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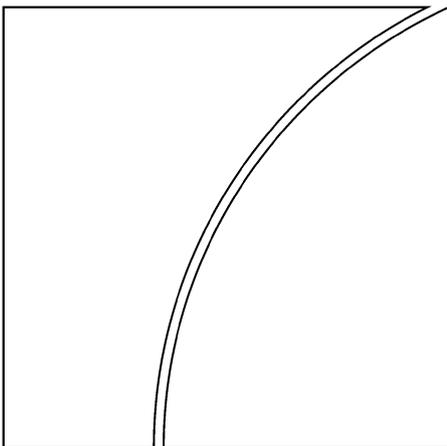
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Monetary and Economic Department

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Keywords: reserve requirements, sterilisation tools, monetary policy, net interest margin and spread, tax incidence, Chinese economy

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# China's evolving reserve requirements

Guonan Ma, Yan Xiandong and Liu Xi<sup>1</sup>

## Abstract

This paper examines the evolving role of reserve requirements as a policy tool in China. Since 2007, the Chinese central bank (PBC) has relied more on this tool to withdraw domestic liquidity surpluses, as a cheaper substitute for open-market operation instruments in this period of rapid FX accumulation. China's reserve requirement system has also become more complex and been used to address a range of other policy objectives, not least being macroeconomic management, financial stability and credit policy. The preference for using reserve requirements reflects the size of China's FX sterilisation task and the associated cost considerations, a quantity-oriented monetary policy framework challenged to reconcile policy dilemmas and tactical considerations. The PBC often finds it easier to reach consensus over reserve requirement decisions than interest rate decisions and enjoys greater discretion in applying this tool. The monetary effects of reserve requirements need to be explored in conjunction with other policy actions and not in isolation. Depending on the policy mix, higher reserve requirements tend to signal a tightening bias, to squeeze excess reserves of banks, to push market interest rates higher, and to help widen net interest spreads, thus tightening domestic monetary conditions. There are, however, costs to using this policy tool, as it imposes a tax burden on Chinese banks that in turn appear to have passed a significant portion of this cost onto their customers, mostly depositors and SMEs. However, the pass-through onto bank customers appears to be partial.

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## 1. Introduction

The People's Bank of China (PBC) has actively changed its statutory reserve requirement ratio (RRR) since the mid 2000s, more so than many of its international peers. The PBC has come to prefer this instrument over other sterilisation tools such as open market operations that use short-dated instruments like repos, foreign exchange swaps and central bank bills on the liability side and outright sales of government bonds on the asset side,<sup>2</sup> against a background of persistently large-scale injections of base money through purchases of foreign currency in the foreign exchange market.

This choice of instruments raises important policy questions. First, how important has the RRR been as a policy tool in China? Second, why have Chinese policymakers come to rely so much more on this tool? Third, how effective is the RRR as a countercyclical measure in tightening domestic financial conditions? Fourth, what is the size of the tax burden imposed by reserve requirements on banks and its likely distribution? Finally, what are the prospects for continued reliance on reserve requirements, given that the current RRR exceeds 20%?

This note reviews the recent developments in the PBC use of reserve requirements as a policy tool and attempts to answer these questions. A number of conclusions can be highlighted from our analysis.

First, since 2007, reserve requirements have been more intensively deployed in China as a regular policy tool. Both the magnitude and frequency of RRR adjustments have picked up considerably in recent years. Relative to both GDP and the monetary authority's balance sheet, the scale of required reserves maintained by Chinese commercial banks has been among the highest in the world, given a large banking sector, wide coverage of reservable deposits and high RRR.

Second, since 2007, reserve requirements have become a preferred sterilisation instrument to withdraw liquidity in the banking system, partially replacing other open market operation tools such as PBC bills. A major factor behind the increased use of reserve requirements is the attempt to more effectively sterilise foreign exchange interventions at reduced cost. This choice also serves the current Chinese monetary policy framework that is still oriented to quantitative targets and features multiple objectives.

Third, China's reserve requirement system has become more complex in recent years and is often applied in conjunction with interest rates and other quantitative, regulatory and administrative measures to address a range of policy concerns from counter-cyclical tightening/easing, macro-prudential objectives to credit policy. The increased complexity of the reserve requirement system in part reflects some of the tactical considerations from the perspective of the PBC.

Fourth, any monetary effects of RRR changes are hard to be isolated from those of other policy measures. While reserve money adjusted for RRR changes better reveals the PBC's monetary policy stance and often leads loan growth, whether a hike in the RRR tightens domestic monetary conditions depends on the sterilisation task on hand and other policy actions. The constraint of higher reserve requirements on bank lending seems more binding when initial excess reserves shrink below some threshold, restraining the subsequent loan expansion while leading to higher, more volatile market interest rates. In response to the higher RRR, Chinese banks charge borrowers more and widen their net interest margins and net interest spreads, thus helping to tighten domestic monetary conditions.

Fifth, while increased reserve requirements have responded to short-term policy dilemmas by tightening domestic monetary conditions with fewer rate hikes, they have increased the

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<sup>2</sup> In China, the available discount window or standing facilities have not been actively used in recent years.

cost of bank intermediation in China, which may prove counterproductive to financial market development. The tax burden imposed on Chinese banks is estimated at 0.3% of GDP, above that of Korea but below India's. Banks appear to have passed a significant portion of the burden onto their customers, mostly depositors and small- and medium-sized enterprises (SMEs). Yet bank shareholders may also bear part of the burden, if wider margins and spreads in part reflect increased risk premium.

Our paper is organised as follows. The next section places in perspective the Chinese application of reserve requirements as a policy tool. Section 3 explores factors influencing the choice of this tool in China. Section 4 discusses the possible channels and effects of a higher RRR in tightening domestic financial conditions. Section 5 examines the tax burden, its incidence and other complications associated with increased reserve requirements, while the final section concludes by considering the medium-term prospects for the use of reserve requirements as a policy tool in China.

## 2. The evolving role of reserve requirements in China

Among many policy purposes, reserve requirements in China serve first and foremost as a tool to drain liquidity in the context of large-scale FX interventions. We first detail the roles of reserve requirement as a sterilisation instrument as well as a tool serving credit policy and macroprudential policy in this section, before examining the role of a countercyclical measure in more depth in Section 4.

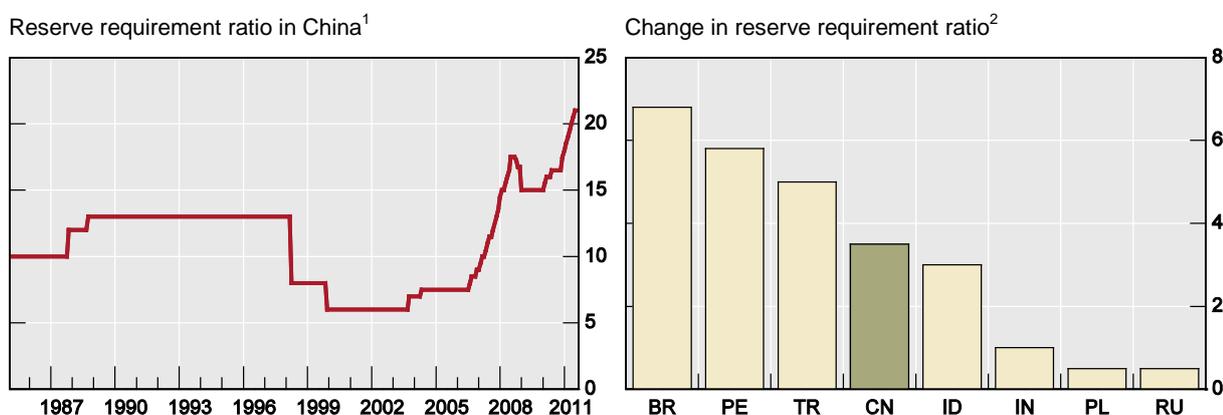
### 2.1 Large and frequent RRR adjustments

Since the mid-2000s, China has used reserve requirements as a policy instrument much more frequently and intensively than before. From its establishment in 1984 to June 2003, the RRR was adjusted just six times and mostly as part of financial liberalisation (Box 1 and Graph 1, left-hand panel). By contrast, between July 2006 and June 2011, the RRR was altered 35 times according to the PBC announcements, usually 50 bps each time, averaging a change every two months over these five years. Between 2006 and 2008, the RRR more than doubled, from 7.5% to 17.5%. It changed ten times in both 2007 and 2008. During the more recent tightening cycle, the RRR rose by 600 bps from January 2010 to June 2011,

Graph 1

#### Reserve requirement ratios in China and selected emerging markets

In per cent



BR = Brazil; CN = China; ID = Indonesia; IN = India; PE = Peru; PL = Poland; RU = Russia; TR = Turkey.

<sup>1</sup> Average RRR for large and small banks. <sup>2</sup> End 2009 – end 2010.

Sources: CEIC, UBS.

Box 1

**China's evolving reserve requirement system**

Currently, China's reserve requirement system features a lagged accounting regime, with a 10-day maintenance period but without averaging. All deposit-taking institutions and most of their deposits are covered by the system but are subject to different requirements. It is essentially a two-tier reserve requirement system, with the benchmark reserve requirement ratio applied to a few large commercial banks standing at 21.5% as of June 2011, 200 bps higher than that on most other smaller deposit-taking institutions. In addition, the RRR for rural and urban credit cooperatives currently ranges from 500 to 600 bps lower than that for the large banks. All required reserves must be held as deposits at the PBC but can be used for intra-day settlements. Both the required and excess reserves are remunerated at rates set by the PBC. Foreign currency deposits are subject to a lower reserve requirement (at 5% currently) but unremunerated.

China's reserve requirement system was first established in 1984 when the nation tried to rebuild its modern banking system. Before 1998, required reserves could not be used for settlements and a separate, mandatory minimum settlement reserves ratio was stipulated by the PBC. Then reserve requirements differed according to the banks and type of deposits (such as corporate deposits, saving deposits or demand deposits). During this episode, the central function of reserve requirements was neither monetary nor prudential. It aimed principally to facilitate the government's credit policy, allowing the PBC to allocate financial resources to priority sectors set by the government, as the PBC lending to commercial banks often far exceeded the required reserves deposited at the PBC in the 1980s and 1990s.

**Table: Reserve requirements in China**

Period	RRR		Remarks
1984 – 1985	20% - 40%		Depending on types of deposits
1985 – 1987	10%		Unified RRR for all reservable deposits
1987 – 1988	10% to 13%		Two increments to fight rising inflation
1988 – 1998	13%		Additional minimum clearing reserves
1998	8%		One cut to unify RRR for all banks while making excess reserves voluntary
1999 – 2003	6%		One cut to fight deflation
2003 – 2006	6% to 9%		5 increments
2007 – Aug 2008	9% to 17.5%		16 increments and differentiated RRRs
2008	<b>Large banks</b>	<b>Small banks</b>	A formal two-tier RRR system established
Sept 2008 – Dec 2008	17.5% to 15.5%	17.5% to 13.5%	3 cuts and two-tier RRRs for large and smaller banks to inject liquidity
2009	15.5%	13.5%	No changes in RRR
Jan 2010 – June 2011	15.5% to 21.5%	13.5% to 19.5%	12 increments, selective RRR hikes and dynamic differentiated RRR

Source: PBC and CEIC.

The current Chinese reserve requirement system has evolved from the basic 1998 setup, with three distinct trends. First, the official remuneration rates on both required and excess reserves have been lowered considerably, from the high levels of 7% to 8% in the late 1990s to less 2% lately, typically serving as a floor to the overnight interbank rate. Second, since 2007, as excess reserves fell noticeably, the use of reserve requirements as a major liquidity withdrawal instrument has been more active. Third, the reserve requirement system has become more sophisticated and differentiated across banks. Such differentiation initially related to capital adequacy or asset quality of the bank on a one-off basis in the mid 2000s but since early 2011, has linked to a bank's systematic importance, prudential indicators and loan growth relative to the aggregate trend on a dynamic basis. The PBC seems to be moving towards a mix of liability- and asset-based reserve requirements at its own discretion, with the benchmark RRR based on the liability side (deposits) and the individual differentials linked to the asset side (loans) on a monthly or quarterly basis (BoK, 2010).

exceeding 21% for large banks. China tops the global league table in terms of both the magnitude and frequency of RRR variations (Graph 1, right-hand panel). In short, the RRR has become a regular and active policy instrument heavily used by the PBC.

## 2.2 A more complex system

China's reserve requirement system has also become more complex over time. The current basic framework first took shape in 1998 and features a uniform RRR applied to most of the non-financial corporate and personal renminbi deposits regardless of maturity, with a separate and much lower RRR for foreign currency deposits and increased differentiations across types of deposit-taking institutions. In addition, there is voluntary holding of excess reserves by commercial banks to meet their daily settlements (Box 1).

Currently, the RRRs on local and foreign currency deposits differ markedly. The current benchmark RRR on local currency deposits exceeds 21% but is only 5% for foreign currency deposits. On the other hand, the required reserves on local currency deposits are remunerated at 1.62% but unremunerated for those on foreign currency deposits. Based on the one-year government bond yield of 2% in 2010, the tax burdens of reserve requirements on one yuan of local and foreign currency deposits are roughly on par with each other at 10 bps. Moreover, on several occasions, Chinese commercial banks reportedly were asked to deposit foreign currency with the PBC to meet the reserve requirements on their local currency deposits.<sup>3</sup>

In addition, reserve requirements differ across banks from time to time and are based on various formal and informal rules. In 2004, a bank's specific RRR level was linked to its capital adequacy and asset quality on an ad hoc basis, possibly aiming to achieve both macro and micro prudential purposes (Borio and Shim, 2007). Chinese newspapers also reported that in early 2010, without official public disclosure, a term RRR hike was imposed on selective banks that experienced more rapid loan growth, perhaps serving to support the PBC window guidance for monetary and macroprudential objectives.<sup>4</sup>

Moreover, rural and urban credit cooperatives have occasionally benefited from more RRR cuts and fewer RRR hikes than other deposit-taking institutions in recent years. The tailored RRR for these cooperatives is 600 bps less than that applied to large banks as of June 2011. Finally, lighter reserve requirements occasionally apply to regions that are remote, poorer and affected by major natural disasters. These last two features serve quasi-fiscal and credit policy purposes of favouring credit allocation to poor regions and agriculture.<sup>5</sup>

Since late 2008, the PBC has also adopted a more formal two-tier reserve requirement system, wherein the RRR for 6 or 7 largest commercial banks has since been 200 bps above that applied to most other smaller commercial banks. This is on top of the differentiated reserve requirements for credit cooperatives discussed above. This perhaps aims to ease the heightened liquidity pressures on small banks in the global financial crisis, while redistributing the tax burden of reserve requirements within the banking system.

In early 2011, the PBC rolled out a pilot scheme of "dynamic differentiated RRR". Under the scheme, the RRR for an individual bank varies on a quarterly, and sometimes even monthly, basis, taking into consideration its contribution to the deviation of aggregate credit growth from the historical trend, implementation of the government credit policy and other prudential indicators, such as provisioning, leverage ratio and capital adequacy (Box 1). The last

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<sup>3</sup> <http://www.nbd.com.cn/newshtml/20100121/20100121043513196.html> .

<sup>4</sup> [http://www.cs.com.cn/wh/03/200711/t20071113\\_1243482.htm](http://www.cs.com.cn/wh/03/200711/t20071113_1243482.htm) .

<sup>5</sup> The last two features resemble some of the differentiated system of reserve requirements in the US history.

component in turn is a sum of the basic capital requirement, additional charges related to a bank’s systematic importance and countercyclical buffers. Such differentiated and complex reserve requirement arrangements suggest the RRR has become a multipurpose instrument aimed at monetary policy, credit policy and macroprudential purposes.

### 2.3 An international comparison

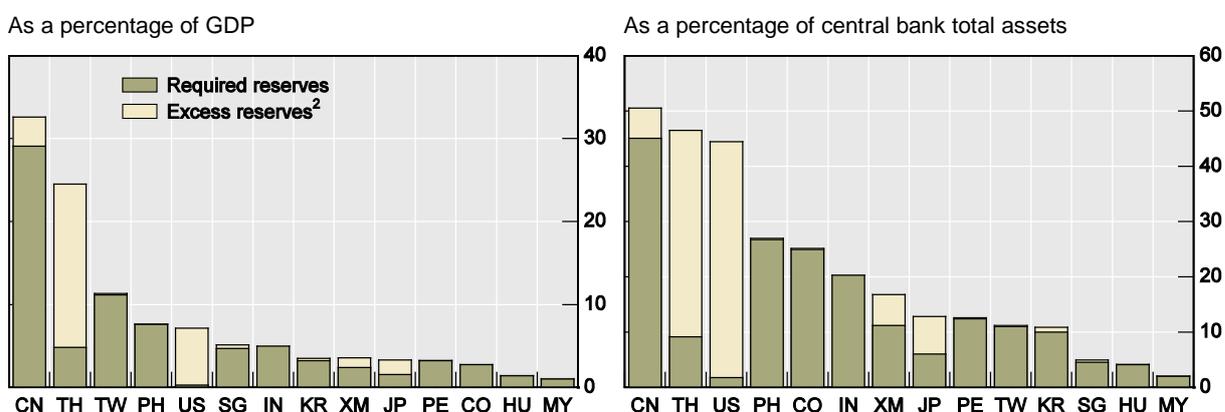
The role of reserve requirements as a sterilisation tool can be assessed both by an international comparison of its use across economies and by a comparison with other sterilisation instruments deployed domestically by the PBC over time. We examine such a role from an international perspective first before taking a closer look into the PBC’s own sterilisation toolkit.

From an international perspective, China’s level of required reserves is undoubtedly among the highest in the world. As a share of GDP, China’s level of required reserves is more than twice as high as advanced economies and most other emerging market economies. It is also extremely high relative to the balance sheet of the PBC when compared to international peers (Graph 2). On the other hand, China’s headline RRR is not the highest. For instance, the RRR on demand deposits in Brazil reaches as high as 45%, and the headline RRR in the Philippines, at 21%, matches that of China. Nevertheless, as will be discussed below, China’s large banking system and broad coverage of reserve requirements ensure its level of required reserves is by far the highest relative to GDP.<sup>6</sup>

Graph 2

#### Required and excess reserves in selected economies<sup>1</sup>

In per cent



<sup>1</sup> As of August 2010. <sup>2</sup> The difference between total reserves and required reserves. In Thailand’s case, excess reserves may include other short-dated instruments.

Source: National data; BIS central bank questionnaires.

It is of interest also to contrast the US and Chinese central bank balance sheets and their bank reserves. Both balance sheets have expanded noticeably in recent years, as bank reserves represent 40% to 50% of their respective balance sheets. The domestic asset purchase programme of the US Federal Reserve has resulted in a sizable increase in total bank reserves (to about 10% of the US GDP), mostly in the form of remunerated excess reserves. By contrast, large-scale foreign currency purchases by the PBC have been the

<sup>6</sup> Another noted feature of China’s reserve requirements is that reserve requirements have hitherto not been used to explicitly tax capital inflows, in contrast to the experience in some other emerging market economies.

main source of China's higher bank reserves that exceed 30% of its GDP and are mostly in the form of required reserves (Filardo and Grenville, 2011).<sup>7</sup>

## 2.4 A favourite sterilisation tool

From a domestic perspective, the PBC has come to prefer using reserve requirements as its main sterilisation tool to drain the liquidity since the mid 2000s. It has not only preferred it at margin but also partially substituted for others within its armoury of sterilisation tools.

Firstly, in stock terms, required reserves have come to dwarf the PBC bills outstanding. PBC bills, government deposits and reserve requirements have been the three most important channels in sterilising the monetary consequence of China's foreign exchange reserve buildup.<sup>8</sup> They combine to fund 90% of its US\$ 3.2 trillion of foreign reserves outstanding by June 2011, compared to just one third in 2003 (Graph 3, left-hand panel). Since late 2007, the balance of required reserves at the PBC has consistently overtaken PBC bills in immobilising the liquidity generated by reserves accumulation. Whereas PBC bills and required reserves each financed some 30% of China's foreign exchange reserves outstanding in 2005, by June 2011 they funded 12% and 67%, respectively, of the much higher dollar assets at the PBC. Thus, the ratio of required reserves to PBC bills outstanding stood at 6:1 as of June 2011, compared to 1:1 in 2005.

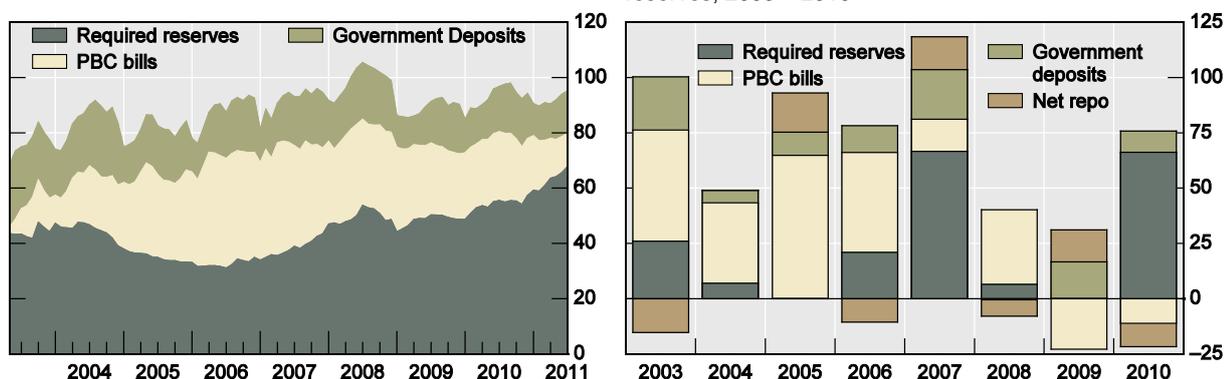
Graph 3

### Sterilisation tools of the People's Bank of China

As a percentage of foreign reserves

Outstanding amount as a percentage of foreign reserves

Flow as a percentage of the annual change in foreign reserves, 2003 – 2010



Note: in the right-hand panel, required reserves are the product of the change in the RRR during a given year and the reservable deposits at the year end.

Sources: PBC; CEIC; WIND; authors' own estimates.

<sup>7</sup> In the US, the ratio of excess to required reserves is about 10:1, while China's is 1:10, given the unsterilized asset purchase of the US Fed policy and the sterilised asset purchase of the PBC. Finally, while the asset purchase of the US Fed intended to influence the yield curve and credit spreads, that of the PBC aimed to manage the exchange rate.

<sup>8</sup> Of course, the PBC has limited influence over government deposits that are subject to large seasonal swings in budgetary outlays and tax receipts. While not a liquidity fine-tuning tool, government deposits play an important role in draining liquidity out of the system. Indeed, the RMB20bn issuance of RMB-denominated MoF bonds in Hong Kong in September 2011 can be interpreted as a cost-efficient operation to sterilise the return of offshore renminbi onshore, while supporting the development of Hong Kong's dim sum bond market.

Secondly, in flow terms, changes in the RRR have to a large extent substituted the net issuance of PBC bills as a tool to absorb liquidity stemming from reserve accumulation. This is evident in the right-hand panel of Graph 3 that compares different policy actions in annual flow terms scaled by the change in foreign exchange reserves.

Finally, it is also useful to compare the impacts of the RRR and other sterilisation tools on reserve money. To compare various sterilisation tools, we follow two approaches adopted by the St Louis Fed to adjust reserve money, by translating the effects of reserve requirement changes into “equivalent” changes in reserve money measured in terms of open market operations and other policy actions (Burger and Rasche, 1977; Wang, 2010). The adjustment is given by the following two equations:

$$adj_t = adj_{t-1} + (r_{t-1} - r_t) * D_{t-1} \quad (1)$$

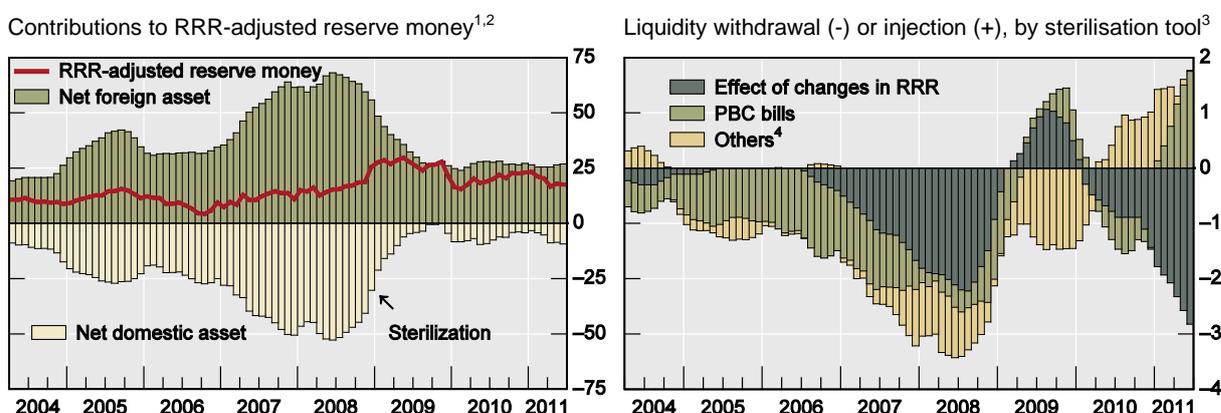
$$adj_t = (r_0 - r_t) * D_t \quad (2)$$

where *adj* is the adjustment to reserve money following changes in reserve requirements, *r* the RRR and *D* the reservable deposit base.<sup>9</sup>

These adjustments in theory capture the amount of reserve money absorbed or liberated by changes in the RRR. A hike in the RRR, like a net issuance of PBC bills, drains liquidity out of the system to reduce bank reserves available for new lending, other things being equal. But the drained liquidity remains as a part of reserve money if not adjusted for RRR changes. On the other hand, an open market operation draining liquidity reduces reserve money. Therefore, the RRR-adjusted reserve money will place the effects of RRR hikes and PBC bill issuance on reserve money on a more comparable basis in terms of their respective roles in absorbing liquidity.

Graph 4

### RRR-adjusted reserve money (approach 1) and sterilisation tools in China



<sup>1</sup> Reserve money adjusted for changes in the RRR (RRR-adjusted reserve money) = reserve money + adjustment (*Adj*), where  $Adj_t = Adj_{t-1} + (r_{t-1} - r_t) * D_{t-1}$ , where *adj* is the adjustment, *r* is reserve requirement ratio and *D* is deposit; see Burger and Rasche (1977) for more details. The starting month of the adjustment (*r*<sub>0</sub>) is December 1999. <sup>2</sup> Year-on-year change of three-month moving average; as a percentage of RRR-adjusted reserve money; a negative number means sterilization. <sup>3</sup> Components of net domestic assets; year-on-year change of three-month moving average; in trillions of RMB; positive (negative) indicates injection (withdrawal) of liquidity. <sup>4</sup> Net domestic assets other than effect of changes in RRR and PBC bond issue.

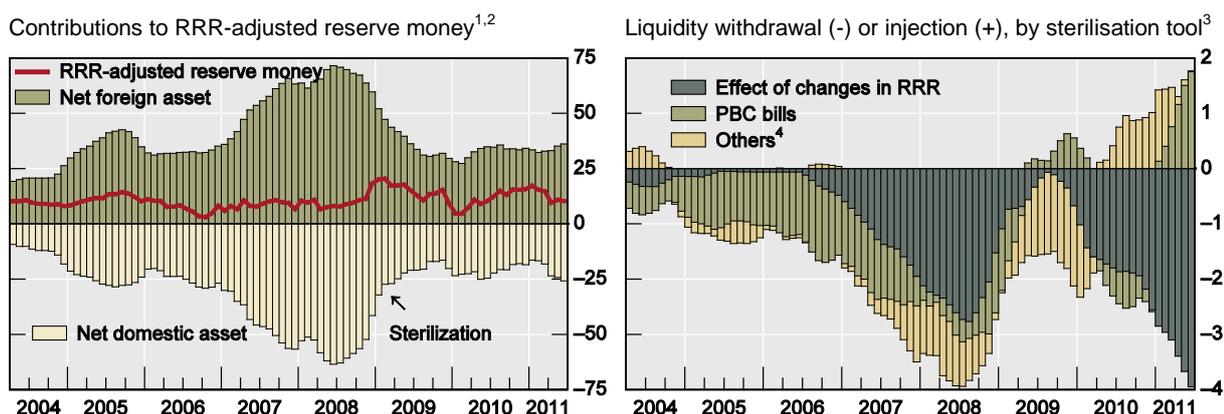
Sources: PBC, CEIC and authors' own estimates.

<sup>9</sup> The two St Louis approaches adjust reserve money at a point in time by capturing the cumulative effects of all the RRR changes from a given starting point. The two adjustment series have a correlation of 95% in China's case for the period under consideration. Alternatively, one may also adjust the reserve money growth by considering the marginal effect of the RRR changes on a 12-month rolling basis (Shu et al, 2008).

The adjustment data show that the mix of sterilisation instruments has varied over time but decisively tilted towards the choice of reserve requirements post-2007. Between 2003 and 2006, the PBC had relied heavily on central bank bill issuance as the main sterilisation tool to drain surplus liquidity (Graph 4 and 5). But since 2007, the PBC has leaned more on the reserve requirement system as the principal tool to freeze liquidity, in partial replacement of open market operations. Indeed, the roles of reserve requirements and PBC bills appeared to diverge after 2009, with the RRR hikes withdrawing liquidity while the net PBC bill runoff injecting liquidity. In a way, the role of PBC bills in this episode had changed to fine-tuning, mainly smoothing out liquidity fluctuations.

Graph 5

### RRR-adjusted reserve money (approach 2) and sterilisation tools in China



<sup>1</sup> Reserve money adjusted for changes in the RRR (RRR-adjusted reserve money) = reserve money + adjustment ( $Adj$ ), where  $Adj_t = (r_0 - r_t) * D_t$ , where  $adj$  is the adjustment,  $r$  is reserve requirement ratio and  $D$  is deposit; The starting month of the adjustment ( $r_0$ ) is December 1999. See Burger and Rasche (1977) for more details. <sup>2</sup> Year-on-year change of three-month moving average; as a percentage of RRR-adjusted reserve money; a negative number means sterilization. <sup>3</sup> Components of net domestic assets; year-on-year change of three-month moving average; in trillions of RMB; positive (negative) indicates injection (withdrawal) of liquidity. <sup>4</sup> Net domestic assets other than effect of changes in RRR and PBC bond issue.

Sources: PBC, CEIC and authors' own estimates.

## 3. Why reserve requirements actively used?

Three related sets of factors help explain the more active use of reserve requirements as a policy instrument in China since the mid 2000s. They are (1) the challenges of absorbing large structural liquidity surpluses arising from sizable foreign reserve accumulation; (2) a quantity-centric monetary policy framework with multiple and sometimes conflicting objectives; and (3) tactical advantages from the perspective of the PBC.

### 3.1 Persistent need for large-scale sterilisations

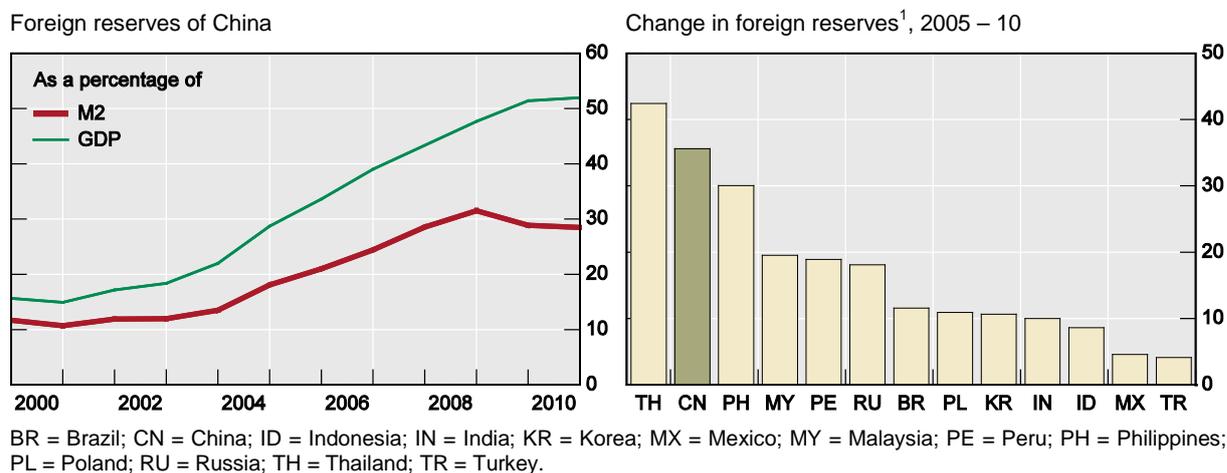
The sizable task to withdraw liquidity stemming from its sustained foreign reserve accumulation brings home the need for permanence, low cost and no policy rate signal and thus heightens the appeal of reserve requirements over other sterilisation tools. China's reserve accumulation has been among the largest in the world (Graph 6, left-hand panel). Indeed, the similar challenge could also be one key factor for several emerging market

economies to resort to this tool (Graph 6, right-hand panel).<sup>10</sup> In response, the PBC has increasingly relied on RRR adjustments as a major liquidity draining tool from 2007 for these three considerations – reserve requirements freeze liquidity in a more permanent fashion and at a lower cost to the PBC and relieve the PBC bills of difficult dual assignments.

Graph 6

**Foreign reserve accumulation in selective emerging market economies**

In per cent



BR = Brazil; CN = China; ID = Indonesia; IN = India; KR = Korea; MX = Mexico; MY = Malaysia; PE = Peru; PH = Philippines; PL = Poland; RU = Russia; TH = Thailand; TR = Turkey.

<sup>1</sup> Including net position in forwards and futures in foreign currencies vis-à-vis the domestic currency; as a percentage of provisional GDP 2010.

Sources: IMF *IFS*; IMF *IRFCL*; national data.

First, reserve requirements withdraw liquidity on a more permanent basis, in contrast to mostly short-dated open-market operation instruments (such as the repos and PBC bills). At the aggregate, reserve requirements and these open-market operation instruments should achieve the similar effects of absorbing liquidity. At the bank level, however, short-term securities allow for more flexible liquidity management than reserve requirements which could target and freeze bank liquidity more deeply, other things equal (Zhang, 2011).

Second, reserve requirements are more cost efficient from the PBC's point of view. With few exceptions, the remuneration rate on required reserves has been below the 1-year PBC bill auction yield (Graph 7, left-hand panel). By this measure, the cost saving for the PBC could be substantial. The gap between the auction yields on one-year PBC bills and the remuneration on required reserves point to a cost saving to the PBC at 0.2% of its total liabilities or 0.12% of GDP in 2010. Thus RRR hikes serve as a cheaper substitute for PBC bills. Of course, the flip side of the same coin is that the banks lose income and assume more of the sterilisation cost. Section 5 will discuss the tax burden imposed by reserve requirements on the Chinese banking sector.

Third, reserve requirements can drain liquidity without directly signalling policy rate. The PBC bill auctions often aim to strike a delicate balance of managing liquidity on the one hand and guiding market expectations or signalling policy rates on the other hand. This dual role has evolved over time. Prior to 2007, the PBC mostly acted as a price taker in auctioning its own bills, with liquidity absorption as the priority. After 2007, the PBC has become more a price

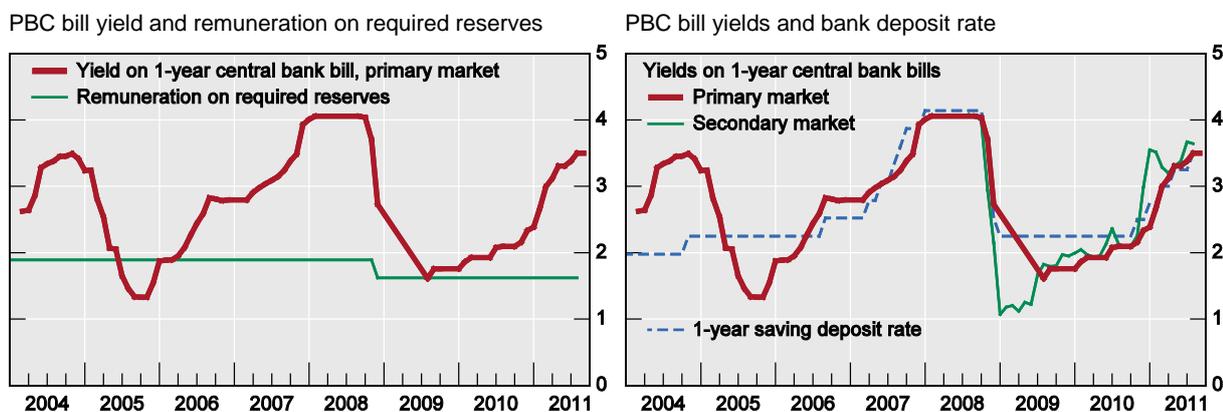
<sup>10</sup> In recent years, Brazil, China, Columbia, India, Indonesia, Malaysia, Peru, the Philippines and Turkey have resorted to adjustments in reserve requirements. However, Thailand presents a noted exception where the Bank of Thailand refrained from leaning on RRR hikes to sterilise its large foreign reserve interventions. Also, reserve requirements have been applied as a Tobin tax on capital inflows in some emerging markets.

maker, aiming to guide the auction yield near the one-year bank deposit rate and to signal a prospective rate change, while mostly leaving the auction volume to clear the market (Graph 7, right-hand panel).

Graph 7

**PBC bill yields, bank deposit rate and remuneration in China**

In per cent



Note: monthly averages.

Source: CEIC.

Reserve requirements thus have replaced PBC bills in recent draining operations. From late 2010 to early 2011, for instance, the PBC scaled down its bill issuance, partly because of rising secondary market yields on PBC bills above the auction yields. In this episode, the PBC allowed some of its maturing bills to run off, with an aim to limit both rises and volatility in the money market rates. By contrast, raising the RRR itself absorbs liquidity without directly signalling a policy rate move, though it may contribute to higher market interest rates over time, depending on other policy operations. Thus the draining task fell more heavily onto the RRR from 2007 to 2011, relegating PBC bills to smooth out market liquidity at margin.

**3.2 Monetary policy framework**

Over the past two decades, many central banks in advanced and emerging economies have shifted away from controlling monetary aggregates to a monetary policy framework oriented more towards inflation-targeting with short-term interest rate as the operating target. The role of reserve requirements has been on the decline accordingly. Some economies (such as Australia, New Zealand and Canada) have either eliminated or set the RRR to zero.<sup>11</sup>

In contrast, China maintains a monetary policy framework that inter alia targets broad monetary (M2 in particular) and aims at multiple objectives. This in part relates to the predominance of China's banking sector in intermediation. In addition, the large presence of state companies and their favoured access to credit continue impeding the transmission of the interest-rate channel. Finally, the government still sets bank deposit and lending rates. Hence, the PBC leans more on quantity-based instruments (Lardy, 1998).

<sup>11</sup> The use of reserve requirements as a policy instrument has declined, in part because of its distortionary tax effect on financial intermediation, reduced predictability of monetary aggregates due to accelerated financial innovation and the bluntness of RRR as policy tool. For an overview of monetary policy tools generally and reserve requirements in particular in both advanced and emerging market economies, see Borio (1997), Ho (2008), Mohanty and Turner (2008), Montoro and Moreno (2011), and Gray (2011).

However, the role of interest rate may have gained in recent years in China's two-track interest rate regime. From 2004, the government only sets the floors for bank lending rates and the ceilings for bank deposit rates, effectively regulating the minimum spread between deposit and loan rates (Ma, 2007). Banks have considerable leeway in pricing deposits and loans within these constraints, though the deposit rate cap is often considered binding. Moreover, bond yields and money market interest rates respond more to demand and supply and interact with official bank rates – it is an evolving two-tracked interest rate regime.<sup>12</sup>

At times, Chinese policymakers have to deal with conflicting objectives. A case in point is the challenges associated with rising domestic inflation in face of extremely low interest rates in major economies. A policy rate rise is contractionary but may induce additional capital inflows, partially offsetting the intended monetary tightening. The RRR may help reconcile such divergent policy objectives. For instance, if not fully remunerated, reserve requirements act as a tax on banks and thus hurt their profits, affecting cost of credit and possibly inducing them to widen the loan-deposit rate spread (Borio and Disyatat (2009); Montoro and Moreno (2011)), assuming that banks can pass reserve requirement costs onto their customers. If so, the financial conditions are tightened without attracting excessive capital inflows.

### **3.3 Other tactical and governance considerations**

From the PBC's perspective, the RRR may have a number of tactical advantages over other instruments in terms of operational autonomy. First, adjusting the RRR is perceived to affect liquidity within the banking sector only, without directly affecting the funding cost to borrowers at large. Thus it is often easier to reach consensus regarding RRR adjustments among Chinese policymakers so that policy decisions can be more timely than a policy rate change.

Second, the PBC has greater discretion in implementing RRR adjustments. For instance, the differentiated and dynamic RRR framework links quarterly adjustments in the RRR to individual banks' loan growth relative to the aggregate trend. The PBC also seems to have some discretion to intensify or suspend this scheme as needed, which can be viewed as serving as a complement to the PBC window guidance. Moreover, the PBC may redefine the reservable deposit base at its own initiative to ease or strengthen effective reserve requirements without altering the headline RRR. For instance, the reservable deposit base was extended to include some of the margin deposits (deposits as collaterals for banker acceptance and letter of credit) in September 2011, with an aim to curtail off-balance sheet lending while signalling continued tight policy bias.

Finally, reserve requirements enhance the role of the Chinese central bank in formulating and implementing the macroprudential policy, as the governance of this policy tool clearly resides with the PBC. This is consistent with a new trend seen at central banks in many major economies after the global financial crisis.

## **4. The monetary effects of reserve requirements**

As discussed, RRR adjustments have sometimes served as a countercyclical measure to tighten domestic monetary conditions, often complementing policy rate changes and in conjunction with administrative and regulatory measures such as window guidance, indicative loan quota and loan-deposit ratio. An often observed pattern in recent years is that

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<sup>12</sup> For a discussion of the evolving Chinese monetary and financial system, see Yi (2008 and 2009), Conway et al (2010), Wang (2011), Chen et al (2011), and He and Wang (2011).

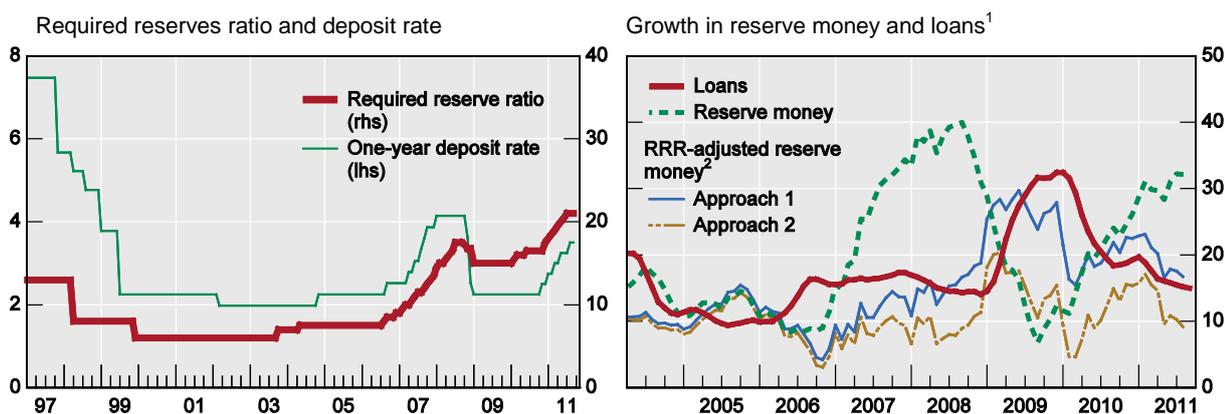
both the policy rate and RRR are adjusted in the same direction one after another, apparently aiming to reinforce the tightening or easing effects (Graph 8, left-hand panel).

Thus, it is often quite difficult, if not impossible, to isolate the effects of reserve requirements from other policy actions. For instance, an RRR hike itself does not necessarily imply a tighter policy stance, depending on the sterilisation task and other policy actions. Hence any contractionary effects of a higher RRR will in part be shaped by the interactions among these policy measures. Finally, the channels for RRR adjustments to influence domestic monetary conditions are not well understood and remain controversial.

Graph 8

**Required reserves, deposit rate, reserve money and bank loans**

In per cent



<sup>1</sup> Year-on-year growth of three-month moving average. <sup>2</sup> Adjusted reserve money = reserve money + adjustment (*Adj*). Adjustment by approach 1 consists of accumulating reserves liberated or absorbed by changes in reserve requirement ratios at each period, that is  $Adj_t^1 = Adj_{t-1}^1 + (r_{t-1} - r_t) * D_{t-1}$ . Adjustment by approach 2 is comparing the current reserve requirement ratio to a fixed initial period of reserve requirement ratio, that is  $Adj_t^2 = (r_0 - r_t) * D_t$ ; where *r* is reserve requirement ratio and *D* is deposit; the starting month of the adjustment (*t*<sub>0</sub>) is December 1999. See Burger and Rasche (1977) for more details.

Sources: PBC; CEIC; authors' own estimates.

**4.1 Channels of transmission**

Conceptually there may be four interrelated channels for an RRR change to affect an economy's monetary conditions. First, signalling policy intention – a hike in the RRR may signal a bias towards tightening, which may not indicate hikes in deposit and loan rates but can spill over to higher market interest rates through changed market expectations. Expectations about the policy stance may translate into expectations of future course of other policy actions following an RRR hike. For example, recently we have seen market interest rates reacting more to the announcements about RRR changes than to the implementation.

Second, raising the RRR can limit monetary growth and squeeze excess reserves if not fully neutralised, potentially limiting banks' capacity to lend over time and strengthening the expectation channel. The roles of excess reserves in the monetary condition and bank credit remain controversial, as the Japan's quantitative easing in 2001-2006 has shown (Borio and Disyatat, 2009). In China's case, the capital controls and two-tracked interest rate regime may further complicate our understanding of the underlying mechanism for this channel.

Third, in response to a higher RRR, banks may adjust their portfolios over time, resulting in higher bond yields and money market rates in a two-tracked interest rate setting. For instance, He and Wang (2011) report that RRR adjustments affect money market interest rates in the same direction, more than PBC bill auctions but less than official changes in the benchmark deposit rates.

Fourth, reserve requirements directly impose a tax levy on banks, making bank credit costlier and thus tightening the monetary condition (Borio and Disyatat, 2009). One special case is that increased reserve requirements may prompt banks to widen their loan-deposit rate spread, assuming some pass through of the RRR cost to bank customers (Montoro and Moreno, 2011). This channel does not need to appeal to the two-tracked interest rate assumption but assumes banks' ability to pass the cost of reserve requirements.

These mechanisms may interweave to influence the domestic monetary conditions. We first discuss the quantity effects by discussing the roles of excess reserve and other policy actions in Section 4.2 and the effects of RRR changes on the money multiplier in Section 4.3. Then Section 4.4 looks at the price effects via both money market spillovers as well changes in borrowing costs within the banking sector. The expectation channel is discussed as a link between quantity and price effects along the way, while the issue of cost pass-through will be explored in greater details in Section 5.

## **4.2 RRR-adjusted reserve money and excess reserves**

One way to investigate the intended monetary impact of RRR changes is to compare reserve money with or without the adjustment for RRR changes in revealing policy intentions. Since the RRR-adjusted reserve money combines in a single index those PBC actions that affect the supply of reserve money (such as PBC bill issuances and foreign exchange interventions) with the actions that affect the demand by commercial banks for reserve money (such as RRR changes), the RRR-adjusted reserve money should better reflect the money policy stance than the unadjusted measure.

Indeed, as the right-hand panel of Graph 8 shows, RRR-adjusted reserve money has been much more consistent with the PBC policy statements (Shu and Ng, 2010; Garcia-Herrero and Girardin, 2010). Its growth was a much slower during 2007-08 when the PBC tightened, quickened significantly in response to the global financial crisis in late 2008 and early 2009 but eased noticeably when monetary policy started normalising into the second half of 2009. In contrast, the unadjusted measure accelerated from the mid teens to 40% in the tightening cycle from 2007 to 2008 but slowed to the single-digit territory during the monetary stimulus between mid 2008 and mid 2009. As China's monetary policy started normalising from mid 2009, its growth jumped instead.

More importantly, growth of the RRR-adjusted reserve money has broadly led bank loan growth (Graph 8, right-hand panel). Our statistical tests strongly confirm that growth in the RRR-adjusted reserve money Granger-causes loan growth and not the other way around, suggesting that changes in the RRR may have influenced the capacity of Chinese commercial banks to book new loans (See Appendix A for details).

Another closely related mechanism for RRR hikes to affect commercial bank lending is the freezing of liquidity otherwise available for loan expansion. Factors conditioning such effects include the initial level of excess reserves and other operations taken in parallel, though this channel remains controversial (Borio and Disyatat, 2009). For instance, if for some reasons the initial slack in the system is substantial, banks can first run down their initially large excess reserves to partially offset the impact of a given RRR hike (Yu, 2009). As their initial excess reserves move closer to some minimum threshold needed for settlements, another RRR hike can bite more. There are also distributional issues. While the government controls the current level of excess reserves for the system, it can only influence their distribution across banks and size relative to bank deposits over time.

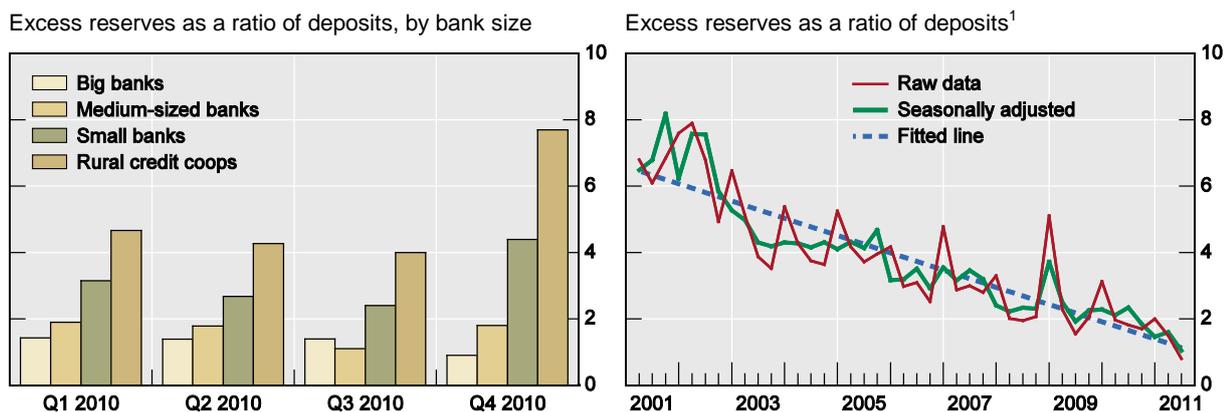
The level of excess reserves varies both across banks and over time in China. During 2010, for instance, excess reserves stood around 1.0% of deposits for large banks but were much higher for smaller institutions – between 1.5% and 2.0% for mid-size banks, 3% and 4% for small banks, and 5% and 7% for rural credit cooperatives (Graph 9, left-hand panel). One

reason for the marked differences is the vast branch networks ensure the large banks a stable funding source from their extensive and cheap retail deposit base, reducing their precautionary demand for excess reserves. Another reason could be the less than well-functioning of the Chinese money market. This helps explain China's two-tier reserve requirement system (Box 1) and why the Chinese rural credit cooperatives have been exempted for a number of the recent RRR increases.

Graph 9

### Excess reserves in China

In per cent



<sup>1</sup> The seasonal adjustment is based on X-12 ARIMA and the fitted linear regression line is  $y = 6.6 - 0.13 t$ , where  $t$  is a quarterly trend variable.

Sources: CEIC; BIS calculations.

Over past ten years, the aggregate excess reserves for the banking sector as a whole have declined considerably, dropping from around 7% of bank deposits in 2001 to 1% by mid 2011 (Graph 9, right-hand panel). While a full discussion is beyond the scope of this paper, this marked decline may reflect a combination of factors including a reduced remuneration on excess reserves (from 2.07% to 0.72%), introduction of online settlement technology, advances in the Chinese bond market permitting better liquidity management, and stronger profit motives on the part of Chinese banks following their public listings.

The recent two monetary policy cycles help illustrate the varying roles of both offsetting operations and initial excess reserves in conditioning the impact of RRR changes. In the first tightening cycle from 2007 to mid 2008, the PBC absorbed liquidity through both an 800-bps advance in the RRR and aggressive PBC bill auctions, in response to large-scale FX interventions (Graph 10, left-hand panel). However, in partial offset, the excess reserves/deposits ratio declined by more than 100 bps in this phase to 2%. Increased reserve requirements combined with aggressive PBC bill issuance and official interest rate hikes to slow loan growth. In this cycle, the PBC actively sold its bills in sterilisation operations but had already begun to shift towards greater reliance on reserve requirements.

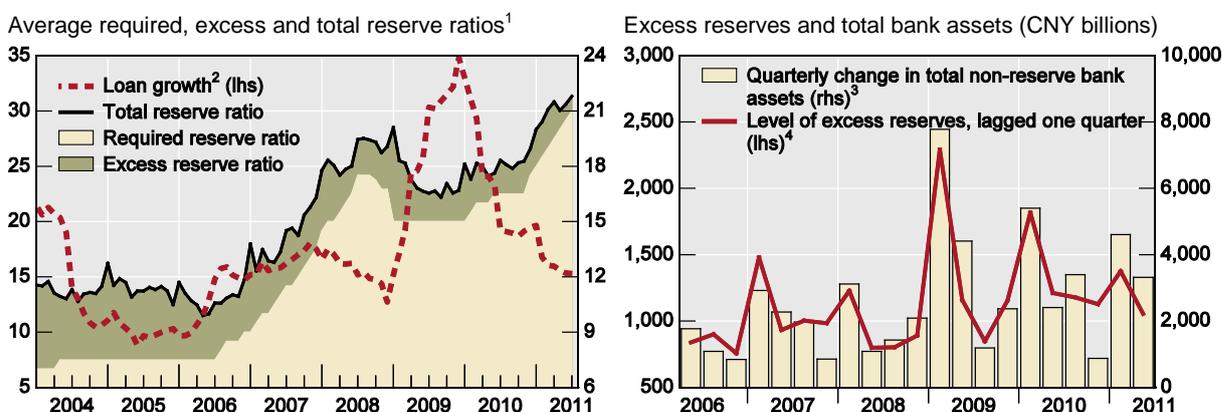
By contrast, during the second tightening cycle, the PBC cumulatively raised the RRR by 600 bps between 2010 and June 2011, while letting more of its bills to run off. In this episode, the excess reserves/deposits ratio declined by less than 80 bps, from 1.6% to 0.8%. As excess reserves approached a threshold of about 1% of bank deposits, RRR hikes became more biting. On the other hand, offsetting PBC operations were substantial, as more of maturing PBC bills were allowed to run off. The PBC bills outstanding fell more than 40% by mid 2011 from its peak in mid 2010. The impact of RRR hikes was strengthened by the initially lower excess reserves but dampened by the runoff of PBC bills outstanding in this cycle.

Thus, diminishing initial excess reserves, interest rate hikes, and increasing reserve requirements, despite policy offsets, combined to restrain the banks' capacity to expand

credit. During these two episodes of rising RRR, the Chinese loan growth did slow significantly. Indeed, the initial level of excess reserves may have become a binding factor influencing the expansion of overall bank assets in the subsequent quarter (Graph 10, right-hand panel).

Graph 10

### Loan growth, bank asset changes and reserves in China



<sup>1</sup> Required reserve and excess reserve ratios are, respectively, required and excess reserves as a percentage of bank deposits. The total reserve ratio is the sum of required and excess reserve ratios. <sup>2</sup> Loans in RMB and foreign currencies; year-on-year changes, in per cent. <sup>3</sup> Quarterly changes in the total bank assets minus bank deposits at the PBC. <sup>4</sup> The outstanding aggregate for the banking sector, lagged one quarter.

Sources: CEIC, CICC and authors' own estimates.

Nevertheless, caution is still required in attempting to disentangle the impact of RRR changes from the potential effects of other policy levers, such as indicative loan quota, window guidance and loan-to-deposit ratios. For instance, a more rigorous implementation of the 75% loan-to-deposit ratio on a daily-average basis rather than a monthly-end basis may force some of the Chinese banks to maintain a larger deposit base on average, potentially making a given RRR hike more biting than otherwise.

### 4.3 Effects on money supply

We also explore the role of reserve requirements in monetary control (Borio, 1997), by estimating the effects of RRR variations on the money multiplier in a textbook fashion (Liu et al, 2011). This approach has its own flaws but is useful in the Chinese context, since the PBC is sometimes perceived to have limited control over its own balance sheet, due to the constraint of heavy FX interventions, and often has resorted to reserve requirements in an attempt to achieve the M2 target, which remains the official intermediate target for the PBC.

Large and frequent changes in the RRR in China can be a major factor influencing the multiplier, which is a function of both the excess reserves/deposits ratio and the RRR. While the excess reserves are maintained by banks for settlement purposes and a function of payment uncertainties, costs of liquidity, and payment infrastructure (Borio, 1997; Disyatat, 2008), the PBC sets the RRR to aim at the M2 growth target by influencing the multiplier.

Liu et al, (2011) conduct a simple scenario analysis to gauge the likely effect of RRR changes on broad money growth in China, taking reserve money as given. According to their vector auto-regression (VAR) estimates, a 100-bps RRR hike lowers the money multiplier by 0.075 on average (See Appendix B for more details). Table 1 compares the actual multiplier and M2 growth with its simulated values without RRR changes in a given year. For instance, without the 300 bps RRR rise in 2010, M2 growth based on our VAR estimation would have reached 27%, much higher than the observed 20%. Our scenario analysis also suggests that should reserve money grow 26% in 2011, which is a reasonable assumption, the RRR would

need to increase by 400 bps in order to deliver the official M2 growth target of 16% at the end of 2011.<sup>13</sup>

<b>Table 1: Monetary growth and multiplier: actual and simulated</b>						
	Actual				Simulated without RRR hikes	
	Growth of reserve money <sup>1</sup>	Multiplier	Growth of M2 <sup>1</sup>	RRR hikes <sup>2</sup>	Multiplier <sup>3</sup>	Growth of M2 <sup>1,3</sup>
2000	8.5	3.79	15.4	0.0	3.79	15.4
2001	9.2	3.97	14.4	0.0	3.97	14.4
2002	13.3	4.10	16.9	0.0	4.10	16.9
2003	17.1	4.19	19.6	10	4.26	21.7
2004	11.4	4.32	14.9	50	4.35	15.9
2005	9.3	4.59	16.3	0.0	4.59	16.3
2006	20.9	4.44	17.0	150	4.55	19.8
2007	30.6	3.97	16.7	550	4.38	28.8
2008	27.3	3.68	17.8	50	3.72	19.1
2009	11.4	4.21	27.6	0.0	4.21	27.6
2010	28.7	3.92	19.7	300	4.15	26.7
<i>Memo</i> 2011 <sup>4</sup>	25.5	3.62	16.0	400	3.92	25.6

<sup>1</sup> Year-on-year growth. <sup>2</sup> In basis points. <sup>3</sup> Computed using our VAR estimate that a rise of 100 bps in the RRR will lower the multiplier by 0.075 in the same year (see Appendix B for details). <sup>4</sup> Estimated on the assumptions that in 2011, reserve money grows at 25.5%, the official M2 target is 16% and if no RRR changes, the multiplier is the same as in 2010.  
Sources: PBC, authors' own estimates.

#### 4.4 Funding costs and loan-deposit rate spreads

There are at least two possible ways for RRR hikes to translate into higher borrowing costs for business and households, thus tightening domestic monetary conditions. First, without sufficient offsetting actions, raising the RRR may force banks to adjust their balance sheets over time, more so as excess reserves move closer to some minimum threshold. In response, commercial banks tap interbank money market more and sell some of their bond holdings, resulting in higher bond yields or higher money-market interest rates in the context of China's two-tacked interest rate environment (Yi, 2009; Chen, et al 2011; He and Wang, 2011). Higher market interest rates would in turn prompt banks to charge borrowers more at the margin. Alternatively, required reserves remunerated at rates below interbank rates tax intermediation and thus directly push up the cost of credit within the banking system, assuming some degree of cost pass-through.

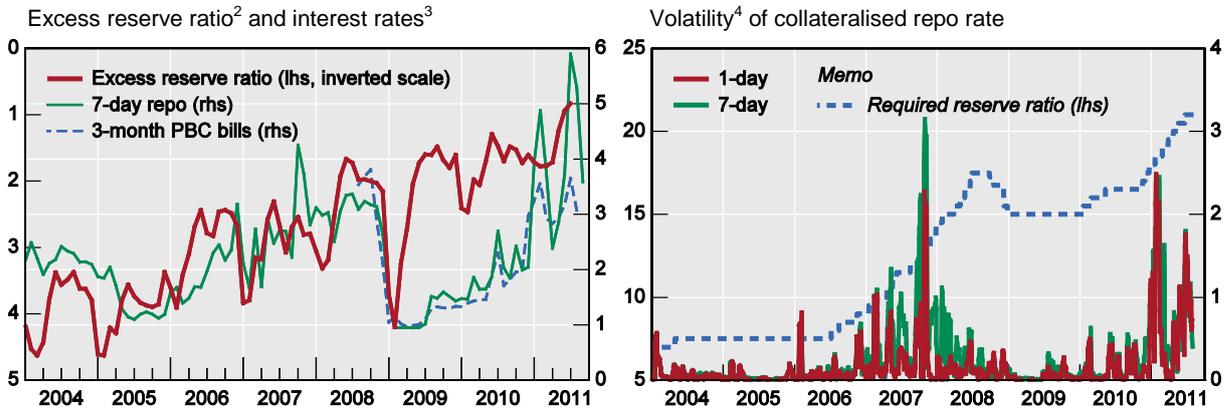
This seems to be the case in both the tightening cycles of 2007-08 and 2010-11 when the interbank funding costs rose. Firstly, as the PBC continued raising the RRR and excess reserves narrowed due to less than full offsetting operations, the 7-day repo rate and 3-month PBC bill yield became more volatile and generally rose, though with a lag (Graph 11). However, the relationship between excess reserves and short rates has been erratic, as argued by Disyatat (2008). This could in part relate to uncertainties about the expected course of other future policy actions through the signalling channel. Further, concurrent hikes in bank interest rates also directly contributed to higher short-dated market rates.

<sup>13</sup> By June 2011, the PBC hiked the RRR by 300 bps. In September 2011, the PBC widened the reservable deposit base in a phased manner, with an estimated effect equivalent to an RRR hike of 125 bps.

Graph 11

**Reserves/deposits ratios and interbank rates in China**

In per cent<sup>1</sup>



<sup>1</sup> Required and excess reserve ratio are, respectively, required and excess reserves as a percentage of bank deposits. <sup>2</sup> Two-month moving averages. <sup>3</sup> Monthly averages. <sup>4</sup> Two-week moving standard deviation.

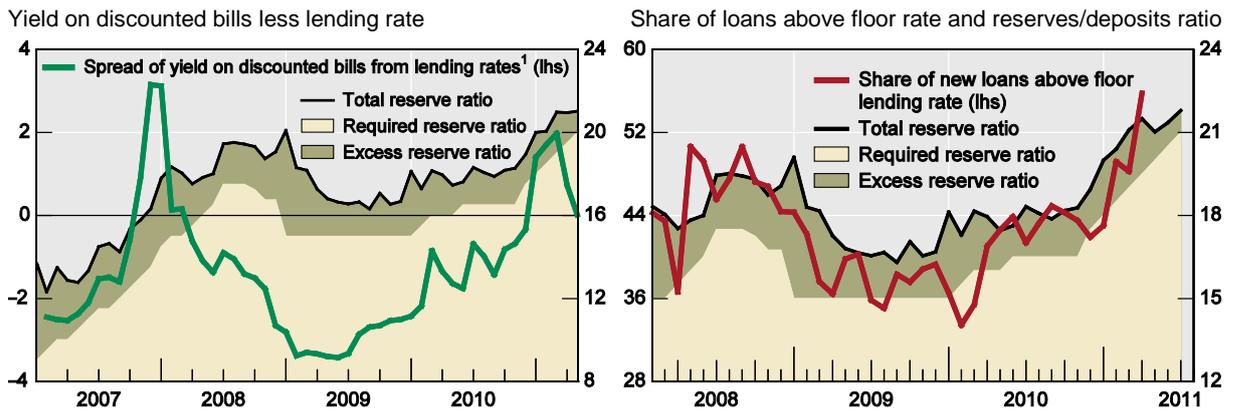
Sources: CEIC; PBC; authors' own estimates.

Alternatively, without directly appealing to a two-tracked interest rate setting, banks are motivated to transfer the cost imposed by reserve requirements via attempts to either pay depositors less or charge borrowers more or both – by widening the loan-deposit rate spread (Montoro and Moreno, 2011). This rests on the implicit assumption that the burden can be passed through. If so, financial conditions may be tightened by advancing reserve requirements. As discussed, Chinese commercial banks within the constraints of minimum loan-deposit rate spreads still have leeway in pricing loans and deposits to widen their spread between lending and deposit rates beyond the regulated minimum rate spread.

Graph 12

**Discounted bill yields and new loans above lending floor in China**

In per cent



<sup>1</sup> Official 6-month lending rate. Required reserve ratio and excess reserve ratios refer to the ratios of required reserves and excess reserves over bank deposits, respectively.

Sources: CEIC, PBC, and authors' own estimates.

If the deposit rate cap is indeed binding in China, higher bank lending rates would be required to support the conjecture that banks managed to pass some of the RRR cost, so as to tighten domestic monetary conditions. The rising RRR did seem to prompt term lending rates to rise. For instance, the yield on 6-month discounted bills rose noticeably relative to the official floor lending rate, in response to a rising RRR that managed to squeeze excess

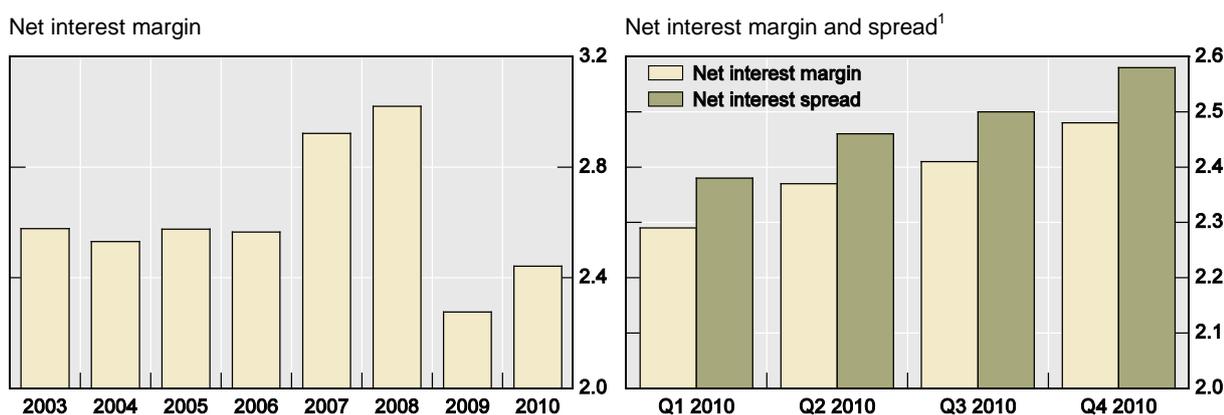
reserves (Graph 12, left-hand panel). The swings in the rate spread between bills and bank loans reached as wide as 500 bps in the last two tightening cycles. More importantly, a higher portion of the new loans is priced by Chinese banks above the official floor lending rate when the rising RRR squeezes excess reserves, pushing funding costs higher (Graph 12, right-hand panel).<sup>14</sup>

Chinese banks also appeared to have widened their net interest margin and net interest spread during the recent two cycles, tightening the domestic financial conditions by passing some of the reserve requirement cost to bank customers (Graph 13, left-hand panel). Conceivably, the observed wider interest margins and spreads were mainly a result of asymmetric adjustments in official loan and deposit rates by the Chinese government to compensate Chinese banks for the increased RRR tax burden, especially given its tendency of hiking the RRR and bank interest rates one after another. Nevertheless, the margins and spreads widened during the first three quarters of 2010 when the PBC hiked the RRR three times by 150 bps without hiking any bank rates (Graph 13, right-hand panel). Therefore, other things equal, wider net interest margins and spreads point to at least some pass-through, serving to tighten local financial conditions. However, other factors may also influence net interest margins, as will be discussed in the next section.<sup>15</sup>

Graph 13

**Net interest margin and spread in China**

In per cent



<sup>1</sup> Net interest margin is the difference of interest income and interest expense over the earning assets, while net interest spread is the difference between the average yield on interest-earning assets and the average cost on interest-bearing liabilities.

Source: CEIC, CBRC; Credit Suisse.

In any case, an interesting question remains what would happen to bank profitability in China if the official protection of loan-deposit rate spread and reserve requirements are both eased or abandoned. We doubt that any margin squeeze would be dramatic, as China's net interest margin appears neither excessively fat nor thin, either relative to its international peers or over its own recent cycles (the left-hand panel of Graph 14 and Table 2). If anything, China's net interest margin is much closer to Australia's, where there are no reserve requirements, than to other emerging markets.

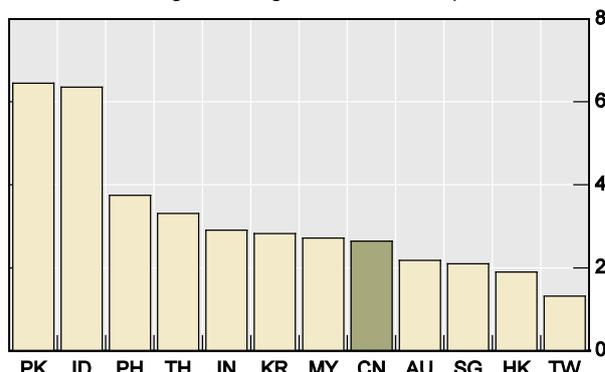
<sup>14</sup> During the recent phase of RRR hiking, interest rates were reported to jump sharply in the Chinese grey credit market, where small private and family businesses often borrow, a debtor database is lacking, and any RRR spillovers onto interest rates is likely non-linear, given slower aggregate credit expansion.

<sup>15</sup> These factors in general include changes in inflation trends, market competition, the composition of bank deposits and loans, the bank yield curve as well as underlying asset riskiness.

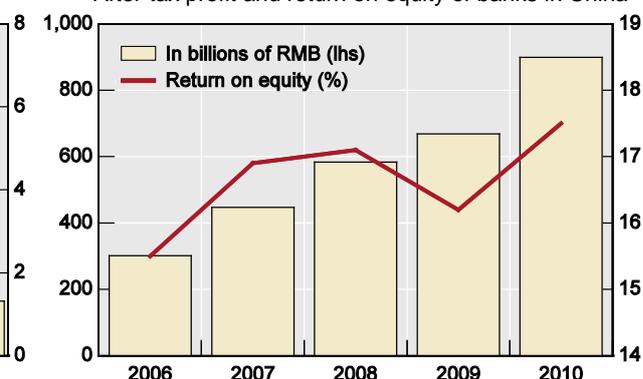
Graph 14

**Bank profits and net interest margin**

Net interest margin, average of 2006–10, in per cent



After-tax profit and return on equity of banks in China



AU = Australia; CN = China; HK = Hong Kong SAR; ID = Indonesia; IN = India; KR = Korea; MY = Malaysia; PH = Philippines; PK = Pakistan; SG = Singapore; TH = Thailand; TW = Chinese Taipei.

Sources: CEIC; CBRC; Credit Suisse.

**Table 2: Net interest margins of listed banks in Asia and the Pacific**

	2003	2004	2005	2006	2007	2008	2009	2010
Australia	2.53	2.38	2.28	2.24	2.13	2.09	2.20	2.23
China	2.58	2.53	2.58	2.56	2.92	3.02	2.28	2.44
Hong Kong SAR	2.02	1.82	1.83	1.94	2.03	2.05	1.80	1.65
India	3.14	3.15	2.98	3.00	2.83	2.85	2.73	3.09
Indonesia	4.75	6.07	6.07	6.28	6.31	6.47	6.34	6.36
Korea	3.28	3.34	3.17	2.94	2.93	2.76	2.66	2.82
Malaysia	3.12	2.97	2.79	2.72	2.68	2.63	2.74	2.79
Pakistan	3.52	3.35	5.48	6.63	6.44	6.39	6.55	6.23
Philippines	3.33	3.54	4.17	4.14	3.64	3.47	3.86	3.62
Singapore	1.95	1.95	1.92	2.08	2.11	2.17	2.18	1.94
Taiwan	1.92	1.82	1.47	1.67	1.46	1.41	0.97	1.07
Thailand	2.20	2.74	3.17	3.40	3.42	3.62	2.97	3.10

Note: in per cent; the listed banks under the coverage of the Credit Suisse.

Source: Credit Suisse estimates.

**5. Tax burden and other side-effects**

Whatever perceived advantages, heavy and sustained reliance on reserve requirements may carry costs and complications (Borio, 1997; Shu, et al, 2008; Montoro and Moreno, 2011). If required reserves are remunerated at a rate below returns to alternative investments, they directly impose a distortionary tax on financial intermediation. This could put depository institutions at a disadvantage and often imply more costly credit to borrowers and/or lower returns to depositors than otherwise. Excess application of reserve requirements could also give rise to regulatory arbitrage, complicating monetary and financial stability.

How big is the tax burden on the Chinese banking sector? Who pays it: banks' shareholders, borrowers or depositors? Finally, can banks avoid the costs by sponsoring disintermediation?

**5.1 The size of the reserve requirement tax**

The implicit tax burden associated with reserve requirements depends on two sets of factors. First, it hinges on whether required reserves are fully remunerated at the opportunity cost. If

so, reserve requirements incur no tax, at least not directly. A levy is imposed on banks when the remuneration is below the returns to alternative investment. However, what is opportunity cost is a tricky question in the context of China's two-tracked interest rate regime. For international comparison purposes, this paper benchmarks the opportunity cost at both one- and five-year "risk-free" domestic government bond yields. The difference between the opportunity cost and the remuneration on required reserves is the implicit average "tax rate".

The second factor is the "tax base", which is the required reserves and depends on the scale of the banking sector, the coverage of the reservable deposits within the banking sector, and the level of the RRR. A larger banking sector, wider coverage of deposits under reserve requirements and higher average RRR all broaden the "tax base". The tax burden implied by reserve requirements, therefore, is the product of the tax rate and base.

	CN	CO	IN <sup>7</sup>	KR	MY	RU
(1) Required reserves ratio (in per cent)						
On local currency	11 – 17	0 – 11 <sup>2</sup>	6	0 – 7	1	2.5
On foreign currency	5	-	5.5	1 – 7	-	2.5
(2) Required reserves as a percentage of GDP <sup>3</sup>						
Credit to private sector	25.42	2.77	4.18	2.98	0.94	0.87
	19.92	8.52	8.59	2.93	0.83	2.08
(3) Opportunity cost <sup>4</sup> (in basis point)						
Base on yield of 1-year government notes	47	353	651	313	290	471
Base on yield of 5-year government bonds	102	683	768	400	337	681
(4) Implicit tax (in per cent) <sup>5</sup>						
<i>Base on yield on 1-year government notes</i>						
As a share of GDP <sup>3</sup>	0.12	0.12	0.27	0.09	0.03	0.04
As a share of credit to private sector	0.09	0.30	0.56	0.09	0.02	0.10
<i>Base on yield on 5-year government bonds</i>						
As a share of GDP <sup>3</sup>	0.26	0.20	0.32	0.12	0.03	0.06
As a share of credit to private sector	0.20	0.58	0.66	0.12	0.03	0.14

CN = China; CO = Colombia; IN = India; KR = Korea; MY = Malaysia; RU = Russia.  
<sup>1</sup> As of August 2010 unless specified. <sup>2</sup> As of December 2010. <sup>3</sup> Provisional data of 2010. <sup>4</sup> Spread between government bond yield in specified maturity and required reserve remuneration. <sup>5</sup> Product of required reserves and opportunity cost: (4) = (2)\*(3). <sup>6</sup> As of Jun 2010. <sup>7</sup> India's cash reserve ratio only, not including the statutory liquidity ratio.  
Sources: Bloomberg; CEIC, Datastream; IMF IFS; National data.

As a percentage of	GDP	Central bank total assets	Credit to private sector	Fiscal revenue
2004	0.22	0.45	0.18	1.33
2005	0.13	0.23	0.11	0.74
2006	0.08	0.13	0.07	0.42
2007	0.26	0.40	0.24	1.29
2008	0.37	0.56	0.36	1.88
2009	0.25	0.37	0.19	1.24
2010	0.35	0.54	0.27	1.68

<sup>1</sup> The product of the required reserve amount outstanding at the year end and the annual opportunity cost associated with holding RRR. The opportunity cost here is defined as the difference between the full-year average 5-year government bond yield and the full-year averaged remuneration rate on the required reserves.  
Sources: PBC, CEIC, IFS and authors' own estimates.

An international comparison would help place our estimates in perspective. China's tax base is unmistakably among the largest globally, owing to its large banking sector, broad deposit

coverage and high RRR (Table 3 and Graph 2). Yet scaled by either GDP or domestic private credit, China's implicit RRR tax burden is manageable (at 0.3% of GDP in 2010) and positions the country in the middle in our international comparison. It is lighter than those in Colombia and India but heavier than those in Korea, Malaysia or Russia.<sup>16</sup> The main reason is China's relatively low interest rates compared to most emerging market peers, as measured by government bond yields.<sup>17</sup>

China's RRR-implied tax burden has also evolved in recent years (Table 4). Its required reserves are currently remunerated at 1.62%, down from the 2008 level of 1.89% and below the prevailing one-year and five-year government bond yields of 2% and 2.8%, respectively. The overall tax burden is estimated to have first more than halved between 2004 and 2006, as a modest rise in the tax base was overwhelmed by the marked decline in the government bond yields in this episode. It however has since rebounded strongly, more than tripling between 2006 and 2010, attributable to both a big expansion of the tax base following a rapid deposit growth and a doubling of the RRR from 9.5% to 18%, in addition to the reduced remuneration. More than 80% of the rise in the implied tax burden during this phase came from a larger tax base.

A manageable tax burden now should not give rise to complacency. With the prospects of a higher RRR and a still elevated inflation trend in 2011 (and eventually higher interest rates), China's RRR-implied tax burden could still climb further in the near term. Also, in theory, a rise in Chinese interest rates to a level about half of its 2010 nominal GDP growth of 15% from an average of 3% in 2010 would imply as much as a five-fold rise in the tax burden from the estimated 2010 level to a much more substantial 1.8% of GDP.<sup>18</sup> Finally, an expansion of the reservable deposit base could also point to an additional rise in the tax burden.

## 5.2 Tax incidence

Bank shareholders, depositors and smaller firms could all shoulder the overall RRR tax burden and ultimately share the sterilisation cost related to FX intervention. At one extreme, a RRR hike tends to squeeze net interest margins by an amount similar to its marginal tax on the whole reservable deposit base, if there is zero pass-through of the tax burden to bank customers. In this extreme case, the bank shareholders pay. However, wider margins under increased reserve requirements can indicate meaningful cost pass-through to bank customers, other things being equal. In the limit, bank depositors and borrowers pay (Montoro and Moreno, 2011). In between, the distribution of the tax burden can be influenced by a host of factors. We first present evidence that at margin, a significant portion of this quasi-fiscal cost may have fallen onto bank customers. However, it is possible that the wider net interest margins reflects higher riskiness of underlying bank assets, leaving this evidence consistent with bank shareholders sharing some of the cost.

Two sets of evidence point to meaningful cost pass-through onto bank customers. First, bank earnings were quite strong during the two RRR-hiking cycles in 2006-2010 when the

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<sup>16</sup> It is comparable to an estimated average of 0.25% for the G10 economies in the 1980s (Borio, 1997). The Eurosystem designed its required reserves not to impose a tax and its remuneration was set at the level of the ECB's main refinancing rate (currently 1.5%) which under normal circumstances is equal to overnight interbank rates. If the overnight rate is taken as the opportunity cost, China's reserve requirement tax burden in 2010 would fall to around 0.1% of GDP.

<sup>17</sup> Key reasons for low interest rates in China include relatively low inflation and high saving rate (Ma and Wang, 2010). Some assert the other way around, claiming that low Chinese interest rates are a consequence of "financial repression" that in turn contributes to a higher Chinese saving rate.

<sup>18</sup> He and Wang (2011) take the saving rate into consideration and still come up with an equilibrium deposit rate that is three times of the actual level in 2005.

immediate tax burden on banks tripled cumulatively. Indeed, their aggregate after-tax profits recorded an average annual compound growth rate of more than 30% in this episode of mostly rising RRR (Graph 14, right-hand panel). The average return on equity for Chinese banks has also trended higher in recent years, confirming higher banking profitability, despite a substantially higher RRR.

Second, wider net interest margins and spreads may in part indicate banks' ability to pass some of the burden onto their customers. As discussed earlier, Chinese banks managed to widen their net interest margin and spread by some 10 bps during the first three quarters of 2010 when the PBC raised the RRR by 150 bps without one single change in the regulated deposit and lending interest rates (Graph 13). Other things being equal, this would lend some support to the conjecture that banks pass some of the cost onto their customers.

Two questions, however, follow in turn. First, assuming a 100% cost pass-through onto bank customers, what is the likely distribution between depositors and borrowers? Second, could the observed margin expansions reflect something else if other things do not stay equal so that bank shareholders may still end up bearing some of the tax burden? The earning announcements of twelve listed Chinese banks, which account for 60% of China's loan and deposit markets, may help shed light on these two questions (Table 5).

	Average deposit rate		Average loan rate		Loan-deposit rate spread	
	2009	2010	2009	2010	2009	2010
ICBC	1.68	1.35	5.21	4.99	3.53	3.64
CCB	1.51	1.28	5.37	5.07	3.86	3.79
BOC	1.44	1.28	4.44	4.22	3.00	2.94
ABC	1.49	1.25	5.25	5.22	3.76	3.97
BoCom	1.57	1.42	5.13	5.13	3.56	3.71
China Merchant	1.44	1.24	4.49	4.87	3.05	3.63
Citic	1.50	1.33	4.78	5.00	3.28	3.67
Pudong Development	1.61	1.43	5.34	5.34	3.73	3.91
Minsheng	1.66	1.53	5.31	5.79	3.65	4.26
Industrial	1.56	1.46	5.39	5.36	3.83	3.90
Huaxia	1.57	1.38	4.82	5.50	3.25	4.12
Shenzhen Development	1.69	1.53	5.46	5.33	3.77	3.80
<i>memo</i>						
<i>Simple average</i>	<i>1.56</i>	<i>1.37</i>	<i>5.08</i>	<i>5.15</i>	<i>3.52</i>	<i>3.78</i>

Note: in per cent; ICBC = Industrial and Commercial Bank of China; CCB = China Construction Bank; BOC = Bank of China; ABC = Agriculture Bank of China; BoCom = Bank of Communication.  
Sources: earnings announcements of listed banks, authors' own estimates.

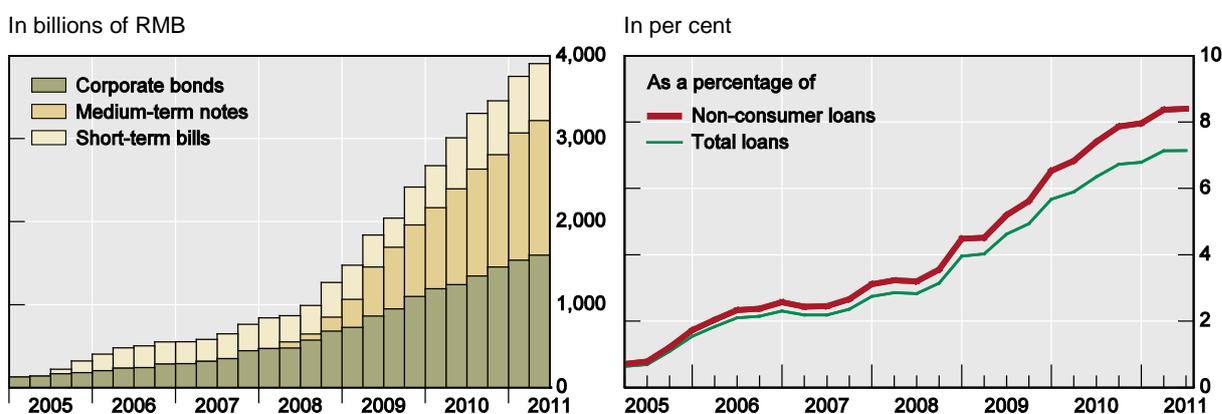
As to the first question, we contend that at least an important part of the RRR cost is passed onto depositors. During 2010, the average net interest spread for these listed banks widened by 26 bps, in tandem with a 300-bps rise in the RRR. This is a combined consequence of a 20-bps decline in the average deposit rate and a 7-bps rise in the average lending rate, suggesting that three quarters of the margin expansion came from a lower average interest cost on deposits, not via charging borrowers more. Indeed, the average interest cost on

deposits fell across all twelve reporting banks, even as the ceiling for the one-year deposit rate, often viewed as binding, was raised by 50 bps in final quarter of 2010.<sup>19</sup>

Regarding the second question, the wider net interest margins may in part reflect increased risk premium and not entirely cost pass-through per se. We note that only half of these listed banks managed to charge their borrowers more during 2010, despite ample incentive and leeway to do so and a hike of 50 bps in the floor lending rate in the fourth quarter. Interestingly, all big four Chinese banks failed to charge their borrowers more, and two of them even suffered an outright margin compression. One likely reason for this is the weaker pricing power of the big four banks over their top borrowers — big state companies with better access to cheaper bond and money-market financing. Indeed, the issuance of corporate bills, notes and bonds has accelerated in recent years, and banks themselves are a major holder of corporate paper (Graph 15).

Graph 15

### Non-financial corporate debt securities



Source: CEIC.

If so, the tiny rise in the average lending rate in 2010 may indicate a shift to direct financing, in order to bypass the regulated floor lending rate. As more blue chip companies tap the corporate debt market directly, a bigger portion of the bank loan portfolio goes to smaller firms. Indeed, loans to SMEs as a share of total bank loans have risen, from 50% at the end of 2008 to 60% in June 2011 (Graph 16, left-hand panel). Hence the observed higher loan rate charged by banks may in part reflect higher risk premium, as banks are moving down the credit spectrum. If so, the risk-adjusted net interest spread may not widen or could even narrow instead. With the implied cost pass-through incomplete, bank shareholders can meaningfully share the cost imposed by reserve requirements, thus qualifying any (Montoro-Moreno) tightening effects of increased reserve requirements.

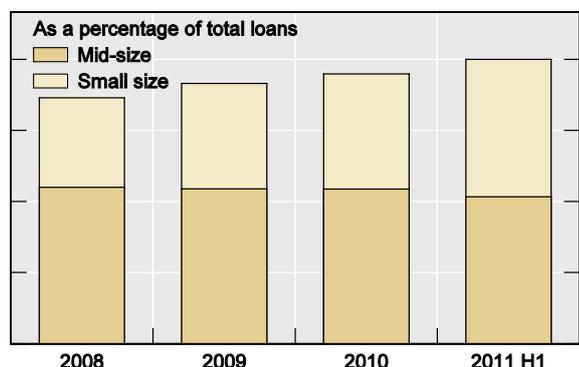
Improved access by SMEs to the formal banking sector is often both welfare and efficiency enhancing. The rub is that it also means a given RRR hike would hurt small firms more, forcing them to shoulder disproportionately any given burden pass-through to corporate borrowers, because of the greater dependence of small businesses on costlier bank credit.

<sup>19</sup> The decline in the average interest cost on deposits in 2010 may have less to do with banks' ability to reduce headline interest rates on deposits and more relate to two factors. First, the maturity composition of deposits shortens as inflation rises, owing to slow deposit rate hikes. Second, some interest expenses could be classified under other bank expense categories to circumvent the official ceiling on deposit rate.

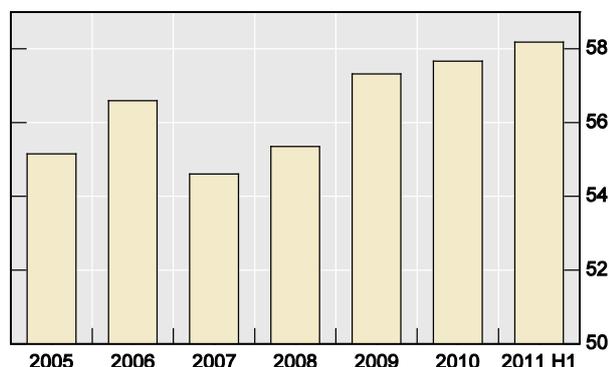
Graph 16

**Corporate loans and bank assets**

Loans to mid- and small-size firms, as % of total loans



Ratio of risk-weighted to unweighted assets, in per cent



Note: the risk-weighted and unweighted bank assets are those of the twelve public Chinese banks listed in Table 4.

Source: CEIC and authors' own estimates.

More generally, changes in the asset composition affect the overall riskiness and thus can influence the observed net interest margins and spreads. For instance, mortgage loans carry a lower risk weight and have risen as a share of total loans in China, from 1% in 1997 to 13% in 2010, offsetting the increased riskiness of bank assets due to more lending to small firms. Also, rising deposits of required reserves at the PBC and diminishing PBC bills outstanding, both with a zero risk weight, may offset each other in terms of their effects on bank asset riskiness. Overall, recent years have witnessed a rise in the riskiness of the bank assets in China, as the ratio of the risk-weighted to unweighted bank assets rose noticeably (Graph 16, right-hand panel). Therefore, it remains too early to ascertain whether risk-adjusted margins and spreads have widened or not, before the full credit cycle plays itself out.

**5.3 Regulatory arbitrage and disintermediation**

Heavy reserve requirements may bring about distortions that encourage regulatory arbitrage and influence the funding strategy of Chinese banks. According to Goodhart's Law, the information content of an indicator tends to diminish after it becomes a policy target, because of incentives to circumvent it. For instance, banks could more actively use non-reservable funding instruments such as bond issuance and wealth management products. In the first half of 2011, bonds issued by Chinese banks accounted for more than 10% of the increase in the total bank funding, compared to less than 4% in the same period of 2010. Most of the bond issuance during this period appears to be unrelated to capital requirements and might have more to do with avoidance of increased reserve requirements.

Also, in response to a combination of rising RRR, indicative loan quota and stricter enforcement of the loan/deposit ratio, banks have increased their off-balance sheet lending while attracting more margin deposits (deposits as collaterals for banker acceptance and letters of credit), which helped meet the loan/deposit ratio cap but were non-reservable before September 2011. As a result, the flows of off-balance sheet credit provision (trust loans, entrusted loans and bank acceptance bills) expanded to 50% of the new bank loans in the first half of 2011 from 20% in 2008. Meanwhile, margin deposits grew faster than the reservable deposits – the former rose 33% in 2010 and 27% in the first half of 2011, compared to 20% and 7% for the latter.

Finally, heavy reserve requirements may carry adverse implications for monetary and financial stability. Firstly, a rapidly rising RRR appeared to have added to the recent higher volatility in the money market interest rates (Graph 11, right-hand panel). Secondly, a higher

RRR burden on Chinese banks may contribute to the ongoing disintermediation, in part because of both more costly bank credit and lower returns on deposits (Graph 15). A disorderly disintermediation driven primarily by regulatory arbitrage could challenge policymakers struggling to balance between financial liberalisation and stability, as the Korean experience in the 1990s has shown (Cho and McCauley, 2003).

## 6. Conclusion

Looking ahead, how much higher would the PBC be able to push the RRR in the medium term? As of June 2011, China's 21% RRR is already quite high, by both historical experience and international standard. The medium-term outlook for the potential use of reserve requirements will depend on a number of factors. The most important factor would be the scale of foreign exchange interventions funded by the PBC balance sheet, which in turn is influenced by China's external surpluses, its exchange rate management policy and effectiveness of capital controls. Should the balance of payments surpluses ease, the PBC may lean less heavily on reserve requirements.

Another consideration is the relative roles of various sterilisation instruments, for a given sterilisation task. The outstanding PBC bills already fell 40% by June 2011 from the June 2010 peak. As open market operation tools (such as repos and PBC bills) tend to be more flexible, entail less distortions and can serve to signal policy rates on occasions, the PBC may wish to retain a reasonable level of its bills outstanding and thus rebalance the mix of various sterilisation tools available in its arsenal (Mehrotra, 2011).

Third, prospective reserve requirements also hinge on the process of China's financial market development and the evolution of its monetary policy framework. Increased reserve requirements add cost to financial intermediation. On the other hand, a faster pace of interest rate liberalisation and greater exchange rate flexibility would foster financial market development and a move towards a more interest rate-oriented monetary policy framework, likely diminishing the reliance on reserve requirements.

Finally, the outlook for higher reserve requirements may also relate to policy stances of major economies. Given the prospects of an extremely easy policy stance in most major economies for an extended period of time, the possibility of a continued preference for this sterilisation tool over others should not be discounted.<sup>20</sup> Overall, China's reserve requirement ratio appears to be peaking in the current tightening cycle.

In sum, this paper examines the role of reserve requirements in absorbing structural liquidity surpluses arising from FX interventions and in tightening monetary conditions in China. This policy tool has been more actively used as a cheaper substitute of open market operation instruments and has become more complex over time. Given the sterilisation task and toolkit mix, higher reserve requirements seem to help constrain bank lending by squeezing excess reserves, lowering the money multiplier, pushing market interest rates higher and inducing commercial banks to widen net interest spreads. The distortionary tax burden imposed by reserve requirements on Chinese banks is, at 0.3% of GDP, manageable, owing to a confluence of high required reserves and low market interest rates. Chinese banks appear to have shifted a large but probably not the whole part of the cost onto their customers.

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<sup>20</sup> The optimal RRR has also been explored in the context of tax revenue maximisation by Zhang, et al (2008). The idea is akin to that of the Laffer curve, wherein when the tax rate rises above some threshold, the tax base may shrink enough to result in a fall in the total tax revenues. Zhang et al (2008) estimates the tax revenue maximising RRR to be around 23%.

## Appendix A: Granger tests

We have conducted simple Granger causality tests to the following two null hypotheses: (i) reserve money growth does NOT Granger cause loan growth ( $H_1$ ); and (ii) loan growth does NOT Granger cause reserve money growth ( $H_2$ ). Our regressions use both measures of RRR-adjusted reserve money from Equation (1) and (2), both local currency loans and local and foreign currency loans, and lags of 3, 6 and 12 months. The following two tables summarise the statistical results.

<b>A1: Granger causality tests of growth in local currency loans and RRR-adjusted reserve money<sup>1</sup></b>						
	RRR-adjusted reserve money (Equation 1)			RRR-adjusted reserve money (Equation 2)		
3-month lag	$H_1$ :	3.459	(0.019)**	$H_1$ :	3.196	(0.026)**
	$H_2$ :	0.677	(0.568)	$H_2$ :	0.542	(0.655)
6-month lag	$H_1$ :	2.906	(0.012)**	$H_1$ :	2.894	(0.012)**
	$H_2$ :	0.337	(0.916)	$H_2$ :	0.154	(0.988)
12-month lag	$H_1$ :	1.694	(0.082)*	$H_1$ :	1.578	(0.113)
	$H_2$ :	1.007	(0.449)	$H_2$ :	1.351	(0.205)

<sup>1</sup> The sample covers March 2001 and July 2011. Growth is defined as the year-on-year percentage changes of 3-month moving averages of the levels.  $H_1$  is the null hypothesis that reserve money growth does NOT Granger cause loan growth;  $H_2$  is the null hypothesis that loan growth does NOT Granger cause reserve money growth. The numbers refer to F-statistics with p-value in parentheses, where \*\*\*, \*\* and \* indicate significance at the 1%, 5%, and 10%, respectively.  
Sources: CEIC; authors' calculations.

<b>A2: Granger causality tests of growth in local and foreign currency loans and RRR-adjusted reserve money<sup>1</sup></b>						
	RRR-adjusted reserve money (Equation 1)			RRR-adjusted reserve money (Equation 2)		
3-month lag	$H_1$ :	7.502	(0.000)***	$H_1$ :	5.583	(0.002)***
	$H_2$ :	0.553	(0.647)	$H_2$ :	0.542	(0.655)
6-month lag	$H_1$ :	4.287	(0.001)***	$H_1$ :	4.006	(0.002)***
	$H_2$ :	0.758	(0.605)	$H_2$ :	0.503	(0.804)
12-month lag	$H_1$ :	2.664	(0.007)***	$H_1$ :	2.169	(0.027)**
	$H_2$ :	1.659	(0.104)	$H_2$ :	1.589	(0.124)

<sup>1</sup> The sample covers February 2004 and July 2011. Growth is defined as the year-on-year percentage changes of 3-month moving averages of the levels.  $H_1$  is the null hypothesis that reserve money growth does NOT Granger cause loan growth;  $H_2$  is the null hypothesis that loan growth does NOT Granger cause reserve money growth. The numbers refer to F-statistics with p-value in parentheses, where \*\*\*, \*\* and \* indicate significance at the 1%, 5%, and 10%, respectively.  
Sources: CEIC; authors' calculations.

## Appendix B: VAR estimations of RRR impact on money multiplier

A vector auto-regression (VAR) model is employed to estimate the impact of a change in the RRR on the money multiplier. Mechanically, the money multiplier (MM) is given by

$$MM = \frac{(1 + CU)}{(CU + R)}; \quad R = RRR + ERR$$

where RRR is the reserve requirement ratio, ERR is the ratio of excess reserves to deposits and CU is the ratio of currency in circulation to deposits. RRR is a policy variable, while CU and ERR can be, in our simplified model, functions of the overnight China interbank lending rate (CHIBOR) which by itself is endogenous. Thus, our model consists of three equations for MM, CU and CHIBOR, respectively, with RRR as the exogenous variable in all three equations. The sample covers monthly data from March 2000 to December 2010. To remove seasonality in the data, we take the 12-month first-order difference of all the variables.

The VAR estimation results are summarised in Table B1. According to the Schwarz criterion, the lag order is 1. The VAR stability condition check shows that no root lies outside the unit circle, indicating that the VAR model satisfies the stability condition. RRR is confirmed to be exogenous to MM, CU and CHIBOR. The F-statistics and Akaike information criterion statistics for both the whole VAR model and for the equation of MM are satisfactory. The estimated RRR coefficient in the MM equation indicates that a rise of 100 bps in the RRR reduces the money multiplier (MM) by 0.075. The estimated RRR coefficient in the CHIBOR equation also indicates that a 100-bps RRR hike lifts CHIBOR by 27 bps, confirming the finding by He and Wang (2011) about spillovers of RRR hikes into higher money market rate. For more details, see Liu et al (2011).

**Table B1: Vector auto-regression estimation of the three-equation system**

	(1) MM	(2) CU	(3) CHIBOR
RRR	-0.075 (-5.558)***	0.056 (1.319)*	0.271 (7.751)***
C	0.146 (6.130)***	-0.605 (-7.979)***	-0.359 (-5.823)***
MM <sub>-1</sub>	0.642 (9.751)***	-0.064 (-0.305)	1.199 (7.028)***
CU <sub>-1</sub>	0.106 (3.211)***	-0.045 (-0.429)	-0.003 (-0.040)
CHIBOR <sub>-1</sub>	-0.023 (-1.016)	0.124 (1.692)**	0.639 (10.756)***
F-statistic	234.304***	5.681***	94.593***
AIC	-1.262	1.057	0.643
SC	-1.144	1.175	0.761
R-squared	0.893	0.169	0.772
No of obs	117 after 12-month first differencing		

1. The sample covers March 2000 and December 2010. MM is the money multiplier, CU the ratio of currency in circulation to deposits, CHIBOR the overnight China interbank offered rate. All variables are seasonally adjusted by 12-month first-order differencing.

2. The numbers in parentheses refer to t-statistics, where \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10%, respectively. AIC refers to Akaike information criterion statistics, and SC Schwarz criterion statistics.

3. For the three-equation system of this model as a whole, AIC = 0.014 and SC = 0.368

Sources: CEIC; authors' own calculations.

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