency basket model specified by Frankel and Wei (2007, 2008), the general form with constant weights can be written as

$$\Delta \log RMB_t = \alpha + \sum_{j=1}^{N} \beta_j \left[\Delta \log X_{j,t}\right] + u_t$$

where α indicates a possible trend and β_j is the weight of currency j. On both sides of the equation, the currency values are exchange rates with respect to the same numéraire, such as SDR. Under the specific assumption that all of the basket currencies are known, the weights should sum up to 1 as a regression constraint. When only major currencies are involved on the right-hand side, an unconstraint regression can be executed without exhausting all of the basket currencies. For a hard dollar peg, the right-hand-side (RHS) involves only the dollar price and its coefficient should be close to 1.

To reflect the slow transition in the RMB exchange rate reform, we choose the time-varying coefficient version of the above model, with three possible specifications.

Dollar peg:

$$\Delta logRMB_t = \alpha + \beta_t^{usd} \Delta logUSD_t + u_t, \;\; u_t \sim N(0, \sigma_u^2) \tag{1}$$

International currency basket with free weights:

$$\Delta logRMB_t = \alpha + \beta_t^1 \Delta logC_{1,t} + \cdots + \beta_t^N \Delta logC_{N,t} + u_t, \;\; u_t \sim N(0, \sigma_u^2) \tag{2}$$

In this specification, we include four major international currencies in addition to the USD: EUR, GBP, JPY and Australian dollar(AUD). Following the official CFETS basket, these currencies, together with the USD, account for a weight of 57–73%.

International currency basket with predetermined weights:

$$\Delta logRMB_t = \alpha + \beta_t \left[w_1 \Delta logC_{1,t} + \cdots + w_N \Delta logC_{N,t}\right] + u_t, \;\; u_t \sim N(0, \sigma_u^2) \tag{3}$$

In setting a currency basket with predetermined weights, $w_1, \cdots, w_N$, we estimate three specifications with the weights of the CFETS, BIS and SDR baskets.

The time-varying coefficients, in general, follow a random walk,

$$\beta_t = \beta_{t-1} + \epsilon_t, \;\; \epsilon_t \sim N(0, \sigma_\epsilon^2). \tag{4}$$

Each of the measurement equations of the currency baskets, (1), (2) and (3), form a state-space model with latent state dynamics (4). We use the Markov chain Monte Carlo (MCMC) algorithm with Gibbs sampling and smoothing following Carter and Kohn (1994) to sample the posterior distributions of the parameters and latent states.

We choose a normal-gamma distribution for the prior distribution of c. We set the Gamma distribution for the prior distributions of the variance parameter, σ_u^2 and $\sigma_{\epsilon,j}^2$ ($j = 1, \cdots, N$). A Kalman smoothing step is embedded in the Gibbs sampler to draw from the posterior distribution of time-varying $\beta_{j,t}$. The hyperparameters of the prior distributions for the time-varying $\beta_{j,t}$ are set at relatively large values, which allow them to vary substantially over time. In our estimation, we set the total number of draws to 6000, with the first 2000 draws being burn-ins to reduce the effects of the initial values in the Gibbs sampler. We check the convergence with the convergence diagnostic test as discussed in Geweke (1992).

For the model comparison, we compute the Akaikes Information Criteria (AIC) and Bayesian Information Criteria (BIC) from the posterior median likelihood conditional on equal model priors.

4.2 Alternative validating measures to address the endogeneity problem

Generally, the single equation regression of the Frankel-Wei approach may suffer from an endogeneity problem. The RHS variables and RMB value may be driven by common shocks that cannot be easily separated, which may bias the estimated coefficients. Although the dynamic pattern of the time-varying coefficients can give information on the changing direction of currency weights, it is worth investigating alternative measures to address the endogeneity problem and provide further evidence of the changing pattern of RMB value determination. Therefore, we propose two ways by which to examine the changing scales of RMB responses to currency/basket shocks with orthogonality identification conditions: impulse response functions (IRFs) from SVAR with subsample analysis and IRFs from TVP-VAR conditional on different time periods. [2]

[2] Thanks to a referee's suggestion, we have also considered adding China's share in the global trade as a possible fundamental variable in the SVAR analysis in addition to the exchange rate variables. Since trade share is at best available at the monthly frequency, we have run a mixed-frequency VAR (MF-VAR) of monthly trade share of China with weekly exchange rates, following the methodology of Ghysels (2016). The IRFs of RMB value to USD and currency baskets are qualitatively similar to that of the VAR analysis with daily exchange rate data only. Therefore, we focus on the results of daily data analysis in the following session. The results of the MF-VAR analysis are available upon request.

4.2.1 Structural vector autoregressive model

In the SVAR analysis, for each specification in the previous Frankel-Wei regression, we vectorise all of the involved variables in a vector y_t and create an endogenous dynamic system with y_t and its lags as follows:

$$Ay_t = B_1 y_{t-1} + ... + B_p y_{t-p} + \epsilon_t, \quad where\ \epsilon_t \sim N(0_K, \Sigma) \tag{5}$$

where the shocks in ϵ_t are assumed to be orthogonal to each other.

In this general SVAR setting, we impose a typical short-run restriction for identification using Cholesky decomposition. In the joint modelling of six currencies, the order of currencies in y_t is USD, RMB, EUR, GBP, JPY and AUD. The identifying assumptions are that the USD shock affects RMB contemporaneously and that both USD and RMB shocks affect other currencies contemporaneously based on their importance rankings in the global economy. When modelling the currency basket and RMB, we rank the currency basket value as the first variable and rank the RMB lower in the vector y_t, assuming that the currency basket affects the RMB contemporaneously. ϵ_t is a vector of independently distributed structural shocks, with a diagonal covariance matrix Σ. The matrix A has a lower triangular form with ones on its diagonal entries. By pre-multiplying the inverse matrix A^{-1} on both sides of equation (5), we obtain the following VAR model, with which we can decompose the VAR shock ξ_t with a restricted A matrix to identify the orthogonal shock to the USD or a certain basket.

$$\begin{aligned} y_t &= A^{-1}B_1 y_{t-1} + ... + A^{-1}B_p y_{t-p} + \xi_t, \quad where\ \xi_t \sim N(0_K, A^{-1}\Sigma A^{-1\prime}) \\ &= \Gamma_1 y_{t-1} + ... + \Gamma_p y_{t-p} + \xi_t, \quad where\ \xi_t \sim N(0_K, \Omega) \end{aligned} \tag{6}$$

By conducting subsample analysis on the RMB responses to USD or basket shocks, we can evaluate whether its weight (elasticity) for the USD or a certain basket has changed. We use BIC to select the preferred lag order in the reduced-form VAR.

4.2.2 TVP-VAR

Assuming that the coefficients in the above SVAR model in equation (5) are time-varying, the TVP-VAR model is given by

$$y_t = \Gamma_{1t} y_{t-1} + ... + \Gamma_{pt} y_{t-p} + \xi_t, \quad where\ \xi_t \sim N(0_K, \Omega_t) \tag{7}$$

We stack the $\frac{K(K-1)}{2}$ parameters in A, the pK^2 parameters in B and the K parameters in Σ into vectors a_t, β_t and h_t, respectively, and assume that each vector follows a random walk process as follows:

$$a_t = a_{t-1} + \epsilon_t^a, \;\; where \; \epsilon_t^a \sim N(0_{\frac{K(K-1)}{2}}, \Sigma^a) \tag{8}$$

$$\beta_t = \beta_{t-1} + \epsilon_t^\beta, \;\; where \; \epsilon_t^\beta \sim N(0_{pK^2}, \Sigma^\beta) \tag{9}$$

$$h_t = h_{t-1} + \epsilon_t^h, \;\; where \; \epsilon_t^h \sim N(0_K, \Sigma^h) \tag{10}$$

We adopt the same identification strategy and lag order as that described in section 4.2.1 and use standard MCMC procedures for estimation, as proposed by Primiceri (2005). To investigate whether the RMB has deviated from the USD peg, we calculate the response of the RMB value to a one-unit USD shock for different periods.

5 Data and empirical results

There are 40 currencies in the CFETS, SDR and BIS baskets. We download daily data on these exchange rates in terms of the USD for the period 5 January 2005 to 20 May 2021 from Bloomberg. We take the SDR as the numéraire currency.

5.1 Declining dollar weight

We first present the dollar impact on RMB value determination using data from the whole sample. Figure 4 plots the time-varying coefficient of the dollar peg in model specification (1) and Figure 5 plots the time-varying weights of all five international currencies in model specification (2). Both figures show similar declining patterns for the dollar impact, with a weight close to 1 until mid-2015 and declining gradually to about 0.3 in 2021. The dollar weight in the official CFETS basket is around 0.2. Given that some of the currencies in the basket more or less target the USD, such as the HKD with a weight of 0.04–0.06, a dollar weight of around 0.3 in a reduced-form regression in the RMB currency basket is quite reasonable. Moreover, the low dollar weight corresponds to the share of China–US bilateral trade in the total foreign trade of China, which is consistent with a report of currency regime depending on trade structure (Devereux and Engel, 2003; Mukhin, 2022) and with another report on the gradually weakening role of the USD in the central parity rate of RMB exchange valuation (Su and Qian, 2021). However, other weights in the international currency basket do not appear to reflect the losing weight of the USD.

[Figure 4. Time-varying weight of USD.]

[Figure 5. Time-varying weights of international currencies in a currency basket of free weights.]

5.2 Sizable coefficient of the official CFETS basket

We next examine the impact of the official currency basket on the RMB value determination using data from the sample following the release of the detailed currency composition in December 2015. Figure 6 plots the time-varying coefficient of the CFETS currency basket as a whole when determining the RMB value with respect to the SDR. It shows that the basket has a significant coefficient of 0.5-0.7, which is much larger than the coefficient on a dollar peg of model specification (1) or the dollar weight in the international currency basket of model specification (2).

[Figure 6. Time-varying coefficient of the CFETS currency basket in RMB value determination.]

5.3 Model comparison

To verify whether the CFETS basket is supported by the data, we compare model specifications (1) and (3) using the sample between December 2015 and May 2021. For specification (3), we also compare the CFETS basket with the SDR and BIS baskets. Should the CFETS perform better, its composition must play an important role in determining the RMB value. The RMB has been part of the SDR from November 2015 onwards, but as the constructed SDR basket for the RMB index contains only major currencies other than the RMB in the SDR, we rescale their weights in the SDR by their total weight without the RMB.

Table 2 reports the model comparison between all five specifications: the dollar peg, the international currency basket with free weights and the CFETS, SDR and BIS baskets. Information criteria of AIC and BIC based on the posterior median indicate that the trade-weighted currency indices, the CFETS and BIS, perform better than other models and that the CFETS performs better than BIS. The model comparison suggests that the CFETS is the true anchor for the government's intervention in the foreign exchange market. Although the SDR and BIS indices of the RMB are highly correlated with the CFETS index, they are noisier when measuring the RMB value.

[Table 2. Model comparison of RMB value determination.]

5.4 Robustness checks based on the IRFs of time-changing VAR

To deal with the endogeneity problem of the previous Frankel-Wei regression, we conduct robustness checks based on IRFs of time-changing VAR analysis, i.e., IRFs from subsamples of SVAR and IRFs conditional on different time periods of the TVP-VAR. We first conduct IRFs analysis using the SVAR model. The results are based on reduced-form VAR models with lag order $p = 1$, which is selected based on the BIC. As Table 3 shows that the most preferred lag order in different models across subsamples is 1. The number of parameters is penaliszed in the BIC, which avoids the over-fitting problem. The findings remain unchanged if we use the specific lag order selected by the BIC for different subsamples or specifications.

[Table 3. Model selection using BIC]

First, we compare the RMB response to a one-unit dollar shock in the subsample periods. As shown in Figure 7, consistent with the decline in the weight of the USD, the response of the RMB to a one-unit USD shock was nearly 1 before the "8.11" reform and decreased to 0.2 after the reform. We examine the response of the RMB to a one-unit basket shock in the sample after the "8.11" reform, as shown in Figure 8. It is evident that the response is almost twice that of the response to the USD shock.

[Figure 7. Impulse response of the RMB to the USD shock in SVAR.]

[Figure 8. Impulse response of the RMB to an official basket shock in SVAR.]

Next, we present the IRFs from the TVP-VAR analysis in Figure 9. To investigate whether the RMB deviated from the USD peg, we calculate the response of the RMB to a one-unit USD shock in 2014, 2018 and 2020. As the first entry in Figure 9 shows, the response to the USD shock was almost 1 in 2014 and decreased dramatically to around 0.3 in 2018 and 2020. The response of the RMB to a one-unit CFETS shock was more than 0.4 in 2018 and 2020. The response of the RMB to a one-unit BIS shock was of a similar size and the response to an SDR shock is the lowest of the three indices.

[Figure 9. Time-varying impulse response of the RMB in TVP-VAR]

Overall, our results from the time-varying Frankel-Wei regression and the IRFs based on the time-changing VAR analysis provide consistent evidence for the transition from the USD peg to the official CFETS currency basket, as instrumented by the "8.11" reform in 2015. Although the complexity and communication problems in the formation of the central parity rate have blurred the role of the currency basket, the regime transition has decisively moved forward.

6 Conclusion

This paper provides a formal quantitative assessment of a much-neglected yet important issue in the hidden transition and up-to-date status of the Chinese exchange rate regime. Using a time-varying Frankel-Wei approach with alternative validating measures based on a time-changing VAR analysis, we find that the RMB has steadily and decisively departed from the dollar peg and adapted to a trade-weighted currency basket, as officially announced after the landmark "8.11" reform in 2015. The significance and impact of this regime transition are yet to be revealed in the forthcoming years.

After controlling for endogeneity problems in the Frankel-Wei regression, the validating measures of IRFs based on the time-changing VAR analysis provide consistent evidence for the transition process, producing a comparable magnitude of initial IRFs to the weight of the currency or basket in the Frankel-Wei regressions. This comprehensive approach strengthens the robustness of our findings. It can be more generally applied to evaluate and monitor such smooth structural changes.

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Figures and Tables

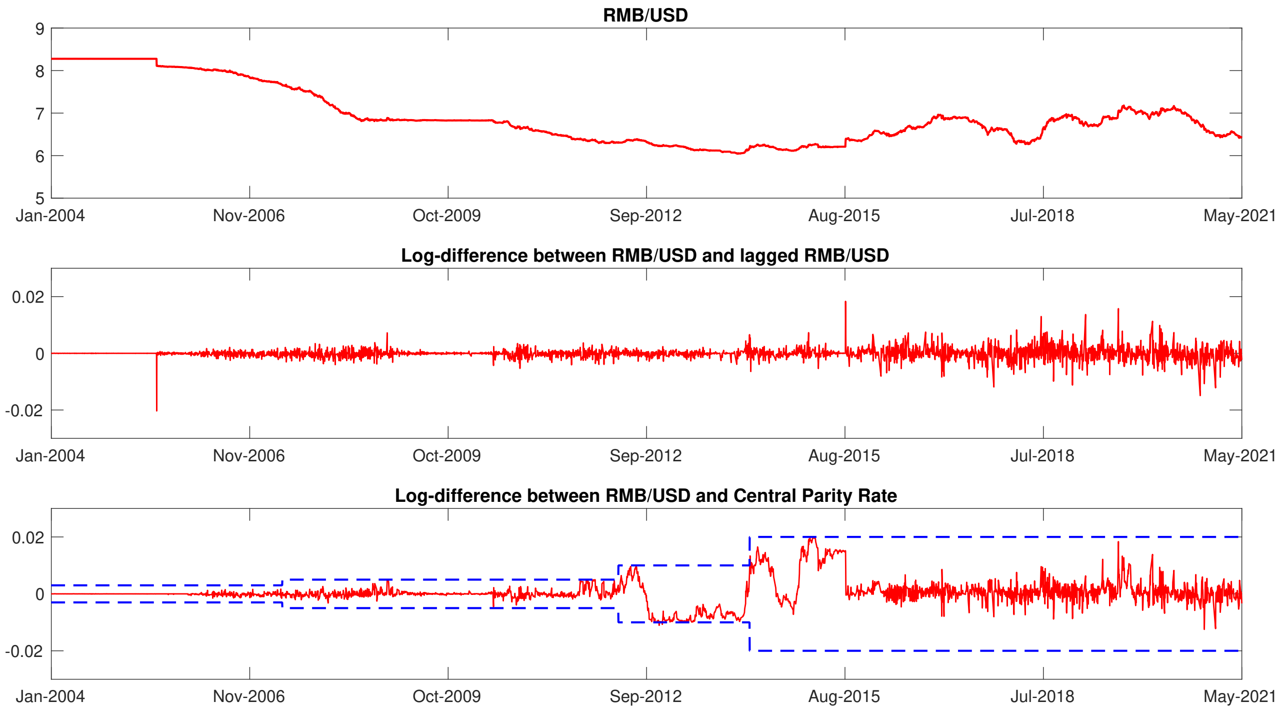

Figure 1. (a) RMB/USD. (b) Log-difference between RMB/USD and lagged RMB/USD. (c) Log-difference between RMB/USD and the central parity rate with policy bands on the deviation (dashed line). RMB/USD data is the daily closing price from 5 January 2004 to 20 May 2021.

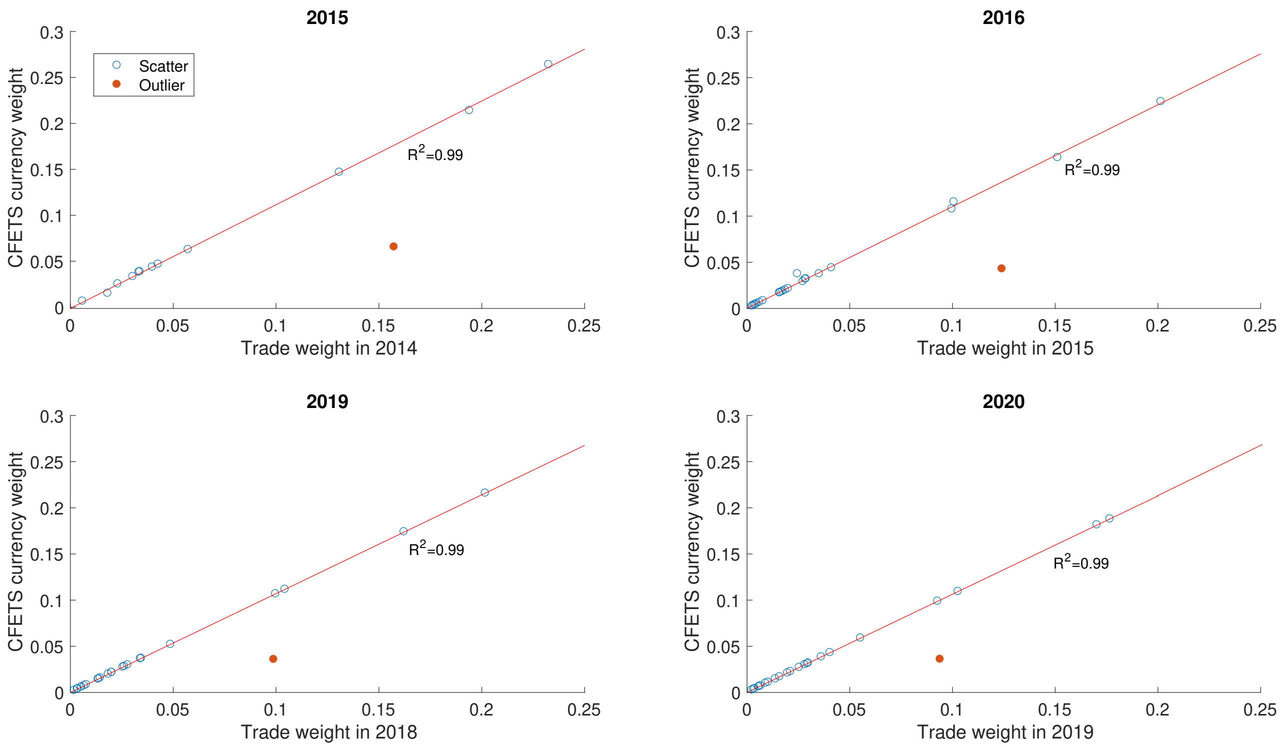

Figure 2. Trade weight and currency weight

Note: Trade weight is calculated as the proportion of total import and export trade with China. The brown point is an outlier, representing Hong Kong. The red line is the fitted line for the remaining currencies in the CFETS basket.

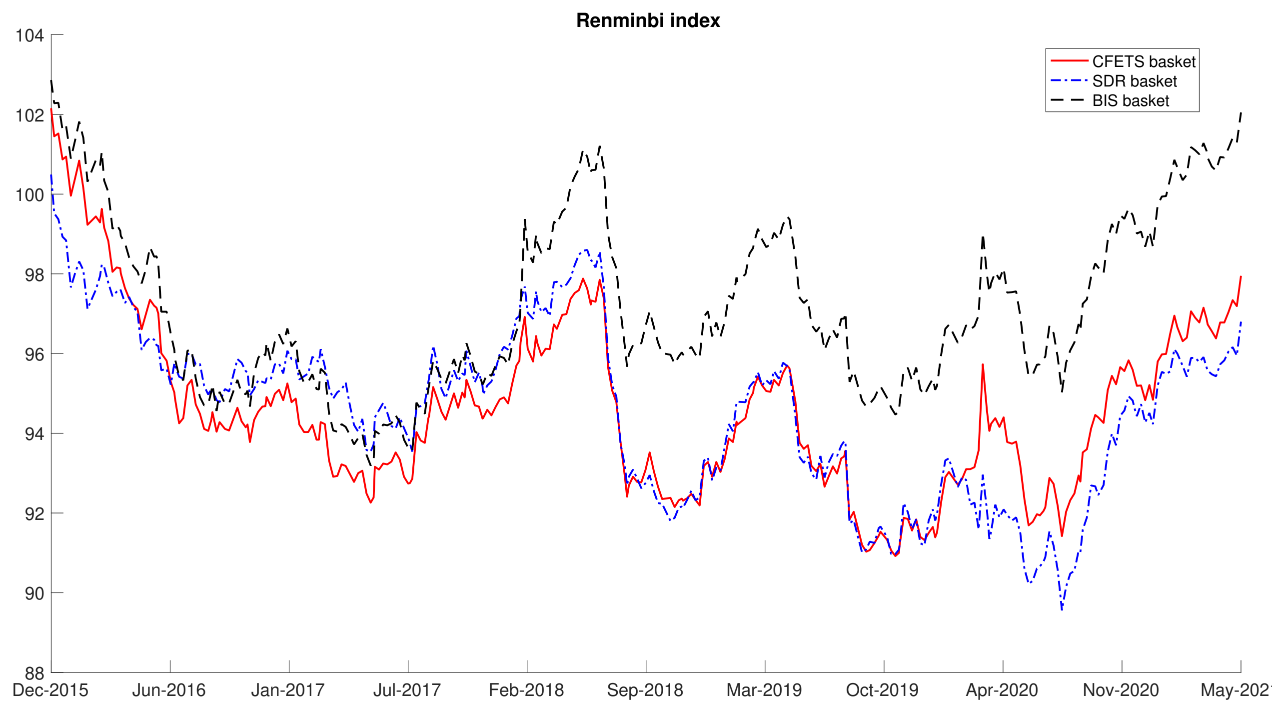

Figure 3. The CFETS, SDR and BIS RMB indices. These indices were first released in December 2015, with the base index of 100 dating back from the end of 2014.

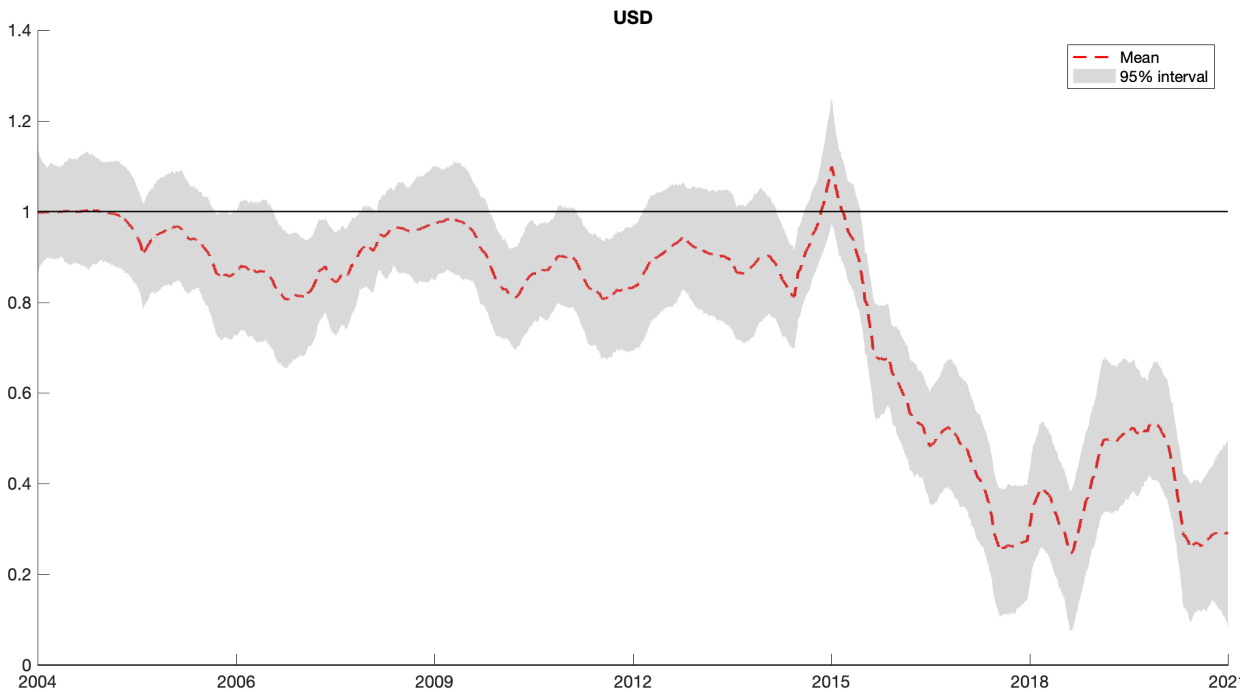

Figure 4. Time-varying weight of the USD. The dashed line is the posterior mean and the shaded area indicates the 95% confidence interval.

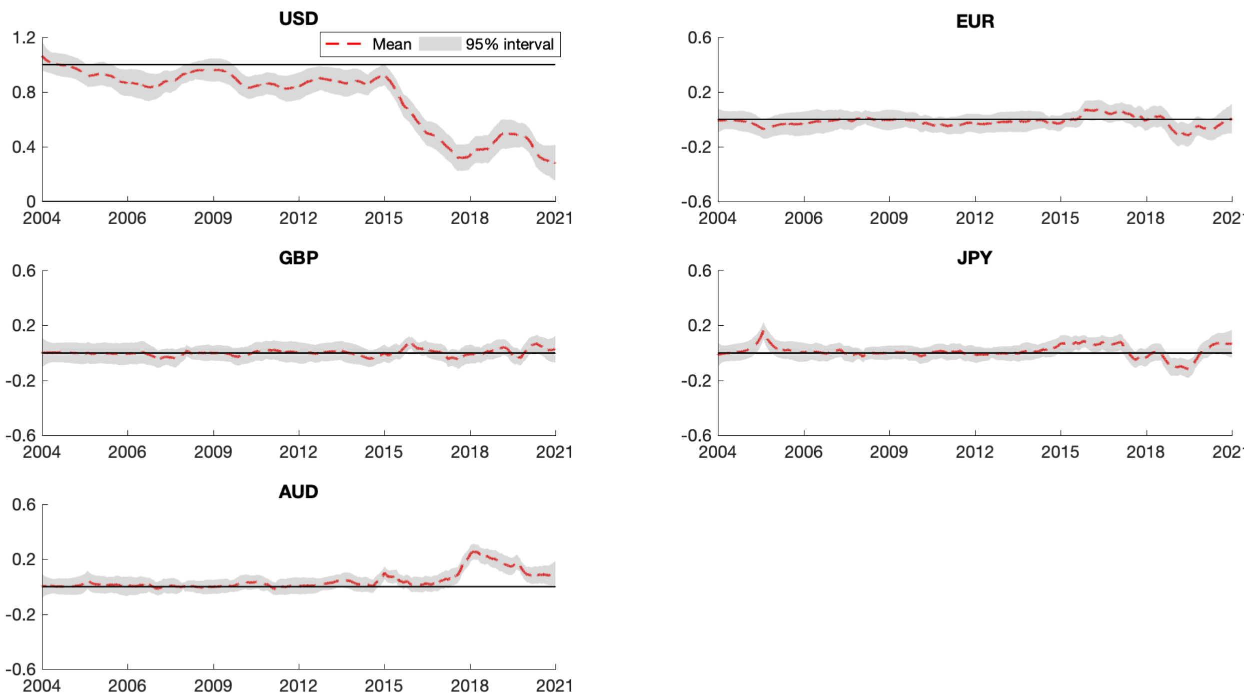

Figure 5. Time-varying weights of international currencies in a currency basket of free weights. The dashed line is the posterior mean and the shadow area indicates the 95% confidence interval.

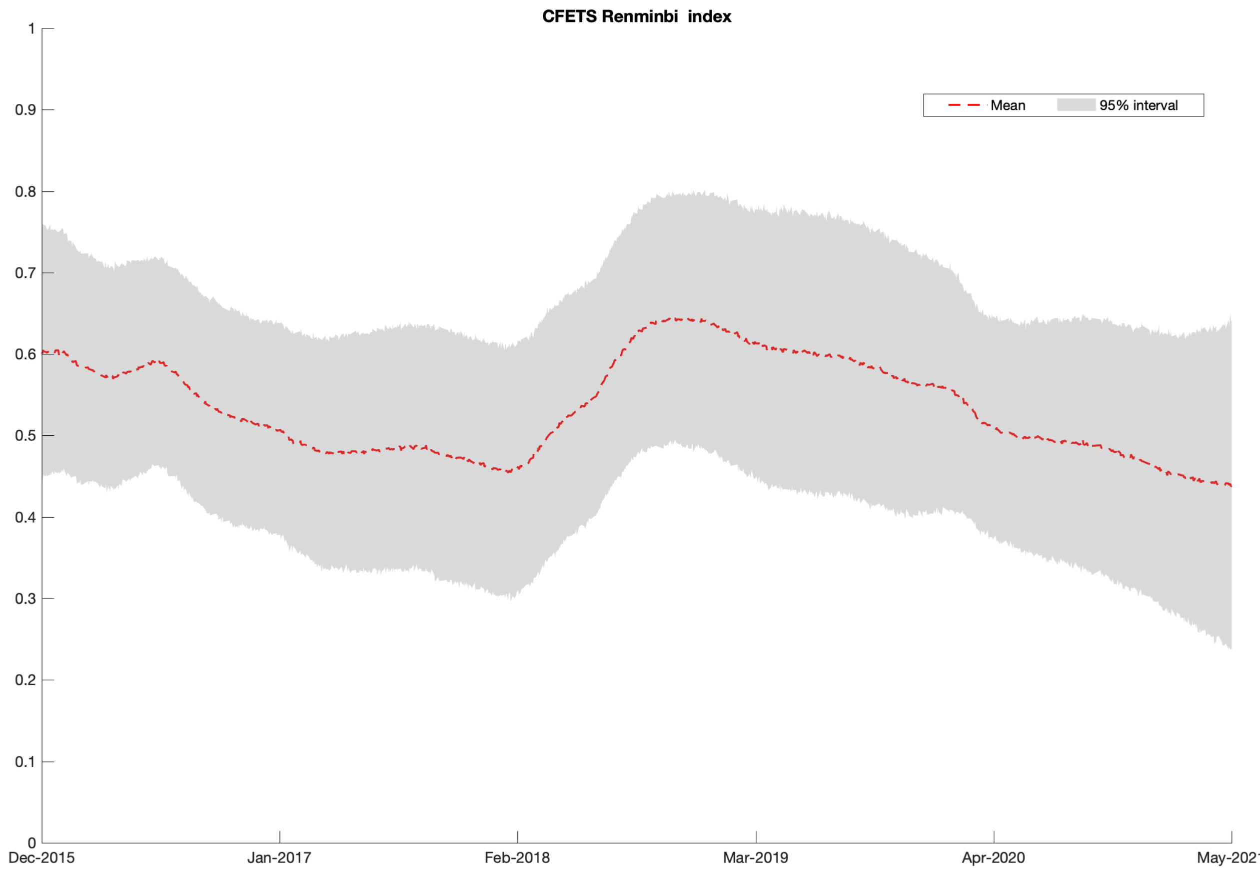

Figure 6. Time-varying coefficient of the CFETS currency basket in the RMB value determination. The dashed line is the posterior mean and the shaded area indicates the 95% confidence interval.

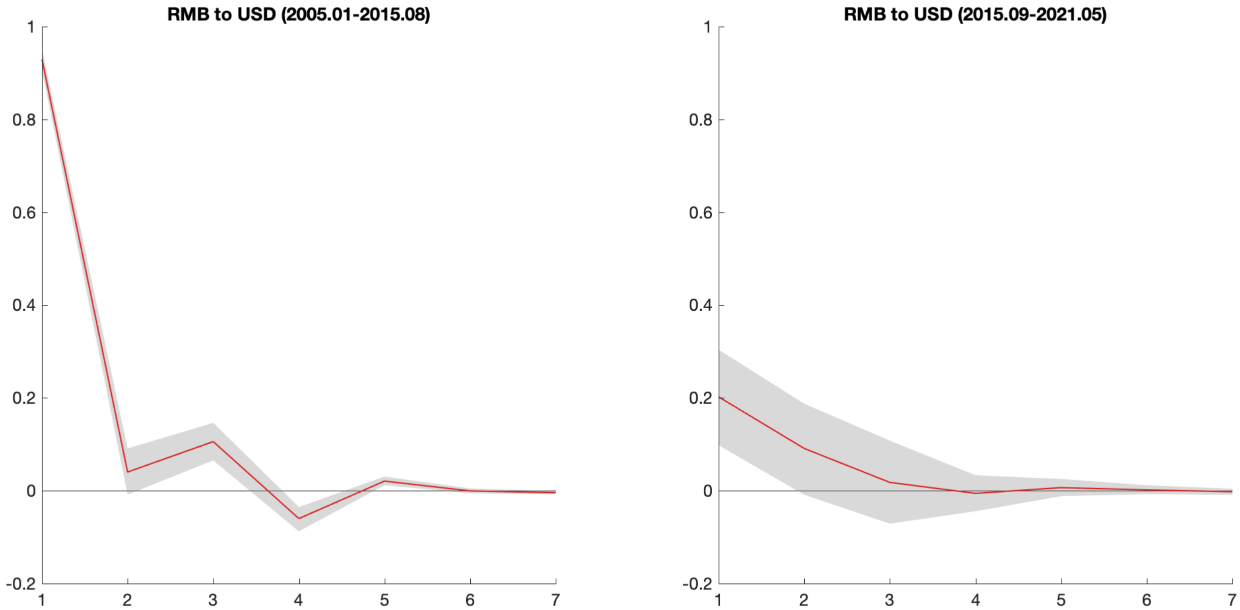

Figure 7. Impulse response of the RMB to a USD shock in SVAR.

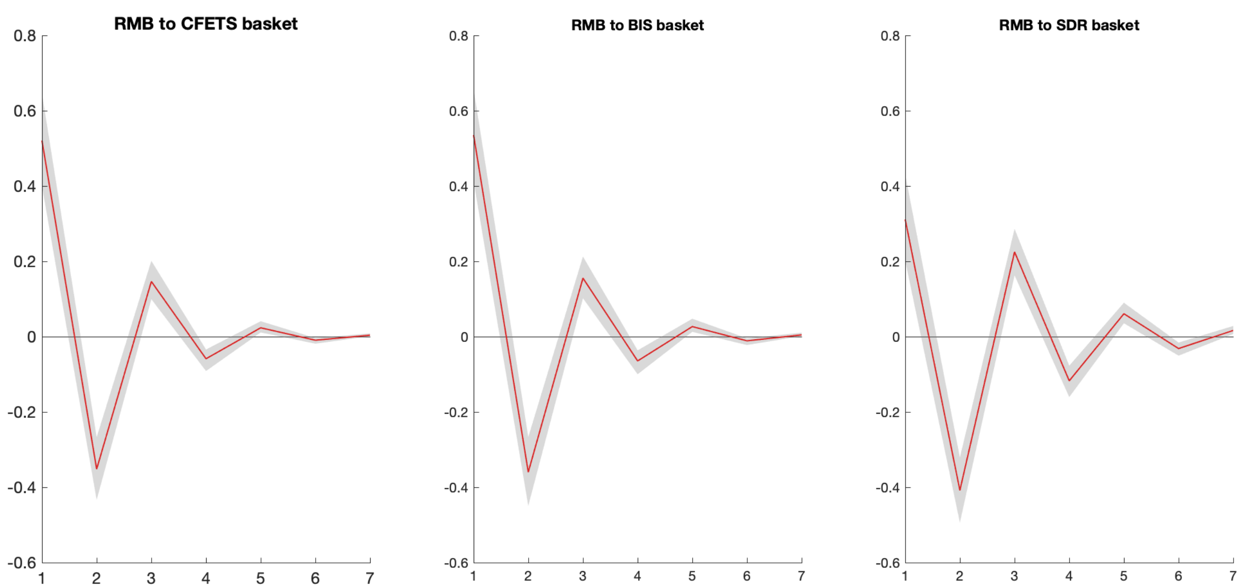

Figure 8. Impulse response of the RMB to an official basket shock in SVAR.

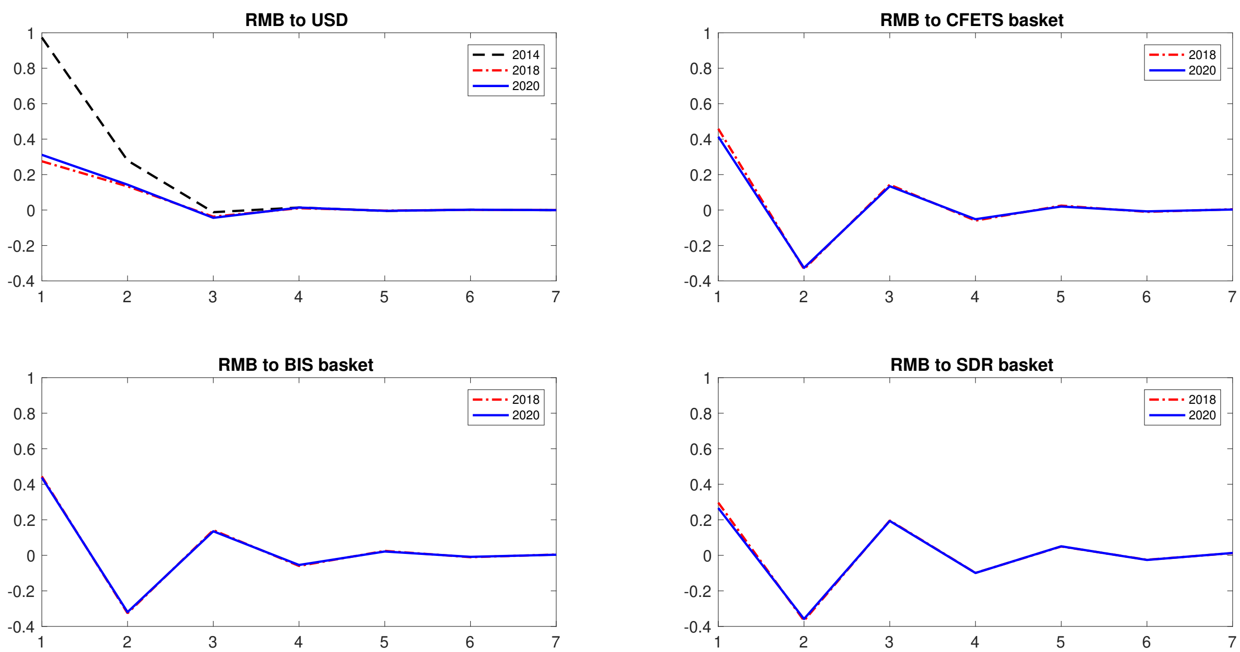

Figure 9. Time-varying impulse response of the RMB in TVP-VAR.

Table 1. CFETS basket: Composition and weights

Currency	2005	2015	2016	2019	2020
USD (US dollar)	✓	0.2640	0.2240	0.2159	0.1879
EUR (Euro)	✓	0.2139	0.1634	0.1740	0.1815
JPY (Japanese yen)	✓	0.1468	0.1153	0.1116	0.1093
HKD (Hong Kong dollar)		0.0655	0.0428	0.0357	0.0359
GBP (British pound)	✓	0.0386	0.0316	0.0275	0.0300
AUD (Australian dollar)	✓	0.0627	0.0440	0.0520	0.0589
NZD (New Zealand dollar)		0.0065	0.0044	0.0057	0.0063
SGD (Singapore dollar)	✓	0.0382	0.0321	0.0282	0.0312
CHF (Swiss francs)		0.0151	0.0171	0.0144	0.0110
CAD (Canadian dollar)	✓	0.0253	0.0215	0.0217	0.0226
MYR (Malaysia ringgit)	✓	0.0467	0.0375	0.0370	0.0431
RUB (Russian ruble)	✓	0.0436	0.0375	0.0365	0.0385
THB (Thailand baht)	✓	0.0333	0.0291	0.0298	0.0319
ZAR (South Africa rand)			0.0178	0.0148	0.0147
KRW (South Korean won)	✓		0.1077	0.1068	0.0988
AED (Emirati dirham)			0.0187	0.0157	0.0169
SAR (Saudi Arabia riyal)			0.0199	0.0216	0.0271
HUF (Hungarian forint)			0.0031	0.0037	0.0035
PLN (Polish zloty)			0.0066	0.0084	0.0100
DKK (Danish krone)			0.0040	0.0040	0.0041
SEK (Swedish krona)			0.0052	0.0058	0.0061
NOK (Norwegian krone)			0.0027	0.0021	0.0026
TRY (Turkish lira)			0.0083	0.0073	0.0072
MXN (Mexican peso)			0.0169	0.0198	0.0211

Note: In the first column, 11 currencies have a checkmark. Xiaochuan Zhou, former governor of the People's Bank of China, claimed that the RMB basket would consider these currencies in 2005. The compositions and weights of the CFETS RMB basket were initially disclosed in December 2015. There were three subsequent revisions in December 2016, December 2019 and December 2020.

Table 2. Model comparison for RMB value determination
(From December 2015 to May 2021)

Equation	Model	Posterior AIC	Posterior BIC
1	Dollar peg	8597	8613
2	Five international currencies	8399	8434
3	CFETS basket	**7969**	**7984**
3	BIS basket	7996	8011
3	SDR basket	8547	8562

Table 3. Model selection using BIC

	Preferred lag order
International currency basket before "8.11" reform	2
International currency basket after "8.11" reform	1
CFETS and RMB	1
BIS and RMB	1
SDR and RMB	4

Note: The five currencies included in the international currency basket are USD, EUR, GBP, JPY and AUD.