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**Trilemma Challenges for the  
People's Republic of China**

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**Abstract**

This paper first reviews recent developments in exchange rate regimes, capital account liberalization, interest rate liberalization, and monetary policymaking in the People's Republic of China (PRC). It then observes that the PRC's monetary policy autonomy may have been reduced with falling capital control effectiveness and a rigid exchange regime that is still tightly managed against the United States (US) dollar. This hypothesis is investigated empirically using both the Taylor rule and the McCallum-like rule to test whether the PRC's money market interest rate and/or quantity of money supply are being increasingly influenced by the US interest rate or reserve accumulation. The paper concludes that there is considerable evidence suggesting diminishing monetary policy autonomy in the PRC. To regain policy autonomy, the monetary authority needs to substantially increase exchange rate flexibility of the renminbi as long as it continues to pursue capital account opening.

**JEL Classification:** E52, E58

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## 1. INTRODUCTION

The People's Republic of China (PRC) is facing trilemma challenges as it continues to liberalize its capital account. The trilemma hypothesis claims that a country's monetary authority cannot achieve exchange rate stability, financial market (or capital account) openness, and monetary policy autonomy at the same time.<sup>1</sup> Thus, as financial market openness has increased over time in the PRC, its monetary authority must choose greater exchange rate flexibility to retain a high degree of monetary policy autonomy.

The PRC has been pursuing a policy of gradually opening its financial markets. Since the 1980s, the authorities have liberalized inward and then outward foreign direct investment (FDI). While strict controls used to be imposed on portfolio investment flows, these controls have also been relaxed in recent years to expand the range of investors and the type of financial assets permitted for cross-border transactions. The authorities introduced the system of qualified foreign institutional investors (QFII) for inward portfolio investment and that of qualified domestic institutional investors (QDII) for outward portfolio investment. The policy of internationalizing the renminbi (RMB), launched in the wake of the global financial crisis (GFC), has also facilitated greater financial market openness. Authorities now allow firms to settle merchandise trade in RMB, permit non-residents to hold offshore RMB deposits, and allow both PRC residents and non-residents to issue offshore RMB bonds and equities.

The PRC used to peg the RMB tightly to the US dollar, but exited from the dollar peg in July 2005. It began to engineer currency appreciation against the US dollar by shifting to a crawling-peg regime, thus allowing a certain degree of exchange rate flexibility. Although the authority temporarily restored a dollar-peg regime in August 2008–May 2010, it once again adopted a crawling-peg-like regime in June 2010. In general, the degree of exchange rate flexibility has gradually increased over time but remains highly limited.

This paper argues that while the PRC's financial markets have become increasingly integrated with external markets, particularly those in Hong Kong, China, the degree of RMB exchange rate flexibility has not risen much, and the combination of greater openness of its financial markets and lack of sufficient exchange rate flexibility has constrained the ability of the monetary authority to pursue autonomous monetary policy.

The organization of the paper is as follows. Section 2 reviews the trilemma hypothesis in international finance, which provides the theoretical foundation for the analysis of the paper. Section 3 discusses the evolution of the PRC's exchange rate regime and the degree of RMB exchange rate flexibility. Section 4 examines the pace and extent of financial market opening (or capital account liberalization) in the PRC and argues that its financial markets have been increasingly integrated with the Hong Kong, China markets despite the existing capital controls. Section 5 provides background information on the discussion of monetary policy effectiveness. Section 6 conducts econometric analysis to identify the monetary authority's policy rule and its changes over time and finds that the PRC authority's ability to set its autonomous monetary

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<sup>1</sup> In the PRC, monetary policy is largely decided by the government (the State Council and the executive branch), while its central bank—the People's Bank of China (PBoC)—serves as a policy implementation agency rather than a main policy decision maker. To reflect this reality, this paper uses the term “monetary authority” to refer to a main monetary policy decision maker. The paper also uses the term monetary policy “autonomy” rather than “independence” to avoid possible confusion with the issue of political and/or operational independence of a central bank.

policy has been hampered since the outbreak of the GFC. Section 7 offers some policy implications. Section 8 concludes the paper.

## 2. THE TRILEMMA HYPOTHESIS IN INTERNATIONAL FINANCE

Achieving noninflationary, stable economic growth is one of the most important policy objectives for monetary authorities, particularly central banks, in the world. Many authorities find it desirable to have stable or even fixed exchange rates, as currency stability can help achieve price stability by establishing inflation anchors and/or reducing macroeconomic and financial volatility. Exchange rate stability can also foster international trade and investment by lowering exchange rate uncertainty and currency risk premiums.

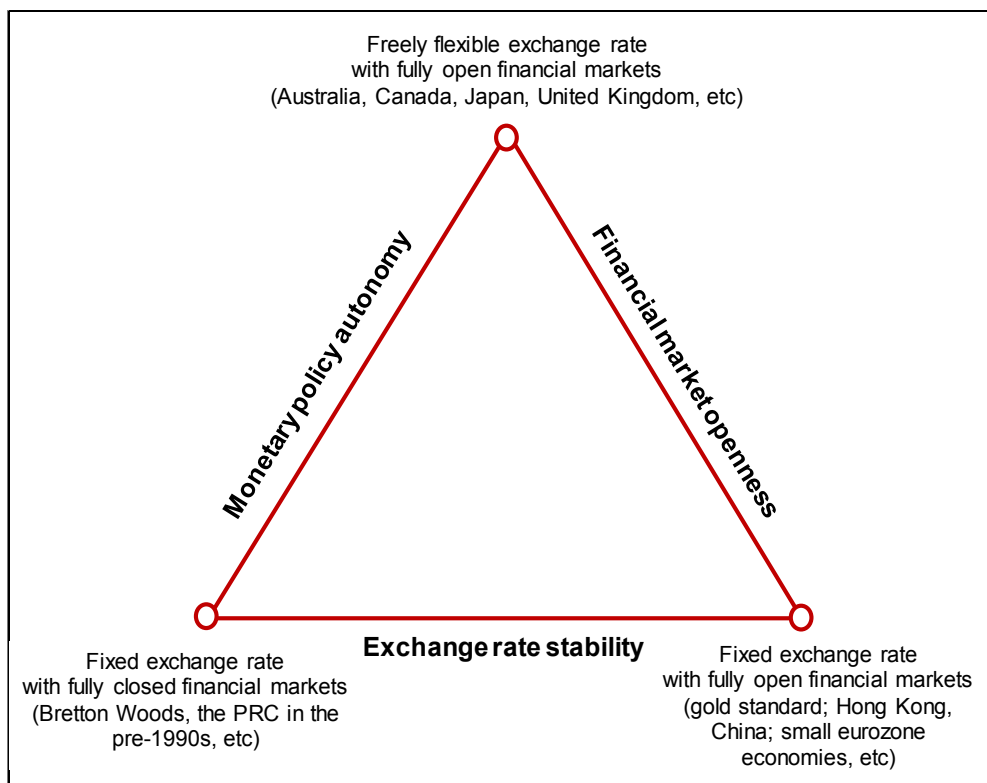
Many authorities also find it useful to have open financial markets as they allow countries to diversify economic and financial risks and smooth consumption, investment, and/or output over time. Financial market openness enhances the efficiency of financial intermediation and saving and investment decisions of households and corporations.

Finally, many authorities find it highly attractive to retain monetary policy autonomy, that is, the ability to set and implement monetary policy to offset other countries' monetary shocks and monetary policy changes without being constrained by their choice of exchange rate regime. Monetary policy autonomy significantly helps contribute to economic stabilization in the sense of achieving low inflation and stable economic growth.

Conceptually, higher levels of exchange rate stability, financial market openness, and monetary policy autonomy would all be useful and attractive for any monetary authority. But no authority can retain all three at any one time. This is the fundamental hypothesis—the “impossible trinity” or the “trilemma”—that dominates monetary policymaking in any open economy (Mundell 1963). The PRC is no exception.

The trilemma is often illustrated using a triangle as shown in Figure 1, with the three sides representing the three desirable properties: exchange rate stability, financial market openness, and monetary policy autonomy (Ito and Kawai 2014). While it is possible to achieve desired levels of two out of the three attributes, it is impossible to achieve desired levels of all three. For example, a country's authority may choose to stand at one of the three corners in the triangle, but it is impossible to achieve all three simultaneously. As only two out of three can be achieved to their full extent (or any extent), we often observe three distinctive policy combinations: (i) a fixed exchange rate regime and full monetary policy autonomy (with closed financial markets, as in the case of the lower left-hand corner—representing, for example, the Bretton Woods system and the PRC in the pre-1990s); (ii) a fixed exchange rate regime and fully open financial markets (while giving up monetary policy autonomy, as in the case of the lower right-hand corner—representing, for example, the gold standard system, a currency board system similar to Hong Kong, China and small eurozone countries); and (iii) fully open financial markets and full monetary policy autonomy (while adopting a freely flexible exchange rate regime as in the case of the top corner—representing for example, Australia, Canada, Japan, and the United Kingdom).

**Figure 1: The Trilemma Triangle**



PRC = People's Republic of China.

Source: Ito and Kawai (2014).

While history is full of episodes of systems that represent such “corner solutions,” monetary authorities can also adopt an intermediate combination of the three properties, that is, a “dot” inside the triangle. There are an infinite number of such combinations. The reason a monetary authority may select such a dot is that it may wish to compromise in selecting the level of attainment of each of the three properties. For example, a monetary authority may wish to have some exchange rate stability, some financial market openness, and some monetary policy autonomy. Or, if a monetary authority wishes to retain full monetary policy autonomy, it needs to strike a good balance between some exchange rate stability (or flexibility) and some financial market openness (or some capital controls). In many developing countries, monetary authorities often limit financial market openness as it would make the economy vulnerable to external financial shocks and capital flow volatility, creating boom and bust cycles and, potentially, financial crises.

The PRC’s monetary authority used to peg the RMB exchange rate to the US dollar while maintaining tight capital controls (the left corner of the triangle in Figure 1). This enabled the authority to retain monetary policy autonomy. However, as it began to gradually open its financial markets over time, its position in the triangle of Figure 1 started to shift from the left corner toward the side of financial market openness. If the authority continues to maintain exchange rate stability, this shift will take place horizontally along the bottom of the triangle, thus compromising monetary policy autonomy. On the other hand, if the PRC authority wishes to maintain monetary policy autonomy, the shift will take place upward along the left side, thus allowing greater exchange rate flexibility.

The choice of exchange rate regime therefore must be made in the context of the trilemma hypothesis, that is, in conjunction with the choices on monetary policy

autonomy and financial market openness. For a large economy like the PRC, maintaining monetary policy autonomy is an important requirement for effective macroeconomic management. So, as financial market (or capital account) openness increases over time, the authority needs to choose greater exchange rate flexibility to retain a sufficiently high degree of monetary policy autonomy.

### 3. EXCHANGE RATE POLICY AND RATE FLEXIBILITY

#### 3.1 Renminbi Exchange Rate Behavior since 2005

On 21 July 2005, the PRC authority de-pegged and revalued the RMB exchange rate against the US dollar by 2.1%, from CNY8.28 to CNY8.11 per US dollar. Accompanying the revaluation, the authority also announced a set of measures to shift the exchange rate regime to a more flexible “managed float” system. The RMB’s valuation from that point onward would be determined with reference to a basket of currencies. Prior to this change, the RMB had been on a fixed exchange rate system pegged to the US dollar with occasional devaluations.<sup>2</sup>

The new RMB exchange rate regime gave the authority a new policy tool to manage its economy. The authority announced a daily reference trading spot rate, called the central parity rate (CPR), for the RMB to trade against the US dollar. The PRC launched a steady appreciation immediately following the RMB revaluation in July 2005. Until January 2006, the authority would set the CPR for the next trading day at the previous trading day’s market close. In January 2006, a new pricing mechanism was introduced to set the CPR using a weighted average scheme.<sup>3</sup> Currency weights were determined by the China Foreign Exchange Trading System according to the previous day’s transaction volumes of individual market participants. In addition, other indicators such as quoted prices from the automatic price matching system could be used in principle as a reference. However, such information was often not available in real time. Thus, it was difficult for the market to determine how a daily CPR was set and whether it would be subject to various external political pressures and internal economic objectives (Liu and Pauwels 2012).

The steady appreciation of the RMB against the US dollar was temporarily halted toward the end of July 2008 with the eruption of the GFC. The peg lasted for almost 2 years until June 2010 at a rate of CNY6.831 per US dollar before resuming a steady path of appreciation. During this re-peg period, the PRC authorities prevented the RMB from appreciating vis-à-vis the dollar in order to help exporters cope with the sharp drop in demand from the US and the rest of the world.

In the past, once the CPR rate was determined against the US dollar, the exchange rate was then set against the euro, the yen, and the Hong Kong dollar using the market cross rates of these currencies with the US dollar. Since 2012, RMB direct trading has been allowed for the yen, Australian dollar, New Zealand dollar, pound sterling, euro, and Korean won. As a result, Shanghai market liquidity for these currencies has

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<sup>2</sup> In January 1994, the RMB was devalued from CNY5.35 to CNY8.28 per US dollar, after which the rate stayed at the same level for more than 10 years.

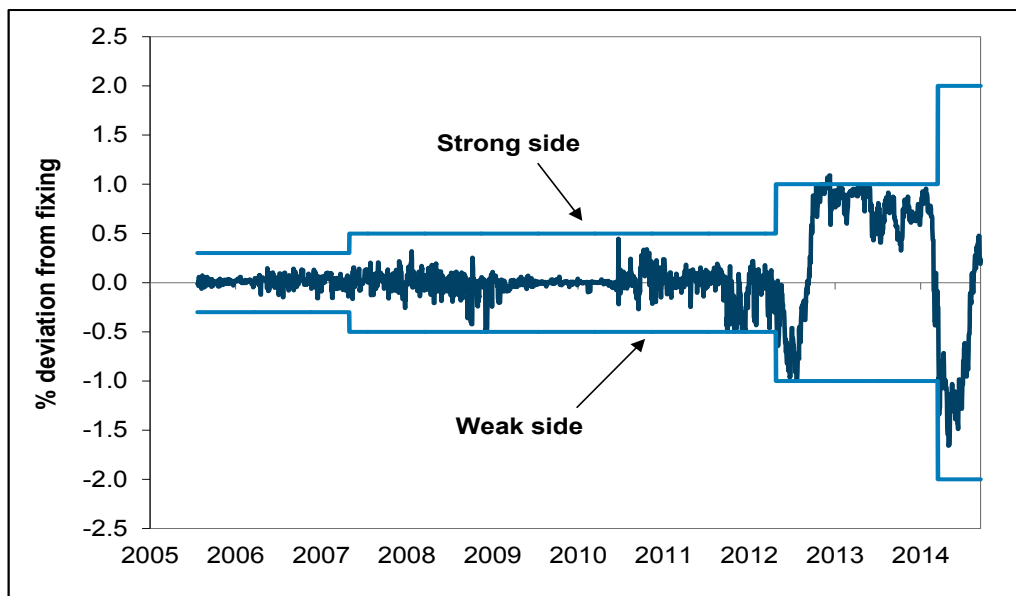
<sup>3</sup> The new CPR had three distinct features: (i) over-the-counter (OTC) trading was introduced as the main form of currency trading; (ii) more CPR pairs of the RMB against the US dollar, the euro, the yen, and the Hong Kong dollar were announced at 9:15 a.m. Beijing time of each business day; and (iii) the CPR was calculated using a weighted average based on trading volume.



become a factor affecting these currencies' onshore rates against the RMB, in addition to their market cross rates calculated against the US dollar.

The RMB trading band vis-à-vis the US dollar was initially set at a tightly controlled range of  $\pm 0.3\%$ , which was later widened to  $\pm 0.5\%$  in May 2007,  $\pm 1\%$  in April 2012, and then to  $\pm 2\%$  in March 2014. Indeed, the RMB's exchange rate flexibility has increased progressively with an enlarged trading band over time (Figure 2).

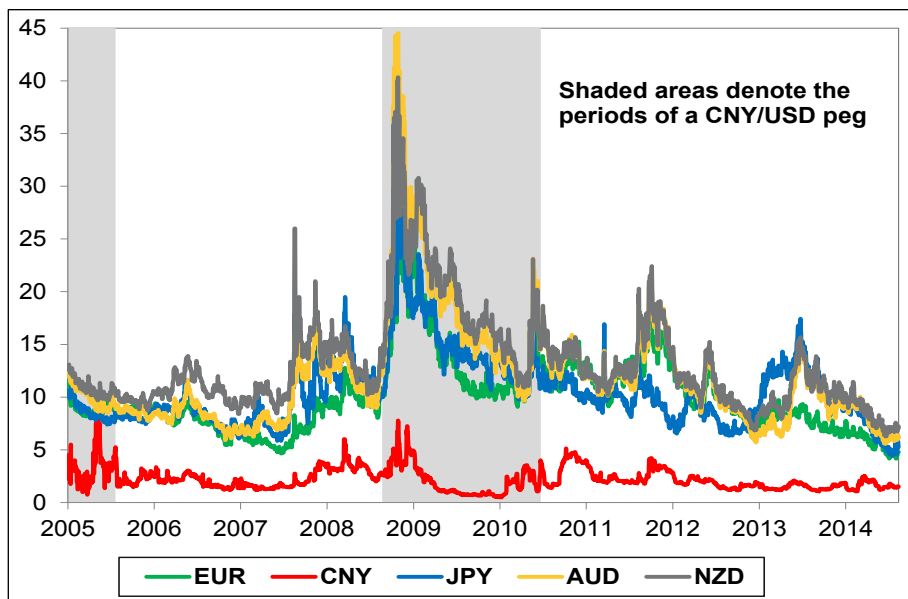
**Figure 2: The Renminbi Exchange Rate with a Widening Band**



Source: Bloomberg.

Although the RMB exchange rate band has been widened over time, RMB volatility has been limited in comparison to the volatility of other freely floating currencies such as the euro, yen, and Australian dollar. Using an option-based currency volatility measure, Figure 3 shows that 1-month at-the-money implied volatility of the euro, yen, Australian dollar, and New Zealand dollar fluctuated at an average of 10%–20% during the GFC period of September 2008–June 2010. Afterward, the average volatility of these currencies still fluctuated at around 10%. In contrast, the option price implied volatility of the RMB reached only 5% with the eruption of the GFC and has since settled down to less than 2%. Thus, RMB exchange rate volatility has remained limited.

**Figure 3: Option Price Implied Volatility of Major Currencies and the Renminbi**  
(%)



AUD = Australian dollar, CNY = renminbi, EUR = euro, JPY = yen, NZD = New Zealand dollar, USD = US dollar.

Note: The chart displays the 1-month at-the-money implied volatility of the various currencies.

Source: Bloomberg.

### 3.2 Exchange Rate Policy after the 2005 De-pegging

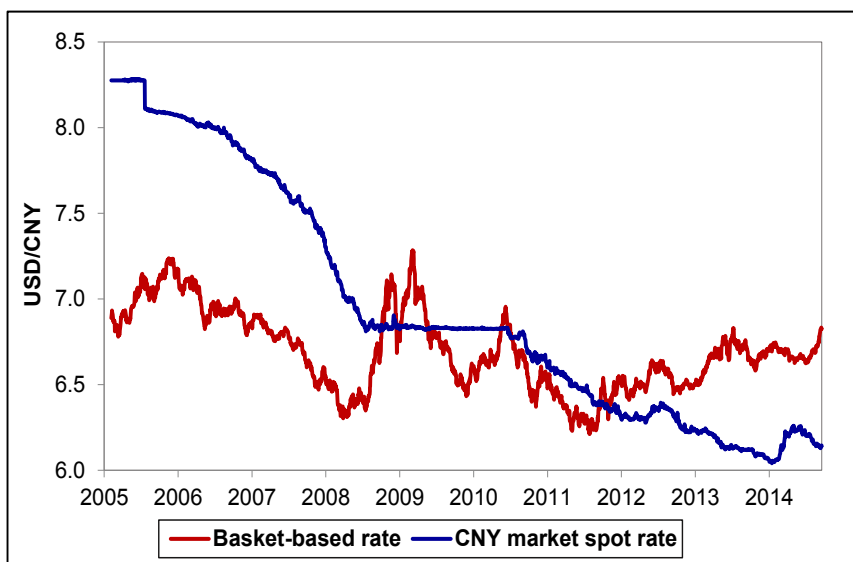
After the RMB's exit from the dollar peg, its exchange rate was supposed to reference a basket of currencies, with its exchange rate reform strategy being to take an approach marked by "self-initiative, controllability, and gradualism" to improve the RMB exchange rate formation mechanism (PBoC 2009).

Whether the RMB has actually been referenced to a basket of currencies can be examined empirically using two approaches. One is to construct a currency basket that reflects enough of the PRC's trade with the rest of the world and see whether the RMB exchange rate has actually followed the valuation derived from this basket of currencies. The other approach is to use the Frankel and Wei (1994) model to econometrically identify major international currencies and estimate their weights in an RMB currency basket.

#### Basket of a large number of currencies?

First, using 11 currencies that make up 70% of the PRC's trade with the rest of the world, we constructed a currency basket for the RMB and expressed it as an implied RMB exchange rate against the US dollar.<sup>4</sup> The basket-based RMB rate is depicted in Figure 4 together with the market RMB spot rate against the US dollar.

<sup>4</sup> The methodology closely follows the usual calculation of a nominal effective exchange rate (NEER)—that is, constructing a geometric average of the 11 currencies' exchange rates against the US dollar and then expressing the value of this currency basket as an exchange rate against the US dollar rather than as an index. The currency basket assigns large weights to the US dollar (34.2%), euro (22.5%), Japanese yen (14.9%), and Korean won (10.2%), followed by the Singapore dollar, pound sterling, Malaysian ringgit, Australian dollar, Thai baht, Canadian dollar, and Russian Federation ruble, with their weights ranging from 2% to 3%.

**Figure 4: Basket-based Renminbi Rate versus Market Renminbi Rate**

CNY = renminbi, USD = US dollar.

Source: Authors' computations using data from Bloomberg.

The figure shows that from July 2005 to September 2008, the movement of the market RMB spot rate followed that of the basket-based RMB rate reasonably well, with a correlation coefficient of 0.91, although the basket-based rate was stronger in value than the market rate vis-à-vis the US dollar. Beginning in September 2008, the basket-based RMB rate started to show more volatile movements than the market spot rate due to sharp changes in the exchange rates of the PRC's trading partners during the height of the financial crisis and the RMB's re-pegging to the US dollar. Between October 2008 and June 2010, the correlation coefficient between the two rates was 0.49. Between June 2010 and August 2014, the correlation even turned negative to  $-0.39$ . The figure clearly shows that in 2012 the market and the basket-based RMB rate began to diverge, with the market rate appreciating and the basket-based rate depreciating against the US dollar, both as a trend.

#### **Frankel–Wei estimation of a currency basket**

The second approach is to examine the major international currencies that have a large influence on the observed movements of the RMB exchange rate and determine the weights assigned to these major currencies using the Frankel–Wei model. Table 1 summarizes the estimation results reported by Kawai and Pontines (2014). The table clearly indicates that the US dollar is still assigned the largest and predominant weight throughout the sample period, while other major international currencies such as the euro and the yen only have limited, occasional influence on the RMB exchange rate.

**Table 1: Changes in Observed Exchange Rate Regimes for the Renminbi**

Estimation Period	US Dollar	Euro	Yen	Pound Sterling	R-squared
<b>Post-AFC period</b> (3 January 2000–30 June 2005)	0.999*** (0.000)	0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	0.999
<b>Pre-Lehman period</b> (21 July 2005–21 July 2008)	0.934*** (0.009)	0.044*** (0.013)	0.028*** (0.007)	-0.017 (0.013)	0.979
<b>GFC period</b> (1 August 2008–31 May 2010)	0.970*** (0.006)	0.023*** (0.008)	0.003 (0.004)	0.003 (0.005)	0.996
<b>Post-GFC period</b> (1 June 2010–31 March 2014)	0.940*** (0.008)	0.034*** (0.007)	0.011** (0.005)	0.002 (0.008)	0.985

AFC = Asian financial crisis, GFC = global financial crisis.

Notes: The values in parentheses are the estimated robust standard errors. \*\* = 5% level of statistical significance, \*\*\* = 1% level of statistical significance.

Source: Kawai and Pontines (2015).

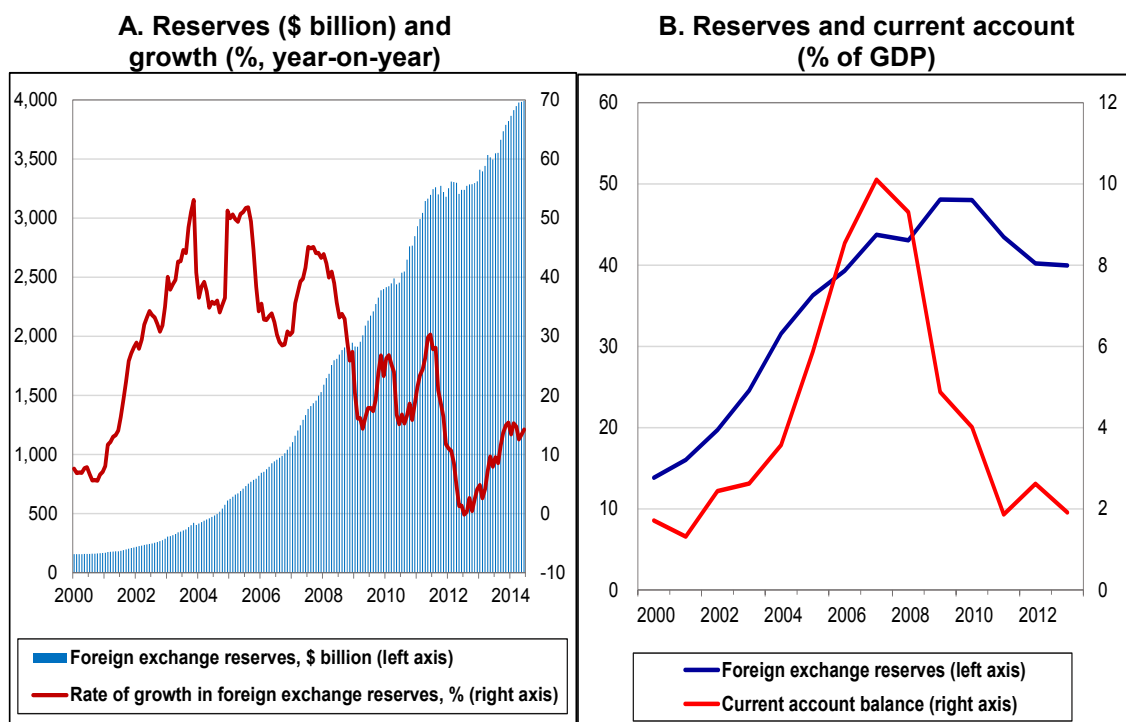
Thus, the post-2005 RMB exchange rate regime has not truly referenced a basket of a wide range of currencies in setting the value of the RMB exchange rate. The RMB exchange rate has relied and continues to rely heavily on the US dollar as its anchor currency, with limited exchange rate volatility.

### Accumulation of foreign exchange reserves

Limited exchange rate volatility, together with a prevailing one-way bet on the RMB's continued appreciation against the US dollar, led to significant capital inflows into the PRC, which required the PRC's monetary authority to engage in massive currency market interventions. Figure 5 shows that the pace of foreign exchange reserve accumulation had been rapid until the outbreak of the GFC. After the crisis, the rate of growth decelerated, with reserves hardly growing during Q2 2011–Q4 2012. But the reserves began to rise once again in 2013, albeit at a lesser pace than in the pre-crisis period.

As a share of gross domestic product (GDP), foreign exchange reserves increased from 14% in 2000 to 48% during 2009–2010, and then declined somewhat to 40% in 2013. As the PRC's current account surplus as a ratio of GDP declined sharply after the GFC from its peak at 10% in 2007 to only 2% in 2014, the pace of reserve accumulation naturally slowed down. As will be shown later, reserve accumulation has been accompanied by a rapid increase in the PRC's monetary base. This suggests that the PRC's monetary policy has been increasingly influenced by external conditions.

**Figure 5: People’s Republic of China’s Foreign Exchange Reserves**



GDP = gross domestic product.

Source: CEIC.

## 4. EFFECTIVENESS OF CAPITAL CONTROLS

### 4.1 Renminbi Internationalization and Rising Arbitrage Opportunities

The PRC started to encourage international use of the RMB for trade purposes in September 2009. This led to rapid increases in the number of RMB offshore trading centers, such as in Hong Kong, China; Singapore; Taipei, China; and London. Among these offshore trading centers, the RMB market of Hong Kong, China remains the largest and most active. Total RMB deposits in the banking system of Hong Kong, China, including certificates of deposit, exceeded CNY1.2 trillion in the first half of 2014, a sizable amount comparable to the value of the PRC’s new loans extended per year before 2005. The main drivers of the rapid rise of RMB deposits in Hong Kong, China have been trade settlements invoiced in RMB. Total trade settlements using RMB between Hong Kong, China and the PRC reached CNY3.8 trillion in 2013.

Meanwhile, offshore capital markets for the RMB have also developed rapidly. The RMB bond market of Hong Kong, China, nicknamed the “dim sum” market, experienced a surge with a total outstanding amount of CNY310 billion in 2013 and CNY374 billion in Q3 2014. The bonds raised in the RMB market of Hong Kong, China, commonly referred to as the CNH market, could be repatriated to the PRC via an approval from the State Administration of Foreign Exchange or via an RMB QFII scheme.

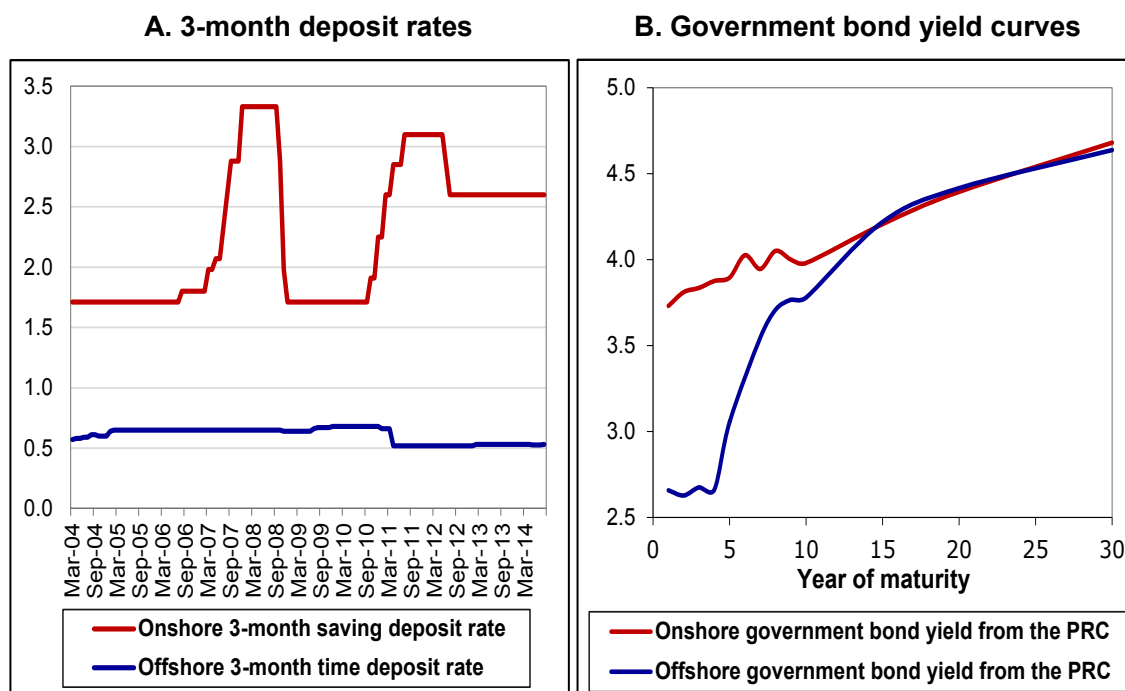
Since July 2013, commercial banks have been allowed to transfer their RMB deposits outside the PRC to their domestic branches, making RMB repatriation to the PRC

easier. The linking of the Shanghai and Hong Kong, China stock markets, launched in late 2014, has allowed investors in both markets to buy each other’s listed shares and is another step toward a more open capital account.

The rapid RMB internationalization process also means that the PRC’s capital account is opening at a faster pace, allowing market participants to arbitrage away exchange rate and interest rate differentials between markets in Hong Kong, China and the PRC. Therefore, it is natural to assume that the existing capital control measures will become less effective.

However, casual observations suggest that RMB assets of the same maturity in both onshore and offshore markets still enjoy large yield differentials. For example, 3-month RMB savings deposits onshore obtain a return of 2.6% per annum, while 3-month time deposits in Hong Kong, China only offer a return of around 0.5% (see Figure 6A). Meanwhile, 3-month Ministry of Finance bonds from the PRC issued in Shanghai and Hong Kong, China still have yield differentials, with the shorter-dated bonds having larger yield differentials (Figure 6B).

**Figure 6: Onshore and Offshore Renminbi Interest Rate Differentials (%)**



PRC = People’s Republic of China.

Note: Offshore refers to Hong Kong, China.

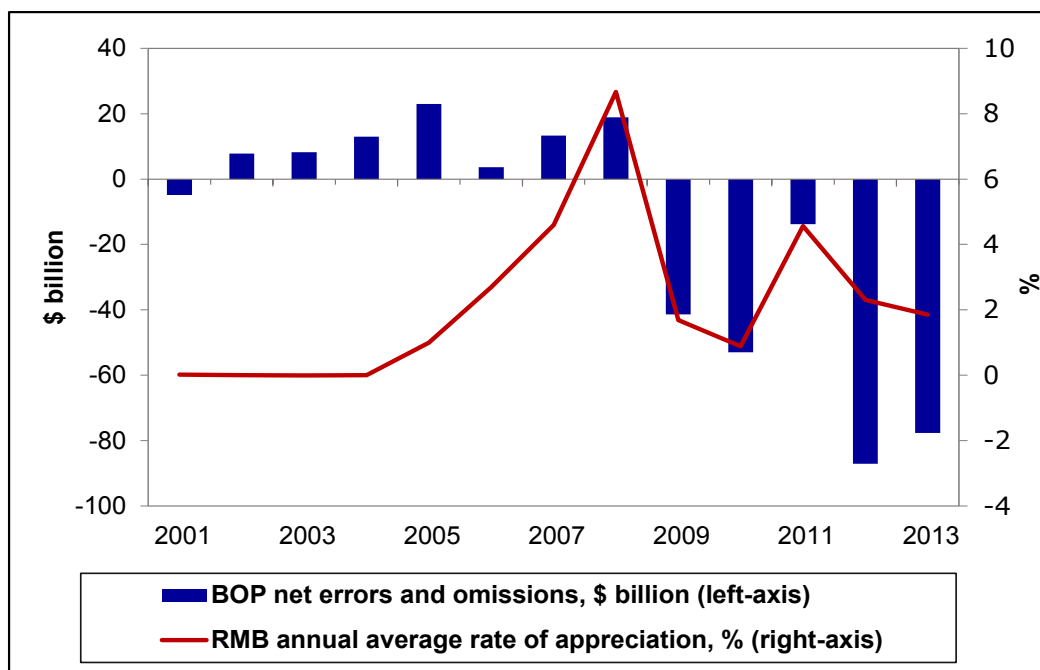
Sources: Bloomberg; CEIC.

These observations appear to suggest that the PRC’s capital controls are still effective or binding. It is these control measures that drive a wedge between onshore and offshore yields by limiting arbitrage activities in the form of capital flows. These straightforward yield comparisons could be misleading, however, as they do not take into account factors such as interest rate controls, transactions costs, and the risk of arbitrage due to capital controls.

One sign of this is the fact that the PRC’s unaccounted capital flows have started to grow over time. Figure 7 shows that until 2008, errors and omissions in the PRC’s balance of payments had been around \$10 billion–\$20 billion, mostly in the form of

unaccounted inflows, coinciding with the expectation of RMB appreciation. Since 2009, errors and omissions have become large outflows, at an average of close to \$55 billion. Errors and omissions numbers became even larger in 2012–2013 to around \$82 billion, suggesting that the leakage from capital controls has become larger over time, even when the RMB exchange rate has been on a steady appreciation.

**Figure 7: Errors and Omissions in the Balance of Payments of the People’s Republic of China and the Rate of Renminbi Appreciation**



BOP = balance of payments, RMB = renminbi.

Source: IMF, International Financial Statistics.

## 4.2 Measuring Capital Control Effectiveness

A useful benchmark for comparing yield differentials in two markets is to rely on the covered or uncovered interest rate parity (IRP) conditions or some modified IRP conditions that can capture distortions caused by capital controls. Under free capital mobility, the IRP condition states that investors should be indifferent to nominal interest rate differentials in two countries because the exchange rate between the two currencies is expected to adjust in a way that offsets nominal interest rate differentials, thus removing any arbitrage opportunities.

Using the IRP approach, Ma and McCauley (2007) found that the PRC’s capital controls remained effective in driving a wedge between onshore and offshore interest rates of the same type of assets, for the period before the RMB’s circulation offshore. A more appropriate approach to investigate the PRC’s capital control effectiveness would be to follow a seminal study by Otani and Tiwari (1981), who looked at Japanese bond yield differentials in both the Tokyo and London markets at the early stage of Japan’s capital account liberalization in the late 1970s.

Following their approach, we present two calculations of the IRP condition to investigate deviations from IRP in both the Hong Kong, China and Shanghai markets. First, we look at the Hong Kong, China CNH market, which is not subject to many controls or market distortions. Second, we look at cross-border investment involving

onshore RMB (CNY) and offshore CNH transactions. The difference between the two deviations can be viewed as a capital control effectiveness measure that addresses transactions costs and other distortions in both markets.<sup>5</sup>

The deviation from the IRP condition in the Hong Kong, China CNH market can be defined as follows:

$$Deviation_{CNH\_1} = \frac{(1+r_{CNH})S_{CNH}}{(1+r_{USD})F_{CNH}} - 1, \quad (1)$$

where  $r_{CNH}$  is the 3-month offshore RMB (CNH) interbank interest rate;  $r_{USD}$  is the 3-month US dollar interbank rate in Hong Kong, China;  $S_{CNH}$  is the CNH spot rate against the US dollar; and  $F_{CNH}$  is the CNH deliverable forward rate. Since we use the 3-month interest rates, the annualized interest rate is divided by a factor of 4 and the results should be interpreted as percentage points.

Similarly, the deviation from the IRP condition in cross-border investment can be expressed as follows:

$$Deviation_{CNY\_1} = \frac{(1+r_{CNY})S_{CNY}}{(1+r_{USD})F_{CNH}} - 1, \quad (2)$$

where  $r_{CNY}$  is the 3-month onshore RMB (CNY) interbank interest rate;  $r_{USD}$  is the 3-month US dollar interbank rate in Hong Kong, China;  $S_{CNY}$  is the onshore RMB (CNY) spot rate against the US dollar; and  $F_{CNH}$  is the CNH deliverable forward rate. Note that this IRP condition uses the Hong Kong, China CNH forward rate, rather than the onshore RMB (CNY) forward rate, which has not been fully developed in terms of depth and liquidity.

Alternatively, investors may use the offshore non-deliverable forward (NDF) rate also quoted in Hong Kong, China,  $F_{NDF}$ , rather than  $F_{CNH}$ , as the RMB NDF market in Hong Kong, China is larger and more liquid at this stage. Many investors still use this market to hedge their onshore RMB exposures. Therefore, the above expression can be changed to:

$$Deviation_{CNH\_2} = \frac{(1+r_{CNH})S_{CNH}}{(1+r_{USD})F_{NDF}} - 1 \quad (1')$$

$$Deviation_{CNY\_2} = \frac{(1+r_{CNY})S_{CNY}}{(1+r_{USD})F_{NDF}} - 1 \quad (2')$$

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<sup>5</sup> Detailed technical derivations of these equations can be found in Otani and Tiwari (1981).



Finally, capital control effectiveness (CCE) measures can be derived by comparing equations (1) and (2) and equations (1)' and (2)'. The difference between onshore and offshore deviations from IRP means that after adjusting for interest rate differentials and forward premiums, the distortion remaining can be attributed to capital controls. Specifically, the CCE measures can be expressed as:

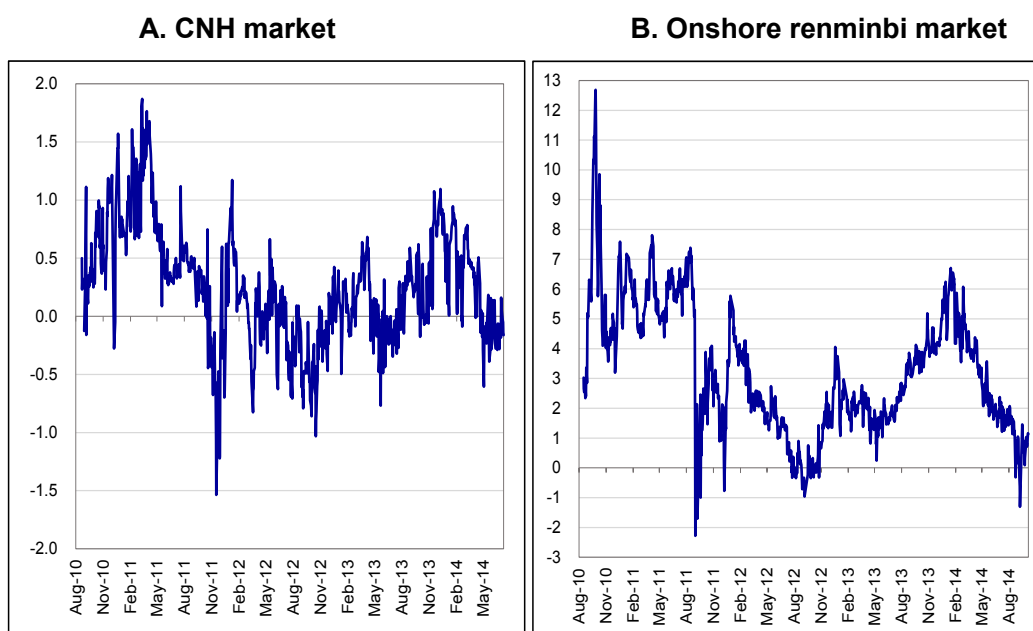
$$CCE1 = | Deviation_{CNY_1} - Deviation_{CNH_1} | \tag{3}$$

$$CCE2 = | Deviation_{CNY_2} - Deviation_{CNH_2} | \tag{3}'$$

Using data from 2009 to the present, we can calculate the deviations from IRP for equations (1) and (2), and equations (1)' and (2)'. Figure 8A depicts the deviations from IRP based on equation (1), which indicates that despite limited liquidity and market depth, deviations in the Hong Kong, China market have become smaller over time. Since March 2012, the deviations have become on average negligible (within ±1%) and are not far from parity. This means that the Hong Kong, China CNH market has quickly become an efficient market, with limited arbitrage opportunities between offshore transactions in US dollars and CNH.

However, this is not the case for cross-border investment involving onshore RMB (CNY) as we do observe large deviations in equation (2). Figure 8B shows that using the onshore RMB (CNY) interbank rate and onshore RMB (CNY) spot rate, we find the deviations from IRP can be as large as 6%–7% on average before September 2011. This means that if the same amount of RMB were to have been shifted from offshore to onshore markets, the arbitrage returns would have been 6%–7%. From November 2011 to September 2014, we observe a fall in arbitrage opportunities of an average of 1%–3%. Though this is a sharp reduction from the pre-September 2011 period, deviations from IRP for cross-border investment involving onshore RMB (CNY) have remained much larger than those in the Hong Kong, China CNH market.

**Figure 8: CNH Deviation from Interest Rate Parity (%)**



CNH = renminbi market of Hong Kong, China.

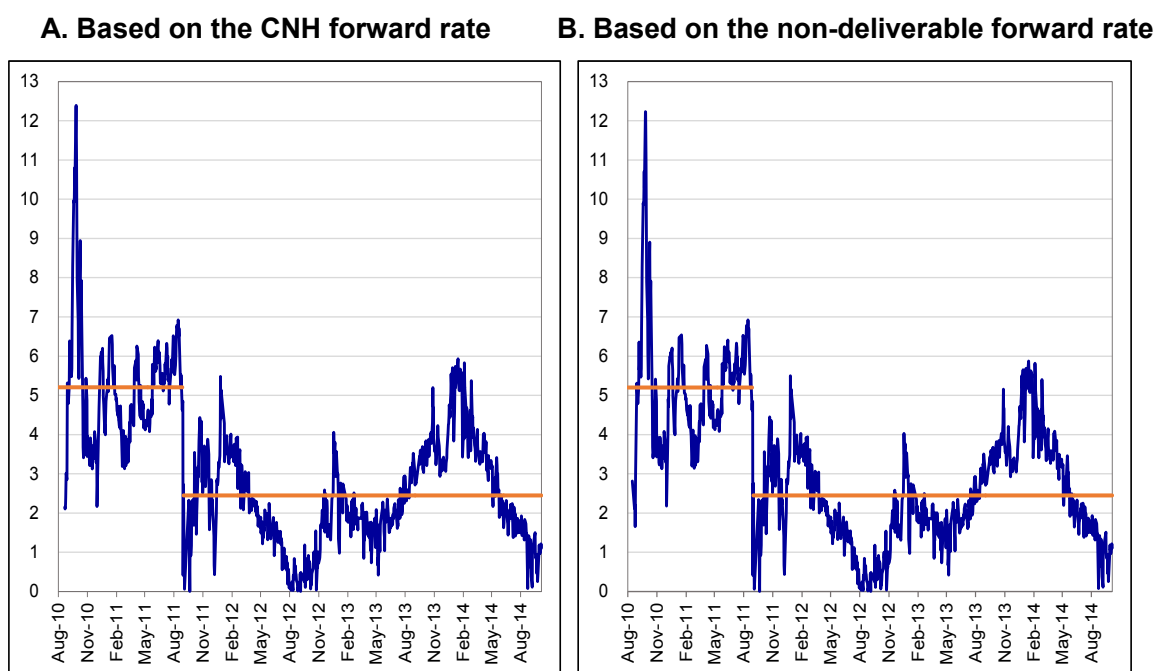
Source: Authors' computations using data from CEIC and Bloomberg.

### 4.3 Declining Capital Control Effectiveness

The two charts in Figure 9 are constructed using equations (3) and (3)' and provide two CCE measures, one based on the CNH forward rate and the other the NDF rate. Over the period 2010–2014, it appears that the PRC’s capital control regime in general remained effective despite the rapid RMB internationalization process and the accelerated pace of capital account opening.

Examining the calculations more carefully, we observe that CCE has been declining since September 2011, when the CNH market in Hong Kong, China began to grow larger, become more liquid, and be better regulated. While this structural break has yet to be tested statistically, the decline has been sizeable. We find that there is no significant difference between CCE1 (Hong Kong, China CNH investment using the CNH forward rate) and CCE2 (onshore RMB [CNY] investment using the NDF rate). Both measures declined from an average of 5.2% in the period before September 2011 to an average of 2.5% in the period after September 2011.<sup>6</sup>

**Figure 9: Capital Control Effectiveness Measures (%)**



CNH = renminbi market of Hong Kong, China.

Source: Authors’ computations using data from CEIC and Bloomberg.

This finding suggests that the *de jure* capital controls adopted by the PRC authority may no longer be successful in preventing profit-driven capital flows between Hong Kong, China and the PRC. The large and growing trade integration of the PRC with Hong Kong, China may have contributed to the *de facto* financial integration of the PRC with Hong Kong, China over time, for a given degree of *de jure* capital controls,

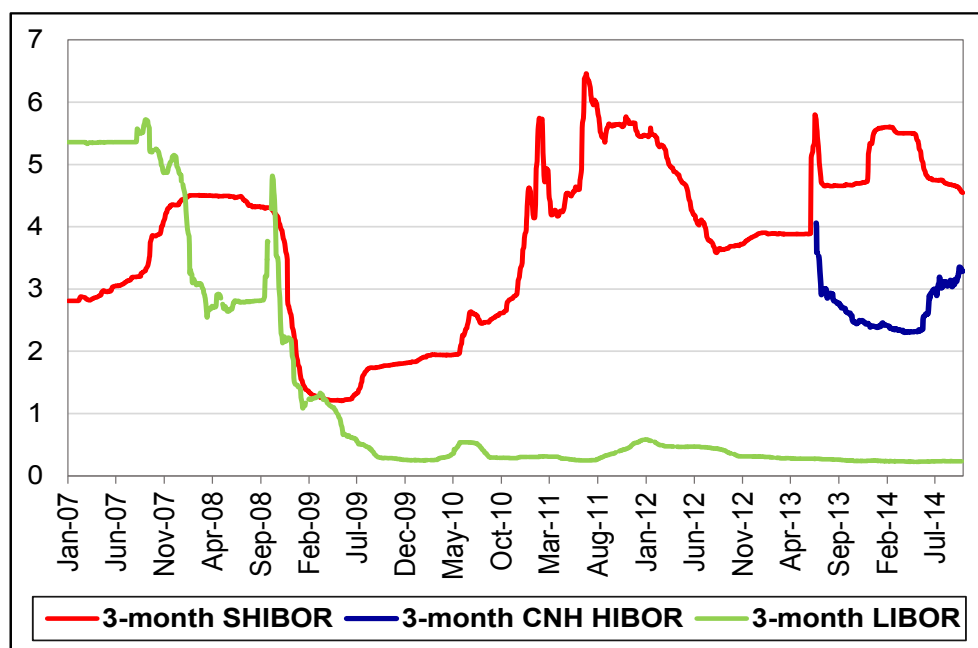
<sup>6</sup> It may be noted that, while the CCE measures saw sharp declines in 2012, they started to rise in the second half of 2013, reaching as high as 5.9% in February 2014, before falling again back to the range of 0%–2% in the second half of 2014. The rise of the CCE in the first half of 2014 could be largely attributed to rising exchange rate volatility as well as a sharp exchange rate depreciation engineered by the PRC’s monetary authority. Once the RMB returned to a one-way bet for appreciation with little volatility in the second half of 2014, the CCE measures dropped again.

through an expanded use of the current account for capital account purposes such as trade mis-invoicing.

Indeed, the RMB's role as a trade settlement currency has facilitated *de facto* capital flows through trade transactions. For example, the PRC's export figure in Q1 2013 was abnormally large. The anomaly could be explained by the round-tripping of goods between Shenzhen and Hong Kong, China, an international entrepôt, as well as the over-invoicing of exports from Shenzhen.

These trade activities intend to seek financial gains on large onshore and offshore interest rate differentials (see Figure 10), leading to large capital inflows, which pose challenges to the PRC's monetary policy while adding appreciation pressures to the RMB exchange rate. The authorities have had to engage in periodic crackdowns and sudden foreign exchange market interventions to slow such activities.

**Figure 10: Three-month SHIBOR, CNH HIBOR, and LIBOR (%)**



HIBOR = Hong Kong, China Interbank Offered Rate (for offshore renminbi [CNH]), LIBOR = London Interbank Offered Rate (for the US dollar), SHIBOR = Shanghai Interbank Offered Rate (for onshore renminbi [CNY]),

Source: Bloomberg.

Recent policy developments allowing firms located in the Shanghai Free Trade Zone to experiment with further capital account liberalization by tapping into offshore markets for funding will make the existing capital control measures even less effective. If the current trend of *de facto* financial market opening continues, the PRC's *de jure* capital controls will lose effectiveness faster than expected. This will also mean that its capital account could become more open (*de facto*) much faster than is currently expected by 2020.

## 5. MONETARY POLICY CHALLENGES IN THE PEOPLE’S REPUBLIC OF CHINA

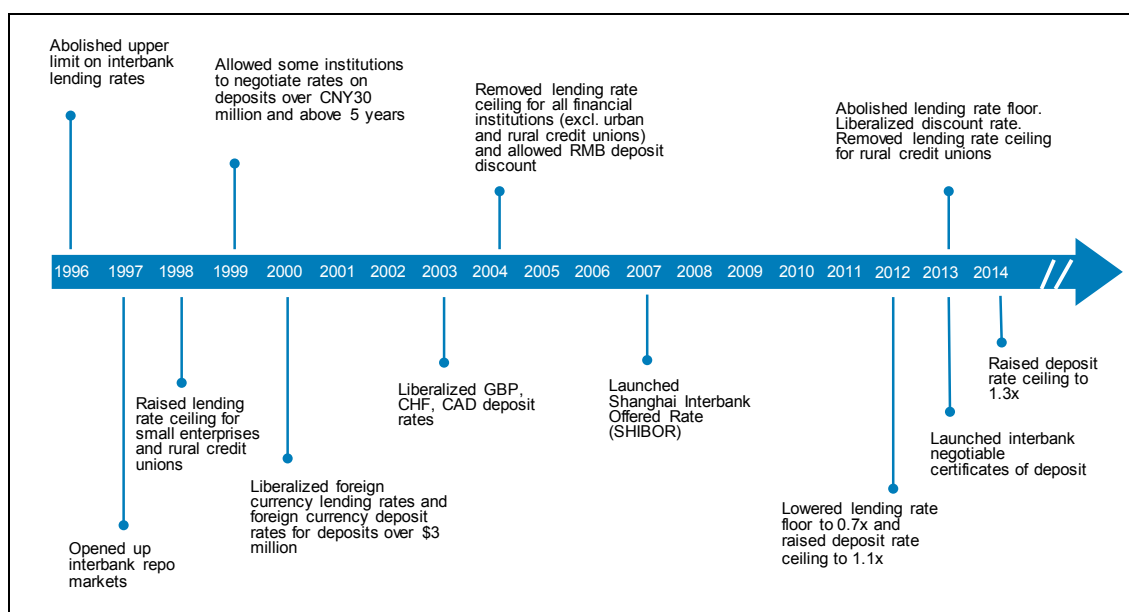
The PRC authority is facing significant challenges in its pursuit of monetary policy. This section discusses the impact of incomplete interest rate reform, the spread of shadow banking, and rising signs of monetary policy ineffectiveness.

### 5.1 Interest Rate Reform

The PRC has used financial repression in the form of controlled interest rates and credit allocation with an aim to support investment and economic growth. Interest rate controls and other financial repression measures have also led to the underdevelopment of the financial sector, inefficient allocation of savings, excessive investment, and overcapacity in certain sectors of the economy.

In 1996, the PRC embarked on interest rate reform by gradually liberalizing interbank lending rates. Since then, various reform measures have been completed, including the abolishment of the upper limit on interbank lending rates in 1996, the liberalization of foreign currency lending rates in 2000, the removal of lending rate ceilings for most financial institutions in 2004, the launch of the Shanghai Interbank Offered Rate (SHIBOR) in 2007, the abolishment of the lending rate floor, and the launch of interbank negotiable certificates of deposit (NCDs) in 2013, as shown in Figure 11.

**Figure 11: Timeline of the People’s Republic of China’s Interest Rate Liberalization**



CAD = Canadian dollar, CHF = Swiss franc, GBP = pound sterling, RMB = renminbi.

Source: People’s Bank of China.

Among the recent policy changes, one of the most significant was the removal of the bank lending rate floor in July 2013, which allowed banks to freely set their own lending rates. While this was a big step in interest rate reform, the actual impact on the real economy has been quite limited. Before the reform, although commercial banks had been allowed to offer a discount of up to 30% of the benchmark lending rate, banks in

practice had rarely done so.<sup>7</sup> Only about 11% of loans were offered below the benchmark rate through most of 2013. The average weighted 1-year lending rate actually increased from 6.7% in March to 7.2% by the end of 2013.

After the removal of the lending rate floor, the monetary authority launched a system for a prime loan rate (PLR) in October 2013. This is an indicative interest rate at which commercial banks lend to their prime customers. The PLR is calculated as the weighted average of a panel of banks' lending rates that they charge their best clients. This was also seen as a step toward further interest rate liberalization, as the PLR could replace the current benchmark policy lending rate and be gradually used as a new market-driven benchmark for lending rates.

The PRC's deposit rate remains controlled. To add some flexibility to the controlled deposit ceiling rate, the authority has been taking a gradual approach to liberalizing bank deposit rates. Commercial banks were allowed to charge a deposit rate premium, increasing the rate by up to 10% from the benchmark deposit rate in 2012, and up to 30% in November 2014.<sup>8</sup> In addition, commercial banks were allowed to issue NCDs from December 2013, which were priced with reference to the SHIBOR. This reflects the actual supply and demand conditions of the interbank market, since interbank NCDs are tradable. This means that large deposits are now priced according to market demand and supply. These policy measures have made deposit rates less binding over time.

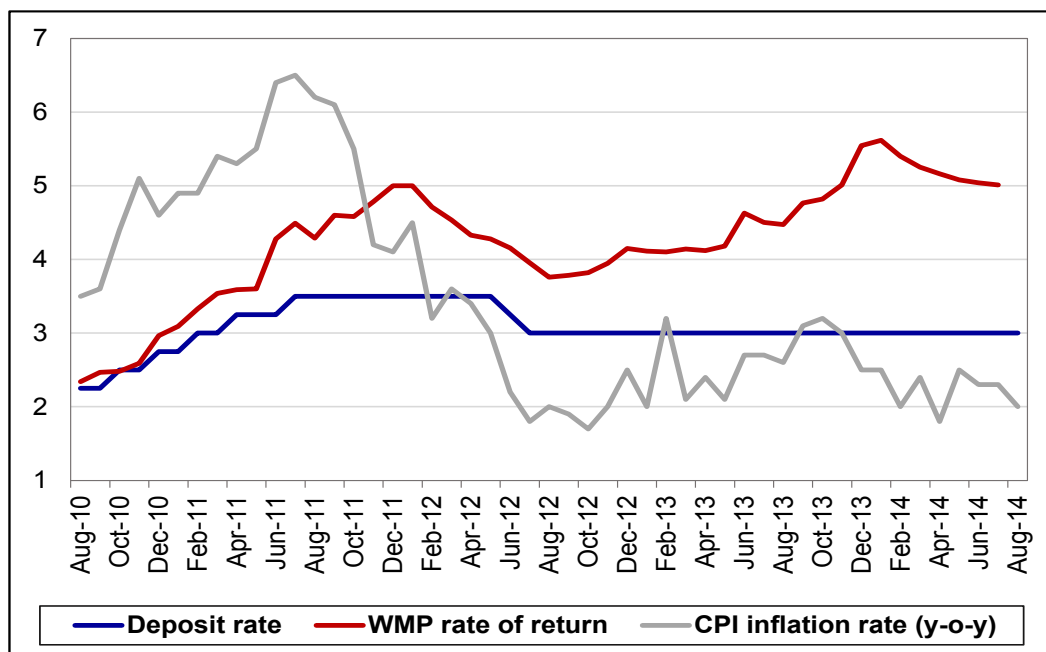
In addition, commercial banks have used off-balance-sheet activities to evade the controlled deposit ceiling rate via wealth management products (WMPs). Close to 45,000 WMPs were issued in 2013 amounting to CNY10 trillion, around 10% of the PRC's total deposits. On average, WMPs offer a rate of return of around 5.5%, which is much higher than traditional deposit rates (Figure 12). Financial innovations such as internet-based financial products have been competing with the banking system for deposits, thus putting further pressure on banks to offer higher deposit rates and more attractive WMP yields to compete for bank funding.

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<sup>7</sup> With the loan rate discount, the minimum loan rate banks could charge on 1-year loans became 4.2% when the 1-year benchmark loan rate was 6%.

<sup>8</sup> With the deposit rate premium, the maximum deposit rate banks could offer on 1-year deposits became 3.9% as the 1-year benchmark deposit rate was 3%.

**Figure 12: Deposit Interest Rate, Wealth Management Product Rate of Return, and Consumer Price Index Inflation Rate (year-on-year, %)**



CPI = consumer price index, WMP = wealth management product.

Sources: CEIC; WIND.

## 5.2 Spread of Shadow Banking Activities

Shadow banking refers to credit intermediation involving entities or activities by non-banks, particularly financial intermediation outside the regulated banking system (IMF 2014a). To apply this concept to the PRC, its shadow banking consists of financial institution business (off-balance-sheet assets by banks not subject to regulation), trust products, and underground banking. We estimate that the shadow banking activities in the PRC could be at least CNY30 trillion, equivalent to 52% of GDP in 2013 or 19% of total bank assets in the PRC.

Commercial banks are subject to tight regulations, such as a limit on the deposit rate ceiling, the 75% loan-to-deposit ratio requirement, and the capital adequacy requirement. Given the rising demand for credit, commercial banks in the PRC began to evade such tight regulations through various measures. These include: (i) financial institution business, i.e., channeling large amounts of deposits to other financial institutions (both banks and non-bank financial institutions) which, unlike corporate lending business, is not subject to the 75% loan-to-deposit ratio requirement or the high capital requirement; (ii) trust products, i.e., collecting quasi-deposits (trust funds, WMPs, etc.) from the public to finance off-balance-sheet activities; and (iii) underground banking, i.e., undertaking informal banking in the form of directly intermediating private funds among enterprises and individuals, which is not subject to the normal regulations of the formal banking system.<sup>9</sup>

<sup>9</sup> With regard to quasi-deposits, in addition to borrowing among themselves, banks normally issue WMPs to finance off-balance-sheet products. Overall, fixed-rate WMPs provide much higher yields than regulated deposits. Typically, commercial banks set up a “capital pool” which consists of bonds, trust products, loan-like claims, and inter-bank loans. Based on this pool, commercial banks issue short-tenor WMPs to match long-term assets, much like what an asset management company (within a bank) does.

Internet financial products and money market funds have also developed rapidly to evade formal banking regulations. Yu'e Bao, the biggest internet financial product, is an investment product offered by Alipay, users of which can put their money into the product with no minimum amount requirement and withdraw their cash anytime, akin to an open-end money market fund. Money market funds put more than 90% of their money as financial institution deposits in commercial banks. Financial institution deposit rates are negotiable, and not subject to the banks' reserve requirements.

The shadow banking system has posed regulatory challenges to the PRC's financial stability. First, its rapid development could force the regulated banking sector to expand its off-balance-sheet activities in order to compete with non-bank financial institutions for deposits, internet financial products, etc. Large off-balance activities could make commercial bank deposits more short term, thus exacerbating maturity mismatches and destabilizing the overall banking system. Second, certain financial institutions are not subject to the same prudential regulations as deposit-taking institutions. As a result, they could increase their financial leverage, magnifying both profits during a boom year and losses during a downturn. Third, the formal banking sector has the incentive to provide loans to non-bank financial institutions because such loans are subject to only a quarter of regulatory capital requirement. This would increase financial links between banks and non-bank financial institutions. Thus the expansion of shadow banking could pose financial risks to the formal banking sector because of its rising interconnectedness with potentially unstable shadow banking activities.

### **5.3 Rising Signs of Policy Ineffectiveness**

Since the eruption of the GFC, the PRC's monetary authority has adjusted its monetary policy stance in response to changing prospects of GDP growth and consumer price index (CPI) inflation. Facing the GFC in the final quarter of 2008, the monetary authority quickly loosened policy by lowering the benchmark deposit and loan rates as well as the reserve requirement ratio. Together with its large fiscal stimulus package, monetary policy easing seemed to have had a stabilizing impact. With the recovery of the economy and rising CPI inflation during 2010–2011, the monetary authority shifted its monetary stance from fighting against the crisis to combating inflation by raising the benchmark deposit and loan rates and the reserve requirement ratio. The reserve requirement ratio was raised 12 times, while the interest rate was adjusted 5 times during this period. When the European financial crisis deepened in the second half of 2011 and 2012, the monetary authority gradually eased its policy.

#### **From “cash crunches” to “quantity swings”**

From May 2012, the monetary authority seemed to have avoided the use of its traditional policy toolkit, such as adjusting the reserve requirement ratio and the benchmark interest rate to conduct monetary policy. Instead, it began to rely on open market operations intensively via repos and reverse repos to inject and withdraw liquidity from the banking system. As a result, large swings of interest rates and loan quantities were observed during June–July 2013.

In mid-June 2013, a sudden re-pricing of counter-party risk brought about a surge in the short-term interest rate and thereafter, significant volatility in the money market. The 7-day repo rate, a reliable indicator measuring market liquidity conditions, surged to almost 12% from less than 4% in a day, with the high rate lasting for 2 weeks. The market panic created “cash crunches” in the PRC's interbank markets. The authority finally injected liquidity into the banking system 2 weeks later via the short-term lending facility (SLF), which eased market liquidity conditions in July 2013. The 7-day repos remained quite volatile until January 2014 after the authority engaged in “double

interventions,” i.e., interventions in both the foreign exchange and money markets via unsterilized interventions, leading to RMB depreciation and money market rate declines.

Since the June 2013 “cash crunches,” the authority appears to have become more proactive in managing money market liquidity conditions. However, the quantity of loans provided has become less stable than before. The PRC’s new RMB loans were only CNY385 billion in July 2014, much lower than the market consensus of CNY780 billion. For the same month, the PRC’s aggregate financing, including new loans, also surprised the markets on the downside. This was also the lowest level since the September 2008 Lehman collapse.<sup>10</sup>

Such large swings, in terms of money market rates or loan quantities, could create significant shocks to the financial system and raise risk premiums sharply, thereby causing large swings in real GDP growth.

### **Changing monetary policy environments**

While the monetary authority has not adjusted its policy stance in a significant way since July 2012, the global financial environment and domestic economic conditions have changed. Domestically, the PRC’s growth has moderated from around 9% to 7.5%. As the output gap narrowed sharply, the risk of deflation has risen. The PRC’s producer price index (PPI) has experienced persistent deflation since March 2012. Externally, the US Federal Reserve System (Fed) expanded asset purchases (adoption of QE3), ended QE, and is now heading toward monetary policy normalization; the European Central Bank (ECB) cut interest rates thrice; and the Bank of Japan began an aggressive quantitative and qualitative easing program under the banner of Abenomics.

Some key central banks in Asia and Oceania (the Reserve Bank of Australia, the Bank of Korea, and the Bank of Thailand) have cut their own policy rates in order to reduce interest rate differentials in an attempt to prevent over-valued currencies for competitiveness reasons. The PRC’s authority, on the other hand, refrained from using its traditional policy toolkits such as changes in the benchmark interest rate and the reserve requirement ratio because of the need to nurture a policy target interest rate. Instead, it has relied on open market operations to manage liquidity conditions. As shown in the previous section, the large interest rate differential between onshore and offshore markets with little exchange rate volatility led to large capital inflows (Figure 7). In 2013 alone, net capital inflows into the PRC were close to \$500 billion. For the first 2 quarters of 2014, net capital inflow was more than \$200 billion.

While the PRC has taken irreversible steps to progressively opening the capital account, its exchange rate policy has remained rigid, steadily appreciating against the US dollar. This condition has drawn large capital inflows on sizable interest rate differentials and expectations of RMB appreciation, thus limiting monetary policy effectiveness and autonomy.

### **Rising signs of asset price bubbles**

Corporate loans as a percentage of the PRC’s aggregate financing have continued to decline and PPI inflation has remained negative for nearly 2 years, suggesting that demand for credit from the real sector has remained weak. Meanwhile, banks’ reserve

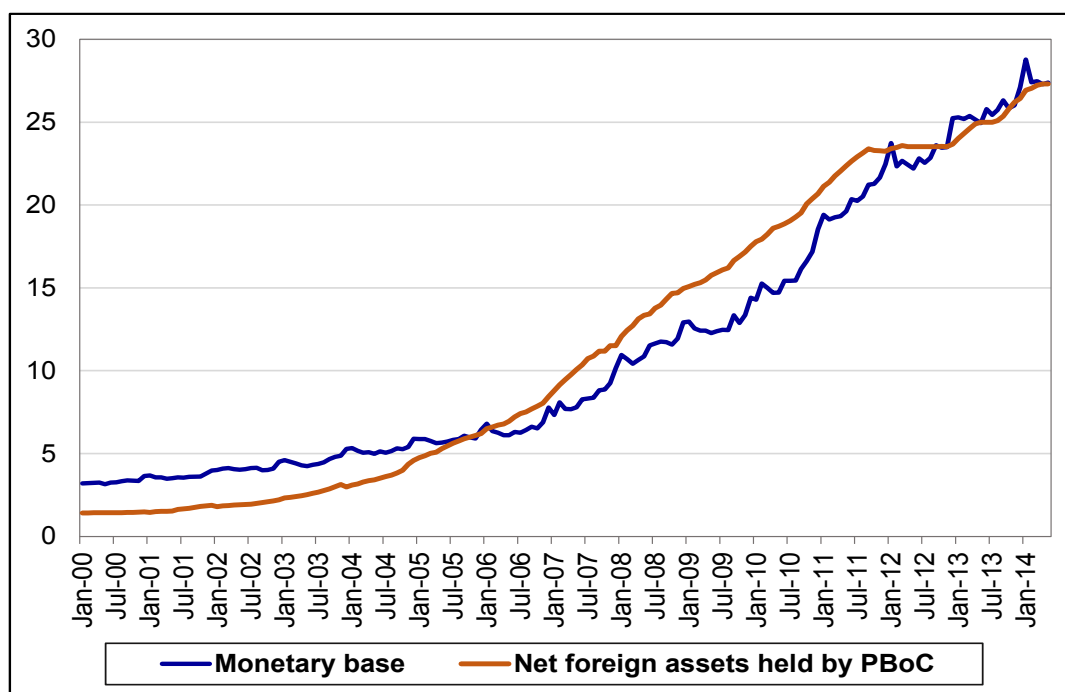
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<sup>10</sup> Undiscounted bank bills declined by CNY416 billion in July 2014, following a CNY144 billion increase in the previous month, largely owing to the crackdown on commodity financing following the Qingdao port fraud case. Trust and entrusted loan growth also softened, indicating that shadow banking activities have slowed down sharply, with further negative implications for the property sector.



money has risen on large capital inflows that have led to a rapid accumulation of foreign exchange reserves (Figure 13). To meet their profit growth target, commercial banks have created new financial vehicles to expand their balance sheets for financial activities. Such activities have resulted in a surge in money supply without significant financial intermediation to the real sector.

**Figure 13: Monetary Base and Net Foreign Assets Purchased by the People's Bank of China**  
(CNY trillion)



CNY = renminbi, PBoC = People's Bank of China.

Source: WIND.

Money has bypassed the real sector and been channeled into high-return, high-risk sectors such as the property market. In 2013, the PRC's property prices soared again, led by first-tier cities. While the stock market has remained depressed, other asset markets such as for art collections and physical gold investments have become buoyant, reflecting a simmering asset price bubble.

## 6. EMPIRICAL EVIDENCE ON DIMINISHING MONETARY POLICY AUTONOMY IN THE PEOPLE'S REPUBLIC OF CHINA

The previous section considered the various challenges facing the PRC's monetary policy. Much documented data suggest that monetary policy effectiveness has declined in the PRC and its policy autonomy has eroded with rapid RMB internationalization and a limited yet increasingly open capital account. The problem seems to stem from the fact that the PRC's capital controls have become less effective over time while its exchange rate regime has remained rigid despite recent efforts to make it more flexible. In this section, we examine the PRC's monetary policy effectiveness and autonomy using a set of econometric analyses.

## 6.1 Monetary Policy Framework of the People's Republic of China

The objective of the PRC's monetary policy is to maintain price stability so as to promote economic growth under the mandate of the law of the People's Bank of China (PBoC). To achieve these dual policy objectives, the monetary authority may use various policy instruments such as reserve requirement ratios, central bank benchmark lending and deposit interest rates, re-discounting, central bank lending, open market operations, and other administrative or window guidance measures. When pursuing policy mandates, the monetary authority encounters some practical constraints. Given the less developed financial markets, it also has the responsibility to promote financial market liberalization and reforms.

It may be argued that the PRC's authority applies both quantity and price instruments to conduct monetary policy while being constrained by the less efficient financial system. Laurens and Maino (2007) describe the process of setting the monetary policy framework in the PRC in the following way: the monetary authority first sets numerical targets for the quantity of money supply and credit growth as its intermediate quantity targets at the beginning of each year, and then monitors these intermediate targets closely during the course of the year and fine-tunes deviations from these targets by a number of policy instruments such as reserve requirements, open market operations, policy interest rates, and window guidance measures. Liu and Zhang (2010) argued that the use of short-term interest rates alone would be inadequate in the PRC, due to the weak interest-rate transmission channel, partly reflecting the dominance of state-owned commercial banks with a penchant to lend to state-owned enterprises (SOEs). They also demonstrated that neither a standard Taylor rule (Taylor 1993) nor a quantity of money rule in the spirit of McCallum (1988, 2000) would track the PRC's policy rate or M2 growth well. Kwan (2013) estimated the Taylor rule for the PRC during the post-Lehman period and found that the interest rate policy did not play a role in stabilizing the PRC's macro economy. On the other hand, Fan, Yu, and Zhang (2011) found that the McCallum rule was able to explain the movement of real money supply well.

In this section, we attempt to identify the PRC's monetary policy rule and examine whether the rule that used to work well under the rigid capital control system has become loose and increasingly constrained by its own exchange rate regime and/or external monetary developments.<sup>11</sup> If we find that a major monetary policy instrument, such as the policy interest rate and growth of monetary aggregates, was used successfully to achieve domestic policy objectives (price stability and economic growth) without being significantly constrained by foreign monetary policy changes or its own exchange rate regime, then we can conclude that the PRC authority retains monetary policy autonomy. And if the policy instrument is influenced by the foreign interest rate (in the case of the policy interest rate as a policy instrument) or by the pace of foreign exchange reserve accumulation (in the case of the growth of monetary aggregates as a policy instrument) rather than by the consideration of domestic economic stabilization, we can conclude that the PRC authority does not have policy autonomy.

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<sup>11</sup> We do this despite the claim made by the PBoC that the monetary authority has multiple policy targets (such as employment, price stability, balance of payments, and promoting financial reform) and that neither price-based (interest rate) rule nor quantity-based (money supply) rule is suitable to the PRC.

## 6.2 Empirical Models for Testing Monetary Policy Autonomy

### Short-term interest rate as a policy instrument

First, following Ito and Kawai (2014), we propose using the following equations to test the PRC's monetary policy autonomy:

$$i_t = \alpha_0 + \beta_0 i_t^* + u_t \quad (4)$$

$$i_t = \phi_0 + \phi_{0y} \tilde{y}_t + \phi_{0\pi} \tilde{\pi}_t + v_t \quad (5)$$

$$i_t = \alpha_1 + \beta_1 i_t^* + \phi_{1y} \tilde{y}_t + \phi_{1\pi} \tilde{\pi}_t + w_t, \quad (6)$$

where  $i_t$  is the policy interest rate the PRC authority sets and  $i_t^*$  is the US dollar London Interbank Offered Rate (LIBOR).<sup>12</sup> In the Taylor rule of equation (5),  $\tilde{y}_t$  is the growth rate of industrial production and  $\tilde{\pi}_t$  is the inflation gap, i.e., the difference between the actual and target inflation rates.<sup>13</sup> Equation (6) is a combination of equations (4) and (5).

Ito and Kawai (2014) then use the overall estimation performance of equations (4), (5), and (6) to judge the degree of monetary policy autonomy. If the PRC's monetary policy closely follows the monetary policy of the base country, the coefficient  $\beta_0$  is significantly positive and close to unity and the goodness of fit of equation (4) is high. In this case, the PRC has no monetary policy autonomy. If the PRC authority follows the Taylor rule to achieve domestic objectives, then  $\phi_{0y} \geq 0$ ,  $\phi_{0\pi} \geq 0$ , and the goodness of fit of equation (5) is high. In this case the PRC authority has full monetary policy autonomy. When the authority follows both the foreign interest rate and domestic objectives, then  $\beta_1 \geq 0$ ,  $\phi_{1y} \geq 0$ ,  $\phi_{1\pi} \geq 0$ , and the goodness of fit of equation (6) is high. In this case, the PRC authority has some, but not full, monetary policy autonomy. We need to pay attention to the signs and statistical significance of the estimated coefficients as well as the size of the adjusted R-squared in judging the degree of monetary policy autonomy.

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<sup>12</sup> Ito and Kawai (2014) use  $i_t^*$  for the synthetic foreign interest rate from the point of view of a country, which is the weighted average of the foreign interest rates, with the weights being estimated from the Frankel and Wei (1994) model. Given that the RMB exchange rate has assigned a weight of over 94% to the US dollar, we use the US dollar LIBOR as the foreign interest rate.

<sup>13</sup> The Taylor equation typically includes the GDP gap, i.e., the difference between actual GDP and potential GDP as well as the inflation rate gap on the right-hand side of equation (5). One might argue that the right-hand side of the equation should also include the exchange rate gap, in the case of the PRC, as the country has been stabilizing the exchange rate. We simplify our analysis by ignoring this possibility. As GDP data are available at most on a quarterly basis, its use would limit the number of observations in our sample. Thus, we have decided to use the monthly growth rate of industrial production in estimating equations (5) and (6) as this would allow us to have a larger number of observations.

### Monetary aggregates as a policy instrument

We next consider the possibility that monetary aggregates, ranging from narrow to broad definitions of the money supply (M0, M1, and M2), are used as policy tools.<sup>14</sup> For this purpose, we consider the following three equations:

$$\Delta M / M_t = \mu_0 + \gamma_0 \Delta FXR / FXR_t + \varepsilon_t \quad (7)$$

$$\Delta M / M_t = \theta_0 + \theta_{0y} \tilde{y}_t + \theta_{0\pi} \tilde{\pi}_t + \nu_t \quad (8)$$

$$\Delta M / M_t = \mu_1 + \gamma_1 \Delta FXR / FXR_t + \theta_{1y} \tilde{y}_t + \theta_{1\pi} \tilde{\pi}_t + \omega_t, \quad (9)$$

Equation (7) states that when an economy's exchange rate regime is rigid and prevents the exchange rate from changing in the face of balance of payments imbalances, the monetary authority will intervene in the currency market to accumulate or reduce foreign exchange reserves. Unless fully sterilized, the effect of a payment imbalance will be to change the economy's monetary aggregates ( $\Delta M / M$ ), so  $\gamma_0 \geq 0$ . If  $\gamma_0$  is unity, the monetary authority has no policy autonomy.

In contrast, the monetary authority may follow a rule similar to that of McCallum (1988, 2000) by setting the monetary aggregates to achieve its objectives of price stability and economic growth.<sup>15</sup> The McCallum-like rule, as postulated in equation (8), sets the quantity of money in reaction to industrial production growth and the inflation rate gap. The equation states that when the actual inflation rate is higher than the target inflation rate and when industrial output expands, the money supply (monetary base or broad money supply) should decrease to contain the overheating or inflationary pressure in the economy, and vice versa. Thus, we expect  $\theta_{0y} \leq 0$  and  $\theta_{0\pi} \leq 0$ . Equation (9) is a hybrid of equations (7) and (8).

As in the case of the Taylor rule, we consider the signs of the estimated coefficients and the size of the adjusted R-squared of equations (7), (8), and (9) to judge the extent of monetary policy autonomy. If the monetary authority is constrained by its choice of fixed exchange rate regime and thus has no policy autonomy, then  $\gamma_0 \geq 0$  and the goodness of fit of equation (7) is high. If the monetary authority follows the McCallum-like rule to achieve domestic objectives and thus has full monetary policy autonomy, then  $\theta_{0y} \leq 0$ ,  $\theta_{0\pi} \leq 0$ , and the goodness of fit of equation (8) is high. When the monetary authority is partially constrained by reserve accumulation while partially trying to achieve domestic objectives, then  $\gamma_1 \geq 0$ ,  $\theta_{1y} \leq 0$ ,  $\theta_{1\pi} \leq 0$ , and the goodness of fit of equation (9) is high.

In what follows, we first test the PRC's monetary policy autonomy by using equations (4), (5), and (6) under the assumption that the short-term interest rate is a policy

<sup>14</sup> The definitions of M0, M1, and M2 are as follows. M0 is currency in circulation; M1 is the sum of M0 and demand deposits; and M2 is the sum of M1, household savings deposits, and corporate time deposits. In addition, M2 began to include securities company customer margin deposits in June 2001, RMB deposits of foreign-funded and joint financial institutions in 2002, and deposits of the Housing Provident Fund Management Center, and deposits of non-depository financial institutions in depository financial institutions in October 2011. It is noted that M0 is a narrower concept of money supply than the monetary base.

<sup>15</sup> In his formulation, McCallum (1988, 2000) attempts to explain the rate of change in the monetary aggregate variable in terms of the growth rate of nominal GDP. Our formulation is a variant of his original formulation and, thus, we call it a McCallum-like rule.

instrument. If we find evidence that the PRC's monetary policy followed the Taylor rule in earlier years but not as closely in later years, we may conclude that monetary policy autonomy has diminished. Next, we test monetary policy autonomy by examining equations (7), (8), and (9) under the assumption that monetary aggregates are the policy instruments. Similarly if we find that the PRC authority followed the McCallum-like rule in the past, but not as closely as before in more recent years, we can conclude that the authority has lost at least partial monetary policy autonomy.

As the specification of equations (7) and (9) may be subject to simultaneity problems, we use the generalized method of moments (GMM) procedure to obtain consistent estimators for the model parameters. Lagged values of foreign assets purchased by the PBoC, and the trade balance are used as instrumental variables when carrying out the regression exercises.

### 6.3 Testing Monetary Policy Autonomy with the Interest Rate as a Policy Instrument

We first examine whether the PRC's monetary policy autonomy has eroded under the assumption that its primary policy instrument is the short-term interest rate. This involves the estimation of equations (4), (5), and (6). We use monthly averages of the 7-day repo rate and 7-day China Interbank Offered Rate (CHIBOR) as the PRC's policy interest rates. See Appendix for data used in the empirical analysis and their sources.

#### Impact of the foreign interest rate

In equation (4),  $i$  and  $i^*$  refer to the short-term rates of 7-day repo or 7-day CHIBOR and the same maturity LIBOR, respectively. In estimation, we take first differences in interest rates (i.e., 1-month changes in rates) in order to avoid the noise or volatility that may cause the problem of non-stationarity and thus affect both the coefficient estimates and adjusted R-squared.

We conducted unit root tests on  $\Delta i_t$  and  $\Delta i_t^*$ , with both test statistics indicating stationarity. We also tested for structural breaks in our sample. Chow's multiple breakpoint test identified several structural breaks in the years 2008, 2011, 2012, and 2013 on unexpected shifts in the time series, for which the F-statistics are larger than the critical values. Dummy variables were added to the first difference version of equation (4) to take into account that major events may have caused structural breaks and affected the interest rate policy choices.<sup>16</sup> However, the results have not indicated much difference.

The regression results of the first-difference version of equation (4) for the two short-term interest rates (7-day repo and 7-day CHIBOR) are summarized in Table 2. We separate the sample (October 2004–October 2014 in the case of the 7-day repo, and September 2001–September 2014 in the case of the 7-day CHIBOR) into two subperiods—that is, the period before the GFC and the period after—to consider the significant changes in the global financial environment.

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<sup>16</sup> The US Fed's quantitative easing takes the value of 1 during the period November 2008–September 2014 (i.e., QE3 will end in October 2014, according to the Federal Open Market Committee's October 2014 meeting).

**Table 2: Estimation of the Short-term Interest Rate of the People’s Republic of China Using the Foreign Interest Rate**

	$\Delta i_t$ (7-day repo rate)			$\Delta i_t$ (7-day CHIBOR)		
	Oct 2004– Oct 2014	Oct 2004– Dec 2008	Jan 2009– Oct 2014	Sep 2001– Sep 2014	Sep 2001– Dec 2008	Jan 2009– Sep 2014
Sample period						
$\Delta i_t^*$	0.141** (0.108)	-0.089 (0.257)	0.841*** (0.000)	0.146*** (0.018)	0.013 (0.7409)	0.886*** (0.000)
Constant	0.165 (0.168)	0.175 (0.2042)	0.541 (0.0039)	0.172** (0.068)	0.077 (0.2783)	0.583*** (0.003)
No. of observations	121	51	70	157	88	69
F-statistic	2.629 (0.108)	1.315 (0.257)	21.084*** (0.0000)	5.731*** (0.018)	0.110 (0.741)	21.863*** (0.0000)
Adjusted R-squared	0.013	0.006	0.225	0.029	-0.010	0.235

CHIBOR = China Interbank Offered Rate.

Notes: The values in parentheses are p-values. \*\* = 5% level of statistical significance, \*\*\* = 1% level of statistical significance.

Source: Authors’ computations.

The results indicate that in the case of the 7-day repo for the full sample, the US dollar LIBOR rate appears to have a positive and statistically significant influence on the PRC’s short-term interest rate. However, the explanatory power measured by the adjusted R-squared is low at 0.013. For the pre-GFC subsample period (October 2004–December 2008), the LIBOR rate does not have much influence on the PRC interest rate, as the coefficient of  $\Delta i_t^*$  is negative though statistically insignificant. The adjusted R-squared is low at 0.006. For the most recent subsample period (January 2009–October 2014), the PRC’s short-term interest rate appears to be significantly influenced by the LIBOR rate. The coefficient is as high as 0.84, suggesting a 1 percentage point change in LIBOR could cause a 0.84 percentage point change in the PRC’s interest rate. Meanwhile, the adjusted R-squared is 0.225, much higher than the pre-GFC sample result. This suggests that the PRC’s short-term interest rate is highly influenced by LIBOR rates in the most recent period, indicating less autonomous monetary policy in the post-GFC period.

The estimation results for the 7-day SHIBOR are generally similar to those of the 7-day repo rate.

**Taylor rule estimation**

Next, we estimate a Taylor rule as specified in equation (5), which describes the response of the monetary authority to changes in industrial production and the inflation rate gap. The rule stipulates to raise the interest rate (introduce tighter monetary policy) when industrial production grows or the actual inflation rate is above the target rate, and vice versa. The coefficient estimates of  $\phi_{0,y}$  and  $\phi_{0,\pi}$  are expected to be positive.

First, stationarity and stability tests were conducted. The time series are generally stable but the stability test identified several structural breaks among the variables. Year dummies are included in equation (5) to control for structural changes in the estimating equation.

The regression results are summarized in Table 3 with the 7-day repo rate and the 7-day CHIBOR used as the policy interest rates. The sample period is again divided into two subsample periods, i.e., before and after the GFC.

Looking at the 7-day repo rate, in the pre-GFC period (October 2004–December 2008), the PRC’s monetary policy appears to have followed the Taylor rule, with the estimated coefficients of both industrial production growth and the inflation gap being statistically significant and positive. This suggests that the PRC’s monetary policy took domestic economic conditions into consideration. The result is consistent with the results reported in Table 2 where the PRC’s policy rate was not affected by the US LIBOR rate in the pre-GFC period.

In the post-GFC period, the estimated coefficient of industrial production growth has become statistically insignificant (though the coefficient on the inflation rate remains statistically significant and positive). This means that the PRC’s monetary policy has responded to the inflation rate gap but not to real economic activity. It appears that the PRC’s monetary authority followed the Taylor rule in the pre-GFC period, while only partially following the Taylor rule in the post-GFC period.<sup>17</sup>

The results for the CHIBOR are largely the same as those for the 7-day repo rate.

**Table 3: Estimation of the Taylor Rule**

Sample period	$\Delta i_t$ (7-day repo)			$\Delta i_t$ (7-day CHIBOR)		
	Oct 2004– Sep 2014	Oct 2004– Dec 2008	Jan 2009– Sep 2014	Sep 2001– Sep 2014	Sep 2001– Dec 2008	Jan 2009– Sep 2014
$\tilde{y}_t$	0.068*** (0.032)	0.091*** (0.043)	0.036 (0.324)	0.056*** (0.020)	0.044*** (0.038)	0.038 (0.319)
$\tilde{\pi}_t$	0.409*** (0.000)	0.164*** (0.020)	0.663*** (0.000)	0.385*** (0.000)	0.157*** (0.000)	0.683*** (0.000)
Constant	0.191** (0.056)	0.134 (0.305)	0.417*** (0.0012)	0.134** (0.081)	0.050 (0.436)	0.420*** (0.002)
No. of observations	120	51	69	157	88	69
F-statistic	28.149*** (0.000)	3.652*** (0.033)	46.501*** (0.000)	36.899*** (0.000)	8.098*** (0.001)	44.976*** (0.000)
Adjusted R-squared	0.313	0.096	0.572	0.315	0.140	0.564

CHIBOR = China Interbank Offered Rate.

Notes: The values in parentheses are p-values. \*\* = 5% level of statistical significance, \*\*\* = 1% level of statistical significance.

Source: Authors’ computations.

We then explore the sensitivity of the short-term policy interest rate to the foreign interest rate as well as the domestic economic conditions. The regression results of equation (6) are summarized in Table 4. In both the pre- and post-GFC periods, the PRC’s short-term interest rate did not respond to the US interest rate in a statistically significant way. In the pre-GFC period, the PRC interest rate did respond positively to domestic output growth and the inflation gap, particularly when the 7-day CHIBOR was the policy instrument. This further supports the view that the PRC’s monetary policy was autonomous prior to the GFC.

In contrast, in the post-GFC period, the PRC’s short-term interest rate continued to have positive responses to the inflation rate gap, but did not have a significantly positive response to domestic output growth. The results for the CHIBOR clearly

<sup>17</sup> Even though the short-term interest rate has significantly positive responses to both output growth and the inflation rate gap in the pre-GFC period, it should be noted that the estimated coefficient on the inflation rate gap is only 0.16. This suggests a weak response of monetary policy. The reason is that when the inflation rate rises by 1% the short-term interest rate rises only 0.16%, which is not sufficient to raise the real interest rate and possibly contain inflation.

indicate that there is a less support for the Taylor rule in the post-GFC period than in the pre-GFC period.

The results for the 7-day repo rate are less clear, but do not suggest rising monetary policy autonomy in the post-GFC period.

The overall results for equation (6) again support the view that the PRC's monetary policy was more autonomous in the pre-GFC period and that it has become less so in the post-GFC period.

**Table 4: Estimation of the Hybrid Taylor Rule**

Sample period	$\Delta i_t$ (7-day repo)			$\Delta i_t$ (7-day CHIBOR)		
	Dec 2004– Sep 2014	Dec 2004– Dec 2008	Jan 2009– Sep 2014	Sep 2001– Sep 2014	Sep 2001– Dec 2008	Jan 2009– Sep 2014
$\Delta i_t^*$	0.170*** (0.019)	-0.094 (0.401)	-0.023 (0.284)	0.123*** (0.017)	0.033 (0.370)	-0.221 (0.317)
$\tilde{y}_t$	0.062*** (0.047)	0.106*** (0.030)	0.027 (0.465)	0.050*** (0.037)	0.040** (0.061)	0.030 (0.450)
$\tilde{\pi}_t$	0.415*** (0.000)	0.118 (0.189)	0.742*** (0.000)	0.378*** (0.000)	0.163*** (0.043)	0.760*** (0.000)
Constant	0.210*** (0.033)	0.194 (0.196)	0.346*** (0.016)	0.181*** (0.021)	0.059 (0.369)	0.350*** (0.019)
No. of observations	120	51	69	157	88	69
F-statistic	21.395 (0.000)	2.660 (0.059)	31.468 (0.000)	27.326 (0.000)	5.657 (0.001)	30.332 (0.000)
Adjusted R-squared	0.340	0.091	0.573	0.336	0.138	0.564

CHIBOR = China Interbank Offered Rate.

Notes: The values in parentheses are p-values. \*\* = 5% level of statistical significance, \*\*\* = 1% level of statistical significance.

Source: Authors' computations.

To summarize, the PRC's short-term interest rate in the pre-GFC period responded positively to both output growth and the inflation rate gap, without being constrained by the foreign interest rate. This suggests that the PRC's monetary policy was relatively autonomous. In contrast, in the post-GFC period, the PRC's interest rate responded positively only to the inflation rate gap. This suggests eroding monetary policy autonomy in the post-GFC period.

## 6.4 Testing Policy Autonomy with Monetary Aggregates as a Policy Instrument

We next examine whether the PRC's monetary policy autonomy has been reduced under the assumption that its primary policy instrument is one of the monetary aggregates, such as M0, M1, and M2. This involves the estimation of equations (7), (8), and (9).

### Impact of foreign exchange reserve accumulation

Equation (7) tests whether changes in the monetary aggregate variable are influenced by changes in foreign assets purchased by the monetary authority. The coefficient on the change in foreign exchange assets purchased is expected to be positive and close to unity if the PRC authority adopts a rigid exchange rate regime and, as a result, gives up monetary policy autonomy. The monetary aggregate variable represents year-on-



year growth of M0, M1, or M2.<sup>18</sup> As changes in the monetary aggregate variable can also cause changes in foreign exchange reserves, equation (7) potentially involves the problem of simultaneity and could result in inconsistent estimates. To address this problem, the GMM procedure has been employed. Lagged values of foreign exchange reserves and the trade balance are included as instrumental variables.

The regression results of equation (7) are summarized in Table 5. The estimated coefficient on  $\Delta FXR / FXR_t$  is significantly negative in the pre-GFC period, while that for the post-GFC period is significantly positive regardless of the definition of monetary aggregates. The size of the adjusted R-squared is larger in the post-GFC period than in the pre-GFC crisis. These results suggest that the PRC's monetary policy autonomy was reduced in the post-GFC period.

**Table 5: Estimation of Money Supply of the Republic of China Using Foreign Exchange Reserves**

	$\Delta M / M_t$ (M0)			$\Delta M / M_t$ (M1)			$\Delta M / M_t$ (M2)		
	Oct 2004– Sep 2014	Oct 2004– Sep 2009	Oct 2008– Sep 2014	Oct 2004– Sep 2014	Oct 2004– Nov 2008	Dec 2008– Sep 2014	Oct 2004– Sep 2014	Oct 2004– Sep 2008	Oct 2008– Sep 2014
$\Delta FXR / FXR_t$	0.128*** (0.048)	-0.316** (0.080)	0.328*** (0.014)	0.238*** (0.011)	-0.443** (0.060)	0.474** (0.063)	0.087** (0.082)	-0.149*** (0.009)	0.196** (0.090)
Constant	8.759*** (0.000)	25.426*** (0.001)	7.563*** (0.000)	8.743*** (0.000)	33.680*** (0.001)	8.344*** (0.010)	15.108*** (0.000)	23.227*** (0.000)	14.930*** (0.000)
No. of observations	120	48	72	120	50	70	120	48	72
J-statistic Prob (J-stats)	14.441 (0.000)	5.479 (0.019)	6.436 (0.011)	0.335 (0.563)	8.402 (0.004)	0.939 (0.332)	8.003 (0.005)	1.195 (0.274)	11.905 (0.001)
Adjusted R-squared	-0.086	-0.166	0.020	-0.059	-0.769	0.161	-0.095	-0.102	0.099

Notes: Estimation follows the generalized method of moments procedure. The values in parentheses are p-values. \*\* = 5% level of statistical significance, \*\*\* = 1% level of statistical significance.

Source: Authors' computations.

### McCallum-like rule estimation

We next examine whether the McCallum-like rule explains monetary policy in the PRC. The McCallum-like rule states that the quantity of money set by the authority reacts negatively to changes in industrial production and the inflation rate gap. Equation (8) postulates that when output grows and the inflation rate is higher than the target rate, the monetary base or broad money supply should decline, and vice versa.

Regression results are summarized in Table 6. The results indicate that the PRC's monetary policy does not appear to have followed the McCallum-like rule in the case of M0 or M1, but may have followed the rule in the case of M2 in the post-GFC period. First, M0 had a significantly negative response to output growth and a significantly positive response to the inflation rate gap (in contrast to the prediction of the McCallum-like rule) in the pre-GFC period, while it did not respond significantly to domestic economic conditions in the post-GFC period. Second, M1 had a significantly positive response to output growth (in contrast to the prediction of the McCallum-like rule) and a statistically insignificant response to the inflation rate gap in the pre-GFC

<sup>18</sup> We use year-on-year growth to avoid the problem of non-stationarity as monetary aggregate variables and foreign exchange reserves are usually non-stationary.

period, while it did not respond to domestic economic conditions during the post-GFC period.

Finally, in the case of M2, the McCallum-like rule seems to be observed in the post-GFC period, but not in the pre-GFC period. That is, M2 responded positively to output growth (in contrast to the prediction) and negatively to the inflation rate gap in the pre-GFC period, while it responded negatively to both output growth and the inflation rate gap (as expected by the McCallum-like rule) in the post-GFC period. Thus, we have mixed results on monetary policy autonomy in the post-GFC period. We observe no evidence of policy autonomy based on M0 or M1, but we observe some evidence of rising policy autonomy based on M2.

**Table 6: Estimation of the McCallum-like Rule**

Sample period	$\Delta M / M_t$ (M0)			$\Delta M / M_t$ (M1)			$\Delta M / M_t$ (M2)		
	Dec 1997– Sep 2014	Dec 1997– Sep 2008	Oct 2008– Sep 2014	Mar 1997– Sep 2014	Mar 1997– Sep 2008	Oct 2008– Sep 2014	Mar 1997– Sep 2014	Mar 1997– Sep 2008	Oct 2008– Sep 2014
$\tilde{y}_t$	−0.522 (0.241)	−0.920* (0.149)	−0.265 (0.711)	−0.384 (0.450)	1.369*** (0.001)	−1.039 (0.372)	−0.221 (0.388)	1.570*** (0.000)	−1.080*** (0.032)
$\tilde{\pi}_t$	0.762*** (0.025)	0.840*** (0.036)	0.737 (0.265)	0.163 (0.668)	0.216 (0.354)	−0.709 (0.509)	−0.754*** (0.000)	−0.813*** (0.000)	−1.056*** (0.023)
Constant	11.635*** (0.000)	11.562*** (0.000)	11.872*** (0.000)	15.162*** (0.000)	15.663*** (0.000)	13.249*** (0.000)	16.737*** (0.000)	16.378*** (0.000)	16.671*** (0.000)
No. of observations	202	130	72	211	139	72	211	139	72
F-statistic	2.851** (0.06)	2.239 (0.111)	1.076 (0.346)	0.300 (0.741)	15.38 (0.000)	3.336 (0.041)	22.015*** (0.000)	31.910 (0.000)	27.887 (0.000)
Adjusted R-squared	0.018	0.019	0.002	−0.007	0.172	0.062	0.167	0.309	0.431

Notes: The values in parentheses are p-values. \*\* = 5% level of statistical significance, \*\*\* = 1% level of statistical significance.

Source: Authors' computations.

The estimation results of equation (9) suggest that the PRC's monetary aggregate variable did not respond to domestic economic conditions, but did respond positively and significantly to foreign assets purchased in the post-GFC period (Table 7). First, M0 responded negatively to foreign exchange reserve accumulation and negatively to output growth in the pre-GFC period, while it responded positively to foreign exchange reserves and the inflation rate gap (in contrast to the prediction of the McCallum-like rule) in the post-GFC period. Second, the results for M1 and M2 are similar. That is, M1 and M2 responded negatively to foreign exchange reserves and positively to output growth (in contrast to the prediction of the rule) in the pre-GFC period. They responded positively to foreign exchange reserves and output growth (in contrast to the prediction of the rule), but negatively to the inflation rate gap (as expected by the rule) in the post-GFC period.

Thus the McCallum-like rule explains the PRC's monetary policy behavior based on M0 only marginally in the pre-GFC period, but not in the post-GFC period. The McCallum-like rule explains the M2 behavior only partially in the post-GFC period. However, there is strong evidence that the PRC's monetary policy in the post-GFC period is positively affected by foreign exchange reserves, whether M0, M1, or M2 is used. Thus, there is not much evidence of increasing monetary policy autonomy in the post-GFC period relative to the pre-GFC period, even when M2 is used.

**Table 7: Estimation of the Hybrid McCallum-like Rule**

	$\Delta M / M_t$ (M0)			$\Delta M / M_t$ (M1)			$\Delta M / M_t$ (M2)		
	Nov 2004– Sep 2014	Nov 2004– Oct 2008	Oct 2008– Sep 2014	Nov 2004– Sep 2014	Jan 2004– Oct 2008	Oct 2008– Sep 2014	Nov 2004– Sep 2014	Jan 2004– Oct 2008	Oct 2008– Sep 2014
$\Delta FXR / FXR_t$	0.108** (0.072)	-0.855* (0.150)	0.327*** (0.016)	0.089** (0.076)	-0.135** (0.108)	0.666*** (0.001)	0.041** (0.070)	-0.082*** (0.01)	0.355*** (0.000)
$\tilde{y}_t$	-0.006 (0.990)	-1.825 (0.369)	0.049 (0.906)	1.649*** (0.005)	1.270*** (0.016)	2.863*** (0.000)	0.459** (0.080)	0.342** (0.072)	1.213*** (0.000)
$\tilde{\pi}_t$	1.152*** (0.017)	0.456 (0.625)	0.794* (0.113)	-0.468 (0.466)	0.491 (0.163)	-2.88*** (0.001)	-1.168*** (0.000)	-0.066 (0.604)	-2.552*** (0.000)
Constant	9.383*** (0.000)	48.168** (0.057)	7.908*** (0.000)	12.459*** (0.000)	20.770*** (0.000)	5.189** (0.055)	16.185*** (0.000)	20.412*** (0.000)	12.285*** (0.000)
No. of observations	119	48	72	119	48	72	119	48	72
J-statistic Prob (J-stats)	0.898 (0.343)	0.011 (0.915)	0.161 (0.688)	21.291 (0.000)	12.229 (0.007)	4.598 (0.204)	47.337 (0.000)	10.528 (0.016)	4.207 (0.240)
Adjusted R-squared	-0.172	-0.256	0.018	-0.080	0.180	-0.231	0.210	0.197	0.259

Notes: Estimation follows the generalized method of moments procedure. The values in parentheses are p-values. \* = 10% level of statistical significance, \*\* = 5% level of statistical significance, \*\*\* = 1% level of statistical significance.

Source: Authors' computations.

Empirical results presented so far do not clearly show that the PRC's monetary policy fully follows either the Taylor rule or the McCallum-like rule. The estimation results of equations (5) and (6) summarized in Tables 3 and 4 suggest that the PRC's monetary policy likely followed the Taylor rule in the pre-GFC period, but not in the post-GFC period. The estimation results of equation (8) as reported in Table 6 suggest the possibility that the PRC's monetary policy, using M2, followed the McCallum-like rule in the post-GFC period, but this is not the case when M0 or M1 is used. The PRC's money supply also responded positively and significantly to changes in foreign assets purchased during the post-GFC period. In this sense, the PRC's monetary policy autonomy seems to have increasingly eroded over time. Our interpretation of this is that the diminishing monetary policy autonomy has been due to the rising ineffectiveness of the PRC's de jure capital control system—in the face of gradual capital account liberalization and RMB internationalization—and a highly managed exchange rate regime that prevents sufficient exchange rate flexibility.

## 7. POLICY IMPLICATIONS

The above analysis suggests that the PRC's monetary policy has become less effective and autonomous over time with the progress on capital account liberalization and the spread of shadow banking. Therefore, the authorities should review their current monetary policy framework, fix the fundamental root issues, and establish supporting infrastructure to improve the monetary policy transmission mechanism and the financial stability framework. The PRC should also accelerate interest rate liberalization. For example, the authorities could set up a deposit insurance system, introduce a short-term policy interest rate, and develop a deep, liquid bond market to help form stable yield curves.

## 7.1 Greater Exchange Rate Flexibility

To cope with the trilemma constraint, the first priority is to address the rigid exchange rate system. That is, the PRC must adopt a more flexible exchange rate regime in order to regain policy autonomy. At this stage, the PRC's capital control regime is unevenly enforced. Capital inflows have had limited controls while capital outflows are still under severe restrictions. Therefore, large interest rate differentials with small exchange rate volatility have attracted large capital inflows, which have forced the authority to engage in larger currency market interventions and accumulate foreign exchange reserves. A one-way bet on the RMB's continued appreciation has led to even larger capital inflows. For this purpose, the authority may enlarge the RMB–US dollar trading band further so as to facilitate greater exchange rate flexibility.

Furthermore, to offset exchange market pressure due to capital inflows, the PRC authorities must encourage capital outflows. This could be achieved by allowing private firms and residents to invest abroad using both the RMB and foreign currencies, particularly the US dollar. The two-way flow of capital will naturally lead to greater volatility of the RMB exchange rate against major currencies.

## 7.2 A Short-term Policy Interest Rate for the People's Republic of China

As the PRC's lending and deposit rates are becoming increasingly liberalized *de facto*, the monetary authority must choose a short-term benchmark interest rate as its policy instrument and help create a market-driven yield structure of interest rates. The authority can carry out its monetary policy by adjusting its short-term policy interest rate and employing a new short-term liquidity facility. This policy rate will be used as the basis for banks to set reference rates, which then will be used to price financial derivatives and products. According to the Bank for International Settlements (BIS 2013), reference rates based on unsecured interbank term lending and borrowing are the dominant types of reference rates used in the world. BIS found that:

- More than 50% of all syndicated loans signed in 2011 were linked to either the LIBOR or the Euro Interbank Offered Rate (EURIBOR).
- A large portion of bonds in the world—to the tune of at least \$10 trillion—were referenced to one of these two rates.
- A significant share of mortgages and other retail loans were linked to them, and the use of these reference rates in derivatives markets was also widespread.

For central banks, the reference rate (such as the overnight rate) also serves as an operational target. Different from the actual policy rate, this operational target is used to guide monetary policy. It is an important component of the monetary policy transmission mechanism because the central bank can influence the financial system through the reference rate and then affect interest rates for loans, money market rates, and interest rate derivatives. Therefore, the PRC's monetary authority should work closely with market participants and review the reference rate setting process.

Before the LIBOR scandal, the SHIBOR was considered a natural candidate for the reference rate for the PRC. As the SHIBOR is an interest rate that participating banks report but do not have to transact using the reported rates, the system could lead to the over fixing or under fixing of the reference rate, especially in a stressed environment. Such problems could lead to a loss of market confidence in the SHIBOR. As a result,

the repo rate has become a more viable alternative for the PRC's future reference rate (Table 8).

**Table 8: The Shanghai Interbank Offered Rate and Repo Rate**

	<b>SHIBOR</b>	<b>Bond Repurchase Agreement</b>
<b>Tenor</b>	Overnight, 1-week, 2-week, 1-month, 3-month, 6-month, 9-month, and 1-year	1-day, 7-day, 14-day, 21-day, 1-month, 2-month, 3-month, 4-month, 6-month, 9-month, 1-year
<b>Credit Line</b>	Need to set up credit line	No need to set up credit line
<b>Risk</b>	Credit risk	Risk-free, secured transaction
<b>Collateral</b>	Credit-based	Government bonds, PBoC bills, and credit bonds

PBoC = People's Bank of China, SHIBOR = Shanghai Interbank Offered Rate.

Source: People' Bank of China.

Looking at major international central banks, the monetary operational target rates used by the US Fed and the Bank of Japan (BOJ) are both overnight rates. The Fed conducts its monetary policy by influencing the federal funds rate (FFR), the rate at which banks lend to each other overnight. After the Federal Open Market Committee (FOMC) sets the FFR target, the Fed then uses tools such as open market operations, reserve requirements, and the discount window to change the supply and demand of funds in the market, thus influencing the FFR.

Similarly, the BOJ publishes and controls the uncollateralized overnight call rate, which is the rate charged for overnight loans between banks. The BOJ sets this rate through open market operations to influence banks' current account balances with the BOJ, which in turn affects the overnight call rate.

The ECB meanwhile acts as the calculation agent for the Euro Overnight Index Average (EONIA), which is also an interbank overnight rate. Officially, the EONIA is not a reference rate or operational target for the ECB, but it plays a similar function (BIS 2008).

### 7.3 Market Infrastructures

Rapid interest rate liberalization without the necessary market, legal, regulatory, and supervisory infrastructure can lead to failures and crises in the banking system. The conventional interest rate liberalization sequencing, based on these concerns, is to liberalize short-term rates first and then to liberalize long-term interest rates.

In addition to interest rate liberalization, the PRC must deepen and broaden the local-currency bond market, foreign exchange, and related derivatives markets to allow firms and investors to diversify the risks; facilitate the use of market-driven prices to price risks; and provide tools for financial institutions and corporations to manage their risk exposures.

Finally, the PRC's monetary authority will also need to make monetary policy forward looking to reflect changes in both domestic and external financial markets and economic conditions. Against this backdrop, the authority should better communicate with the market and adjust the interest rate proactively to anchor market expectations.

## 8. CONCLUSION

This paper finds that the de facto degree of financial market openness is surprisingly high in the PRC despite the presence of de jure capital controls. Nonetheless, the authority still maintains a tightly managed RMB exchange rate regime and continues to

accumulate foreign exchange reserves. As a result, the authority's ability to set autonomous monetary policy has been constrained. This could lead to the accumulation of domestic macroeconomic and financial imbalances, which could eventually lead to financial crises in the future.

To avoid such consequences, the PRC authority faces several options. One is to reverse policies to open financial markets and limit international capital flows. This would allow the authority to achieve both exchange rate stability and monetary policy autonomy, but would require the process of RMB internationalization to slow down. In addition, reversing policy direction could reduce the PRC's growth prospects by sending a negative message to financial markets.

The other more reasonable option would be to increase RMB exchange rate flexibility and thereby restore monetary policy autonomy. Two-way flexibility can be achieved by substantially liberalizing capital outflows, as capital inflows have already been substantially liberalized and large capital inflows have been pushing up the RMB value. This option presents the risk of excessively large RMB exchange rate volatility, but the authority can contain this through smoothing interventions in the currency market.

However, to continue to pursue financial market opening, the PRC would need to make its financial markets deeper and more liquid, and strengthen financial market supervision and regulation. The interest rate needs to be determined in the market through the demand and supply of funds, which would help create stable yield curves and strengthen the transmission mechanism of monetary policy.

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\* ADB recognizes China as the People's Republic of China.

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## APPENDIX: DATA DESCRIPTION

Variables	Description	Period	Source
$\Delta i_t$	7-day Repo 7-day CHIBOR 3-month SHIBOR	Oct 2003 – Oct 2014 Sep 2000 – Oct 2014 Oct 2006 – Oct 2014	CEIC
$\Delta i_t^*$	3-month US dollar LIBOR	Jan 1990 – Oct 2014	Bloomberg
$\tilde{y}_t$	Industrial production (real) growth rate	Jan 1995 – Oct 2014	CEIC
$\tilde{\pi}_t$	CPI inflation gap	Jan 1990 – Oct 2014	CEIC
$\Delta FXR / FXR_t$	Foreign currency assets purchased by PBoC	Dec 1999 – Oct 2014	CEIC
$\Delta M / M_t$	M0 M1 M2	Dec 1997 – Oct 2014 Mar 1997 – Oct 2014 Mar 1997 – Oct 2014	CEIC

CHIBOR = China Interbank Offered Rate, CPI = consumer price index, LIBOR = London Interbank Offered Rate, PBoC = People's Bank of China, SHIBOR = Shanghai Interbank Offered Rate.