

IMF Working Paper

RMB Internationalization: Onshore/Offshore Links

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Monetary and Capital Markets Department

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Abstract

Among emerging market currencies, the RMB holds the most potential to become widely used internationally, due to China's large economic size, diversified trade structure and network, macroeconomic stability, and high growth rates—both current and expected. Yet, foreign access to RMB-denominated assets that could act as global stores of value remains limited due to extensive restrictions on capitals flows. At the same time, the rapid expansion of RMB trade settlement and issuance of RMB-denominated bonds by the Chinese government and corporates in Hong Kong, SAR have created some feedback channels across onshore (CNY) and offshore (CNH) RMB markets. We employed a bivariate GARCH model to understand the inter-linkages between onshore and offshore markets and found that, while developments in the onshore spot market exert an influence on the offshore spot market, offshore forward rates have a predictive impact on onshore forward rates. We also find evidence of volatility spillovers between two markets. Overtime, those spillover channels would be expected to grow as the offshore market further develops.

JEL Classification Numbers: E42, F31, F33

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I. INTRODUCTION

Efforts to encourage cross-border use of the renminbi (RMB) picked up speed in the aftermath of the global financial crisis. In general, currency internationalization could provide a number of advantages to the country of issuance. Particularly, it would reduce exchange rate risk facing economic agents, and allow both the public and private sectors to issue debt in domestic currency internationally, thereby improving risk management of cross-border transactions and reducing liquidity and exchange rate risks facing domestic firms.

From a global perspective, internationalizing currencies of large emerging markets could improve global risk sharing and address some of the imperfections in the international monetary system, revealed with the outbreak of the recent financial crisis. The concentration of many functions of the IMS in one or two currencies, while efficient, does not reflect the increasingly multi-polar structure of the global economy when it comes to real economic activity and growth drivers. Further, such concentration may increase systemic vulnerability stemming from shocks or policy decisions in reserve currency issuers that would impact the rest of the world (Zhou, 2009). It also leads to a very uneven sharing of currency risk among international currency issuers and others who face the bulk of those risks. In addition, the global financial crisis and debt sustainability concerns have raised questions over the long-term store of value properties of the main global currencies, and along with it, created interest in encouraging wider use of various emerging market (EM) currencies, particularly the RMB (Maziad et. al, 2011; IMF, 2011c).

The Chinese authorities focused on encouraging use of the RMB in settling cross-border trade with neighboring countries and on the development of RMB financial services in Hong Kong, SAR. The use of RMB in trade settlement has expanded exponentially and along with it, RMB-denominated deposits and financial instruments has been growing steadily. Such rapid development of the offshore RMB financial market suggests potential for feedback channels between onshore and offshore currency markets. The paper tries to shed some light on those potential links and finds some evidence of spillovers across onshore and offshore markets.

Despite wide-ranging capital controls and a heavily managed exchange regime, onshore and offshore exchange rates have moved quite closely in most of the period since the RMB began trading offshore in mid-2010. To examine the linkages of exchange rates between onshore and offshore markets, we employed a bivariate generalized autoregressive conditional heteroscedasticity (GARCH) model. We find that developments in the onshore spot rates exert an influence on both spot and forward rates in the offshore market under normal market conditions while the offshore forward market do seem to move ahead of the onshore forward market: today's offshore forward rates have a predictive impact on tomorrow's onshore forward rates. Under conditions of financial stress offshore, exchange rate movements offshore impact spot rate onshore, while volatility spillovers exist in both directions.

The rest of the paper is organized as follows: Section II discusses RMB's potential for gaining wide international use in light of recent policy initiatives and experience of other currencies, focusing on ascendance of the dollar, international role of the German mark, and efforts to internationalize the yen; section III presents the results of the empirical analysis of links between onshore and offshore RMB exchange rate markets; and section IV concludes with policy implications.

II. INTERNATIONAL CURRENCIES AND POTENTIAL ROLE OF THE RMB

The experience of international currencies over the past century points to a few key factors that drive international demand for a currency, supported by policies that aid its supply. These factors include the size and structure of the economy, as well as a number of requirements that determine demand and supply of the currency. First, the structure and breadth of the trade network (closely linked to economic size) and invoicing practices determine demand for the currency as unit of account and medium of exchange; second, macroeconomic stability and the currency's credibility/strength make it an attractive store of value, further fostering demand for it. The third requirement is on the supply side: depth and openness of financial markets and currency convertibility. Domestic policies conducive to financial development and capital account liberalization supply the currency and allow access to financial assets denominated in it. In addition, the authorities' willingness to provide global liquidity (especially at times of financial stress) often plays an important role in cementing the currency's global status. These elements are elaborated below in the discussion of country cases and applied to assess the RMB's potential in light of recent efforts to encourage its cross-border use.

II.A. HISTORICAL EXPERIENCE AND INSIGHTS FOR THE RMB

A. The U.S. Dollar

The traditional view on the emergence of international currencies has been slow evolution. However, recent research argue that the U.S dollar overtook the pound as early as the mid-1920s, implying a lag of about ten years from the time the U.S. economy took over that of the U.K. (Eichengreen, 2008; Eichengreen and Flandreau, 2010; Subramanian, 2011). Indeed, if one judges economic size not by GNP but by trade volume, then the implication is that the lag was even shorter. The level of U.S. exports first surpassed U.K. exports during World War I and it was not until World War II that U.S. trade definitively overtook that of the U.K. This revelation would suggest that the landscape of international currencies, and thus the evolution of the international monetary system could actually take place rather quickly once the preconditions are in place, with implications for the speed with which the RMB could actually acquire wider international use.

Historians estimate, for example, that roughly 60 percent of the world's trade was invoiced in pounds in the late nineteenth century. In 1899, almost two-thirds of known foreign exchange holdings of official institutions were in pounds, more than twice the total of the next

competitors, the French franc and German mark. The dollar did not even feature as an internationally used currency (Frankel, 2011). The ranking of the four currencies remained the same in 1913. By 1917, however, the dollar had emerged as a major international currency. Foreign central banks had begun to hold dollar reserves and the currency was increasingly used in trade and finance. Interestingly, the dollar's main problem prior to 1914 was not the size of the economy (the first criterion for an international currency as described above): the U.S. economy had surpassed the U.K. economy, at least as measured by gross national output, in 1872. Rather, the country lacked financial markets that were deep, liquid, and open. Indeed, it even lacked a central bank, which is considered a prerequisite for the development of financial market instruments such as bankers' acceptances. Perhaps the dollar also fell short in terms of foreign confidence in its value, since the U.S. experienced a number of financial crashes and lacked a lender of last resort. Later on, the establishment of the Federal Reserve System (Fed) was a decisive element in promoting use of the dollar as international currency for trade finance. Once the central bank was established, the U.S. made rapid progress in terms of the third criterion for an international currency; increasing the depth, liquidity, and openness of U.S. financial markets. Eichengreen (2008; 2011) argues that it was the establishment of a market in dollar-denominated trade acceptances among banks that mattered most. The Fed established the credibility of the dollar as a source of reliable trade credit by becoming a leading market-maker in the secondary market for dollar-denominated trade acceptances. As the financial markets developed, so did the international role of the dollar. The onset of World War I accelerated the transformation: large-scale wartime lending by the U.S. to the U.K. and other combatants reversed the nineteenth-century creditor-debtor relationship, and positioned the dollar as a strong and credible currency (Frankel, 2011). When the Fed stepped out of the market, the sterling regained some grounds and sterling reserves expanded again in the interwar period due to the willingness of the Bank of England to act as global provider of liquidity (Eichengreen and Flandreau, 2010; Flandreau, 2011). Similarly today, the status of the dollar was reinforced as 'safe haven' currency in the global crisis due to the Fed's actions as global provider of dollar liquidity.

Notwithstanding the Fed's active role in the trade acceptance market, it is important to note that ultimately the rise of the dollar to global status was predominantly market-driven. Frankel (2011) emphasizes that the rapid ascent of the dollar happened without any desire, whether on the part of the public or politicians, for international prestige or power on the world stage, nor was the Fed actively promoting a special global role for the currency. The law creating the Fed passed through Congress due to the shock of the financial panic of 1907, not because Congress aspired to boost the dollar's international standing (Karmin, 2008).

Another critical phase in the ascent of the dollar to global currency status was the development of a thriving offshore U.S. dollar market, Eurodollars. Eurodollars are deposit liabilities, denominated in U.S. dollars, of banks located outside the U.S. He and McCauley (2010) note that a significant portion of international use of major reserve currencies take place offshore, particularly in international financial centers. They argue that without such

offshore markets, the dollar would not have attained its dominant role. Several factors contributed to the growth of dollar market offshore, particularly that it was relatively free of regulations, allowing banks to operate on narrower spreads between dollar borrowing and lending rates compared with banks in the U.S. This allowed offshore banks to compete effectively with banks operating inside the U.S. in attracting deposits to the offshore market. By accepting deposits and making loans denominated in U.S. dollars outside the U.S., banks were able to avoid many banking regulations in the U.S. In particular, banks located outside the U.S. were not required to keep noninterest-bearing reserves against Eurodollar deposits. These foreign banks held balances with U.S. banks for clearing purposes only. Moreover, the Federal Deposit Insurance Corporation assessment was not required for Eurodollar deposits. There were virtually no restrictions for interest rates payable on Eurodollar deposits or loans and there were also little regulatory impediments for Eurodollar banking. In addition, banks with Eurodollar business could engage in regulatory arbitrage by setting up in locations where tax rates were low (Goodfriend, 1981). Offshore depositors/investors were also able to separate currency risk from country risks as investors could hold the currency without necessarily being exposed to the country.

As discussed above, relatively light regulation is a key factor behind the development of offshore market. He and McCauley (2010) argue that the development of the Eurodollar market was in fact a reaction to capital controls in the U.S., particularly the interest equalization tax of 1963 and later restraints on capital exports. However, offshore markets do not exist independently of the financial sector onshore, as payments associated with offshore accounts must be cleared through accounts and investments onshore. In fact, He and McCauley (2010) stress that, while U.S. authorities put in place some capital controls from the late 1960s until early 1970s, they never restricted the flow of payments through U.S. banks to allow the settlement of offshore trade and investment transactions, which allowed offshore market to flourish despite some capital controls onshore.

The experience of the U.S. dollar offshore market provides useful insights into the long-term potential evolution of the RMB. A thriving offshore market allows non-residents less restricted and more favorable conditions to trade in the currency. In light of this, efforts by the Chinese authorities to develop an offshore market for the RMB in Hong Kong SAR seem to go in the right direction and capitalize on the advantages of the island as an established financial center with long history of free movement of capital. Critical to its success, however, is the ability of offshore banks to access RMB onshore to meet the demand for RMB in settling trade and investment, ensuring the smooth functioning of the RMB market. This is one of the reasons the Chinese authorities created a swap line with the Hong Kong Monetary Authority (HKMA), which was activated in October 2010 to ensure the demand for the RMB is met, which at the time exceeded the conversion quota of the Bank of China, Hong Kong (BoCHK as the offshore clearing bank). Although no banks actually needed to tap RMB funding through the swap arrangement, its activation as a precautionary measure ensured market confidence. In late 2011, the authorities further boosted this swap line by doubling its size, from RMB 200 billion to RMB 400 billion, while at the same time raising

the conversion quota of the BoCHK and other correspondent banks to meet demand for RMB conversion. It is important to note that ensuring the smooth functioning of the offshore market, while critical, also creates important feedback and arbitrage channels between onshore and offshore markets. Arbitrage opportunities and flow of capital across markets would ensure that interest rates and exchange rates remain closely linked. In other words, market pressures that may arise offshore could be transmitted onshore.

B. The German Mark

The experience of the German mark as international currency provides an interesting example of the strength of market forces that could propel a currency in wider use. The German mark attained a high degree of confidence and prestige in the latter part of the twentieth century after replacing the Reichsmark (which itself had been created in 1924, in the aftermath of the German hyperinflation of 1921–23). The Bundesbank was not founded until 1957. The mark gained international use in the context of rising U.S. balance of payments deficit and declining ratio of U.S. gold reserves to dollar liabilities, which brought into question the long-term prospects of the dollar, as predicted by the Triffin dilemma. The gist of the Triffin Dilemma rests on the idea that under the gold standard the provider of the global currency, the U.S. in this case, would have to run large current account deficits to supply the rest of the world with dollars, which ultimately would debase the currency and raise doubts about its credibility as store of value as its gold cover declines. But the trend was greatly accelerated by the U.S. government's Vietnam war spending, which was not matched by a willingness to raise taxes to pay for it, but rather accompanied by monetary expansion and inflation, raising doubt about the long-term credibility of the dollar as a store of value. The U.S. response to this challenge prioritized domestic policy objectives rather than safeguarding the dollar's global standing. The U.S. instituted capital controls such as the interest equalization tax. The controls together with financial repression in the banking system (reserve requirements and Regulation Q's ceiling on the interest rate that banks were allowed to pay their depositors) resulted in the relocation of banking business offshore, beginning with the Eurodollar market in London, which later thrived (McCauley, 2011; Frankle, 2011). President Nixon took the dollar entirely off gold in 1971, effectively ending the Bretton Woods system of fixed exchange rates.

Two newly international currencies, the mark and the yen, began to gain share as a reaction to the perceived loss of credibility of the dollar. Yet, German policy was in fact opposed to internationalization (Eichengreen, 2011). Domestically, the economically and politically powerful manufacturing sector feared that internationalization would lead to upsurges in the demand for the mark, which would result in either further appreciation, if the currency was allowed to float, or in monetary inflows, if the Bundesbank sterilized the impact of capital flows. In the former case, appreciation would immediately hurt export competitiveness. In the latter case, the same loss of price competitiveness would eventually come through inflation. Frankel (2011) points to the distinction between the financial sector, which supports a strong currency, and the manufacturing sector that does not. He suggests that the

financial sector could be more influential in countries where it is large and powerful: the U.K. and Switzerland. But the financial sector was probably too small, relative to manufacturing sector, to carry much weight in Germany or Japan later on.

Yet despite this ‘official’ resistance, the mark continued to gain status throughout the 1980s. The trend took place not because of policy, but in spite of it. It was a side effect of the growing size of the German economy (especially trade) and the impeccable reputation that the Bundesbank had established for keeping the mark strong in value, whether measured by inflation or the exchange rate. By the foreign exchange reserve measure, the currency’s share reached almost 20 percent in 1989 (Tavlas, 1992). The trend was reversed in the 1990s for a number of contributing factors, including slow economic growth and the regained strength and credibility of the U.S. economy as reflected in sustained noninflationary economic expansion, the steady elimination of budget deficits, and the appreciation of the dollar in the second half of the 1990s. More importantly, the ambition of the common currency coming to fruition in January 1999 cast the mark as an important European currency, rather than an international one.

C. The Japanese Yen

The period of internationalization of the yen can be divided into two phases. The first phase, when international use of the yen trended upward even though domestic politics was opposed to internationalization and government policy was at best neutral toward it. Similar to Germany, there was a perception that increased demand for their currency would hurt export competitiveness. By the mid-1980s, there was a policy shift towards actively promoting internationalization in the context of the Yen/Dollar Agreement and later with the Plaza Accord aimed at depreciating the dollar and resolving global imbalances of that era. Frankel (2011) argues that this effort came too late, as economic fundamentals had already turned around, dominated by the shrinking economy.

After World War II, Japan’s export-driven economic miracle allowed its currency to meet the first criterion for internationalization: the country’s size, both in terms of its share of global GDP and global trade. But it was slower to meet the other criteria. Only during the period 1960–73 did the government begin to allow foreigners to acquire some types of assets in Japan. In 1964, full current account convertibility under the IMF Articles of Agreement was achieved (Takagi, 2011). After the breakup of the Bretton Woods system (1971–73), as the Bank of Japan began to establish a reputation for a currency that strengthened in value, central banks around the world began gradually to hold some yen as foreign exchange reserves. But other measures of internationalization, such as use of the currency in invoicing trade or denominating debt, continued to show a very low share for the yen. In 1979, only 25 percent of Japanese exports and 2 percent of imports were denominated in yen, as Japanese financial markets remained less competitive, highly regulated, and mostly closed to foreigners (Frankel, 2011). In 1979–80, the government began to allow foreign residents to hold a fuller range of domestic assets. But the Foreign Exchange Law of 1980 still allowed

“minimum necessary controls” on capital flows to manage the exchange rate or balance of payments. Further liberalization came in the context of the Yen/Dollar Agreement in 1984. In addition to agreeing to the demands to further lift capital controls and to internationalize the yen, the government also agreed to give more favorable treatment to U.S. banks and financial institutions wishing to do business in Japan. However, the authorities did not agree to immediate and complete deregulation of domestic financial markets (Takagi, 2011).

Despite expectations that internationalization of the yen would lead to its appreciation against the dollar and help U.S. exporters, this did not happen at first. U.S. interest rates in 1984 were well above those in Japan, so that the removal of remaining capital controls led to acceleration in net outflow of capital from Japan rather than the reverse. The sharpest appreciation of the yen came instead between 1985 and 1987, and is usually associated with the Plaza Accord, in which Japan agreed with the U.S. and other G7 countries to intervene in foreign exchange markets to push the dollar down.

International use of the yen rose gradually in the 1980s and its share of foreign exchange reserves reached almost 9 percent in 1991, which turned out to be the peak (Tavlas, 1992). In the 1990s, official policy at last shifted firmly in favor of internationalization, with the aims of reducing exchange rate risk for domestic firms, facilitating business for Japanese banks and other financial institutions, and promoting Japan as a financial center with a comprehensive package of financial liberalization measures announced in 1996 (Takagi, 2011). However, indicators of the yen’s use in international transactions, such as official reserves holdings, foreign currency turnover, and denomination of international debt securities showed a stagnating or declining share over the past two decades. Recently, the yen received safe haven capital inflows after the global financial crisis of 2008, and remains an international currency that ranks above the Swiss franc and roughly as high as British pound on most indicators of international currency use.

In addition to the yen’s limited use as unit of account for trade invoicing, it became largely a funding currency and its internationalization remained lopsided. The three-year episode that led to the Japanese crash of the 1990s also played a role: the 1987–89 bubbles in Japan’s stock market and real estate sector undermined the currency as a global store of value. Several factors contributed to the uneven internationalization of the yen possibly because of the two-track strategy of liberalizing offshore use of the currency, while domestic yen market remained relatively controlled. At the same time, capital markets remained segmented and unevenly developed with several restrictions in place. This approach prevented deepening of domestic financial markets and limited foreign access to domestic financial system. This may have delayed the development of market-based mechanism and did not attract foreign capital flows and investment in yen-denominated assets (Semblat, 2006; Murase, 2000).

Yen internationalization stalled largely due to the stagnation of the Japanese economy, which has shown little growth since the bursting of the equity and real estate bubbles in the early 1990s. Tavlas (1992) attributed the path of the yen’s evolution to the following factors: (1)

Japan functioned as an international financial intermediary during the 1980s, borrowing short term and lending long term to the rest of the world on a net basis; (2) Japanese net long-term capital outflows (by both banks and nonbank financial institutions) were predominantly invested in foreign currencies denominated-securities, reflecting the long-term interest rate differentials in favor of non-yen assets (e.g., U.S. dollar and Canadian dollar), and even more importantly the scarcity of long-term financial instruments in Japan, along with the gradual lifting of restrictions on the foreign currency allocations of portfolios during the 1980s, particularly portfolios of nonbanks and pension funds, which weren't fully hedged or matched by corresponding foreign-currency-denominated inflows; (3) the fact that Japanese banks have mainly engaged in maturity transformation of external funds denominated in currencies other than the yen indicates that Japan has not, to any great extent, provided yen-denominated liquidity to the international monetary system and, accordingly, has not functioned as a world banker. This latter point illuminates one of the main causes behind the underperformance of the yen as international currency despite large economic size and trade network. In fact, whereas a world banker accepts liquid liabilities denominated in its own currency and transforms such liabilities into a larger number of longer-term loans and investments, Japanese banks appear to have done just the opposite.

The experiences of the mark and the yen highlight that the process of currency internationalization is largely market-determined and is driven by the country's economic growth, credibility of the currency, and financial sector development and stability. This suggests that the fundamental drivers for internationalization of the RMB appear to be place, based on China's economic size, trade ties, and growth potential. It thus becomes critical to proceed with care along the path of modernizing and deepening the financial sector and gradually opening the capital account to promote two-way use of the RMB and a balance between offshore use of the currency and capital flows onshore. These points will be elaborated further in the next sections, discussing recent policies to promote cross-border use of the RMB and policy implications.

Selected indicators of reserve currency use (Shares of total)

	2001	2004	2007	2010
FX Market Turnover				
(as a percentage of total value of Transactions)				
US Dollar	44.9	44.0	42.8	42.4
Euro	19.0	18.7	18.5	19.5
Pound	6.5	8.2	7.4	6.4
Yen	11.8	10.4	8.6	9.5
Share of allocated FX reserves				
U.S. dollar	71.5	65.9	64.1	61.6
Euro	19.2	24.8	26.3	26.7
Pound sterling	2.7	3.4	4.7	4.1
Japanese yen	5.0	3.8	2.9	3.1
OTC foreign exchange derivatives turnover by currency				
(Daily averages in April, percentage shares)				
US dollar	n.a	95.5	95.2	94.7
Euro	n.a	19.3	15.1	15.8
Japanese yen	n.a	16.6	14.0	9.7
Pound Sterling	n.a	7.9	6.7	4.3
International Debt Securities				
Euro	31.8	46.9	48.5	44.0
US dollar	50.9	36.6	34.9	39.2
Pound sterling	7.2	7.8	8.2	8.0
yen	6.0	3.9	2.7	2.8

Source: COFER; BIS Bank of International Settlement, International Debt Securities Statistics and Triennial Survey of Foreign Exchange and Derivatives Activity

II.B. RMB INTERNATIONALIZATION—POTENTIAL AND RECENT POLICIES

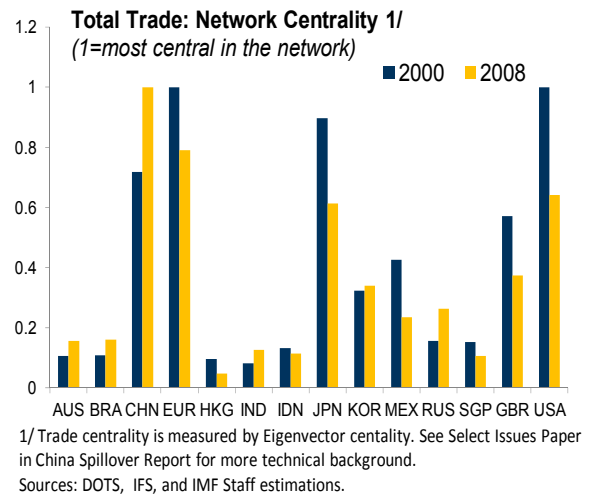
In light of international experience, this section will analyze the potential for the RMB to play a greater international role, while highlighting the authorities' efforts towards that goal. The discussion at the end of this section will also point to a number of risks to the process of RMB internationalization.

The process of RMB internationalization is already off to a good start with rapid growth in its use for cross-border trade settlement and the expansion of investment vehicles denominated in it. For instance, RMB cross-border trade settlement expanded fourfold from less than RMB 50 billion in August 2010 to almost RMB 200 billion in September 2011, supporting rapid growth in RMB deposits in Hong Kong SAR, which stood at over RMB 600 billion in

October 2011. In addition, the central bank (People's Bank of China, PBoC) is setting up currency swap lines¹ with other central banks within Asia and outside, with several countries announcing plans to add the RMB to its foreign exchange reserves, including South Korea and Japan.

Broadly speaking, the RMB already meets the pre-requisites for cross-border use in terms of potential demand for the currency: international demand for the RMB exists due to China's central role within the Asian supply chain and its role as the second largest exporter. At the same time, China's trade links are wide-ranging both across countries, products, and commodities. The currency's demand is also backed by a large economy and strong growth outlook. Nevertheless, there is still significant progress to be made on the supply side to allow non-residents access to the currency and to RMB-denominated assets as stores of value. To meet that latter requirement, there is scope for policy action to reform the exchange rate and interest rate regimes and lay the ground for financial sector development and deepening. With that in mind, the expansion of the role of the RMB will ultimately be market-driven and will evolve gradually from use as unit of account (through trade settlement) towards becoming an international store of value in the private sector, and ultimately use as a reserve currency. Assessing the requirements for achieving international currency status could be undertaken on several dimensions, including economic size and macroeconomic stability, trade network, financial development, and policy support for internationalization. These dimensions are discussed below.

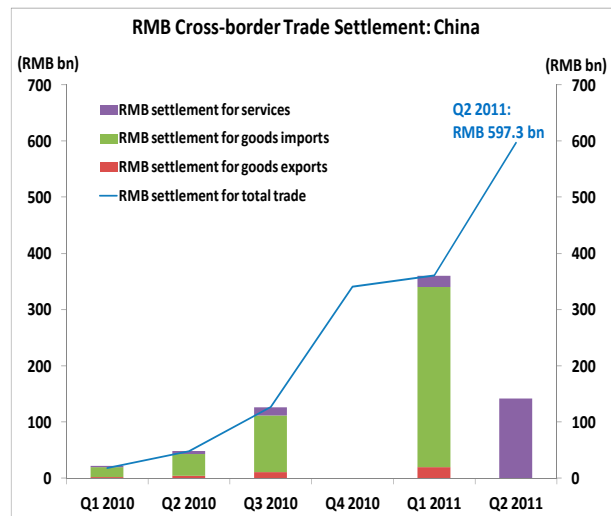
Economic size, trade, and invoicing: China has become the second largest economy after the U.S. and second largest exporter after the euro area with a very wide and varied trade network. In fact, China has become the most central economy to global trade, supporting demand for the RMB as currency of settlement for cross-border trade. A number of factors influence trade invoicing behavior and determine effective use of the currency in international trade, including a country's share in world exports, the proportion of the country's exports to countries that are not



¹ Between December 2008 and July 2010, the PBoC established currency swap lines to the tune of RMB 800 billion with eight central banks, including Argentina, Belarus, Hong Kong, Iceland, Indonesia, Malaysia, Singapore, and South Korea. In November 2011, Premier Wen proposed expanding the use of swap lines with countries that belong to the Shanghai Cooperation Organization. Member countries include Russia, Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan and China. India, Iran, Mongolia and Pakistan take part as observer. In January 2012, China signed the first currency swap agreement with an Arab nation, worth 35 billion RMB with the United Arab Emirates.

themselves issuers of international currencies, and the share of specialized manufacturing products in exports; all support the use of one's own currency in invoicing trade (Tavlas, 1992). Commodity exporters are less likely to invoice their trade in domestic currencies, and instead adopt the global standard (e.g., U.S. dollar pricing for many commodity exports). On this front, the RMB would be well-positioned to gain wider international use given China's diversified trade structure, which is not particularly dominated by commodities trade. Other factors, such as the composition of the supply chain, also influence pricing behavior. For instance, Japanese exports are often priced in U.S. dollar since Japan is part of the Asian supply chain, which essentially belongs to the dollar bloc. Japanese firms often centralize exchange rate management by invoicing in U.S. dollar for imports and exports. Similarly, pricing to market to protect competitiveness encourages firms to invoice exports in the importer's currency (Goldberg and Tille, 2008; Ito et al., 2010). Some of these factors limited the use of the Japanese yen as a dominant invoicing currency even in Asia (Takagi, 2009; Xu, 2009).

- Trade settlement.* Cross-border trade settlement was officially permitted in trade with China's neighboring countries since 1997. In July 2009, a pilot scheme to expand the use of the RMB in trade settlement was launched. The scheme permitted cross-border RMB trade settlement in five Chinese cities trading with Hong Kong, SAR, Macau, and ASEAN countries. In 2010, the scheme was expanded to 20 provinces and cities, covering over 90 percent of national exports and became open to all countries. In August 2011, the authorities announced a package of measures to boost RMB internationalization, including the extension of the RMB trade settlement scheme nationwide. By end-2010, RMB-trade settlement was available to nearly 70,000 approved exporters. Later, at the end of December 2011, the Japanese and Chinese authorities announced an initiative to encourage the use of RMB in settling trade between the two countries. The use of the scheme has been skewed towards import settlement due to the general market expectations of RMB appreciation. As of November 2011, those expectations moderated and the direction of RMB fund flows under cross-border trade settlement has become more balanced.² The recent expansion of the scheme nationwide may also contribute to more balanced use of RMB with the likely increase in the number of exporters engaging in RMB trade settlement (Goldman Sachs, 2011).



² According to PBoC's Monetary Policy Report for Q4 2011, use of the scheme has become more balanced with the ratio of inflows to outflows from Mainland China declining from 1:5.5 in 2010 to 1:1.7 in 2011.

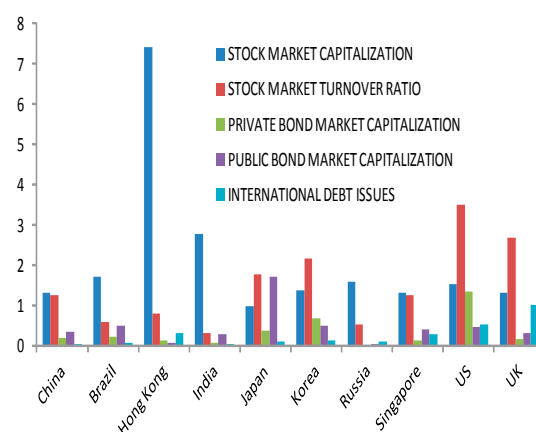
Macroeconomic indicators (in percent) and Sovereign rating

Country	Average real GDP growth		Average inflation		Sovereign rating (S&P)
	2000-2005	2005-2010	2000-2005	2005-2010	2011
Brazil	3.9	6.3	8.5	4.7	BBB
China	11.8	12.9	1.3	3.3	AA-
India	6.0	6.2	4.4	9.1	BBB-
Russia	9.3	4.7	13.6	10.3	BBB
Euro Area		2.0	2.3	1.9	n.a.
Japan	0.4	-0.8	-0.4	-0.1	AA-
US	2.3	0.8	2.6	2.2	AA+

Source: WEO

Macroeconomic stability: Over the past decade, China's growth rate averaged over 10 percent annually, with low and stable inflation comparable to those in advanced economies and large emerging markets. In addition, strong economic performance and macroeconomic stability is expected to continue over the medium term. Strong macroeconomic fundamentals are also reflected in China's investment-grade sovereign credit rating, currently at AA-.

Financial depth and openness: Despite progress in financial development, compared to advanced markets, China's financial markets remain less developed according to traditional measures of financial depth. However, a new proxy for financial depth, measured as an index of total financial claims (both domestic and external) over GDP for individual countries and for the world as a whole, shows that China compares better. The index shows that advanced economies (U.S., euro area, Japan, U.K.) contribute most to "global financial depth", followed closely by China (Goyal et al., 2011). However, this measure only captures total financial stocks as one proxy for depth and needs to be augmented with additional information on capital account openness and international tradability. On this front, China's capital account remains largely closed compared to other advanced and emerging countries, despite some progress in allowing some access (within specified quotas) under the Qualified Foreign Institutional Investors program (QFII) and capital outflows under the Qualified Domestic Institutional Investors program (QDII). Since initiating



Source: Database on Financial Development and Structure, World Bank, 2011

Top five contributors to global financial depth*In percentage share of global financial depth weighted by GDP*

	1989	2009
Advanced countries	92.8	Advanced countries 82.4
United States	32.5	United States 29.4
Japan	28.3	Japan 13.2
United Kingdom	5.7	United Kingdom 7.8
Germany	5.3	Germany 6.1
France	4.5	France 5.4
Emerging markets	7.2	Emerging markets 17.6
Brazil	1.9	China 7.2
China	0.9	Brazil 1.6
Hong Kong SAR	0.7	Hong Kong SAR 1.6
Korea	0.7	Korea 1.2
India	0.5	India 1.1

Source: Goyal et. al (2011)

RMB internationalization efforts, foreigners were able to develop and trade a wide range of RMB-denominated financial instruments in Hong Kong, SAR, making it the first financial center for RMB investments offshore. Below is a detailed discussion of these recent developments.

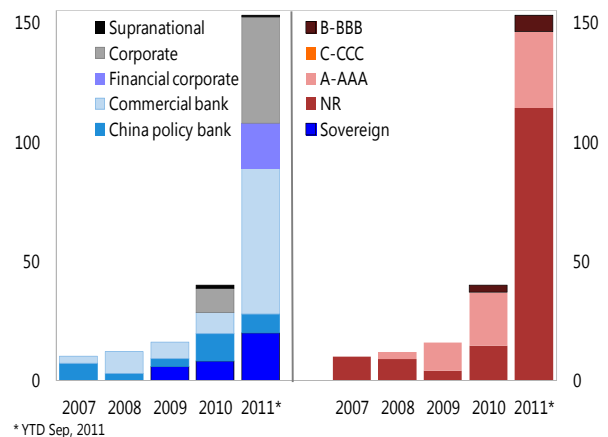
- RMB deposits and financial instruments.* The origins of the RMB offshore market can be traced back to January 2004, when residents in Hong Kong, SAR were allowed to hold RMB in offshore accounts. However, the outflow of RMB remained limited until the trade settlement scheme was introduced and expanded, allowing RMB to flow back and forth from mainland without restrictions as long as it is for trade settlement. Once offshore, it is reclassified as CNH without restrictions on its end use as long as it remains offshore. During the course of 2010, the pool of RMB deposits offshore increased fourfold to a stock of RMB 300 billion and the market for RMB-denominated products expanded rapidly. By the end of September 2011, RMB deposits in Hong Kong, SAR reached RMB 622 billion. At this level, RMB deposits accounted for 10.4 percent of total deposits in Hong Kong, SAR. The first offshore RMB mutual fund was created in August 2010 and the list of offshore RMB products had already become substantial. Beyond active spot and forward foreign exchange markets, RMB cross currency swaps, certificates of deposit, interbank lending, and some structured products are available in Hong Kong, SAR. While the offshore RMB market is expected to continue to flourish, this will depend on the availability of RMB-denominated investment instruments offshore and the ability of investors to deploy deposits back to the mainland. In August 2010, the PBoC expanded the channels, through which offshore RMB could flow back to the mainland; central banks and qualified financial institutions (offshore commercial banks engaging in RMB trade settlement and offshore RMB clearing banks) were allowed to invest RMB directly in the onshore interbank bond market, subject to individual quotas.
- RMB bonds.* The supply of the RMB-denominated assets offshore has lagged demand and the rapid growth of the pool of RMB deposits in Hong Kong, SAR. Issuers of RMB-bonds or “Dim-Sum” bonds are benefiting from this excess demand and are able to raise funds offshore at much lower yields in comparison to onshore issuers. The first RMB bond was issued in July 2007, and Chinese banks were permitted to remit the proceeds onshore subject to approval and could pay principal and interest in RMB subject to quota. This is an important channel for RMB funds to be transferred back onshore and created an additional important feedback loop between onshore and offshore RMB markets. With strong demand from investors and banks, who are eager to deploy their stock of RMB deposits, the market is also growing rapidly. The value of RMB-denominated bonds issued in Hong Kong, SAR reached RMB 41 billion in 2010, compared to RMB16 billion in 2009. Issuance surged in 2011 and the stock of outstanding RMB bonds was already RMB 167 billion by end of October, while market structure shifted from sovereigns to banks and corporates. Issuance is mostly by businesses with natural RMB hedge who take advantage of lower yields offshore compared with RMB or dollar funding on the mainland. McCauley (2011) notes that the dominant role of domestic issuers in the offshore RMB market is a very unusual trait compared with other offshore markets. The dearth of non-Chinese RMB issuers has allowed corporates with unusually weak credit

ratings to issue bonds offshore. Despite weak credit, yields on CNH bonds were lower due to the high demand for gaining RMB exposure, driven by appreciation expectations and lack of demand for RMB loans from offshore borrowers. Although most issuances were not rated, investors were able to differentiate between issuers based on other available information. For instance, as quite a number of the issuers were listed companies, information about those firms was available to investors and hence they did not necessarily need to rely on credit rating. Appreciation expectations were also reflected in the short tenor (less than three years) of most issues. In addition, absence of alternatives for offshore RMB investments and appreciation expectations have caused offshore RMB bond holders to maintain their position, thus the secondary bond market has little or no volume. Thus, there is a potential for mispricing of risk, especially given that many offshore issues do not have a credit rating. In this context, the authorities' plans to expand the issuance of Treasury bonds in Hong Kong, SAR, announced in August 2011, will offer critical support for market development and will help establish a benchmark risk-free rate.

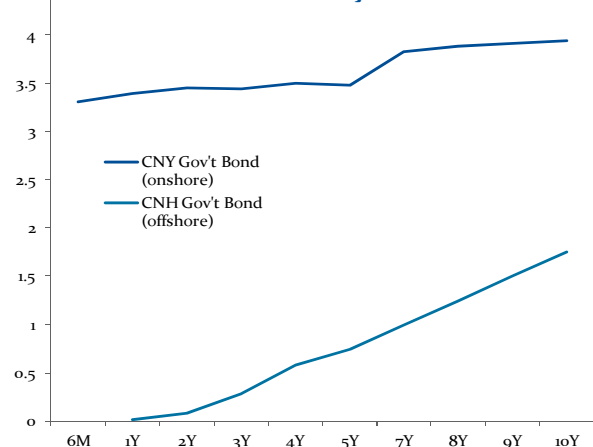
- RMB FDI.** In October 2011, the authorities announced the rules governing the use of RMB for foreign direct investment (FDI) in the country, allowing foreign enterprises to invest in the form of FDI in the mainland. Prior to that, FDI denominated in RMB was allowed on a case by case subject to approval. This development would make RMB-denominated FDI more transparent under a standardized framework, giving foreign enterprises greater incentive to use the RMB in their cross-border transactions and potentially to speed up two-way circulation of RMB funds both in and out of the mainland. In the longer run, this should further spur the development of offshore RMB products in Hong Kong and increase the confidence of enterprises to raise fund in Hong Kong, SAR for investments on the mainland. Under the rules, FDI flows would have to be backed by actual settlement or business need to be settled within three months of the transaction, and applications for RMB FDI totaling more than 300 million will be subject to approval by the Ministry of Commerce (MoC), while those of lesser amounts will be subject to approval by branches of the MoC at provincial level.

CNH Bonds: New Issuance

(In billions RMB; by issuer sector & type of rating)



Government bond yield



- *Portfolio flows.* Prior to August 2011, a narrow set of qualifying institutions, including RMB-trade settlement banks, qualifying central banks, and the Bank of China in Hong Kong, SAR and Macau (the offshore clearing bank for trade settlement) were able to invest in the interbank bond market onshore. In the package of measures announced in August 2011, the long awaited “mini QFII” scheme was finally given the official green-light with an initial quota of RMB 20 billion (and the relevant administrative rules were announced by the Chinese authorities in December 2011). This is effectively a RMB-settled version of the current U.S. dollar-settled QFII. Although the size of the quota is small, reflecting concerns over capital inflows, it is nevertheless an important step towards greater RMB internationalization.

Policy support and credibility: The emergence of international currencies is predominantly market-determined. The process is gradual and depends on the interplay between free access to the currency, domestic capital market development, and availability of safe store of value assets, as well as the willingness (and ability) of foreign agents to hold, issue and actively trade assets denominated in that currency. However, enabling institutions and policies could provide impetus and lend credibility to the process of currency internationalization. Specifically, policies supportive of financial sector reforms and liberalization, and willingness to invest in the infrastructure necessary to use and trade the currency are crucial. Moreover, the willingness of the issuing central bank to act as global lender of last resort at times of financial stress, for instance by extending swap lines to foreign banks, play an important role in cementing the currencies’ global status. In this vein, the Chinese authorities’ initiative to encourage cross-border use of the RMB is clearly supportive of achieving the currency’s potential international role both as a medium of exchange through trade settlement, and as a store of value by allowing access to RMB-denominated assets offshore and more gradually onshore. However, building the RMB’s credibility as international currency will be long-term process with a number of requirements along the way. A steady progress in reforming and developing the financial sector and gradual liberalization of the capital account will be necessary to complete the process of currency internationalization.

Potential risks. Rapid development of the offshore RMB market entails a number of risks, especially at a time of transformation in China’s financial system. Potential risks could be broadly divided into two types: market development and financial stability risks.

- *Market dynamics:* The rapid development of the RMB business in Hong Kong, SAR suggests strong interest in holding the currency and investing in it. Yet, part of investors’ interest has been driven by expectation of RMB appreciation. Thus in the absence of a sufficient supply of RMB-denominated assets, there is a risk that market development may lose momentum or stagnate as appreciation expectation are met or becomes less one-sided. In late 2011, market expectations of currency appreciations moderated in light of lower growth projections for 2012 and generalized risk aversion due to the debt crisis in Europe, resulting in lower demand and deleveraging of CNH-denominated investments, while the accumulation of RMB deposits in Hong Kong, SAR decelerated and the stock actually shrank for the first time in October 2011. Market dynamics offshore pushed the

CNH offshore towards depreciation, creating a wider wedge with RMB valuation onshore.

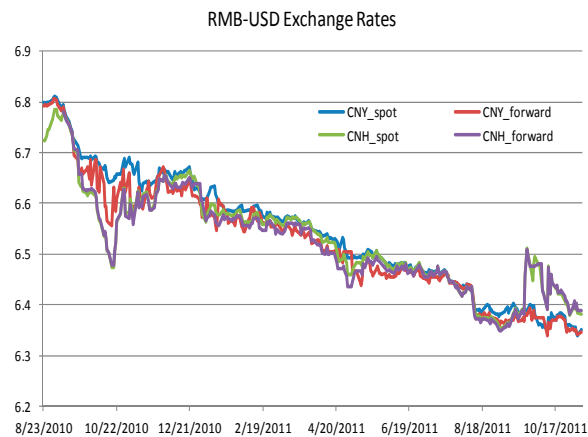
- Bond market and RMB flows:* To keep the momentum for market development beyond appreciation expectations, the authorities would be expected to expand the channels to invest RMB funds productively onshore, and expand the repatriation of bond proceeds raised offshore. Requiring approval for repatriating bond proceeds keeps offshore RMB issuance small. Similarly, two-way currency movement could encourage the well-functioning of the offshore RMB bond market. A major deterrent for non-Chinese firms to issue CHN-denominated bonds despite low yields is the risk of currency appreciation. If issuers perceived a two-way currency movement, it would encourage non-Chinese firms to take on RMB-denominated liabilities, thus contribute to expanding the stock of RMB-denominated assets offshore. Recent measures to allow RMB-denominated inward FDI and the launch of the mini-QFII sent a clear signal about the authorities' commitment to maintain the momentum and support gradual currency internationalization. In this regard, the scale of repatriation of bond proceeds and access to RMB-denominated assets onshore should keep pace with the growing demand and business needs offshore. As offshore RMB continues to accumulate through trade settlement, the PBoC would be expected to increase the quotas and allow more RMB to flow across the borders. For instance, the current quota-based regulatory framework was tested when the HKMA activated its currency swap arrangement with the PBoC for the first time on October 28, 2010, as the BoCHK's annual quota for RMB trade settlement conversions was depleted. In this regard, the experience of the yen suggests the importance of encouraging two-way demand for the currency. In the case of the RMB, facilitating financial development onshore to absorb foreign demand for RMB-denominated investments would be critical for the success of internationalization.
- Stability risk:* Generally speaking, financial stability risks due to offshore market development would be limited given the size of the offshore market of about 10 percent of onshore base money, and the effectiveness of controls on the flow of capital onshore. However, going forward the process of RMB internationalization and the strong demand for RMB assets would expand the channels of feedback and arbitrage across onshore and offshore markets. Particularly, as mainland businesses have greater access to credit through offshore subsidiaries of mainland banks or issue RMB bonds offshore, some of effectiveness of the credit rationing onshore could be undermined. As of now, this risk remains contained as repatriation of bond proceeds issued offshore remain subject to quota set and approved by the mainland authorities. In the long run, this could lead to disintermediation of large Chinese firms from the banking system onshore as they forge ties with banks offshore or borrow directly in the offshore bond market. Eventually, as the offshore market grows, larger cross-border flows could undermine the effectiveness of credit controls onshore and administered interest rates as offshore banks extend credit directly to firms onshore.³ Mainland corporates are reported to have sourced foreign

³ For instance, between 1985 and 1989, the proportion of offshore yen claims on Japanese residents jumped from around 20 to 60 percent (McCauley, 2011)

currency loans in Hong Kong, SAR as a result of the tightening credit environment in the mainland (Bank of America, 2011). Similarly, the ability to remit RMB back onshore as FDI and portfolio flows would also strengthen links across the two markets. This could potentially lead to: i) some loss of monetary control due to access to credit offshore at unregulated interest rates; ii) exchange rate pressure on RMB offshore would lead to exchange rate movement onshore due to arbitrage opportunities available to market participants operating in both markets; and iii) pressure on reserve accumulation due skewed demand towards import settlement in RMB and as investment rather than funding currency (He, 2011; IMF, 2011a). Bearing these potential risks in mind, the rest of the paper will explore some empirical evidence on the links between the onshore and offshore RMB markets, which could strengthen as the market develops.

III. RMB INTERNATIONALIZATION-CROSS MARKET LINKS

Given that the onshore spot market is heavily managed and there are wide-ranging capital controls on cross-border flows, linkages between onshore and offshore exchange rates are expected to be limited. However, both rates have tracked each other quite closely, with the exception of some divergence in late 2010 and again in late 2011, suggesting some *de facto* links between onshore and offshore markets. For example, market participants offshore would extract policy signals from onshore market prices, while onshore market participants might believe that price development offshore better reflect global market conditions due to its better integration in global financial markets. Based on this intuition, the rest of the paper will explore some empirical analysis that evaluates the existence of such links.



What would have led to close convergence of onshore and offshore exchange rates? Onshore corporates operating in both mainland and Hong Kong can be a channel since they can trade either onshore or offshore markets, though there are still wide-ranging restrictions on repatriation of funds as discussed in the previous sections. While onshore and offshore banks are not allowed to trade in offshore and onshore markets, respectively, both can trade in the Non-Deliverable Forward (NDF) market. So there are also opportunities of arbitraging indirectly through the NDF market.⁴

Previous research on the impact of the RMB on other currencies has been mixed and mostly limited to analyzing NDF market, due to the very recent introduction of the offshore market in Hong Kong, SAR. Investigating the impact of RMB NDF on other currencies markets,

⁴ See Morgan Stanley (2011) for more detailed discussion.

Izawa (2005) could not find evidence that RMB NDF is an unbiased predictor of future spot rates. Colavecchio and Funke (2008) found evidence of volatility spillovers between RMB NDF market and NDF markets for seven Asian currencies, with the RMB driving increasing co-movement among the other NDF markets. Ma et al. (2004) also found that co-movement among six Asian NDF currencies are larger than their spot counterparts. Regarding interest rates, Ma and McCauley (2008) found sustained and significant divergence between onshore and NDF rates and persistent interest rate differentials during the *de facto* dollar peg period. The inter-linkages between onshore spot rates and offshore NDF rates have also been studied for many other countries, including Park (2001) for Korea and Behera (2010) for India. We contribute to this literature by examining the inter-linkages of RMB exchange rates between onshore (CNY) and offshore (CNH) markets, bearing in mind that we cover a period of market creation and rapid development. While Ding et al. (2011) found limited spillovers between onshore and offshore spot rates from the onset of the offshore spot market to the second quarter of 2011, we find that spillover patterns have been different under different market conditions; a period of offshore market dislocation until the end of 2011, and a period of normal market conditions since then.

Methodology: To examine the linkages between onshore and offshore exchange rate markets, we employed a bivariate generalized autoregressive conditional heteroscedasticity (GARCH) model. Multivariate GARCH models have been used extensively for understanding the inter-linkages between various markets, including among stock markets (Bala and Premaratne, 2004) and between stock and exchange markets (Mishra, Swain, and Malhorta, 2007). In particular, to capture volatility spillovers from the time-varying conditional covariance, we specify the conditional covariance following Engle and Kroner (1995).⁵

The mean equation is specified as:

$$Y_t = \mu + \theta Y_{t-1} + \varepsilon_t: \text{ with } \varepsilon_t | I_{t-1} \sim N(0, H_t)$$

or

$$\begin{pmatrix} y_{1,t} \\ y_{2,t} \end{pmatrix} = \begin{pmatrix} \mu_1 \\ \mu_2 \end{pmatrix} + \begin{pmatrix} \theta_{11} & \theta_{12} \\ \theta_{21} & \theta_{22} \end{pmatrix} \begin{pmatrix} y_{1,t-1} \\ y_{2,t-1} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{pmatrix}$$

where Y_t is a vector of daily returns on exchange rates between time $t-1$ and t (log difference) in onshore and offshore markets, μ is a constant vector, and ε_t is a vector of error terms. Parameters in the off-diagonal terms of the coefficient matrix θ capture how the exchange

⁵ This specification has the advantage of imposing positive definiteness on the conditional covariance matrix, which is needed for the likelihood function estimation. More restricted version of multivariate GARCH models have been explored in the literature following Bollerslev et. al (1988) with no correlation on conditional covariance matrix or Bollerslev (1990) with constant conditional correlation restriction.

rate movement in one market at time $t-1$ affects the movement in the other market at time t (*mean spillovers*), while parameters in diagonal terms measure the lagged impact.⁶

Conditional variance-covariance matrix H_t is specified as:

$$H_t = C'C + A'\varepsilon_{t-1}\varepsilon_{t-1}'A + B'H_{t-1}B$$

$$H_t = \begin{pmatrix} \sigma_{1,t}^2 & \sigma_{12,t} \\ \sigma_{12,t} & \sigma_{2,t}^2 \end{pmatrix}, C = \begin{pmatrix} C_{11} & 0 \\ C_{21} & C_{22} \end{pmatrix}, A = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}, B = \begin{pmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{pmatrix}$$

where C is restricted to be a lower triangular matrix. A matrix A captures how conditional variances are correlated with forecast errors in the last period. In particular, while the parameters on the diagonal measure the impact of shocks (forecast errors) in each market on its own volatility next period, those off-diagonal terms capture *shock spillovers* across different markets. The matrix B captures how conditional variances at time $t-1$ affect those at time t . The parameters on the diagonal measure the persistence of volatility, and those off-diagonal capture *volatility spillovers* across different markets.

To better understand the coefficients of interest that capture various spillovers, we expand the above mean and conditional variance equations as follows:

Mean equations:

$$y_{1,t} = \mu_1 + \theta_{11}y_{1,t-1} + \theta_{12}y_{2,t-1} + \varepsilon_{1,t}$$

$$y_{2,t} = \mu_2 + \theta_{21}y_{1,t-1} + \theta_{22}y_{2,t-1} + \varepsilon_{2,t}$$

Conditional variance equations:

$$\sigma_{1,t}^2 = \text{constant} + a_{11}^2\varepsilon_{1,t-1}^2 + 2a_{11}a_{21}\varepsilon_{1,t-1}\varepsilon_{2,t-1} + a_{21}^2\varepsilon_{2,t-1}^2$$

$$+ b_{11}^2\sigma_{1,t-1}^2 + 2b_{11}b_{21}\sigma_{1,t-1}\sigma_{2,t-1} + b_{21}^2\sigma_{2,t-1}^2$$

$$\sigma_{2,t}^2 = \text{constant} + a_{12}^2\varepsilon_{1,t-1}^2 + 2a_{12}a_{22}\varepsilon_{1,t-1}\varepsilon_{2,t-1} + a_{22}^2\varepsilon_{2,t-1}^2$$

$$+ b_{12}^2\sigma_{1,t-1}^2 + 2b_{12}b_{22}\sigma_{1,t-1}\sigma_{2,t-1} + b_{22}^2\sigma_{2,t-1}^2$$

The mean equations show that return on onshore (offshore) exchange rates at time t is affected not only by its own lagged return but also by lagged return on offshore (onshore)

⁶ While Ding et al. (2011) considered five lags in VAR model with daily data to take into account up to one trading week's worth of activity, we consider only one day lag in our model to focus on short-term price dynamics.

exchange rates. In particular, parameters θ_{12} and θ_{21} measure these *mean spillovers* from offshore to onshore markets and from onshore to offshore markets, respectively. Conditional variance equations also show that shocks (forecast errors) and volatilities are transmitted across markets; a_{12} (a_{21}) measures the effects of *shock spillover* from onshore (offshore) to offshore (onshore) markets, while b_{12} (b_{21}) captures the *volatility spillover* from onshore (offshore) to offshore (onshore) markets.

Data: While onshore spot rates are heavily controlled by government policies, onshore forward rates and offshore spot and forward rates are determined in respective markets. Considering this difference, we empirically examine various spillover effects (mean, shocks, and volatility) not only between spot rates but also between forward rates and between spot and forward rates. We use daily closing spot and 3-month forward exchange rates in onshore and offshore markets from August 23, 2010 to September 16, 2011.

Sample period:⁷ To capture different dynamics between onshore and offshore markets under different market conditions, we split the entire sample period into two sub-periods: August 23-December 31, 2010, covering a period of offshore market dislocation, and the other from January 3-September 16, 2011, representing normal market conditions. During the first period, the RMB was trading with significant premium in the offshore market relative to the corresponding onshore rates reflecting lack of liquidity in the newly created market and capital controls on flows between onshore and offshore markets.⁸ As market liquidity improved in the offshore market after the activation of swap arrangement between the HKMA and the PBoC in late October, onshore and offshore exchange rates began to converge.

Conversely, since mid-September in 2011, offshore RMB started trading at a discount, in part due to generalized risk aversion and deleveraging related to the European debt crisis, and the moderation of expectations of RMB appreciation in the context of global financial turmoil. However, extension of the second sample period to include this episode of market turmoil does not change our main results.

⁷ Offshore spot and forward exchange rates began trading in Hong Kong, SAR in August 23, 2010 and September 8, 2010, respectively.

⁸ In particular, on the back of stronger-than-expected demand for RMB for cross-border trade settlement, the Bank of China in Hong Kong (the official clearing bank for trade settlement) used up its initial quota of RMB 8 billion in the third quarter of 2010, leading to a sharp appreciation of the CNH as liquidity in the offshore market dried up. In response, the Hong Kong Monetary Authority (HKMA) activated its swap arrangement with the PBoC in late October and, since then the exchange rate differential began to narrow. As market liquidity improved in line with the use of RMB in trade settlement, onshore and offshore exchange rates continued to converge.

Main results and discussion of onshore/offshore links

Links between spot exchange rates: Empirical results suggest that (i) developments in the offshore spot market could influence the onshore spot market in terms of both level and volatility during a period of offshore market dislocation, and (ii) the onshore market drives price movement offshore under normal market conditions, while developments in the offshore market could still affect the volatility of price movement in the onshore market.

We find evidence that developments in the offshore spot market influenced onshore spot rates during the first sub-period of market development and dislocation, with little mean spillover from the onshore to the offshore market. The estimation results imply that 1 percent appreciation of offshore spot rates leads to 0.14 percent appreciation of onshore spot rates in next trading day (Table 1, top panel). We can also see that coefficient estimate capturing volatility spillover from the offshore to the onshore market is statistically significant: 1 percent rise in conditional standard deviation of offshore spot rates today increases the conditional standard deviation of onshore spot rates by about 0.5 percent tomorrow. These findings suggest that, developments in the offshore spot market could influence the onshore spot market in terms of both level and volatility during a period of offshore market turmoil, possibly because market participants believe that price development offshore better reflect global market conditions due to its better integration in global markets. Considering that the market volatility increases in the offshore market during a period of financial turbulence, these results imply that the stability of the onshore market could be negatively impacted by market dislocation offshore.

By contrast, we could see the opposite pattern during the second sample period: onshore market movement impacted offshore prices (Table 1, bottom panel). As discussed above, once the liquidity situation improved in the offshore market after the activation of the swap arrangement between HKMA and PBoC and expansion of trade settlement flows offshore, the exchange rate differential between onshore and offshore markets gradually narrowed. Under such normal market conditions, onshore market developments seem to have an impact on price movement offshore in next trading day as policy signals are incorporated in prices—for example, PBoC's intervention or policy announcements. This is an intuitive result given market size and liquidity in the onshore market. The estimation results indicate that 1 percent appreciation of onshore spot rates today leads to 0.26 percent appreciation of offshore spot rates tomorrow. Coefficient estimate capturing mean spillover from the offshore to the onshore market is small and statistically insignificant in the second sub-period, suggesting little impact from the offshore to the onshore market under normal market conditions.⁹

⁹ Coefficient estimates for own one-day lag are small and statistically insignificant for both CHY and CNH, consistent with low serial correlations of return series.

However, volatility spillovers from the offshore to the onshore market remain important and become larger during the second sample period. We find evidence for shock and volatility spillovers in both directions even during normal times. One percent increase in conditional standard deviation of offshore spot rates increases the conditional standard deviation of onshore spot rates by about the same magnitude in next trading day, almost twice as high as during the first sample period. These findings suggest that, despite the wide-ranging capital controls on flows between onshore and offshore markets, already existing links through volatility channels from the offshore to the onshore market have strengthened as the offshore market developed.

Links between forward exchange rates: In contrast with the pattern of influence in the spot markets, we find that the offshore forward market moves ahead of the onshore forward market. In particular, (i) today's offshore forward rates have a predictive impact on tomorrow's onshore forward rates, but not vice versa, in both sample periods, and (ii) the offshore forward market also has influence on the onshore forward market through the channel of volatility spillover during the second sample period (January 3-September 16, 2011).

We find evidence that developments in the offshore forward market have an influence on the onshore forward market in both sample periods. However, there seem to be little mean spillover from the onshore to the offshore market in both sample periods. The estimation results imply that 1 percent appreciation of offshore forwards rates leads to more than 0.2 percent appreciation of onshore forward rates in next trading day for both sub-sample periods (Table 2). These findings suggest that offshore market participants' expectations about price movement in the future have significant influence on onshore market participants' expectation of future price movement. In other words, onshore market participants seem to count on price signals in the offshore market in forming their price expectation of forward exchange rates.

The offshore forward market also has influence on the onshore forward market through the channel of volatility spillover during the second sample period. The coefficient estimate capturing this effect is statistically significant during this period: 1 percent rise in conditional standard deviation of offshore forward rates increases the conditional standard deviation of onshore forward rates by more than 0.5 percent in next trading day. In contrast, volatility in the onshore forward market, which used to have some effect on volatility in the offshore market during a period of offshore market dislocation, became smaller and insignificant under the normal market conditions.

The above findings suggest that the offshore forward market have statistically significant impact on the onshore forward market both in level and volatility. This could be due to the market-determined nature of the forward market onshore compared to the spot rate, allowing market participants to extract price signals from offshore market in setting forward rates onshore.

Links between spot and forward exchange rates: Empirical results indicate that (i) today's offshore forward rates have a predictive impact on tomorrow's onshore spot rates in the early phase of market development and disruption, similar to the spillover patterns across spot markets, and (ii) the onshore spot rates drives the offshore forward rates under normal market conditions, while developments in the offshore market could still affect price movement onshore through the volatility channel (Table 3). As above, these findings suggest that there are already some cross-market spillovers between the policy-driven onshore spot market and the market-determined offshore forward market. In contrast, there seem to be little cross-market mean spillovers between the onshore forward market and the offshore spot market under normal market conditions (Table 4).

In sum, given that the onshore spot market is heavily controlled, developments in the onshore spot rates exert an influence on both spot and forward rates offshore under normal market conditions as policy signals and market size of the onshore market drive price movement offshore. In contrast, the offshore forward market do seem to move ahead of the onshore forward market, with today's offshore forward rates having predictive impact on tomorrow's onshore forward rates. We can also find evidence that, despite wide-ranging capital controls on flows between onshore and offshore markets, developments in the offshore market could influence onshore markets through volatility channels. Given that volatility in the offshore market has been higher than that in the onshore market¹⁰, these findings imply that offshore market developments should be monitored carefully, as it could impact exchange rate stability on the mainland. In addition, during a period of offshore market dislocation, developments in the offshore market could influence the onshore spot market in terms of both level and volatility possibly because market participants believe that price development offshore better reflect global market conditions.

IV. POLICY IMPLICATIONS

Emergence of international currencies is closely linked to demand for the currency related to real economic activity, currency convertibility, and financial depth and openness. There is already demand for the Chinese currency driven by the country's wide trade network and significant economic weight in the global economy, which has been encouraged with the launch and expansion of the trade settlement scheme. Similarly, there is strong demand for RMB-denominated assets as stores of value given the rapid progress of the offshore RMB market.

At this stage, cross-border use of the RMB in trade settlement and in the offshore market remains largely lopsided: greater RMB outflows through import settlement and strong demand from investors in the face of limited availability of RMB-denominated liabilities.

¹⁰ Standard Chartered Bank (2011) reported that volatility of offshore spot exchange rates is higher than that of onshore spot rate by 40-50 percent (based on daily data)

Market expectations of RMB appreciation limits interest by non-Chinese borrowers to raise RMB funds offshore, while the limited scope to repatriate funds onshore constrain the ability of mainland residents to tap the offshore market more widely. As appreciation expectations moderate and the RMB approaches further its equilibrium value, the availability and access to RMB-denominated assets would be critical to maintain investors' interest in RMB-denominated assets and support two-way RMB flows. Ultimately, the pool of RMB deposits offshore will have to be deployed in RMB-denominated assets either onshore (through FDI or portfolios flows) or offshore. The Chinese authorities have been taking steady steps to the gradually expand access to RMB assets onshore and have been willing to support the smooth functioning of the offshore RMB market as well. This gradual approach to RMB internationalization is expected to continue.

Although there is scope for gradualism and market segmentation, existing market dynamics and the empirical analysis presented in this paper suggest that some feedback channels already exist across onshore and offshore markets. Notably, there seems to be strong and persistent volatility spillovers between the two markets, where market turmoil offshore – despite its small size – impact exchange rate volatility onshore in the spot and forward markets. As the offshore market develops, feedback channels are likely to strengthen. In this context, the pace of RMB internationalization and the growth of the offshore market should be accompanied by financial sector reforms and deepening onshore to be able to absorb growing cross-border flows that will necessarily accompany further RMB internationalization. While the process of RMB internationalization will advance based on market forces, supportive policies to ensure smooth evolution of the RMB's role could be contemplated in three broad areas:

- *More assets offshore.* Expanding the supply of RMB-denominated assets offshore is necessary to maintain the momentum of RMB internationalization beyond appreciation expectations. This is especially important given existing controls on FDI and portfolio flows onshore. As the RMB further approaches its equilibrium value and market expectations of exchange rate movement become more balanced, non-Chinese residents would be encouraged to tap the offshore market to raise funds, thus improving the composition of market players and the quality and credit risk of issuers.
- *Financial deepening and liberalization onshore.* Experience of other international currencies, including the US dollar and yen offshore markets, suggest that offshore market development is not divorced from developments onshore. Thus, to successfully internationalize the currency, financial deepening onshore should keep pace with the growing offshore market to minimize risks to the stability of the financial sector onshore, reduce risk of disintermediation of the domestic financial sector, and also keep the momentum for internationalization.
- *Building the RMB's credibility.* International use of the currency is ultimately based on the credibility of the monetary authorities that support its value. In fact, questions about the long-term credibility of the US dollar prompted a lot of interest in the RMB's

potential as the next international currency, as was the case before with the rising use of the mark and yen more than two decades ago. Establishing confidence in the currency is a long-term process and requires a track record of sound economic policies, including stable and low inflation to maintain the value of the currency. This would lay the foundation for the RMB's international role and lead to genuine two-way demand for the currency for trade and investment purposes.

Table 1. GARCH Model: Onshore Spot Rates and Offshore Spot Rates

Sample period: 08/23/10 — 12/31/10			
Mean equations			
θ_{11}	-0.231**	θ_{12}	0.136*
θ_{21}	0.087	θ_{22}	0.213*
Variance-covariance equations			
a_{11}	-0.021	a_{12}	-0.927***
a_{21}	0.339***	a_{22}	0.636***
b_{11}	-0.481**	b_{12}	0.313
b_{21}	0.502***	b_{22}	0.715***
Sample period: 01/01/11 — 09/16/11			
Mean equations			
θ_{11}	-0.088	θ_{12}	0.068
θ_{21}	0.257*	θ_{22}	-0.086
Variance-covariance equations			
a_{11}	-0.172	a_{12}	-0.840***
a_{21}	0.338**	a_{22}	0.743***
b_{11}	0.322	b_{12}	0.603*
b_{21}	-0.972***	b_{22}	-0.885***

Notes: *, **, *** indicate statistically significant coefficients with 10%, 5%, and 1% confidence levels, respectively.

Table 2. GARCH Model: Onshore Forward Rates and Offshore Forward Rates

Sample period: 09/08/10 — 12/31/10			
Mean equations			
θ_{11}	-0.049	θ_{12}	0.232*
θ_{21}	0.036	θ_{22}	-0.011
Variance-covariance equations			
a_{11}	0.742***	a_{12}	-0.067
a_{21}	-0.967**	a_{22}	0.377***
b_{11}	0.622***	b_{12}	0.163***
b_{21}	0.234	b_{22}	0.820***
Sample period: 01/01/11 — 09/16/11			
Mean equations			
θ_{11}	-0.334***	θ_{12}	0.205**
θ_{21}	0.071	θ_{22}	-0.098
Variance-covariance equations			
a_{11}	0.349***	a_{12}	-0.243**
a_{21}	0.241***	a_{22}	0.466***
b_{11}	0.803***	b_{12}	-0.025
b_{21}	-0.575***	b_{22}	0.300

Notes: *, **, *** indicate statistically significant coefficients with 10%, 5%, and 1% confidence levels, respectively.

Table 3. GARCH Model: Onshore Spot Rates and Offshore Forward Rates

Sample period: 09/08/10 — 12/31/10			
Mean equations			
θ_{11}	-0.216**	θ_{12}	0.139*
θ_{21}	0.136	θ_{22}	0.133
Variance-covariance equations			
a_{11}	0.039	a_{12}	-0.726***
a_{21}	0.311***	a_{22}	0.442***
b_{11}	-0.209	b_{12}	0.505
b_{21}	0.424***	b_{22}	0.710***
Sample period: 01/01/11 — 09/16/11			
Mean equations			
θ_{11}	-0.045	θ_{12}	0.039
θ_{21}	0.329***	θ_{22}	-0.167*
Variance-covariance equations			
a_{11}	-0.021	a_{12}	-0.841
a_{21}	0.132	a_{22}	0.744***
b_{11}	1.024***	b_{12}	0.789*
b_{21}	-0.881***	b_{22}	-0.717*

Notes: *, **, *** indicate statistically significant coefficients with 10%, 5%, and 1% confidence levels, respectively.

Table 4. GARCH Model: Onshore Forward Rates and Offshore Spot Rates

Sample period: 08/23/10 — 12/31/10			
Mean equations			
θ_{11}	-0.283***	θ_{12}	0.470***
θ_{21}	-0.128***	θ_{22}	0.240**
Variance-covariance equations			
a_{11}	0.412***	a_{12}	-0.334***
a_{21}	-1.286***	a_{22}	-0.199
b_{11}	0.527***	b_{12}	0.376***
b_{21}	-0.230**	b_{22}	0.516***
Sample period: 01/01/11 — 09/16/11			
Mean equations			
θ_{11}	-0.226***	θ_{12}	0.109
θ_{21}	0.067	θ_{22}	0.071
Variance-covariance equations			
a_{11}	-0.459***	a_{12}	-0.021
a_{21}	0.393*	a_{22}	0.621***
b_{11}	0.387**	b_{12}	-0.118
b_{21}	-0.982***	b_{22}	0.299**

Notes: *, **, *** indicate statistically significant coefficients with 10%, 5%, and 1% confidence levels, respectively.

Table 5. Highlights of Developments in RMB Internationalization

Date	Policy Measure
November, 2003	PBoC agreed to provide RMB clearing arrangements in Hong Kong
Early 2004	Personal RMB business initiated in Hong Kong, including deposit taking, remittances, ATM, and card services
January, 2007	Mainland financial institutions permitted to issue RMB bonds in Hong Kong
July, 2009	RMB cross-border trade settlement pilot launched
October, 2009	First sovereign bond issued offshore by the Ministry of Finance
July, 2010	RMB cross-border trade settlement scheme expanded to 20 provinces and cities, and became available worldwide; New regulations between PBoC and HKMA to allow RMB investment products offshore under established regulations for products in other currencies
August, 2010	Pilot scheme for qualified institutions to invest in mainland bond market, including banks participating in the RMB trade settlement program, overseas clearing bank (Bank of China, Hong Kong), and offshore monetary authorities
October, 2010	HKMA activated central bank swap line with PBoC in response to liquidity pressures in the offshore RMB market
November, 2010	Auction of Ministry of Finance bonds completed (RMB 5bn in total)
December, 2010	List of eligible exporters under the cross-border trade settlement expanded
January, 2011	Bank of China, New York branch begins RMB business
January, 2011	PBoC launched pilot scheme to allow domestic institutions to make outward direct investment in RMB
April, 2011	Launch of first RMB equity IPO in Hong Kong
August, 2011	Announcement of a range of measures to support Hong Kong's development as the offshore RMB businesscenter, including launch of RMB 'mini-QFII' allowing investment in mainland securities in RMB, totalling RMB 20bn; expansion of the issuance of RMB bonds offshore by domestic financial institutions and corporates; expansion of the government bond issuance in HK; expansion of RMB trade settlement nationwide.
October, 2011	Launch of RMB-denominated FDI scheme
December, 2011	Initiative to encourage use of RMB in settling trade between Japan and China.
March, 2012	All Chinese exporters became eligible for cross-border trade settlement scheme

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