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China's evolving reserve requirements

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Abstract

This paper examines the evolving role of reserve requirements as a policy tool in China. Since 2007, the Chinese central bank (PBC) has increasingly relied on this tool for withdrawing domestic liquidity surpluses, it being a cheaper substitute for open-market operations in this period of rapid FX accumulation. China's reserve requirements have also become more complex and have been used to address a range of other policy objectives, not least macroeconomic management, financial stability and credit policy. The preference for reserve requirements reflects the volume of China's FX sterilisation and the associated costs, in a quantity-oriented monetary policy framework faced with policy dilemmas and tactical concerns. The PBC often finds it easier to reach consensus on reserve requirements than interest rate decisions and enjoys greater discretion in applying this tool. The monetary effects of reserve requirements need to be explored not in isolation but in conjunction with other policy actions. 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 in using this policy tool, as it imposes a tax burden on Chinese banks, albeit banks seem to have passed through a significant portion of these costs to their customers, mostly depositors and SMEs. However, the pass-through to bank customers appears to be partial.

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Tiivistelmä

Tutkimuksessa tarkastellaan pankkien varantovaatimuksien käyttöä rahapolitiikan väli-neenä Kiinassa. Vuodesta 2007 alkaen Kiinan keskuspankki on entistä enemmän käyttänyt avomarkkinaoperaatioiden sijaan varantovaatimuksia pankkisektorin likviditee-tin hallinnassa. Varantovaatimuksista on samalla tullut aiempaa monimutkaisempia ja niitä on käytetty myös laajempien politiikkatavoitteiden, kuten makrovakauden, rahoitus-vakauden ja luottopolitiikan, saavuttamiseen. Varantovaatimusten lisääntynyt käyttö ku-vastaa tarvetta neutraloida valuuttamarkkinat, määräperusteisen rahapolitiikkakehikon asettamia haasteita sekä taktisia pohdintoja. Kiinan keskuspankin on helpompi saavuttaa tarvittava konsensus varantovelvoitteiden kuin korkojen muutoksista. Tutkimuksessa pai-notetaan, että varantovaatimusten vaikutuksia täytyy tarkastella yhdessä muiden politiik-katoimien kanssa. Usein varantovaatimusten nostamiset viestivät rahapolitiikan kiristy-misestä. Varantovaatimusten käyttäminen politiikkatoimena aiheuttaa kuitenkin ylimääräisen veron luonteisen kustannuksen kiinalaisille pankeille. Pankit ovat siirtäneet huomattavan osa näistä kustannuksista asiakkailleen, lähinnä pienille ja keskisuurille yri-tyksille sekä tallettajille. Kustannusten välittyminen (pass-through) on kuitenkin vain osittaista.

Asiasanat: varantovelvoitteet, sterilointi, rahapolitiikka, korkomarginaali, veron kohtaan-to, Kiinan talous

JEL : E40, E50, E52, E58, E60, H22

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 based on such short-dated instruments as repos, foreign exchange swaps and central bank bills (on the liability side) and outright sales of government bonds (on the asset side).[1] The backdrop for such a revealed preference is a persistence of large-scale injections of base money via purchases of foreign currency. The recent successive RRR hikes can be viewed as a form of "quantitative tightening", akin to the quantitative easing by major central banks.

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 heavily on this tool? Third, how effective is the RRR as a counter-cyclical tool 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 is over 20%?

This note reviews the recent developments in the PBC's use of reserve requirements as a policy tool and attempts to answer these questions. A number of conclusions can be drawn 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 increased 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 the 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 from the banking system, partially replacing other open market operations eg in PBC bills. A major factor behind the increased use of reserve requirements is the attempt to more effectively sterilise foreign exchange interventions at

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[1] In China, the discount window or standing facility has not been actively used in recent years.

reduced cost. This choice also serves the current Chinese monetary policy framework, which 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 such as counter-cyclical tightening/easing, macro-prudential objectives and credit policy. The increased complexity of the reserve requirement system in part reflects some of the PBC's tactical considerations.

Fourth, any monetary effects of RRR changes are hard to separate 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 at hand and other policy actions. The constraint of higher reserve requirements for bank lending seems more binding when initial excess reserves shrink below some threshold, restraining the subsequent loan expansion while leading to higher and 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 reserve requirement hikes have enabled domestic monetary tightening with fewer rate hikes and so have alleviated the short-term policy dilemma, they have also increased the 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 through a significant portion of the burden to 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 premia.

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 counter-cyclical 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, usually in the context 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 by 50 bps, 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 2007 and in 2008. During the more recent tightening cycle, the RRR rose by 600 bps from January 2010 to June 2011, to over 21% for large banks. China tops the global league, in terms of both magnitude and frequency of RRR variations (Graph 1, right-hand panel). In short, the RRR has become a regular and actively used policy instrument of 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 depos-

its are remunerated at 1.62% but not 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.[2]

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 selected banks experiencing rapid loan growth, perhaps serving to support the PBC window guidance for monetary and macroprudential objectives.[3]

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 aim to serve the quasi-fiscal and credit policy purposes of favouring credit allocation to regions and agriculture.[4]

Since late 2008, the PBC has also adopted a more formal two-tier reserve requirement system, where the RRR for the 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 two-tier system was perhaps intended 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 introduced 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

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[2] http://www.nbd.com.cn/newshtml/20100121/20100121043513196.html .
[3] http://www.cs.com.cn/wh/03/200711/t20071113_1243482.htm .
[4] The last two features bring to mind the earlier US regime of differentiated reserve requirements.

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 component in turn is a sum of the basic capital requirement, additional charges related to a bank's systemic importance and countercyclical buffers. Such differentiated and complex reserve requirements suggest that the RRR has become a multipurpose instrument of monetary, credit and macroprudential policy.

2.3   An international comparison

The role of reserve requirements in sterilisation can be assessed by international comparison of its use across economies or by comparison with other sterilisation instruments deployed domestically by the PBC over time. We first examine reserve requirements from an international perspective before taking a closer look at 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 as 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 much 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 that its level of required reserves is by far the highest relative to GDP.[5]

It is of interest also to contrast the US and Chinese central bank balance sheets and their bank reserves. Both balance sheets have expanded markedly in recent years, as bank reserves represent 40% to 50% of the 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 US GDP), mostly in the form of remunerated excess reserves. By contrast, large-scale foreign currency purchases by the PBC have been the

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[5] Another noted feature of China's reserve requirements is that reserve requirements have hitherto not been used explicitly to tax capital inflows, in contrast to some other emerging market economies.

main source of China's higher bank reserves (exceeding 30% of GDP) and are mostly in the form of required reserves (Filardo and Grenville, 2011).[6]

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 liquidity since the mid 2000s. It has preferred it not only at the margin but also as a partial substitute for other sterilisation tools.

Firstly, in stock terms, required reserves have become more important than PBC bills outstanding. PBC bills, government deposits and reserve requirements have been the three most important channels for sterilising the monetary consequences of China's build-up of foreign exchange reserves.[7] They combined 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.

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

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[6] 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 purchases of the US Fed were intended to influence the yield curve and credit spread, those of the PBC were aimed at managing the exchange rate.

[7] 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 from the domestic system. Indeed, the RMB20bn issuance of RMB-denominated MoF bonds in Hong Kong in September 2011 can in a way be interpreted as a cost-

terms of open market operations and other policy actions (Burger and Rasche, 1977; Wang, 2010). The adjustment is given by the following two equations:

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

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

where adj is the adjustment to reserve money following a change in reserve requirements, r the RRR and D the reservable deposit base. [8]

These adjustments theoretically 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 from the system so as to reduce bank reserves available for new lending, other things 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 effect of RRR hikes and PBC bill issuance on reserve money on a more comparable basis in terms of their respective roles in absorbing liquidity.

The adjustment data show that the mix of sterilisation instruments has varied over time but is 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 relied more on the reserve requirement system as the principal tool for freezing liquidity, in partial replacement of open market operations. Indeed, the roles of reserve requirements and PBC bills appeared to diverge after 2009, with RRR hikes withdrawing liquidity and net PBC bill runoffs injecting liquidity. In a way, the role of PBC bills in this episode had changed to fine-tuning, mainly smoothening liquidity fluctuations.

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efficient operation to sterilise the return of offshore renminbi, while supporting the development of Hong Kong's dim sum bond market.

[8] 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).

3   Why the active use of reserve requirements?

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-oriented 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).[9] In response, the PBC has increasingly relied on RRR adjustments as a major liquidity draining tool from 2007 for three reasons: reserve requirements freeze liquidity in a more permanent fashion and at a lower cost to the PBC and relieve the PBC bill operations of a difficult dual role.

First, reserve requirements withdraw liquidity on a more permanent basis than do the mostly short-dated open-market operation instruments (such as the repos and PBC bills). In the aggregate, reserve requirements and these open-market operation instruments should achieve similar liquidity absorbing effects. At the bank level, however, short-term securities allow for more flexible liquidity management than reserve requirements, which may 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

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[9] 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 relying 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.

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 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 on policy rate. The PBC bill auctions often aim to strike a delicate balance between managing liquidity and guiding market expectations by signalling policy rates. 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. Since 2007, the PBC has become more of a price maker, aiming to steer the auction yield near the one-year bank deposit rate and to signal a prospective rate change, while generally leaving the auction volume to clear the market (Graph 7, right-hand panel).

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, in order 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 the short-term interest rate as 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 the RRR or set it at zero.[10]

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 to impede the interest-rate channel. Finally, the government still sets bank deposit and lending rates. Hence, the PBC relies more on quantity-based instruments (Lardy, 1998).

However, the role of the interest rate may have expanded in recent years, in part owing to China's two-track interest rate regime and growing fixed-income market. 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. Over time, bond yields and money market interest rates respond more to demand and supply and interact with official bank rates in an evolving two-track interest rate regime.[11]

At times, Chinese policymakers have to deal with conflicting objectives. A case in point is the challenges associated with rising domestic inflation in the 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.

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[10] 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).

[11] 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).

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 seen as complementary to 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 collateral for banker's acceptances and letters of credit) in September 2011, with the aim of curtailing 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 macroprudential policy, as control of this policy tool clearly resides with the PBC. This is consistent with a new trend for central banks in many major economies since the global financial crisis.

4   The monetary effects of reserve requirements

As discussed, RRR adjustment has 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 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 of RRR adjustments in influencing domestic monetary conditions are not well understood and remain controversial.

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 the future thrust 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-track interest rate regime may further hinder 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-track 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 benchmark deposit rates.

Fourth, reserve requirements directly impose a tax on banks, making bank credit costlier and thus tightening monetary conditions (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 need not rely on the two-track interest rate assumption but it does assume banks' ability to pass on the costs of reserve requirements.

These mechanisms may interact to influence domestic monetary conditions. We first discuss the quantity effects by discussing the roles of excess reserves 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 as 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 detail 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 issuance 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 PBC policy statements (Shu and Ng, 2010; Garcia-Herrero and Girardin, 2010). Its growth was 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 began a trend of normalisation going 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 single-digit territory during the monetary stimulus between mid 2008 and mid 2009. As China's monetary policy began to be normalised in mid 2009, its growth rate 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 re-

verse, 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 channel 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 pursued in parallel, though this channel remains controversial (Borio and Disyatat, 2009). For instance, if for some reason the initial slack in the system is substantial, banks can first run down their 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 that vast branch networks ensure the large banks a stable funding source — their extensive and cheap retail deposit base, which reduces their precautionary demand for excess reserves. Another reason could be the less than well-functioning of the Chinese money market. This in turn helps explain China's two-tier reserve requirement system (Box 1) and why the Chinese rural credit cooperatives were exempted from a number of the recent RRR increases in recent years.

Over the past ten years, aggregate excess reserves of the banking sector have declined considerably, 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 declined may reflect a combination of factors, including reduced remuneration for excess reserves (from 2.07% to 0.72%), introduction of online settlement technology, advances in the Chinese bond and money markets that the enable better liquidity management, and stronger profit motives on the part of Chinese banks following public listing.

Two recent monetary policy cycles illustrate the varying roles of 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, as a partial offset, the excess reserves/deposits ratio declined by more than 100 bps in the same period, 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 raised the RRR by a total of 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, a given RRR hike tended to become more biting than otherwise. On the other hand, offsetting PBC operations were substantial, as more of the 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 some 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 in the expansion of overall bank assets in the subsequent quarter (Graph 10, right-hand panel).

Nevertheless, caution is required in attempting to disentangle the impact of RRR changes from the potential effects of other policy tools, 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, rather than monthly-end, basis may force some 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 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 its 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 excess reserves are maintained by banks for settlement purposes and are a function of payment uncertainties, costs of liquidity, and payment infrastructure (Borio, 1997; Disyatat, 2008), the PBC sets the RRR so as to hit 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 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 their VAR estimation would have reached 27%, much higher than the observed 20%. This scenario analysis also suggests that should reserve money grow by 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.[12]

4.4   Funding costs and loan-deposit rate spreads

There are at least two 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 the interbank money market more and sell some of their bond holdings, resulting in higher bond yields and/or higher money-market interest rates in the context of China's two-track 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 raise 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 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-term market rates.

Alternatively, without directly appealing to a two-track 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 spreads between lending and deposit rates beyond the regulated minimum spread.

If the deposit rate cap were binding in China, higher bank lending rates would be required to support the conjecture that banks managed to pass through 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 gyrating rate spread be-

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[12] By June 2011, the PBC had 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.

tween bills and bank loans reached as much 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).[13]

Chinese banks also appeared to have widened their net interest margin and net interest spread during the recent two cycles, tightening 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 to hike 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 the observed net interest margins, as will be discussed in the next section.[14]

In any case, an interesting question remains what will 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 seems neither excessively wide nor narrow, either relative to its international peers or over its own recent cycles (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.

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[13] 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 into interest rates are likely to be non-linear, given the slower aggregate credit expansion.

[14] 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.

5   Tax burden and other side-effects

Whatever its 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 impose a direct 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, potentially 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 these 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 less than the returns on alternative investments. However, what is opportunity cost is a tricky question in the context of China's two-track 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", i.e. the required reserves, which depend 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 of reserve requirements, therefore, is the product of the tax rate and base.

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 is located in the middle of our international comparison. It is lighter than those in Colombia and India but heavier than those in Korea, Malaysia or Russia.[15] The main reason is China's low interest rates (government bond yields) compared to most emerging market peers.[16]

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 a marked decline in government bond yields. It however has since rebounded strongly, more than tripling between 2006 and 2010, due to 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 brisk inflation trend in 2011 (and potentially higher interest rates), China's RRR-implied tax burden may not lighten much in the near term. Also, in theory, a rise in Chinese interest rates to about half of its 2010 nominal GDP growth rate 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.[17] Finally, an expansion of the reservable deposit base could also lead to an additional rise in the tax burden.

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[15] 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.

[16] Key reasons for low interest rates in China include relatively low inflation and high saving rate (Ma and Wang, 2010). Some, in contrast, claim that low Chinese interest rates are a consequence of "financial repression" that in turn contributes to a higher Chinese saving rate.

[17] He and Wang (2011) take the saving rate into consideration and still come up with an equilibrium deposit rate three times the actual level in 2005.

5.2   Tax incidence

Bank shareholders and depositors, and smaller firms could all bear the overall RRR tax burden and ultimately share the sterilisation cost of FX intervention. At one extreme, a hike in the RRR 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 may indicate meaningful cost pass-through to bank customers, other things equal. In the limit, bank depositors and borrowers would 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 on bank customers. However, it is possible that the wider net interest margins reflect higher riskiness of underlying bank assets, leaving this evidence consistent with bank shareholders sharing in the cost.

Two sets of evidence point to meaningful cost pass-through to bank customers. First, bank earnings were quite strong during the two RRR-hiking cycles in 2006-2010 when the immediate tax burden on banks tripled. 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 bank 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 a single change in the regulated deposit and lending interest rates (Graph 13). Other things equal, this would support the conjecture that banks pass on some of the cost to their customers.

Two questions arise here. First, assuming 100% cost pass-through to 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 remain the same and bank shareholders could 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).

As to the first question, we contend that at least an important part of the RRR cost is passed on to 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 derived from a lower average interest cost on deposit rather than from higher charges on borrowers. Indeed, the average interest cost of 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.[18]

Regarding the second question, we believe that the wider net interest margins may in part reflect increased risk premia rather than complete 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 actually experienced margin compression. One likely reason for this is the weaker pricing power of the four big 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 major holders of corporate paper (Graph 15).

If so, the slight rise in the average lending rate in 2010 may indicate more of 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 premia, as banks move down the credit spectrum. If so, the risk-adjusted net interest rate spread may not widen or could even narrow. With the implied cost pass-through incomplete, bank shareholders can meaningfully share the cost imposed by reserve require-

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[18] 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 to do with two other factors. First, the maturity composition of deposits shortens as inflation rises, owing to lags in deposit rate hikes. Second, some interest expenses could be included in other bank expense categories to circumvent the official ceiling on deposit rates.

ments, 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 disproportionally any given burden of pass-through to corporate borrowers, because of the greater dependence of small businesses on costlier bank credit.

More generally, changes in asset composition affect overall riskiness and thus can influence the observed net interest margins and spreads. For instance, mortgage loans, which carry a lower risk weight, 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. Moreover, expansion of required reserves held at the PBC and diminishing PBC bills outstanding, both zero risk-weighted, may offset each other in terms of their effects on bank asset riskiness. Overall, recent years have witnessed a rise in the riskiness of bank assets in China, as the ratio of the risk-weighted to unweighted bank assets rose notably (Graph 16, right-hand panel). Therefore, it is still too early to ascertain whether risk-adjusted margins and spreads have widened, before the full credit cycle is played out.

5.3   Regulatory arbitrage and disintermediation

Heavy reserve requirements may bring about distortions that encourage regulatory arbitrage and influence funding strategies of Chinese banks. According to Goodhart's Law, the information content of an indicator tends to diminish after it is becomes a policy target, because of the incentive 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.

Moreover, 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 used as collateral for bankers' acceptances 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 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 have negative implications for monetary and financial stability. Firstly, a rapidly rising RRR appeared to have added to the recent higher volatility of 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 more costly bank credit and lower returns on deposits (Graph 15). Disorderly disintermediation driven primarily by regulatory arbitrage could challenge policymakers struggling to reach a 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, both historically and in terms of international standards. The medium-term outlook for the potential use of reserve requirements will depend on a number of factors, the most important being 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 surplus decline, the PBC may lean less heavily on or even cut reserve requirements.

Another consideration is the relative roles of various sterilisation instruments, for a given sterilisation task. The outstanding amount of PBC bills had already fallen 40% by June 2011 from the June 2010 peak. As open market operation tools (such as repos and PBC bills) are generally more flexible, entail less distortions and can sometimes be used to signal policy rate changes, the PBC may wish to retain a reasonable level of 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 costs to financial intermediation. On the other hand, faster 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 reducing the reliance on reserve requirements.

Finally, the outlook for higher reserve requirements may also relate to policy stances in 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 should not be discounted.[19] But as the first RRR cut in three years suggests, China's tightening cycle may be turning in December 2011.

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 for open market operations and has become more complex over time. Given the sterilisation task and toolkit mix, higher reserve requirements seem to help to 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 (0.3% of GDP) is manageable, owing to a confluence of high required reserves and low market interest rates. Chinese banks appear to have passed on a large part (but probably not all) of these costs to their customers.

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[19] 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 total tax revenues. Zhang et al (2008) estimates the RRR that maximises tax revenue at around 23% in China.

Appendix A   Granger tests

We have conducted simple Granger causality tests of 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 employ both measures of RRR-adjusted reserve money from Equations (1) and (2), local and foreign currency loans, and lags of 3, 6 and 12 months. The following two tables summarise the statistical results.

A1   Granger causality tests of growth in local currency loans and RRR-adjusted reserve money[1]

	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)

[1] The sample covers March 2001 and July 2011. Growth is defined as year-on-year percentage change in 3-month moving average of levels. H1 is the null hypothesis that reserve money growth does NOT Granger cause loan growth; H2 is the null hypothesis that loan growth does NOT Granger cause reserve money growth. The numbers are F-statistics and p-values in parentheses, where ***, ** and * indicate significance at 1%, 5%, and 10% level, respectively.

Sources: CEIC; authors' calculations.

A2   Granger causality tests of growth in local and foreign currency loans and RRR-adjusted reserve money[1]

	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)

[1] The sample covers February 2004 and July 2011. Growth is defined as the year-on-year percentage change in 3-month moving average of levels. H1 is the null hypothesis that reserve money growth does NOT Granger cause loan growth; H2 is the null hypothesis that loan growth does NOT Granger cause reserve money growth. The numbers are F-statistics and p-values in parentheses, where ***, ** and * indicate significance at 1%, 5%, and 10% level, 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; CU and ERR may, in our simplified model, be 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, and RRR is the exogenous variable in all three. The sample comprises monthly data from March 2000 to December 2010. To remove seasonality, we take the 12-month first-order differences for 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 as exogenous to MM, CU and CHIBOR. The F-statistics and Akaike information criterion statistics for both the whole VAR model and for the MM equation 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 raises 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 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_{-1}	0.642 (9.751)***	−0.064 (−0.305)	1.199 (7.028)***
CU_{-1}	0.106 (3.211)***	−0.045 (−0.429)	-0.003 (−0.040)
$CHIBOR_{-1}$	−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. Numbers in parentheses are t-statistics, where ***, ** and * indicate significance at 1%, 5% and 10% level, respectively. AIC indicates 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.

References

Bank of Korea (2010): "Asset-based reserve requirement (ABRR) as a macroprudential instrument", Memo.

Burger, A and R Rasche (1977): "Revision of the base money", *Federal Reserve Bank of St Louis Review*, July, pp 13-27.

Borio, C (1997): "Monetary policy operating procedures in industrial countries", *BIS Working Papers*, No 40

Borio C and I Shim (2007): "What can (macro-) prudential policy do to support monetary policy?", *BIS Working Papers*, no 242.

Borio, C and P Disyatat (2009): "Unconventional monetary policies: an appraisal", *BIS Working Papers*, no 292.

Chen, H, Q Chen and S Gerlach (2011): "The implementation of monetary policy in China",HKIMR Working Papers, No 26, August.

Cho, Y and McCauley (2003): "Liberalising the capital account without losing balance: lessons from Korea", in *China's Capital Account Liberalisation: International Perspective, BIS Papers No 15*, pp 75-92, April.

Conway, P, R Herd and T Chalaux (2010): "Reforming China's monetary policy framework to meet domestic objectives", *OECD Economics Department Working Papers*, No. 822.

Disyatat, P (2008): "Monetary policy implementation: Misconceptions and their consequences", *BIS Working Papers*, No 269.

Garcia-Herrero, A and E Girardin (2010): "China's monetary communication: money markets not only listen, they also understand", paper presented at the HKIMR International Conference on the Chinese Economy, January.

Gray, S (2011): "Central Bank Balances and Reserve Requirements", *IMF Working Paper*, WP/11/36.

Filardo, A and S Grenville (2011): "Central bank balance sheets and foreign exchange rate regimes: understanding the nexus in Asia", *BIS Working Papers*, forthcoming.

He, D and H Wang (2011): "Dual-track interest rates and the conduct of monetary policy in China", *HKIMR Working Paper* No 21/2011.

Ho, C (2008): "Implementing monetary policy in the 2000s: operating procedures in Asia and beyond", *BIS Working Papers*, no 253.

Lardy, N (1998): *China's Unfinished Revolution*, Brookings Institute, Washington DC.

Liu, X, Yan, X, and G Ma (2011): "The impact of reserve requirement adjustments on the money multiplier in China", the PBC Statistics Department Working Papers *Finance and Statistics*, No 19/2011.

Ma, G (2007): "Who pays China's bank restructuring bill?", *Asian Economic Papers*, 6 (1), pp 46-71.

Ma, G and R McCauley (2008): "The efficacy of China's capital controls — Evidence from price and flow data", *Pacific Economic Review*, Vol 13, No 1, pp 104-123, January.

Ma, G and Y Wang (2010): "China's high saving rate: myth and reality", *International Economics,* 122, December, p. 5-40.

Mehrota, A (2011): "On the use of sterilisation bonds in emerging Asia", *BIS Working Papers*, forthcoming.

Mohanty, M and P Turner (2008): "Monetary policy transmission in emerging market economies: what is new?", *Transmission mechanisms for monetary policy in emerging market economies*, BIS Papers No 35, pp 1-59, January.

Montoro, C and R Moreno (2011): "The use of reserve requirements as a policy instrument in Latin America", *BIS Quarterly Review*, March, pp 53-65.

Obrien, Y (2007): "Reserve Requirement Systems in OECD Countries", *OECD Finance and Economics Discussion Series*, 2007-54.

Shu, C and B Ng (2010): "Monetary stance and policy objectives in China: a narrative approach", *HKMA China Economic Issues*, No 1/10.

Shu C, et al (2008): "China's monetary regime in dealing with large BoP surplus: framework, effectiveness and costs", *HKMA China Economic Issues*, No 3/08.

Wang, T (2011): *The Chinese Monetary Policy Handbook*, UBS Investment Research, February.

Yi, G (2008): "The monetary policy transmission mechanism in China", in *Transmission mechanisms for monetary policy in emerging market economies*, BIS Papers No 35, pp 179-181, January.

Yi, G (2009): "Market-oriented interest rte reform during China's reform period", *Financial Research* (in Chinese), No 1: pp 1-19.

Yu, M (2009): "The effectiveness of China's reserve requirement policy", *World Economy*, No 2009-2, pp 56-65 (in Chinese).

Zhang, X (2011): "The choice, application and innovation of monetary policy tools in the context of balance of payments surplus", 27 April 2011: http://www.pbc.gov.cn/publish/goutongjiaoliu/524/2011/20110324100726785335 219/20110324100726785335219_.html

Zhang, X et al (2008): "China's reserve requirement, tax effect and monetary control: 1984-2007", *Economic Research*, No 7, pp 65-77 (in Chinese).

Box 1   China's evolving reserve requirement system

Currently, China's reserve requirement regime features lagged accounting, with a 10-day maintenance period but without averaging. All deposit-taking institutions and most of their deposits are included in the system but are subject to different requirements. It is essentially a two-tier reserve requirement system, with a benchmark reserve requirement ratio (applied to a few large commercial banks) amounting to 21.5% as of June 2011, 200 bps higher than that applied to 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 (currently 5%) 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 settlement and a separate, mandatory minimum settlement reserves ratio was set by the PBC. Then reserve requirements differed according to the bank and type of deposit (corporate deposit, saving deposit or demand deposit). During this episode, the central function of reserve requirements was neither monetary nor prudential but rather aimed mainly at facilitating government credit policy, allowing the PBC to allocate financial resources to priority sectors specified 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 type of deposit
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	**Large banks**	**Small banks**	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 change 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 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, and typically serve as a floor for the overnight interbank rate. Second, since 2007, as excess reserves have declined considerably, more active use has been made of reserve requirements as a major liquidity withdrawal instrument. Third, the reserve requirement system has become more sophisticated and differentiated across banks. The differentiation was initially related to the bank's capital adequacy or asset quality on a one-off basis in the mid 2000s but since early 2011 has been linked to a bank's systemic importance, prudential indicators and loan growth relative to the aggregate trend on a dynamic basis. The PBC seems to be moving to a mix of liability- and asset-based reserve requirements of 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).

Tables

Table 1   Monetary growth and multiplier: actual and simulated

	Actual				Simulated without RRR hikes	
	Growth of reserve money[1]	Multiplier	Growth of M2[1]	RRR hikes[2]	Multiplier[3]	Growth of M2[1, 3]
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
Memo						
2011[4]	*25.5*	*3.62*	*16.0*	*400*	*3.92*	*25.6*

[1] Year-on-year growth.

[2] In basis points.

[3] Computed using our VAR estimate that a rise of 100 bps in the RRR reduces the multiplier by 0.075 in the same year (see Appendix B for details).

[4] Estimated on assumption that in 2011 reserve money grows at 25.5%, official M2 target is 16%, with no RRR change, the multiplier is the same as in 2010.

Sources: PBC, authors' own estimates.

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; listed banks under coverage of Credit Suisse.

Source: Credit Suisse estimates.

Table 3   Reserve requirement and implicit tax in selected economies[1]

	CN	CO	IN[7]	KR	MY	RU
(1) Required reserves ratio, %						
On local currency	11 – 17	0 – 11[2]	6	0 – 7	1	2.5
On foreign currency	5	-	5.5	1 – 7	-	2.5
(2) Required reserves as % of						
GDP[3]	25.42	2.77	4.18	2.98	0.94	0.87
Credit to private sector	19.92	8.52	8.59	2.93	0.83	2.08
(3) Opportunity cost[4] (in basis pts)						
Based on yield on 1-year gov notes	47	353	651	313	290	471
Based on yield on 5-year gov bonds	102	683	768	400	337	681
(4) Implicit tax. %[5]						
Based on yield on 1-year gov notes						
share of GDP[3]	0.12	0.12	0.27	0.09	0.03	0.04
share of credit to private sector	0.09	0.30	0.56	0.09	0.02	0.10
Based on yield on 5-year gov bonds						
share of GDP[3]	0.26	0.20	0.32	0.12	0.03	0.06
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.

[1] As of August 2010 unless specified.

[2] As of December 2010.

[3] Provisional data for 2010.

[4] Spread between government bond yield at specified maturity and required reserve remuneration.

[5] Product of required reserves and opportunity cost: (4) = (2)*(3).

[6] As of Jun 2010.

[7] India's cash reserve ratio only, not including statutory liquidity ratio.

Sources: Bloomberg; CEIC, Datastream; IMF IFS; National data.

Table 4   Implicit tax burden of reserve requirements in China, %[1]

Year	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

[1] Burden is the required reserve amount outstanding at year-end times the annual opportunity cost associated with holding RRR. Opportunity cost is the difference between full-year average 5-year government bond yield and full-year average remuneration rate on required reserves.

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

Table 5   Loan and deposit rates and net interest spread in China, %

	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
memo						
Simple average	*1.56*	*1.37*	*5.08*	*5.15*	*3.52*	*3.78*

Note: 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.

Graphs

Graph 1   Reserve requirement ratios in China and selected emerging markets. %

Reserve requirement ratio in China[1]

Change in reserve requirement ratio[2]
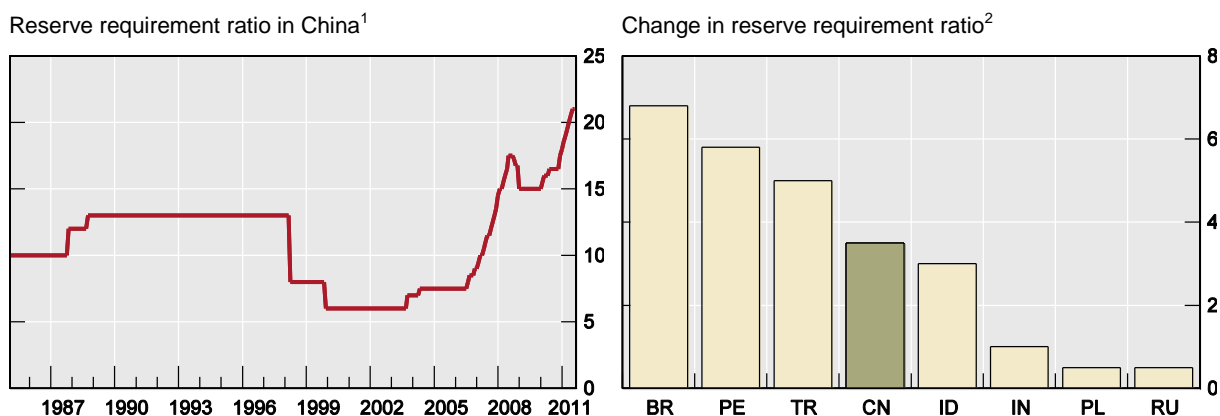
BR = Brazil; CN = China; ID = Indonesia; IN = India; PE = Peru; PL = Poland; RU = Russia; TR = Turkey.

[1] Average RRR for large and small banks.
[2] End-2009 to end-2010.

Sources: CEIC, UBS.

Graph 2   Required and excess reserves in selected economies, %[1]

Relative to GDP

Relative to central bank total assets
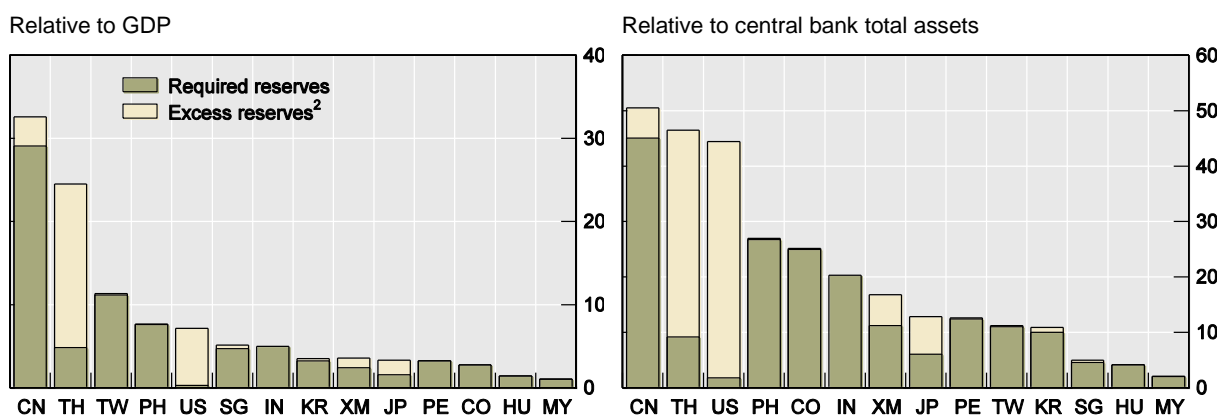
[1] As of August 2010.
[2] Difference between total reserves and required reserves. For Thailand, excess reserves may include other short-dated instruments.

Source: National data; BIS central bank questionnaires.

Graph 3   Sterilisation tools of People's Bank of China relative to foreign reserves

Outstanding amount, % of foreign reserves

Flow, % of annual change in foreign reserves, 2003 – 2010
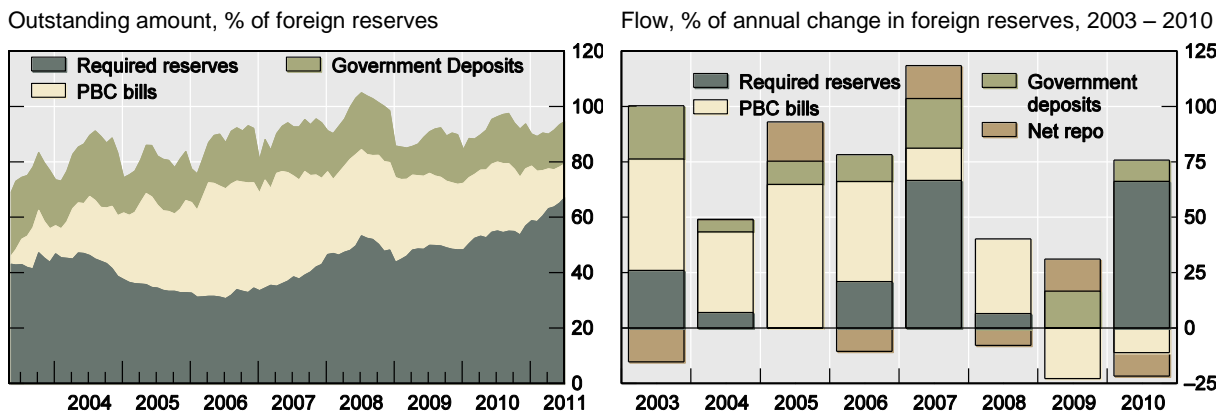
Note: In right-hand panel, required reserves equals change in the RRR in a given year times reservable deposits at year-end.

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

Graph 4   RRR-adjusted reserve money (approach 1) and sterilisation tools in China
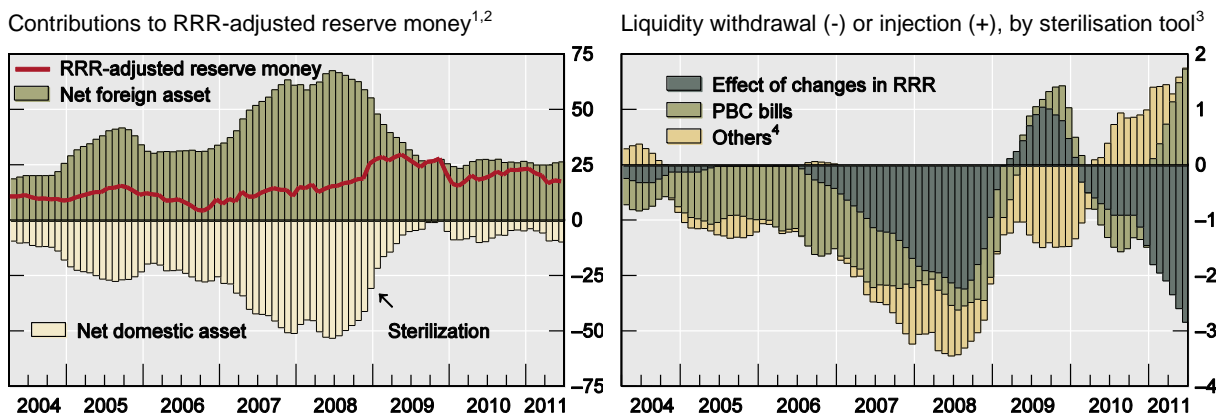
Contributions to RRR-adjusted reserve money[1,2]

Liquidity withdrawal (-) or injection (+), by sterilisation tool[3]

[1] 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 deposits; see Burger and Rasche (1977) for details. Starting month of adjustment (r0) is December 1999.
[2] Year-on-year change in three-month moving average as percent of RRR-adjusted reserve money; a negative number means sterilization.
[3] Components of net domestic assets; year-on-year change in three-month moving average; in trillions of RMB; positive (negative) indicates injection (withdrawal) of liquidity.
[4] Net domestic assets other than effect of changes in RRR and PBC bond issue.

Sources: PBC, CEIC and authors' own estimates.

Graph 5   RRR-adjusted reserve money (approach 2) and sterilisation tools in China
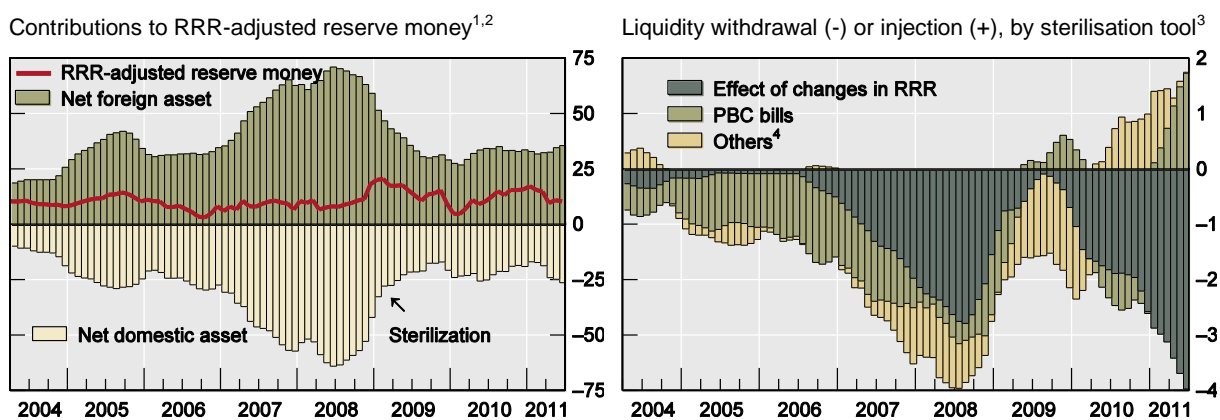
Contributions to RRR-adjusted reserve money[1,2]

Liquidity withdrawal (-) or injection (+), by sterilisation tool[3]

[1] Reserve money adjusted for changes in the RRR (RRR-adjusted reserve money) = reserve money + adjustment (Adj), where Adjt = (r0 – rt)*Dt, where adj is the adjustment, r is reserve requirement ratio and D is deposit; Starting month of adjustment (r0) is December 1999. See Burger and Rasche (1977) for details.
[2] Year-on-year change in three-month moving average; as percent of RRR-adjusted reserve money; a negative number means sterilization.
[3] Components of net domestic assets; year-on-year change in three-month moving average; in trillions of RMB; positive (negative) indicates injection (withdrawal) of liquidity.
[4] Net domestic assets other than effect of changes in RRR and PBC bond issue.

Sources: PBC, CEIC and authors' own estimates.

Graph 6   Foreign reserve accumulation in selective emerging market economies, %

Foreign reserves of China

Change in foreign reserves[1], 2005 – 10
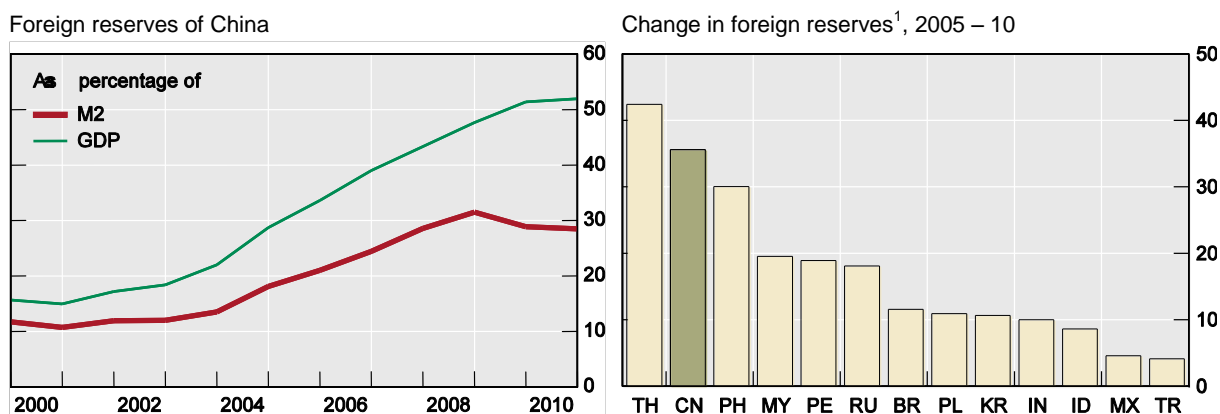
BR = Brazil; CN = China; ID = Indonesia; IN = India; KR = Korea; MX = Mexico; MY = Malaysia; PE = Peru; PH = Philippines; PL = Poland; RU = Russia; TH = Thailand; TR = Turkey.

[1] Including net position in forwards and futures in foreign currencies vis-à-vis domestic currency as percent of provisional GDP 2010.

Sources: IMF IFS; IMF IRFCL; national data.

Graph 7   PBC bill yields, bank deposit rate and remuneration in China, %

PBC bill yield and remuneration on required reserves

PBC bill yields and bank deposit rate
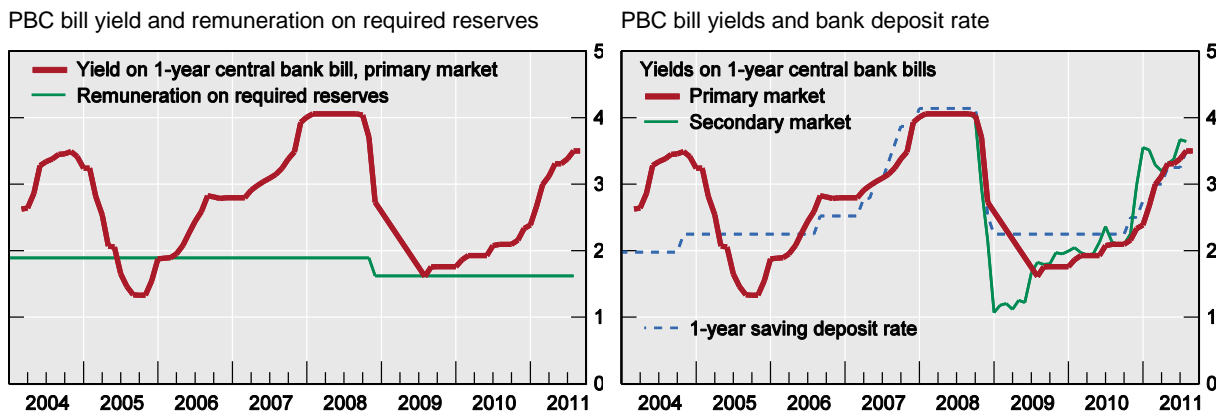
Note: monthly averages.

Source: CEIC.

Graph 8   Required reserves, deposit rate, reserve money and bank loans, %

Required reserves ratio and deposit rate

Growth in reserve money and loans[1]
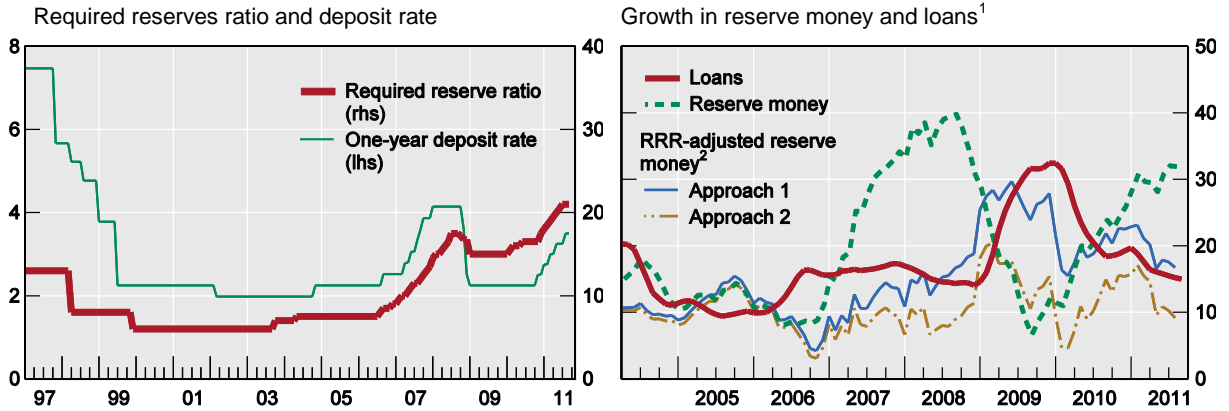
[1] Year-on-year growth of three-month moving average.
[2] Adjusted reserve money = reserve money + adjustment (Adj). Adjustment by approach 1 consists of accumulating reserves liberated or absorbed by changes in reserve requirement ratios in each period, that is $Adj1_t = Adj1_{t-1} + (r_{t-1} - r_t)*D_{t-1}$. Adjustment by approach 2 compares current reserve requirement ratio to a fixed initial period of reserve requirement ratio, that is $Adj2_t = (r_0 - r_t)*D_t$; where r is reserve requirement ratio and D is deposits; starting month of adjustment (r_0) is December 1999. See Burger and Rasche (1977) for details.

Sources: PBC; CEIC; authors' own estimates.

Graph 9   Excess reserves in China, %

Excess reserves/deposits, by bank size

Excess reserves/deposits[1]
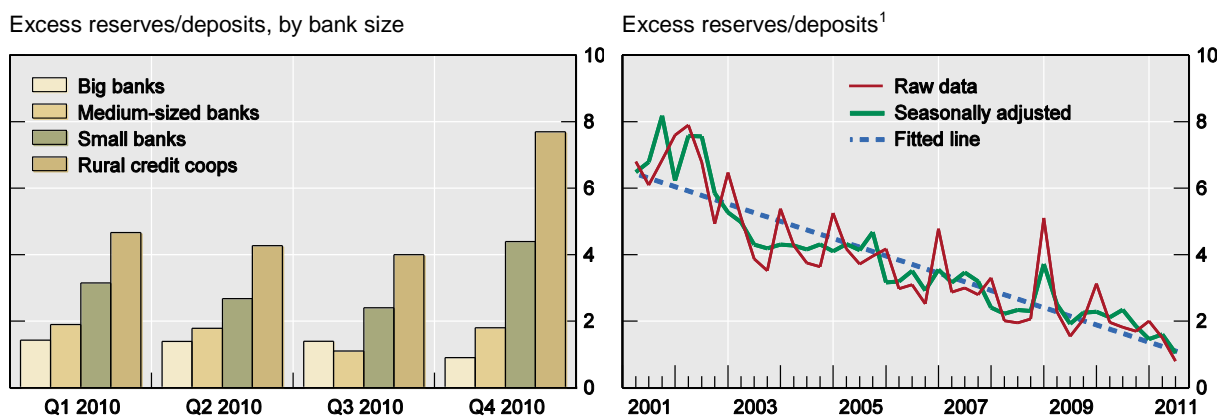
[1] Seasonal adjustment based on X-12 ARIMA, and fitted linear regression line is y = 6.6 – 0.13 t, where t is a quarterly trend variable.

Sources: CEIC; BIS calculations.

Graph 10   Loan growth, bank asset changes and reserves in China

Average required, excess and total reserve ratios[1]

Excess reserves and total bank assets (CNY billions)
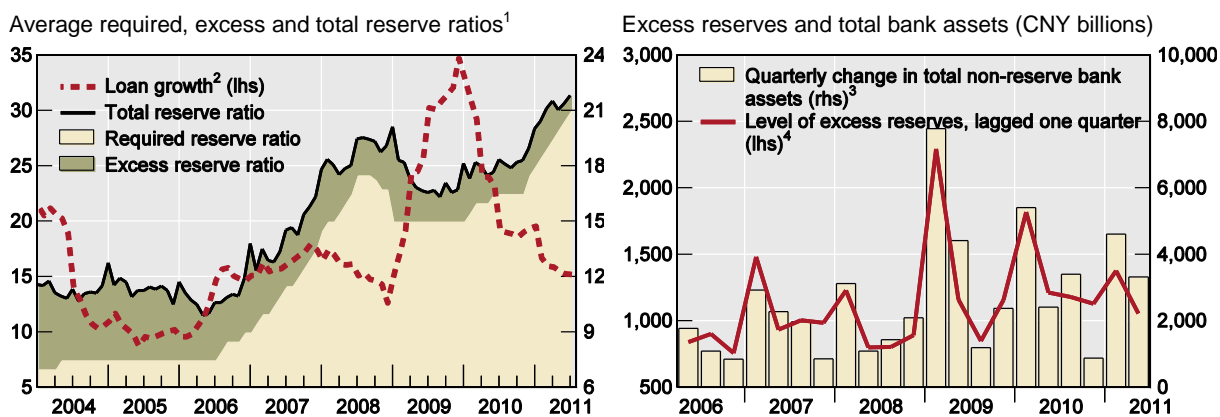
[1] Required reserve and excess reserve ratios are, respectively, required and excess reserves as percent of bank deposits. Total reserve ratio is the sum of required and excess reserve ratios.
[2] Loans in RMB and foreign currencies; year-on-year changes, in per cent.
[3] Quarterly change in total bank assets minus bank deposits at PBC.
[4] Outstanding aggregate for banking sector, lagged one quarter.

Sources: CEIC, CICC and authors' own estimates.

Graph 11 Reserves/deposits ratios and interbank rates in China, %[1]

Excess reserve ratio[2] and interest rates[3]

Volatility[4] of collateralised repo rate
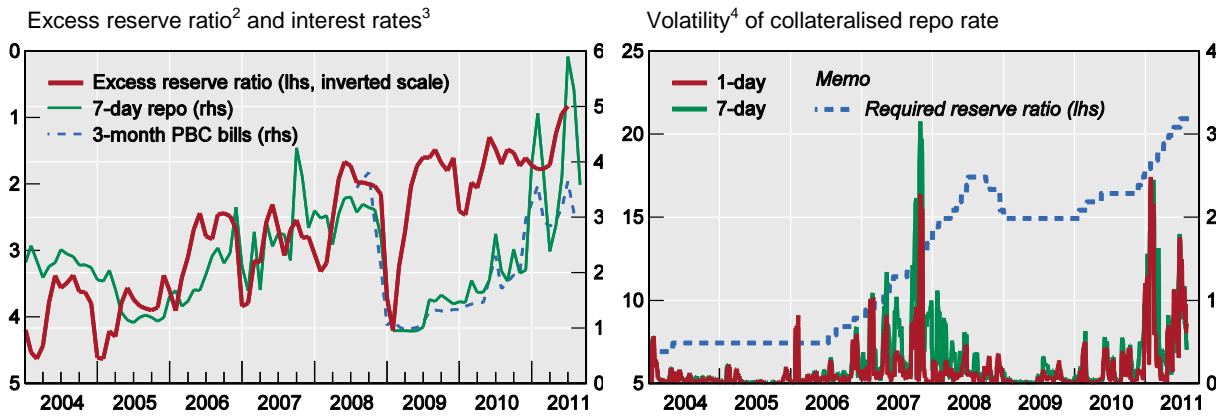
[1] Required and excess reserve ratio are, respectively, required and excess reserves as percent of bank deposits.
[2] Two-month moving averages.
[3] Monthly averages.
[4] Two-week moving standard deviation.

Sources: CEIC; PBC; authors' own estimates.

Graph 12 Discounted bill yields and new loans above lending floor in China, %

Yield on discounted bills less lending rate

Share of loans above floor rate and reserves/deposits ratio
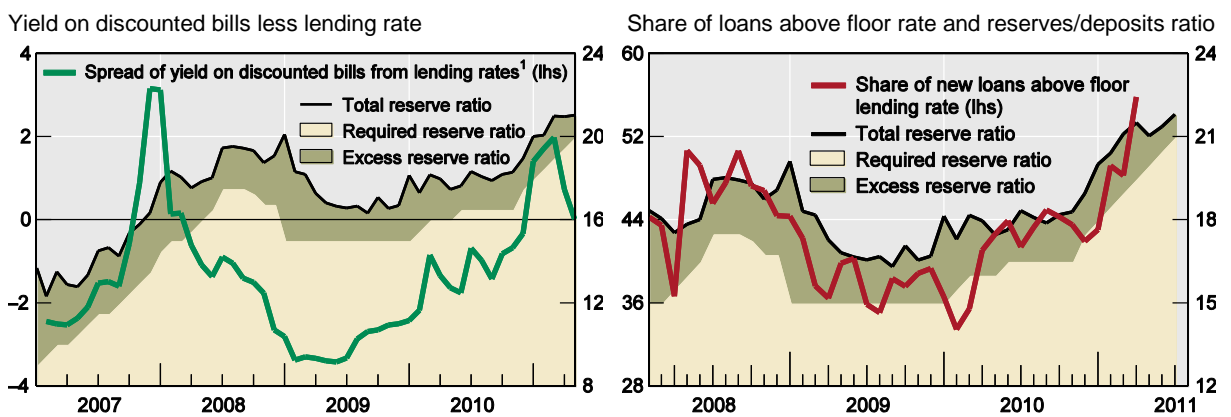
[1] Official 6-month lending rate. Required reserve ratio and excess reserve ratios are ratios of required reserves and excess reserves to bank deposits, respectively.

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

Graph 13   Net interest margin and spread in China, %

Net interest margin

Net interest margin and spread[1]
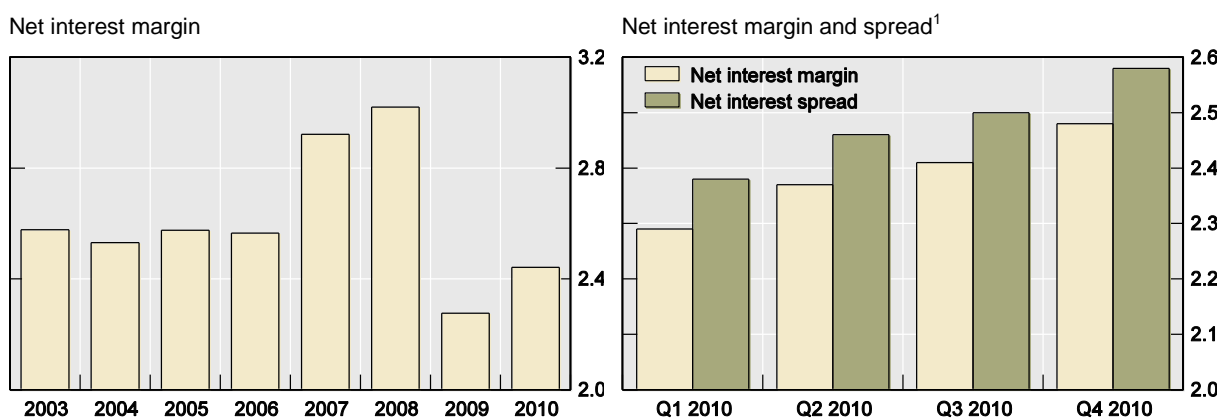
[1] Net interest margin is the difference of interest income and interest expense divided by earning assets; net interest spread is the difference between average yield on interest-earning assets and average cost of interest-bearing liabilities.

Source: CEIC, CBRC; Credit Suisse.

Graph 14   Bank profits and net interest margin

Net interest margin, average of 2006–10, %

After-tax profit and return on equity of banks in China
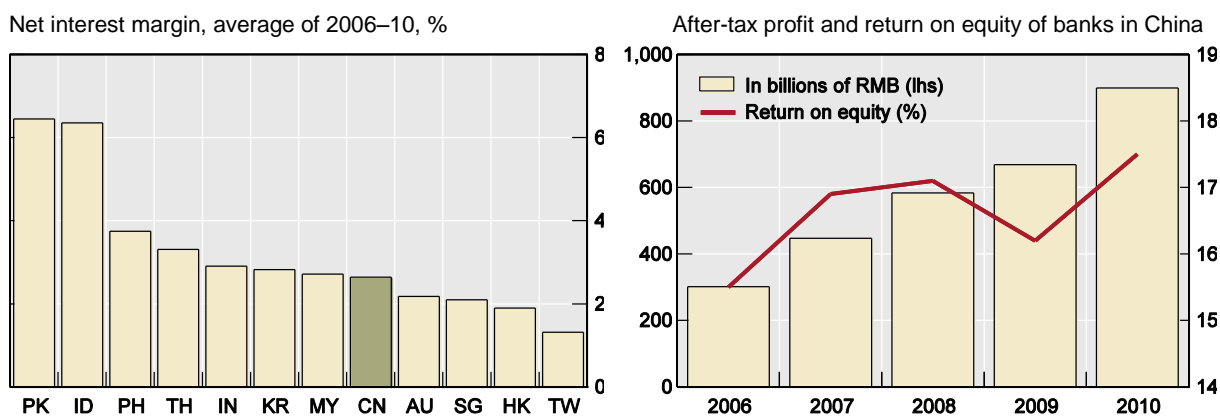
AU = Australia; CN = China; HK = Hong Kong SAR; ID = Indonesia; IN = India; KR = Korea; MY = Malaysia; PH = Philippines; PK = Pakistan; SG = Singapore; TH = Thailand; TW = Chinese Taipei.

Sources: CEIC; CBRC; Credit Suisse.

Graph 15   Non-financial corporate debt securities

RMB bn   %
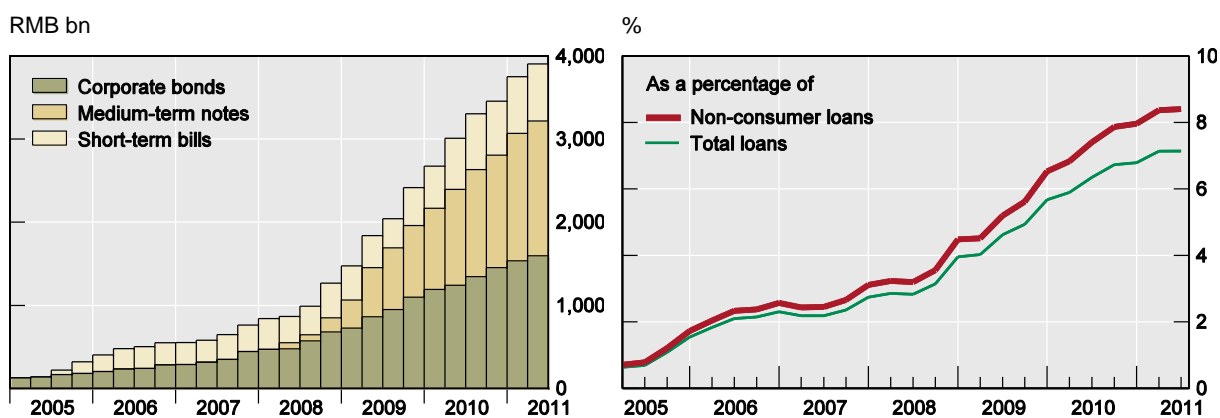
Source: CEIC.

Graph 16   Corporate loans and bank assets

Loans to mid- and small-size firms, % of total loans   Ratio of risk-weighted to unweighted assets, %
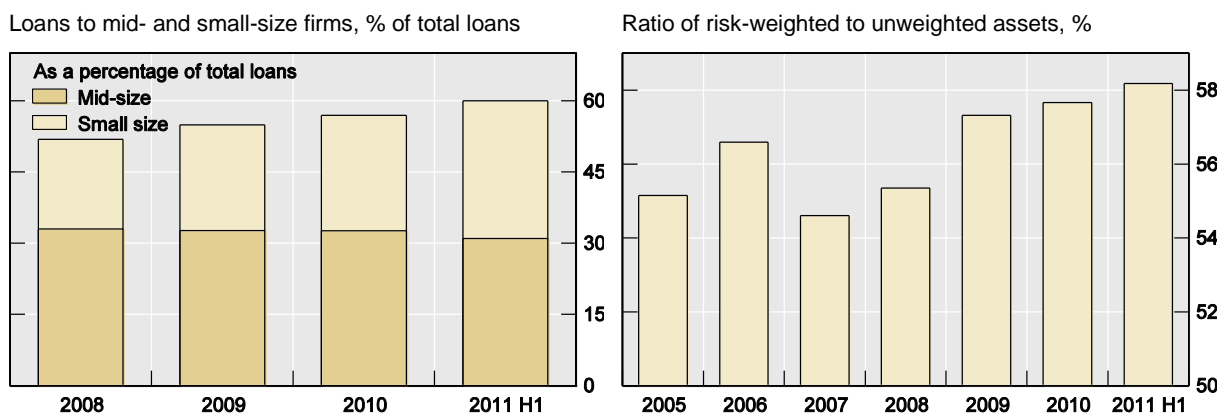
Note: Risk-weighted and unweighted bank assets are for the twelve public Chinese banks listed in Table 4.

Source: CEIC and authors' own estimates.

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