China policy spillovers in August 2015: an RMB bloc?

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Abstract: This study combines daily and heretofore unstudied deal-by-deal foreign exchange trade data to assess the impact of the change in the renminbi fixing mechanism in August 2015. We find that this policy shock in China exerted strong high frequency effects on the volume and pricing of other emerging market currencies in Asia and less so elsewhere in the event week. We also find that this policy change saw a step up in the measured co-movement of the renminbi, particularly the onshore rate, with emerging market currencies in the 18 months since. A less variable renminbi than dollar vis-à-vis domestic currencies would make investment and borrowing in the renminbi more attractive. This, along with continued improvements in, and non-resident access to, the Chinese bond market, would favour renewed progress in renminbi internationalisation after recent set-backs.

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Introduction

A three or four percent depreciation of an emerging market currency against the US dollar in a week in countries like Brazil, Russia, South Africa or Turkey would not make global waves. However, for the Chinese renminbi, the depreciation associated with the reform of the official fixing mechanism in early August 2015 stands out as the largest since the renminibi's official rate was unified in early 1994. And it made waves in global currency markets and beyond.

This extreme move by renminbi standards, dubbed "8.11" in China, is worth study because of the light it can shed on the question of the influence that China's currency exerts on other currencies. The renminbi's depreciation in August 2015 resulted from market participants' efforts to anticipate the outcome of a reform of the official currency management that was explicity intended to put more weight on market forces. It was accompanied by two explanatory press releases on Tuesday 11 August and Wednesday 12 August from the central bank and a long press conference including the People's Bank of China (PBoC) Deputy Governor on Thursday 13 August. It is a stretch to ascribe observed co-movement between the renminbi and other currencies during this episode to both currencies responding to a common third factor.[2] The changes to the management of the renminbi, which we show loosened the linkage of the renminbi to the dollar, also motivates our using August 2015 as a break in estimating the influence of the renminbi on emerging market currencies.

We analyse this event with not only the usual daily foreign exchange rates but also two kinds of higher frequency data. We have intraday data for selected domestic and international foreign exchange markets from Reuters. And we have transactions data derived from the Depository Trust Clearing Corporation (DTCC) on non-deliverable forwards (NDFs) traded in a dozen currencies. This is an important emerging market instrument that trades mostly offshore and settles in dollars; we aggregate time-stamped trade records containing both prices and amounts. These enable us to track, in this corner of the foreign exchange market at least, the actual behaviour of market participants, to supplement the usual analysis of posted prices.

Quite a few studies have addressed the question of the effect of the renminbi on other currencies. Findings range from a very limited effect of the renminbi on other currencies (Balsubramanian et al (2011); Chow (2011)) to a discernable but modest effect (Ho, Ma and McCauley (2005), using CNY NDFs; Shu, Chow and Chan (2007); Chen, Peng and Shu (2009); Fratzscher and Mehl (2011); Fang, Huang and Niu (2012); Shu (2010); Chen, Siregar and Yiu (2013); Shu, He and Cheng (2014 , 2015); Kawai and Pontines (2016)) to the finding of a renminbi bloc (Subramanian and Kessler (2012); Henning (2012)); Ito (2016).

Our paper is closest in motivation, scope and time period to that of Ito (2016). Our focus on the August 2015 reform, and more generally our emphasis on the management of the renminbi effective exchange rate rather than the bilateral dollar rate, allows us to identify an important shift. August 2015 marked a change in both

[2] Also worth study are the squeezes in the offshore renminbi market, for example, episodes in September 2015, January 2016 and January 2017 that brought the offshore renminbi exchange rate (CNH) into line with the onshore rate (CNY). Some of these were associated with sharp movements in the renminbi markets, particularly in the offshore markets for the CNH and NDF. However, while widely interpreted as the results of policies to drain offshore liquidity, these episodes are not as clearly identified as mid-August 2015.

the relationship of both the renminbi and the dollar and the relationship between the renminbi and emerging market currencies.

We find that the change in the management of the renminbi's exchange rate in August 2015 exerted strong high frequency effects on the volume and pricing of other emerging market currencies in Asia and less so elsewhere. Previously unused transaction level data on offshore trading allow us to to measure volume effects. The Chinese policy change also marked a step up in the measured partial effect of the renminbi on emerging market currencies in daily data in the 18 months since August 2015. Onshore renminbi rates gained more in influence compared to offshore rates as market participants seemed to put more weight on contemporaneous policy signals by the Chinese authorities.

In the rest of this paper, we first give a bird's eye view of the recent management of the renminbi, framing the August 2015 move as a response to the rise of the effective exchange rate given the sharp appreciation of the dollar in late 2014. Then we describe the NDF data. Then we go through the time line of events during 10-14 August 2015 and trace the effects on the renminbi. Then, we marshal high frequency volume and price data and daily data to measure the event week spillovers to other emerging market currencies. Then we use daily data to show that August 2015 saw a step up in the co-movement of the renminbi and emerging market currencies over the months to February 2017. We draw implications for renminbi internationalisation and conclude.

Background to fixing reform: the market and the dollar

The reform of the fixing announced on 11 August 2015 had two facets. First, the daily fixing would put greater weight on market forces by taking the previous day's closing rate in Shanghai as the starting point. And the fixing was to deviate from this closing rate in the direction that would stabilise the renminbi against its basket of partner currencies. In other words, if the dollar rose overnight against the euro, yen and other currencies, the parity would be fixed somewhat weaker (ie a higher CNY/$ rate); if the dollar fell then the parity would be fixed somewhat stronger against the dollar.

The PBoC had in recent years publicly stated a goal of gradually moving to greater reliance on market forces in the management of the renminbi. Market participants interpreted the ongoing negotiations over the entry of the renminbi into the IMF's currency basket, the Special Drawing Right (SDR), as a possible influence on the timing of reform. The "Review of the method of valuation of the SDR—initial considerations", published 3 August 2015, highlighted that the fixing could differ from the market rate by up to 2%.[3] On 22 July 2015 the IMF Board discussed an Article IV staff report that argued that the management of the renminbi would benefit from more responsiveness to market forces.[4]

[3] However, for the operational question at hand, namely a rate for the dollar/renminbi, the staff report noted the technical availability of market-based benchmarks published by the authorities, such as the 3pm CFETS benchmark rate, that could serve the need of converting dollars into renminbi.

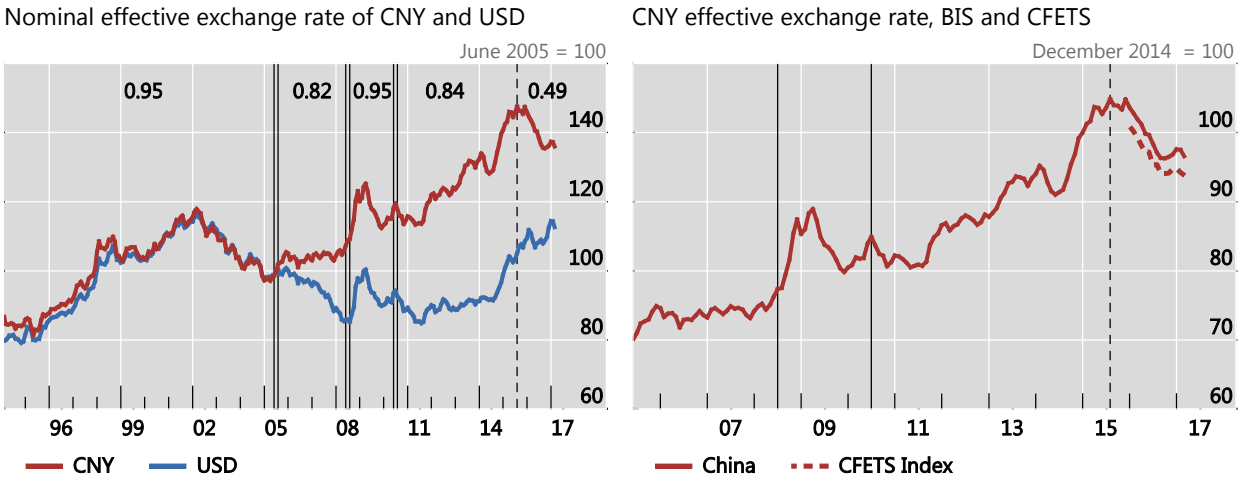
[4] On 14 August the published report featured a graph that showed that today's fixing was closely related to yesterday's fixing but unrelated to yesterday's fixing.

The linkage of the daily fixing to daily movement of the dollar can be understood against the background of evolution of the effective exchange rate of the renminbi since 2005. After years of a virtual peg against the US dollar, the currency was de-pegged in July of 2005, only to be in effect repegged for two years and two months at the outbreak of global financial instability in the spring of 2008. Though the People's Bank of China and the SAFE often referred to a basket of currencies as a reference for the renminbi' management, most analysts interpreted this as lip service to multilateralism and the renminbi's movements as no more than a crawling peg against the dollar. After all, the official daily fixing was stated in dollar terms and the daily trading band was defined as first 0.5%, then 1% and then 2% from this fixing. More formally, this interpretation rested on the Frankel-Wei regression based on daily, or sometimes higher frequency, data, which was unable to pick up much response to movements in the dollar against the euro, yen or other currencies.[5]

A minority view read the same evidence as supporting the reference to a basket of currencies, albeit at a frequency so low as almost to defy measurement. While daily movements of the renminbi against the dollar were limited, the influence of the euro became discernible at frequencies of weeks and months. If the renminbi initially followed the dollar in a sustained move against major currencies, its subsequent moves against the dollar tended to return it to an up-trend against its own trade-weighted basket (Graph 1, left-hand panel).

The nominal effective exchange rate of the renminbi

Breaking free of the US dollar? Graph 1



Note: Numbers in left-hand panel graph indicate correlation of monthly changes in the two nominal effective rates in the sub periods, 1999-June 2015, July 2005-June 2008, July 2008-June 2010, July 2010-July 2015, and August 2015-February 2017..

Source: CFETS; BIS.

One piece of evidence supporting the reference to the renminbi's basket is the decline of the correlation between the effective exchange rate of the renminbi and that of the dollar. During periods of de facto pegs of the renminbi to the dollar, from 1998 to June 2005 and between July 2008 and June 2010, the correlation of monthly percentage changes was near one, at .95. It fell to .82 in July 2005-June 2008 and .84

[5] References here.

in July 2010 through July 2015. A simple crawl against the dollar could have left this correlation unaffected.

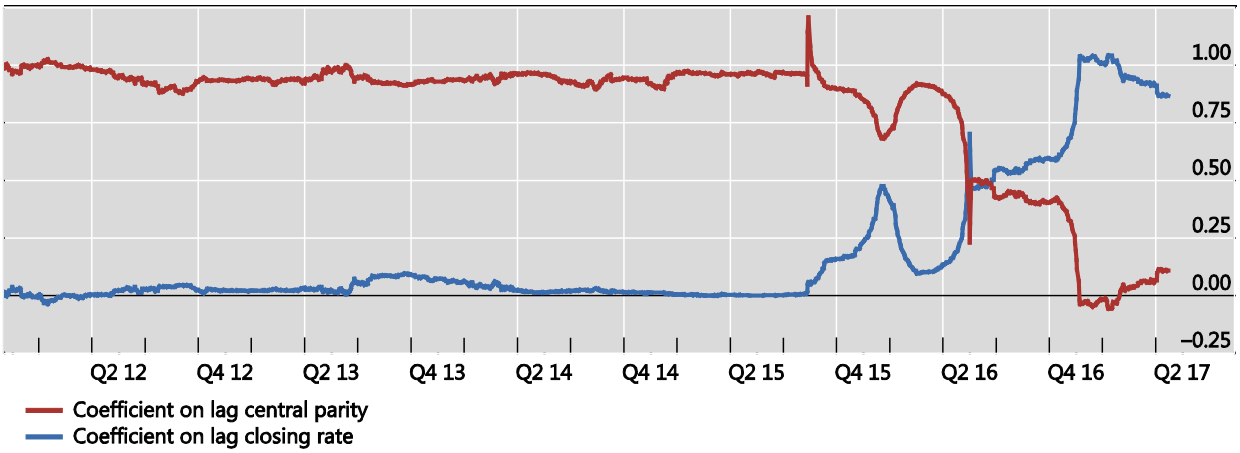
The surge of the dollar from the summer of 2014 into 2015, however, was associated with a rise in the effective renminbi of over 10% in a matter of months. Beyond the long-standing constraints on adjusting the bilateral rate, the Chinese corporate sector had built up in excess of $1 trillion in dollar debt (McCauley et al (2015)). Rapid net repayment of such debt might have implied a rapid decline in foreign exchange reserves, which had peaked along with the renminbi/dollar rate in early 2014. In any case, the renminbi's stability against the dollar destabilised the effective renminbi.

The peak of the effective renminbi in the summer of 2015 provides a generally overlooked perspective on the content and timing of the 11 August reform of the renminbi fixing. As noted, many interpretations put weight on publicly disclosed IMF staff views in the context of ongoing discussions to add the renminbi to the SDR. But these interpretations overlook that the reform of the fixing mechanism involved not only a stronger linkage to the market exchange rates but also an immediate linkage to the dollar's movements against major currencies.

Indeed, the evidence since August 2015 is consistent with both an increase in the role of market forces in the fixing and reduced linkage to the US dollar's exchange rate. Graph 2 updates the graph that the IMF (2015b) used to argue that the fixing lacked a linkage to market forces. It shows the result of a 200-day rolling regression of today's fixing on yesterday's fixing and yesterday's closing rate in Shanghai. Before August 2015, the fixing put zero weight on the previous day's close. With the reform, the weight on yesterday's close rose unevenly to a level near one by the fourth quarter of 2016. On this measure, introduced ex ante, the fixing since August 2015 incorporates market outcomes as it did before August 2015.[6]

Role of yesterday's closing CNY rate in today's fixing rose post-August 2015

Estimated regression coefficient over 200-day rolling window — Graph 2



Note: Coefficients estimated from log fixing (t) = a * log fixing (t-1) + b * log closing rate (t-1) + c over 200-day rolling window

Sources: Update of IMF (2015b) using Bloomberg; BIS calculations.

[6] That said, the extent of foreign exchange intervention that censors the deviation of the close form the fixing qualifies the sense of greater reliance on market forces in the fixing.

The August 2015 reform has also measurably reduced the linkage of the renminbi and US dollar effective exchange rates. In particular the correlation of monthly changes in the two effective exchange rates fell from .84 in July 2010 through July 2015 to just .48 in August 2015 through February 2017. Moreover, as shown in Graph 1, right-hand panel, the renminbi's effective exchange rate has fallen back from its peak in the summer of 2015 toward the trend over the period since July 2005.[7]

In sum, the August 2015 reform of the renminbi fixing mechanism took a step toward both more reliance on market forces and a tighter management of the effective exchange rate. As we turn the spotlight from the strategic background of policy change to the market reaction to it, it bears emphasis that market participants' immediate interpretation of the policy was all over the lot.[8]

Background: NDFs in the foreign exchange market

For our data we rely on three kinds of data of ascending difficulty and rarity. First we have gathered daily data on exchange rates from Bloomberg, choosing London afternoon at 4pm [CHECK], the time of heaviest trading (see below). Second, we have obtained intraday data on exchange rates from Reuters. And third, we have trade level data on non-deliverable forwards (NDFs), which we have aggregated into intraday data. NDFs are essentially side bets ("contracts for difference") on a currency; one side pays the other side at maturity for the difference between the agreed rate and the actual rate, typically a closing rate in the domestic market (but, atypically, the fixing for the CNY).

As other researchers have found using trade repository data, volumes seem reasonably plausible, but prices can seem anomalous (see Brazilian real NDFs below). This is so even when we infer pricing from the ratio of the two amounts of currencies traded on a forward basis against each other.

That said, McCauley and Shu (2016) show that the NDF is quite a representative foreign exchange instrument for at least the major emerging market currencies covered by the BIS Triennial Survey for foreign exchange markets, namely the Korean won, the Taiwan dollar, the Indian rupee and the Brazilian real. In Graph 3, the sand-coloured portion of the right-hand bar for these four currencies bulks large in offshore trading, which itself represents most of trading in most currencies. The process of internationalisation of the renminbi and the longer-standing liberalisation of the rouble, by contrast, have tended to marginalise the CNY and RUB NDFs over time, and these represent small shares of the offshore trading.

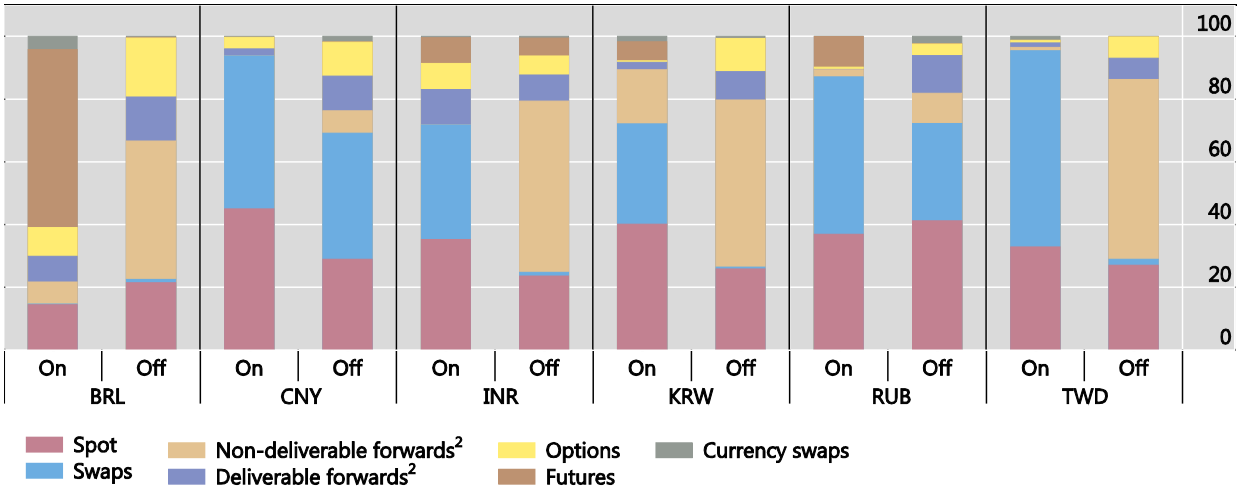
[7] The staff in IMF (2015b) assessed the renminbi's exchange rate level to have been not far from its prediction based on slowly evolving demographic, fiscal and other variables.

[8] In particular, understanding of the linkage of the fixing to the dollar's exchange rate remained uneven well into 2016. Even after the disclosure of the CFETS basket in December 2015, views differed widely. However, after clarification by Governor Zhou of the PBoC in Caixin in early 2016, market participants found themselves able to predict with general accuracy the daily fixing. Market participants' turned their attention away, despite the subsequent decline of the renminbi as measured by the BIS or CFETS index..

NDF trading offshore[1] big for Brazilian real, Indian rupee, Korean won, Taiwan $

In per cent

Graph 3



On = onshore; Off = offshore.

[1] Onshore is defined as all trades executed in the jurisdiction where a currency is issued on a "net-gross" basis (ie adjusted for local inter-dealer double-counting). Offshore is calculated as the difference between total for the currency on a "net-net" basis (ie adjusted for local and cross-border inter-dealer double-counting) and onshore transactions. [2] NDF turnover is against the US dollar only (thus understating total NDFs by an average of 3%); deliverable forwards are outright forwards less US dollar NDFs and are correspondingly overstated.

Sources: Adapted from McCauley and Shu (2016) using Euromoney TRADEDATA; Futures Industry Association; The Options Clearing Corporation; BIS derivatives statistics and Triennial Central Bank Survey; authors' calculations.

While the NDF is for these four currencies quite representative, the selection process for trades to be publicly disclosed by the DTCC is that they involve US persons. This is a legal term that does not map neatly onto US residents, but by most descriptions such residents account for most of the traders whose transactions are lodged in DTCC and disclosed. A comparison with the 2016 Central Bank Triennial Survey shows that … a third for the Asian currencies and more like half for the Brazilian real and the Russian rouble.

Time line in August 2015 and effects on the renminbi

Tuesday, 11 August 2015: At 9:15 [?] the PBoC announced a 1.9% weaker fixing compared to the day before. At 9:26 it provided an explanation and background. The broad principle of the change in the fixing was to make it reflect the market close of the day before, along with some offset of the change in the renminbi's exchange rate arising from US dollar appreciation or depreciation over the previous day. During the course of Shanghai trading, the CNY depreciated close to but not through the weak upper end of the 2% band (Graph 4, left-hand panel).

Some market participants initially drew the inference that the CNY could depreciate by double-digit percentages in a matter of weeks, even if the exchange rate were held within the 2% band every day. And few market participants had taken seriously the reference to a basket of currencies at that point, as discussed above.

Announcements timeline 11-17 August 2015 Table 1

Announcement time	Event	Link
11 August, Tuesday; Beijing time: 9.15 am (GMT 1.15 am)	CFETS fixing	10 Aug: http://www.chinamoney.com.cn/fe/static/html/column/basecurve/rmbparity/notice/2015-08-10/RMBParityNoticeSearchNoticeByDate2015-08-10.html 11 Aug: http://www.chinamoney.com.cn/fe/static/html/column/basecurve/rmbparity/notice/2015-08-11/RMBParityNoticeSearchNoticeByDate2015-08-11.html
Beijing time: 9:25 am (GMT 1.25 am)	Short document announcing changes: market makers make reference to previous closing, fx supply, changes in major currencies	http://www.pbc.gov.cn/goutongjiaoliu/113456/113469/2927054/index.html
Beijing time: 9:26 am (GMT 1.26 am)	Q&A; why depreciate so much; talked about extend trading hours	http://www.pbc.gov.cn/goutongjiaoliu/113456/113469/2927057/index.html
12 August, Wednesday; Beijing time: 9.15 am (GMT 1.15 am)	CFETS fixing	http://www.chinamoney.com.cn/fe/static/html/column/basecurve/rmbparity/notice/2015-08-12/RMBParityNoticeSearchNoticeByDate2015-08-12.html
Beijing time: 9:32 am (GMT 1.32 am)	Further Q&A: explain the mechanism; no fundamentals to support persistent depreciation	http://www.pbc.gov.cn/goutongjiaoliu/113456/113469/2927848/index.html
13 August Thursday; Beijing time: 9.15 am (GMT 1.15 am)	CFETS fixing	http://www.chinamoney.com.cn/fe/static/html/column/basecurve/rmbparity/notice/2015-08-13/RMBParityNoticeSearchNoticeByDate2015-08-13.html
Beijing time: meeting: 10:30-12:10; 12:57 (on internet) (GMT 2:30-4:10; 4:57 (on internet)	Press conference: Yi Gang and Zhang Xiao Hui emphasise no basis for persistent devaluation; suggest 3% overvaluation is largely corrected since reform; flexibility is good; explain mechanism: previous day close plus changes overnight	http://www.pbc.gov.cn/goutongjiaoliu/113456/113469/2927856/index.html
14 August Friday; Beijing time: 9.15 am (GMT 1.15 am)	CFETS fixing	http://www.chinamoney.com.cn/fe/static/html/column/basecurve/rmbparity/notice/2015-08-14/RMBParityNoticeSearchNoticeByDate2015-08-14.html
17 August Monday; Beijing time: 9.15 am (GMT 1.15 am)	CFETS fixing	http://www.chinamoney.com.cn/fe/static/html/column/basecurve/rmbparity/notice/2015-08-17/RMBParityNoticeSearchNoticeByDate2015-08-17.html

Sources: PBoC, authors.

Fears of depreciation showed up in the two offshore rates that were not subject to the management of the domestic rate. These are the offshore CNH, which has traded feely as a deliverable currency since 2010, and the one-month NDF. These both depreciated by more than the CNY, with the CNH continuing to depreciate in London and New York time (Graph 4, right-hand panel). The NDF swung from pointing to an appreciation of the renminbi to a depreciaiton

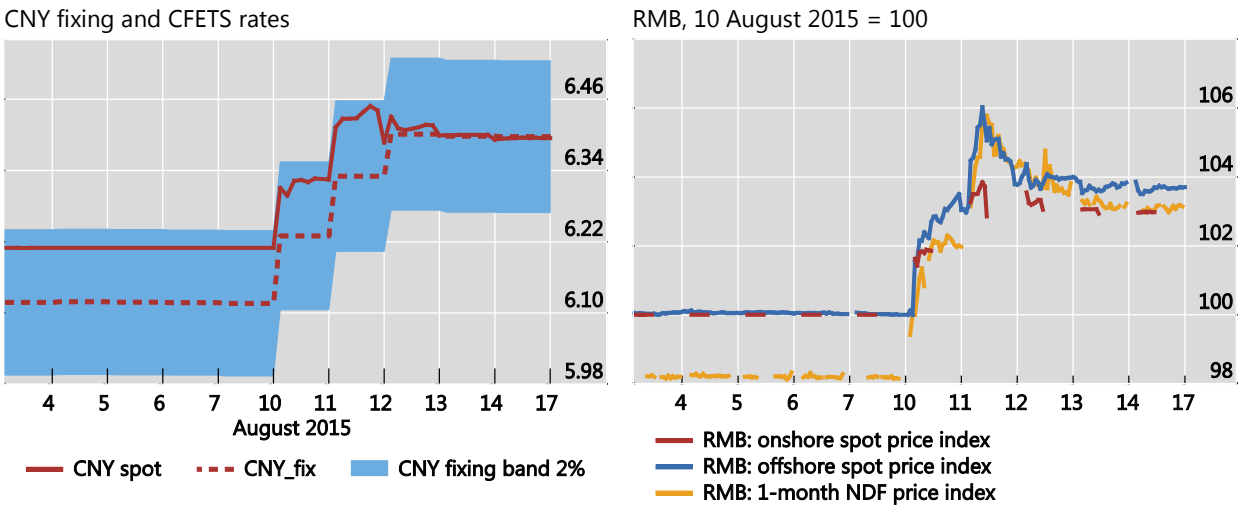
Wednesday, 12 August 2015: The PBoC at 9:30 announced a fixing 1.6% higher (weaker). In effect this put new fixing on the previous day's close. At 9:32 a Q&A on

the new fixing mechanism was released in Chinese; an English version was released at 10:32. Again the spot rapidly depreciated most of the way to the weak end of the 2% band. In the last hour of trading, there was a notable retracement that was widely interpreted as the result of official intervention.

On Thursday, 13 August. After the usual 9:15 fixing, a press conference started at 10:30 Beijing time and continued for an hour and 40 minutes. An important message was that there was no case for a double-digit depreciation of the renminbi.

On Friday 14 August and Monday 17 August, the change in the fixing was scant and the range of trading in the onshore renminbi was narrow.

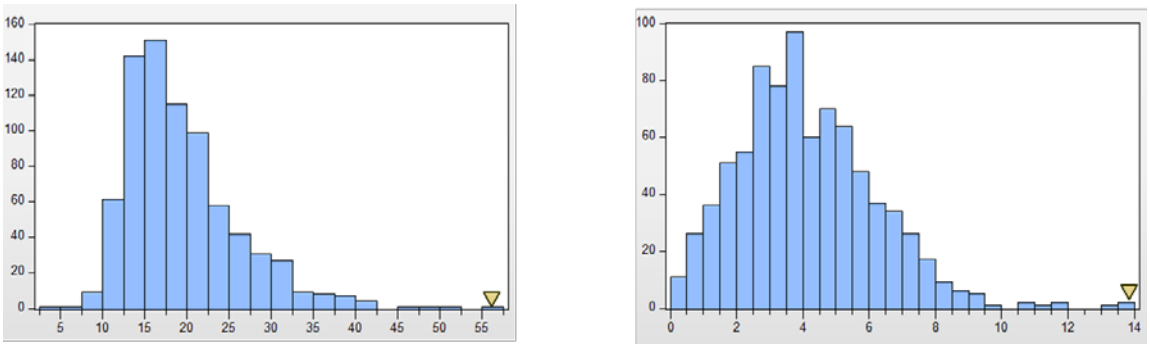
NDFs responses to RMB CNH and NDF prices moving more than onshore market — Graph 4



Sources: CFETS; Thomson Reuters; DTCC via Clarus.

These days resulted in tail events for the onshore CNY market and the offshore NDF markets in both price and volume terms. For the CNY markets, the two declines were the largest on record. Taking daily transactions volumes for the onshore and the offshore NDF market over the sample period January 2014 to February 2017, turnover above $55 billion in the domestic market and over $13 billion in the offshore NDF market both were at the maximum.

Graph 5: Distribution of daily turnover in RMB in domestic and NDF market

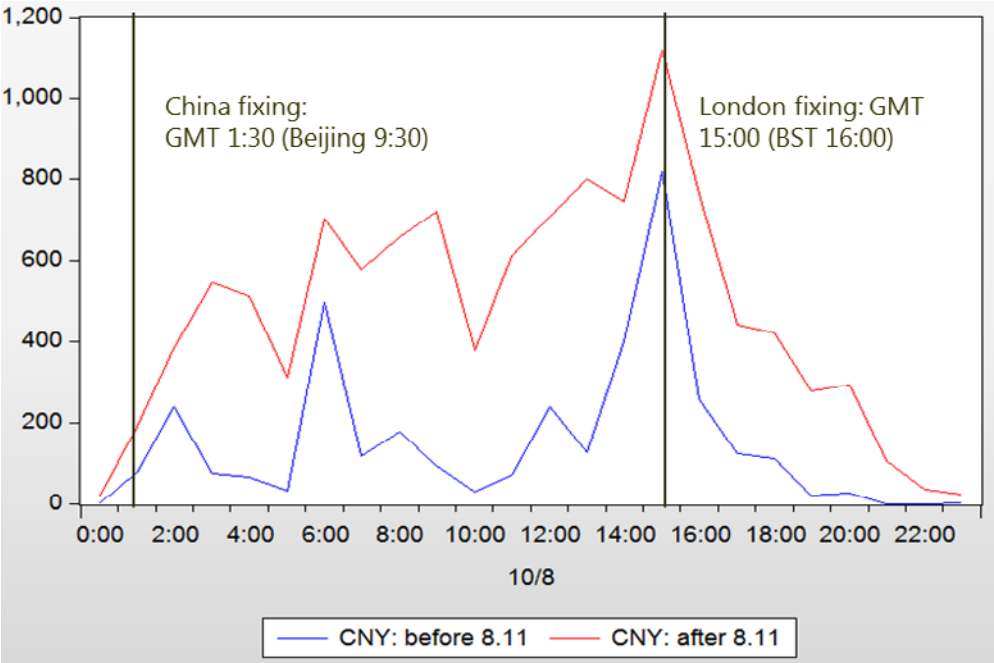


Sources: CFETS; Thomson Reuters; DTCC via Clarus; authors' calculations.

Examination of the turnover by hour of NDFs shows a huge response. Such turnover in the week before 11 August 2017 show two peaks, one during London time and the other during Shanghai time. This is consistent with the observation "All currencies exhibit sharp spikes in trading volume at certain times of the day, with the timing of some spikes common to all currencies and the timing of other spikes dependent on the specific currency[9] (FSB (2014, p ". The big spike just before 4:00 pm London time corresponds to the fix in London, a broadly used standard by both asset managers trying to match multicurrency benchmarks and corporations seeking a transparent and verifiable rate. Perhaps nonfinancial firms with renminbi cash flows to hedge (eg US technology firms) remained important NDF customers in August 2015. The other peak occurs between 2 and 3 pm Shanghai time.

With the surprising and newsworthy announcements early in the Shanghai day, trading shifted into Asian time and another peak appears after the fixing announcements. Trading also persists more into New York time. Our interpretation is that the news draws trading away from the normal "technical" profile that results from customer concentration of order flow on the London fix—though a spike is still visible at the London fix. Below we take this own effect as a standard for contagion. Similarly affected currencies pass our volume contagion test; those that differ fail.

Graph 6: Hourly CNY NDF trading in the week before and after 11 August 2015



Source: DTCC via Clarus; authors' calculations.

Response of EM currencies in the event week

In this section we show first the volume spillovers in NDFs at both the daily and hourly frequency. Then we examine intraday prices during the August 2015 episode. The

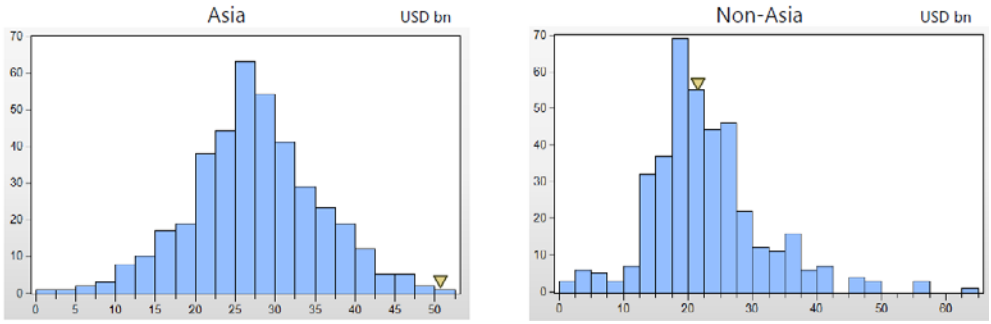
[9] For instance, the euro/dollar pair has another spike at the ECB fixing at 2:15 European time.

next section reports regression analysis of daily data showing a break in August 2015 in the co-movement of emerging market currencies and the renminbi.

Quantities

Like renminbi NDF trading Asian NDF trading reached a record level on 12 August. By contrast, in non-Asian NDFs, turnover was close to the median over the 26 month sample period. On this view, the

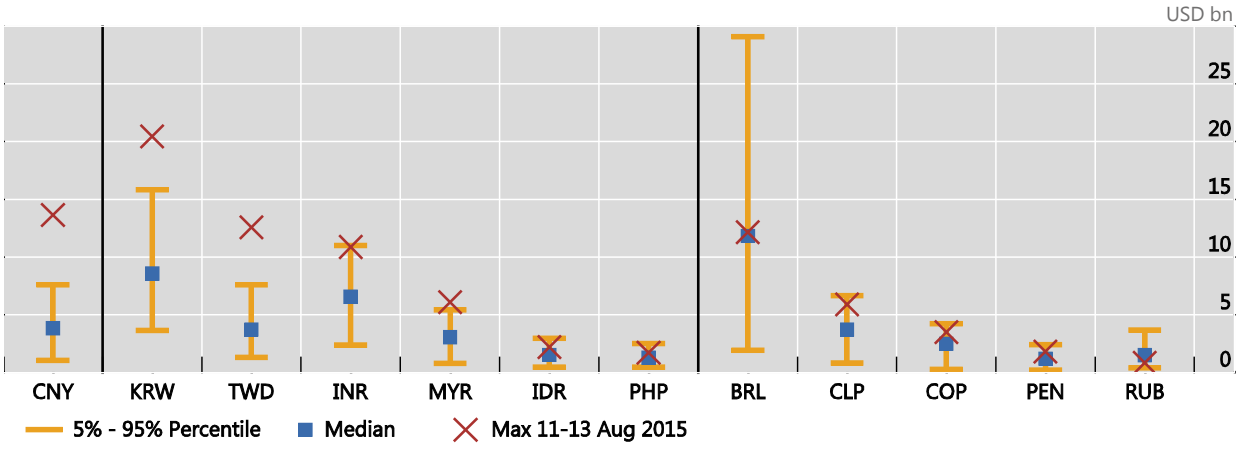
Graph 7: Distribution of daily turnover in NDFs, January 2014 to February 2017



Note: Arrow marks maximum in event week.
Source: DTCC via Clarus; authors' calculations.

Looking at individual currencies, it is clear that the maxima reached in 11-13 August were well in the top 5% for not just CNY, but also for KRW and TWD. MYR and INR traded at about the 5%. The PHP, IDR and all the non-Asian currency NDFs experienced more normal trading.

Daily trading of NDFs by currency: only some hit extremes in 11-13 August 2015 Graph 8

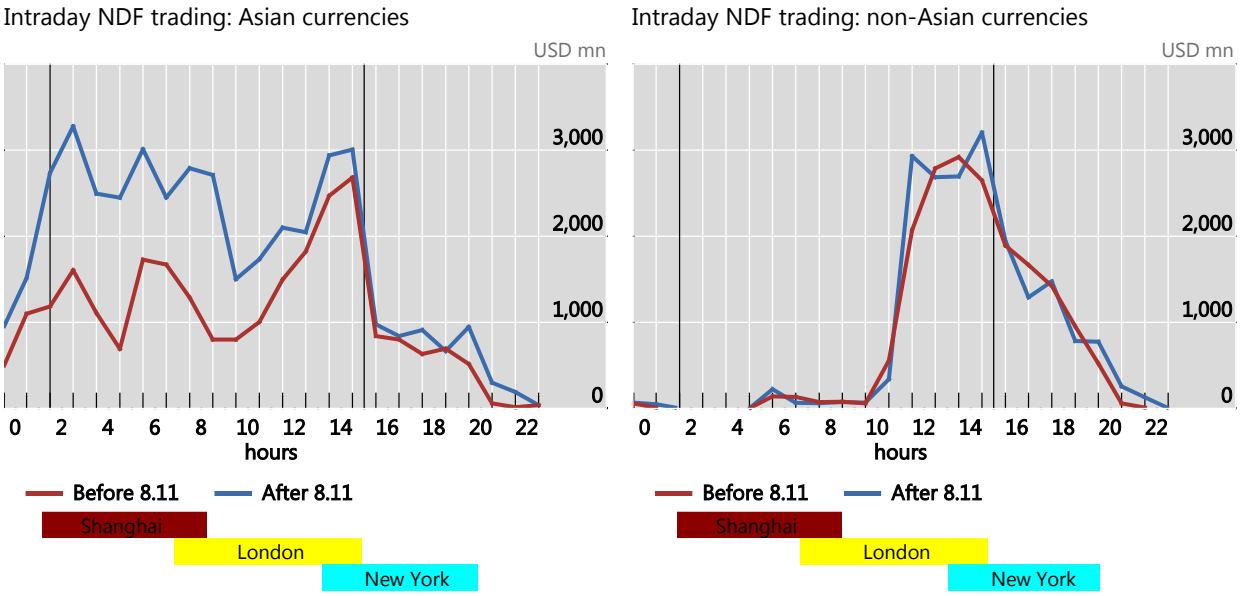


Source: DTCC via Clarus; authors' calculations.

Looking at intraday volumes before and after the policy change, the pattern of NDF transactions in Asian currencies shifts in a way that broadly resembles that in the CNY. In particular, peak trading now occurs in Asian time shortly after the CNY fixing, and Asian trading remains elevated. By contrast, the pattern of transactions in other currencies does not change much.

Asian NDF trading shifts into Asian time

Turnover by the hour GMT — Graph 9



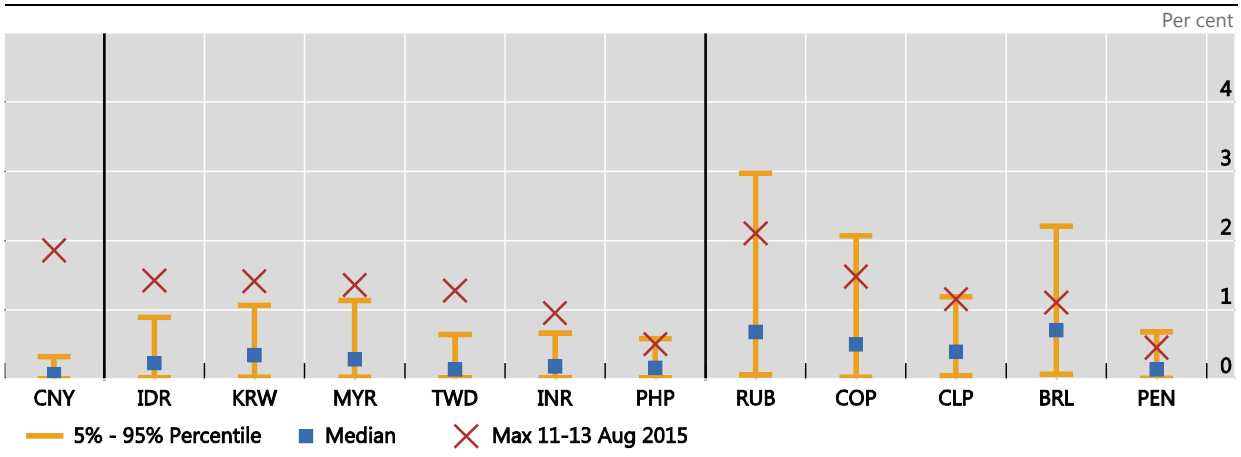
Note: the vertical lines mark 1:30 and 15:00.

Sources: Clarus Financial Technology; authors' calculations.

Prices

Price spillovers resemble the volume spillovers just reviewed. Maximum moves were in the 5% tail everywhere in Asia save in the Philippines (Graph 10). Outside of Asia, price movements were not particularly outliers.

Daily spot exchange rate changes: only some experienced extreme depreciations — Graph 10



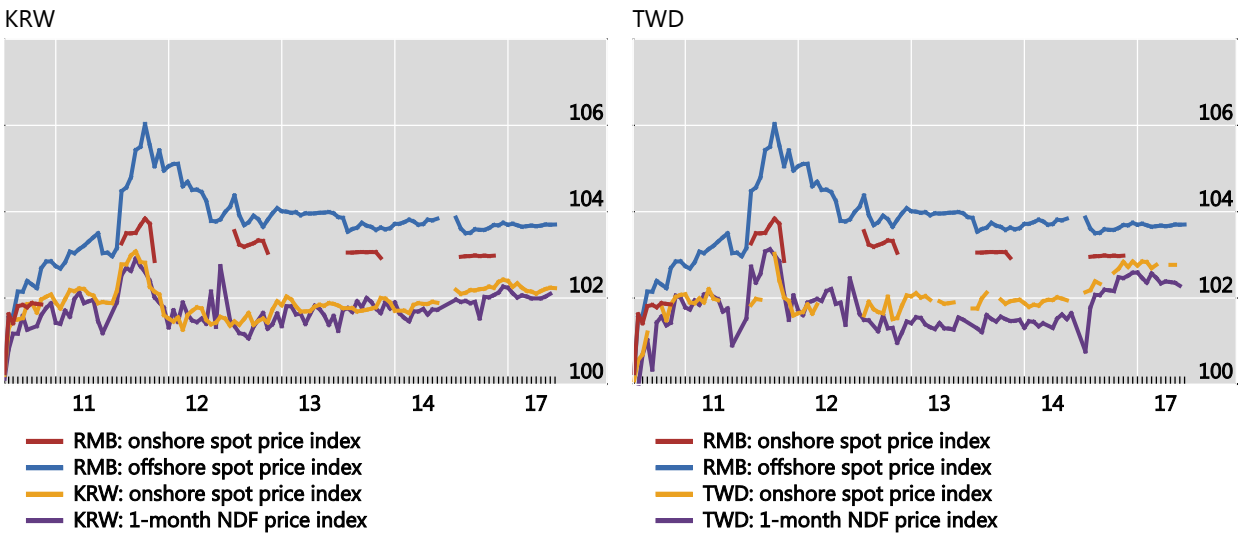
Sources:Bloomberg; authors' calculations.

In North East Asia, the immediate reaction was strong for the Korean won and the Taiwan dollar. On 11 August their spots ended the day very much in line with the CNY (Graph 11). On the Wednesday, they did not depreciate as much as the CNY, but late in the day they shared the appreciation that observers at the time ascribed to

official intervention in the CNY. When the dust settled on the week, these currencies had depreciated 2% against the dollar versus the CNY's 3% and the CNH's 4%.

KRW and TWD follow CNY closely

10 August 2015 = 100 Graph 11

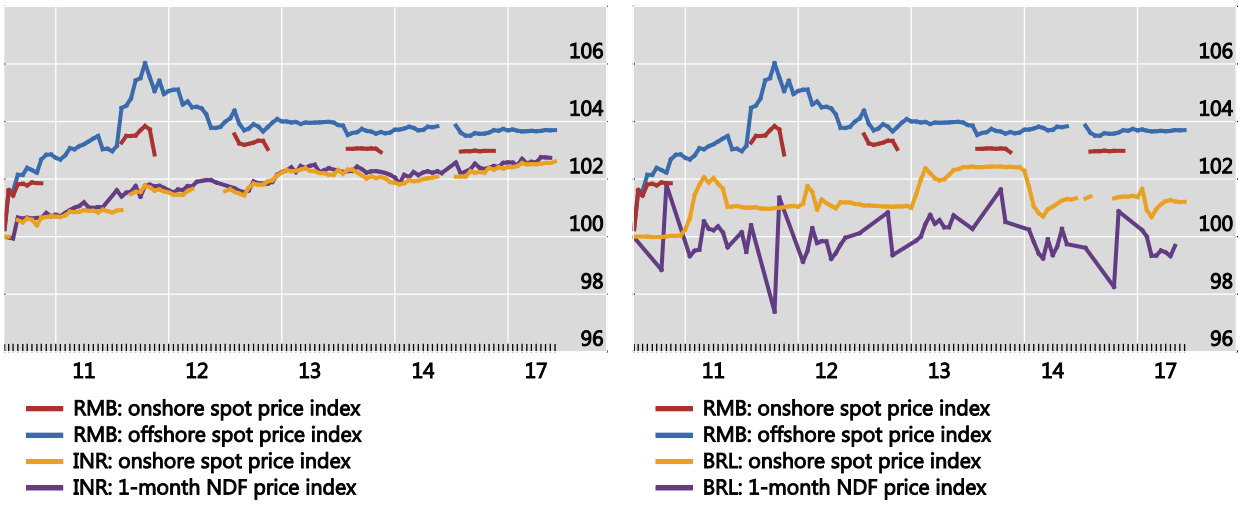


Source: Thomson Reuters; DTCC via Clarus..

The price action in India and Brazil look quite different. The INR opened on 11 and 12 August weaker against the dollar by less than 1%, with the NDF anticipating the move on the 12th. It depreciated a bit more on Friday and Monday after the CNY and the CNH had stabilised. The BRL depreciated when the domestic market opened on 11 and 12 August while the NDF moved erratically.

INR and BRL show weaker responses

10 August 2015 = 100 Graph 12



Source: Thomson Reuters; DTCC via Clarus

A Frankel-Wei regression on available hourly data shows that the association of the CNH and Asian currencies stepped up in the week of the policy change. We use the CNH for this exercise because it trades outside of Shanghai hours. From showing no systematic effect in the week before, the beta on the CNH rose to .15 for Asian currencies and .29 for Northeast Asian currencies (Table 2). The greater responsiveness to the CNH came at the expense of the yen and, to a lesser extent, the euro.

Intraday panel regression: impact of CNH before and after 8.11 Table 2

	Week before "8.11" (4/8/2015-10/8 /2015)			**Event week (11/8/2015-17/8/2015)**		
	Asia	North-East Asia	Non Asia	Asia	North-East Asia	Non Asia
CNH	0.01	-0.28	-0.08	0.16***	0.29***	0.04
EUR	0.28***	0.44***	0.12	0.15*	0.32**	0.05
JPY	0.24***	0.36***	0.13	-0.09	-0.10	-0.04
adjusted R-squared	0.17	0.27	0.00	0.05	0.17	0.00
Country effect	Yes	Yes	Yes	Yes	Yes	Yes
Number of countries	6	2	5	6	2	5
Number of observations	477	210	324	260	111	204

[1] Note: *** indicates 0.01 significance level; **, 0.05; * 0.1.

Sources: Authors' calculations.

As suggested by the graphs above, the closer co-movement of the CNH and the regional currencies was evident in Asian and not London and New York trading hours. This is evident in the aggregate of Asian currencies (Annex Table 1). Focusing on the KRW and the TWD, the former tracked the CNH during Asian hours, with a highly significant beta of 0.37, but the relationship lost scale and significance in London and New York hours. The sparser data for the TWD suggest only a relation in Asian hours.

Intraday (hourly) impact of CNH spot on KRW and TWD in different time zones Table 3

	Week before "8.11" (4/8/2015-10/8/2015)				**Event week (11/8/2015-17/8/2015)**			
	KRW		TWD		KRW		TWD	
	Asian trading	London/ New York trading	Asian trading	London/ New York trading	Asian trading	London/ New York trading	Asian trading	London/ New York trading
CNH	0.74	-0.99	0.01	1.80*	0.37***	0.19**	0.47**	-0.03
EUR	0.23	0.69***	0.42*	0.34***	0.39	-0.05	0.72*	0.01
JPY	0.63	0.42	0.39	0.05	-0.02	0.14	-1.42*	0.43
adjusted R-squared	0.06	0.39	0.10	0.35	0.22	0.05	0.32	0.00
Number of observations	45	92	32	60	44	70	26	40

[1] Note *** indicates 0.01 significance level; **, 0.05; * 0.1.

Sources: Authors' calculations.

Renminbi impact after August 2015

In this section we turning to the more familiar ground of daily regressions in order to test whether August 2015 marks a break in the co-movement of the renminbi and emerging market currencies. In aggregate both the Asian and the non-Asian currencies show a greater response to the CNY. In particular the beta on the CNY for Asian currencies rose from 0.55 to 0.77, and that of non-Asia from 0.42 to 0.78 (Annex Table A2).

Individual currency regressions point to a strengthening of the effect of the CNY, often at the expense of the yen and in cases at the expense of the euro. (Table 4). Unlike regressions using the SDR, Swiss franc or the New Zealand dollar as the numeraire, these can be immediately interpreted as currencies in the renminbi zone. We have highlighted cases of the beta on the CNY/USD above 0.5.

We read the table to include the Korean won, the Malaysian ringgit and the Taiwan dollar in an Asian currency zone centred on the renminbi. The hypersensitivity of the KRW (estimated beta over 1) should not be overstated. The tail event pictured in Graph 11 suggests a beta less than one and the null hypothesis of a one-for-one co-movement with the renminbi is not rejected (standard error of 0.17).[10] On the other side, the null hypothesis that the parameter for the IDR is less than 0.5 is not rejected (standard error of 0.14). The IDR thus joins the INR and the PHP, with betas not far from 0.5 in the daily regression post-August 2015, at the margin of the renminbi zone. This position is reinforced in the case of the INR by the subdued response in the event window (Graph 12, left hand panel; the IDR looks similar).

Three considerations lead us to put the Latin American currencies on no more than a watch list for membership in the renminbi zone, despite the highlighted estimated betas for the latter period for the Brazilian real, the Chilean peso and the Colombian peso. First, the null hypothesis that he Brazilian real's beta is less than 0.5 cannot be rejected (standard error of 0.35) and this most traded currency in Latin America showed a subdued response to the policy shock of August 2015 (Graph 12, right-hand side). Second, there was no reaction to speak of their NDF transactions to the August 2015 policy shock (Graphs 7 and 8). Third, there is a known missing variable in the Frankel Wei regression for commodity currencies like those in Latin America (Kohlsheen et al (2016)). It is possible that China's role as commodity importer makes the renminbi as an imperfect proxy for commodity prices.

Thus, our conservative approach leads us to put the Korean won, the Malaysian ringgit and the Taiwan dollar in the renminbi zone, with the other Asian currencies at the margin. This is a larger renminbi zone than the non-existent one found by Kawai and Pontines (2016) with data into 2013. It is narrower than found by Subramanian and Kessler (2013) for July 2010 through July 2013, who included not only the KRW, MYR and TWD but also the IDR and PHP. It is also narrower than the finding of Ito (2016), who includes the IDR (but wider in our inclusion of the unanalysed TWD).

Separate regressions suggest that the onshore CNY's relationship with emerging market currencies strengthened more than those of the offshore CNH or NDF. One interpretation is that the August 2015 reform strengthened the policy signal in the onshore rate. Another interpretation is that the CNH pricing became more subject to

[10] By contrast, a one-for-one relationship can be rejected for the Taiwan dollar, where the standard erro is 0.10 for the latter period.

liquidity squeezes in September 2015, January 2016 and January 2017 that changed its former status as purely market determined (Funke et al (2015)). For its part, the NDF is suffering a progressive loss of market share in the renminbi complex (Graph 3; McCauley and Shu (2016)). The upshot is that what happens in Shanghai now seems more important for emerging market currencies than what happens in Hong Kong SAR.

Regression analysis of daily exchange rates, January 2014 to February 2017

Exchange rates in difference of logs — Table 4

	Asian currencies			Other currencies	
Currency	1/1/14-10/8/15	18/8/15-18/2/17	Currency	1/1/14-10/8/15	18/8/15-18/2/17
KRW			**MYR**		
CNY	0.64***	1.28***	CNY	0.81***	0.97***
EUR	-0.04	0.08	EUR	-0.04	0.06
JPY	0.15***	-0.09*	JPY	0.17***	-0.13**
VIX	0.005	0.01**	VIX	0.01***	0.01**
R^2	0.05	0.18	R^2	0.10	0.12
IDR			**PHP**		
CNY	0.87***	0.63***	CNY	0.32***	0.55***
EUR	-0.003	0.02	EUR	-0.01	0.05*
JPY	0.01	-0.07*	JPY	0.03	-0.02
VIX	0.01**	0.01**	VIX	0.004*	0.01***
R^2	0.07	0.10	R^2	0.03	0.20
INR			**TWD**		
CNY	0.31*	0.49***	CNY	0.31***	0.70***
EUR	0.001	0.01	EUR	-0.02	-0.02
JPY	-0.01	-0.05**	JPY	0.07***	-0.03
VIX	0.01***	0.01***	VIX	0.004**	0.006***
R^2	0.07	0.23	R^2	0.06	0.16
BRL			**COP**		
CNY	-0.03	0.72**	CNY	-0.09	1.67***
EUR	0.21**	0.37***	EUR	0.24***	0.16
JPY	0.39***	0.04	JPY	0.23***	-0.11
VIX	0.05***	0.04	VIX	0.03***	0.05
R^2	0.18	0.12	R^2	0.14	0.22
CLP			**PEN**		
CNY	-0.20	0.92***	CNY	0.11	0.55
EUR	0.14***	0.21***	EUR	0.05***	0.11**
JPY	0.14**	0.02	JPY	0.03	-0.56
VIX	0.02***	0.03***	VIX	0.01***	0.01***
R^2	0.10	0.24	R^2	0.08	0.13

[1] Note: Highlighted estimated parameters are those over 0.5.

Sources: Bloomberg, authors' calculations.

Implications for renminbi internationalisation

Over time, idiosyncratic movement of the renminbi and other emerging market currencies following it can exert strong portfolio effects and contribute to the use of the renminbi both as a currency for international investment and for borrowing. In other words, the greater responsiveness of emerging market currencies to the renminbi/dollar can contribute to renminbi internationalisation. This underscores the point that renminbi internationalisation does not depend just on the policies of the Chinese authorities and the behaviour of Chinese firms and investors, but also on the response of authorities, investors and firms outside of China.

The higher betas of emerging market currencies on the renminbi/dollar make it more attractive for emerging market investors to hold renminbi-denominated bonds. This is because in these investors' numeraire, namely their domestic currency, renminbi bonds will have lower realised exchange rate risk relative to dollar bonds.

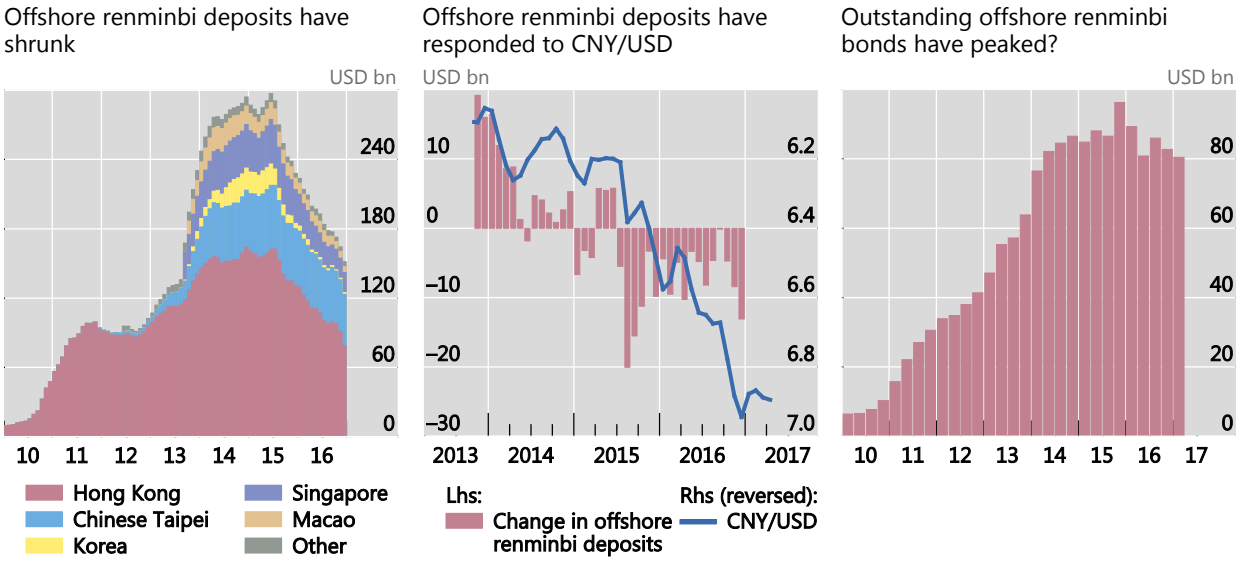
This portfolio balance effect holds for official and private investors alike. The very limited evidence on the currency composition of official foreign exchange reserves shows a strong association between the dollar share of such reserves and the weight of the dollar in the movements of the domestic currency (McCauley and Chan (2014); Ito et al (2015)). This alignment of portfolios and domestic currency co-movement is also observed in largely private portfolios. Thus the dollar share of BIS bank claims by country lines up with the degree of co-movement of domestic currency with the dollar.

The same logic applies to borrowers when the domestic currency moves with the renminbi against the dollar. Unhedged borrowing in the renminbi will pose less foreign exchange rate risk relative to unhedged borrowing in the dollar. In fact, there is a strongly positive relationship between the dollar share of external bank liabilities and the dollar share of international bond issuance, on the one hand, and the degree of co-movement of domestic currency with the dollar.

It may seem untimely to consider these portfolio effects that could work in favour of renminbi investment and borrowing by those outside of China, given the recent setbacks to renminbi internationalisation. One setback is private offshore holdings of renminbi assets. In particular, the stock of renminbi deposits held in Hong Kong, Korean, Taiwanese, Singaporean and Macanese banks has fallen by something like a half (Graph 13, left-hand side). This shrinkage reflects the bilateral exchange rate against the dollar (centre panel).). And the stock of offshore renminbi bonds is no longer growing rapidly (Graph 13, right-hand side). In addition to these facts on the ground in Asia, most observers consider the renewed enforcement of China's capital outflow controls, including on renminbi outflows, as well as bouts of extreme illiquidity in the offshore CNH market, to represent at least temporary setbacks.

Offshore renminbi deposits and bonds

In billions of US dollars — Graph 13



Sources: Monetary Authority of Macao; Bloomberg; CEIC; BIS Locational Banking Statistics and International Debt Securities; BIS calculations,

We submit that the process that is being unwound is a one-sided renminbi internationalisation that was not conducive to the balanced long-term internationalisation of the currency. As long as the renminbi was expected to appreciate against the dollar and offered higher yields, it attracted investors, but not borrowers. This process ultimately had as its counterpart higher official reserves. Thus the Chinese official sector accumulated a long-dollar short- renminbi position corresponding to the private carry trades of offshore investors and the Chinese corporate sector.

The depreciation of the renminbi since early 2014 against first a broadly stronger dollar and then against the renminbi own trade –weighted basket may prove to have set up more two-way expectations. Such expectations are a necessary condition for borrowers in the rest of the world to consider selling debt denominated in the renminbi and not hedging it.

In short, balanced internationalisation, exemplified by an investor outside of China holding a renminbi-denominated claim on a borrower outside of China, was not happening through 2014. The unravellin of the previous one-sided internationalisation could possibly set the stage for a more balanced process in which the portfolio effects of the co-movement of the renminbi and emerging market currencies plays a key role. It bears emphasis that any outlook for renewed renminbi internationalisation also depends on the confidence of investors and borrowers in the management of Chinese capital flows.

The portfolio effects that favour emerging market investors' shifting to *renminbi bonds* at the same time imply higher exchange rate risk in holding or issuing *dollar bonds*. Idiosyncratic renminbi movements (ie against its trade-weighted basket with its heavy dollar, euro and yen weightings) and the co-movement of East Asian currencies point to the formation of a renminbi zone at the expense of the de facto dollar zone (Ito and McCauley (2017)). It can be argued that the dollar's pre-eminent

role reflects not the size of the US economy and inertia but the share of the world economy with relatively stable dollar exchange rates. If so, the formation of a stable renminbi zone could prove a tectonic shift.

Conclusion

This study combines daily and heretofore unstudied deal-by-deal foreign exchange trade data to assess the impact of the change in the renminbi fixing mechanism in August 2015. We find that this policy shock in China exerted strong high frequency effects on the volume and pricing of other emerging market currencies in Asia and less so elsewhere in the event week. We also find that this policy change saw a step up in the measured co-movement of the renminbi, particularly the onshore rate, with emerging market currencies in the 18 months since. We place the Korean won, the Malaysian ringgit and the Taiwan dollar in the renminbi zone.

A less variable renminbi than dollar vis-à-vis domestic currencies would make investment and borrowing in the renminbi more attractive. This, along with continued improvements in, and non-resident access to, the Chinese bond market, would favour renewed progress in renminbi internationalisation after recent set-backs.

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Annex tables

Intraday (hourly data) panel regression: impact of RMB offshore spot rate on Asian exchange rates in different time zones

Table A1

	Week before "8.11" (4/8/2015-10/8/2015)		**Event week (11/8/2015-17/8/2015)**	
	Asian trading	London/New York trading	Asian trading	London/New York trading
CNH	0.30	-0.15	0.22***	0.05
EUR	0.17**	0.36***	0.28**	-0.04
JPY	0.32**	0.16	-0.32	0.1
adjusted R-squared	0.05	0.26	0.06	0.01
Country effect	Yes	Yes	Yes	Yes
Number of countries	6	6	4	5
Number of observations	228	246	213	215

[1] Note *** indicates 0.01 significance level; **, 0.05; * 0.1.

Sources: Authors' calculations

Daily panel regression: impact of CNY on spot rate

Table A2

	Before "8.11" (1/1/2014-10/8/2015)		**After "8.11" (18/8/2015-28/2/2015)**	
	Asia	Non Asia	Asia	Non Asia
CNY	0.55***	0.42**	0.77***	0.78***
EUR	-0.02	0.18***	0.03*	0.21***
JPY	0.07***	0.13**	-0.06***	-0.02
VIX	0.01***	0.03***	0.01***	0.03***
adjusted R-squared	0.05	0.07	0.14	0.15
Country effect	Yes	Yes	Yes	Yes
Number of countries	6	4	6	4
Number of observations	2,390	1,616	2,121	1,424

[1] Note *** indicates 0.01 significance level; **, 0.05; * 0.1.

Sources: Authors' calculations