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Macroprudential Policy, Central Banks and Financial Stability: Evidence from China

Jan Klingelhöfer and Rongrong Sun¹

Abstract: This paper studies the Chinese case to show that a central bank can use macroprudential policies to play an active role in safeguarding financial stability. The narrative approach is used to disentangle macroprudential policy actions from those monetary. We show that many monetary policy tools, such as the reserve requirement, window guidance, supervisory pressure and housing-market policies, can be used for macroprudential purposes. Time series are constructed to measure macroprudential tightness/ease. The VAR estimates suggest that macroprudential policy has immediate and persistent impact on the credit cycle, but no significant effect on output. Macroprudential policy can be used either alone to retain financial stability, without harming the real economy; or as a complement to monetary policy to offset the buildup of financial vulnerabilities resulted from a monetary easing. Our analysis suggests that it is the multi-instrument framework that enables a central bank to achieve both macroeconomic and financial stability objectives. This finding has implications for the current debates on the post-crisis central bank's operating regime.

Key words: macroprudential policy, monetary policy, credit cycle, financial stability, China

JEL-Classification: E52, E58, E44

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1. Introduction

The financial crisis hit economies worldwide during the period of 2007-2009. Such crises are known as a hardy perennial, deeply rooted in the financial history (Kindleberger 1978). Quite often, they are concomitant with deep asset market collapses as well as profound drops in output and employment. This time is *not* different: the crisis triggered downturns of the global economy in 2008-2009, the so-called Great Recession (see, e.g., Reinhart & Rogoff 2009; Ball 2014; Reinhart & Rogoff 2014; Romer & Romer 2015). Over decades, economists have been trying to understand how to identify financial instability early enough for successful countermeasures and how to make the financial system more resilient to shocks. Among them, Minsky (1977) and Kindleberger (1978) have argued that the financial system is prone to turn unstable over periods of prolonged prosperity through endogenous credit booms. That is, the financial imbalances and risks increase with a progressive growth of credit during upswings (e.g., the Great Moderation) and materialize in downturns (e.g., in 2007 when housing prices plunged in the U.S.). Along this line, Eichengreen and Mitchener (2004) provide evidence for the credit-boom view of economic cycles and interpret the Great Depression as “credit booms gone wrong”. More studies (e.g., Schularick & Taylor 2012; Jorda *et al.* 2013; Taylor 2015) explore this argument further and find that the past growth of credit predicts future financial instability.² All these findings confirm that the “most of expansions of money and credit do not lead to a mania; (...) but every mania has been associated with the expansion of credit” (Kindleberger 1978: 64).³

This “credit-booms-gone-bust” finding provides the rationale for using credit booms as one of the early warning indicators of financial fragility. More importantly, in the aftermath of the recent crisis, the policy makers take more cautious and preemptive attitude towards the risks of progressive credit growth and rapid asset price rises. Surveillance and policy are designed to preventively use macroprudential tools in response to early warnings rather than in response to shocks. The “leaning vs. cleaning” debates seem to settle down in favor of the policy to lean against bubbles rather than cleaning up the mess after bubbles burst (the latter is known as the Greenspan view). The consensus seems to emerge among both academics and policymakers that financial stability needs to move in a macroprudential direction (Hanson *et al.* 2011). The current discussions are largely involved in the search for some regulations on state-varying capital and liquidity requirements for banks (for example, under Basel III) and state-varying margin controls for various asset markets. All these

² Eichengreen and Mitchener (2004), Taylor (2015) and Bordo and Meissner (2016), among others, provide comprehensive literature reviews over studies exploring the interdependence among credit, asset prices and financial instability.

³ Gorton and Ordoñez (2016) examine the question why only some credit booms end in a crisis. They document that crises become more likely during booms that display large productivity declines.

regulations play similar roles in increasing institutions' resilience to absorb shocks and better aligning private and social incentives (Blanchard *et al.* 2012).

Meanwhile, monetary policy is inseparable from policies toward financial stability (Adrian & Shin 2009). The Bank for International Settlements (BIS) suggests that central banks perform macroprudential responsibility as they are in a stronger position to carry out macro and systemic analysis. This kind of consensus is reflected in the policy design. "Most countries have put in place macroprudential authorities", as pointed out by Blanchard (2016: 288), either at the central bank (such as in the UK) or separately but with central bank participation (such as in the Euro Area and the United States). The ECB recognizes that macroprudential policy has become a necessary complement to monetary policy and introduced the bi-annual *ECB Macroprudential Bulletin* in March 2016, aiming at contributing to the understanding of this new policy (Constâncio 2016). Moreover, since the onset of this crisis, central banks in many advanced economies are returning to their roots by re-assuming a broad mandate that includes both price stability and financial stability (Goodhart 2014).⁴ This task to safeguard financial stability requires the central bank to play an active role in following a macroprudential approach in the making of monetary policies and monitoring the payment and settlement system, which is more than providing necessary liquidity support as the lender of the last resort (*China Monetary Policy Report 2011-4*: 16).

This paper presents the Chinese experience, where financial stability has always been one of key objectives of monetary policy of the People's Bank of China (PBC).⁵ We aim to answer the following questions: What kind of instruments can a central bank employ in macroprudential management and how effective are they? How does macroprudential policy interact with monetary policy?

Our paper supplements the existing literature from several perspectives. First, we focus on the PBC's policy measures in achieving financial stability, by using macro-level data over the 2000-2015 period. To disentangle the observed macroprudential policy actions from those monetary, we employ the narrative approach, studying the PBC's documents to extract the relevant information on the policy intentions behind each policy action. Those policy actions are identified as macroprudential that tend to smooth the credit cycle or guide the credit to improve the resilience of the banking sector. This

⁴ In fact, leaning-against-financial-instability monetary policies were not new in the monetary history of advanced economies. For example, financial stability took center stage in the mandate of the United States' central bank, when the Fed was founded in 1913 (Reinhart & Rogoff 2013). Over its post-1930s history until the early 1980s, the Fed had taken various monetary and credit policy tools, together with a web of regulations that discouraged banks from taking excessive risks (see, among others, Elliott *et al.* 2013; Gorton & Metrick 2013; Reinhart & Rogoff 2013). This coincides with a "quiet period," in which the U.S. financial system proved remarkably stable.

⁵ So is it in many emerging economies (see, among others, Cerutti *et al.* 2015; Chang & Velasco 2016; Zhang & Zoli 2016).

identification contributes to unbiased estimates as many policy instruments are used for both macroeconomic and macroprudential purposes. Second, we examine the effectiveness of these macroprudential measures on macroeconomic and financial conditions, with their interaction with monetary policies allowed. Third, in so doing, we use a vector autoregression (VAR) framework to model bidirectional causality of policies and macroeconomic/financial conditions. The PBC adjusts its monetary or macroprudential policies based on its perceptions about the macroeconomic and financial states. That is, changes in policies can be endogenous. It is widely agreed that the causal dynamic effect of monetary policy on the macroeconomy cannot be consistently estimated by an OLS regression without controlling for policy responses. This applies to the estimation of macroprudential policies as well.

Our main findings are fourfold. First, monetary policy tools, such as reserve requirements, window guidance⁶, housing-market related policies (e.g., the caps on the LTV ratio, the mortgage rate, the tax rate policies, etc.), and the supervisory measures, can be used to lean against credit bubbles and improve financial stability. Second, both monetary and macroprudential policy are effective in restraining excessive credit expansion. Yet, macroprudential policy has no effect on the macroeconomy. Macroprudential policy can be used either alone to retain financial stability, without harming the real economy; or as a complement to monetary policy to offset the buildup of financial vulnerabilities arising from a monetary easing. Our analysis suggests that the multi-instrument framework enables the central bank to use both monetary and macroprudential policy to reinforce each other. A well-designed use of these two policies helps to achieve both macroeconomic and financial stability objectives. This finding has implications for the current debates on the post-crisis central bank's operating regime. Third, compared to monetary policy, macroprudential policy reacts faster. It is the PBC's primary toolkit choice to restrain financial vulnerability. Fourth, as for individual policy instrument, window guidance is particularly effective in curbing credit, while only housing market policies are effective in reining in the housing price.

Our paper is related to several strands of fast growing literature.⁷ The first branch, using mainly panel datasets, examines the effectiveness of macroprudential policies in constraining financial vulnerability.^{8,9} Those policies include caps on the loan-to-value (LTV) ratio, caps on the debt-to-

⁶ It is an administrative tool in a form of "moral suasion" or "indirect pressure" through regular meetings with commercial banks so as to influence the quantity and the structure of bank lending.

⁷ One strand, which we will not be able to discuss in detail, consists of theoretical contributions based on the New Keynesian DSGE models with financial frictions to model the interaction between monetary and macroprudential policy (see, e.g., Angelini *et al.* 2014; Rubio & Carrasco-Gallego 2015; Cesa-Bianchi & Rebucci 2016; Rubio & Carrasco-Gallego 2016; Chen *et al.* 2017).

⁸ Cerutti *et al.* (2015) provide a comprehensive literature review on this group of studies.

⁹ A few of exceptions run regressions or a Qual VAR, using macro-level time series data (see, e.g., He 2013, 2014; Tillmann 2015).

income (DTI) ratio, reserve requirements, capital requirements, limits on credit growth, foreign currency lending, limits on profit distribution and dynamic provisioning. A few studies build their findings on panel regressions with cross-country macro-level datasets. For example, Lim *et al.* (2011) and Cerutti *et al.* (2015) provide supportive evidence particularly for the joint effectiveness of macroprudential policies in reducing the growth rate of credit. Cerutti *et al.* (2015) point out that the effectiveness of individual policies is instrument and country specific. Federico *et al.* (2014) find that developing countries actively use the reserve requirements as a countercyclical tool. Several other studies employ bank-level panel datasets, either cross-country or within a country. For instance, Claessens *et al.* (2013) run panel regressions and find that the effectiveness of macroprudential policies is state-dependent. Their efficacy is more obvious in boom times in reducing bank leverage and assets. They hence suggest macroprudential policies adopted in a preemptive way. Jiménez *et al.* (2012) show that countercyclical loan loss provisioning smooths cycles in the supply of credit, using difference-in-differences estimation based on rich micro-level data from Spanish banks and firms.

The second strand is a relatively small, but growing literature that reconsiders the interaction of monetary and macroprudential policies as well as their effectiveness on macroeconomic and financial stability.¹⁰ These studies examine the historical use of macroprudential tools in advanced economies.¹¹ For example, Elliott *et al.* (2013) and Kelber and Monnet (2014) review and identify macroprudential policies used in the U.S. history and those used by the main European central banks before 1980. Based on the findings in Elliott *et al.* (2013), Zdzienicka *et al.* (2015) build a time series to measure these macroprudential policy actions. Using on distributed lag (DL) model, they find that monetary policy shocks and macroprudential policy actions both have significant effects on real credit growth. Yet, the effects of the former are delayed but more persistent while the impact of macroprudential policy measures is more immediate but shorter-lasting. Aikman *et al.* (2016) carefully identify credit controls adopted by the Bank of England over the 1960-1982 period. Their factor-augmented local projections impulse response functions¹² suggest that monetary policy affected output and inflation, but credit controls had markedly different effects and acted primarily to modulate bank lending. Using structural panel vector autoregressions based on data from four Asia-Pacific countries, Kim and Mehrotra (2017) examine the effects and interaction of monetary and macroprudential policies. They find that monetary and macroprudential policies have similar effects on credit and other measures of the macroeconomy (output and the price level).

¹⁰ Adrian and Liang (2014) and the IMF (2013) provide conceptual guidelines in this line as well as the literature review.

¹¹ The new development in this line was reflected in the discussions about the role of post-crisis unconventional monetary policies in safeguarding financial stabilities. Greenwood *et al.* (2016) argue that the Fed's balance sheet can be used as a financial stability tool through ensuring an ample supply of government-provided safe short-term claims.

¹² The impulse response functions are estimated with local projections at each horizon, i.e., regressing the response variables on policy variables and conditioning on the forecasts and factors.

The third and final strand consists of a few studies that have focused on China's practice and examined its prudential policies. Liao (2012), from a financial regulator's perspective (China Banking Regulatory Commission (CBRC)), presents the framework how China has monitored and assessed systemic risks. He points out that macroprudential policy complements microprudential supervision and in China, financial stability is a shared responsibility among different authorities.¹³ Wang and Sun (2013) use bank-level panel data to study a set of policies launched by the PBC and the CBRC, including monetary and macroprudential policies, and microprudential supervision. Their findings, based on the panel regressions, are mixed, possibly due to the lack of careful identification. The impact of the required reserve ratio on credit is not significant for the sample of all banks, but significant for the sample of large banks.

This paper proceeds as follows. Section 2 applies the narrative approach and identifies the PBC's macroprudential policy actions. Section 3 discusses data issues and presents the credit cycle in China. Section 4 sets up a VAR model and estimates the policy efficacy. Section 5 concludes.

2. The PBC's macroprudential policy toolkit

The PBC's mandate is defined in the People's Bank of China Act (amended in 2003) as "to maintain the stability of the value of the currency and thereby promote economic growth" (Article 3). At the same time, the PBC's monetary policy is entrusted to "guard against and eliminate systemic financial risk and maintain financial stability" (Article 2). In summary, the PBC's policy objectives are threefold: price stability, economic growth, and financial stability. The last objective, financial stability, is mainly reflected in exchange rate stability as well as credit control/guidance. The current managed floating exchange rate regime¹⁴ requires that the PBC be actively engaged in foreign exchange interventions and the attendant sterilization operations.¹⁵ Meanwhile, the PBC is targeting the new total bank lending and the broad money (M2)¹⁶ on a yearly basis. Besides this aggregate targeting, the PBC attaches great importance to the loan structure in its policy implementation and is

¹³ The PBC used to be responsible for the comprehensive supervision of the banking, securities, insurance and trust industries. Since the 1990s, the financial supervisory tasks were split into several authorities. The current system is featured with a pattern of separate supervision of financial subindustries. It consists of one Bank (the People's Bank of China (PBC)) and three Commissions (the China Banking Regulatory Commission (CBRC), established in April 2003; China Securities Regulatory Commission (CSRC), established in October 1992; China Insurance Regulatory Commission (CIRC), established in November 1998). Though the regulators hold regular joint Quartet-Supervision meetings to enhance supervision and coordination, this separate supervisory system is criticized to breed regulatory arbitrage arising from market fragmentation and ununified regulatory standards.

¹⁴ In Jul. 2005, China announced to give up its decade-long dollar peg and switch to a managed floating exchange rate regime. The daily movement band in bilateral exchange rates has been extended gradually to the current level (+/- 3 percent).

¹⁵ The foreign exchange purchases are first reflected in rises of excess reserves. This resulted excessive liquidity is not necessarily what the PBC wants. The PBC withdraws excessive liquidity through three ways: repo transactions, issuance of central bank bills, and increase of the required reserve ratio (Sun 2015).

¹⁶ In China, M0 = currency in circulation; M1 = M0 + demand deposits; M2 = M1 + savings and time deposits.

actively engaged in “administration of guidance planning” so as to guide bank lending to resolve financial risk (*China Monetary Policy Report 2003-3*: 6).

To achieve various policy objectives, the PBC relies on a toolkit including both monetary and credit policy instruments, as described in Table 1. With monetary policy, the PBC aims to alter the stock of high-powered money outstanding (Goodfriend 2011:2), controlling the quantity of money and hence the supply of bank loans, while with credit policy, the PBC is actively engaged in directing bank lending and thereby shaping the structure of bank loans.

Table 1. The PBC’s policy instruments

| Monetary policy instruments | |
|---------------------------------------|--|
| Open market operations | Quantity-based indirect tool, including repurchases transactions, outright transaction, the issuance of central bank bills (CBB) ^a and short-term liquidity operations (SLO) ^b . |
| Central bank lending | Including central bank lending, rediscounting, the standing lending facility (SLF) and the medium-term lending facility (MLF) ^c . |
| Interest rates | Price-based tool, including various central bank base interest rates. The deposit rate and lending rate of commercial banks used to be highly regulated. |
| Required reserve ratio | On a discretionary basis; a more direct tool. |
| Credit policy instruments | |
| Credit policies | For example, down payment requirements, which also affect the money multiplier. |
| Credit laws and regulations | Sometimes set jointly with other regulators. |
| Specific central bank lending schemes | On a discretionary basis. Under certain specific eligibility requirements, the PBC provides special funds at a lower cost for a particular group of industries or regions. |
| Window guidance | Administrative tool in a form of “moral suasion” or “indirect pressure” through regular meetings with commercial banks so as to influence the quantity and the structure of bank lending. |

Notes: a. CBBs are short-term securities issued by the PBC, introduced in 2002 to deal with the inadequate government bonds traded in OMOs. Since then, they have been used extensively as “sterilization” bonds.

b. The SLO was introduced in early 2013, used on a discretionary basis as a supplement to the regular OMOs. SLOs are mainly repos with a maturity of less than seven days, carried out in market-based interest-rate tenders, mainly.

c. In two steps, the PBC introduced two lending facilities: the SLF in early 2013 (together with the launch of the SLO) and the MLF in Sep. 2014. They are intended to meet the large-scale demands for liquidity of financial institutions and with interest rates on these facilities, to anchor the market rates. Lending is extended mainly on collaterals to policy banks and large-sized national commercial banks.

Source: Authors’ updated modification based on Sun (2013: 59).

Monetary policy instruments include open market operations (OMOs), central bank lending, interest rates and changes in the required reserve ratios. The PBC uses OMOs extensively, via repurchase transactions, outright transactions and the issue of central bank bills, to absorb the excess liquidity in the banking sector as a result of foreign exchange market interventions, rather than to meet the operational target of a money market rate (as the Fed and the ECB do). On the other hand, the PBC does not crucially rely on the money market interest rate to transmit policy changes to key prices in the banking sector, i.e., the deposit rates and lending rates. Instead, it used to exert direct influences

on them by setting the benchmark (of various maturities), while banks were required to follow with limited autonomy.¹⁷

Credit policy mainly relies on credit ceilings, eligibility requirements for central bank lending, window guidance and down payment requirements on mortgage to “affect the allocation of loans or of deposits or the structure of interest rates”, as pointed out by Friedman (1960: 25). These credit policy tools were widely used by many central banks over the post-WWII era until the deregulation 1980s, including those advanced economies as well (see, e.g., Angelopoulou 2007; Elliott *et al.* 2013; Kelber & Monnet 2014; Monnet 2014).¹⁸ In China, the PBC believes that the development and implementation of credit policy is one of its important duties.¹⁹ The aggregate bank lending is one of its intermediate targets. Besides this, the PBC routinely applies specific central bank lending schemes as well as window guidance, as shown in the lower panel of Table 1, to control the quantity of credit and influence the structure of credit by “guiding” bank lending, often on a more discretionary basis.

2.1 Taxonomy

Only since the onset of the recent crisis, the term “macroprudential” has been widely used to describe policies/regulations that are counter-cyclical, aiming to restrain systemic risks and maintain financial stability, though such actions have been long existing. Our paper reviews the PBC’s policies before and after the crisis. For the prior-crisis period, we are defining macroprudential policy in retrospect using today’s term. Naturally, we cannot expect that this term appeared in the PBC’s policy description for that period. A conceptual outline would be helpful for us to detect and categorize these actions.

Macroprudential policy differs from the microprudential approach in intention and policy framework. The former seeks to safeguard the financial system as a whole, while the latter, the microprudential approach, is a partial equilibrium concept, aiming to prevent the costly failure of individual financial institutions (Hanson *et al.* 2011). Good macroprudential policy is preemptive by taking the punchbowl away just as the party gets going. Its “instruments are intended to be counter-cyclical – to tighten during the boom over asset prices and credit expansion, and to be relaxed, or even removed

¹⁷ The lending-rate ceiling and the deposit-rate floor were abolished in 2004. Slowly, the floating bands for the lending and the deposit rate were extended, with the lending-rate floor and the deposit-rate ceiling lifted in Jul. 2013 and Oct. 2015, respectively.

¹⁸ Credit policy regained its importance in these countries since the onset of the 2007-2008 crisis when facing the ZLB of the nominal interest rate, the central banks turned to quantitative/credit easing, including changing the composition of their asset portfolio between Treasury securities and credit to the private sector or to non-Treasury government entities (Goodfriend 2011).

¹⁹ It is clearly stated on its homepage: <http://www.pbc.gov.cn/jinrongshichangsi/147160/147289/147304/2899801/index.html>.

entirely, during the subsequent slump. (...) In particular, it is much more granular than the use of interest rates in monetary policy more broadly” (Goodhart 2014: 13).

Furthermore, it is widely agreed that macroprudential policy should increase the resilience of the financial system against financial shocks, contain financial booms; and strengthen the structure of the financial system (FSB *et al.* 2011; Schoenmaker 2014). We hence define the PBC’s policy actions to be of a macroprudential nature if they are state-varying, aiming to smooth credit cycle (through stimulating credit supply in busts and restraining excess credit in booms), and/or improve the resilience of the financial system.²⁰ That is, policy actions are:

- (a) Targeting the credit aggregate and in particular, aiming to smooth credit cycle through stimulating credit supply in busts and restraining excess credit in booms; and/or
- (b) Targeting the credit structure and more specifically, aiming to soothe maturity mismatching of the assets and liabilities in financial institutions; reduce non-performing loans (NPLs) to resolve the financial risks; rein in asset prices through guiding bank loans away from booming asset markets.

The first part of our definition follows the “credit-booms-gone-bust” finding, which suggests that macroprudential policy monitors total loans in a countercyclical way. In the second part of our definition, we include those policy actions addressing the maturity mismatch problem and NPLs. These lead to the build-up of potential financial vulnerability that concerns the PBC, as addressed in its Reports repeatedly. Also, we include actions that particularly target property markets and asset prices. The theoretical argument for this lies in the hypothesis of systematic risk spillovers, i.e., disturbances in property markets would spill over on the rest of the financial system. In his classical work about financial crises, Kindleberger (1978) describes this kind of risk transmission as “manias, panics and crashes”. Thus, it is necessary for central banks to keep an eye on asset price inflation as well, in addition to its traditional mandate of keeping price stability of consumer goods. Changes of the policy-makers’ attitudes towards the assets price bubbles in the pre- and post-crisis periods are reflected in “cleaning vs. leaning” debates.

Another important guideline that we use to distinguish macroprudential policy from monetary policy actions is to allow macroprudential policy to take a more granular approach (see. e.g., Brunnermeier & Schnabel 2014; Goodhart 2014). This is reflected mainly in two dimensions. First, the central bank might apply different prudential standards to different financial institutions in proportion to their

²⁰ Our definition is comparable to the Federal Reserve’s policy description about risk surveillance as described in Yellen (2010: 9): “In risk surveillance (...) we must also keep a close eye on broad credit and asset market conditions. (...) If overall credit growth is extraordinarily rapid, it may be a sign that financial institutions are taking greater risks onto their balance sheets.”

systemic relevance. For example, large systemic important institutions might be subject to higher capital requirements and more intensive supervision, because problems at these institutions pose more severe threats to the stability of the whole system.²¹ Second, rather than broad use of monetary policy, macroprudential policy can target particular markets or sectors, such as housing and asset markets, as discussed in the second part of our definition.

The PBC regularly addresses the loan structure and corresponding measures to guide bank loans in its *Monetary Policy Reports*. However, the PBC does not confine the use of credit guidance to resolving financial risk only. Rather, credit guidance is often used to tackle structural imbalances. Together with other policy measures (either fiscal or industrial), monetary policy has been widely used, through either central bank lending schemes or window guidance, to guide bank loans to underinvested sectors/regions, including small- and medium-sized enterprises (SMEs), agriculture, western underdeveloped regions, job creation, etc. (for example, *China Monetary Policy Report 2003-2*; *2009-4*; *2010-1*). Yet, these policies are better defined as industrial policies. We carefully exclude them from those aiming to improve the resilience of the financial system.

Our definition is strictly in line with the PBC's conceptual formulation about "macroprudential". In 2011, it outlined "a countercyclical financial macroprudential management framework" as the one where it relies on "effective measures, (such as) credit policy, differentiated reserve requirements and adjustments in the down payment share for mortgage loans, as well as risk warnings through window guidance" while "closely watching money and credit growth" (*China Monetary Policy Report 2011-4*: 17). Since then, this term has appeared frequently in its documents to describe its monetary policy. The PBC also realized that "interest rates and the reserve requirement provide strong signals, it is thus necessary to adopt (more granular) macroprudential measures to guide commercial banks to (...) refrain from excessive expansion" (*China Monetary Policy Report 2014-3*: 18).

With this definition, we apply the following identification strategy. First, we observe all the PBC's policy actions, which include monetary policy actions (addressing output and inflation), exchange-rate-related policy actions (interventions and sterilizations) and macroprudential policy actions (addressing financial systemic risks). Second, we identify the intentions behind each policy action. Third, we entangle those policy actions, consistent with our definition, as macroprudential actions. Fourth, we quantify those identified macroprudential policy changes.

²¹ If we follow the framework of the FSB, the IMF and the BIS (2011), which formulates systemic risks in two dimensions: the time dimension (to mitigate financial system procyclicality) and the cross-sectional dimension (to reduce systemic risk concentrations), this granular approach addresses systemic risks in the second dimension.

We apply narrative approach to identify policy intentions. We study *China Monetary Policy Report*. This Report is an executive summary of monetary policy and published each quarter by the PBC since 2001. It covers analysis of the macroeconomic and financial situation and explains the monetary policy operations. It provides sufficient information for us to identify the intentions of each policy action. As a cross check, we also study the PBC's *Chronicle of Events*.

In so doing, we build a table of the PBC's macroprudential policy changes on a monthly basis. We then quantify the policy changes with 1, 0 and -1. With 1, we define as a macroprudential tightening, aiming to curb the fast growth of total credit and/or rapid rise of property prices; tackle problems such as accelerating nonperforming loans and maturity mismatching. 0 indicates a neutral policy without changes. With -1, we define as a macroprudential ease, where policies tend to expand credit and/or stimulate the development of the real estate industry; encourage consumption loans. The policy instruments that the PBC uses in a macroprudential manner mainly include: the requirement reserve ratio, window guidance, housing policy and supervisory pressure. For each of them, we construct a time series to measure the policy stance that their adjustments convey. Then, summing up individual time series, we construct a time series to measure the overall stance of macroprudential tightness/ease. We take a simple sum to convert these five time series into a quarterly basis. Due to data conversion, these indicators take values beyond 1, 0 and -1. The larger (smaller) the value is, the tighter (easier) is the stance of the macroprudential policy.

2.2 Required reserve ratio

Reserve requirements were originally designed to allow banks to maintain liquidity even in case of large deposit withdrawals on the one hand and on the other hand to allow central banks to influence money supply by changing the minimum required ratios. This policy tool has a direct effect on the ability of the banking system to create money and hence extend credit. It was widely employed by central banks in the post-WWII era, for example, the Fed kept adjusting the reserve requirement till 1992; the Bundesbank frequently amended this ratio prior to 1981. However, this instrument has gradually faded out of the monetary policy toolkit of advanced economies in the 1980s and 1990s.²² In today's advanced economies, the legal reserve-deposit ratios are usually set at a fixed level and kept unchanged.

²² The reasons include: first, the reserve ratio is like a "reserve tax" on banks as they earn less or none on reserves and thus impairs their competition against other financial institutions, which are not subject to reserve requirements; second, changes in reserve requirements are on a discretionary basis and result in large discontinuous quantity changes (Friedman 1960).

The PBC did not make frequent changes in the reserve ratio in its early years. However, the second half of the last decade is featured with a shift of the PBC in favor of more extensive use of this tool, as shown in Fig. 1.²³ This shift was preceded by surging foreign exchange reserves in the mid-2000s and open market operations failed to offset the resultant monetary expansion, because they “were partly constrained by weaker purchasing willingness on the part of commercial banks” (*China Monetary Policy Report 2006-2*: 8). Instead, hikes in reserve requirements are more direct and effective in influencing the money supply. In 2006, the PBC started to combine these two tools – open market operations and variations in the reserve – to “sterilize” the monetary base (*ibid.*: 8).

Meanwhile, the PBC adjusts the reserve requirement for the purpose of credit management so as to “increase the lendable funds of the financial institutions” (as in November 1999) or “to guide credit growth” (as in September 2003) (*China Monetary Policy Report 2003-3*: 16). Initially, China’s reserve requirement system was relatively simple with a uniform required reserve ratio applied to all kinds of the non-financial corporate and household RMB deposits, regardless of maturity.²⁴ Then in two steps, the PBC introduced the dynamic differentiated required reserve ratio (see *China Monetary Policy Report 2014:3*, Ma *et al.* 2013; Wang & Sun 2013). In 2008, the PBC adopted a two-tier reserve requirement system. A higher ratio is applied to bigger commercial banks, usually 1-2 percentage points above that applied to small banks.²⁵ Later in 2011, the PBC introduced “the mechanism to adjust the differentiated reserve requirement on a continuous and case-by-case basis to effectively ensure steady money and credit growth and the soundness of financial institutions by linking aggregate control of money, credit, and liquidity with macroprudential policy” (*China Monetary Policy Report 2011-4*: 17). That is, the reserve requirement applied to different banks is allowed to vary, reexamined on a quarterly basis with reference to criteria such as the bank’s systemic importance, its contribution to the deviation of aggregate credit growth from its trend and various other prudential indicators.

The frequent changes in reserve requirements have drawn a lot of attention – they were publicly announced and newsworthy. However, as the PBC’s Governor, ZHOU Xiaochuan, pointed out (Caixin 2012), variations in reserve requirements are not necessarily indicative of monetary easing or tightening, but are more related to the liquidity or macroprudential management (see also Sun 2013, 2015, 2017).

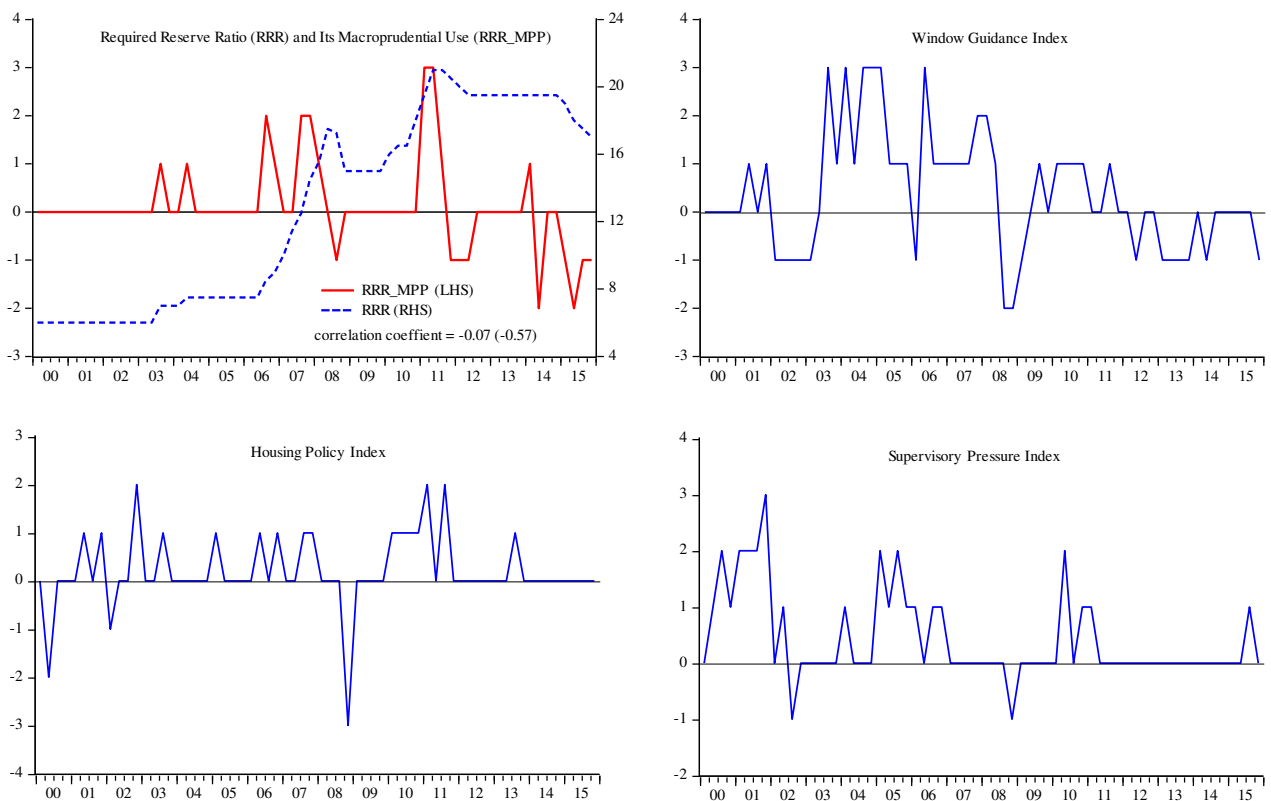
²³ Like China, central banks in many emerging economies use the reserve requirements as one of the most important policy tools for liquidity management to stabilize credit (see, e.g., Frankel 2010). For example, in Peru this tool is used as “a first line of defense” facing financial vulnerability and is employed to avoid unsustainable trends in the credit/GDP ratio (Rossini 2012).

²⁴ Foreign currency deposits are subject to a lower seldom-adjusted reserve requirement (5% since 2007). In this paper, the reserve requirements policy refers to that for RMB deposits only.

²⁵ In addition, rural and urban credit cooperatives enjoy an ever more favourable RRR. Currently, it is about 5-6 percentage points lower than that for the large banks.

We record the changes in the required reserve ratio only when this policy shift is clearly stated to target at the total credit aggregate or when this policy tool is used in a differentiated way. For example, in September 2003, July, August and November of 2006, the PBC clearly stated that hikes in the reserve ratio were aiming to control the high growth of credit. In August, September, October and December of 2007, January 2008, the first half of 2011, December 2011 and February 2012, the adjustments in the reserve ratio were accompanied with differentiated modifications, i.e., those institutions of low CAR (capital adequacy ratio), high NPLs or high credit growth were subject to a higher reserve ratio. More targeted cuts of the ratio were found in July 2008, March, April and June of 2014 as well as several times in 2015, applying to certain institutions only (e.g., Urban Commercial Banks (UCB) or Rural Credit Cooperatives (RCC)) or to those institutions only that met the specific lending criteria (mainly, referring to the lending to agro and SMEs).

Figure 1. Individual macroprudential policy instruments, 2000Q1-2015Q4



Source: Authors' calibration.

Fig. 1 shows four identified individual macroprudential policy instruments on a quarterly basis in four panels. This macroprudential reserve requirement (RRR_MPP, hereafter) time series is presented together with the headline reserve ratio (RRR),²⁶ with their correlation coefficient reported

²⁶ From 2008Q3 onwards, the reported headline required reserve ratio is a weighted average of those for large and small banks (with $\frac{3}{4}$ attributed to the former and $\frac{1}{4}$ to the latter, as applied in the CEIC data).

in the Figure as well (t-statistics in parentheses). Most of the RRR_MPP adjustments are accompanied with the changes in the RRR. However, only a small proportion of the RRR changes falls in the category of the macroprudential policy actions. Moreover, several targeted cuts in the post-2008 period (particularly, in 2014) are applied only to a very small fraction of banks (UCB and RCC), which is not captured in the headline reserve ratio. Not surprisingly, the correlation coefficient between these two time series is essentially close to zero and not significant.

2.3 Window guidance

The PBC uses window guidance – a form of “moral suasion” or “indirect pressure” – to influence the quantity and the structure of bank lending, in addition to other measures. It believes that window guidance plays an important role in guiding market expectations, improving policy transparency and thereby enhancing the effectiveness of monetary policy (*China Monetary Policy Report 2006-4*: 13). Moreover, through communicating with the banks about its policy favors and disfavours, the PBC “guides” the quantity and direction of credit funds.

In 1998, the PBC started to hold monthly meetings with financial institutions – analysis of economic and financial situations (*China Monetary Policy Report 2001-4*: 2). Thereafter, this practice has turned institutionalized and regularly, which is reported in its *China Monetary Policy Report*. The main purpose is to “improve credit policy guidance and encourage financial institutions to properly adjust the credit structure and manage the pace of credit provisions” so as to ensure the credit to be guided to the sectors of the PBC’s favors (*China Monetary Policy Report 2010-4*: 8).

According to Geiger (2006), window guidance must be effective in China given Chinese political hierarchy system. The effectiveness of window guidance as a complementary policy measure is also documented in the PBC’s report. For example, between July and September of 2003, the PBC “summoned 3 window guidance meetings (...) to give out warning of the possible systemic risks that could be caused by the excessive credit expansions. (...) Since July, the state-owned commercial banks have taken appropriate measures to address the excessive credit growth. (...) Most joint-stock commercial banks made necessary adjustment to their credit growth as well. Between July and September, the monthly growth of credit was RMB100 billion yuan, less than the average in the first half of the year” (*China Monetary Policy Report 2003-3*: 16-17).

Although the focus of the PBC’s window guidance varies slightly from year to year in accordance with the economic situation, there is a general guideline for window guidance – the PBC guides financial institutions to follow “the principle of differentiated treatment” in making loans (*China*

Monetary Policy Report 2005-4: 13). From time to time, the PBC warns banks against lending to particular sectors. The guiding directions – support vs. restrict – are clearly stated in the PBC’s monetary policy reports (various issues of *China Monetary Policy Report*). Those actions are identified as macroprudential that aim to improve financial resilience.

Also, we identify those as macroprudential that through window guidance, the PBC has been trying to have impact on the credit growth over the credit cycle. For example, in April 2001, 2004-2007 and 2009-2011, in these window guidance meetings the PBC guided banks to enforce loan management, warned them against fast growth of bank loans and the maturity mismatching problem, alerted them of the new credit risks, guided banks to improve assessment mechanism and pushed differentiated mortgage policies (various issues of *China Monetary Policy Report*). They are identified as macroprudential tightening. Macroprudential easing is found in various cases where the PBC pushed banks to issue consumption loans, for example, in 2002-2003, 2008 and 2013-2015. As shown in Fig. 1, frequently the PBC uses this window guidance for the macroprudential purpose, with the tightening clustered in 2004-2007 and 2009-2011 period and the easing centered in 2013-2015 period.

2.4 Supervisory pressure

As other central banks,²⁷ the PBC supervises and invigilates the financial development as well as systematically important financial institutions (SIFIs) to safeguard the financial stability, jointly with other regulators (e.g., CBRC). In so doing, the PBC, alone or jointly with other regulators, issues a series of laws and regulations. Over this period, many of these regulations are aiming to standardize and improve market order, e.g., to set up frameworks and rules for the money market and the capital market; to push the development of the capital market. For example, “Regulations on Interbank RMB Borrowing” issued in June 2002. In these cases, they are not counted as macroprudential. Rather, we identify those regulations as macroprudential that enforce banking lending criteria (e.g., forbid unauthorized consumption loans in 2001); regulate collaterals; call for attention to risk management, NPLs and maturity mismatching problem (e.g., in 2003 and 2005); enforce financial regulations and controls (e.g., in 2006-2007); enforce the risk warning system (in 2010). More examples include that in 2000-2001, the PBC regulated the exit of failed financial institutions to show its determination to safeguard the financial system. It is clear that most of supervision works in the direction to control rapid credit expansion and alert against potential risks. These actions are identified as macroprudential tightening, as shown in Fig. 1. Only in two cases, supervision works in

²⁷ As in the U.S., “the Federal Reserve will ... supervise all systemically important institutions. ... Supervision and regulation must serve as the first and main line of defence in addressing systemic risk.” (Yellen 2010: 5).

the direction to push banks to issue loans and set up the joint supervision system (in 2002 and 2008), which are identified as macroprudential easing.

2.5 Housing policy index

The PBC considers real estate industry as one of the key industries of national economy. It is important to sustain stable and healthy development of the real estate sector to ensure the targeted GDP growth rate. In practice, the PBC keeps close watch on the housing market. In its quarterly *China Monetary Policy Report*, there is one section, “The Real Estate Industry”, which reviews the development of the real estate, its sales and its prices, the growth of housing mortgage loans, and its implication for the financial stability, etc. Quite often, policy measures to curb excessive housing mortgage expansion are discussed.

We identify housing policy actions, mainly taking following forms: regulations on mortgages as well as mortgage rates, the caps on the loan-to-value (LTV) ratio and credit policies on real estate developments. First, in 1999 and 2000, the PBC, jointly with the other regulators, extended the maturity of mortgages and issued regulations to standardize mortgages to support mortgage borrowing. In February 2002, the PBC lowered the mortgage rate to push mortgage borrowing. In general, the mortgage rate is subject to the lending rate floor as well. Yet, in 2006 and 2008, twice the PBC extended the floating band for mortgage rates particularly by lowering the bound. Moreover, the mortgage and the mortgage rate can be set differentiated, targeting on different kinds of demand. For example, the mortgage rate was increased for the 2nd home purchases in September 2007; the mortgages for 3rd home purchases were suspended in September 2010.

Second, starting from 2001, the LTV ratio is subject to a cap: the no-down-money mortgage is forbidden. This cap is set by the PBC, since 2003 jointly with the CBRC. One important feature on this cap is that quite often, it is set differentiated across regions, across apartments of different sizes and targeting on different kinds of demand. For example, the LTV cap was lowered only in areas with fast rising housing prices in March 2005; the cap was lowered for large apartments (i.e., > 90 m²) in June 2006; targeting at 2nd home purchases, the LTV cap was lowered in September 2007 and early 2011.

In one case, this housing-market related policy is reflected in the adjustments of the tax rate. In November 2008, the real estate tax rate was cut to 1% for the 1st homes of < 90 m²; the stamp tax and the land VAT were freed for private sales of apartments.

All these above-mentioned policy actions work on the demand side of the housing market. Meanwhile, we identify one policy action that work on the supply side – credit policies applying to real estate developers. For example, the real estate development loans were subject to more strict assessment in March 2002 and August 2003. In 2006, the entry to the real estate developments tightened. In 2010, 2011 and 2013, the PBC pushed financial services to support the affordable and government-subsidized housing projects so as to restrain the speculation in the housing market.

Based on these actions, we summarize the housing policy index as tightening in case of a rising mortgage rate, a lowering LTV cap or controlling the real estate development; and easing vice versa. This housing policy index is presented in Fig. 1 as well. With a few exceptions (2000:2, 2002:1, 2008:4), in general the housing policy is tightening over this sample period.

Different from the other policy actions identified in the previous sections, this housing policy is a borrower-based tool that works on the credit demand side through restraining households' or real estate developers' borrowing, while all other three measures (the reserve requirement, window guidance and supervisory pressure) are bank-based tools that work on the credit supply side by effecting the commercial banks' lending decisions.

2.6 Other policy actions

Our reading suggests that sometimes, other policy instruments were also used to safeguard financial stability, for example, open market operations (OMOs) and central bank lending. In eight cases, open market operations took macroprudential features. In 2006 (May to Jul) and 2007 (Mar, May, Jul, Aug and Sep), through OMOs the PBC issued central bank bills, targeted at those banks of ample liquidity and excess loan growth, intending to send them warning signals (*China Monetary Policy Report 2006-2; 2007-2; 2007-3*). Most of central bank lending (CBL) and standing lending facilities are aiming to provide liquidity to the regions of natural disasters or guide banks to lend to certain industries (ago loans; loans to SMEs or policy-preferred industries) (various issues of *China Monetary Policy Report*). Only in three cases, we identify central bank lending as macroprudential where it was well tailored and aiming to improve financial stability. In 2001 (Feb and Dec) and 2004 (Jan), through targeted central bank lending schemes, the PBC provided liquidity to those Urban Commercial Banks (UCCs) and Rural Credit Corporations (RCCs) that had high level of NPLs or were of insolvency risk, partly due to the role that they played in policy lending in the history, to safeguard financial stability.

A separate time series for each of these two instruments is a sequence of zeros with very limited variations. We will not be able to estimate their individual efficacy on credit. However, while

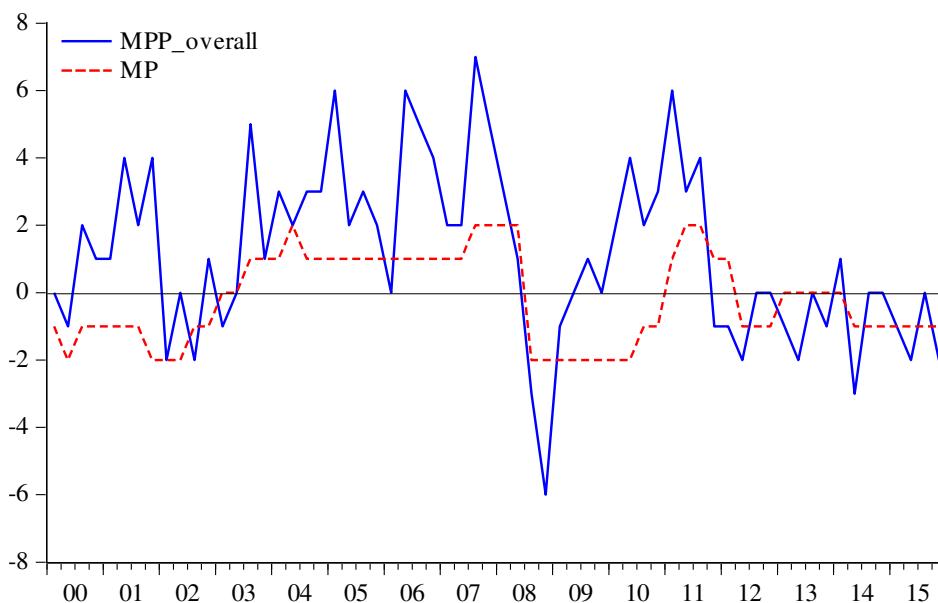
building the overall macroprudential policy stance time series, we take these OMO and CBL actions into account.

2.7 Overall macroprudential stance indicator

The above review suggests that with several instruments, the PBC is actively engaged in directing bank lending and thereby shaping the structure of bank loans. When financial distortions are more acute in some particular sectors, as is often the case, monetary policy is too blunt a tool. On the other hand, macroprudential policy is granular, targeting at the credit quantity and credit allocation, and hence restraining build-up of risk of the whole system.

By summing up the indices of individual instruments, we build a time series of an overall indicator to measure macroprudential ease/tightness. Fig. 2 presents this overall indicator, together with the Sun monetary policy indicator. As discussed above, the PBC uses multiple policy tools and none of them itself is sufficient to measure the PBC's monetary policy stance (see, among others, He & Pauwels 2008; Shu & Ng 2010; Xiong 2012; Chen *et al.* 2013; Sun 2013, 2015). Sun (2017) builds a time series of a narrative index to measure the PBC's monetary policy ease and tightness by referring to its macroeconomic objectives (output and inflation).²⁸ In this paper, we use the Sun monetary policy index as our MP indicator.

Figure 2. The overall MPP indicator, together with the Sun-MP index, 2000Q1-2015Q4



Source: Authors' calibration and Sun (2015).

²⁸ It is a 5-value time series of index, with 2 indicating very tight, 1 tight, 0 neutral, -1 easy and -2 very easy. Using this index, Klingelhöfer and Sun (2017) estimate a regime-switching Taylor-type response function for the period of 2000-2015, modelling the PBC's reaction to output gap and inflation deviation.

These two time series are significantly positively correlated. We observe two clustered periods where these two policy stances take the same position: in the 2003-2007 period both monetary policy and macroprudential policy are tight; while in the 2012-2015 period these two policies are both easy. However, in the periods of 2001 and 2009, these two policy positions differ. Moreover, the correlation coefficient of these two policies is only 0.53, as reported in Table 2, indicating that these two policy stances do not necessarily change at the same time. It implies that the PBC is able to take different policy stances towards different policy objectives, particularly when facing conflicting macroeconomic and financial conditions. Such flexibility is due to its multiple-instrument framework that allows it to employ different policy instruments to address different problems.

Table 2 reports the correlation coefficients between various policy measures, with t-statistics in parentheses. Monetary policy is positively correlated with three individual macroprudential instruments, but not significantly correlated with the supervisory pressure. As expected, the overall MPP policy index is significantly positively correlated with all four individual policy instruments, ranging from 0.45 to 0.8. The pairwise correlations among individual macroprudential instruments suggest that with exception of the supervisory pressure that is not significantly correlated with others, the remaining three are positively correlated with each other, but the coefficients are around 0.3 only. The co-movement of these individual policies is limited. This indicates that the PBC does not necessarily tighten/ease all these instruments when adjusting its macroprudential policy stance. Nor can any single instrument be described as a dominant instrument. Rather, it seems that the PBC has been employing these instruments in a discretionary and flexible way.

Table 2. Correlations between various policy measures

| | MP | MPP_overall | RRR_MPP | Window guidance | Housing policy | Supervision |
|-----------------|------------------|-----------------|----------------|-----------------|----------------|---------------|
| MP | 1.00 ----- | | | | | |
| MPP_overall | 0.53 [4.94] | 1.00 ----- | | | | |
| RRR_MPP | 0.48 [4.36] | 0.63 [6.45] | 1.00 ----- | | | |
| Window guidance | 0.52 [4.77] | 0.79 [10.00] | 0.28 [2.32] | 1.00 ----- | | |
| Housing policy | 0.27 [2.24] | 0.66 [6.85] | 0.29 [2.42] | 0.35 [2.91] | 1.00 ----- | |
| Supervision | -0.09 [-0.71] | 0.45 [3.95] | 0.05 [0.36] | 0.23 [1.89] | 0.22 [1.81] | 1.00 ----- |

Note: T-statistics are reported in parentheses.
Source: Authors' estimation.

3. Measuring financial conditions

In this paper, we use the total credit to measure financial conditions. Consistent with the credit-booms-gone-bust findings, total credit, often scaled as the ratio to nominal GDP, is a useful measure of procyclicality (see, e.g., Borio & Lowe 2002; Hume & Sentance 2009; Hahm *et al.* 2012). Also, this ratio has been widely used as a reference variable in designing prudential supervisions and policies, for example, Basel III framework and Geneva Report on bank regulation (see, e.g., Brunnermeier *et al.* 2009; FSB *et al.* 2011).

Our sample period is 2000Q1-2015Q4. The data are collected from various sources. The macroeconomic data (i.e., nominal GDP, real GDP and its growth, inflation) are from *IMF International Financial Statistics*. The aggregates such as total loans, total assets and total deposits are based on the PBC's statistic table "Summary of Sources and Uses of Credit Funds of Financial Institutions", available from the PBC's statistic dataset. Financial institutions in this table include the PBC, banking depository financial institutions and banking non-depository financial institutions.²⁹ Total loans or total lending is defined as the end-of-period amount of outstanding RMB lending issued by those financial institutions to the real economy (non-financial enterprises and households). Analogously, total deposits is defined as the end-of-period sum of RMB deposits placed at those financial institutions and total assets as the end-of-period sum of total RMB funds at those financial institutions.

Table 3 presents a snapshot of the aggregate asset and liability structure of all Chinese financial institutions (as defined above, with the PBC included) for selective years, all values as the end-of-year outstanding amount, based on the PBC's statistic table "Summary of Sources and Uses of Credit Funds of Financial Institutions". Total financial assets have more than decupled over the last 16 years, from 13 trillion yuan in 2000 to 154 trillion yuan in 2015. The main assets that financial institutions hold are loans: the loan-to-asset ratio was as high as 0.74 in 2000 though it declined to the trough of 56% in 2008; then it climbed slowly back to above 60%. Another distinct feature is reflected in the accumulation of foreign reserves in financial institutions. Their share in total assets tripled to the peak of 31% over the period 2000-2008; afterwards it dropped slowly and in 2015 it was 17%. As for portfolio investment, in general financial institutions did not invest much in securities: throughout 2014 the securities-to-asset ratio was quite stable, remaining at 0.12-0.15, with the exception of 0.22 in 2015.

²⁹ According to the PBC, the former includes banks, credit cooperatives and finance companies, while the latter refers to financial trust and investment corporations, financial leasing companies, auto-financing companies, as well as loan companies.

On the liabilities side, financial institutions are mainly (more than 85% throughout the whole period and in the early 2000s more than 90%) funded by various deposits, while funding through financial bonds is increasing but still limited.³⁰ The FIs' net worth (defined with capital) has been improved, as shown in "Capital" in the Table 3. The capital-to-asset ratio was initially negative in 2000; but in 2007 it turned out positive and remained around 4% afterwards till 2012. This ratio rose rapidly to 5.5% and 8.6% in 2013 and 2014, respectively.

Table 3 suggests that in China, the financial system is still dominated by deposit-taking banks. These banks play a traditional financial intermediary role: they take deposits and make loans; these two account for a large proportion of their balance sheet. Meanwhile, commercial banks have been subject to the regulation since 1995 that the loan-to-deposit ratio not exceed 0.75. It implies that the expansion of loans at each individual bank crucially relies on its ability to attract depositors. Given the deposit-rate ceiling, small banks are often in an inferior position to compete with large national banks. Large national banks are the main source of lending; their stability is of particular significance to the financial system. The PBC exerts direct influence on their lending, not only the quantity but also the structure, through various monetary and credit policy measures as well as window guidance. The observation made by Reinhart and Rogoff (2013: 5) for the U.S. case is true for China as well: "whatever distortions that these policies may have led to in terms of misallocation of resources, it is important to note that there (have been) no systemic banking crises (in China)."

Table 3. Aggregate balance sheet of all the Chinese financial institutions, 2000-2015

| | 2000 | | 2004 | | 2008 | | 2011 | | 2015 | |
|-------------------------------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|
| | ¥ trillion | % of assets | ¥ trillion | % of assets | ¥ trillion | % of assets | ¥ trillion | % of assets | ¥ trillion | % of assets |
| Assets | 13.33 | 100% | 26.19 | 100% | 53.84 | 100% | 91.32 | 100% | 154.12 | 100% |
| Loans | 9.94 | 74.5% | 17.74 | 67.7% | 30.34 | 56.4% | 54.79 | 60% | 93.95 | 61.0% |
| Securities | 1.97 | 14.7% | 3.09 | 11.8% | 6.53 | 12.1% | 10.93 | 12% | 33.20 | 21.5% |
| Foreign Reserves | 1.43 | 10.7% | 5.26 | 20.1% | 16.84 | 31.3% | 25.36 | 27.8% | 26.59 | 17.3% |
| Other assets | 0.001 | 0.01% | 0.10 | 0.4% | 0.13 | 0.2% | 0.24 | 0.3% | 0.38 | 0.2% |
| Liabilities | 13.85 | 103.9% | 26.65 | 101.8% | 52.20 | 97% | 87.09 | 95.4% | 143.11 | 92.9% |
| Deposits | 12.38 | 92.9% | 24.05 | 91.8% | 46.62 | 86.6% | 80.94 | 88.6% | 135.70 | 88% |
| Cash | 1.47 | 11% | 2.15 | 8.2% | 3.42 | 6.4% | 5.07 | 5.6% | 6.32 | 4.1% |
| Financial Bonds | 0 | 0.02% | 0.40 | 1.5% | 2.09 | 3.9% | 1.00 | 1.1% | 1.01 | 0.7% |
| Other liabilities | 0 | 0 | 0.06 | 0.2% | 0.07 | 0.1% | 0.08 | 0.1% | 0.08 | 0.1% |
| Capital (Assets-Liabilities) | -0.52 | -3.9% | -0.46 | -1.8% | 1.64 | 3% | 4.23 | 4.6% | 11.01 | 7.1% |

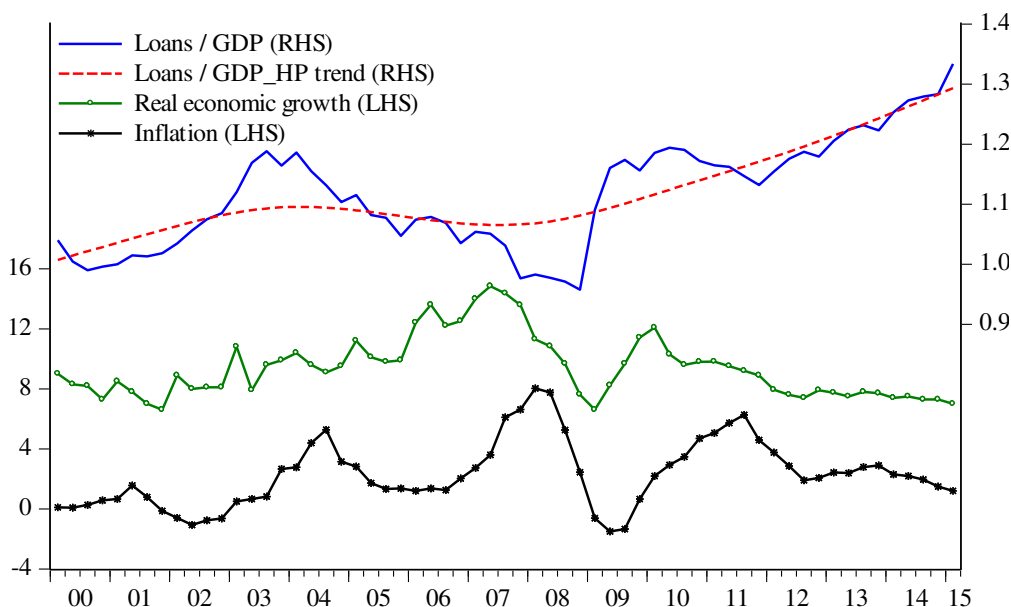
Source: Authors' calculation and compilation, based on the PBC's statistic table "Summary of Sources and Uses of Credit Funds of Financial Institutions" of various years.

³⁰ By contrast, under a market-based financial system (e.g. in the U.S.), financial institutions rely on financial markets to raise funding to supplement their traditional deposit funding and hence the broad money is no longer a good measure of liquidity (Adrian & Shin 2008; Shin & Shin 2011).

On the other hand, Chinese real economy heavily relies on (bank) loans for external financing while direct financing plays a limited role mainly because of less developed capital markets. Indirect financing amounted to over 90% of total financing in the early 2000s; with a steady rise of direct financing (through corporate bonds and equity), this share declined slowly, but still accounted for about 80% of total financing to the real economy in 2014 (*China Monetary Policy Report 2014-4*). It suggests that the total bank loans well approximate the debt accumulation in the Chinese economy.³¹

Fig. 3 presents the total loans, scaled as the loan-GDP ratio, together with its HP-filtered trend.³² The loan-GDP ratio fluctuated along a moderate growth drift, as illustrated with the HP-filtered trend. Fig. 3 suggests two hump-shaped credit booms: one in 2003-2004 and the other in 2009-2010, each lasting about two years. The latter hike followed an obvious large credit slip in 2008. Overall, a kind of cyclical pattern is suggested.

Figure 3. Loan-GDP ratio, real growth and inflation, 2000Q1-2015Q4



Note: The ratio is calculated by authors, using the data from *IMF International Financial Statistics* and the PBC's statistic dataset.
Source: Authors' calculation and the *IMF IFS*.

³¹ Alternatively, one can use the "Aggregate Financing to the Real Economy" (AFRE) to measure the debt accumulation. This measure was newly introduced and in 2012, the PBC started to frame its intermediate targets as "money supply and new lending, (...) complemented by analysis of aggregate social financing" in the *12th Five-Year Plan for Financial Sector Development and Reform* (*China Monetary Policy Report 2012-3*: 18). Also from 2012, the PBC started to provide the AFRE statistic table on a monthly basis, including bank loans, trust loans, entrusted loans plus direct financing through corporate bonds and equity. This short sample period does not allow us to draw any reliable statistical inference. On the other hand, the total bank loans, used in this paper, include both bank loans and trust loans, as listed under the AFRE, which account for the majority of the AFRE (minus equity).

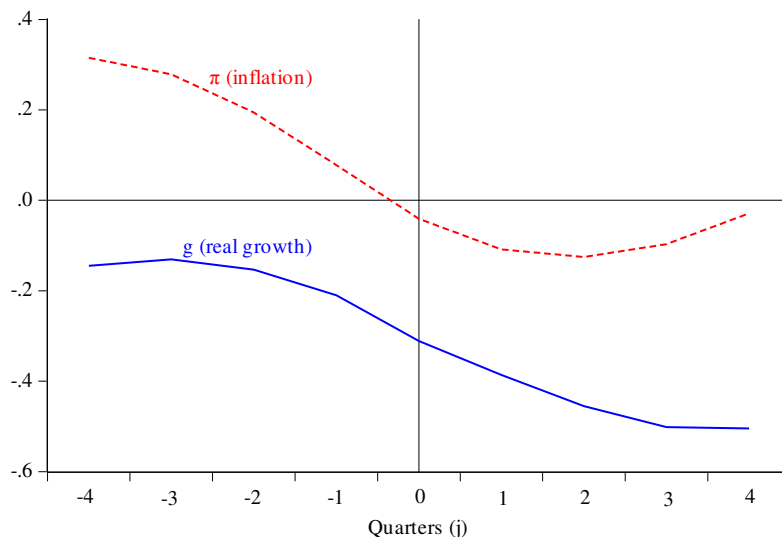
Of course, neither of them can capture the off-balance loans, of which the majority is asset-management products (AMPs) that have expanded fast in recent years.

³² The ratio is defined as total loans to GDP, both in nominal term and GDP annualized (as a moving sum of up-to-current four quarters). Its trend is estimated with the Hodrick-Prescott filter (with the smoothing parameter $\lambda=1600$).

Fig. 3 also displays the macroeconomic condition, measured with real economic growth and inflation. Over the sample period, the Chinese economy has grown at a relatively stable rate, around an 8-10% annual rate, except a boom over the 2006-2007 period (with a growth rate of 12-14%) and a subsequent slowdown in 2008. In 2009Q1, the growth rate reached the trough, 6.6%; afterwards it gained momentum and moved back to 8-10%. Since 2012, output growth has remained below 8%, but above 7%. High economic growth did not trigger much high inflation in China over last fifteen year: inflation was moderate in general, except 2004, 2007Q3-2008Q3 and 2011, when it went up to above 5%, with the highest inflation of 8% in 2008Q1. In 2009, China experienced deflation.

Fig. 4 graphs dynamic correlations between the business cycle and the financial cycle to investigate their interconnections. It suggests that a hike in total lending (relative to GDP) was followed by a rise in the inflation rate, most likely with a four-quarter delay; while real growth was negatively associated with lagged total lending. This provides supportive evidence for the hypothesis of “credit-booms-gone-bust”: excessive lending is not sustainable and eventually it ends with an economic slowdown. Meanwhile, real growth was negatively correlated with the loan-GDP ratio at lead. It suggests that low economic growth was often followed by an increase of total lending. It is possible when rises in lending were used to stimulate economic growth. Lending reacts to the state of the economy: We find that real growth and inflation both Granger-cause changes in the loan-GDP ratio.

Figure 4. Dynamic correlations, real growth g_t and inflation π_t with the loan-to-GDP ratio $(\frac{L}{Y})_{t+j}$



Note: The correlations are calculated between real growth (g_t) as well as inflation (π_t) and the loan-GDP ratio $(\frac{L}{Y})_{t+j}$, with $j = -4, -3, -2, -1, 0, 1, 2, 3, 4$ for the sample 2000Q1 – 2015Q4.

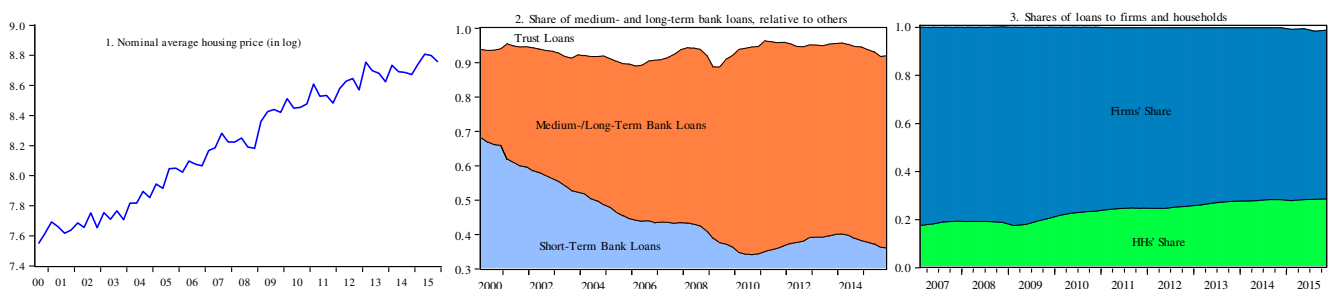
Source: Author’s estimation.

Our findings are consistent with the literature where studies, based on historical data, either focusing on a single country (the U.S.) or a group of countries, find supportive evidence for the link between

these two cycles: financial distress associated with recessions; credit booms are connected with economic expansion (see, e.g. Mendoza & Terrones 2008; Bordo & Haubrich 2010; Reinhart & Rogoff 2014). This finding strengthens the financial accelerator theory, as modelled in Bernanke *et al.* (1996), in the way that credit matters, “above and beyond its role as a propagator of shocks hitting the economy” (Schularick & Taylor 2012: 1058). Or in Kindleberger (1978: 64)’s words, “most of expansions of money and credit do not lead to a mania; ... but every mania has been associated with the expansion of credit.”

Together with the total bank loans, we include other financial condition measures in different model specifications, all shown in Fig. 5. For example, in the baseline model we also include the nominal average housing price (¥ / m²).³³ Alongside some seasonal patterns, this housing price displays a clear upward trend over the sample period. This housing price, which the PBC monitors closely, helps gauge the real estate market conditions that in turn have significant implications to the financial stability, as the literature suggests.

Figure 5. Three other financial condition measures



Source: Authors’ calculation, based on the data from the NBS and the PBC.

In the extended alternative models, we replace this housing price with either the share of medium- and long-term loans in the total loans or the share of loans to households in the total loans. In Fig. 5-2, the bank loans, with trust loans excluded, are decomposed into two parts according to the maturity. At the beginning of the sample period, around 70 percent of the total bank loans were short term. Yet, throughout the time banks issued more and more medium- and long-term loans, which accounted for more than half (56 percent) by the end of 2015. This medium- and long-term loan share sheds some light on the potential systemic risk due to the banks’ maturity mismatch problem, which the PBC pays close attention to.

³³ It is calculated as commercial residence sales / areas, based on the monthly data from the National Bureau of Statistics of China (NBS).

In Fig. 5-3, the total bank loans are decomposed into those to firms and households. This kind of decomposition is only available since 2007. The loans to households accounted for 18 percent in 2007. Yet, their share in the total climbed up steadily over time, except a minor reversal in 2008. By the end of 2015, it was close to 30 percent. The share gauges the debt accumulation of households, of which the majority is due to mortgages. This sheds some light on potential default risks in the housing market. On the other hand, our reading suggests that many of the PBC's policy actions were designed to stimulate/restrain bank loans to households.

4. How effective are macroprudential policies on the credit cycle?

4.1 Baseline model

To examine effectiveness of macroprudential policies, we let the economy be described in the following structural VAR model,³⁴ given in Eqs. (1)-(2):

$$\mathbf{Y}_t = \mathbf{Con}_t^Y + @trend + \sum_{i=0}^k \mathbf{B}_i \mathbf{Y}_{t-i} + \sum_{i=0}^k \mathbf{C}_i \mathbf{X}_{t-i} + \mathbf{A}^Y \mathbf{v}_t^Y \quad (1)$$

$$\mathbf{X}_t = \mathbf{Con}_t^X + @trend + \sum_{i=0}^k \mathbf{D}_i \mathbf{Y}_{t-i} + \sum_{i=0}^k \mathbf{G}_i \mathbf{X}_{t-i} + \mathbf{A}^X \mathbf{v}_t^X \quad (2)$$

where boldface variables denote vectors or matrices. Variables are classified into two groups – \mathbf{Y} and \mathbf{X} , which stand for vectors of macroeconomic/financial-condition variables and policy variables, respectively. The vectors \mathbf{v}^Y and \mathbf{v}^X are mutually uncorrelated structural error terms. Macroeconomic and financial-condition block \mathbf{Y} contains a vector of four variables, all in logarithm: real GDP index (Y) (seasonally adjusted), consumer price index (CPI), the total bank loans (L) and the average housing price (HP).³⁵ For policy variables, we include monetary policy index ($Sun-MP$ indicator) and the overall macroprudential policy index (MPP). In addition, a constant and a time trend are included.

All the endogenous variables in the system depend on their own lags, and both contemporaneous values and up to k lags of all other variables. Eq. (1) describes how macroeconomic and financial-condition variables evolve over time, with the policy impact on them incorporated. Eq. (2) can be considered as the policy response function of the PBC to the macroeconomic and financial conditions. We include a monetary policy indicator as it is not deniable that monetary policy, which responds to the economic conditions (output and inflation), does have impact on the financial conditions as well. With monetary policy controlled for, we are more confident to obtain unbiased estimates of the impact of macroprudential policies.

³⁴ Alternatively, we also follow Jordà (2005), using a local projection approach to compute impulse response functions (IRFs). The obtained IRFs are similar to what we estimate with the VAR model.

³⁵ These four time series are obtained (or compiled by authors) from the IMF IFS, the OECD, the PBC and the NBS.

Quarterly data for the period 2000Q1-2015Q4 are used and two lags are included, i.e., $k = 2$. To identify the model, we follow the literature and propose a recursive ordering assumption (Cholesky decomposition) on the contemporaneous relationship between variables.³⁶ We assume that policy variables affect \mathbf{Y} vector with one-period lag, i.e., $\mathbf{C}_0 = 0$. We further assume that \mathbf{X} vector is ordered as (MP, MPP).

4.1.1 Policy effects and policy responses

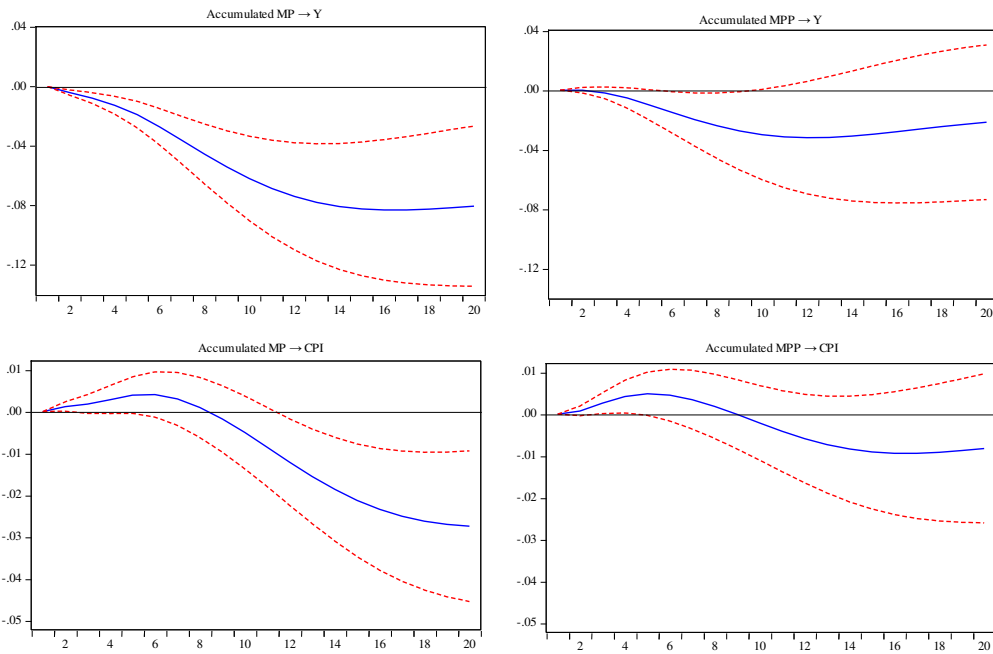
Fig. 6 shows the impulse responses estimates of the accumulated impacts of one-standard-deviation innovation to two policy variables (MP, MPP) on output and the price level over the 20-quarter horizon, together with one-standard-error bands. Throughout our analysis, quite often we present the IRs of these policies in parallel. However, our discussion will not focus on the magnitude comparison of responses. It is because both MP and MPP are qualitative measures, and quite often, the magnitudes of the impulse and response variables are not comparable and hard to interpret. Rather, our analysis throughout will focus on the timing, significance level and persistence of the estimated IRs.

Following a monetary tightening (r.t. the first row), both output and prices drop, though prices start to decline with a 2-year time lag. This finding is consistent with those in the literature. Interestingly, the impacts of macroprudential policies on both output and prices display similar patterns as those from monetary policy. Yet, the uncertainty around these estimates is high: None of them is statistically significant.

Analogously, Fig. 7 shows the impulse responses estimates of the accumulated impacts of one-standard-deviation innovation to two policy variables (MP, MPP) on loans and the housing price over the 20-quarter horizon, together with one-standard-error bands. The first row suggests that both monetary policy and macroprudential policy have significant impact on the credit growth, though the timing of the policy impact differs. A tightening of macroprudential policy turns out to have an immediate impact on the total credit: The lending drops immediately after a rise in the macroprudential policy indicator and reaches the trough after about 2 years. Afterwards, this negative impact on the lending remains at this level. In contrast, a monetary policy tightening affects the total credit with a lag of about two quarters; the trough is found 2.5 years later. Similarly, its impact on the credit is persistent. After five years, the credit is still significantly below the level that it would otherwise be.

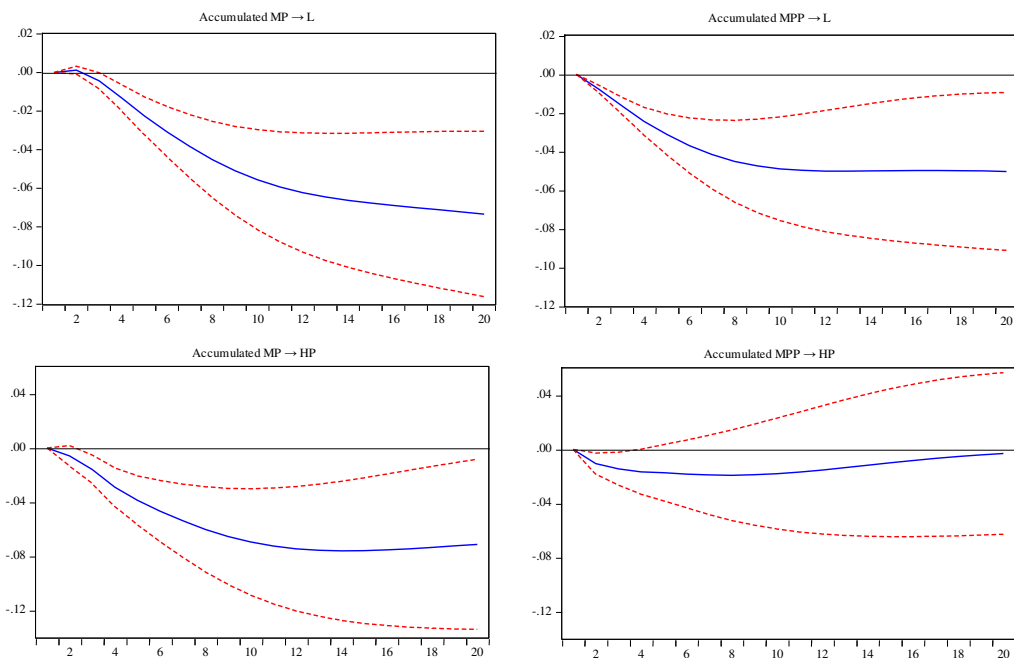
³⁶ That is, it assumes that the variable ordered first in the VAR is contemporaneously unaffected by all other variables.

Figure 6. Baseline model: Accumulated Impulse responses – policy effects on the macroeconomy



Note: The impulse responses are estimated from the VAR model specified in the system (1)-(2) (see text for explanations). The dotted red lines are one-standard-error bands.
Source: Authors' estimation.

Figure 7. Baseline model: Accumulated Impulse responses – policy effects on financial conditions



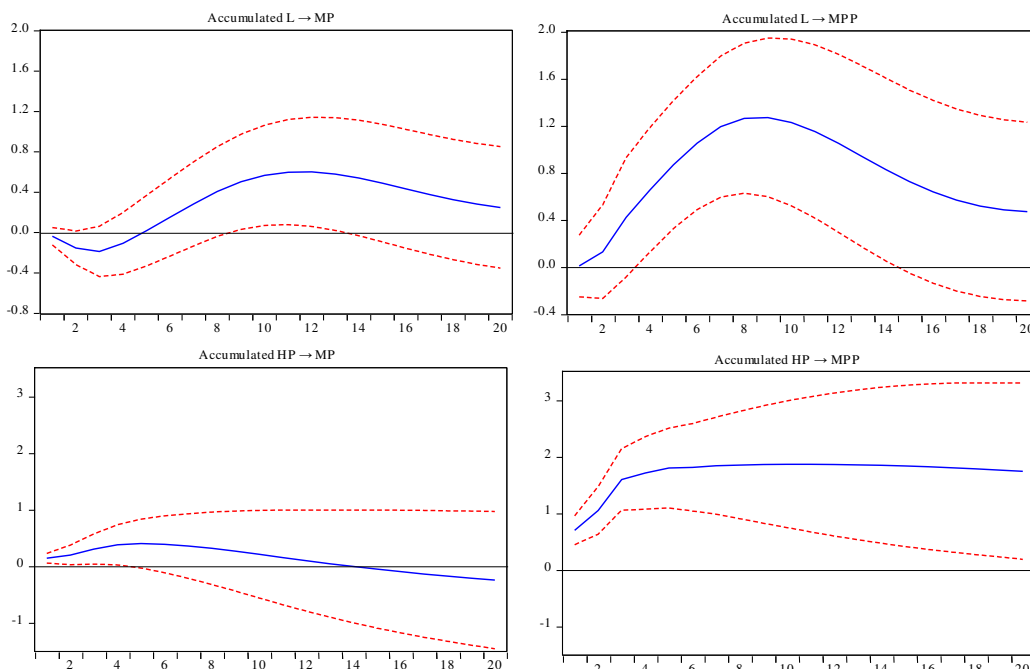
Note: See note to Fig. 6.
Source: Authors' estimation.

However, macroprudential policy is found not to have significant impact on the housing price due to high uncertainty around these estimates, while following a monetary policy tightening, the housing price drops.

In sum, our estimates suggest that monetary policy is effective on both macroeconomic and financial variables, while macroprudential policy has effects only on credit. The finding on the impact of monetary policy is consistent with what theory predicts. Changes in monetary policy have impacts on output and inflation via transmission channels, which are reflected in changes in financial variables. A monetary policy easing will lead to faster growth of credit. However, not all credit booms are what the PBC desires as this can lead to an unintended buildup of financial vulnerabilities. With macroprudential policy available, it is possible for the PBC to design a policy mix with a simultaneous macroprudential tightening to offset the negative impact of a monetary policy easing on financial stability. For example, as shown in Fig. 2, the PBC had easing monetary policy in 2001 and 2009 to stimulate the real economy. At the same time, it tightened various macroprudential measures (window guidance, supervision and housing-market policies) to maintain financial stability.

On the other hand, the ineffectiveness of the overall macroprudential policy on output and inflation builds a buffer for the PBC to rein in the fast growth of credit in attaining financial stability, but without harming real economic activities, when facing two conflicting policy objectives. In this way, the PBC can use macroprudential policies as a complement to monetary policy to address the financial stability problem.

Figure 8. Baseline model: Accumulated impulse responses – policy reaction to financial conditions



Note: See note to Fig. 6.

We also ask the question whether policies respond to financial conditions. Fig. 8 shows the reaction of monetary policy and macroprudential policy to the total credit and the housing price, together with one-standard-error bands. Macroprudential policy responds to both credit and the housing price

immediately, compared to monetary policy. This suggests that in response to a credit or a housing-price shock, the PBC chooses to tighten macroprudential measures immediately and significantly. Macropudential policy, rather than monetary policy, is the PBC's primary policy choice to address its financial stability concerns.

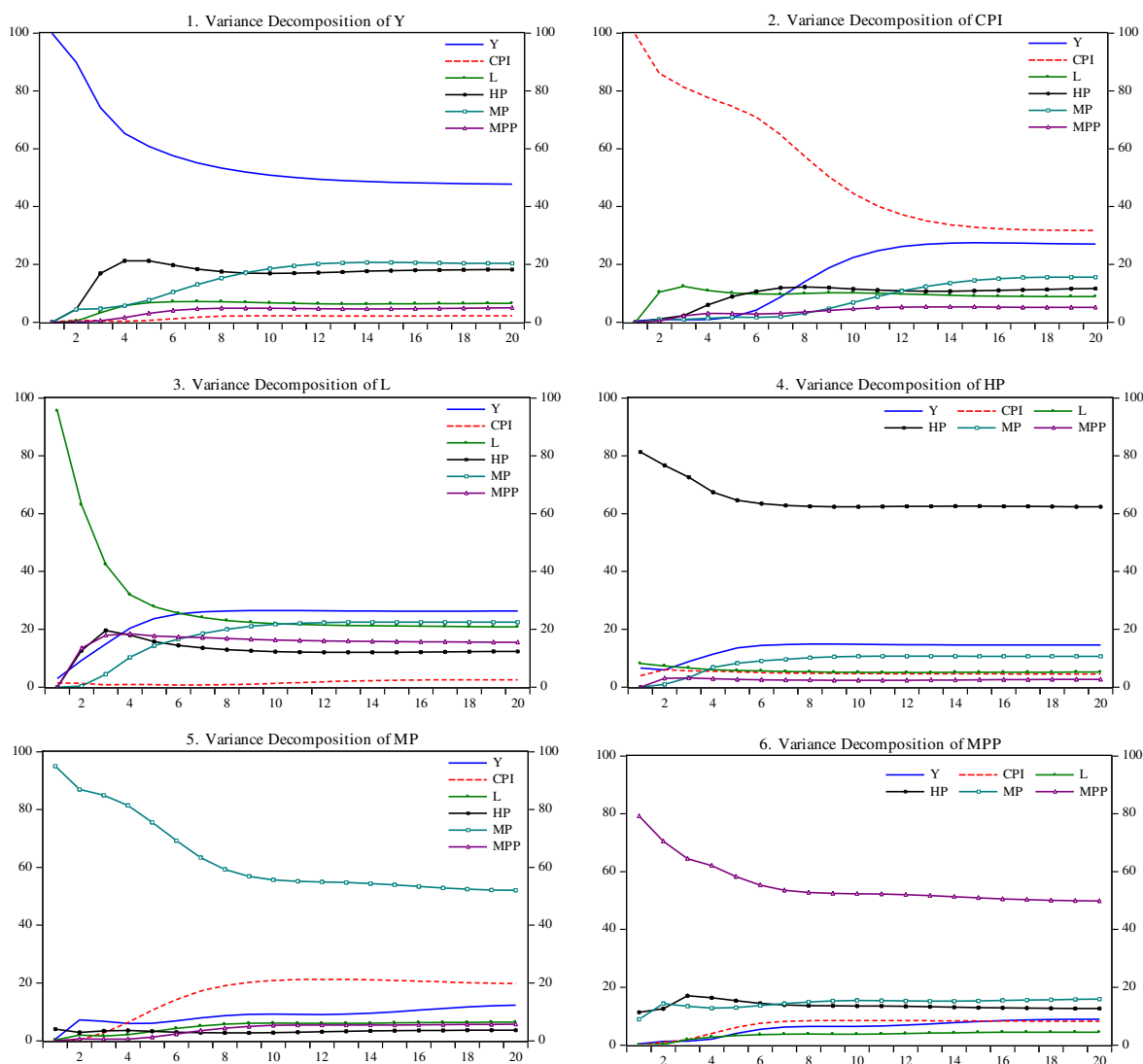
4.1.2 Policy shocks and volatility

Besides the dynamic policy effects discussed above, in Fig. 9 we report the VAR forecast error decomposition. This helps answer the question how policy shocks contribute to the volatility of various economic aggregates. A curve in each panel gives the percentage of the variance of the k-quarter ahead forecast errors in Y, CPI, L, HP, MP and MPP that attribute to shocks to each variable. The estimated confidence intervals are not reported in the figures to keep them readable.

In general, the own shocks account for the majority of the volatility of the underlying variable, with this percentage dropping fast in the near future forecast and then stabilizing at the 2-year horizon. One exception is the total bank loans, L. Its own shocks have had a limited impact on its volatility after a 1-year forecast horizon, accounting for 96%, 63%, 32%, and 23% of the variance of 1, 2, 4 and 8 quarter ahead forecast error variance in L, respectively.

Also, the figures suggest moderate interaction among the variables. A number of results are interesting to note. First, none of the policy shocks, neither monetary nor macroprudential, account for much of the volatility of the price level. The same holds for the housing price. The variance of these two price measures are mainly due to their own shocks and output shocks. Second, monetary policy shocks have had impacts on the volatility of output (15%) and credit (20%) at the 8-quarter horizon. Third, macroprudential policy shocks help explain 17 percent of the 8-quarter ahead forecast variance of credit, while these policy shocks play a very minor role in accounting for the variability in output. Fourth, most of the policy variation, both monetary and macroprudential, arises as a consequence of their own shocks, as shown in Figs. 9-5 and 9-6. Still, macroeconomic shocks, but not financial-condition shocks, play a nontrivial role in accounting for the variability in monetary policy, with 20% and 9% due to price level shocks and output shocks, respectively, in the medium run. In contrast, macroeconomic shocks do not play any important role in accounting for the volatility in macroprudential policy measure. Neither do credit shocks. Rather, it is housing price shocks and monetary policy shocks that account, for example, for both 15 percent at the 8-quarter horizon.

Figure 9. Baseline model: Forecast error variance decomposition



Note: The forecast variance decompositions are estimated from the VAR model specified in the system (1)-(2) (see text for explanations).

Source: Authors' estimation.

In sum, our findings suggest that monetary policy shocks have been an independent source of impulses to the business cycle and the credit cycle, though of only modest degree; while macroprudential policy shocks have played only limited role in the credit cycle.

4.2 Alternative models

In this part, we consider some variations. First, we examine the policy impacts on two other financial-condition indicators – medium- and long-term loans and the loans to households. Second, we examine the impact of individual macroprudential policy instruments.

Other financial-market indicators: We ask the question of the policies efficacy on other measures of financial conditions. We modify our baseline VAR model, as specified in Eqs. (1)-(2). As in the

baseline model, vector \mathbf{X} (the policy block), contains the monetary policy index (MP); the overall macroprudential policy index (MPP). The variations are reflected in the changes in macroeconomic and financial-condition block \mathbf{Y} . We examine two variations. In the first variation (Model I), we incorporate medium- and long-term loans ($MLTL$) into the model. In this case, the macroeconomic and financial-condition block \mathbf{Y} contains four variables: Y , CPI , L and $MLTL$, all in logarithm. In the second variation (Model II), we incorporate the loans to households (HHL) into the model. It then follows that the macroeconomic and financial-condition block \mathbf{Y} contains Y , CPI , L the HHL , all in logarithm.

Figure 10. Model I: Accumulated impulse responses – policy effects on medium- and long-term loans

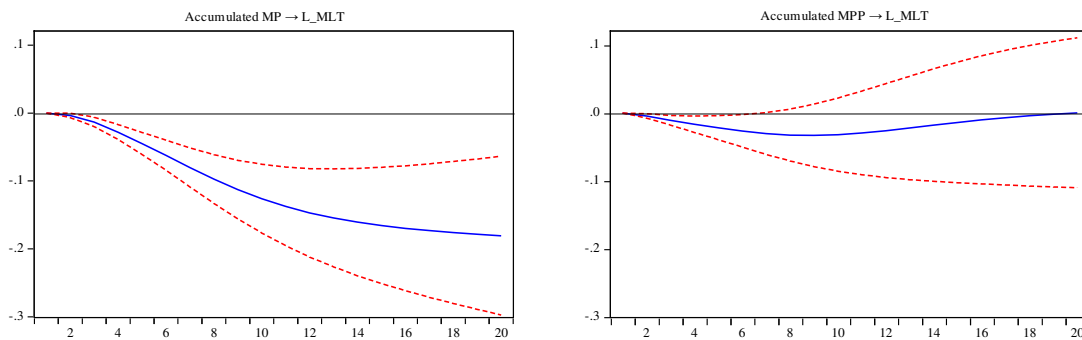
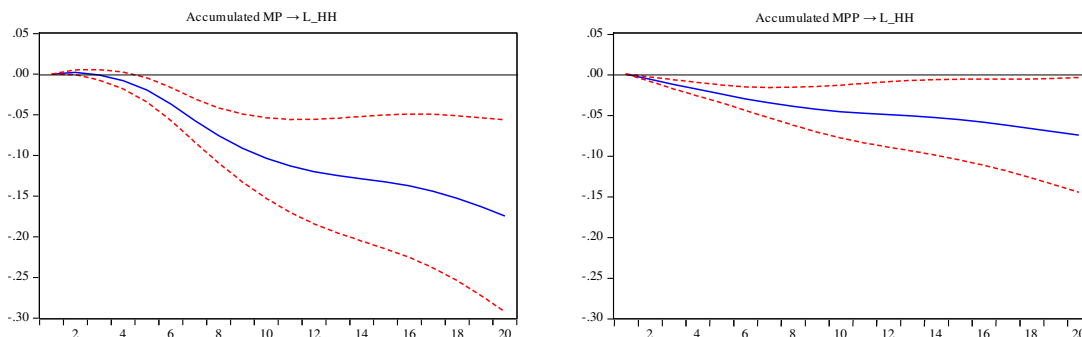


Figure 11. Model II: Accumulated impulse responses – policy effects on the loans to households



Note: See note to Fig. 6 and text for explanations.
Source: Authors' estimation.

Figs. 10 and 11 show the cumulative impacts of one-standard-deviation innovation to two policy variables (MP , MPP) on two alternative financial indicators (medium- and long-term loans; the loans to households) over the 20-quarter horizon, together with one-standard-error bands. In both figures, we do not report accumulated responses of credit to policy shocks as their estimation is robust against these variations: The results from Model 1 and Model 2 are similar to those obtained in the baseline model. Following a monetary tightening, both medium- and long-term loans (in Fig. 10) and the loans to households (in Fig. 11) drop significantly. A macroprudential tightening yields a decline of these two financial measures as well. Particularly, the loans to households fall immediately and since then, lie significantly below what they would otherwise be. That is, the macroprudential policy

has immediate and persistent impact on the loans to households. Yet, the uncertainty around the first estimate is high: Quite fast (after 7 quarters), the estimated cumulative responses of medium- and long-term loans to a MPP shock turn to be statistically insignificant.

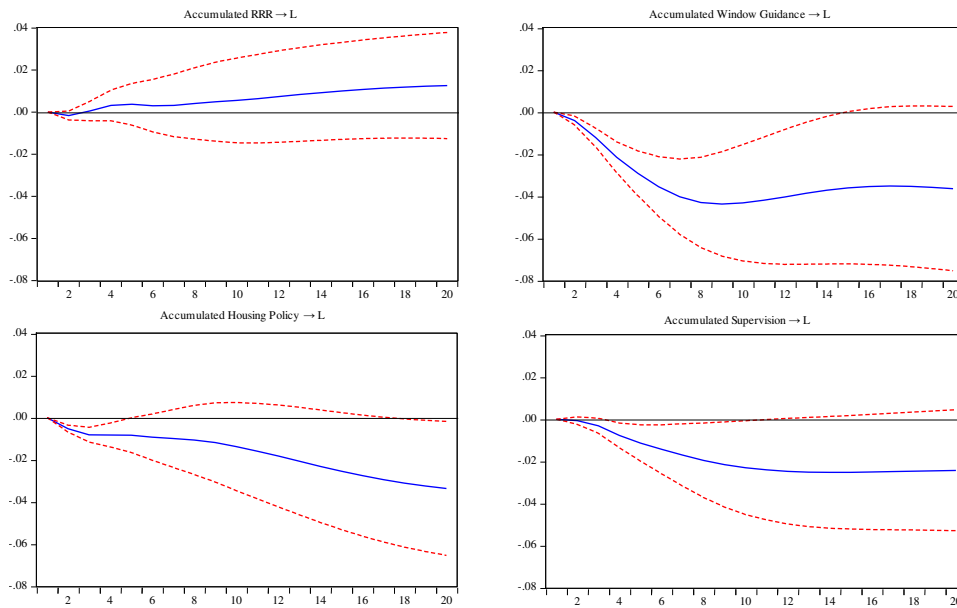
Individual policy instruments: So far, we have examined the policy efficacy of the overall macroprudential policy. A related question is: What are the dynamic effects of four individual policy measures? We model the interaction of individual macroprudential policies with financial-condition indicators (Model III). Again, the model is specified as in Eqs. (1)-(2). This time, the variations are reflected in vector \mathbf{X} , while macroeconomic and financial-condition block \mathbf{Y} contains four same variables as in the baseline model – Y , CPI , L and HP , all in logarithm. We let vector \mathbf{X} include *five* policy variables: monetary policy index (MP); four individual macroprudential policy index: RRR_MPP , *window guidance*, *housing policy*, *supervision*. This specification ensures us to examine the policy efficacy of each individual policy measure, while with all other policy actions (including monetary policy) controlled for.

Fig. 12 shows the estimated cumulative responses of loans and the housing price to one-standard-deviation innovation to four individual policy measures over the 20-quarter horizon, together with one-standard-error bands. First, of these four measures, window guidance is most effective in slowing down the total credit. Following a tightening in window guidance, credit drops immediately and reaches the trough about 8 quarters later. However, this policy effect is not persistent: It dies out and after 14 quarters, it is not statistically significant. Housing policies have immediate impact on credit, but this impact turns to insignificant after 5 quarters. The supervisory pressure has impact on credit, but with a 4-quarter delay. This impact lasts about 2 years and then turns to insignificant. Following a tightening in the required reserve ratio, credit rises, though it is estimated with high uncertainty and is not significant. It is puzzling and not consistent with what the theory predicts.³⁷

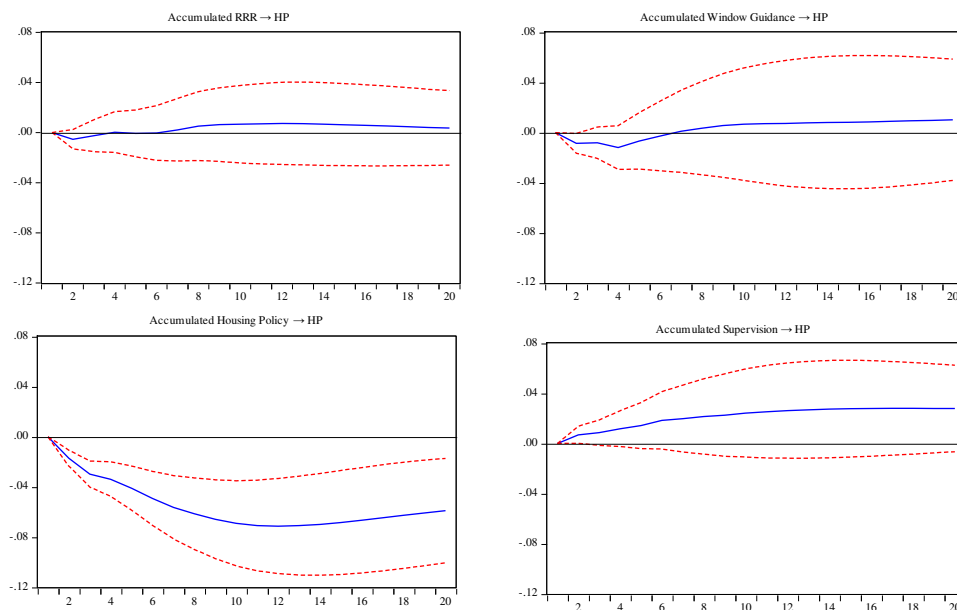
³⁷ We will leave the investigation to this puzzle to our future work. Plausibly, the PBC tightens this ratio in expecting a rise in credit. The possible solution could be to include a variable to proxy the PBC's expectation of credit.

Figure 12. Model III: Policy effects of individual instruments on loans and the housing price

1. Policy effects on loans



2. Policy effects on the housing price



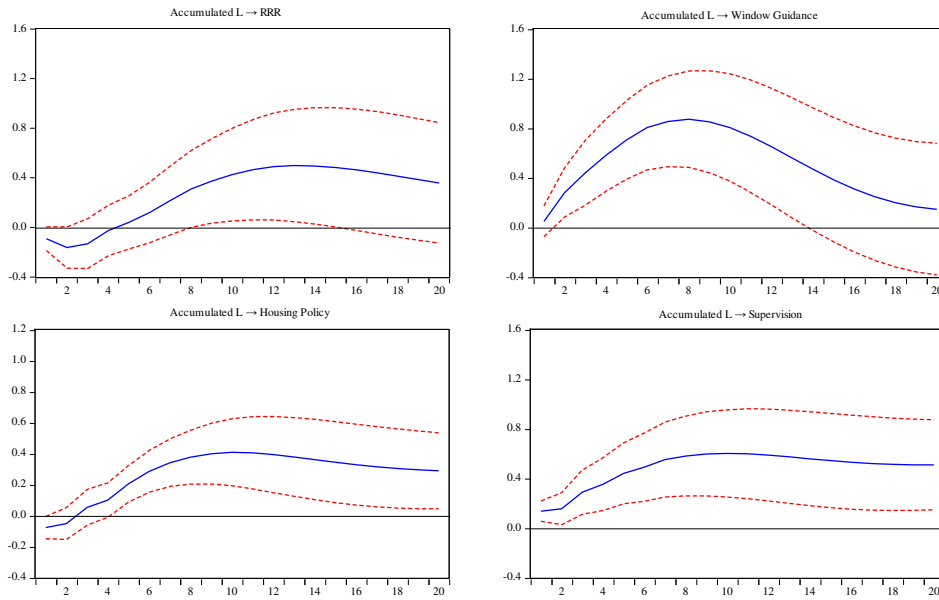
Note: See note to Fig. 6.
Source: Authors' estimation.

Second, of four policy measures, only the housing policy index is effective in reining in housing prices. Following a tightening in housing policies, the housing price falls immediately and reaches the trough 8 quarters later. The impact is persistent: After 5 years, the housing price is still significantly lower than what it would otherwise be. The estimated responses of the housing price to a policy shock of the reserve requirement and supervisory pressure are both puzzling: This housing price goes up following a tightening of these two policy measures. It could be due to the fact that these two are not intended to address the housing price. Rather, they are used to rein in the total credit. Credit and the housing price is interlinked with each other, but not perfectly. The housing

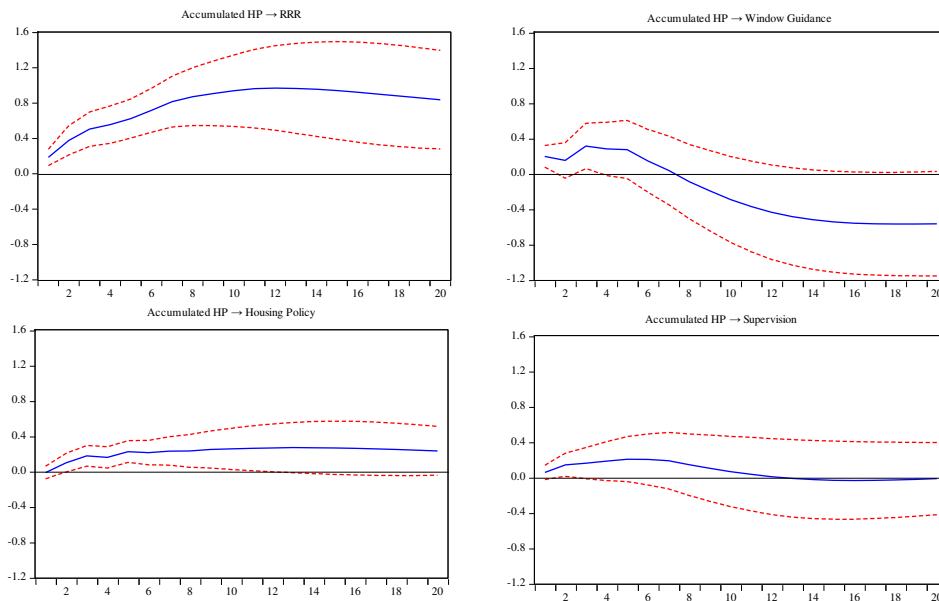
price is estimated to drop following an unexpected tightening in window guidance, but not significantly.

Figure 13. Model III: Individual policy reaction to loans and the housing price

1. Policy responses to loans



2. Policy responses to the housing price



Note: See note to Fig. 6.
Source: Authors' estimation.

Fig. 13 shows the estimated impulse responses on individual policy reaction to financial market shocks. In response to an unexpected rise in credit, the PBC tightens all these four policy measures, though the uncertainty around the estimated responses of reserve requirement is high. In response to an unexpected hike in the housing price, the PBC tightens the reserve requirement and housing policies, while the estimated responses of window guidance and supervisory pressure are not significant.

To conclude, of individual policy measures, window guidance is particularly effective in slowing down credit while only housing policies are found to have significant effects in reining in the housing price. As for the policy toolkit choice, the PBC tightens up all these four policy measures in response to a credit shock, but it chooses to contract the reserve requirement and housing policies only in response to a housing price shock.

5. Conclusion

In this paper, we show that a central bank can play an active role in safeguarding financial stability. We find that many monetary policy tools can be used as macroprudential to lean against credit bubbles, such as the reserve requirement, window guidance, housing-market policies and supervisory pressure. We show that these policy measures help to smooth the credit cycle and contribute to financial stability.

Our VAR estimates show that monetary policy has impacts on both the business cycle and the credit cycle, while macroprudential policy has effects on credit only. It suggests that with both monetary policy and macroprudential policy in use, the central bank does not have to face a tradeoff between macroeconomic and financial stability. Rather, it can use well-targeted macroprudential measures alone to retain financial stability, without sacrificing economic growth; or as a complement to monetary policy to offset the negative impact of a monetary easing on financial stability. A well-designed mix of these two policies helps to achieve both macroeconomic and financial stability objectives. Our study of the Chinese case provides supportive evidence for the argument that the central bank can use both monetary and macroprudential policy to reinforce each other (see, e.g., Blanchard 2012; IMF 2013; Aikman *et al.* 2016; Woodford 2016).

We do not argue that these PBC's macroprudential measures are universal for all countries. After all, the design of macroprudential policy measures and the assessment of their efficacy are country-specific, as emphasized in Blanchard (2012) and IMF (2013). The key message from our study is that it is the PBC's multiple-instrument and multiple-objective operating framework that enables it to choose different instruments while addressing different problems. To incorporate financial stability and macroprudential policy into its operating regime, a central bank needs to be equipped with multiple instruments and instrument independence. This has important implications for the current debates on the central bank design in the post-crisis era (see also Blanchard 2012; IMF 2013; Aikman *et al.* 2016; Blinder *et al.* 2016; Woodford 2016). It sheds light on questions such as whether all the unconventional monetary policy tools should fade out when the ZLB is no longer a concern or

whether the monetary operating regime should go back to its (prior-crisis) normal, a one-instrument and one-target framework.

A search for the macroprudential toolkit needs to take the country's specific institutional features into account. Many instruments, such as capital or reserve requirements on banks and down-payment or margin requirements on borrowers, help to absorb shocks and make the financial system more resilient. But obviously, there are social costs linked to these shock absorbers. Meanwhile, too many interventions (such as credit control) lead to distortions, resulting in capital misallocations, while country-specific or sector-targeted measures can give rise to spillovers or regulatory arbitrage, pushing banks to shift their loans off the balance sheets. All these have aroused concerns among the academia and policy makers (see, e.g., Yellen 2010; Blanchard 2012; IMF 2013; Reis 2013; Adrian & Liang 2014; Aikman *et al.* 2016; Buch & Goldberg 2016; Mendoza 2016; Woodford 2016; Collard *et al.* 2017). In short, macroprudential policy is promising but also challenging. While designing it, central banks or other regulators should monitor and balance the tradeoffs between the costs and benefits (Blanchard *et al.* 2012: 80). Our study suggests that in addition to all these mentioned instruments, supervision and communication tools work well as macroprudential instruments. The latter can take form of window guidance, as used in China through formally organized meetings with banks; or forward guidance, as used in the U.S. and the Euro Area in the post-crisis era to improve the policy transparency and guide the market's expectations. They appear to be able to affect banks' lending decisions as well as their risk-taking attitudes, and so to moderate financial instability risks.

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