The Nexus of Monetary Policy and Shadow Banking in China[†]

By Kaiji Chen, Jue Ren, and Tao Zha*

We study how monetary policy in China influences banks' shadow banking activities. We develop and estimate the endogenously switching monetary policy rule that is based on institutional facts and at the same time tractable in the spirit of Taylor (1993). This development, along with two newly constructed micro banking datasets, enables us to establish the following empirical evidence. Contractionary monetary policy during 2009–2015 caused shadow banking loans to rise rapidly, offsetting the expected decline of traditional bank loans and hampering the effectiveness of monetary policy on total bank credit. We advance a theoretical explanation of our empirical findings. (JEL E32, E52, G21, O16, O23, P24, P34)

In the aftermath of an unprecedented stimulus of multitrillion RMBs injected by the Chinese government to combat the 2008 financial crisis, the People's Bank of China (PBC) pursued contractionary monetary policy by tightening the M2 supply between 2009 and 2015. The policy of persistent monetary tightening, which aimed to contract the credit supply that had soared during the stimulus period, achieved the expected outcome of a simultaneous fall of M2 supply and bank loans (panel A of Figure 1). During the same period, however, shadow banking loans rose rapidly (panel B of Figure 1). The share of shadow banking loans in the sum of shadow

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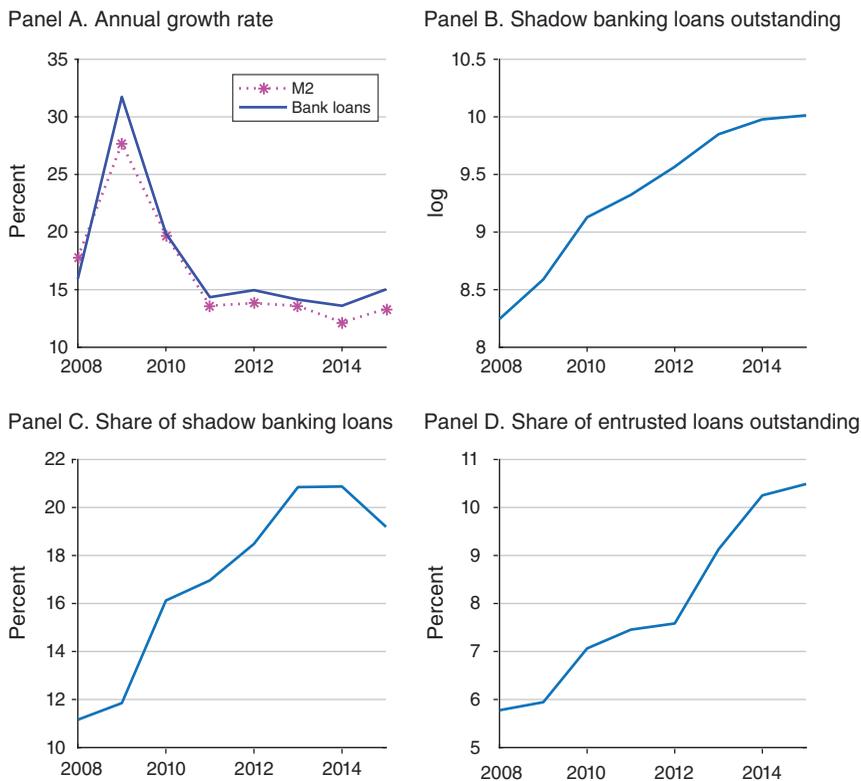
FIGURE 1. AGGREGATE TIME SERIES OF M2, BANK LOANS, AND SHADOW BANKING VARIABLES

Notes: The shadow banking loan volume is the sum of entrusted lending, trusted lending, and bank acceptances, all of which are off balance sheet. The share of shadow banking loans is the ratio of shadow banking loans to the sum of shadow banking loans and bank loans. The share of entrusted loans is the ratio of entrusted loans to the sum of entrusted loans and bank loans.

Source: PBC and CEIC (the database provided by China Economic Information Center, now belonging to the Euromoney Institutional Investor Company)

banking loans and bank loans increased steadily to around 20 percent in 2013–2015 (panel C of Figure 1).

In this paper, we establish empirical evidence that contractionary monetary policy during 2009–2015 in China, although exerting an expected effect on traditional bank loans, stimulated shadow banking and encouraged banks to bring shadow banking products onto their balance sheets in the form of risky nonloan assets. We advance a theory to explain why banks, in response to contractionary monetary policy, have an incentive to circumvent banking regulations by increasing nonloan assets. Both empirical evidence and theoretical analysis demonstrate that the effectiveness of monetary policy on the total credit in the banking system was severely hampered by the rise of shadow banking.

Specifically, we make four distinctive contributions. First, we provide institutional details of China's quantity-based monetary system, its regulations on commercial banks, and the relationship between shadow banking and traditional banking. One unique feature of monetary policy in China is to use M2 growth as the intermediate target to support growth of gross domestic product (GDP) beyond annually targeted

GDP growth. In fact, M2 growth has been the only intermediate target used on a quarterly basis by the central government since 2000.

We find that China's quantity-based monetary policy interacted with two major regulations specific to China's banking system to influence bank lending. One regulation is the legal ceiling on the ratio of bank loans to bank deposits imposed by the PBC on each commercial bank, which we call the LDR regulation, where LDR stands for the loan-to-deposit ratio; the other regulation, issued by the Chinese Banking Regulatory Commission (CBRC), prohibits commercial banks from expanding bank loans to risky industries such as real estate, which we call the safe-loan regulation. The LDR regulation controls the quantity of bank lending and the safe-loan regulation controls the quality of bank lending.

We also find that one of the most unique characteristics in China's banking system is an institutional division of state and nonstate commercial banks. State banks are owned by the central government and the remaining commercial banks are nonstate banks. Nonstate banks as a whole represent almost half the size of the entire banking system. State banks, directly controlled by the central government, are part of the government and thus adhere to the government's own policy against actively bringing shadow banking products onto their balance sheets. This is not true of nonstate banks, however. Between 2009 and 2015, contractionary monetary policy gave nonstate banks a strong incentive to take advantage of the lax regulatory environment of shadow banking by first increasing shadow banking activities off balance sheet and then bringing shadow banking products into a special investment category on the asset side of their balance sheets. This special category, called account-receivable investment (ARI), is not subject to the LDR and safe-loan regulations.

To test whether nonstate banks behave differently than state banks in their responses of shadow banking activities to changes in monetary policy, it is essential to estimate the existing quantity-based monetary policy rule and obtain an exogenous M2 growth series usable for our subsequent empirical analysis. The estimated monetary policy rule is based on China's institutional facts. It is tractable in the spirit of Taylor (1993, p. 197) "to preserve the concept of a policy rule even in an environment where it is practically impossible to follow mechanically the algebraic formulas economists write down to describe their preferred policy rules." The estimation of both endogenous and exogenous components of China's monetary policy constitutes a second contribution of this paper.

As a third contribution of the paper, we construct two micro datasets at the level of individual banks and use these data to shed light on the disparate responses of shadow banking activities conducted by state versus nonstate banks to changes in monetary policy. The first dataset, named the entrusted loan dataset, covers new entrusted loans between nonfinancial firms for the period 2009–2015 during which entrusted lending was the most important part of shadow banking in China and grew rapidly relative to bank loans (panel D of Figure 1). The dataset identifies the name of a financial trustee that facilitated each entrusted loan, which is crucial for our subsequent panel regression analysis. We follow Jiménez et al. (2014) and control for bank-specific attributes such as LDR, size, liquidity, and profitability in our regressions. We find that entrusted lending funneled by nonstate banks rose significantly in response to contractionary monetary policy, while there is no such evidence for state banks.

The second dataset, named the bank asset dataset, covers the two major categories on the asset side of an individual bank's balance sheet: bank loans and ARI excluding central bank bills or government bonds, which we call ARIX. A major part of ARIX is in the form of beneficiary rights of entrusted loans funneled by banks. Thus, this new dataset connects off-balance-sheet activities to risky nonloan investments on the balance sheet. Our panel regression analysis based on this dataset finds strong evidence that in response to a fall in M2 growth, nonstate banks increased their ARIX holdings significantly, but state banks did not. This finding of nonstate banks' risk-taking behavior, consistent with the finding of their off-balance-sheet behavior, implies that these banks bear the risk of shadow banking products in the form of ARIX.

A fourth contribution of this paper is to advance an analysis of how the rise of shadow banking dampens the effectiveness of monetary policy *on the banking system*. The total bank credit combines both bank loans and ARIX holdings on banks' balance sheets. For monetary policy to be effective, it is the total bank credit that matters. To lay the groundwork for our empirical work, we build a theoretical model of how monetary policy functions through open market operations to influence banks' portfolio allocations and the total bank credit. The theory, inspired by Bianchi and Bigio (2017), highlights nonstate banks' optimal portfolio choices between bank loans and risky nonloan assets. Bank loans are safe but subject to the LDR regulation, while nonloan assets are subject to default risks but not to the LDR regulation. As a result, individual banks trade off the default risk of nonloan assets against the regulation cost of bank loans. We show that contractionary monetary policy increases the risk of deposit withdrawals in individual banks. This risk in turn increases the expected cost for individual banks to recoup deposit shortfalls and leads to banks' portfolio adjustments toward risky nonloan assets. Consequently, contractionary monetary policy not only exerts the opposing effects on bank loans and nonloan assets, but also can lead to an increase in total bank credit.

The theoretical analysis provides a framework for empirically evaluating the effectiveness of monetary policy. We estimate a panel structural vector autoregression (VAR) model with the identifying restriction justified by our theory. Unlike the existing VAR literature, the model allows bank loans and ARIX holdings to be determined simultaneously. Despite the simultaneity, the panel structural VAR is globally identified. Our estimation indicates that in response to a one-standard-deviation fall of M2 growth, bank loans fall persistently. The estimated dynamics are statistically significant. But the estimated response of ARIX is positive over time. The rise of ARIX, therefore, makes monetary policy ineffective on total bank credit because the rise of ARIX offsets the decline of bank loans.

A complementary paper is Hachem and Song (2016). They explore how a regulatory tightening can lead to a credit expansion due to the growth of shadow banking. Relative to that paper, we make a number of contributions, including: propose and estimate a monetary policy rule; provide new microdata both off and on banks' balance sheets; estimate the impacts of contractionary monetary policy on banks' shadow banking activities, again both off and on the balance sheet; and quantify the opposing effects of monetary policy on bank loans and ARIX in the banking system. The latter point on the opposite effects of contractionary policy on the formal and shadow banking system is not a point of emphasis in Hachem and Song (2016).

The rest of the paper is organized as follows. Section I presents the institutional details of China's banking system and monetary policy. Section II estimates China's quantity-based monetary policy rule. Section III discusses the two new datasets we constructed. Section IV provides panel regressions on banks' roles in shadow banking activities both off and on the balance sheet. Section V explores how the rise of ARIX affects the effectiveness of monetary policy on the banking system by first developing a theoretical model and then obtaining empirical evidence from estimation of a panel structural VAR. Section VI concludes the paper.

I. China's Banking System and Monetary Policy

In this section, we discuss the unique features of China's monetary policy, banking system, and banking regulations, all of which are pertinent to the subsequent empirical and theoretical analyses in the paper. The discussion centers on three issues: (i) how quantity-based monetary policy works in China, (ii) institutional facts about rising shadow banking during the 2009–2015 period of monetary policy tightening, and (iii) institutional asymmetry between nonstate and state banks in shadow banking activities off and on the balance sheet.

A. Quantity-Based Monetary Policy

The Intermediate Target of Monetary Policy.—For the US monetary authority, the intermediate target of monetary policy is the federal funds rate to meet the two ultimate goals: inflation and employment (or output). For China, the intermediate target of monetary policy has been M2 growth since 2000.[1] The central government's ultimate goals are price stability and output growth (panels A and B of Figure 2). Unlike the US economy with the inflation target as the primary goal of monetary policy, China is an emerging market economy and the overriding objective of the central government is to achieve the annual GDP growth target.

The monetary policy goal is to use M2 growth as the intermediate target in support of GDP growth beyond its annual target while keeping stable inflation measured by the consumer price index (CPI). According to the Chinese law, the PBC must formulate and implement monetary policy under the leadership of the State Council. GDP and M2 growth targets have been specified in the State Council's Annual Report on the Work of Government (RWG) until recently. The Central Economic Work Conference, organized jointly by the State Council and the Central Committee of Communist Party of China (CPC) and typically held in December of each year, decides on particular target values of GDP growth and M2 growth for the coming year. Once these targets are decided, it is formally announced by Premier of the State Council as part of the RWG to be presented to the annual assembly of the National People's Congress (NPC) during the next spring.[2]

The central government's GDP growth target for a particular year is a lower bound of GDP growth for that year. Because of its strong desire of maintaining social stability, the government views such a lower bound as a crucial factor in keeping

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[1] In 1999, the PBC officially switched its monetary policy from controlling bank credit to controlling M2 growth.
[2] For the State Council's RWG, see: http://www.gov.cn/test/2006-02/16/content_200875.htm.
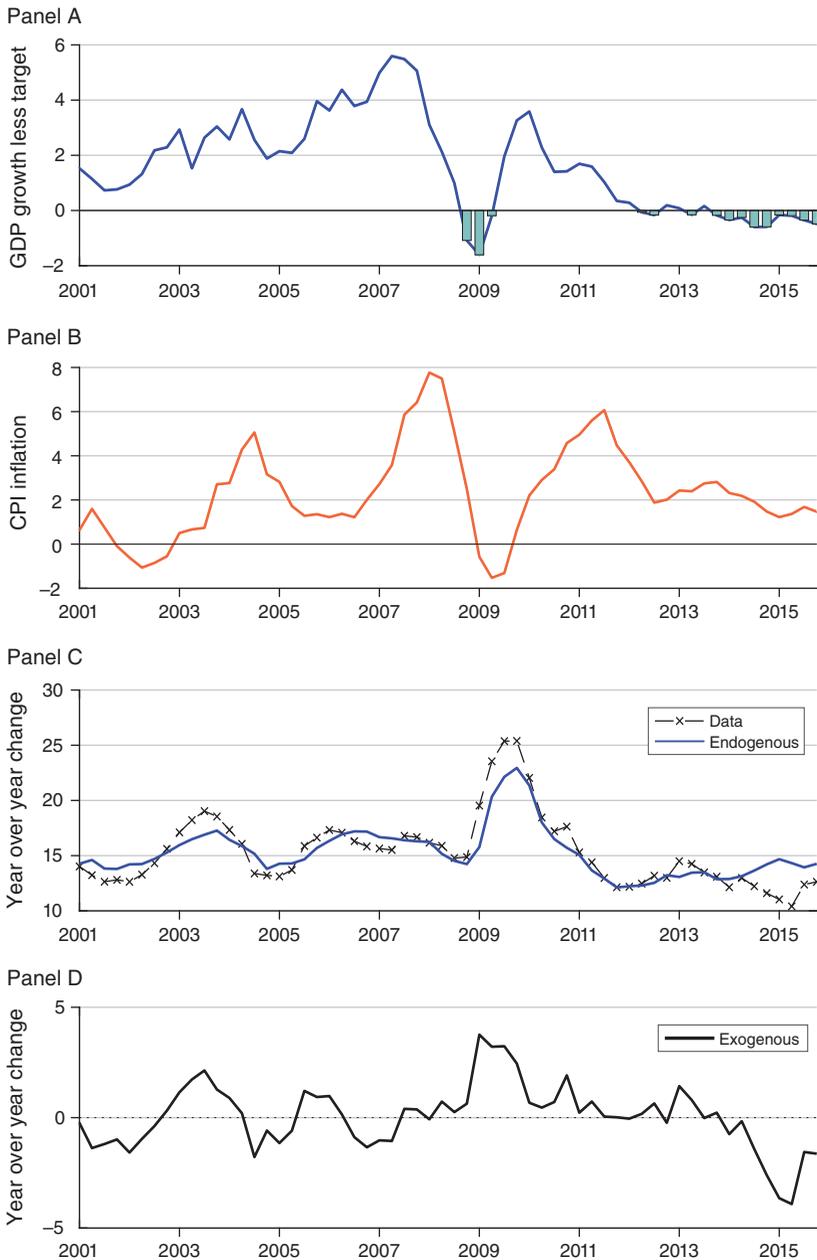
FIGURE 2. ULTIMATE GOALS OF MONETARY POLICY AND ITS ENDOGENOUS AND EXOGENOUS COMPONENTS

Notes: The values on all the *y*-axes are expressed in percent. Top two panels: quarterly year-over-year real GDP growth rates minus the year-over-year growth targets set by the State Council and quarterly year-over-year CPI inflation rates. The small bars mark periods in which an actual GDP growth rate is less than the GDP growth target. Bottom two panels: quarterly year-over-year M2 growth rates, estimated systematic responses of monetary policy, and monetary policy shocks. The gap between the actual M2 growth path and the systematic response path represents the series of (exogenous) monetary policy shocks.

Source: PBC and CEIC

unemployment low by means of economic growth. For example, when explaining why 6.5 percent was a targeted lower bound for the GDP growth rate during a press conference for the NPC's 2016 annual assembly, Xu Shaoshi, Head of the National Development and Reform Commission (NDRC) for the State Council, remarked: "The floor is employment, the floor has another implication, which is economic growth. Therefore, we set this lower bound (of GDP growth)." The central government's GDP growth target as a lower bound is an overarching national priority for every government unit, especially for the PBC.

Important decisions on adjusting M2 growth from quarter to quarter are made by the Politburo consisting of General Secretary of CPC, Premier of the State Council, and other top central government officials including Governor of the PBC. Unlike the Federal Reserve System, the PBC is not independent of other central government units and its decision on quarterly changes of monetary policy is severely constrained by its obligation of meeting the ultimate goal of *surpassing* targeted GDP growth and by the central government's view of how monetary policy should be conducted. For example, the 2009:I Monetary Policy Report (MPR) stated: "In line with the overall arrangements of the CPC Central Committee and the State Council, and in order to serve the overall objective of supporting economic growth, expanding domestic demand, and restructuring the economy, the PBC implemented a moderately loose monetary policy, adopted flexible and effective measures to step up financial support for economic growth, and ensured that aggregate money and credit supply satisfy the needs of economic development."[3]

In practice, the PBC adjusts M2 growth rates on a quarterly basis in response to economic conditions but at the same time makes these adjustments consistent with the annual M2 growth target set by the State Council (see various issues of quarterly MPRs). On an annual basis, the targeted and actual rates of M2 growth are very close (Figure 3). No other policy variables employed by the PBC, not even market interest rates, have been used to serve as the intermediate target of monetary policy since 2000. On the contrary, a plethora of instruments are used for the purpose of meeting the M2 growth target set by the central government.

Instruments for Monetary Policy.—There are many instruments used by the PBC to meet the M2 growth target, including open market operations, central bank base interest rate, central bank lending, reserve requirement, rediscounting, and other tools specified by the State Council.[4] In this section, we focus our discussion on two major instruments: open market operations and changes in the reserve requirement.

The system for open market operations was established by the PBC in May 1998. Over the past 20 years, it has matured rapidly to become the main tool for the PBC to manage the money supply on a regular basis. Initially, primary dealers in open market operations were commercial banks that undertook a large number of bond transactions. Over time, however, primary dealers have been extended to security

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[3] Since 2001:I, the MPR has been the only official release of how the PBC conducts monetary policy each quarter. The MPR provides an executive summary of the state of the economy along with additional descriptions of how the PBC adjusts its monetary policy actions in response to the state of the economy.

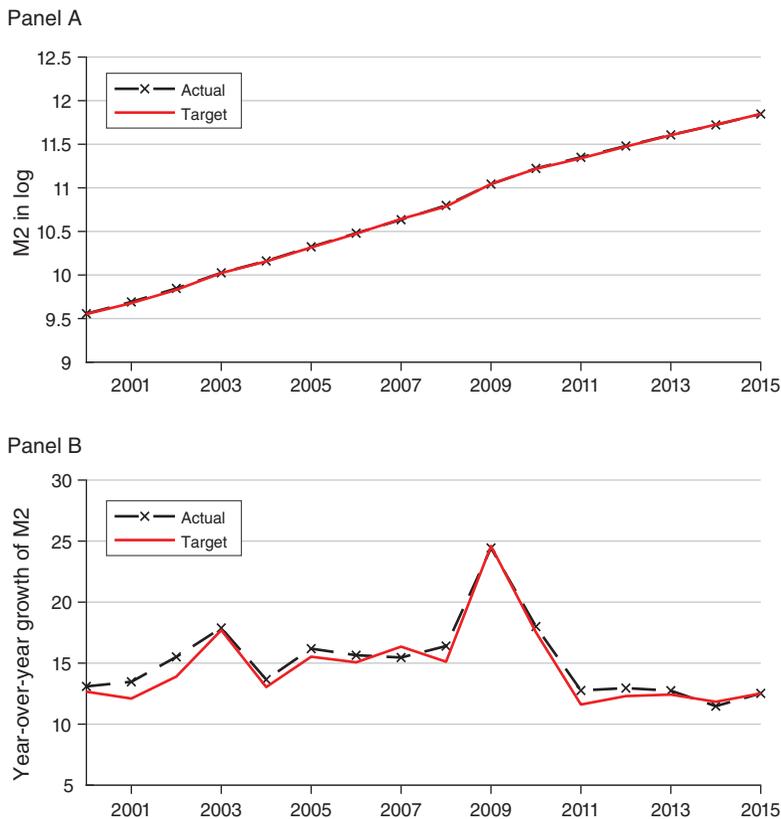[4] See the link: http://www.pbc.gov.cn/english/130727/130870/index.html.

Panel A

Panel B

FIGURE 3. ACTUAL AND TARGETED END-OF-YEAR M2 SERIES

Notes: The government sets the M2 growth target each year as year-over-year M2 growth at the end of the year. Note that the end-of-year M2 growth (year-over-year) rates are slightly different from the annual M2 growth rates based on the average M2 stock for each year (panel A of Figure 1). Year-over-year growth rates are expressed in percent.

Source: Various RWG issues published by the State Council and PBC

companies and other financial institutions. In May 2015, there were a total of 46 primary dealers.

Bond trading in open market operations includes spot trading, repurchase trading, and issuance of central bank bills (short-term bonds issued by the PBC) and government bonds. Repurchase transactions are divided into the "repurchase" (repo) and "reverse repurchase" (reverse repo) categories. In 2010 and 2011, for example, the PBC used issuance of both central bank bills and repos to tighten the M2 supply: issuance of central bank bills totaled 4.3 trillion RMBs in 2010 and 1.4 trillion RMBs in 2011, and repo operations totaled 2.1 trillion RMBs in 2010 and 2.5 trillion RMBs in 2011. In Section VA, we analyze how open market operations change deposits in the banking system.

The system for reserve requirements was established in 1984. Changes in the reserve requirement ratio (RRR) are used by the PBC to help meet the M2 growth target, but this instrument is used much less regularly than open market operations. Reserve requirements should not be considered as representative of the PBC's
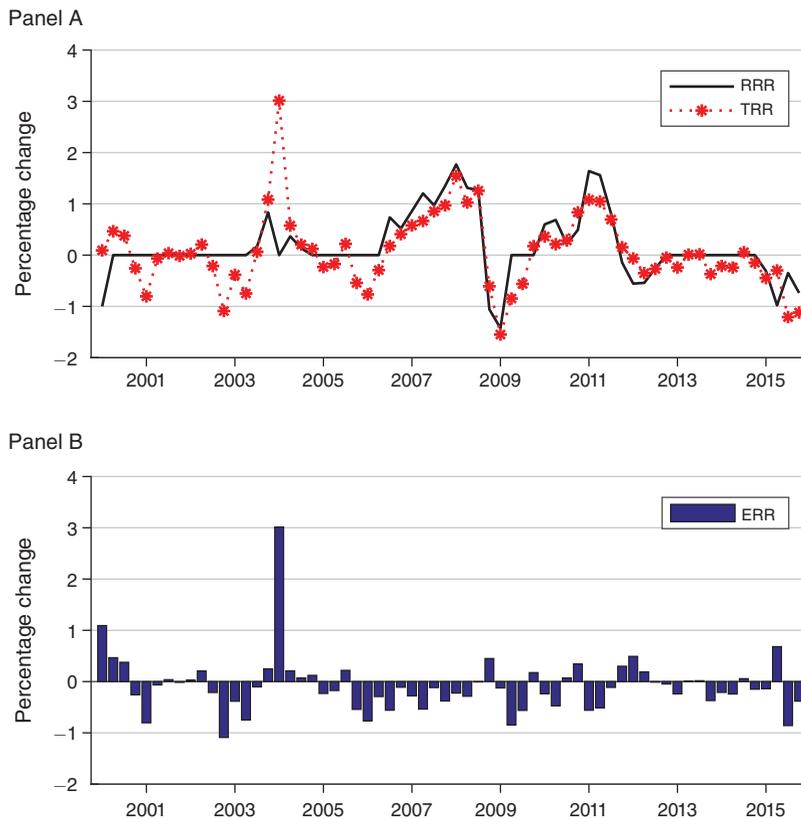
Panel A

Panel B

Figure 4. Quarterly Time Series of the Reserve Requirement Ratio (RRR), Total Reserve Ratio (TRR), and Excess Reserve Ratio (ERR)

Source: PBC and CEIC

monetary policy instrument *on a quarterly basis*. It is well known that a change in the RRR is one of several main instruments or tools used by the central bank to target the money supply or the federal funds rate in recent US history.[5] The logic that a change in the RRR is not the intermediate target of monetary policy remains the same for China, though the RRR is less frequently changed in the United States. Leeper et al. (1996) argue that because excess reserves fluctuate considerably on a regular basis, the reserve requirement is an insufficient statistic for measuring the contraction or expansion of money supply. This is certainly the case for China as shown in Figure 4, where excess reserves as a difference between total reserves and required reserves are volatile.

Distinction between instrument and target is essential for understanding monetary policy. For many countries, open market operations and reserve requirements are two instruments used to meet the intermediate target of monetary policy. In the US and other developed countries, the intermediate target has been explicitly the interest rate. In China, the intermediate target has been explicitly M2 growth until

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[5] See the Federal Reserve Board's website for details: https://www.federalreserveeducation.org/about-the-fed/structure-and-functions/monetary-policy.

recently. Indeed, as shown in Figure 3, the PBC has been successful in employing various instruments to keep its targeted M2 growth on track.

The Bank Lending Channel of Monetary Policy.—Given M2 growth as the intermediate target of monetary policy, the PBC uses various instruments such as open market operations to influence the credit volume in the banking system with the help of China's two specific banking regulations. As a result, growth rates of M2 supply and bank loans move closely together.

The first banking regulation is a 75 percent ceiling on the ratio of bank loans to bank deposits for each commercial bank as a way to manage the quantity of bank loans. The LDR regulation was established in 1994. To see how monetary policy interacts with the LDR regulation to influence the quantity of bank lending, consider the following episode. At the end of 2009, the PBC began to tighten the M2 supply for fear of an overblown bank credit expansion after the 2008 financial crisis. As M2 growth continued to slow down, banks became more vulnerable to unexpected deposit withdrawals, which exposed banks to the risk of violating the LDR regulation.

To meet unexpected deposit shortfalls against the LDR ceiling, the bank attracted additional deposits by offering a much higher price than the official deposit rate imposed by the PBC. The government used the phrase "the last-minute rush (*chongshidian* in Chinese)" to refer to the last-minute actions taken by banks to pay high prices to increase deposits in order to recoup deposit shortfalls.[6] Such high prices during the last-minute rush decreased the effective return on bank loans and compelled banks to reduce issuance of new bank loans. As a result, growth in M2 and bank loans declined simultaneously. This impact of monetary policy on bank loans via the LDR regulation is called the bank lending channel.

In addition to controlling the quantity of bank loans, the PBC uses another regulation to control the quality of bank lending. In 2006 the State Council, concerned with potential financial risks associated with bank credit to real estate and other risky industries, issued a notice to accelerate the restructuring process of these industries. The CBRC took concrete steps in 2010 to curtail an expansion of bank credit to these industries.[7] These actions were reinforced by the State Council in its 2013 Guidelines.[8] In the introduction, we term this quality-control regulation the safe-loan regulation. This regulation gave banks incentives to invest in risky nonloan assets that deliver higher expected returns. Our newly constructed dataset (Section III) reveals that these risky assets were associated with shadow banking products. In the next section, we provide an institutional background of banks' shadow banking activities in 2009–2015.

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[6] See the proclamation "Number 236 Notice on Strengthening Commercial Banks Deposit Stability Management" announced on September 12, 2014 jointly by the CBRC, the Ministry of Finance, and the PBC.

[7] The 2010:I MPR stated that "in the next stage, the PBC will tightly control lending to new projects, strictly restrain lending to high energy-consuming, heavily-polluting industries, and industries with excess capacity…"

[8] In addition, the 2014 CFSR (pp. 37 and 41) emphasizes the significant credit risks in real estate, local government financing vehicles, and overcapacity industries. As a result, the CBRC has strengthened supervision of credit advancements to high risk industries.

B. *Facts about Shadow Banking during the Period of Monetary Policy Tightening*

In contrast to the slowdown of growth in both M2 and bank loans since late 2009, shadow banking activities sprang up with a rapid increase of the loan volume in the shadow banking industry (panels A and B of Figure 1). The shadow banking loan volume is the sum of entrusted lending, trusted lending, and bank acceptances, all of which are off balance sheet. The share of shadow banking loans in the sum of shadow banking loans and bank loans increased steadily to around 20 percent in 2013–2015 (panel C of Figure 1). All these loans are in outstanding amount; a similar time series pattern holds for newly originated loans as well. In particular, new bank loans during 2010–2015 declined on average by 7 percent from the 2009 level, but an increase of shadow banking loans more than offset this decline so that the total new credit as the sum of new bank loans and new shadow banking loans increased on average by 4.2 percent from the 2009 level during the same period.

Entrusted Lending.—From 2009 to 2015, entrusted loans became the second largest financing source of loans after traditional bank loans, and their share in the sum of entrusted and bank loans reached over 10 percent in 2015 (panel D of Figure 1). In particular, the share of outstanding entrusted loans in total outstanding shadow banking loans was always high with 47 percent in 2009 and 49 percent in 2015. Given the importance of entrusted lending in the shadow banking industry, we provide below a detailed discussion of this particular shadow banking product.

In 1996, the PBC issued "General Rules for Loans" that allowed entrusted lending. In May 2000, the PBC provided formal operational guidelines for commercial banks to be trustees of entrusted lending in its "Notice on Issues Related to Practices of Commercial Banks in Entrusted Lending" (No. 100 Notice). The key requirement in these guidelines was the mandatory participation of a financial institution acting as a trustee to facilitate a loan transaction between two nonfinancial firms. This regulation required the participating financial institution to verify that all lending practices met various legal forms and requirements. An entrusted lending transaction between nonfinancial firms with a commercial bank or a nonbank financial company acting as a trustee is summarized as follows:

$$\boxed{\text{Lender (firm A)}} \longrightarrow \boxed{\text{Trustee}} \longrightarrow \boxed{\text{Borrower (firm B)}}.$$
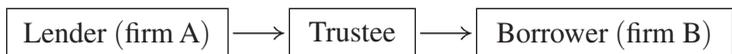
On paper, a trustee is a middleman in the transaction of an entrusted loan as a passive facilitator. If the trustee is a commercial bank, it is commonly assumed that "the bank earns a fee for its service, but does not bear the risk of the investment" (Allen et al. forthcoming). In Section IV, however, we show that the risk was brought onto the balance sheet: entrusted loans were first facilitated by banks and then their beneficiary rights (entrusted rights for short) were in turn purchased by banks as risky investments on the asset side of banks' balance sheets.

Entrusted lending activity, as well as other shadow banking activities, did not really blossom until after 2009, a period when monetary policy tightened. One important piece of direct evidence from our entrusted loan data as described in Section IIIA reveals that most entrusted loans ended up in real estate and other

Table 1—Bank Loans versus Entrusted Loans (*Average for 2009–2015*)

Loan type	Loan maturity	Loan rate
Bank loans	30.91	6.51
Entrusted loans	20.99	7.59

Notes: Loan maturity is expressed in months and loan rate in percent. Both measures are averages weighted by loan amount.

Source: CEIC and our constructed entrusted loan dataset

risky industries classified by the Ministry of Industry and Information Technology, most of which have problems with excess capacity. From 2009 to 2015, over 60 percent of entrusted loans were funneled to these industries. For the entrusted loans that went to real estate companies, 75.33 percent of loan volumes were channeled to enterprises that are *not* state-owned. Table 1 reports that the average maturity of entrusted loans is shorter than that of bank loans, but the interest rate is higher due to the risky nature of entrusted loans relative to bank loans.

The Asset Side of Banks' Balance Sheets.—We now describe how banks brought off-balance-sheet products into their balance sheets. In the introduction, we discuss the category of ARIX holdings on the asset side of banks' balance sheets. These holdings are not counted as part of traditional bank loans; they conceal risky investment assets brought onto the balance sheet from shadow banking products. As a result, they are not subject to the LDR and safe-loan regulations.

One principal component of ARIX is entrusted rights. Because commercial banks were not required to report the detailed products within the ARIX category until recently, it is impossible to obtain a complete time series of entrusted rights within ARIX. For 2014–2015, however, the share of entrusted rights in ARIX is as high as 78.04 percent for nonstate banks. For a longer time series, we can calculate the correlation between entrusted loans facilitated by a bank and ARIX on the same bank's balance sheet. Section IVD reports that the correlation for nonstate banks is over 0.60. The high share for nonstate banks in 2014–2015 is consistent with the high correlation between entrusted loans and ARIX.

Other components of the ARIX category include trusted rights (associated with trusted loans) and various wealth management products. Because ARIX holdings are risky investments brought onto the balance sheet from shadow banking products, we use the two terms (ARIX holdings and risky nonloan assets) interchangeably. Our empirical work based on ARIX in Sections IVC and VB quantifies the impact of monetary policy on investments in shadow banking that is broader than entrusted loans.

C. *State versus Nonstate Commercial Banks*

As discussed in the previous sections, one distinctive characteristic of China's banking system is a division of state and nonstate commercial banks. There are five state banks controlled and protected directly by the central government: the Industrial and Commercial Bank of China, the Bank of China, the Construction

TABLE 2—CAPITAL ADEQUACY RATIOS (CAR), EXCESS RESERVE RATIO (ERR),
AND LDR FOR STATE AND NONSTATE BANKS IN 2009–2015 (*Percent*)

Description	CAR	ERR	LDR (EOY)	LDR (average)
State banks	13.07	1.45	68.06	68.69
Nonstate banks	12.16	3.32	73.02	76.68
Overall	12.71	1.90	69.15	70.4
SE	4.49	0.46	1.48	1.86
p-value	0.85	0.00	0.4	0.27

Notes: EOY stands for end of year. Average means an average value of the LDRs within each year for each bank. Each ratio for each year is weighted by bank assets and the reported ratio is a simple average across years. The calculation is based on the balance-sheet information of commercial banks reported by Bankscope and WIND. Capital adequacy ratios for all commercial banks are available from Bankscope. LDRs and excess reserve ratios are manually collected from annual reports of publicly listed banks, which are available from WIND. We compute the excess reserve ratio of each bank for every year, calculate a weighted average of these ratios for all the banks within each group (the state group and the nonstate group) for each year, and then take a simple average of these ratios across years. "SE" stands for standard error. The standard error for the difference between the ratio for state banks and the ratio for nonstate banks, along with the corresponding *p*-value (round to two decimal places), is reported in the last two rows of the table.

Bank of China, the Agricultural Bank of China, and the Bank of Communications.[9] The remaining commercial banks are nonstate banks, including China CITIC Bank, China Everbright Bank, China Merchants Bank, Shanghai Pudong Development Bank, the Industrial Bank of China, and the Bank of Beijing. Nonstate banks as a whole represent almost half the size of the entire banking system. In 2015, for example, the share of their assets was 47.38 percent and the share of their equity was 47.22 percent.

The most conspicuous fact from our entrusted loan data is that nonstate banks play a dominant role in channeling entrusted loans between nonfinancial firms. In this section, we review a list of key regulatory requirements and analyze which one is likely to contribute to the difference between state and nonstate banks in their roles of promoting shadow banking activities.

The Usual Suspects.—There were three major regulatory requirements of commercial banks: capital requirement, reserve requirement, and LDR requirement. We provide evidence on whether there was a notable difference between state and nonstate banks in meeting each of the three requirements for the 2009–2015 period.

First, both state and nonstate banks met the capital requirement by a comfortable margin (first column of Table 2). One can see from the table that the difference of capital adequacy ratios between state and nonstate banks is statistically insignificant and economically inconsequential because both ratios are far above the capital requirement ratio of 8 percent. Second, nonstate banks had more cushion than state banks in meeting reserve requirements with a considerably higher excess reserve ratio than state banks (second column of Table 2), implying that nonstate banks were more cautious than state banks in managing their reserves to meet reserve requirements.

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[9]The Bank of Communications, initially listed in the Hong Kong Stock Exchange, has officially become the fifth largest state-owned bank since May 16, 2006.

Third, the LDR of nonstate banks is higher than state banks' LDR during 2009–2015, but the difference is statistically insignificant.[10] Thus, the issue for banks is not the LDR ceiling per se, but rather the risk of surpassing the ceiling due to unexpected deposit shortfalls. This is especially the case for nonstate banks, as their average LDR was above 75 percent in the earlier part of the 2009–2015 period and needed the last-minute rush to keep the ratio below the 75 percent ceiling around the time of the PBC audit. The deposit withdrawal risk is an important ingredient in our theoretical analysis presented in Section VA.

In summary, the difference between state and nonstate banks in each of the three major policy requirements during 2009–2015 is statistically insignificant. It is therefore not any of these regulatory requirements that helps explain the disparate roles played by state and nonstate banks in promoting shadow banking products. Our empirical findings in later sections of the paper indicate that nonstate banks, not state banks, play a dominant role in shadow banking activities after controlling for a host of bank-specific attributes such as LDR, size, liquidity, and profitability. In the next section, we argue that the difference between state and nonstate banks is mainly institutional in the sense that the central government's direct control of state banks make them behave differently than nonstate banks.

Institutional Asymmetry.—State banks, controlled directly by the central government, adhere to the government's regulations for promoting the healthy banking system rather than undermine the soundness of the banking system by circumventing the regulations. In 2010, the PBC and the CBRC issued a joint notice to reinforce the 2006 announcement made by the State Council that banks shall not partake in risky investments themselves to maintain "the soundness of the banking system." Government-controlled state banks should not and did not circumvent the safe-loan regulation by bringing risky shadow banking products onto their balance sheet.

The institutional structure for nonstate banks is different: the government does not have direct control of these banks. Despite the regulations intended for limiting the risk on the balance sheet, nonstate banks had largely benefited from China's lax regulatory system for shadow banking until the end of 2015. On November 12, 2012, for example, the PBC Governor Zhou Xiaochuan told a news conference: "Like many countries, China has shadow banking. But the scale and problem of China's shadow banking are much smaller compared with its counterpart for the developed economies that was exposed during the latest financial crisis" (reported in the Chinese edition of January 15, 2014 *Wall Street Journal*).[11] Indeed, before 2015 the government viewed the development of shadow banking as a new way to diversify financial services. The PBC's 2013:II MPR had a positive view on rapid growth of entrusted and trusted lending because "the financing structure continues to diversify." Therefore, a combination of contractionary monetary policy and the lax regulatory system on shadow banking allowed nonstate banks to take advantage

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[10] A direct measure of the LDR is not provided by Bankscope. We construct this measure as the ratio of "gross loans" to "total customer deposits." For a publicly listed bank, we compare this measure to the reported LDR published by the bank's own annual report and verify that they match.

[11] Bob Davis and Lingling Wei, "Does China's attention to reforms overlook the shadow of banking problems?" *Wall Street Journal* http://cn.wsj.com/gb/20140115/bog093219.asp (accessed October 18, 2018).
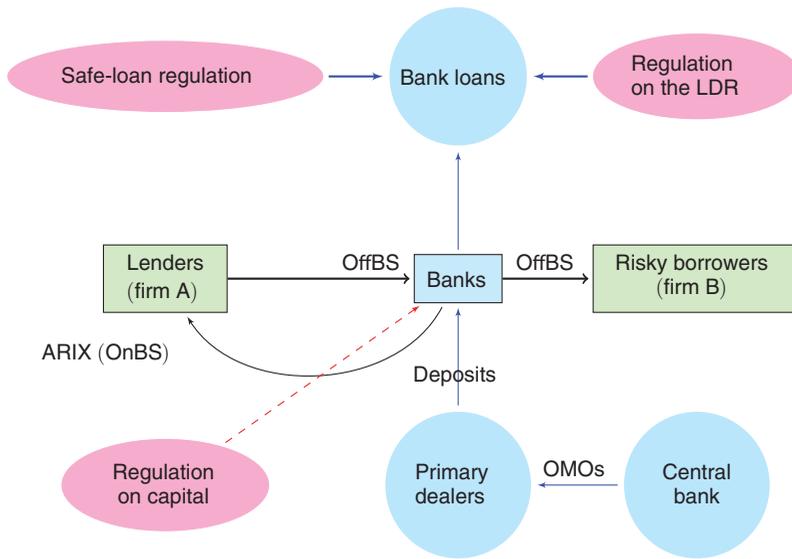
FIGURE 5. An Illustration of the Nexus between Monetary Policy, The Banking System, and Shadow Banking

Notes: Banks refers to nonstate banks. Safe-loan regulation refers to a series of 2010–2013 laws that strictly banned commercial banks from expanding bank loans to risky industries. OffBS refers to off balance sheet, OnBS on the balance sheet, and OMOs open market operations. The dashed line arrow indicates that the current capital requirement regulation is far from binding.

of regulatory arbitrage by increasing ARIX, which was not subject to the LDR and safe-loan regulations.

D. *Roadmap*

Against a backdrop of all these institutional elements, Figure 5 presents a roadmap for the rest of the paper. The lines connecting "Central bank" through "Primary Dealers" and "Banks" to "Bank loans" depict how monetary policy shocks are transmitted to affecting bank loans. To obtain monetary policy shocks, Section II estimates the quantity-based monetary policy rule based on China's institutional facts. The lines on the top of Figure 5 connecting the two regulations to bank loans highlight the importance of these regulations for monetary transmission into bank loans. All these relationships, taken together, summarize the bank lending channel enhanced by the interaction between monetary and regulatory policies.

Section III constructs two bank-level data for all the empirical analyses conducted in the paper. The lines connecting "Lenders" and "Risky borrowers" describe off-balance-sheet activities and the role of banks as passive facilitators. Sections IVA and IVB present a panel regression analysis along these lines. The curly line connecting "Banks" and "Lenders" reflects how nonstate banks, as active participants in shadow banking, brought off-balance-sheet shadow banking products onto the balance sheet through ARIX. Section IVC provides another panel regression analysis along this particular line. Section V provides both theoretical and panel VAR

analyses of the effectiveness of monetary policy along the lines connecting "Central bank" through "Primary Dealers" and "Banks" to "Lenders."

II. Estimation of China's Monetary Policy

Monetary policy consists of two components: endogenous growth of money supply in response to economic fundamentals and an exogenous change in money growth. To determine the extent to which monetary policy causes a rapid rise of shadow banking in China, it is necessary to extract from the data a series of changes in exogenous money growth (i.e., unexpected monetary policy shocks) as in the empirical macroeconomic literature (Leeper et al. 1996; Christiano, Eichenbaum, and Evans 1999, 2005; Sims and Zha 2006). In his June 24, 2016 speech to the International Monetary Fund (Zhou 2016), the PBC's Governor Xiaochuan Zhou acknowledged: "As China has the features of both a large transition economy and an emerging market economy, the central bank of China and its monetary policy are yet to be well understood by the outside world."

In this section, we develop and estimate a tractable rule that characterizes the essence of the otherwise intractably complex operations of China's monetary policy. With the estimated rule, we obtain an exogenous M2 growth series used for subsequent empirical analyses in this paper.

A. *Estimating the Monetary Policy Rule*

The original interest rule of Taylor (1993), called the Taylor rule, is inapplicable to the Chinese economy for two reasons. First, China is an emerging-market economy and its transitional path is characterized by unbalanced growth with the rising share of investment in GDP since the late 1990s (Chang et al. 2016). For such an economy, it is conceptually problematic to define what constitutes potential output or trend growth. Second, financial markets in China have yet to be fully developed and no interest rate has become the intermediate target of monetary policy.[12] The intermediate target of China's monetary policy has been to control M2 growth in support of rapid economic growth as discussed in Section IA.

The PBC's Monetary Policy Committee (MPC) is an integral part of the policymaking body.[13] At the end of each year, the central government sets the target of M2 growth consistent with targeted GDP growth for the next year. Within each year, the MPC meets at the end of each quarter t (or the beginning of the next quarter) to decide on a policy action for the next quarter (i.e., quarterly M2 growth $g_{m,t+1} = \Delta M_{t+1}$) in response to CPI inflation $\pi_t = \Delta P_t$ and the gap between GDP growth ($g_{x,t} = x_t - x_{t-1}$) in the current quarter and the GDP growth target

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[12] In Appendix A, we show that the conventional monetary policy rules using either market interest rates or potential GDP yield no significant empirical results and thus fail to describe China's monetary policy.

[13] The MPC is composed of the PBC Governor, two PBC Deputy Governors, a Deputy Secretary-General of the State Council, a Deputy Minister of the NDRC, a Deputy Finance Minister, the Administrator of the State Administration of Foreign Exchange, the Chairman of China Banking Regulatory Commission, the Chairman of China Securities Regulatory Commission, the Chairman of China Insurance Regulatory Commission, the Commissioner of National Bureau of Statistics (NBS), the President of the China Association of Banks, and experts from academia (three academic experts in the current MPC).

$(g^*_{x,t} = x^*_t - x_{t-1})$, where the superscript star denotes the targeted value.[14] The GDP growth target set by the State Council serves as a lower bound for monetary policy. When actual GDP growth in each quarter is above the target, therefore, M2 growth increases to accommodate output growth as long as inflation is not a serious threat.

The description above of China's monetary policy can be formalized as

$$(1) \qquad g_{m,t} = \gamma_0 + \gamma_m g_{m,t-1} + \gamma_\pi (\pi_{t-1} - \pi^*) + \gamma_{x,t}\left(g_{x,t-1} - g^*_{x,t-1}\right) + \varepsilon_{m,t},$$

where $\varepsilon_{m,t}$ is a serially independent random shock that has a normal distribution with mean zero and time-varying standard deviation $\sigma_{m,t}$. Every quarter, the PBC adjusts M2 growth in response to inflation and output growth in the previous quarter, a practice consistent with the PBC's decision-making process. The inflation coefficient γ_π is expected to be negative.[15] Since the GDP target serves as a lower bound, we allow the output coefficient to be time-varying with the form

$$\gamma_{x,t} = \begin{cases} \gamma_{x,a} & \text{if } g_{x,t-1} - g^*_{x,t-1} \geq 0 \\ \gamma_{x,b} & \text{if } g_{x,t-1} - g^*_{x,t-1} < 0 \end{cases}$$

where the subscript "a" stands for "above the target" and "b" for "below the target." These coefficients represent two states for policy response to output growth: the normal state when actual GDP growth meets the government's target as a lower bound, and the shortfall state when actual GDP growth falls short of the government's target. During the period when GDP growth is above the target, we expect the coefficient $\gamma_{x,a}$ to be positive. On the other hand, when actual GDP growth is below its target, we expect the coefficient $\gamma_{x,b}$ to be negative. This asymmetric response reflects the central government's determination in making economic growth an overriding priority.[16] Accordingly, the heteroskedasticity is specified as

$$\sigma_{m,t} = \begin{cases} \sigma_{m,a} & \text{if } g_{x,t-1} - g^*_{x,t-1} \geq 0 \\ \sigma_{m,b} & \text{if } g_{x,t-1} - g^*_{x,t-1} < 0 \end{cases}.$$

The sample period for estimation is from 2000:I to 2016:II. This is a period in which the PBC has made M2 growth an explicit policy target. The endogenously switching rule is estimated with the maximum likelihood approach of Hamilton (1994). Table 3 reports the results. As one can see, all the estimates are significant statistically with the p-value much less than 1 percent. The persistence coefficient for M2 growth is estimated to be 0.39 percent, implying that monetary policy is mildly inertial. When GDP growth is above the target, annualized M2 growth is estimated to rise by 0.72 percent (0.18×4) percent in support of a 1 percent annualized GDP growth rate above its target. When GDP growth falls short of the target, the estimate of $\gamma_{x,b}$ indicates that annualized M2 growth rises by 5.20 percent (0.013×4) in response to a 1 percent annualized GDP growth

[14] The variables M_t, P_t, and x_t, expressed in natural log, represent M2, CPI, and GDP. For construction of the quarterly time series of these and other variables, see Appendix B.
[15] Discussions in the MPRs indicate that the annual CPI inflation target is around 3–4 percent. We set π^* at 0.875 percent (i.e., an annualized quarterly rate of 3.5 percent).
[16] See Kahneman and Tversky (1979) and Chen, Xu, and Zha (2017) for theoretical justifications.

TABLE 3—ESTIMATED MONETARY POLICY

Coefficient	Estimate	SE	p-value
γ_m	0.391	0.101	0.000
γ_π	−0.397	0.121	0.001
$\gamma_{x,a}$	0.183	0.060	0.002
$\gamma_{x,b}$	−1.299	0.499	0.009
$\sigma_{m,a}$	0.005	0.001	0.000
$\sigma_{m,b}$	0.010	0.002	0.000

Notes: Estimated results for the endogenously switching monetary policy rule. SE stands for standard error.

rate below the target. Thus, the negative sign of $\gamma_{x,b}$ and its estimated magnitude reveal that monetary policy takes an unusually aggressive response to stem a shortfall in meeting the GDP growth target. The asymmetry in China's monetary policy is also reflected in the volatility of its policy shocks (0.005 versus 0.10). The estimate of the inflation coefficient in the monetary policy rule, which is negative and highly significant, indicates that annualized M2 growth contracts 1.6 percent (0.04×4) in response to a 1 percent increase of annualized inflation.

We test the endogenously switching policy rule, represented by equation (1), against other alternatives. One alternative is the same rule without any of the time-varying features (i.e., $\gamma_{x,t} = \gamma_x$ and $\sigma_{m,t} = \sigma_m$ for all t). The log maximum likelihood value for the constant-parameter rule is 192.42. We then allow $\gamma_{x,t}$ to depend on the two different states of the economy (the normal and shortfall states) while keeping $\sigma_{m,t} = \sigma_m$ for all t. The log maximum likelihood value for this rule is 198.49. The log maximum likelihood value for our endogenously switching rule (i.e., allowing both $\gamma_{x,t}$ and $\sigma_{m,t}$ to be time varying) is 203.78. The likelihood ratio test for a comparison between the rule with time-varying $\gamma_{x,t}$ only and the constant-parameter rule rejects the constant-parameter rule at a 0.05 percent level of statistical significance, implying that the data strongly favor the time-varying parameter $\gamma_{x,t}$. The likelihood ratio test for a comparison between the rule with both time-varying $\gamma_{x,t}$ and $\sigma_{m,t}$ and the rule with only time-varying $\gamma_{x,t}$ rejects the latter rule at a 0.11 percent level of statistical significance, implying that the data strongly favor additional time variation coming from volatility.[17] These econometric tests rationalize the statistical results of high significance reported in Table 3.

B. *Exogenous M2 Growth*

Panels C and D of Figure 2 display the decomposition of M2 growth into the endogenous component and the exogenous component according to the estimated monetary policy rule. All the series in the figure are expressed in year-over-year changes. Endogenous monetary policy tracks the series of actual M2 growth rates very closely (panel C of Figure 2). This suggests that a large fraction of the variation in M2 growth can be attributed to the systematic reaction of the policy authority to the state of the economy, which is what one would expect of endogenous monetary policy.

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[17] These two tests are supported by both the Bayesian information criterion (BIC) and the Akaike information criterion (AIC).

The series of exogenous M2 growth is the gap between actual and endogenous M2 growth rates, displayed in panel D of Figure 2. As discussed in Section IA, changes in various instruments such as the reserve requirement aim at helping achieve the intermediate target of monetary policy mandated by the State Council and thus should be encompassed by the endogenous part of monetary policy. To see whether this argument is supported by empirical evidence, we regress the endogenous M2 growth series on contemporaneous or lagged changes in the RRR. The testing hypothesis is that the coefficient of RRR changes on the right-hand side of the regression is zero. The *p*-value is 0.6 percent for the contemporaneous coefficient and 2.4 percent for the lagged coefficient. The hypothesis is thus rejected. When we regress the estimated exogenous M2 growth series on the same variables, however, we find the regression coefficients statistically insignificant: the *p*-value is 15.5 percent for the contemporaneous coefficient and 74.7 percent for the lagged coefficient. These results indicate that the estimated series of exogenous M2 growth is orthogonal to changes in the RRR and thus reflects only the outcome of open market operations.[18]

As shown in panels C and D of Figure 2, both endogenous M2 growth and exogenous monetary policy shocks have been steadily declining since 2009. After controlling for endogeneity of monetary policy, the exogenous series allows us to analyze how contractionary monetary policy caused the rise of shadow banking products off banks' balance sheets as well as the rise of risky assets on banks' balance sheets in 2009–2015.

III. Microdata of Shadow Banking Activities Off and On the Balance Sheet

While the aggregate time series on shadow banking reported in Figure 1 are informative, they do not show the degree to which commercial banks are involved in shadow banking. In this section, we provide such information by constructing two datasets at the level of individual banks. These datasets help show the level of banks' involvement in shadow banking and enable us to conduct an empirical analysis of the effects of monetary policy shocks on banks' activities in shadow banking both off and on their balance sheets.

A. *Off Balance Sheet: A Quarterly Panel Entrusted Loan Dataset*

We constructed an entrusted loan dataset that maps each loan transaction between two nonfinancial firms to a particular trustee. The trustee information is most important for this paper. During the long construction process, we manually collected all the PDF files of raw entrusted loan announcements made by firms that were publicly listed on China's stock exchanges. By definition, listed firms are those that issue A-share stocks. The Chinese laws require listed lending firms to make public announcements about each entrusted loan transaction; listed borrowing firms may choose to make announcements but are not required by law. China Securities Law Article 67, published in 2005, requires all listed firms to announce

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[18] Chen et al. (2017) document that the estimated monetary policy shocks are also orthogonal to changes in the exchange rate and net exports.

major events which may have influenced their stock prices. According to Article 2 of the Chinese Securities Regulatory Commission's "Rules for Information Disclosure by Companies Offering Securities to the Public" published in 2011, listed firms have responsibility to disclose all entrusted loan transactions. Moreover, according to two disclosure memoranda provided by the Shenzhen Stock Exchange in 2011, a listed company must disclose information of entrusted loans as long as its subsidiary firm is a lender of entrusted loans, even if the company itself is not a direct lender.

A raw announcement made for each transaction concerns either a newly originated loan or a repaid loan. Information in each raw announcement contains the names of both lender and borrower, the amount transacted, and the trustee name.[19] For each year between 2010 and 2013, we verified the number of collected raw announcements against the number published by the PBC's 2011–2014 CFSRs. (The number was always published in the next-year report and the PBC no longer published this number after 2014.) Figure 6 plots the number of announcements. One can see from the figure that the discrepancy between our data and the PBC's published data is of little importance. Although both our data source and the PBC's data source were from WIND (the data information system created by the Shanghai-based company called WIND Co. Ltd., the Chinese version of Bloomberg), at the time the PBC reported the number of announcements, some companies had not yet made announcements until a later year. These delayed announcements, included in our data collection but not in the PBC's data collection, partially explains the inconsequential discrepancy between the two datasets.

We cleaned up raw announcements by removing announcements of repayment to the existing entrusted loans as well as duplicated announcements and by correcting inaccurate reports of loan amounts (see online Appendix A for details). We call our cleaned-up announcements "announcements" to be distinguished from "raw announcements." From 2009 to 2015, the total number of announcements is 1,379. Prior to the year 2009, there are only a handful of data observations (announcements). From the announcements of entrusted lending we constructed a quarterly panel dataset that contains the total loan volume, the average loan amount, and the number of loans facilitated by each financial trustee. We have 80 individual banks and 45 nonbank trustees, a total of 125 trustees. These 80 individual banks include the 5 state banks; the rest are all nonstate banks.

B. *On the Balance Sheet: A Quarterly Panel Bank Asset Dataset*

The second dataset we manually constructed is a quarterly panel dataset of bank loans and ARIX holdings on the balance sheets of 16 publicly listed banks. There are a total of 19 banks listed in the Hong Kong, Shenzhen, or Shanghai Exchange, but only 16 of them have information about ARIX. These 16 publicly listed banks include the 5 state banks; the rest are all nonstate banks. Their assets take up, on average for 2009–2015, 81 percent of total bank assets and 83.4 percent of total bank loans in the entire banking system. Thus, these banks are representative of the Chinese banking system.

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[19] Allen et al. (forthcoming) use the annual reports of listed nonfinancial companies to gather information about entrusted lending. Most of the trustee information, however, was missing in the annual reports.
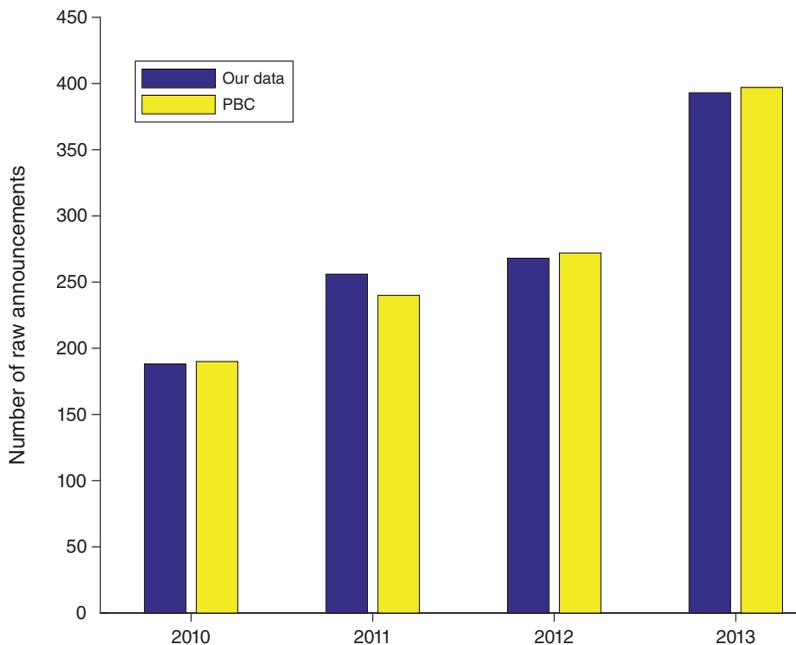
FIGURE 6. CROSS-CHECK ON THE NUMBER OF RAW ANNOUNCEMENTS OF ENTRUST LENDING

Notes: The number of raw announcements we collected is plotted against the number published by the PBC's CFSRs. There were no numbers published by the PBC in years other than 2010–2013.

Sources: PBC and WIND

We read through annual reports of these 16 publicly listed banks, collected the data on bank loans and ARI, and constructed the data on ARIX by excluding central bank bills or government bonds. The annual reports are downloadable from WIND. Our quarterly panel of entrusted loan data are bridged to the balance-sheet information from WIND. When a particular entrusted loan transaction was announced, we first identified the name of the bank and then linked the transaction to the WIND information of this bank. This allows us to compute, in Section IVD, the correlation of entrusted lending and ARIX. Bankscope provides another data source for obtaining financial information such as LDR, size, capital, liquidity, and profitability of a particular bank, but Bankscope does not have information on ARIX or bank excess reserves, which we manually collected from banks' annual reports (see online Appendix A.2 for the construction of the ARIX series).

Using these two panel datasets, we estimated panel regressions on the impact of monetary policy on both shadow banking loans and ARIX holdings. For the entrusted loan dataset, we did not run regressions on the data at the transaction level as in Jiménez et al. (2014). Since the bank asset dataset is not transaction-based, we need to run panel regressions on both datasets at the bank level in order to establish the link between the findings based on entrusted lending and ARIX. Such a link provides a perspective on the degree of how representative the estimated impact of monetary policy on shadow banking is from our entrusted loan dataset, as discussed in Section IVC.

IV. Impact of Monetary Policy on Banks' Shadow Banking Activities

In this section, we use the two sets of panel data constructed in this paper to show that state and nonstate banks behave differently in response to changes in monetary policy in their shadow banking activities. We establish first that state and nonstate banks behave differently as *passive facilitators* of entrusted loans (illustrated by the OffBS arrows in Figure 5) and then that they behave differently as *active participants* in bringing shadow banking products onto their balance sheets (illustrated by the OnBS arrow in Figure 5). We argue that these two empirical findings reinforce each other in the sense that the different behaviors between state and nonstate banks are similar whether they are off balance sheet or on the balance sheet.

A. *Banks as Passive Facilitators: Off-Balance-Sheet Activities*

With the entrusted loan dataset, we run the following panel regression:

$$(2) \quad \log \mathcal{L}_{bt} = \alpha + \alpha_g g_{t-1} + \beta_{nsb} g_{t-1} \mathcal{J}(NSB_b) + \beta_{sb} g_{t-1} \mathcal{J}(SB_b) + Control_{bt} + u_{bt},$$

where *NSB* stands for nonstate banks, *SB* stands for state banks, $\mathcal{J}(NSB_b)$ returns 1 if the trustee is a nonstate bank and 0 otherwise, and $\mathcal{J}(SB_b)$ returns 1 if the trustee is a state bank and 0 otherwise. The subscript "*bt*" stands for a particular trustee (*b*) that facilitates entrusted lending at time *t* and $\mathcal{L}_{bt}$ represents the total loan amount facilitated by trustee *b* at time *t*. The variable g_{t-1} is an annual change in the exogenous M2 supply in the previous year. The regression residual is u_{bt}. The control variables, denoted by $Control_{bt}$, include GDP_{t-1} (an annual change in GDP in the previous year), Inf_{t-1} (an annual change in the GDP deflator in the previous year), and the types of trustees ($\mathcal{J}(NSB_b)$ and $\mathcal{J}(SB_b)$). GDP and inflation variables control for other macroeconomic factors than exogenous monetary policy. Our regression results change little when the GDP deflator is replaced by the CPI. Including nonbank trustees helps obtain the accurate estimate of double interactions between monetary policy and the type of banks. The sample size for this panel regression is 583. All panel regressions in Section IV are unbalanced: for the entrusted loan dataset, a trustee may have facilitated one entrusted loan in the whole sample, or a few loans but in distant intervals separated by years; for the bank asset dataset, a handful of ARIX observations are missing in the original annual reports from 2009 to 2011.

Column 1 of Table 4 reports the estimated results of panel regression (2). The coefficient α_g reflects the impact of monetary policy on entrusted loans facilitated by nonbank trustees. The positive coefficient value indicates that the amount of entrusted lending facilitated by nonbank trustees decreases, not increases, in response to a fall in M2 growth (and the coefficient is statistically significant at a 10 percent level). This result indicates that nonbank trustees did not actively participate in entrusted loans during the period of monetary policy tightening.

The coefficient β_{sb} of the double-interaction term $g_{t-1} \mathcal{J}(SB_b)$ captures how much entrusted lending is intermediated by state banks in addition to the lending channeled by nonbank trustees when M2 growth changes. From column 1 of Table 4, one can see that this marginal effect is statistically insignificant, indicating that state

TABLE 4—ESTIMATED RESULTS FOR PANEL REGRESSIONS ON TOTAL ENTRUSTED LENDING

log of total entrusted lending:	Trustee sample (1)	Bank sample (2)	Bank sample (3)
$g_{t-1} : \alpha_g$	13.12 (7.51)	16.50 (10.14)	253.6 (85.76)
$g_{t-1} \, \mathcal{J}(NSB_b) : \beta_{nsb}$	−23.77 (7.70)	−30.46 (9.838)	−55.30 (13.49)
$g_{t-1} \, \mathcal{J}(SB_b) : \beta_{sb}$	4.306 (10.72)		
$g_{t-1} \times Liquidity$			0.51 (0.90)
$g_{t-1} \times ROA$			90.47 (30.22)
$g_{t-1} \times Size$			−18.87 (6.35)
$g_{t-1} \times Capital$			−4.17 (2.59)
$g_{t-1} \times NPL$			9.62 (14.77)
$g_{t-1} \times LDR$			−0.37 (0.590)
Observations	583	342	342
Single term controls for bank attributes	No	No	Yes
GDP, deflator controls	Yes	Yes	Yes
Impacts of money growth via state banks	17.42 (9.29)	16.50 (10.14)	37.33
Impacts of money growth via nonstate banks	−10.65 (4.39)	−14.00 (5.73)	−17.97

Notes: This table shows that nonstate banks facilitated more entrusted lending during monetary policy tightening while state banks did not. The table presents estimates from the panel regressions in which the dependent variable is the logarithm of total entrusted loan amount. Column 1 uses a total of 583 trustee-quarter observations from 2009:I to 2015:IV, including observations of entrusted loans facilitated by nonbank trustees. Columns 2 and 3 report the regression results based on a smaller sample with bank-specific attributes. The smaller sample has a total of 342 bank-quarter observations from 2009:I to 2015:IV. The bank-specific attributes include LDR, size, capital level, liquidity ratio, return on assets, and non-performance loan ratio. We also include GDP at $t-1$ (an annual change of GDP in the previous year) and Inf at $t-1$ (an annual change of the GDP deflator in the previous year) as control variables. A constant term is included but its coefficient is not reported. Standard errors are reported in parentheses.

banks' activities in facilitating entrusted loans did not increase when monetary policy tightened.

The coefficient β_{nsb} of the double-interaction term $g_{t-1} \, \mathcal{J}(NSB_b)$ captures how much entrusted lending is intermediated by nonstate banks in addition to the lending channeled by nonbank trustees when M2 growth changes. This marginal effect is estimated to be negative and the estimate is highly significant. The negative sign means that a fall in M2 growth leads to an increase, not a decrease, in entrusted lending. The estimates of overall impacts of monetary policy tightening on entrusted lending facilitated by state and nonstate banks are given at the bottom of Table 4. As one can see, the overall impact of M2 growth on entrusted lending intermediated by state banks, $\alpha_g + \beta_{sb}$, has a sign opposite to the impact on nonstate banks. Monetary policy tightening reduces entrusted lending facilitated by state banks with a decrease of 17.42 percent (at a 10 percent level of statistical significance) in response to a one-percentage-point fall in M2 growth. On the other hand, the overall

impact of M2 growth on entrusted lending intermediated by nonstate banks, $\alpha_g + \beta_{nsb}$, is large and highly significant. Indeed, the total volume of entrusted lending intermediated by nonstate banks increases by 10.65 percent (at a less than 1 percent level of statistical significance) in response to a one-percentage-point fall in M2 growth. This empirical result indicates that nonstate banks' activities in facilitating entrusted loans increased in response to contractionary monetary policy.

B. *Robustness Analysis*

In this section, we perform a robustness analysis of the previous regression results. The analysis centers on two questions. Is an increase of entrusted lending driven by an increase in the number of transactions (extensive margin) or an increase in the average loan amount (intensive margin)? And do the empirical results for nonstate banks simply reflect the effects of bank-specific attributes such as LDR, size, capital, and liquidity?

Intensive versus Extensive Margins.—The significant role played by nonstate banks in funneling entrusted loans may reflect the number of loans (extensive margin), not the average loan amount (intensive margin). A large number of loans may reflect the diversification strategy of nonstate banks, not necessarily a concentration of risk. To see whether nonstate banks' promotion of entrusted lending stems from the increasing number of loans or the increasing average loan amount, we run two additional panel regressions as

$$(3) \quad S_{bt} = \alpha + \alpha_g g_{t-1} + \beta_{nsb} g_{t-1} \mathcal{J}(NSB_b) + \beta_{sb} g_{t-1} \mathcal{J}(SB_b) + Control_{bt} + u_{bt},$$

where S_{bt} represents either the log value of the average loan amount facilitated by trustee b at time t or the number of loans facilitated by trustee b at time t.

Column 1 of Table 5 reports the regression results on the average loan amount. As one can see, the estimated values in column 1 of Table 5 are comparable to those in column 1 of Table 4. When we use the number of loans as the dependent variable in a panel regression, the estimates of α_g, β_{sb}, and β_{nsb} are all statistically insignificant (thus not reported). These results indicate that the increase of the total loan amount channeled by nonstate banks is driven by the intensive margin. There is no evidence that state banks or nonbank financial companies intermediated more entrusted lending when monetary policy tightened in terms of either the number of loans or the average loan amount.

Individual Bank Attributes.—One critical question is whether the bank variable $\mathcal{J}(NSB_b)$ is an outcome of other bank characteristics such as LDR, size, liquidity, and capital position. A significant portion of our data sample contains entrusted loans facilitated by nonbank financial trustees. Because the data on characteristics such as size and liquidity do not exist for nonbank trustees, we need to reduce our sample by selecting the data intermediated by commercial banks only. With this reduced sample (342 observations), we extend regression (2) by adding control of various bank-specific attributes as in Kashyap and Stein (2000) and Jiménez et al.

TABLE 5—ESTIMATED RESULTS FOR PANEL REGRESSIONS ON AVERAGE ENTRUSTED LENDING

log of average entrusted lending:	Trustee sample (1)	Bank sample (2)	Bank sample (3)
$g_{t-1} : \alpha_g$	13.24 (6.38)	12.95 (8.41)	175.4 (79.76)
$g_{t-1} \mathcal{J}(NSB_b) : \beta_{nsb}$	−21.80 (6.61)	−27.63 (8.12)	−34.85 (16.10)
$g_{t-1} \mathcal{J}(SB_b) : \beta_{sb}$	3.36 (9.26)		
$g_{t-1} \times Liquidity$			−0.32 (0.82)
$g_{t-1} \times ROA$			87.38 (27.25)
$g_{t-1} \times Size$			−12.98 (6.12)
$g_{t-1} \times Capital$			−6.88 (3.10)
$g_{t-1} \times NPL$			12.91 (12.42)
$g_{t-1} \times LDR$			−0.25 (0.53)
Observations	583	342	342
Single term controls for bank attributes	No	No	Yes
GDP, deflator controls	Yes	Yes	Yes
Impacts of money growth via state banks	16.60 (7.96)	12.95 (8.41)	17.75
Impacts of money growth via nonstate banks	−8.56 (4.18)	−14.68 (4.09)	−17.09

Notes: This table shows that nonstate banks facilitated more entrusted lending on average (intensive margin) during monetary policy tightening while state banks did not. The table presents estimates from the panel regressions in which the dependent variable is the logarithm of average entrusted loan amount. Column 1 uses a total of 583 trustee-quarter observations from 2009:I to 2015:IV, including observations of entrusted loans facilitated by nonbank trustees. Columns 2 and 3 report regression results based on a smaller sample with bank-specific attributes. The smaller sample has a total of 342 bank-quarter observations from 2009:I to 2015:IV. The bank-specific attributes include LDR, size, capital level, liquidity ratio, return on assets, and non-performance loan ratio. We also include GDP at $t − 1$ (an annual change in GDP in the previous year) and Inf at $t − 1$ (an annual change in the GDP deflator in the previous year) as control variables. A constant term is included but its coefficient is not reported. Standard errors are reported in parentheses.

(2014). These attributes are the LDR (China-specific), log value of total assets (size), the ratio of bank equity to total assets (capital), the ratio of liquid assets to total assets (liquidity), the ratio of total net income to total assets (ROA), and the nonperforming loan ratio (NPL). Table 6 reports the summary statistics of these bank-specific attributes. As one can see, there are considerable variations across banks for each of these attributes.

We add all these bank attributes to the existing control variables and run the following panel regression:

$$(4) \qquad \log \mathcal{L}_{bt} = \alpha + \alpha_g \, g_{t-1} + \beta_{nsb} g_{t-1} \, \mathcal{J}(NSB_b) + Control_{bt} + u_{bt},$$

TABLE 6—SUMMARY STATISTICS OF BANK-SPECIFIC ATTRIBUTES FROM 2009 TO 2015

Attribute/variable	Observations	Mean	SD	Min	Median	Max
LDR	396	69.49	7.11	47.43	71.70	85.16
Size	396	14.86	1.20	11.42	14.84	16.84
Capital	396	6.05	1.25	3.18	5.99	12.34
Liquidity	396	27.01	7.13	12.21	25.44	48.10
ROA	396	1.06	0.19	0.42	1.06	1.58
NPL	396	1.08	0.56	0.38	0.96	4.32

Note: All variables except size (log value of total assets) are expressed in percent.

Source: Bankscope

where the control variables, represented by *Control*$_{bt}$, are GDP_{t-1}, Inf_{t-1}, $\mathcal{J}(SB_b)$, $\mathcal{J}(NSB_b)$, single terms for all the bank-specific attributes listed in Table 6, and their double-interaction terms with g_{t-1}. A key question is whether the bank-type indicator $\mathcal{J}(NSB_b)$ in its double-interaction term remains statistically significant after we control for bank-specific attributes. The results are reported in column 3 of Table 4. We do not find that the LDR is an important factor in influencing entrusted loans. The bank size and ROA in the double-interaction terms are significant (column 3 of Table 4). After these bank-specific attributes are controlled for, the coefficient of the double-interaction term $g_{t-1}\mathcal{J}(NSB_b)$ remains highly significant. That is, the bank-type indicator $\mathcal{J}(NSB_b)$ does not reflect whether the bank is small or large, whether the bank's LDR is different from the LDRs of other banks, how strong the bank's capital position is, or whether the bank's other characteristics differ from those of other banks. Furthermore, the demand for entrusted loans has no bearing on whether a trustee is a state bank or a nonstate bank, ceteris paribus. As long as the borrower's loan demand is met, the borrower does not care whether the loan is facilitated by a nonbank trustee, a state bank, or a nonstate bank.

In regression (4), we calculate the overall impact of monetary policy on entrusted lending funneled by nonstate banks as the sum of α, β_{nsb}, and the coefficients of double-interaction terms related to all bank-specific attributes at the mean bank level.[20] Recall that the regression is run on a smaller sample because there are no data on the balance-sheet information of nonbank trustees. To see whether bank-specific attributes severely affect the estimated impact of monetary policy, we need to compare the results based on the same sample. For that purpose, we run regression (4) on the same reduced sample with and without bank-specific attributes to be included in the control variables. The estimated impact without any bank-specific attribute is −14.00 percent (reported at the bottom in column 2 of Table 4). With the smaller sample, the estimated impact is expected to differ from the estimate in regression (2): −10.65 percent versus −14.00 percent reported at the bottom in columns 1 and 2 of Table 4. More important is our finding that given the standard error 5.73 percent, this estimate is not statistically different from the estimated impact of monetary policy with inclusion of all bank-specific attributes as control variables (−17.97 percent reported at the bottom of column 3 in Table 4). By contrast, the

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[20]We use mean bank to indicate that the average value of each attribute across banks is used as an input for computing the overall impact of money growth when bank-specific attributes are controlled for.

estimated impact of monetary policy on total entrusted lending channeled by state banks has an opposite sign and is statistically insignificant for the smaller sample. Comparing the results for the smaller sample with and without bank-specific attributes at the bottom of columns 2 and 3 in Table 5, one can see the similar results when the average entrusted loan amount is used as the dependent variable in the panel regression. In summary, we establish robust evidence that nonstate banks facilitated more entrusted lending when monetary policy tightened while state banks did not.

Despite the statistical significance of some bank-specific attributes in double-interaction terms, these results suggest that the bank-type indicator $\mathcal{J}(NSB_b)$ in regressions without any bank-specific attribute as a control variable is a good approximation to capturing the institutional asymmetry between state and nonstate banks, not the difference in individual attributes such as LDR, size, capital position, and liquidity. In other words, the institutional asymmetry discussed in Section IC is, to a large extent, orthogonal to individual bank characteristics.

C. Banks as Active Participants: On-Balance-Sheet Activities

In the preceding two sections, we establish evidence of banks' activities as passive facilitators in channeling entrusted loans between nonfinancial firms. In this section, we obtain evidence of banks' activities as active participants in bringing shadow banking products onto their balance sheets. In the next section, we provide a general perspective of the connection among the results obtained in this and previous sections.

Using the bank asset dataset, we run the following panel regression:

$$(5) \qquad \log \mathcal{A}_{bt} = \alpha + \alpha_g g_{t-1} + \beta_{nsb} g_{t-1} \mathcal{J}(NSB_b) + Control_{bt} + \varepsilon_{bt},$$

where $\mathcal{A}_{bt}$ represents ARIX for bank b at time t and control variables, including GDP_{t-1}, Inf_{t-1}, and $\mathcal{J}(NSB_b)$, are similar to those used in previous regressions. Column 1 of Table 7 reports the estimated results without controlling for various bank-specific attributes. The impact of monetary policy on state banks' ARIX is estimated to be a 26.56 percent decrease, not an increase, in response to a one-percentage-point fall in M2 growth and the estimate is at a 5 percent level of statistical significance (bottom of column 1 in Table 7). This finding indicates that ARIX on state banks' balance sheets did not increase when monetary policy tightened. By contrast, the impact of monetary policy on nonstate banks' ARIX is estimated to be a 37.69 percent *increase* in response to a one-percentage-point fall in M2 growth, with an extremely high statistical significance. In sum, our evidence shows that nonstate banks invested in more ARIX on their balance sheet when monetary policy tightened while state banks did not.

As discussed in Section IVB, the bank-type indicator $\mathcal{J}(NSB_b)$ is a good approximation to the institutional feature of nonstate banks even when we omit individual bank attributes. To see whether this result continues to hold for the bank asset dataset, we run the same regression as (5) but add single terms of all the bank-specific attributes listed in Table 6 as well as their double-interaction terms to the existing

TABLE 7—ESTIMATED RESULTS FOR PANEL REGRESSIONS ON ARIX

log of ARIX:	Bank sample (1)	Bank sample (2)	Bank sample (3)	Bank sample (4)
$g_{t-1} : \alpha_g$	26.56	23.57	245.9	341.1
	(12.55)	(13.01)	(189.8)	(215.3)
$g_{t-1}\mathcal{J}(NSB_b) : \beta_{nsb}$	−64.26	−69.30	−108.6	−113.8
	(15.45)	(15.48)	(32.83)	(32.59)
$g_{t-1} \times Liquidity$			1.006	0.992
			(1.15)	(1.35)
$g_{t-1} \times ROA$			196.2	190.7
			(93.56)	(87.09)
$g_{t-1} \times Size$			−24.26	−27.34
			(16.60)	(18.40)
$g_{t-1} \times Capital$			−13.29	−14.73
			(12.47)	(12.89)
$g_{t-1} \times NPL$			−18.74	−29.19
			(24.62)	(21.09)
$g_{t-1} \times LDR$			0.731	0.448
			(1.37)	(1.29)
Observations	410	373	373	373
Single term controls for bank attributes	No	No	Yes	Yes
GDP, deflator controls	Yes	Yes	Yes	Yes
Impacts of money growth via state banks	26.56	23.57	66.27	70.12
	(12.55)	(13.01)		
Impacts of money growth via nonstate banks	−37.69	−45.73	−42.33	−43.68
	(9.85)	(8.89)		

Notes: This table shows that nonstate banks invested in more ARIX on their balance sheets during monetary policy tightening while state banks did not. The table presents estimates from the panel regressions in which the dependent variable is ARIX, which includes all shadow banking products on the balance sheet. The sample period is from 2009:I to 2015:IV. Column 1 uses a total of 410 bank-quarter observations from 2009:I to 2015:IV without inclusion of bank-specific attributes. Columns 2–4 report regression results based on a smaller sample with bank-specific attributes. The smaller sample has a total of 373 bank-quarter observations from 2009:I to 2015:IV. Column 3 reports the regression results with the end-of-year LDR. Column 4 reports the regression results with the average of daily LDR. We also include GDP at $t-1$ (an annual change in GDP in the previous year) and Inf at $t-1$ (an annual change in the GDP deflator in the previous year) as control variables. A constant term is included but its coefficient is not reported. Standard errors are reported in parentheses.

control variables. This exercise leads to a loss of 37 observations because the data on several bank-specific attributes in certain years are missing for some banks. When we run the same regression on this reduced sample without including any bank-specific attribute as a control variable, the estimated impact on nonstate banks' ARIX is a 45.73 percent increase in response to a one-percentage-point fall in M2 growth (bottom of column 2 of Table 7). As expected, this value is different from the estimated 37.69 percent based on the original and larger sample (bottom of column 1 of Table 7).

Column 3 of Table 7, where the end-of-year LDR is used, reports the estimated results for ARIX with bank-specific attributes as control variables. The estimated coefficients of double-interaction terms are statistically insignificant except for those involving $\mathcal{J}(NSB_b)$ and ROA. The statistical significance for the coefficient of the double-interaction term involving $\mathcal{J}(NSB_b)$ is particularly high. Taking into account all bank-specific attributes, the impact of monetary policy on nonstate banks' ARIX is estimated to be a 42.33 percent increase in response to a one-percentage-point fall in M2 growth (bottom of column 3 of Table 7). This estimate is not significantly

different from the estimated 45.73 percent (with the estimated standard error of 8.89 percent) when none of the bank-specific attributes is included as a control variable. Such a finding is similar to the result discussed in Section IVB, where the entrusted loan dataset is used.

Our estimated results hold when the end-of-year LDR is replaced by the average LDR. In regression (5) with all bank-specific attributes included as control variables, the estimated impact is -42.33 percent when the end-of-period LDR is used and -43.68 percent when the average LDR is used (bottom of columns 3 and 4 of Table 7). As for double-interaction terms, the coefficient of $g_{t-1}\mathcal{J}(NSB_b)$ is -108.58 percent when the end-of-year LDR is used and -113.84 percent when the average LDR is used instead (top of columns 3 and 4 of Table 7). The difference between the results for the end-of-year and average LDRs is inconsequential.

Because entrusted lending is part of shadow banking loans, the significance of nonstate banks' activities in shadow banking may be underestimated. To determine the degree of such an underestimation, we compare the regression results based on the entrusted loan dataset and those based on the bank asset dataset, which includes all shadow banking products brought onto the balance sheet. That is, we compare the estimated 17.97 percent (bottom of column 3 of Table 4) to the estimated 42.33 percent (bottom of column 3 of Table 7). Because the entrusted loan dataset pertains to new loans (flow) and the bank asset dataset concerns outstanding loans (stock), we convert the flow estimate 17.97 percent to its stock value as $(1 + 0.1797) \times 0.3010 = 35.51$ percent, where 30.10 percent is an average quarterly growth rate of ARIX between 2009 and 2015. Comparing the stock coefficient 35.51 percent based on the entrusted loan data to the stock estimate 42.33 percent based on the bank asset data, we conclude that although the regression results based on the entrusted loan dataset may underestimate nonstate banks' response to contractionary monetary policy in funneling shadow banking loans, the degree of underestimation may not be large, especially when one takes into account the standard error of the estimate. This conclusion also holds if we compare the regression results with the original and larger sample but without any bank-specific attribute.

The robust finding of a highly significant impact of monetary policy on nonstate banks' ARIX holdings provides an additional support for the argument that nonstate banks' activity in funneling entrusted loans when monetary policy tightens is not driven from borrowers' demand for entrusted loans. Demand itself would not explain why only nonstate banks, not state banks, would actively bring shadow banking products onto their balance sheets via ARIX. Rather, it is the *institutional asymmetry* that explains the disparate behaviors between state and nonstate banks, which persist even after we control for all individual bank attributes.

D. *The Connection between Off-Balance-Sheet and On-Balance-Sheet Activities*

The previous results from our panel regressions on both entrusted lending and ARIX are mutually consistent; together they show that nonstate banks were willing to use the ARIX category to bear a credit risk of entrusted lending as well as other shadow banking products for higher profits. Had off-balance-sheet shadow banking products never been brought onto the balance sheet in the form of ARIX, we would not have obtained these consistent results. Such consistency implies that nonstate

Table 8—Correlation between New Entrusted Loans ($\mathcal{L}$) Channeled by Banks and Changes in ARIX or the Share of ARIX in 2009–2015

Description	State banks	p-value	Nonstate banks	p-value
corr(ΔARIX, $\mathcal{L}$)	0.224	0.197	0.621	0.000
corr$\left(\frac{\text{ARIX}}{\text{ARIX}+B}, \mathcal{L}\right)$	−0.179	0.304	0.458	0.001

Note: B stands for bank loans.

Source: Our constructed microdata at the level of individual banks

banks were not only passive facilitators but also active participants in bringing off-balance-sheet shadow banking products onto the balance sheet.

To see whether an individual bank facilitated entrusted lending off balance sheet and at the same time brought these shadow banking products onto its balance sheet, we report in Table 8 the correlation of entrusted lending and ARIX by the same bank. During 2009–2015, the correlation between newly issued entrusted loans and changes in ARIX is significantly positive for nonstate banks, while the same correlation is statistically insignificant for state banks. A similar result holds for the correlation between entrusted lending and $\text{ARIX}/(\text{ARIX} + B)$, where B stands for bank loans. These correlation facts are not a mere accident; they suggest that nonstate banks had a penchant for bringing shadow banking products onto their balance sheets in the form of ARIX while state banks did not.

The correlation evidence presented in Table 8 is corroborated by the share of ARIX in total credit (the sum of ARIX holdings and bank loans on banks' balance sheets). Figure 7 shows that the share for state banks was unimportant, below 3 percent for most of the period 2009–2015. By contrast, the share of ARIX for nonstate banks increased rapidly during 2009–2015 until it reached almost 30 percent in 2015.

Since ARIX includes all possible shadow banking products brought onto the balance sheet, a key question is how important ARIX is in total bank credit. Table 9 provides more summary information about the importance of ARIX in total credit. As previously argued, state banks do not avail themselves of regulatory arbitrage to circumvent the government's regulations. As a result, the share of ARIX in total credit on their balance sheets remained at a very low level and the high seventieth percentile for the share was only 4.8 percent in 2009 and 5.3 percent in 2015. The opposite is true for nonstate banks, which rapidly brought shadow banking loans onto their balance sheets in the form of ARIX during the same period. The thirtieth percentile for their share increases from 0.5 percent in 2009 to 20.6 percent in 2015 and the seventieth percentile indicates an even higher share.

In a recent paper, Chen, He, and Liu (2017) demonstrate that as bank loans declined, local government debts that funded shadow banking products such as entrusted loans and wealth management products increased. But was this off-balance-sheet activity brought onto the balance sheet in the banking system? The consistent results based on both entrusted loan and ARIX datasets establish a positive answer to this question. In the empirical analysis presented in the following section, we treat ARIX as a whole rather than single out entrusted rights within ARIX. What matters to the effectiveness of monetary policy is ARIX, which encompasses all shadow banking products brought into the banking system.
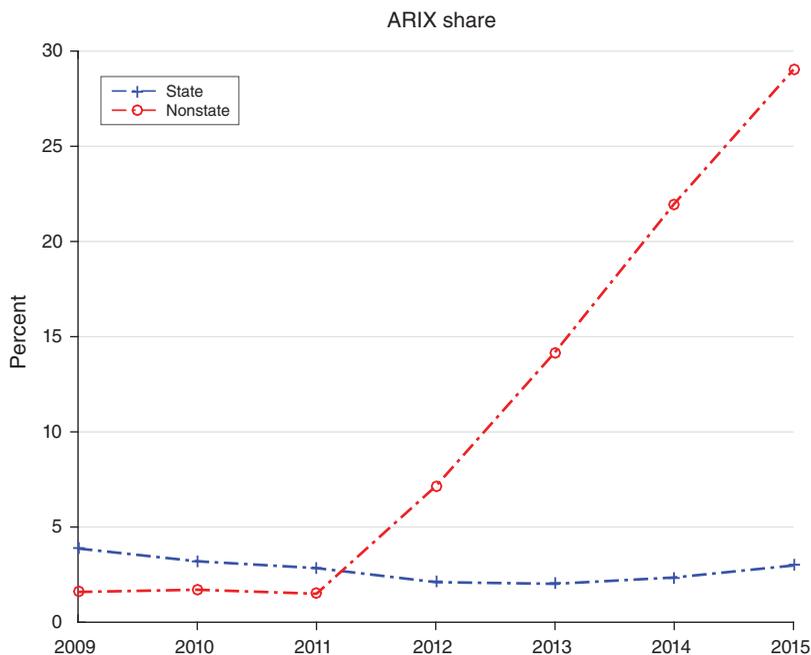
FIGURE 7. SHARE OF ARIX IN TOTAL BANK CREDIT

Notes: ARIX share is the ratio of ARIX holdings to the sum of ARIX holdings and bank loans on the balance sheets of the 16 publicly listed commercial banks. Based on the bank asset data from these individual banks, the data are categorized into state banks as one group and nonstate banks as the other group. ARIX holdings and bank loans are aggregate values for each group.

Sources: PBC and WIND

TABLE 9—ARIX SHARES IN 2009–2015 (*Percent*)

	State banks				Nonstate banks			
Year	p30	Median	Average	p70	p30	Median	Average	p70
2009	2.82	3.89	3.87	4.79	0.50	1.68	1.59	4.56
2010	1.77	3.35	3.20	4.43	0.65	1.12	1.71	6.78
2011	1.03	3.02	2.84	3.54	0.59	1.13	1.50	2.20
2012	1.78	2.00	2.10	2.27	3.35	9.25	7.14	11.37
2013	1.64	1.86	2.02	2.58	9.84	17.67	14.18	18.70
2014	1.29	1.86	2.35	4.12	17.98	20.80	21.98	25.88
2015	2.18	2.27	2.98	5.31	20.58	22.28	29.03	31.06

Note: The (weighted) average values are computed in the same way as in Figure 7. The distribution demarcations p30 and p70 stand for the thirtieth and seventieth percentiles. These percentiles, as recommended by Sims and Zha (1999), contain two thirds of the pointwise probability for the distribution of each group of banks.

Source: Data source is the same as in Figure 7.

V. The Effectiveness of Monetary Policy on the Banking System

In the preceding sections, we establish micro evidence that nonstate banks responded to monetary policy tightening first by helping increase entrusted loans as passive facilitators and then by bringing shadow banking products onto their balance sheets via investments in ARIX as active participators. While monetary policy tight-

ening is expected to reduce traditional bank loans, the impact of the rise of shadow banking loans on the effectiveness of monetary policy has been a serious concern for the Chinese government. In this section, we analyze the extent to which investments in shadow banking products in the form of ARIX reduce the effectiveness of monetary policy. We first build a theoretical model to shed light on how monetary policy shocks affect the optimal portfolio choice of nonstate banks between bank loans and investments in ARIX.[21] We then develop a panel structural VAR model with the identifying restriction justified by the theory, and estimate the dynamic impacts of changes in monetary policy on total bank credit.

A. *A Theoretical Model*

Consider an economy populated by a continuum of banks whose identity is indexed by $j \in [0, 1]$. All banks are infinitely-lived and are subject to idiosyncratic withdrawal shocks to deposits with a fraction ω_t of deposits withdrawn in the economy. We model the stochastic process of the idiosyncratic shock ω_t to be continuously distributed with the probability density function $\mathfrak{f}(\omega_t)$ that is uniformly distributed with the support of $[\mu(\varepsilon_{m,t}), 1]$, where $\mu(\varepsilon_{m,t})$ is a function of the monetary policy shock $\varepsilon_{m,t}$. The lower bound is influenced by a monetary policy shock that directly affects aggregate deposits in the economy.

We derive the functional form of $\mu(\cdot)$ to formalize Anna J. Schwartz's informative description of how monetary policy changes influence total (aggregate) deposits in the banking system.[22] We denote the deposits of bank j in period t by $D_t(j)$. The deposits of bank j after the realization of an idiosyncratic withdrawal shock to deposits, therefore, is $D_t(j)(1 - \omega_t)$.

To understand the mechanism of how changes in monetary policy influence the banking system, we first show that $\varepsilon_{m,t}$ has direct impact on aggregate deposits. Note that $\varepsilon_{m,t} = \Delta \log M_t^{exog}$, where M_t^{exog} represents the exogenous money supply. It follows that

$$\varepsilon_{m,t} = \Delta \log M_t^{exog} = \log \int_0^1 \int_{\mu(\varepsilon_{m,t})}^1 D_t(j)(1 - \omega_t) \mathfrak{f}(\omega_t) \, d\omega_t \, dj - \log \int_0^1 D_t(j) \, dj$$

$$= \log \left[\int_0^1 D_t(j) \, dj \int_{\mu(\varepsilon_{m,t})}^1 (1 - \omega_t) \mathfrak{f}_t(\omega_t) \, d\omega_t \right] - \log \int_0^1 D_t(j) \, dj$$

$$= \log \left(1 - E\left[\omega_t \mid \mu(\varepsilon_{m,t}) \right] \right)$$

$$\simeq -\left(1 + \mu(\varepsilon_{m,t}) \right)/2,$$

which leads to

$$(6) \qquad\qquad \mu(\varepsilon_{m,t}) \simeq -(2\varepsilon_{m,t} + 1).$$

Estimated annual changes of $\varepsilon_{m,t}$ (Section II) are between -0.05 and 0.05. Since the variation of $\varepsilon_{m,t}$ is small, approximation (6) is valid. It indicates that contractionary monetary policy leads to a fall of aggregate deposits by directly altering the distribution of the idiosyncratic deposit withdrawal. This result is consistent with Figure 8, in which the fall of growth in aggregate deposits after 2009 tracks the fall of M2 growth closely.

In Section II, we show that the estimated monetary policy shocks are orthogonal to changes in the reserve requirement. That is, exogenous shifts in the money supply are carried out only through open market operations. In our theoretical model, therefore, changes in $\varepsilon_{m,t}$ affect bank deposits directly through open market operations.

We now analyze how banks' portfolio allocation and total credit react to monetary policy changes via open market operations. Following Bianchi and Bigio (2017), there are two stages within each period: a lending stage and a balancing stage. To keep the notation simple, we omit the time subscript in the following description of our dynamic model.

At the very beginning of the period, the central bank conducts its contractionary monetary policy (i.e., ε_m falls) through open market operations by selling central bank bills to the primary dealer, while making short-term liquidity loans (within the period) to the primary dealer with an amount equal to the increase of central bank bills.[23] Diagram I illustrates how such open market operations change the T-accounts of both central bank and primary dealer at the lending stage.[24]

Diagram I: Lending Stage

Central Bank (CB)		Primary Dealer (PD)	
Loans to PD ↗	CB Bills ↗	CB Bills ↗	CB Loans ↗
	Cash	Deposits at Banks	

At this stage, the bank observes the open market operations initiated by the central bank and anticipates a higher risk of deposit withdrawal from the primary dealer (i.e., an increase of $\mu(\varepsilon_{m,t})$). The bank then decides the amount of deposits to demand (D), how much of the dividend to distribute (DIV), and how to allocate three types of assets for investment: intertemporal bank loans (B), within-period risky nonloan assets (I^r), which are in the form of ARIX in reality, and cash

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[23] For a description of open market operations through primary dealers who have depository accounts in commercial banks, see also the Federal Reserve Bank of New York website: https://www.newyorkfed.org/aboutthefed/fedpoint/fed32.html.

[24] In addition to central bank bills, China's central bank also sells and purchases government bonds as in many other countries. In that case, government bonds appear on the asset side of the central bank's balance sheet in lieu of central bank bills on the liability side. The balance sheet of the primary dealer remains the same except central bank bills are now replaced by government bonds.
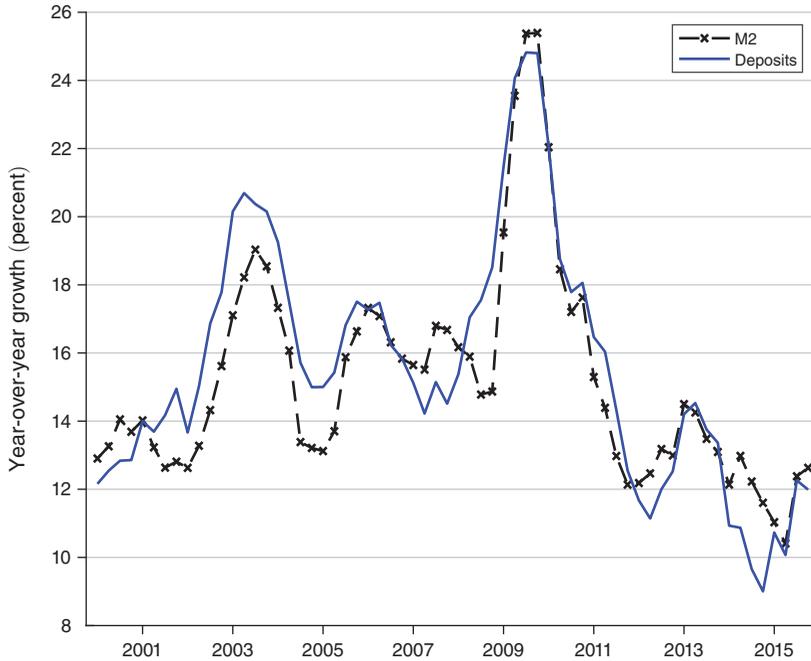
FIGURE 8. QUARTERLY TIME SERIES OF M2 GROWTH (*Year-over-Year*) AND GROWTH OF BANK DEPOSITS (*Year-over-Year*)

Sources: PBC and CEIC

(C).[25] Bank loans are safe (default free) but subject to the regulatory constraint on the LDR, and are purchased at a discount price $0 < q < 1$. By contrast, risky nonloan assets are not subject to the LDR constraint, but to a default risk. They are purchased at a discount price $0 < q^r < 1$.

In the balancing stage, two random events occur: an idiosyncratic withdrawal shock (ω) to deposits and a default shock (ξ) to risky nonloan assets. At this stage, the primary dealer pays off central bank loans by withdrawing deposits from commercial banks. This action of primary dealers affects the T-accounts as shown in Diagram II and forms idiosyncratic withdrawal shocks from the perspective of individual banks.

Diagram II: Balancing Stage

Central Bank (CB)		Primary Dealer (PD)	
Loans to PD ↘	CB Bills	CB Bills	CB Loans ↘
	Cash ↘	Deposits at Banks ↘	
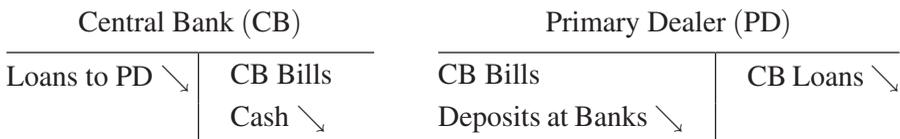
[25] To keep our model tractable and clear, we abstract from other considerations such as bank reserves. Reserves play a similar role to cash in our model. For an extensive analysis on reserves and other issues, see Bianchi and Bigio (2017).

When the withdrawal shock ω to deposits is realized, the volume of bank loans is constrained by the LDR regulation as

$$qB \leq \theta \frac{(1-\omega)D}{R^D},$$

where θ is the LDR ceiling set by the government[26] and R^D is the interest rate of deposits. When deposits are short of what is required by the LDR regulation, the bank incurs an extra cost to recoup the deposit shortfall (the last-minute rush discussed in Section IA). Denote the deposit shortfall by

$$(7) \qquad\qquad x = qB - \theta \frac{(1-\omega)D}{R^D}$$

and the extra cost to recoup the shortfall by

$$\chi(x) = \begin{cases} r^b x & \text{if } x \geq 0 \\ 0 & \text{if } x < 0 \end{cases},$$

where $r^b > 0$ is a cost of acquiring additional deposits.

The second random event represented by default shocks has the binary stochastic process as

$$\xi = \begin{cases} 1 & \text{with probability } 1 - p^r \text{ (the no-default state)} \\ \phi & \text{with probability } p^r \text{ (the default state)} \end{cases},$$

where $0 \leq \phi < 1$ represents the recovering rate of risky nonloan assets in the default state. When the default on I^r does not occur (the no-default state), the bank's liability is reduced by I^r at the end of the period because of repayment of the principal of risky nonloan assets. If I^r is defaulted (the default state), the bank's equity is reduced by $(1-\phi)I^r$ at the end of the period.

At the end of each period (the beginning of the next period), all the stock variables are determined as

$$(8) \qquad\qquad \tilde{D}' = D(1-\omega) + \chi(x) - \xi R^{D'} I^r,$$

$$(9) \qquad\qquad \tilde{C}' = C - \omega D,$$

$$(10) \qquad\qquad \tilde{B}' = B,$$

where $\tilde{C}, \tilde{B}$, and $\tilde{D}$ denote these variables at the beginning of the period and the superscript prime denotes the beginning of the next period (or the end of the period).

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[26] The LDR is the key ingredient of both our model and Hachem and Song (2016). Hachem and Song (2016) argue that a tightening in the LDR regulation (isomorphic to a decrease in θ in our model) is the key to increasing shadow banking loans. In our model, we fix the value of θ and focus on monetary policy and changes in deposits because evidence shows that a decrease in M2 growth leads to a decrease in deposits.

When there is a liquidity shortfall ($C < \omega D$) due to a deposit withdrawal, the bank can borrow from the central bank to satisfy depositors' withdrawal needs and repay the loan at the beginning of the next period.[27] Accordingly, $\tilde{C}'$ corresponds to the net balance with the central bank. A negative value of $\tilde{C}'$ simply means net borrowing from the central bank. We summarize the time line of events within each period in Diagram III.

Diagram III: Time Line within Each Period

Lending stage		Balancing stage	
OMOs Aggregate shock $\varepsilon_m, \mu(\varepsilon_m)$	Portfolio choice DIV, C, B, I^r, D	Idiosyncratic shocks ω, ξ	Recoup deposit shortfall $\chi(x)$
Beginning of each period (C, B, D)			End of each period (C', B', D')
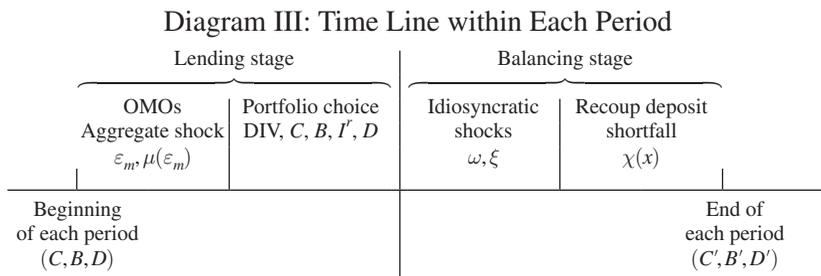
The bank's optimization problem in the lending stage can thus be summarized as

$$(11) \qquad V^l\big(\tilde{C}, \tilde{B}, \tilde{D}; \varepsilon_m\big) = \max U(\mathrm{DIV}) + E_{\omega, \xi}\big[V^b(C, B, D; \varepsilon_m)\big],$$

where V^l denotes the value function at the lending stage, V^b denotes the value function at the balancing stage (described later), $U(\cdot)$ is the bank's utility function, and $E_{\omega, \xi}$ is the mathematical expectation with respect to the (ω, ξ) measure. Expectation with respect to ω is governed by the distribution of deposit withdrawal shocks, which is in turn influenced by monetary policy shocks (i.e., $\mu(\varepsilon_m)$). The bank takes $\{\varepsilon_m, \mu, r^b, q, q^r, R^D\}$ as given when solving its problem. By choosing $(\mathrm{DIV}, \varphi, S, I^r, D)$, the bank solves problem (11) subject to

$$(12) \qquad \underbrace{D/R^D - \tilde{D}}_{\Delta \text{deposits}} + \underbrace{(1 - q^r)I^r + (1 - q)S - \mathrm{DIV}}_{\Delta \text{equity}} = \underbrace{\varphi + I^r + \big(B - \tilde{B}\big)}_{\Delta \text{assets}},$$

$$(13) \qquad D/R^D \leq \kappa \underbrace{\big[C + q^r I^r + qB - D/R^D\big]}_{\text{ex-dividend equity}},$$

$$(14) \qquad C \geq \psi \underbrace{\big[C + q^r I^r + qB - D/R^D\big]}_{\text{ex-dividend equity}},$$

$$(15) \qquad C = \tilde{C} + \varphi,$$

$$(16) \qquad B = \delta\tilde{B} + S,$$

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[27] A major task of the PBC is to maintain the stability of liquidity within the banking system to prevent default. For instance, the PBC provides short-term liquidity to the bank in need of liquidity via central bank liquidity loans or the standing lending facility. On the bank's balance sheet, this short-term liquidity is termed "Liability to Central Bank." The practice of these policy instruments is documented in the PBC's quarterly MPRs.

where φ represents additional cash holdings chosen by the bank, $(1 - \delta)\tilde{B}$ represents a fraction of loans that are retired, and S represents new bank loans. Equation (12) is the bank's flow-of-funds constraint. Equation (13) represents the leverage constraint on the bank, where κ is the leverage ratio and the term in brackets after κ represents the equity net of the dividend payout. Equation (14) is the liquidity constraint on the bank, which serves as a proxy for a regulation on the sufficiency of the bank's liquid assets. The liquidity ratio is denoted by ψ. Equations (15) and (16) are the laws of motion for cash and bank loans in the lending stage.

The bank's behavior in the balancing stage can be described as

$$V^b(C, B, D; \varepsilon_m) = \beta E_m\left[V^l(\tilde{C}', \tilde{B}', \tilde{D}'; \varepsilon_m') \mid \varepsilon_m\right]$$

subject to equations (7), (8), (9), and (10), where β is a subjective discount factor and E_m represents the mathematical expectation with respect to monetary policy shocks. The solution to the bank's optimization is fully derived in online Appendix B. In particular, Proposition B3 in the Appendix shows that the bank chooses between bank loans and risky assets according to the no-arbitrage asset pricing condition that equates the effective return of bank loans and the expected return of risky nonloan assets adjusted for the default premium. The returns of bank loans and risky nonloan assets are

$$R^B = \frac{q'\delta + 1 - \delta}{q}, \quad R^I = \frac{\xi R^D}{q^r}.$$

The effective return of bank loans is R^B net of expected regulation cost and regulation risk premium (defined in online Appendix B). As shown in online Appendix B.5, when monetary policy tightens, the bank, in anticipation of a higher probability of deposit shortfalls in the future, optimally adjusts its portfolio by decreasing traditional bank loans ($B\searrow$) and increasing risky nonloan assets ($I^r\nearrow$). Bank loans decline because monetary policy tightening increases the risk of deposit withdrawal and thus the expected cost for the bank to recoup a deposit shortfall. As a result, the effective return of bank loans declines. Because I^r is not subject to the LDR and safe-loan regulations, it is optimal for the bank to raise I^r as an effective way to circumvent these regulations.

Not only does a contractionary monetary policy shock shift the bank's portfolio toward risky nonloan assets, but also it exerts a dynamic impact on total bank credit, measured as the sum of bank loans and risky nonloan assets. Proposition B4 in the online Appendix shows that a contractionary monetary policy increases the total bank credit when the risk aversion parameter in the bank's utility function ($U(\text{DIV})$) is greater than 1. An increase in the expected regulation cost reduces the return of the bank equity, which generates two opposing effects. The first is an income effect under which the dividend declines and thus the ex-dividend equity increases. The second is a substitution effect (the substitution between today's and tomorrow's dividend payoffs), which reduces the bank's incentive to save. When the income effect dominates the substitution effect, it is optimal for the bank to expand the total credit through an increase in risky nonloan assets to compensate for the extra cost of recouping deposit losses.

This intuitive result can be readily seen from the following balance-sheet equation (derived from equations (12), (15), and (16)):

$$(17) \qquad D/R^D + \mathcal{E} - \text{DIV} = C + q^r I^r + qB,$$

where the bank's equity at the beginning of each period is

$$\mathcal{E} = \tilde{C} + q\delta\tilde{B} - \left(\tilde{D} - (1-\delta)\tilde{B}\right).$$

One can see from equation (17) that the ex-dividend equity $(\mathcal{E} - \text{DIV})$ and thus the total liability (the right-hand side of (17)) rises as the dividend (DIV) falls. This result relies on the fact that both the leverage constraint (13) and the liquidity constraint (14) are always binding under the assumption $R^D < R^B - r^b$ (Proposition B3 in the online Appendix). The low borrowing cost is a unique Chinese institutional fact that the deposit rate imposed by the government is kept artificially low. The increase of the total liability on the bank's balance sheet, together with the decline in bank loans in response to monetary policy tightening, implies that risky assets $(q^r I^r)$ must increase by more than the fall of bank loans (qB).

B. *Evidence from a Panel Structural VAR*

Our theoretical analysis suggests that monetary policy tightening should reduce bank loans but increase risky nonloan assets. This effect hampers the intended impact of monetary policy. In this section, we provide VAR evidence of the effectiveness of monetary policy on the banking system during the shadow banking boom. Specifically, we extend the Romer and Romer (2004) methodology and develop a dynamic panel model that is estimated using our constructed bank asset dataset.

The dynamic quarterly panel model is of simultaneous-equation form as

$$(18) \quad A_0^b \begin{bmatrix} \Delta B_{bt} \\ \Delta ARIX_{bt} \end{bmatrix} = c^b + \sum_{k=1}^{\ell} A_k^b \begin{bmatrix} \Delta B_{bt-k} \\ \Delta ARIX_{bt-k} \end{bmatrix} + \begin{bmatrix} \sum_{k=0}^{\ell} c_k^b \varepsilon_{m,t-k} \\ 0 \end{bmatrix} + \eta_{bt},$$

where the subscript b represents an individual bank, B_{bt} represents bank loans made by bank b at time t, $ARIX_{bt}$ is accumulated by bank b at time t, η_{bt} is a vector of i.i.d. disturbances that capture other shocks than monetary policy shocks, ℓ is the lag length set to 4 (one year), and for $k = 0, \ldots, \ell$,

$$c^b, c_k^b, A_k^b = \begin{cases} c^{nsb}, c_k^{nsb}, A_k^{nsb}, & \text{if bank } b \text{ is a nonstate bank} \\ c^{sb}, c_k^{sb}, A_k^{sb}, & \text{if bank } b \text{ is a state bank} \end{cases}.$$

Both ΔB_{bt} and $\Delta ARIX_{bt}$ are scaled by nominal GDP to keep the panel VAR stationary. The lagged variables ΔB_{bt-k} and $\Delta ARIX_{bt-k}$ on the right hand side of the panel equations are used to capture changes of B_{bt} and $ARIX_{bt}$ influenced by different maturities at which some bank assets are retired. After controlling for these lagged variables, the dynamic impact of $\varepsilon_{m,t}$ reflects the effect only on new loans and new investment. Both contemporaneous and lagged changes of exogenous M2 growth

are included in the panel VAR. Because of missing data on ARIX in earlier years, the sample period for panel estimation is from 2011:I to 2015:IV.

The identification of equations in panel structural VAR (18) is achieved as follows. The first equation captures the direct effects of exogenous changes in M2 growth on bank loans; the second equation, excluding all monetary policy shocks, reflects the indirect effects on both types of assets. This identifying restriction is justified by our theory in which monetary policy shocks directly affect bank loans via the LDR regulation, while indirectly influencing risky nonloan assets only through the no-arbitrage asset pricing equation. A combination of direct and indirect effects leads to the simultaneous portfolio adjustment between the two types of assets and generates the overall equilibrium effect of monetary policy on these assets. Unlike the existing literature, we impose no restriction on A_0^b. That is, there are no strong and controversial assumptions such as a Cholesky ordering of A_0^b.

Because of the simultaneity in the dynamic panel system, a key question is whether the dynamic responses of B_{bt} and $ARIX_{bt}$ in response to $\varepsilon_{m,t}$ are uniquely determined. Since $\varepsilon_{m,t-k}$ for $k = 0, \ldots, \ell$ enters the first equation but not the second equation and because $\varepsilon_{m,t-k}$ is exogenously given, the dynamic system represented by (18) is globally identified according to Theorem 1 of Rubio-Ramírez, Waggoner, and Zha (2010). In other words, conditional on the observed bank asset data of B_{bt} and $ARIX_{bt}$, all the coefficients c^b and A_k^b ($b = nsb, sb$ and $k = 0, \ldots, \ell$) are uniquely determined by the maximum likelihood estimation, which can be executed equation by equation (Waggoner and Zha 2003).

Given the estimated coefficients, the next step is to calculate the dynamic responses of B_{bt} and $ARIX_{bt}$ in response to $\varepsilon_{m,t}$. As an illustration, we consider the following simple one-variable process:

$$\Delta x_t = a_0 + \sum_{k=1}^{\ell} b_k \Delta x_{t-k} + \sum_{k=0}^{\ell} c_k \varepsilon_{m,t-k} + \eta_t.$$

For this simple example, the dynamic responses of x_{t+h} for $h = 0, 1, 2, \ldots$ to a one-standard-deviation unit of $\varepsilon_{m,t}$ can be calculated as

- x_t ($h = 0$): c_0;
- x_{t+1} ($h = 1$): $c_1 + b_1 c_0 + c_0$;
- x_{t+2} ($h = 2$): $c_2 + b_2 c_0 + b_1 (c_1 + b_1 c_0) + c_1 + b_1 c_0 + c_0$.

Although the complete formula for the dynamic responses to $\varepsilon_{m,t}$ in the dynamic panel system is much more involved, the calculation is similar to this simple example.

The coefficients in system (18) have two different values, depending on whether the bank is state owned. Allowing for different values captures the institutional asymmetry between state and nonstate banks as well as other potential differences between these two groups of banks. Given this panel structure, the estimated dynamic responses of ARIX and bank loans for all banks (the banking system) to a one-standard-deviation fall in M2 growth are a simple sum of the dynamic responses for each group of banks. The responses are plotted in Figure 9. Bank loans steadily decline in response to contractionary monetary policy as expected. ARIX holdings, however, respond in an opposite direction, increasing and reaching the peak at
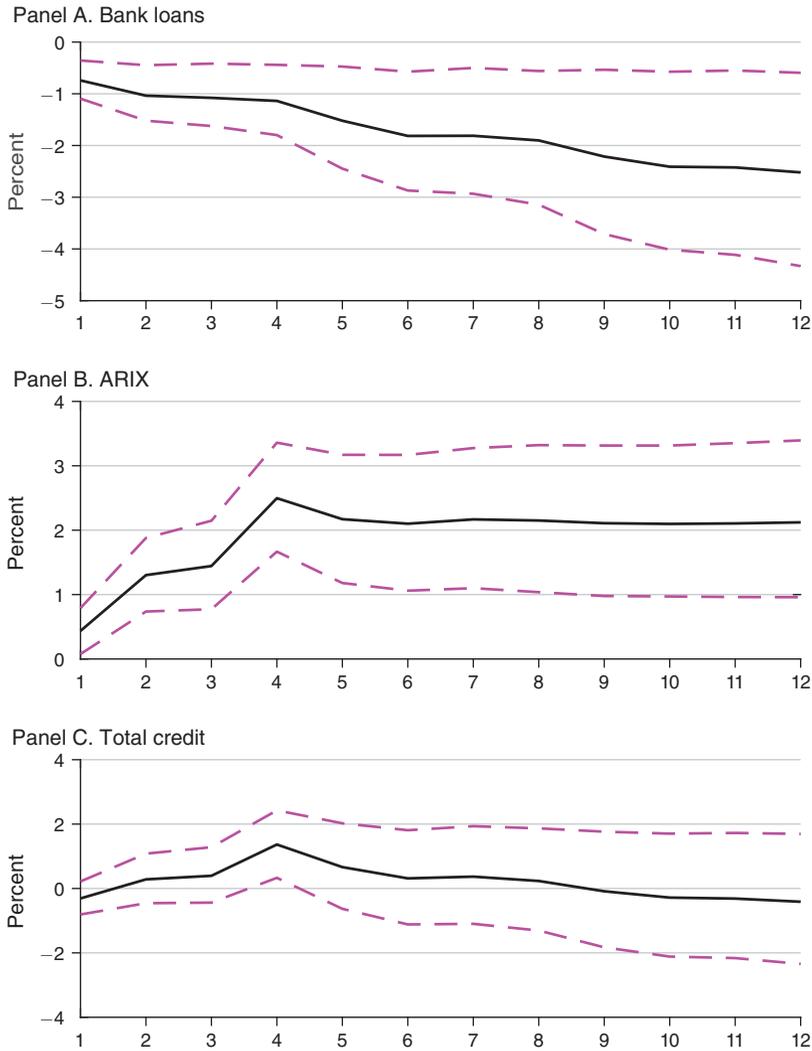
Panel A. Bank loans

Panel B. ARIX

Panel C. Total credit

FIGURE 9. ESTIMATED QUARTERLY DYNAMIC RESPONSES TO A ONE-STANDARD-DEVIATION FALL
OF EXOGENOUS M2 GROWTH

Notes: The estimation is based on our constructed banking data. Solid lines are the estimates and dashed lines represent the 0.68 probability bands as advocated by Sims and Zha (1999).

2.5 percent at the fourth quarter. The response of nonstate banks contributes to most of the rise in ARIX. According to the error bands displayed in Figure 9, estimates of the aggregate dynamic responses are statistically significant. As a result, the total credit in the banking system (bank loans and ARIX holdings combined) increases steadily over time for the first year with the estimated increase marginally significant above zero at the fourth quarter (judged by the error bands). Afterward, the response of the total bank credit becomes statistically insignificant. From the central bank's viewpoint, the effect of contractionary monetary policy on the banking system is ineffective because the responses of ARIX holdings offset those of bank

loans. These empirical findings are consistent with our simulated impulse responses presented in online Appendix C.

Given the existing quantity-based monetary policy in China, what regulatory remedy would make monetary policy more effective? The difficulty in dealing with ARIX is that the degree of its risk is largely unknown partly because the detailed assets contained in the ARIX category are murky and partly because the extent to which ARIX is implicitly guaranteed by the government is unknown. The lack of precise knowledge about risk factors within ARIX and the unknown degree of implicit guarantee make it difficult, if not impossible, to make necessary risk adjustments to capital adequacy related to ARIX. The CBRC recognizes this difficulty and has begun to impose a direct restriction on growth of the total credit by requiring it to be in line with M2 growth targeted by the PBC.[28]

In light of our panel VAR results, such a regulatory change is moving in the right direction to improve the effectiveness of monetary policy on the banking system. The quantity-based monetary policy works through the bank lending channel to influence the total bank credit. This system was set up long before shadow banking became popular. But the rise of ARIX allowed banks to bypass the LDR and safe-loan regulations by promoting shadow banking activities on the balance sheet. Consequently, it marginalized the effectiveness of monetary policy tightening on total bank credit.

Alternative and comprehensive reforms would require simultaneous changes in monetary and regulatory policies: moving the monetary policy system toward using some policy interest rate as the intermediate target of monetary policy, removing the LDR regulation in its entirety, and strengthening the criterion of capital adequacy requirements by appropriately adjusting the risk associated with the detailed assets within the ARIX category. The central government is moving gradually toward these reforms, but their speed and success depend on how the government will address much broader issues such as liberalizing financial markets and restructuring government-protected industries with excess capacity, a topic that merits thorough and separate research in the future.

VI. Conclusion

The rapid rise of shadow banking induced incentives for China's banking sector to bring the shadow banking risk onto its balance sheet. In this paper, we establish empirical evidence that contractionary monetary policy during 2009–2015 caused the rise of both shadow banking lending off balance sheet and risky assets in the form of ARIX in the banking system. Grounded in China's institutional facts, we estimate the tractable monetary policy rule and obtain a time series of monetary policy shocks. This time series, together with the two micro banking datasets we constructed, enables us to perform robust analyses on our findings, especially about the role nonstate banks played in shadow banking activities both off and on the

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[28] Since late 2015, the government has gradually enforced stricter guidelines to restrict fast growing off-balance-sheet products that eventually showed up in the ARIX category of nonstate banks. At the beginning of 2016, for example, the government incorporated the so-called Macro Prudential Assessment System, which requires that the "broad credit" growth rate should not deviate from the targeted growth rate of M2 by more than 22 percent.

balance sheet. Our theory shows that while contractionary monetary policy reduces bank loans as expected, it simultaneously encourages nonstate banks to increase investments in risky nonloan assets to circumvent the LDR and safe-loan regulations to which bank loans are subject.

Our research focuses on the banking sector: how monetary policy affects the asset side of banks' balance sheets. It abstracts from other important issues. One issue is how the bank lending channel is transmitted into the real economy. It is possible that the transmission mechanism for bank loans differs materially from transmission for ARIX holdings. The importance of this topic merits future research.

Another issue relates to policy reforms. In a recent paper, Brunnermeier, Sockin, and Xiong (2017) provide a discussion on how financing flexibility may erode the effectiveness of the government's well-intended policies. In particular, they argue that China's liberalized financial system, by loosening financial regulations on the shadow banking system, does not allow its government to experiment with a temporary stimulus such as the post-2008 stimulus program, that can be easily reversed afterward. Our paper provides strong empirical support for their argument and is consistent with calls for establishing a macroprudential framework to coordinate with monetary policy while financial markets are liberalized. Although our empirical findings are specific to China, we hope that their broad policy implications as well as our empirical methodology for analyzing the banking data will be useful for studies on other economies.

Appendix A. Conventional Monetary Policy Rule Specifications

In this section, we show that mechanically applying various policy rules in the existing literature without taking into account China's institutional facts leads to weak or misleading results. We start with the conventional money growth rule and end with the standard interest rate rule using various market interest rates in China.

A. *Conventional Money Growth Rules*

The existing Taylor-type rules in the dynamic stochastic general equilibrium (DSGE) literature, whether money growth or the interest rate is used as a monetary policy variable, require one to specify potential GDP or output. As discussed in Section IIA, there is no applicable concept of potential GDP for emerging-market economies like China. Nonetheless, if one wishes to estimate conventional monetary policy rules mechanically with the Chinese data, one could obtain the potential GDP labeled as $\bar{x}_t$ or the corresponding growth rate $\bar{g}_{x,t}$ using either the HP filtered series with the smoothing parameter set at 1,600 for the quarterly series or the fitted log-linear trend. In the spirit of Sargent and Surico (2011), we estimate the following conventional monetary policy rule using "output gap" constructed from one of the these detrended series:

$$(A1) \quad g_{m,t} = \gamma_0 + \gamma_m g_{m,t-1} + \gamma_\pi(\pi_{t-1} - \pi^*) + \gamma_x(g_{x,t-1} - \bar{g}_{x,t-1}) + \sigma_m \varepsilon_{m,t}.$$

TABLE A1—ESTIMATION OF CONVENTIONAL MONETARY POLICY RULES FOR M2 GROWTH

Coefficient	HP filtered			log-linear detrended			$\overline{g}_{x,t} = g_{x,t}^*$		
	Estimate	SE	p-value	Estimate	SE	p-value	Estimate	SE	p-value
γ_m	0.607	0.095	0.000	0.514	0.096	0.000	0.569	0.097	0.000
γ_π	−0.551	0.191	0.005	−0.629	0.155	0.000	−0.555	0.165	0.001
γ_x	0.132	0.142	0.357	0.085	0.032	0.009	0.094	0.065	0.156

Note: SE stands for standard error.

For comparison, the inflation and output growth variables on the right-hand side are lagged one period to be consistent with the timing of practical monetary policy actions represented by equation (1).

The left and middle panels of Table A1 report the regression results. As one can see, the estimated coefficient of "output gap" is statistically insignificant for the HP filtered approach or carries a wrong sign for the log-linear detrending method. The positive sign of output coefficient implies destabilizing monetary policy; that is, when output growth is below the potential, monetary policy contracts instead of expanding to stabilize the macroeconomy. These results confirm our argument that the standard concept of output gap is inappropriate for understanding China's monetary policy.[29]

We also estimate the conventional monetary policy rule represented by (A1) by setting $\overline{g}_{x,t} = g_{x,t}^*$. The estimates are reported in the right panel of Table A1. As one can see in the table, their magnitude is remarkably similar to that when potential GDP is approximated by either HP filter or log-linear trend. What is common across the three cases (HP filter, log-linear trend, and $\overline{g}_{x,t} = g_{x,t}^*$) is that monetary policy is strongly anti-inflation. But the output coefficient for the $\overline{g}_{x,t} = g_{x,t}^*$ case has a wrong sign and is statistically insignificant.

B. *The Interest Rate Rule*

Another conventional specification for monetary policy is the widely-used empirical Taylor rule for many developed economies as described in Rotemberg and Woodford (1997):

$$(A2) \qquad R_t = \alpha_0 + \alpha_R R_{t-1} + \alpha_\pi(\pi_t - \pi^*) + \alpha_x(x_t - \overline{x}_t) + \varepsilon_{R,t},$$

where R_t is the (net) nominal interest rate. Table A2 reports the estimated results with various short-term market interest rates, where potential GDP $\overline{x}_t$ is the HP-filtered series. As one can see, although the persistence parameter α_R is statistically significant, α_π is statistically insignificant at a 10 percent level for all four cases while α_x is statistically significant only at a 10 percent level for three out of four interest rates. These results imply that monetary policy does not care at all about inflation pressures, contradictory to the MPRs (the central bank's own reports). Worse than

[29] In a recent paper, Li and Liu (2017) do not use potential output but instead use long-run output growth in their money growth rule. All coefficients in that rule are statistically insignificant, supporting our argument that researchers should not ignore China's institutional facts when estimating China's monetary system.

TABLE A2—ESTIMATION OF THE WIDELY-USED TAYLOR RULE

Coefficient	1-day Repo			7-day Repo		
	Estimate	SE	*p*-value	Estimate	SE	*p*-value
α_R	0.706	0.078	0.000	0.770	0.063	0.000
α_π	0.007	0.103	0.948	0.144	0.098	0.144
α_x	0.139	0.078	0.079	0.147	0.076	0.057
	1-day Chibor			7-day Chibor		
	Estimate	SE	*p*-value	Estimate	SE	*p*-value
α_R	0.707	0.078	0.000	0.779	0.063	0.000
α_π	−0.010	0.101	0.919	0.149	0.096	0.123
α_x	0.132	0.076	0.085	0.117	0.074	0.119

Note: SE stands for standard error.

this implication, these results are unstable as they are sensitive to how potential output is computed. When log-linear trend is applied to output as potential GDP and the 7-day repo rate is used, for example, the output coefficient becomes statistically insignificant at a 49 percent significance level but the inflation coefficient is now significant at a 1.6 percent significance level. When lagged output gap and inflation are used as regressors instead of the contemporaneous counterparts, α_π is often statistically significant at a 1 percent significance level but α_x is statistically insignificant even at a 10 percent significance level, a result similar to the conventional monetary policy rules for M2 growth. Clearly, the results for the interest rate rule vary widely, depending on which interest rate, which potential output, or which variable (lagged or contemporaneous) is used.

Such unstable and contradictory results are unsurprising; they support the argument that Chinese financial markets are yet to be fully developed and that the standard interest rate rule may be incompatible with the central government's ultimate target of *real GDP growth*. This target is achieved by carefully planning M2 growth to support the central government's strategy of promoting economic growth by allocating medium and long term bank credit to investment. The standard interest rate rule represented by equation (A2) does not take into account these key institutional facts.

APPENDIX B. QUARTERLY TIME SERIES DATA

The methodology of collecting and constructing the quarterly data series used in this paper is based on Higgins and Zha (2015) and Chang et al. (2016). The main data sources are China National Bureau of Statistics, People's Bank of China, CEIC, Bankscope, and WIND. The X11 method is used for seasonal adjustments. We do not use the X12 software package because there are no independent regressors used to seasonally adjust our quarterly data.[30] All series bar interest and exchange rates

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[30] For monthly series, one should use the X12 package by incorporating independent regressors to account for the Chinese New Year effect that may cause problems for data in January and February. The Census Bureau's X13

are seasonally adjusted. All interpolated series are based on the method of Fernandez (1981), as described in Higgins and Zha (2015).

- **Aggregate Bank Loans:** Quarterly series of bank loans aggregated from all commercial banks within the banking system.
- **ARI:** Quarterly series of account receivable investment (ARI) on the asset side of an individual bank's balance sheet. The series is based on WIND, which collects the ARI series from quarterly reports of 16 publicly listed commercial banks. See online Appendix A.2 for details.
- **ARIX:** Quarterly series of ARI excluding central bank bills and government bonds. See online Appendix A.2 for details.
- **Bank Loans:** Quarterly series of bank loans for each individual bank. The series is based on WIND, which collects the bank loan information from quarterly reports of 16 publicly listed commercial banks. See online Appendix A.2 for details.
- **Chibor Rates:** The 1-day and 7-day China interbank offered rates, quarterly average.
- **CPI:** Consumer price index monitored by the central government of China.
- **Deposits:** Deposits in the banking system (RMB billion), quarterly average of monthly deposit series. The monthly series is constructed based on CEIC ticker CKSAB and CEIC ticker CKAAAB.
- **Entrusted Loans:** Quarterly series of entrusted loans facilitated by an individual trustee, constructed from the transaction-based data from announcements of entrusted loans. See online Appendix A.1 for details.
- **ERR:** Excess reserves ratio computed as TRR–RRR.
- **GDP:** Real GDP by value added (billions of 2008 RMB).
- **GDP Growth Target**: Real GDP growth target set by the central government of China.
- **M2:** M2 supply (RMB billion), quarterly average of monthly M2 series.
- **Repo Rate:** The 7-day market rate for national interbank bond repurchases, quarterly average.
- **RRR:** Required reserve ratio based on CEIC ticker CMDAAJM "CN: Required Reserve Ratio." The original CEIC series is available daily; it is converted to a monthly average and then an average of the three months. Daily series starts in September 2003. The values prior to 2003:IV are constructed as follows. We first average the contemporaneous and end-of-month values of CEIC ticker CMAAAA "CN: Required Reserve Ratio" and then take an average of these monthly values within the quarter.
- **TRR:** Total reserve ratio computed as the ratio of total reserved divided by total deposits.

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program removes outliers before seasonal adjustments using TRAMO/SEATS software from the Bank of Spain. For this paper, the quarterly series since 2000 does not appear to have serious outliers.

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