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Currency co-movements in Asia-Pacific: The regional role of the Renminbi

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Abstract

The internationalization of China's currency, the renminbi (RMB) bolsters the growing economic and political influence of China in the Asia-Pacific region. This paper assesses the evolution of RMB exchange rate co-movements against the US dollar (USD) within the region. While the RMB's influence is growing, it is also found to be asymmetric and varying over time depending on the global movement of the USD. The trend is strong when the USD depreciates, but fades when the USD appreciates.

JEL classification: F31, F33.
Keywords: Exchange rates, Asia-Pacific, renminbi, China.

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1 Introduction

Since the Asian financial crisis of 1997–1998, the array of exchange rates within the Asia-Pacific (AP) region has changed considerably. Many currencies that were once strictly anchored to the US dollar have become progressively more flexible. According to the latest IMF assessment (IMF, 2016), a large share of exchange rate arrangements in the AP region are currently of a floating nature, with just a handful of countries (including China, Malaysia, Singapore and Hong Kong) maintaining more tightly managed arrangements.

China's exchange rate regime has been reformed repeatedly over the last decade, moving towards greater flexibility. In the summer of 2005, China abandoned its strict peg to the US dollar (USD), allowing a limited fluctuation around a central parity fixed on a daily basis. Since then, the exchange rate flexibility of the renminbi (RMB) has gradually increased.

Regional trade integration has grown dramatically over the last two decades. For many AP countries, intra-regional trade now accounts for over 60 % of their total external trade. Thanks to its central position in the region's production network, China has exerted a pivotal role in this process (IDE-JETRO and WTO, 2011; Baldwin, 2011). Since 2002, the share of trade with China has nearly doubled in almost all these countries, mainly at the expense of Japan.

In July 2009, China's State Council introduced a pilot scheme for RMB trade settlement. The Chinese authorities have since proactively encouraged the internationalization of the RMB with the aim of reducing its reliance on the USD as a medium of exchange and store of value. The range of transactions that can be settled in RMB has been progressively expanded to include all current account transactions and certain financial account transactions.[1]

The use of the RMB as a trade settlement currency has also grown significantly. The share of Chinese transactions settled in RMB peaked at 30 % in the first half of 2015 (up from zero at the beginning of 2010). By 2014, the AP region accounted for over half of China's total trade in goods and about 80 % of cross-border RMB payments (PBC, 2015). To promote the use of the RMB, the People's Bank of China (PBC) has signed bilateral currency swap agreements with many central banks in the region (Australia, New Zealand, South Korea, Hong Kong, Malaysia, Indonesia, Singapore and Thailand), as well as allowed for the creation of offshore centers for RMB trading in Hong Kong, Singapore, Seoul, Sidney, Kuala Lumpur, Bangkok, Taipei and Macau. Intra-region financial integration, even if it lags trade integration, is progressing.

[1] For an overview of the RMB internationalization process, see Eichengreen and Kawai (2015) and Marconi et al. (2016).

This paper investigates whether the growing economic influence of China in the AP region is reflected in currency co-movements against the USD. The growing use of the RMB to settle trade transactions within the region in association with higher exchange rate flexibility may have increased the sensitivity of AP exchange rates to RMB movements against the USD. This greater sensitivity may be *policy-driven*, with policymakers seeking to stabilize relative competitiveness and reduce currency risks, or *market-driven*, with international traders increasingly taking RMB movements into account when trading other AP currencies.

This study contributes to the existing literature by proposing an identification strategy that helps distinguish among the global, regional and RMB factors that drive AP daily exchange rate returns.

When the main global and regional factors are considered, regional currencies have shown co-movement with the RMB against the USD since China's 2005 exchange rate reform. These co-movements, however, are asymmetric depending on the global USD trend. Specifically, when the USD depreciates globally, daily exchange rate returns within the region tend to be more positively correlated among themselves and with the RMB and less correlated to other major global currencies. When the USD appreciates globally, AP exchange rates tend to follow the global depreciation trend against the USD more closely. Here, the RMB plays little or no role. This asymmetry suggests that AP currencies move as if driven by the aim of stabilizing the effective exchange rate and avoiding excessive appreciation. Similar interpretations have been offered by Ho et al. (2005) and Rajan (2012).

The paper is organized as follows. Section 2 reviews the relevant literature on the topic of RMB co-movements with other Asian currencies. Section 3 describes the data and the empirical strategy used. Section 4 presents the results of the analysis. Section 5 concludes.

2 Literature review

A growing body of literature has started to look at the role of the RMB in the exchange rate configuration of the AP region. Most research focuses on determining whether the RMB has begun to appear in the implied currency baskets against which markets, policymakers or both tend to stabilize the currencies of other Asian economies, e.g. Henning (2012), Subramanian and Kessler (2013), Fratzscher and Mehl (2014), Kawai and Pontines (2016) and Eichengreen and Lombardi (2017). A common feature of the empirical strategy is to estimate a Frenkel-Wei equation (Frenkel and Wei, 1994) of the following type:

$$\Delta \log\left(\frac{E_{it}}{CHF_t}\right) = \alpha_i + \beta_1 \Delta \log\left(\frac{USD_t}{CHF_t}\right) + \ \beta_2 \Delta \log\left(\frac{EUR_t}{CHF_t}\right) + \beta_3 \Delta \log\left(\frac{JPY_t}{CHF_t}\right) +$$
$$\beta_4 \Delta \log\left(\frac{GBP_t}{CHF_t}\right) + \beta_4 \Delta \log\left(\frac{RMB_t}{CHF_t}\right) + \epsilon_{it}\ , \qquad (1)$$

where $\Delta \log\left(\frac{E_i}{CHF}\right)$ is the change of the log of the exchange rate (E) of country i, vis-à-vis the Swiss franc (CHF); USD, EUR, JPY and GBP denote the US dollar, the euro, the Japanese yen and the pound sterling. All exchange rates are expressed vis-à-vis the Swiss franc, but other currencies may be selected as numéraire*:* for instance, Fratzscher and Mehl (2014) choose the SDR, while Kawai and Pontines (2016) prefer the New Zealand dollar.

The evidence based on this approach is mixed. Henning (2012), Subramanian and Kessler (2013) and Eichengreen and Lombardi (2017) conclude that an RMB bloc has emerged in East Asia. In contrast, Fratzscher and Mehl (2014) and Kawai and Pontines (2016) find a more limited effect. This ambiguity essentially arises from two main problems. First, much of the difficulty in assessing the degree of co-movements with the RMB arises as a result of the choice of the numéraire. The USD is both the dominant currency in the international monetary system and the main reference currency in the RMB basket. Whenever a currency other than the USD is chosen as the numéraire, and both the USD and the RMB are included on the right-hand side, multicollinearity problems arise (Ito, 2008). A second problem is due to omitted variables, i.e. exchange rate changes may be driven by common factors at both the global and regional level. Not accounting for these factors may cause the RMB to take on a too small or a too large role also depending on the sample period.

Fratzscher and Mehl (2014) suggest overcoming the collinearity problems using orthogonal explanatory variables. Taking the USD/SDR exchange rate as the exogenous variable, they control for omitted variable problems by introducing a set of global variables that includes oil prices, a proxy for global liquidity conditions and a proxy for risk aversion.[2] Kawai and Pontines (2016) use a two-step estimation approach. They conclude that the importance of the RMB in the currency basket of many East Asian economies has grown in recent years, but USD still remains the most important anchor currency in the region. Fratzscher and Mehl (2014) reach a similar conclusion.

Another approach is to choose the USD itself as the numéraire. This choice focuses on the degree of exchange rate co-movements against the USD. Using this approach, Shu et al. (2015) find significant, but differentiated, co-movements of AP currencies with the RMB.

[2] Fratzscher and Mehl (2014) propose numerous specifications for testing the hypothesis of Chinese dominance. The reference here is to the specification reported in their Table 4 (p. 1361).

Finally, Chow (2014) estimates country-specific VAR models using bilateral exchange rates against the USD. She finds evidence that after the global financial crisis the RMB started exerting a role in Asian exchange rate determination, and the RMB impact has since become at least as large as the USD.

To summarize, the existing evidence points to (i) an increasing role of the RMB in explaining exchange rate movements in Asia, (ii) an even larger role since the global financial crisis, and (iii) a variation in magnitude across studies, depending on the specification.

3 Estimation strategy

We propose an estimation approach that overcomes the above-mentioned multicollinearity problems and omitted variable bias by combining several strategies. As in Shu et al. (2015), the USD is chosen as the numéraire, thereby overcoming a possible source of collinearity. We focus on the response of daily exchange rate returns against the USD in a panel of eleven AP currencies to developments of the RMB/USD daily exchange rate. We select the currencies of the largest and most interconnected economies in the region, including the Australian dollar (AUD), Hong Kong dollar (HKD), Indian rupiah (INR), Indonesian rupee (IDR), Korean won (KRW), Malaysian ringgit (MYR), New Zealand dollar (NZD), Philippines peso (PHP), Singaporean dollar (SGD), Thailand dollar (THD) and Taiwan dollar (TWD). Along with the RMB/USD exchange rate, explanatory variables include global and regional factors to control for omitted variables.

Our basic specification is the following:

$$\Delta \log\left(\frac{E_{it}}{USD_t}\right) = \alpha_i + \beta_{GD}\Delta \log(GD_t) + \beta_{REG}\Delta \log(REG_{it}) + \beta_{RMB}\Delta \log\left(\frac{RMB_t}{USD_t}\right) + \gamma_1\Delta\log(GSCI_t) + \gamma_2\Delta SOVX_t + \gamma_3\Delta\log(VIX_t) + \delta_1\Delta REPO_t + \epsilon_{it} \ . \quad (2)$$

The dependent variable is the two-day (non-overlapping) return for the nominal (spot) exchange rate expressed in units of the *i-th* national currency per USD. *i* indicates the *i-th* AP currency. Variables on the right-hand side include the two-day log change of an outside-region global dollar index (GD), the two-day return of a regional dollar index (REG) and the two-day return of the RMB/USD exchange rate.[3] The two variables GD and REG take inspiration from the work of Verdelhan (2015), who shows that the dollar factor accounts for a large share of exchange rate variation against the

[3] It is standard in the literature to use two-day non-overlapping exchange rate returns to account for possible non-overlapping trading zones affecting global variables and avoid spurious correlations if the two-day returns overlap.

USD. In Verdelhan (2015), the global dollar factor corresponds to the average change in the exchange rate between the USD and all other currencies, excluding currency i itself. In his case, the global dollar factor is country-specific. Here, we split Verdelhan's global dollar factor into two parts: an outside-region part, common across the currencies considered (GD), and a regional part, which is country-specific (REG).[4]

The GD index is the trade-weighted exchange value of the USD versus six major free floating currencies.[5] The GD index is invariant across the countries included in the sample. An increase of GD indicates an average appreciation of the USD with respect to the major international currencies. The variable REG corresponds to a trade-weighted average index of the bilateral AP exchange rates against the USD, excluding currency i itself:

$$REG_{it} = \sum_{s \neq i} \frac{E_{st}}{USD_t} * w_s^i \ ; \ i \in AP; s \in AP \ ; \ \sum_{s \neq i} w_s^i = 1 \ , \tag{3}$$

where w_s^i indicates the trade weight (for country i) assigned to the currency of trading partner s. An increase in REG indicates an appreciation of the USD against the regional currencies. A more detailed description of the variables and the list of the currencies included is reported in Table A1 in the appendix.

Other global variables included are a commodity price index (GSCI), the emerging market sovereign spread index (SOVX) to capture the degree of stress on global financial markets, and the Chicago Board Options Exchange Volatility Index (VIX) to capture global risk aversion. To account for any additional effect stemming from liquidity conditions in China, we also include the Chinese 1-week interbank repo rate (REPO). β_{RMB} is the parameter of interest, it measures the degree of response of daily returns to the RMB/USD exchange rate.

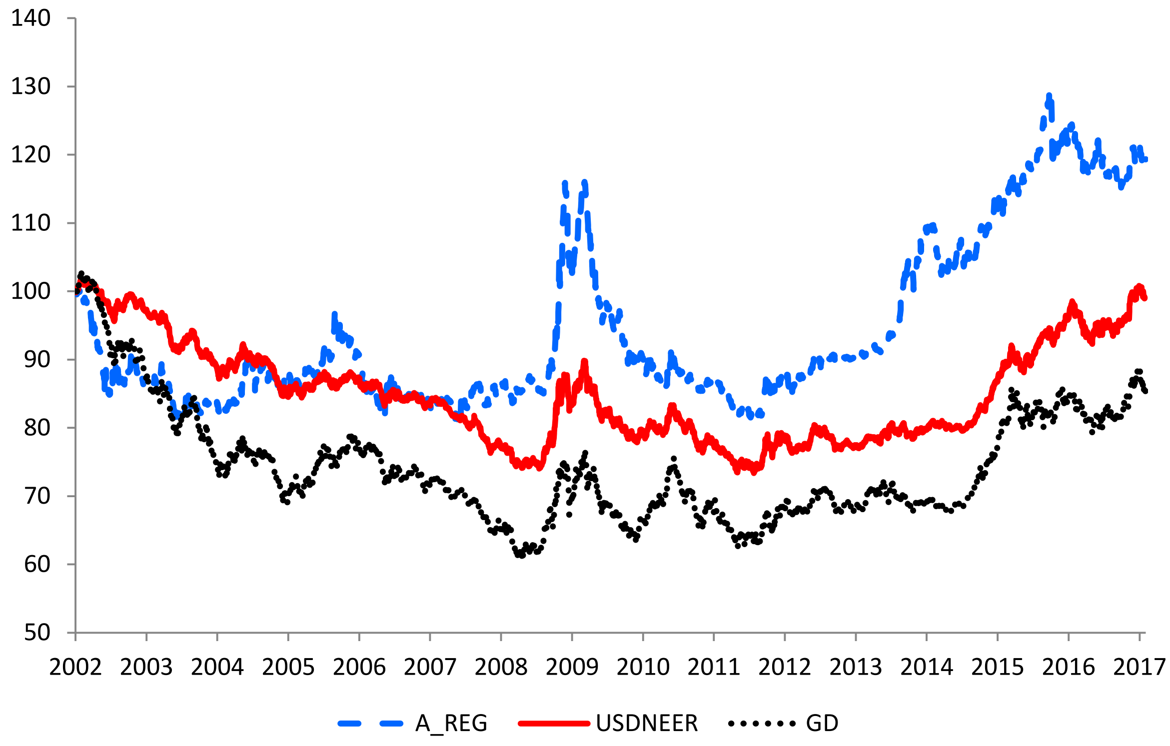
Figure 1 reports the GD index, as well as a simple average of the eleven country-specific REG indexes and the USD broad nominal effective exchange rate index (NEER). GD and REG have been on diverging paths since 2003, with a sharper increase in the distance between the two variables after the 2008–2009 global financial crisis. Thereafter, the gap has tended to increase in periods of sustained USD depreciation and to narrow in periods of USD appreciation. This is our

[4] Fratzscher and Mehl (2014) consider a regional currency factor similar to ours. However, their specification of regional factor for Asia includes the RMB, so the RMB effect is not distinguished from the regional effect. Similarly, when they single out the RMB effect, they exclude the regional factor.

[5] The index, computed by the Board of Governors of the Federal Reserve System (US), includes the Canadian dollar, euro, Japanese yen, Swiss franc, UK pound and Swedish krona.

first indication of an asymmetric movement of AP exchange rates. Appreciation is likely to be contained, while depreciation is observed as less contained. We explore this issue in greater detail later on. In any case, the correlation between the GD and REG is relatively low, around 0.3.

Figure 1 Global dollar, Regional dollar and USD nominal effective exchange rate.



Source: Thomson Reuters Datastream and author's calculations.

Note: An increase indicates a dollar effective appreciation against the group of currencies considered. A_REG is the average of country-specific REG_{it} computed in (3); GD is the USD index against 6 major currencies; USDNEER is the daily USD effective exchange rate index.

4 Empirical results

We use daily data running from 5 September 2005 to 31 January 2017. This time span provides a sufficient perspective to assess the evolution of exchange rate co-movements in the AP region, since it encompasses both periods in which the RMB experienced a tighter peg to the US dollar (when β_{RMB} is expected to take a low or zero value), as well as periods of higher RMB flexibility. Indeed, China's exchange rate regime underwent several changes during our sample period. Thus, it is important to check whether its regional influence changes over time. Looking at the RMB/USD exchange rate, it is possible to identify six sub-periods (Table 1).

Table 1 RMB exchange rate reforms

Period	Label	Description
Period 1: 05/09/2005 – 01/08/2008	Early reform	Introduction of the crawling-peg regime with a maximum daily trading band against the US dollar of ±0.5%
Period 2: 02/08/2008 – 18/06/2010	Post-GFC stabilization	Restoration of a stricter peg to the dollar
Period 3: 21/06/2010 – 13/04/2012	Return to 0.5% band	Return to flexibility within a daily trading band of ±0.5%
Period 4: 16/04/2012 – 14/03/2014	1% band	Daily trading band widens to ±1%
Period 5: 15/03/2014 – 10/08/2015	2% band	Daily trading band widens to ±2.0%
Period 6: from 11/08/2015	Post-fixing reform	New mechanism for determination of daily central parity [6]

Table 2 reports panel estimates for equation (2) on the full sample period using various estimators: pooled OLS estimator (column 1), fixed-effect estimator (FE, column 2) and panel-corrected standard error estimator (PCSE, column 3). The estimators give quite similar results in terms of both magnitude and significance of estimated parameters. The panel-specific autocorrelations estimated with the PCSE model also appear to be quite low (the largest is 0.2). Given the similarities, we go with the fixed-effect estimator.

Turning to the coefficients, we first examine their relative magnitude. The largest impact comes from the GD factor, followed by RMB and REG. All three variables are highly statistically significant.[7]

[6] The latest exchange rate reform has sensibly changed the dynamics of China's central parity. For a comprehensive analysis of this regime shift, see Cheung et al. (2016).
[7] While we do not posit a true causal effect running from RMB to AP exchange rates against the USD, the Hausman-Taylor estimator rules out the endogeneity of both RMB and REG (results available on request).

Table 2 Basic panel regressions comparing different estimators

	OLS (1)	FE (2)	PCSE (3)
GD	0.280***	0.280**	0.281***
	[0.011]	*[0.078]*	*[0.011]*
REG	0.198***	0.198***	0.201***
	[0.019]	*[0.034]*	*[0.011]*
RMB	0.254***	0.254**	0.255***
	[0.031]	*[0.057]*	*[0.037]*
SOVX	0.007***	0.007**	0.008***
	[0.001]	*[0.002]*	*[0.001]*
GSCI	-0.022***	-0.022	-0.020***
	[0.004]	*[0.011]*	*[0.004]*
VIX	0.010***	0.010**	0.009***
	[0.001]	*[0.003]*	*[0.001]*
REPO	-0.001	-0.001	0.003
	[0.009]	*[0.008]*	*[0.013]*
N	16390	16390	16390
Adj. R^2	0.252	0.252	0.263

Note: *p<0.05; ** p<0.01; *** p<0.001. FE = fixed-effect estimator with cluster-robust standard errors; PCSE = panel-corrected standard error model, controlling for cross-panel correlation and autocorrelation. Robust standard errors are reported in parentheses. Sample period runs from 5 September 2005 to 31 January 2017.

Table 3 reports the relative contribution of GD, REG and RMB to the model's goodness of fit. All these variables improve the model's goodness of fit. The introduction of GD explains a slightly larger portion of variance compared to a specification, which considers only the EUR/USD, GBP/USD and YEN/USD exchange rates. The introduction of the RMB brings an additional slight improvement (the adjusted R-squared increases from 0.220 to 0.227). Finally, the inclusion of the REG variable brings about the largest improvement to the overall fit of the model. Here, it is worth noting that the inclusion of REG reduces the coefficient on RMB, $\hat{\beta}_{RMB}$ from 0.35 (column 3) to 0.25 (column 5), suggesting that relative competitiveness within the region is an important driver of AP exchange rate movements. Not controlling for this effect would cause the value of $\hat{\beta}_{RMB}$ to be excessively large.

Table 3 Marginal contributions of GD, REG and RMB

	EUR&GBP&YEN (1)	GD (2)	GD&RMB (3)	GD&REG (4)	GD&REG&RMB (5)
EUR	0.170** *[0.037]*				
GBP	0.104** *[0.024]*				
YEN	0.033 *[0.019]*				
GD		0.334** *[0.078]*	0.316** *[0.079]*	0.291** *[0.077]*	0.280** *[0.078]*
REG				0.209*** *[0.035]*	0.198*** *[0.034]*
RMB			0.349*** *[0.061]*		0.254** *[0.057]*
SOVX	0.009*** *[0.002]*	0.010*** *[0.002]*	0.010*** *[0.002]*	0.007** *[0.002]*	0.007** *[0.002]*
GSCI	-0.034* *[0.013]*	-0.028* *[0.011]*	-0.025* *[0.011]*	-0.024 *[0.011]*	-0.022 *[0.011]*
VIX	0.012** *[0.003]*	0.011** *[0.003]*	0.011** *[0.003]*	0.010** *[0.003]*	0.010** *[0.003]*
REPO	-0.001 *[0.007]*	0.000 *[0.008]*	-0.004 *[0.007]*	0.002 *[0.008]*	-0.001 *[0.008]*
N	16390	16390	16390	16390	16390
Adj. R^2	0.215	0.220	0.227	0.248	0.252

Note: *p<0.05; ** p<0.01; *** p<0.001. Fixed-effect estimator; cluster-robust standard errors reported in parentheses.
Sample period runs from 5 September 2005 to 31 January 2017.

To appreciate the marginal contribution of the RMB across the seven sub-periods, we run regression 2, first excluding the RMB from the right-hand side and then including it. The marginal effect can be appreciated through the changes of the adjusted R-squared, and we also compute the F-test from the Residual Sum of Squares (RSS) of the two regressions. Table 4 reports the results for the restricted regression (RMB excluded), while Table 5 reports the results for the unrestricted regression (RMB included). The inclusion of the RMB is statistically significant in Period 1, Period 3, Period 4 and Period 6, corresponding to the periods of higher volatility of the RMB (Fig. 2).

Focusing on the results reported in Table 5, we find that $\hat{\beta}_{RMB}$ varies considerably across the six sub-periods. $\hat{\beta}_{RMB}$ is not significantly different from zero in two occasions. First, $\hat{\beta}_{RMB}$ is not significant during the post-GFC stabilization period (Period 2), as one would expect. Less intuitive is the lack of significance over the 2%-band period (Period 5). A possible explanation is that, despite the widening of the band over this time span, the RMB displays very low volatility as the

USD tended to appreciate globally, and global and regional volatility increased. $\hat{\beta}_{RMB}$ is higher between June 2010 and March 2014 (Period 3 and Period 4), a phase of rapid increase in the use of the currency within the region and in the post-fixing reform period (Period 6), when the volatility of the Chinese currency increased considerably and the RMB tended to depreciate against the USD. In contrast, $\hat{\beta}_{GD}$ and $\hat{\beta}_{REG}$ remained highly significant and fairly stable in magnitude across the various sample periods.

Table 4 Co-movements with GD and REG

	All sample	Early reform	Post-GFC stabilization	0.5% band	1% band	2% band	Post-fixing reform
	P1-P6	P1	P2	P3	P4	P5	P6
GD	0.291**	0.279**	0.313**	0.259**	0.286**	0.257**	0.335**
	[0.077]	*[0.087]*	*[0.08]*	*[0.064]*	*[0.065]*	*[0.080]*	*[0.090]*
REG	0.209***	0.225***	0.148***	0.232*	0.212**	0.202***	0.267**
	[0.035]	*[0.036]*	*[0.031]*	*[0.074]*	*[0.052]*	*[0.037]*	*[0.070]*
SOVX	0.007**	0.014**	0.004*	0.006**	0.014***	0.005	0.013**
	[0.002]	*[0.004]*	*[0.002]*	*[0.002]*	*[0.003]*	*[0.003]*	*[0.003]*
GSCI	-0.024	0.005	-0.031	-0.051*	-0.018*	-0.016	-0.01
	[0.011]	*[0.006]*	*[0.018]*	*[0.017]*	*[0.006]*	*[0.010]*	*[0.005]*
VIX	0.010**	0.004	0.021*	0.010*	0.002	0.004**	0.012**
	[0.003]	*[0.003]*	*[0.008]*	*[0.004]*	*[0.002]*	*[0.001]*	*[0.003]*
REPO	0.002	-0.02	-0.045	-0.022*	0.073***	0.024	0.113
	[0.008]	*[0.015]*	*[0.099]*	*[0.008]*	*[0.015]*	*[0.020]*	*[0.118]*
N	16390	4180	2695	2607	2750	2013	2134
Adj. R^2	0.249	0.152	0.270	0.350	0.197	0.188	0.368
RSS	0.7730	0.1617	0.2953	0.0913	0.0810	0.0515	0.0773

Note: * p<0.05; ** p<0.01; *** p<0.001. Fixed-effect estimator; cluster-robust standard errors reported in parentheses.

As mentioned, the instability of $\hat{\beta}_{RMB}$ may reflect an asymmetric degree of flexibility of Asian currencies depending on the type of pressure they face. Indeed, a number of works in recent years have found evidence indicating asymmetric behavior of many East Asian currencies, whereby depreciation is largely permitted, while there is a tendency to counter appreciation with exchange-rate interventions (Ho et al., 2005; Pontines and Siregar, 2012; Rajan, 2012).

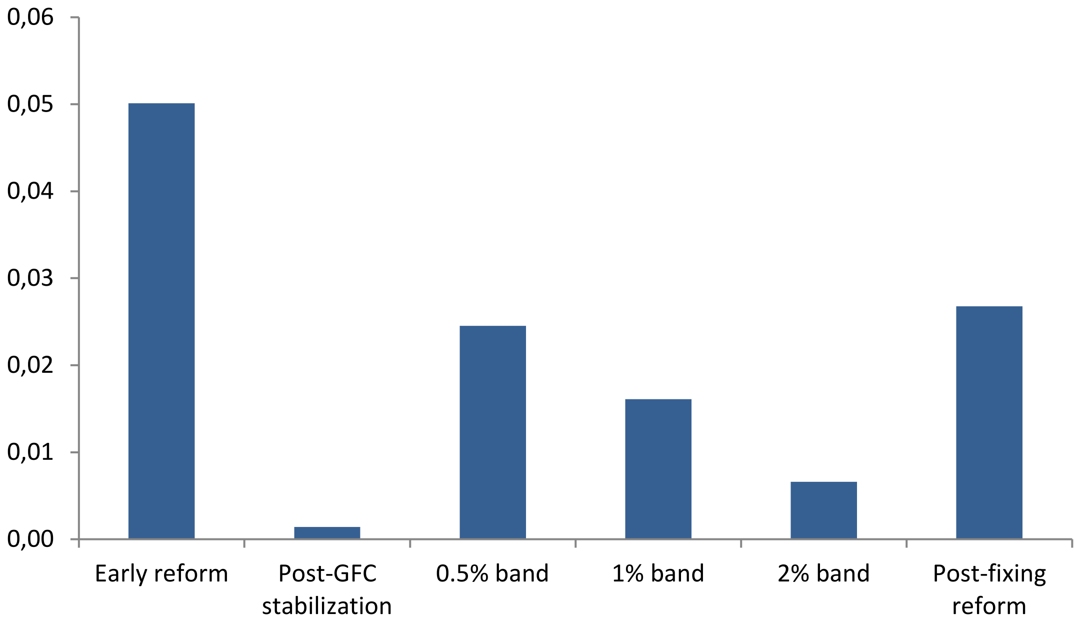
To clarify the degree of co-movements of AP currencies with the RMB during different phases of USD global movements, we divide the sample period according to appreciation and depreciation phases of the USD against other major international currencies (Table 6). Phases are identified by a simple visual inspection of the GD variable, and details are reported in the appendix. A clear pattern emerges. When the USD depreciates globally (and AP currencies face appreciating pressure), or when it is stable, AP currencies co-move more with both REG and RMB. However, when the USD appreciates globally, indicating depreciating pressure on AP currencies, daily returns co-move more with GD slightly less with REG, and show no correlation with RMB. This asymmetry suggests that the stronger the appreciation pressure within the region, the more important it is to co-move with the RMB to maintain relative competitiveness. On the other hand, faced with depreciation pressure, authorities tend to let their currencies move freely. Chinese authorities, in contrast, seem inclined to attempt containment of both types of pressures.

Table 5 Co-movements with GD REG and RMB

	All sample	Early reform	Post-GFC stabilization	0.5% band	1% band	2% band	Post-fixing reform
	P1-P6	P1	P2	P3	P4	P5	P6
GD	0.280**	0.267*	0.315**	0.244**	0.278**	0.257**	0.307**
	[0.078]	*[0.087]*	*[0.084]*	*[0.065]*	*[0.064]*	*[0.080]*	*[0.088]*
REG	0.198***	0.218***	0.149**	0.219*	0.205**	0.198***	0.234**
	[0.034]	*[0.036]*	*[0.032]*	*[0.073]*	*[0.052]*	*[0.040]*	*[0.070]*
RMB	0.254**	0.227***	-0.147	0.253***	0.276**	0.049	0.263***
	[0.057]	*[0.046]*	*[0.354]*	*[0.043]*	*[0.075]*	*[0.110]*	*[0.042]*
SOVX	0.007**	0.014**	0.004*	0.006**	0.013**	0.005	0.013**
	[0.002]	*[0.004]*	*[0.002]*	*[0.002]*	*[0.003]*	*[0.003]*	*[0.003]*
GSCI	-0.022	0.005	-0.032	-0.049*	-0.018*	-0.015	-0.004
	[0.011]	*[0.006]*	*[0.020]*	*[0.017]*	*[0.006]*	*[0.010]*	*[0.006]*
VIX	0.010**	0.004	0.021*	0.011*	0.002	0.004**	0.011**
	[0.003]	*[0.003]*	*[0.008]*	*[0.004]*	*[0.002]*	*[0.001]*	*[0.003]*
REPO	-0.001	-0.021	-0.045	-0.023*	0.068**	0.018	0.05
	[0.008]	*[0.015]*	*[0.099]*	*[0.008]*	*[0.015]*	*[0.030]*	*[0.117]*
N	16390	4180	2695	2607	2750	2013	2134
Adj. R^2	0.252	0.155	0.270	0.353	0.199	0.188	0.378
RSS	0.7695	0.1611	0.2952	0.0908	0.0807	0.0515	0.0760
Testing the hypothesis $\hat{\beta}_{RMB} = 0$							
F-stat (1,N-18)	*75.74*	*15.71*	*0.47*	*13.51*	*8.19*	*0.54*	*36.04*
Prob>F	*0.0000*	*0.0001*	*0.4925*	*0.0002*	*0.0042*	*0.4718*	*0.0000*

Note: * p<0.05; ** p<0.01; *** p<0.001. Fixed-effect estimator; cluster-robust standard errors reported in parentheses. F-stat is obtained from the residual sum of squares (RSS) of the restricted regression that excludes the RMB (Table 4) and the RSS of the unrestricted regression that contains the RMB factor (Table 5).

Figure 2 RMB/US$: coefficient of variation across reform periods.



Source: Thomson Reuters Datastream and author's calculations.

Table 6 Fixed-effects panel regressions based on USD phases of appreciation/depreciation

	USD depreciation (1)	USD appreciation (2)	USD stability (3)
GD	0.290**	0.306**	0.256**
	[0.088]	*[0.073]*	*[0.072]*
REG	0.186***	0.184*	0.235***
	[0.026]	*[0.058]*	*[0.039]*
RMB	0.279***	0.115	0.331***
	[0.060]	*[0.097]*	*[0.056]*
SOVX	0.009**	0.003	0.009**
	[0.003]	*[0.002]*	*[0.002]*
GSCI	-0.014	-0.04	-0.009
	[0.009]	*[0.018]*	*[0.007]*
VIX	0.008	0.012**	0.008**
	[0.004]	*[0.004]*	*[0.002]*
REPO	-0.001	0.021	-0.031
	[0.007]	*[0.041]*	*[0.015]*
N	7271	4411	4675
Adj. R^2	0.240	0.242	0.290

Note: * p<0.05; ** p<0.01; *** p<0.001. Cluster-robust standard errors reported in parentheses. USD depreciation, appreciation and stability periods are reported in Table A2.

4.1 Robustness checks

This section provides additional checks. A first check is to evaluate the degree of endogeneity of the RMB factor by regressing RMB/USD on GD and REG,[8] including all the controls considered in equation (2). We run the regression on the full sample period, as well as on the sample period starting from the return to flexibility after the GFC (Periods 3–6). The results reported in Table 7 show that both GD and REG exerted a mild effect on RMB/USD daily returns over the full sample period. After 21 June 2010, however, REG exerts a stronger impact. The very low levels of the adjusted R-squared indicate that the model has low explanatory power for the RMB/USD exchange rate.

Running a Granger-causality test, we cannot reject the null hypothesis that regional exchange rates (summarized by REG) do not Granger-cause RMB, but we do find evidence that RMB Granger-causes REG. Both RMB and REG are found to be endogenous to GD as expected (results available on request).

Table 7 OLS regressions for RMB/USD exchange rate

$$\Delta \log\left(\frac{RMB}{USD_t}\right) = \beta_{GD}\Delta\log(GD_t) + \beta_{REG}\Delta\log(REG_{RMBt}) + \gamma_1\Delta\log(GSCI_t) + \gamma_2\Delta SOVX_t + \gamma_3\Delta\log(VIX_t) + \delta_1\Delta REPO_t + \epsilon_{it}$$

	Full sample period *05/09/2005-31/01/2017*	Post-GFC stabilization period *21/06/2010-31/01/2017*
GD	0.040***	0.036
	[0.011]	*[0.019]*
REG	0.044***	0.108***
	[0.011]	*[0.026]*
SOVX	0.00	-0.001
	[0.000]	*[0.001]*
GSCI	-0.007*	-0.012*
	[0.003]	*[0.005]*
VIX	0.000	0.000
	[0.001]	*[0.001]*
REPO	0.012	0.016
	[0.011]	*[0.016]*
N	1490	864
Adj. R^2	0.075	0.126

* p<0.05; ** p<0.01; *** p<0.001. Heteroskedasticity robust standard errors are reported in parentheses.

[8] In the RMB regressions, REG is a trade-weighted average of all eleven AP currencies.

Our second check consists in estimating equation (2) using monthly, instead of bi-daily, data. It is widely accepted that Asian currencies remain heavily managed, both against the USD and against a basket of currencies (Rajan, 2012). The reaction function of policymakers can have lags that may be difficult to capture at high frequencies, so lower frequency data may better reflect the influence stemming from our three factors: GD, REG and RMB.

Table 8 Fixed-effect panel regressions on monthly data

	Full sample (1)	Post-GFC stabilization period (2)	Full sample period excluding HKD, AUD and NZD (3)	Post-GFC stabilization period excluding HKD, AUD and NZD (4)	USD appreciation (5)
GD	0.335**	0.272**	0.294**	0.227**	0.348**
	[0.077]	*[0.071]*	*[0.068]*	*[0.060]*	*[0.089]*
REG	0.240***	0.249*	0.213***	0.196*	0.263***
	[0.040]	*[0.084]*	*[0.024]*	*[0.077]*	*[0.041]*
RMB	0.191*	0.234*	0.266*	0.330**	0.081
	[0.073]	*[0.075]*	*[0.082]*	*[0.076]*	*[0.108]*
SOVX	0.010**	0.019***	0.011*	0.021***	0.008*
	[0.003]	*[0.004]*	*[0.004]*	*[0.004]*	*[0.003]*
GSCI	0.004	0.023	0.021	0.034*	0.001
	[0.013]	*[0.013]*	*[0.010]*	*[0.014]*	*[0.016]*
VIX	0.007*	0.005	0.005	0.002	0.004
	[0.003]	*[0.003]*	*[0.003]*	*[0.003]*	*[0.006]*
REPO	0.005	0.079	0.035	0.135*	0.116
	[0.048]	*[0.049]*	*[0.059]*	*[0.055]*	*[0.123]*
N	1507	869	1096	632	495
Adj. R^2	0.416	0.419	0.411	0.405	0.452

* p<0.05; ** p<0.01; *** p<0.001. Cluster-robust standard error.
All regressions include a constant term. The full sample period is 09/2005–01/2017. The Post-GFC stabilization period is 07/2010–01/2017. USD appreciation periods are reported in Table A2.

Results reported in Table 8 show the estimated coefficients based on monthly data. The first regression is based on the full sample starting on September 2005. The second regression is based on observations from June 2010 to January 2017 (return to flexibility after the GFC). The third and fourth regressions consider the two sample periods excluding the free-floating AUD and NZD, as well as the HKD, which is tightly pegged to the USD. The fifth regression restricts the sample period to the appreciation phases of the USD. The results are quite similar to those based on daily data. In particular, the influence of the RMB grows larger as the RMB becomes more flexible, this tendency is reinforced if we exclude AUD, NZD and HKD. We confirm an asymmetric correlation of Asian currencies with the RMB: the correlation is stronger when the currencies face appreciation pressure (USD depreciation), and vanish when Asian currencies face depreciation pressure (USD appreciation; column 5).

Finally, using monthly data to regress RMB/USD on GD and REG (including all the other controls) does not deliver any meaningful result, indicating that the feedback influence at lower frequencies is not yet visible from global currencies or AP currencies on RMB changes against the USD (unreported results available on request).

5 Conclusions

By considering the evolution of exchange rate co-movements, this study looked at whether the RMB exchange rate against the USD has come to exert an influence on Asia-Pacific currencies. Considering global and regional factors, regional currencies were found to be increasingly co-moving with the RMB against the USD on average since the 2005 exchange rate reform in China, even if global and regional factors other than the RMB exchange rate were still predominant. The intensity of the co-movements of regional currencies with the RMB are asymmetric, becoming stronger when currencies face appreciation pressure against the USD and fading during depreciation phases. This suggests that the stronger the appreciation pressure within the region, the more important policymakers see the need for their currency to co-move with the RMB to maintain relative competitiveness. On the other hand, faced with depreciation pressure, AP currencies tend to move more freely. This contrasts with the Chinese approach, where the authorities are inclined to attempt containment of both appreciating and depreciating pressures.

The economic and political influence of China in the Asia-Pacific region has grown considerably in recent years, particularly since the 2008–2009 global financial crisis. Our evidence suggests that the internationalization of the Chinese currency has the potential to further increase the regional influence of the RMB to make it the dominant currency, especially if the RMB progresses along the path to becoming a fully market-determined exchange rate.

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Appendix A

Table A1 Description of variables

Variable	Description	Additional information
$\frac{E_{it}}{USD_t}$	*i-th* currency to US dollar exchange rate	i = Australian dollar, Hong Kong dollar, Indian rupiah, Indonesian rupee, Korean won, Malaysian ringgit, New Zealand dollar, Philippines peso, Singaporean dollar, Thailand dollar and Taiwan dollar
$\frac{RMB_t}{USD_t} = \frac{CNY_t}{USD_t}$	onshore Chinese RMB to US dollar exchange rate	
GSCIt	S&P GSCI Commodity Total Return	
SOVXt	JPM EMBI GLOBAL	composite – stripped spread
REPOt	CHINA REPO 1 WEEK	middle rate
VIX	Volatility index	Chicago Board Options Exchange Volatility Index
REGit	Trade-weighted dollar exchange rate index against a basket of AP currencies	$REG_{it} = \sum_{s \neq i} e_{st} * w_s^i$; $i \in AP; s \in AP$ $\sum_{s \neq i} w_s^i = 1$. An increase indicates a dollar appreciation with respect to the basket of AP currencies considered (excluding JPY and RMB).
GDt	Trade-weighted US dollar exchange rate index against a basket of six major global currencies (provided by the Board of Governors of the Federal Reserve System).	Trade-weighted US dollar exchange rate with respect to the Canadian dollar, euro, Japanese yen, Swedish krona, Swiss franc and UK pound. An increase indicates a dollar appreciation against the basket of six major currencies.

Note: All data are retrieved from *Thomson Reuters Datastream* at daily frequencies.

Table A2 Dollar appreciation and depreciation phases

Phase	Dates
Appreciation	17/07/08-21/11/08; 18/12/08-03/03/09; 26/11/09-04/06/10; 27/08/11-24/07/12; 26/06/14-17/03/15; 30/09/16-31/01/2017
Depreciation	10/03/06-18/04/08; 22/11/08-17/12/08; 04/03/09-25/11/09; 05/06/10-29/04/11; 25/07/12-19/09/12;
Stability	05/09/05-09/03/06; 19/04/08-16/07/08; 30/04/11-26/08/11; 20/09/12-25/06/2014; 18/03/15-29/09/16

Note: The phases are detected from daily movements of the trade-weighted USD index against six currencies.

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