What They Do In The Shadows: Chinese Shadow Credit Growth and Monetary Policy

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Abstract

This paper evaluates the effect of Chinese monetary policy shocks on credit creation through the shadow banking sector in mainland China. I identify monetary policy shocks by constructing a measure of monetary policy surprises based on changes to the 1-Year Interest Rate Swaps on the 7-Day Repo Rate on monetary policy announcement dates. A two-stage local projection was then estimated, using the surprise measure as an instrument. The results give two key findings: 1) shadow credit expands in response to contractionary monetary policy, and 2) I provide additional evidence of the transmission of monetary policy through the interest rate channel.

JEL Classification

E5, F3, G0

Keywords

Monetary Policy; Instrumental Variables; High-Frequency Identification; Local Projection; Shadow Banking; Chinese Economy

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1 Introduction

As Chinese financial markets continue to develop and liberalize, many questions remain unanswered regarding the linkages between Chinese monetary policy, shadow banking, and financial stability. The rapid expansion of Chinese shadow banking is considered an increasing source of system-wide risk, potentially upending Chinese regulators' efforts to carefully manage the gradual liberalization of the Chinese financial system. In fact, since at least 2012, the Chinese central bank, The People's Bank of China (PBOC), and the Chinese banking regulator, China Banking and Insurance Regulatory Commission (CBIRC), have highlighted the growing risks associated with shadow credit intermediation, with particular focus on wealth management products (WMPs) and other asset management schemes (The People's Bank of China 2019). Like its analogues in developed economies, the regulatory environment in the shadow sector is less restrictive, allowing banks and non-bank financial institutions to play a game of regulatory arbitrage in an attempt to bypass the more restrictive traditional banking regulations. In 2018, the Chinese government introduced new regulations governing some of the behavior of wealth management products (The State Council of China 2018). However, the implementation of these proposed tighter regulations has not occurred and is likely postponed until the end of 2022, given the macroeconomic conditions in China due to the COVID-19 pandemic (Chen 2020). Despite the implementation delay, it is clear that Chinese regulators believe that shadow banking in China is a source of financial stability risk and are attempting to shape macroprudential policies to address these system-wide concerns.

What is less clear, however, is the potential for monetary policy to drive the very behavior that Chinese regulators deem undesirable. If monetary policy has an expansionary effect on shadow credit growth, then the potential effectiveness of macroproduential policies designed to reduce system-wide risk may be muted or even rendered ineffective. Investigating the nature of the linkage between monetary policy and shadow banking is important for various reasons. First, it allows policy makers to evaluate how monetary policy is affected by shadow credit intermediation. For example, if monetary transmission channels are dampened due to the presence of shadow banking, researchers would then have insights on the effectiveness of monetary policy in other developing countries, using the Chinese experience as a guide to inform further research into optimal monetary policy design. Second, investigating these linkages gives broader context to regulatory efforts designed to mitigate threats to financial stability. If monetary policy is implemented to meet the statutory goals of the central bank, but the implementation works counter to risk mitigating macroprudential policies, the financial system may end up worse off — increasing the chances of regulatory failure and the corresponding increase in the vulnerability of the financial system.

In this paper, I evaluate the effect of monetary policy shocks on shadow credit growth in China. First, following Kamber and Mohanty (2018), I construct a measure of surprise monetary policy shocks for China, examining changes to the 1-Year Interest Rate Swaps on the 7-Day Repo Rate on PBOC policy announcement dates. Second, using the surprise shocks as an instrumental variable, I estimate impulse responses using a two-stage local projection (LP-IV) to examine the effect of a surprise monetary policy shock on traditional lending and various shadow credit products in China, with a particular focus on wealth management products.

The results suggest that a tightening of the reserve requirement causes shadow credit to expand as banks shift from issuing on-balance sheet products to off-balance sheet products. More specifically, non-guaranteed wealth management products grow while traditional lending declines in the face of contractionary monetary policy. The behavior of shadow credit is mostly in line with other studies focusing on different time periods and products. The results also corroborate the growing consensus on the importance of the interest rate channel of Chinese monetary policy — contractionary policy yielded higher interest rates (specifically through the lending rate), a decline in industrial production, and a deflationary response in overall prices.

To be clear, this paper's contribution is two fold. First, it shows that transmission of monetary policy through the bank lending channel is mitigated by a concurrent increase in off-balance sheet shadow credit, whose growth can be explained by simple regulatory arbitrage. And second, this paper reinforces the existing evidence for the transmission of monetary policy through the interest rate channel in China. Although the Chinese experience is unique, the insights gained from this study could prove useful in a broader context in understanding monetary policy, financial stability, and shadow banking in other developing and emerging markets.

This paper relates to three strands of literature. The first revolves around identifying Chinese monetary policy shocks and monetary policy transmission. The investigation into the identification of Chinese monetary policy shocks from an empirical perspective has gained ground in recent years. Taking inspiration from Romer and Romer (2004), Shu and Ng (2010) and Sun (2018) construct narrative measures of the Chinese monetary policy stance utilizing PBOC statements. Further work utilizing a narrative approach to identifying monetary policy was done in Chen et al. (2017), who estimate a Qual VAR incorporating policy announcements using a binary variable that measures tightening and easing. They find that the PBOC generally meets its statutory requirements of combating inflation and an overheating economy. As of the writing of this paper, Kamber and Mohanty (2018) is the only paper that has utilized the Gertler and Karadi (2015) identification method for Chinese monetary policy by constructing a surprise measure of Chinese monetary policy by examining changes to the 1-Year Interest Rate Swaps on the 7-Day Repo Rate on PBOC announcement dates. For an assessment of the narrative versus the high-frequency measures of monetary policy, Funke and Tsang (2019) provide an excellent overview of both Chinese measures (and their own, utilizing a dynamic factor approach).

Previous studies examining Chinese monetary transmission find that the interest rate channel is increasing in importance (Porter and Xu 2009, Porter and Cassola 2011, He and Wang 2012, Fernald et al. 2014), although, there is less consensus on the relationship between monetary policy, the benchmark interest rate, and market rates in China (Kamber and Mohanty 2018). Fernald et al. (2014) use a FAVAR model to estimate the effectiveness of Chinese monetary policy and find that transmission channels have begun to match those of developed Western economies. Although they do not claim that China's monetary transmission is a one-to-one match of its Western counterparts, they argue that the timing of the transmissions are beginning to mimic those of more developed economies. Sun et al. (2010), estimate the differential effects of monetary policy on bank balance sheets and the real economy. They find the existence of the bank lending channel, and interest rate channel, and an asset price channel, but place par-

ticular emphasis on the importance of the bank lending channel in the transmission of monetary policy into the real Chinese economy. Chen et al. (2017) find that the bank-lending channel is largely ineffective, underscoring the lack of consensus given the multi-policy environment at the PBOC's disposal. This is important — the overarching question regarding Chinese monetary policy has always revolved around whether or not it "matters" in the context of affecting real variables (Sun 2013). The results of Fernald et al. (2014) suggests that Chinese monetary policy does matter, confirming the conclusions presented in Sun (2013).

The second strand of literature relates to shadow banking in China. Existing studies on Chinese shadow bank have a relatively narrow examination of trust loans and wealth management products. Elliott et al. (2015), Ehlers et al. (2018), Hachem and Song (2015), and Hachem (2018) broadly detail the structure and nature of Chinese shadow banks. Chinese shadow banks were designed to provide credit services to firms that had limited access to the traditional banking sector, due to the "boy's club" nature of loan issuance in the People's Republic. Namely, large state-owned enterprises were the preferred borrowers to the state-owned banks. Hale and Long (2011) find that state-owned enterprises had better access to external finance than their non-state owned counterparts. As a result, demand for credit products offered by intermediaries (which are effectively run by banks) increased as a way for banks to both avoid regulatory limitations and as a way to service growing demand for credit by other agents in the economy that were effectively locked out of the standard loan process.

Like its Western counterparts, there is an element of regulatory avoidance that drives the development of Chinese shadow banking. Elliott et al. (2015), Jiang (2016), and Lu et al. (2015) examine the growth of shadow banking arising due to traditional banking constraints. The regulatory arbitrage behavior that these studies find mirror that of similar findings on Western shadow banking, highlighting the role of regulatory arbitrage in the development of the shadow banking sector (Buchak et al. 2018). Dang et al. (2014) argues that one of the drivers of Chinese shadow banking lies in the "implicit guarantees" offered by banks on these shadow products, in contrast with the United States, where financial engineering that relied on markets to redistribute risk. Borrowers believe that the products offered by the banks through intermediaries carry a level of risk similar to a traditional bank deposit. With respect to wealth management products, Acharya et al. (2016) find that WMP growth could be explained by increased competition amongst Chinese banks, which lead to an increase in WMP issuance, a result that is complimentary to the work done in Hachem and Song (2015), where the Chinese shadow banking sector is susceptible to a run-like event. An and Yu (2018) focus their efforts on examining guaranteed off-balance sheet products and find that macroprudential policies undertaken by the CBIRC drove the guaranteed off-balance sheet growth.

The third strand of literature looks at the intersection between monetary policy and shadow banking in China. Funke et al. (2015) examine liberalization scenarios under a DSGE framework that incorporates shadow banking. They find that liberalization of interest rates would provide a more solid foundation for monetary policy in China as well as cutting the shadow banking expansion that it currently faces. Yang et al. (2019) argues that monetary policy is less effective in China, owing in part due to the presence of shadow banks. They find that shadow banking presence creates a "dual financial accelerator", exacerbating the risks of finan-

cial and economic stability in China and that better coordination between the PBOC and other regulators engaged in macroprudential policies could have helped stabilize the economy and reduce shadow credit expansion. This result is in line with the growing work on monetary policy transmission effectiveness in the presence of shadow banking in the United States, where Xiao (2020), finds the presence of a shadow banking channel that offsets commercial bank deposits and drives an increase in shadow deposits— mitigating the impact of U.S. monetary policy. Two complimentary papers (Chen et al. 2018, Hachem and Song 2015), examine the linkages between regulatory changes, monetary policy and shadow banking and the effect of shadow banking on monetary policy effectiveness on standard banking. In Hachem and Song (2015), they find that increased regulatory burdens caused an expansion in shadow credit. Chen et al. (2018) find that contractionary monetary policy caused an increase in shadow credit in the form of entrusted lending.

In contrast to Hachem and Song (2015), this study aims to examine in more detail the effect of monetary policy on shadow credit expansion, a point not emphasized in their paper. The Chen et al. (2018) paper examines a similar question put forth in this study. However, two fundamental differences arise — 1) Chen et al. (2018) identify monetary policy using an endogenous M2 growth target, whereas I use a surprise measure of monetary policy as an instrumental variable and 2) they focus on examining the relationship of banks issuing more off-balance shadow credit via entrusted loans and how the banks take these off-balance sheet products (listed broadly as account's receivable investments (ARI) on banks' balance sheets) back onto their balance sheets in response to tighter policy. This study focuses on the growth of specific types of shadow credit products in response to tighter policy, as well as re-examine the evidence of the interest rate channel of monetary policy.

It is clear that the literature has much to gain from an examination of the linkages between monetary policy and shadow banking development in China. Given the above considerations, this paper slots itself broadly into the existing literature on monetary policy and shadow banking. The rest of the paper is as follows. Section 2 examines the shadow banking system and shadow products in China. Section 3 describes the data used. Section 4 discusses the identification strategy and construction of monetary policy surprises. Section 5 details the local-projection methodology used to estimate the impulse responses. Section 6 discusses the paper's results and provides a quick back of the envelope calculation of the net effect on shadow credit. Section 7 concludes.

2 Shadow Credit in China

Defining and measuring shadow credit in China poses some challenges. As Ehlers et al. (2018) points out, the literature tends to call shadow banking different things, depending on the goal of the study. Hachem (2018) argues that although dressed up in different names, Chinese shadow banking serves a very similar goal to its western counterparts – credit intermediation with maturity mismatch designed to avoid regulatory burdens imposed by the state. In this sense, shadow credit in the Chinese system serves as a means of liquidity access through various financial products. Following the definition put forth in Ehlers et al. (2018), "shadow credit"

includes activities taken by both depository and non-depository financial intermediaries that relate with credit intermediation and exploiting regulatory arbitrage. Figure 1 maps out the path that shadow funds move through the Chinese financial system.

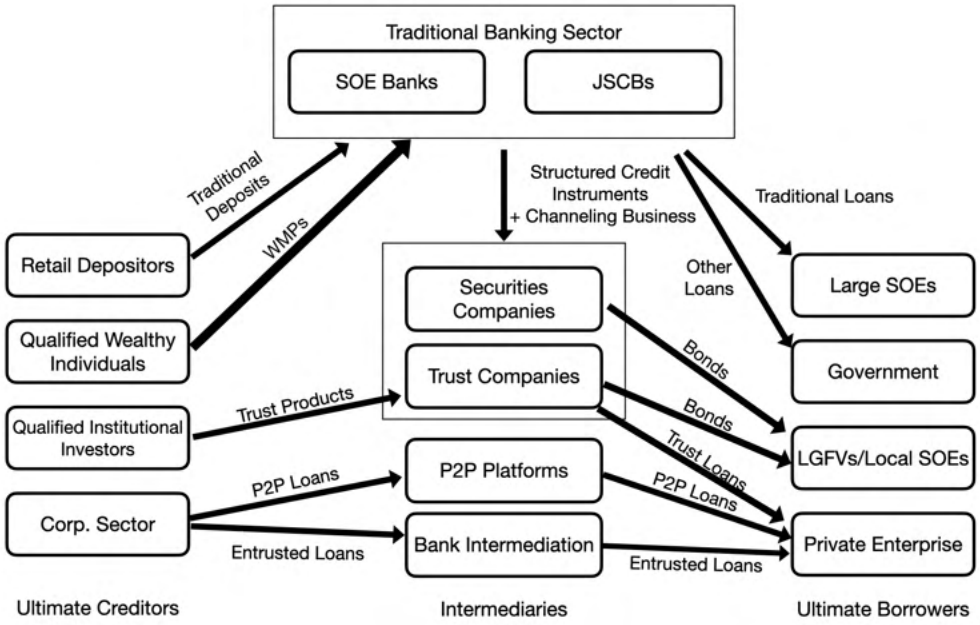

Figure 1: Stylized Map of the Chinese Banking System

Notes: Figure adapted from Ehlers et al. (2018)

From the above figure, we can see that qualified wealthy individuals (QWI) purchase wealth management products over the counter from traditional banks, who then channel the cash flow generated from this sale into securities and trust companies. There is some degree of double-counting that exists when including wealth management products in a measure of shadow credit: funds generated from wealth management products are channeled into both securities and trust companies, where a portion of that capital is channeled out of the trust company via trust loans. From the map, we can see the centralized role that the traditional banking sector plays, where it funnels wealth management products from the destination side into additional intermediation, as well as provide intermediation services between creditors and borrowers. In general, we see that trust companies gain funding through two primary sources — qualified institutional investors and through a channeling business with a traditional bank. On the destination side, we can see that private enterprises and local governments gain access to credit markets as a result of shadow financing through a variety of products. Examining these products in more detail, below is a list of shadow instruments (but not exhaustive) utilized in the Chinese context. Peer-to-Peer (P2P) lending is explicitly left out of the discussion, owing to its relative size and the recent crackdown by regulators, causing most P2P platforms to collapse. More details will be described further below.

Entrusted Loans

Chinese banks are subject to direction from the various Party apparatuses — government priorities and policy goals can directly influence which industries receive bank loans. Additionally, firms may find it difficult to find sources of external finance from the formal credit sector, as the state-owned banks have a preference for state-owned enterprise (Ehlers et al. 2018). As a result, the traditional credit channel between the banks and firms remain constrained. With this in mind, larger corporations began to offer loans intermediated by the banks. These entrusted loans are effectively firm to firm or firm to customer loans, where the traditional banking sector acts as trustees. The banks themselves do not hold the loan, but act as administrators due to existing regulations preventing non-financial firms from lending to each other (Hachem 2018). Because the banker acts as a facilitator between the creditor and the debtor, entrusted loans sit off-balance sheet.

Undiscounted Bankers' Acceptances

Bankers' acceptances are credit products where the bank issuing the instrument effectively guarantees that the depositor will repay a third party at a certain date in the future. So long as the depositor does not renege on this guarantee, this instrument stays off-balance sheet and is undiscounted. If the depositor does renege, however, the bank that issued the product is now liable for the guarantee and the third party collects the guarantee from the bank directly. At this stage the bankers' acceptance is discounted and is recorded on-balance sheet for the bank.

Trust Loans and Trust Company Activity

Trust companies in China are a unique financial intermediary that intermediates financial transactions between the financial and non-financial firms using specific asset classes. Ehlers et al. (2018) points out that banks channel funds from wealth management products into trust companies, which provides a linkage between traditional banks and trust companies. This "bank-trust cooperation" allows banks to transform both maturity and credit risk by funneling funds into trust companies. These trust companies issue various financial products, ranging from trust loans, trust investment into capital markets, and more. As an example of the capital market investments made by trust companies, Figure 18 in the supplemental appendix A.2 shows a time series of bonds held by trusts.

Wealth Management Products

Because the paper puts additional focus on wealth management products, understanding the differences in type and bank-type issuance characteristics is important. On the origination side of shadow credit, wealth management products act as shadow deposits. WMPs are effectively asset-backed term deposits that are sold over-the-counter by traditional banks. These products can be further broken down into two broad types — guaranteed and non-guaranteed WMPs. The primary distinction between guaranteed and non-guaranteed WMPs is the role of the WMP on the banks' balance sheet. If the bank provides an explicit guarantee on the principal of the WMP, then bank investments using the WMP cash flow will be recorded on the banks'

balance sheet. Non-guaranteed WMPs, however, are not subject to balance sheet reporting requirements. Instead, the bank leverages the so-called "bank-trust cooperation" channel and funnel the cash generated from the WMP into a trust company that will invest it into a financial product of a different asset class. Figure 2 details the monthly WMP issuance over time by WMP type:

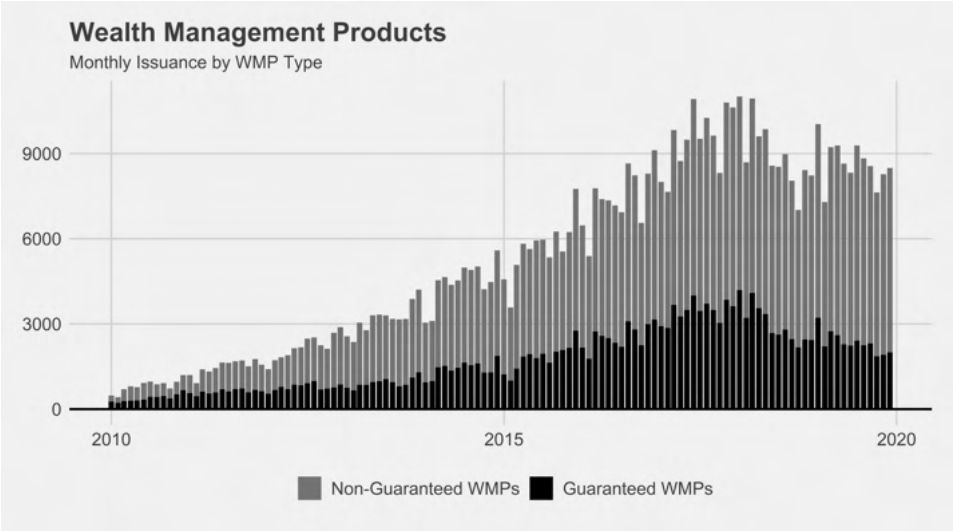

Figure 2: Monthly Issuance of WMPs by Type

Notes: There has been a steady increase in both on and off-balance sheet WMP product issuance since 2010. Off-balance sheet non-guaranteed WMPs are issued at a much larger volume than its guaranteed counterpart. Source: CEIC China Database

We can see that the issuance of non-guaranteed WMPs dominates the WMP market, broadly suggesting that banks use this primarily as a channel for off-balance sheet investment and activities.

2.1 Measuring Shadow Credit

The breakdown in the previous subsection serves to inform the choice of how this paper measures shadow credit. Specifically, there needs to be a determination of which measures of shadow credit would have adequate exposure to monetary policy spillovers due to surprise monetary policy shocks undertaken by the PBOC. As a result, this paper will focus on the traditional "narrow" measure comprising of entrusted loans, trust loans, and undiscounted bankers' acceptances, as well as a "broader" measure that examines wealth management products. The broader measure allows us to expand our examination into off-balance sheet activities undertaken by the bank via offering non-guaranteed WMPs. In conjunction with the narrow measure, the on-balance and off-balance sheet activities can be differentiated and analyzed with respect to banking behavior in the presence of monetary policy, given the level of granularity provided for in the data.

It should be noted that these measures also explicitly leave out other shadow instruments that could be counted as shadow credit. These measures leave out P2P lending and informal lending. I also do not evaluate the broader category of "accounts receivable investment", which has been used by banks to place off-balance sheet credit products back onto their balance

sheets (Chen et al. 2018). A couple of comments are important here. First, the P2P lending market is relatively small in China. Figure 19 in the supplemental appendix A.3 shows the P2P loan balance over time, where it barely crosses the 1 Billion CNY threshold. Additionally, the PBOC cracked down hard on P2P lending in 2019, causing the number of platforms operating to drop from its 2015 peak of 6000 to 708 (Leng and Tham 2019). With this context in mind, the inclusion of the much smaller P2P industry has been omitted from the primary analysis done in Section 6. Second, informal lending roughly accounts for 4.5% of 2016 GDP versus the 18% from entrusted loans (Ehlers et al. 2018). Its omission (mainly due to lack of data) should not largely affect the paper's findings given the relative size of the informal lending sector. Third, ARI came into prominence as a way for banks to conduct off-balance sheet shadow banking activities and bring the cash flow onto the asset side of their balance sheets. This paper, however, is less interested in this aspect of bank behavior, but rather focuses on aggregate shadow credit behavior differentiated by product type. As a result, the omission of these categories should pose no large effect on the analysis done in this study.

2.2 Sources of Shadow Funding and Credit

The PBOC publishes an annual summary of "Aggregate Financing to the Real Economy (AFRE)"[1] that breaks down direct financing channels to households and firms. It should be noted that in practice, there are alternative means of channeling funds to local, provincial, and the central governments (Hachem 2018). The PBOC reports the monthly aggregate AFRE measure as well as a breakdown of the various sources of AFRE. The typical breakdown includes trust loans, entrusted loans, undiscounted bankers' acceptances, local currency loans, foreign currency loans, domestic equity financing, and corporate bond financing. Figure 3 shows the stock of foreign and local currency loans in China, while Figure 4 examines shadow credit products measured in the AFRE series as a percentage of the stock of total loans.

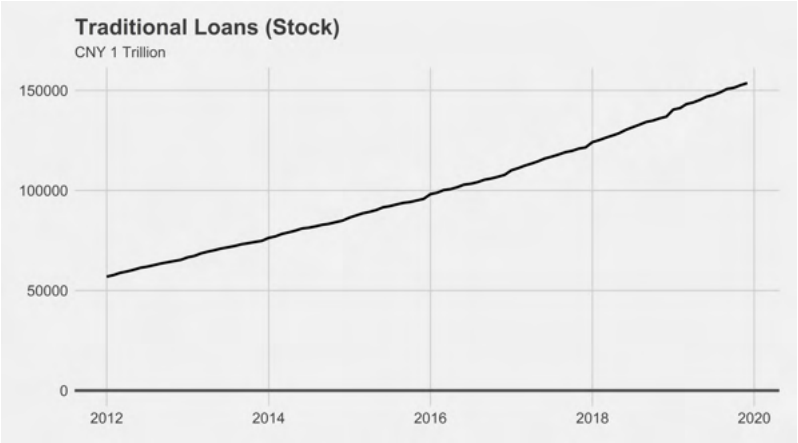

Figure 3: Sum of Local and Foreign Currency Loans Reported in AFRE

Notes: Data prior to 2016 estimated using reported stocks and flows from CEIC and PBOC. Source: CEIC China Database, People's Bank of China, and Author's Construction.

[1] This is the new official designation. Previously this measure was reported by the central government as "Total Social Financing".

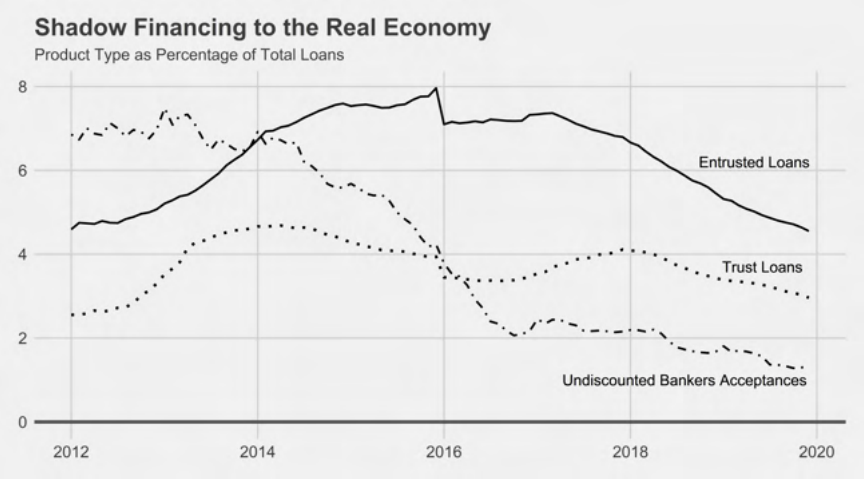

Figure 4: Shadow Finance as a Percentage of Traditional Lending

Notes: Data prior to 2016 estimated using reported stocks and flows from CEIC and PBOC. Percentage calculated using the stock value of traditional loans, entrusted loans, undiscounted bankers' acceptances, and trust loans. Source: CEIC China Database, People's Bank of China and Author's Construction.

A couple of things are immediately clear — shadow credit in China is overshadowed by traditional loans. This fact should be unsurprising, given the relative immaturity of the Chinese financial system. At its peak, combining entrusted lending, trust lending, and undiscounted bankers' acceptances represented almost 16% of the total value of traditional loans.[2] If we include the broader measure of shadow credit, the overall value of shadow credit increases substantially. Looking purely at all WMPs and noting that off-balance sheet non-guaranteed WMPs dominate the issuance volume of these products, Figure 5 details the outstanding balance of WMPs since 2014:

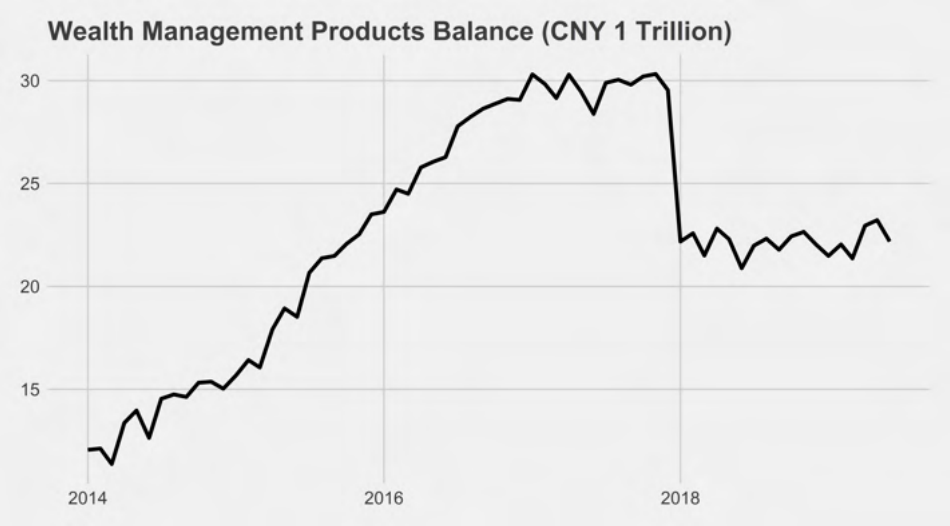

Figure 5: Outstanding Balance of WMPs

Notes: Although there was a decline in WMP balances in 2018, there was no large corresponding decline in WMP issuances during that time frame, see Figure 2. Source: CEIC Asia Database

[2] See supplemental appendix A.1 for a figure showing the combined shadow finance products as a percentage of traditional loans.

Given its size and exposure, any analysis of the dynamics of shadow credit in China that does not include WMPs would not be complete and would ignore a large portion of shadow funds working its way through the system.

At face value, because shadow credit intermediation creates tighter financial linkages between the traditional banking sector and shadow finance firms, as well as the desire of financial intermediaries to gain regulatory arbitrage, the PBOCs conduct of monetary policy, as both the central bank and the financial regulator, should have an effect on shadow credit.

3 Data

The data for this study is a mixture of publicly available and proprietary data. The public data is taken directly from The People's Bank of China and FRED. Proprietary data was taken from the China database through CEIC Data. Most of the data is standard, however, a few comments are necessary regarding author constructed data. First, please refer to Section 4 on details of the instrument construction. Second, AFRE data is broken up into a few categories: Aggregate, trust loans, entrusted loans, undiscounted bankers' acceptances, local currency loans, foreign currency loans, domestic equity financing, corporate bond financing, and occasionally an "other" category. Prior to 2016, there is limited stock data for these sub-categories, so using the flow data that was published, I estimate the stock values prior to 2016 for each category. This study uses the stock value, rather than flows, for the empirical analysis. I also sum together the local currency loans and the foreign currency loans into a broader "Loans" category to simplify the empirical analysis. Table 1 below details the data, sample length, and source.

Data Type	**Sample and Frequency**	**Source**
Aggregate Financing to the Real Economy	2012M4 – 2019M12	CEIC, Author Constructed
1-Year Interest Rate Swap	Daily from 2012 – 2019	Bloomberg Terminal
Monetary Policy Surprises	Daily and Monthly from 2012 – 2019	CEIC, Author Constructed
WMP Issuance	2012M4 – 2019M12	CEIC
M2	2012M4 – 2019M12	CEIC
Reserve Requirement Ratio	2012M4 – 2019M12	CEIC
Lending Rate	2012M4 – 2019M12	CEIC
7-Day Repo Rate (DR007)	2012M4 – 2019M12	CEIC, PBOC
Industrial Production	2012M4 – 2019M12	CEIC
CPI Core	2012M4– 2019M12	CEIC
Crude Oil Prices (WTI)	2012M4 – 2019M12	FRED
CBOE Volatility Index (VIX)	2012M4– 2019M12	FRED
PBOC Monetary Policy Report	2012Q1 – 2019Q4	PBOC
PBOC Policy Announcements	Daily from 2012 – 2019	PBOC

Table 1: Data Description

A minor problem arises when utilizing data from China due to Chinese New Years. First, two forms of seasonal adjustments are made—Chinese variables received both Chinese New Year adjustments and the standard X-13 adjustment. Fernald et al. (2014) note that not including both seasonal adjustments to Chinese data led to spurious regressions. Chinese New Year presents itself as a unique problem here. For starters, like Ramadan, Chinese New Year does

not fall on the same date on the Gregorian calendar, rather it follows the Lunar calendar. As such, Chinese New Year fluctuates year after year within January and February. For Chinese businesses, Chinese New Year is a large source of variation within January and February, as productivity tends to fall during the weeks before and during the holiday.

To adjust for Chinese New Year, I follow the method described by Fernald et al. (2014).[3] Adjusting for all Chinese variables, I assume that growth rates from December to January and January to February are constant. Then, I average the January and February values and distribute the average across the two months. Chinese statistical series occasionally omit reporting January and February data. These missing values are imputed using the Chinese New Year adjustment detailed above. I then deseasonalize using X-13. Following the X-13 seasonal adjustment, every variable except for the interest rates and reserve requirement is transformed into monthly growth rates by taking the log change multiplied by 100.

4 Identifying Monetary Policy Shocks

This paper follows the rich literature utilizing high-frequency information around the Federal Reserve announcement dates to measure monetary policy shocks, (e.g.: Kuttner 2001, Cochrane and Piazzesi 2002, Bernanke and Kuttner 2004, Gertler and Karadi 2015, Miranda-Agrippino 2016) by adapting it to the case of China. I adopt the approach used in Kamber and Mohanty (2018) to identify Chinese monetary policy shocks. The primary benefit of this method is the ability to remain agnostic about any assumptions regarding the PBOC's reaction function. Rather, I assume that market participants, despite having limited information about the PBOCs reaction function, have reasonable expectations regarding how the PBOC would react and price in those expectations in interest rates. Financial market participants should have a reasonable expectation of what tighter monetary policy looks and behaves like in China and would respond accordingly. With this assumption, and following the method laid out in Kamber and Mohanty (2018), we can measure surprises to the expected future path of the 7-Day Repo Rate using the 1-year interest rate swaps (IRS) on the 7-Day Repo rate. In terms of information content, the 7-Day Repo rate is generally seen as revealing the monetary policy stance of the PBOC, as well as provide insights on the overall market liquidity and cost of external finance for banks. PBOC announcements are organized by date, type of policy, and any additional comments relating to the policy announcements. A selected sample of these announcements are shown in Table 2 below:

[3] There are other ways of accounting for Chinese New Year. One way is to directly specify the dates as dummy variables in the X-12 adjustment but that requires some degree of subjectivity.

Date	RR	LR	FX	MPR	OMO	Other	Comments
06/28/15	-0.5	-0.25					Changes In Percent
01/13/16						X	Liquidity Injection Through TLF
10/01/16			X				RMB Added to IMF SDR Basket
08/09/19				X	X		Quarterly MPR, CBS, OMO

Table 2: Example Announcement Dates

Notes: RR is the reserve requirement, LR is the lending rate, FX are changes to the foreign exchange, MPR is the PBOC Monetary Policy Report, OMO is open market operations, Other represents other policy or regulatory changes, TLF is Term Liquidity Facility, IMF SDR is the IMF's Special Drawing Right, and CBS are central bank bills swap operations.

4.1 Constructing the Instrument

After collecting a sample of monetary policy announcements and their dates, I calculate the surprises using the following rules:

1. Take the difference between the IRS value on the day of the announcement and the day prior to the announcement: $IRS_t - IRS_{t-1}$.
2. If the announcement was over the weekend, I take the difference between the following Monday and the preceding Friday.
3. If the announcement falls on a non-trading day (holidays, etc.), then I take the difference between the next available trading day and the preceding trading day prior to the non-trading day.

For example, The PBOC announced a 0.5% reduction in the reserve requirement on July 5th, 2018. Using the method described above, the surprise measure is then measured as the difference between the July 5th IRS value and the July 4th IRS value. Figure 6 shows the interest rate swap differential between the two days.

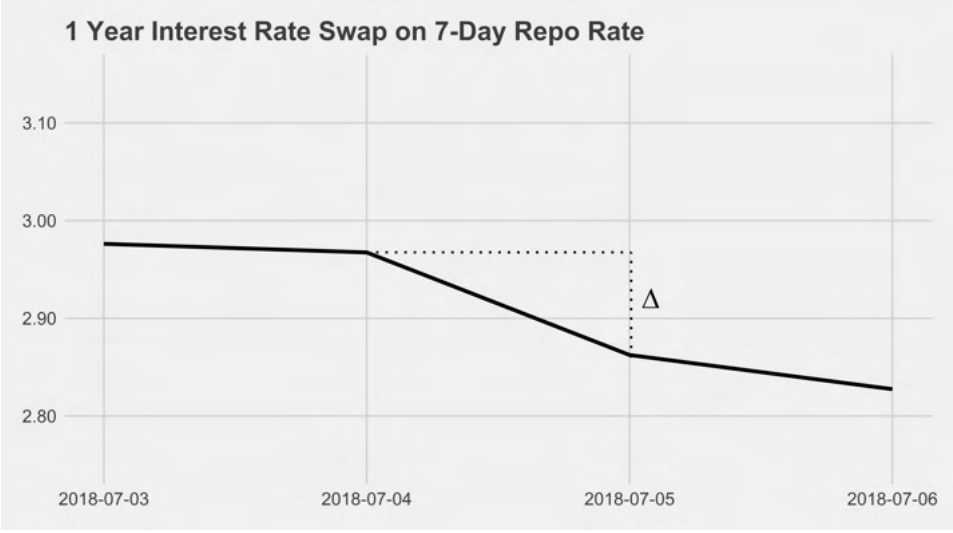

Figure 6: Δ Measures Effect of PBOC Announcement to 1-Year IRS

Source: Bloomberg Terminal

The surprise measure, shown in the figure as Δ, is calculated as $2.8625\% - 2.9675\%$, which yields a surprise measure of a 10.5 basis point reduction.

A potential concern, however, is the actual timing of the announcement. Typically, high frequency studies look at a 30-minute window before and after an announcement (e.g.: Gurkaynak et al. 2003, Swanson 2011, Gertler and Karadi 2015, Nakamura and Steinsson 2018) to evaluate the high-frequency effects of an announcement on asset prices. Unfortunately, there is a potential timing issue with this study. The PBOC announcements listed on their website do not include a time-stamp of the announcement — just the date.[4] This could potentially introduce some measurement error into the surprise measure, since there is no easy way to reconcile announcements made after market close, which should not have an effect on the announcement date's close price. As a result, the surprise measure generated in this paper may not be fully accurate in measuring the high-frequency information effect from an announcement. For robustness, I construct an alternative instrument using the following rules:

1. Take the difference between the IRS value on the day after the announcement and the day prior to the announcement: $IRS_{t+1} - IRS_{t-1}$

2. If the announcement was on a Monday, take the Tuesday value and subtract it from the closing value of the preceding Friday.

3. If the announcement was over the weekend, take the difference between the following Monday and the preceding Friday.

4. If the announcement falls on a non-trading day (holidays, etc.), then I take the difference between the next available trading day and the preceding trading day prior to the non-trading day.

In this case, the alternative measure assumes that announcement days have no effect on asset prices and rather, the announcement has an effect on the prices through to market close on the day after the announcement. This potentially addresses some of the measurement issues of after market close announcements, but has the reverse problem of potentially picking up asset price moving information from the day *after* that is unrelated to the announcement. Therefore, using the alternative calculation, the July 6th IRS value was 2.8275%, so the new Δ measure would be a 14 basis point decrease between July 4th and July 7th, with the announcement falling on July 5th.

Figure 7 plots the constructed surprise measure for the full sample taking into account all policy announcements made between 2012 and 2019, where I simply take the sum of all daily IRS changes within a month as the surprise measure for that month.[5] This monthly surprise measure is then used to identify surprise monetary policy shocks from the PBOC. The robustness surprise measure can be found in the supplemental online appendix B.1 (Figure 24), where the alternative measure is similar. Looking at the primary measure, we can see the

[4] And even then, there is some discrepancy of the actual date of the announcement, depending on whether or not the PBOC maintained the same dates across their English and Chinese versions of their press releases.

[5] Kamber and Mohanty (2018) take a slightly different approach and sum across various weeks within a month, taking into consideration whether or not the last week fo a month is counted toward that month's measure. My end result is qualitatively similar to their method, with a few discrepancies.

changes in basis points are smaller in magnitude after 2016. Extending the findings of Kamber and Mohanty (2018), as well as Funke and Tsang (2019), the volatility of the interest rate swap differences decreased after 2008, where it peaked. For this sample, the largest swing is a roughly 20 basis point differential, compared to a near 50 basis point differential during a few announcements during 2008.[6] This could seemingly indicate that market expectations regarding Chinese monetary policy has stabilized, following more direct and transparent guidance from the PBOC. Further research could prove worthwhile in evaluating the information channel and efficient markets in China.

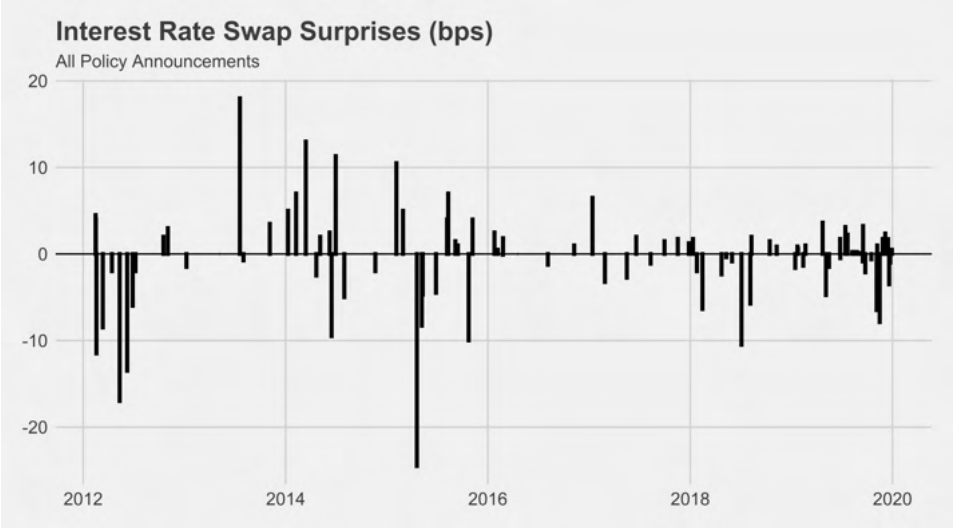

Figure 7: Constructed Surprise Measure

5 A Local Projection – Instrumental Variables (LP-IV) Approach

5.1 Motivation

Utilizing a local projection method originally described by Jordà (2005) and combining it with the identification strategy described in Section 4, I estimate a two-stage local projection (LP-IV) using the surprise measure as an instrumental variable. This method follows Ramey (2016) and Stock and Watson (2018). The LP-IV is similar to the approach used in estimating identified IRFs from a proxy SVAR. In fact, as shown in Plagborg-Møller and Wolf (2020), SVAR identification applied to LPs provide effectively the same IRFs as the SVAR. They note that structural LP-based estimation only works if the equivalent SVAR estimation can also succeed. Stock and Watson (2018) and Ramey (2016) provides an empirical comparisons between an externally identified SVAR and LP and found no statistical difference in the results. Jordà (2005) argues that the choice in using an LP based approach is the attractiveness of having more robust impulse responses, even if the model is mispecified (relative to the true data generating process) when compared to a mispecified VAR. Moreover, Brugnolini (2018) shows that the local projection estimator is more robust when there is a small sample size and a misspecified model

[6] The 2008 period is not shown in this paper. For the most updated reference, see Funke and Tsang (2019)

lag-length, when compared to a VAR. Specific to this paper, the sample size only spans monthly observations from 2012 to 2019 ($T = 93$) and the risk of misspecification with Chinese data is higher, given the institutional realities of Chinese data collection, as well as the continuing structural changes in the Chinese economy (both of which could affect the lag-structure). As a result of this higher potential for misspecification of the lags and the relatively smaller sample size, an LP-IV approach is ideal for evaluating the dynamic causal effects of Chinese monetary policy.

5.2 Econometric Set up

Following Ramey (2016), Stock and Watson (2018), and Jordà et al. (2020), suppose the LP-IV is estimated using the following set of regressions:[7]

$$\boldsymbol{y}_{t+h} = \beta_{i,h}\hat{\epsilon}_{1,t} + \phi_{i,h}\boldsymbol{x}_t + u_{t+h}, \qquad h = 0, 1, \cdots, H-1 \tag{1}$$

Where h is the selected forecast horizon, $\hat{\epsilon}_{1,t}$ is our shock of interest and $\boldsymbol{x}_t$ is a vector of controls that include lags of the instrument, exogenous controls, and the vector of observed variables in $\boldsymbol{y}$. For simplicity, the regression constant has been omitted. Using two-staged least squares, we first estimate $\hat{\epsilon}_{1,t}$ using:

$$\epsilon_{1,t} = \beta^{2SLS} Z_t + p_{i,h}\boldsymbol{x}_t + \xi_{1,t} \qquad (\hat{\epsilon}_{1,t} = \beta Z_t + p_{i,h}\boldsymbol{x}_t) \tag{2}$$

Where Z_t is the constructed monetary surprise instrument that needs to satisfy the following three assumptions:

A1: Instrument Relevance	$E[Z_t\epsilon_{1,t}] \neq 0$
A2: Exogeneity Condition Holds	$E[Z_t\epsilon_{2:n,t}] = 0$
A3: Lead-Lag Exogeneity	$E[Z_t\epsilon_{t+j}] = 0$ for $j \neq 0$

Assumptions A1 and A2 are standard to the Proxy SVAR literature and are analogous to their microeconometric counterparts. In effect, to be valid, Z_t needs to be correlated with monetary policy shocks and uncorrelated with other structural shocks in the model. Because we are only interested in the effect of monetary policy shocks and because the instrument is constructed as surprises as a result of monetary policy announcements, A1 is met. By construction, monetary policy shocks and the instrument are correlated since the instrument measures the surprise effect of those shocks. A2 is also met, since there are no other structural shocks in the model. A3, however, is specific to the LP-IV, due to the behavior of the model dynamics. Stock and Watson (2018) explain that the instrument itself needs to be uncorrelated with all shocks at all leads and lags since the path of y will depend on all the shocks in the system. As a result, to properly identify $\epsilon_{1,t}$, I lag the control vector, which consists of the instrument, all the observable variables, as well as an oil price index and VIX, by 3 months when estimating (1) and (2).[8]

[7] The LP-IV was estimated using the modified replication files of Stock and Watson (2018) in Matlab.

[8] Stock and Watson (2018) state that including 1 lagged instrument should suffice in meeting the lag-lead exogeneity condition. However, they note that higher lag orders increase precision to the first-stage. For this

6 Results

6.1 Policy Indicator

Kamber and Mohanty (2018) find that the combination of constructed monetary policy surprises and the reserve requirement ratio provides the strongest instrument and policy indicator combination. They also note that despite potential weak instrument problems with the other indicators, the impulse responses generated were similar. To test this, I estimate LP(5) from Table 5 in Section 6.3 further below, which includes the central government expenditure variable, but examine different policy indicators. Table 3 shows the first-stage F^{HAC}-statistic for various policy indicators.

Table 3: Baseline F^{HAC}-Statistics For Various Monetary Policy Indicators

	Reserve Requirement	Repo Rate	Lending Rate
Primary Instrument	25.31	0.93	4.86
Alternate Instrument	5.23	0.99	10.46

Notes: F^{HAC} estimated following Stock and Watson (2018).

The primary instrument results are in line with Kamber and Mohanty (2018) — the reserve requirement seems to be the strongest contender as the chosen policy indicator, given an F-statistic > 10, suggesting a low-likelihood of a weak instrument problem Staiger and Stock (1997). Note here that the alternative instrument does not yield a strong instrument using the reserve requirement as the policy indicator, however, with LP results are similar to the primary instrument specification. The other policy indicators are particularly weak-instruments (with the exception of the alternate instrument with the lending rate). However, the results under both instruments are qualitatively similar. In line with Kamber and Mohanty (2018), I choose the reserve requirement as the primary monetary policy instrument for the baseline case.

6.2 Baseline Analysis

In the baseline case, the question of interest is the effect of surprise Chinese monetary policy shocks on shadow credit growth in China. As defined in Section 2, the narrowest measure of shadow credit is the sum of entrusted, trust loan growth, and undiscounted bankers' acceptances. The aggregate effect of Chinese monetary policy can be estimated using equations (1) and (2), where I first define the vector of observable variables, $\boldsymbol{y}$, as consisting of Chinese industrial production growth, inflation, narrow shadow credit growth, aggregate WMP growth, loan growth, M2 growth, the growth rate of government expenditure[9] the 7-Day Repo Rate, the reserve requirement, and the bank lending rate. There are two exogenous controls for global oil prices and VIX, to control for any potential oil price shocks and global financial volatility that

model, lag order 3 gave the highest F^{HAC}-statistic (> 20), so it was chosen.

[9] I estimate the baseline regressions in three ways — one without government expenditures, one with central government expenditures, and one that aggregates local and central government expenditures.

could have an affect on the Chinese economy. The inclusion of the reserve requirement, M2, the 7-Day Repo, and the lending rate is in line with including all potential policy indicators for Chinese monetary policy. By including the policy variables, I control for the potential of other policy channels to influence our left-hand side.[10] In the first stage, the "surprise" component of monetary policy, measured using the surprise measure of the interest rate swaps, isolates the variation in the reserve requirement shocks, thus allowing us to identify the effects of a surprise monetary policy shock on the dynamic system measured using the reserve requirement as the policy indicator. The baseline model is estimated using the full, transformed sample available to me in my data, from 2012M4 to 2019M12.

Interest Rate Channel Evidence

To examine the interest rate channel, I first show the baseline results of a surprise monetary policy shock (measured as a 1% increase in the reserve requirement) on interest rates and macro aggregates. Figures 8 and 9 show these impulse responses.

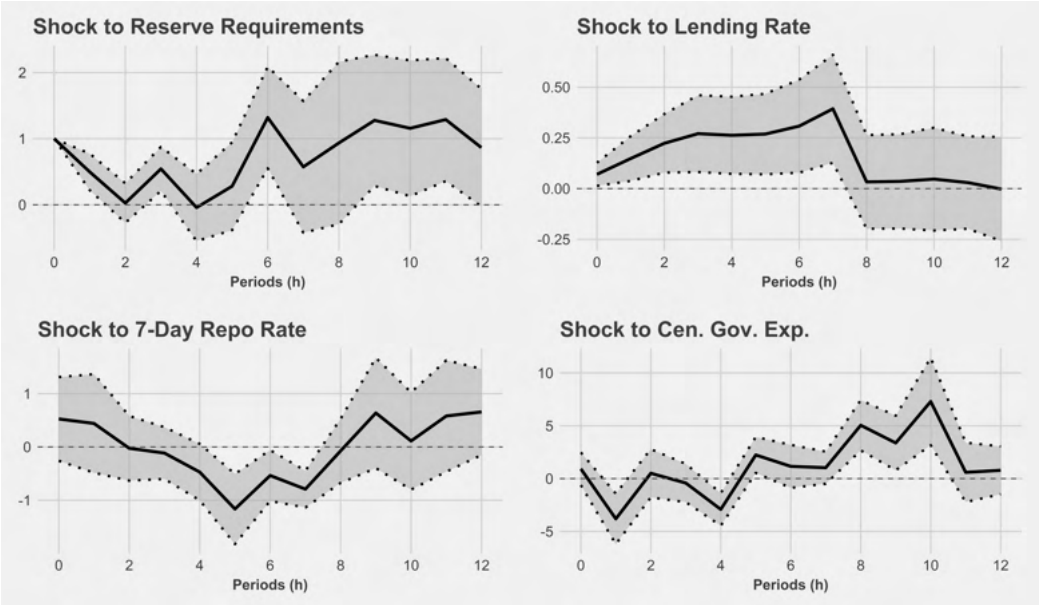

Figure 8: 1 Unit Reserve Requirement Shock on Policy Measures

Notes: Central Government Expenditure response in terms of growth rates. Error bands at the 68% confidence interval.

The impulse responses shown in Figure 8 indicate some transmission through interest rates. A contractionary monetary policy caused the bank lending rate to increase over a period of 7 months, suggesting that monetary policy is transmitted from the PBOC through at least the lending rate. The behavior of the 7-Day Repo rate is less clear. On impulse it increases, but this effect fades pretty quickly. Since the tenor of the repo is at a higher frequency than the forecasted periods, it is possible that monetary policy transmission dissipates quickly through the repo rate. Alternatively, it could also be that the market views the repo rate as indicative

[10] Insofar as there are many policy levers available to policy makers at the PBOC, it seems prudent to include and control for as many explicit levers to reduce the chances of not strictly identifying the identified policy shock. Fiscal policy can also be seen as a policy lever for monetary policy (See Fernald et al. 2014)

of monetary policy stance, but monetary policy itself is not transmitted very clearly through the repo rate and instead, works itself through the lending rate.

The results to the central government expenditure growth show nothing particularly statistically significant, save for a few observations. Conventional wisdom suggests that Chinese monetary policy could be implemented with a fiscal component, but these results suggest that any surprise monetary policy transmission through this lever is negligible at best. It should be pointed out, however, that if examining the results utilizing total government expenditures, there is a decline in total government expenditures in response to a surprise contractionary monetary policy shock. This could indicate that local governments would feel the liquidity and credit constraints imposed on the banks, and as a result, are themselves constrained in their ability to access loans for local government projects. However, a caveat here is that the total measure also includes local government spending, which is notoriously unreliable.[11] Because of measurement difficulties due to unique institutional incentives, the results including the total government expenditures should be taken with a grain of salt. However, its inclusion serves as an additional robustness check — an imperfectly measured control is better than none at all. The other results are similar to the baseline case with central government expenditures. The impulse responses utilizing total government expenditures can be found in the supplemental appendix A.4 as Figures 20, 21, and 22.

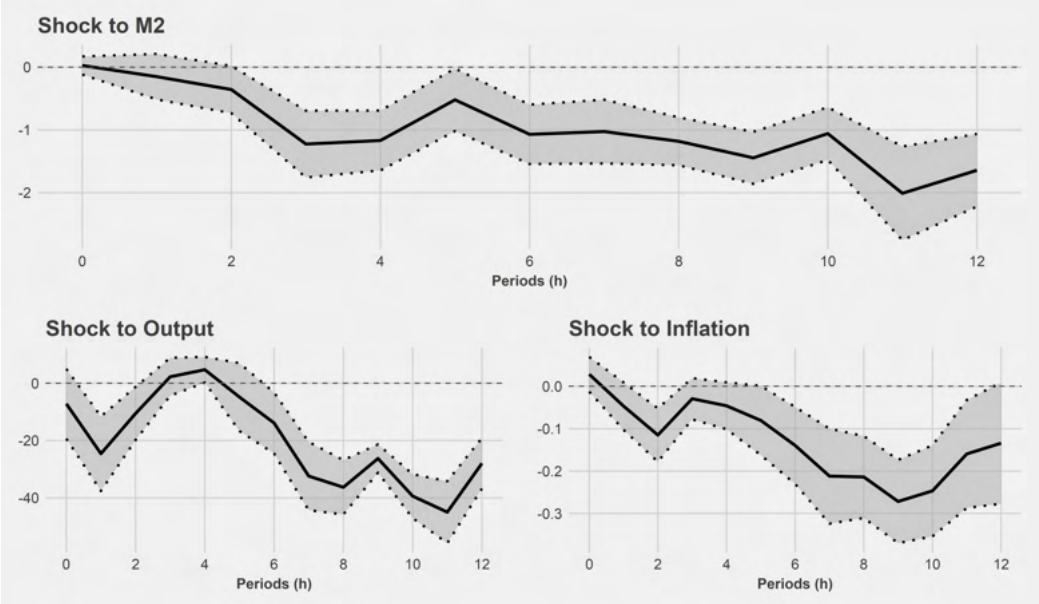

Figure 9: 1 Unit Reserve Requirement Shock on Macro Aggregates

Notes: M2 and Output responses are in terms of growth rates. Error bands at the 68% confidence interval.

The impulse responses for the macro aggregates paints a relatively standard picture. Contractionary monetary policy causes a statistically significant decline in M2, industrial production, and inflation. Although industrial production seems to somewhat recover around period four, the overall trend is negative. This could merely result from the limitations on sample size and measurement error in the industrial production measure.

[11] Refer to Koch-Weser (2013)

The baseline results on the policy and macro measures indicate that there is evidence that China's monetary policy has some transmission mechanism through the interest rate channel – in these specifications, it would primarily work through the lending rate channel. As will be expanded below, there is strong evidence linking the lending rate, loan growth, and tightening credit conditions in China, where loan growth decreased in response to tighter credit conditions in response to a contractionary monetary policy shock.

Effect on Aggregate Traditional and Shadow Credit

I now turn to the main analysis of this study — the effect of surprise monetary policy shocks on both traditional and shadow credit in China. Table 4 details the effect of a 1 unit reserve requirement shock on credit variables across three specifications. Figure 10, shows the impulse response out to 12 months for the LP-IV(2) specification. .

Table 4: Selected Impulse Responses from a 1 Unit Reserve Requirement Shock

Responses at month h $(100 \times \log \Delta \boldsymbol{Y}_{t+1})$		Local Projection – Instrumental Variable		
	Horizon (h)	(1)	(2)	(3)
Narrow Shadow	0	0.39 (0.45)	0.55 (0.52)	0.39 (0.44)
	2	0.63 (1.64)	0.59 (1.54)	0.53 (1.61)
	4	1.21 (3.47)	1.02 (3.28)	1.28 (3.44)
	8	-4.02 (5.25)	-4.1 (5.01)	-3.71 (5.08)
	12	-5.2 (5.51)	-5.01 (5.48)	-5.24 (5.62)
Aggregate WMP	0	6.94 (7.19)	4.76 (5.44)	6.74 (6.86)
	2	6.44 (5.18)	6.26 (4.73)	6.6 (5.2)
	4	20.27 (8.14)	19.67 (7.48)	20.39 (8.12)
	8	6.13 (9.68)	4.7 (8.47)	6.66 (9.1)
	12	0.94 (7.21)	0.23 (6.58)	2.44 (9.85)
Traditional Loans	0	-0.22 (0.07)	-0.16 (0.07)	-0.21 (0.06)
	2	-0.31 (0.12)	-0.29 (0.12)	-0.3 (0.12)
	4	-0.59 (0.17)	-0.54 (0.15)	-0.57 (0.17)
	8	-0.87 (0.36)	-0.81 (0.27)	-0.78 (0.35)
	12	-0.73 (0.45)	-0.7 (0.39)	-0.81 (0.51)
Lags (Monthly)			3 lags of $\{\boldsymbol{Y}, \boldsymbol{X}\}$	
Government Expenditure		None	Central	Total
First Stage F^{HAC}		13.53	17.14	15.43

Notes: HAC standard errors in parentheses.
$\boldsymbol{Y}$ is the vector of observed variables.
$\boldsymbol{X}$ is the vector of controls including the lagged instrument, observables, and exogenous variables.

Table 4 shows the results of three specifications of equation (1). The first of which does not include any government expenditure variable, the second includes the central government expenditure, and third uses the total, which includes local government expenditures as well. As shown, the results are all relatively similar and multiple periods have statistical significance at the 68%. What jumps out immediately across all three specifications is the following: in response to a contractionary monetary policy shock, traditional credit declined as expected, but

both measures of shadow credit expanded, with WMPs dominating the shadow credit growth. At peak, aggregate WMPs grew by roughly 20% across all three specifications. Although the traditional loan growth magnitude looks small, a 0.87% decline would be on the order of roughly 180 billion CNY if we assume the December 2014 loan amount for both domestic and foreign bank local currency loans. The results for aggregate WMP, although informative about the issuance of WMPs, does not tell us whether or not this is primarily driven by on or off-balance sheets. Those results will be examined in more detail in a later section. This also goes for the results of the narrow shadow credit growth. Although overall, we see an increase, the majority of the result is not statistically significant. Moreover, we do not see which shadow credit product — entrusted loans, trust loans, or undiscounted bankers' acceptances — dominate this behavior.

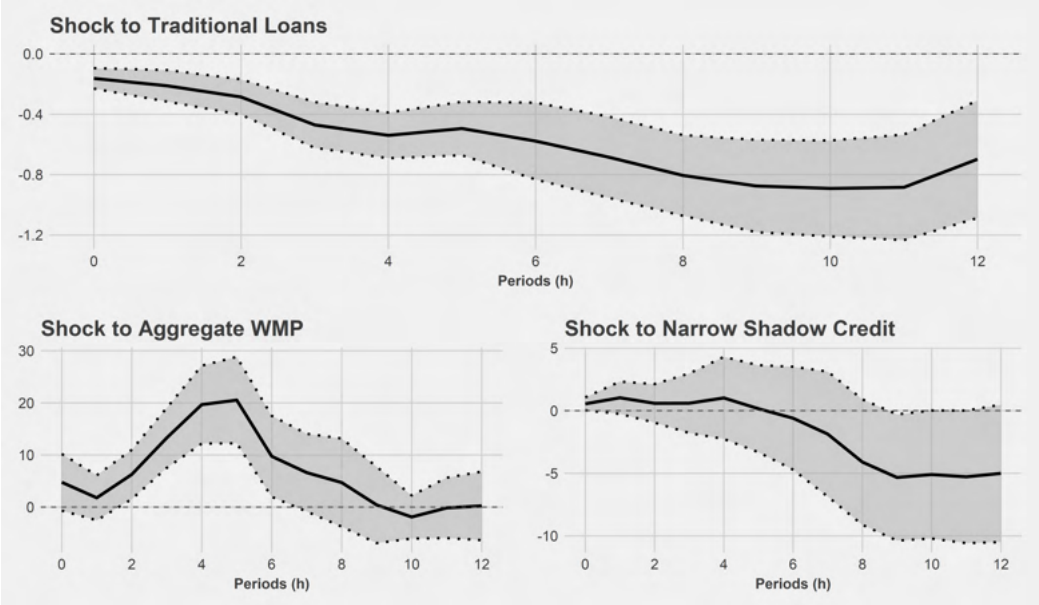

Figure 10: 1 Unit Reserve Requirement Shock on Credit Measures

Notes: Responses in terms of growth rates. Narrow shadow credit defined as the entrusted loans, trust loans, and undiscounted bankers' acceptances. Error bands at the 68% confidence interval.

Although the level of granularity in the baseline case is lacking, there are a few key takeaways. First, the behavior of WMPs suggest that banks prefer to substitute away from traditional credit products into shadow products in the face of tighter liquidity restrictions through the reserve requirement and lending rate increases. To be clear, in the baseline case the monetary transmission mechanism appears to work through two channels. Increasing the reserve requirement increases the lending rate (and to some extent, the repo rate), confirming the linkage between contractionary monetary policy and its effects on interest rates.[12] Moreover, this contractionary monetary policy shock causes the expected responses from output, inflation, and M2 growth — they decline. Second, the monetary transmission channel also appears to work through a regulatory avoidance behavior, where banks create shadow credit in response to tighter liquidity and capital requirements. Given the behavior of loans (which are subject to the reserve requirement) relative to the behavior of WMPs (which are not subject to the reserve requirement),

[12] Also broadly falling in line with the conclusions of Porter and Xu 2009, Porter and Cassola 2011, He and Wang 2012, Fernald et al. 2014, Kamber and Mohanty 2018 regarding the interest rate channel.

Chinese banks engage in regulatory avoidance in response to liquidity constraints tightening by increasing credit products that are not subject to stricter regulations. The response of the narrow shadow credit measure is potentially too noisy, given its components. To allow for more granular analysis of differing shadow credit products, a dis-aggregated LP-IV is detailed below (Section 6.3), where I redo the analysis but examine the individual components of the narrow shadow credit measure, as well as split the WMP products into guaranteed and non-guaranteed types.

6.3 Dis-aggregated Shadow Credit Analysis

To examine the individual contributions to the narrow shadow credit measure results, I re-estimate equations (1) and (2) but separate the components of narrow shadow credit: entrusted loans, trust loans, and undiscounted bankers' acceptances, as well as split WMPs between non-guaranteed and guaranteed. The instrument and the shock remain the same. Table 5, along with Figures 11, 12, and 13 from LP-IV(5) examine the effect of a 1 unit reserve requirement shock on the dis-aggregated measures of shadow credit and on WMP growth. The impulse responses show the specification utilizing central government expenditures. The policy indicator results are shown in Figure 23 in supplemental appendix A.5.

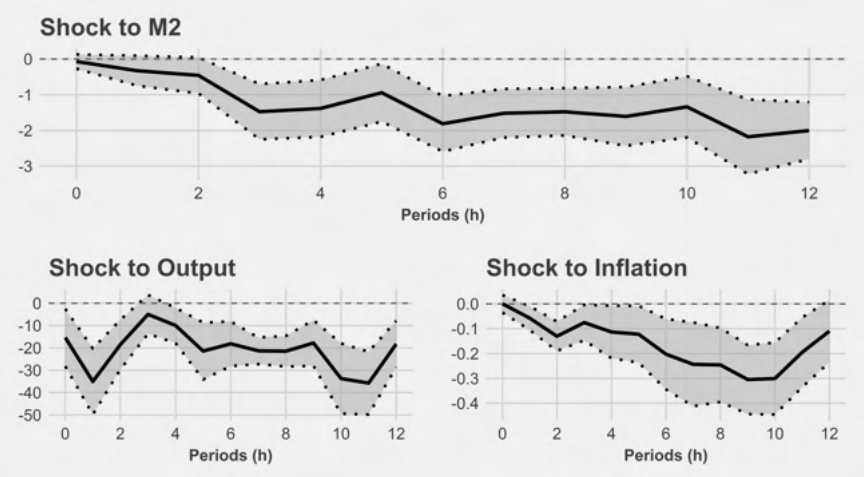

Figure 11: 1 Unit Reserve Requirement Shock on Macro Aggregates

Notes: M2 and Output responses in terms of growth rates. Error bands at the 68% confidence interval.

Starting with Figure 11, we can see that the macro indicators are consistent with the baseline results, where contractionary monetary policy shocks cause M2, industrial production, and inflation to decline. Figure 23 in supplemental appendix A.5 also provides similar policy variable responses to the baseline case, which, combined with the macro responses, give more credence to the robustness of the identification measure and the transmission of monetary policy through the interest rate channel.

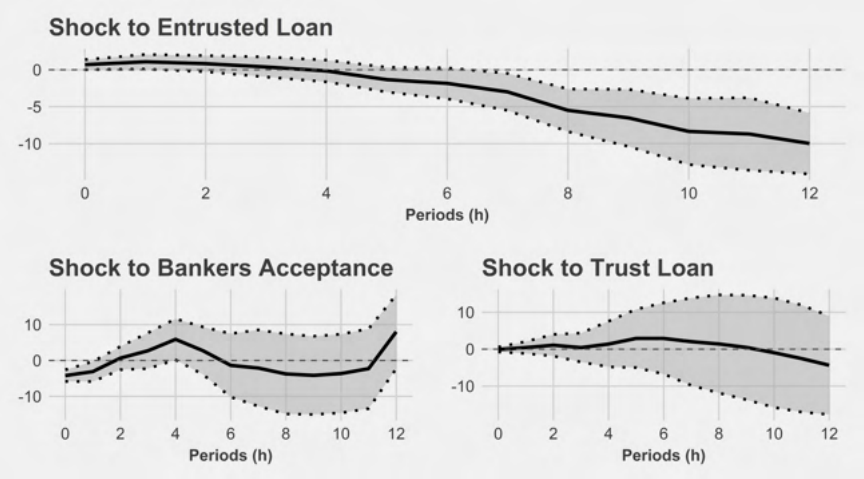

Figure 12: 1 Unit Reserve Requirement Shock on Credit Measures

Notes: Responses in terms of growth rates. Error bands at the 68% confidence interval.

Examining the dis-aggregated narrow shadow credit, there are some interesting insights. We see that entrusted loan growth increases rather consistently across all three specifications for the first few periods before declining, with significance, past period 4. This behavior is in line with the results of Chen et al. (2018), who find that contractionary monetary policy shocks increased entrusted loans. However, unlike the results in Chen et al. (2018), entrusted loans here eventually decline, with significance. The increase could be explained by tightening loan conditions, driving firms to bypass standard loans for firm-to-firm loans facilitated by the banks, while the decline could be the monetary policy shock wearing off. It appears that a reserve requirement shock has little to no effect on average on trust loans, where it never approaches any statistical significance. This result can be explained by the potential for double counting due to the inclusion of WMPs in the analysis. It could be that an increase in non-guaranteed WMPs did not necessarily increase trust loans, but could have instead been funneled into trust company investment into bonds.[13] Alternatively, it could also be that the effect of increased WMP issuance was funneled more to the banks' wealth management and securities arm, which would also utilize that cash flow for other investments, like bonds. A limitation to this study is the lack of access to bond holdings data differentiated between securities companies and trust companies to trace the destination of WMP funds from bank to non-bank intermediary.

As for the results on the undiscounted bankers' acceptances, the results are similar to those of the trust loans. Although on impulse, the decline is significant (roughly 4%), the effect dissipates quickly and the overall trend appears to indicate a negligible net effect throughout the forecast horizon. Arguably, the increasing trend in both trust loans and bankers' acceptances up until roughly period 4 could indicate that, despite being noisy, shadow credit expansion through these traditional measures exist in some form, though not large enough to hit statistical significance. Taking this at somewhat face value, the overall shadow credit behavior is still consistent with

[13] Non-guaranteed WMPs could represent the same transaction on banks' off-balance sheet holdings. Consider a non-guaranteed WMP as a liability and a trust loan as an off-balance sheet asset. Since funds generated from WMPs can be channeled into trust corporation investments into bonds, as well as trust loans, the insignificant results of the trust loan could indicate more funds from WMPs are channeled into bond investments rather than trust loans in response to tighter monetary policy.

the regulatory avoidance mechanism discussed in the baseline case. Since entrusted loans are off-balance sheet (trust loans originate from trust firms, so would not be on a bank balance sheet), they would not be subject to the higher capital restriction due to higher reserve requirements. With the decline in traditional lending, firms may be forced to rely on entrusted loans for external finance, hence the modest increase in the results.

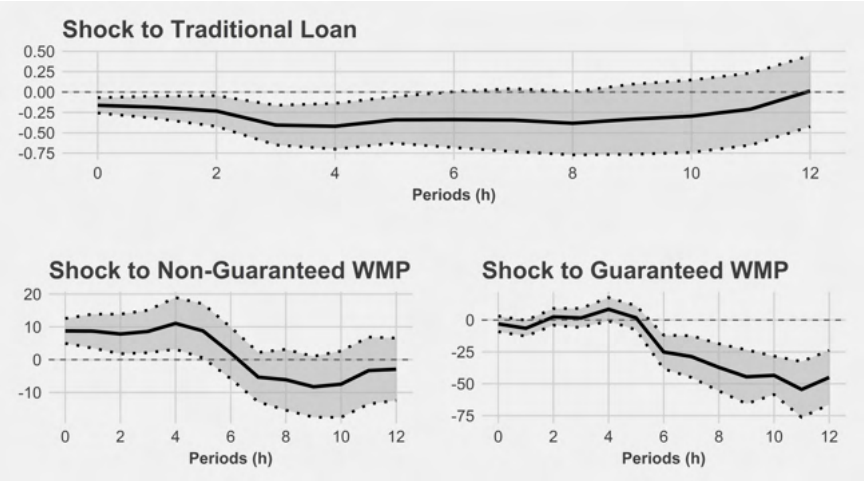

Figure 13: 1 Unit Reserve Requirement Shock on Wealth Management Products

Notes: Responses in terms of growth rates. Error bands at the 68% confidence interval.

The more interesting result, however, is the behavior of the non-guaranteed WMP issuance. There is a statistically significant increase over at least 6 periods in the issuance of non-guaranteed WMPs, with a peak change of roughly 11.06% in non-guaranteed WMP issuances. This suggests that off-balance sheet activity (since non-guaranteed WMPs are not recorded on the banks' balance sheet) increases in response to a tightening of monetary policy, at least on the aggregate level. This makes sense for a couple of reasons – the banks are simply responding to higher liquidity and capital constraints by bypassing these regulations through issuing more off-balance sheet products (non-guaranteed WMPs). In this sense, the regulatory arbitrage game being played allows the banks to recoup their losses from the falling loan issuance by utilizing non-guaranteed WMPs (and the bank-trust cooperation) to offset the revenue loss from the higher capital requirement imposed by a higher reserve requirement. The non-guaranteed WMP funds investment by trust funds are directed by the banks that issued the WMPs, who receive "full participation rights in the profits and losses of the underlying loans or debt securities..." (Ehlers et al. 2018). The findings here are in line with Hachem and Song (2015), who argue that tighter liquidity restrictions trigger a rise of non-guaranteed WMPs. This finding also is consistent with Chen et al. (2018), who find that shadow products like wealth management products increased in response to a decline in bank loans.[14]

The behavior of guaranteed WMP growth, however, is noisier. Although there is a small upward trend for the first 5 periods, guaranteed WMPs appear to decline, with significance, at roughly the same period as its non-guaranteed counterpart. Broadly, the response does some-

[14] It should also be noted, however, their main mechanism is that a fall in bank loans caused local governments to issue debt that funded shadow credit products that also include entrusted loans.

what mimic the non-guaranteed WMP growth. Although guaranteed WMPs are not listed on banks balance sheets, they are designed as a financial product that provides maturity transformation that avoids some regulatory requirements that would have been imposed on traditional credit products. To that end, the significant increase at around period 4 (as well as the increasing trend from period 0 through roughly 5) could suggest that as loan volumes decline in response to a reserve requirement shock, banks issue more guaranteed WMPs in line with their original purpose — as a shadow savings product. Recall that guaranteed WMPs are considered safe assets that have higher returns relative to a traditional loan, which were subject to deposit rate ceiling requirements.[15] Under this context, the response of guaranteed WMPs behave (roughly) in an expected manner in response to tighter liquidity requirements that apply to traditional credit products.

[15] These requirements were lifted in October of 2015, in line with the interest rate liberalization plan.

Table 5: Granular Narrow Shadow Credit Response from a 1 Unit Reserve Requirement Shock

Responses at month h ($100 \times \log \Delta \boldsymbol{Y}_{t+1}$)		Local Projection – Instrumental Variable		
	Horizon (h)	(4)	(5)	(6)
Entrusted Loans	0	0.85 (0.72)	0.69 (0.68)	0.8 (0.73)
	2	0.88 (1.12)	0.83 (1.09)	0.88 (1.16)
	4	-0.04 (1.43)	-0.16 (1.48)	0.24 (1.55)
	8	-5.72 (2.88)	-5.49 (2.88)	-4.53 (3.26)
	12	-9.66 (4)	-9.97 (4.13)	-7.57 (3.69)
Trust Loans	0	-0.33 (0.68)	-0.1 (0.65)	-0.31 (0.69)
	2	0.88 (3.15)	1.07 (2.92)	0.98 (3.19)
	4	1.34 (6.26)	1.38 (6.18)	1.64 (6.4)
	8	0.6 (13.87)	1.41 (13.27)	2.62 (13.07)
	12	-4.76 (13.64)	-4.35 (13.33)	-2.71 (14.62)
Bankers' Acceptances	0	-4.42 (1.59)	-4.22 (1.62)	-4.49 (1.72)
	2	1.33 (3.78)	0.66 (3.24)	0.68 (3.79)
	4	6.47 (6.55)	5.89 (5.72)	6.27 (6.54)
	8	-3.03 (13.75)	-3.75 (11.15)	-1.48 (11.83)
	12	8.35 (11.62)	7.99 (10.27)	5.83 (11.65)
WMP (Non-Guaranteed)	0	9.6 (4.56)	8.77 (3.79)	10.28 (4.48)
	2	6.69 (5.46)	7.83 (6.05)	7.89 (5.64)
	4	10.6 (7.71)	11.06 (7.88)	10.77 (8.01)
	8	-6.25 (9.44)	-6.13 (9.27)	-4.47 (9.02)
	12	-2.88 (9.45)	-2.93 (9.51)	0.63 (10.08)
WMP (Guaranteed)	0	-1.37 (7.83)	-3.06 (6.12)	-1.03 (7.81)
	2	2.44 (8.59)	2.42 (6.58)	1.15 (8.46)
	4	10.51 (9.29)	8.39 (9.19)	9.74 (9.95)
	8	-33.17 (17.54)	-37.16 (18.5)	-30.17 (20.08)
	12	-42.55 (19.6)	-45.03 (21.21)	-42.9 (20.01)
Traditional Loans	0	-0.22 (0.09)	-0.16 (0.09)	-0.21 (0.09)
	2	-0.25 (0.21)	-0.23 (0.19)	-0.23 (0.21)
	4	-0.47 (0.3)	-0.42 (0.28)	-0.44 (0.3)
	8	-0.45 (0.5)	-0.38 (0.39)	-0.33 (0.44)
	12	-0.01 (0.48)	0.01 (0.44)	0.02 (0.52)
Lags (Monthly)		3 lags of $\{\boldsymbol{Y}, \boldsymbol{X}\}$		
Government Expenditure		None	Central	Total
First Stage F^{HAC}		15.42	25.31	16.91

Notes: HAC standard errors in parentheses.

$\boldsymbol{Y}$ is the vector of observed variables.

$\boldsymbol{X}$ is the vector of controls including the lagged instrument, observables, and exogenous variables.

Overall, the results are complimentary to the baseline results and explain the insignificant movement of the narrow shadow credit measure. While the decline in narrow shadow credit is clearly being driven down by the response of the undiscounted bankers' acceptances, the increase in off-balance sheet activity through entrusted loan growth gives additional credibility to the story that banks substitute between regulated and less-regulated products. Again, this is consistent with the results in Chen et al. (2018), who find that tighter monetary policy increased

entrusted loan growth.

To reiterate, there are two key findings: 1) There is further evidence of the interest rate channel of monetary policy transmission, as shown in both the baseline results and the disaggregated results. And 2) monetary policy has a direct effect on shadow credit creation — a surprise contractionary monetary policy shock caused an increase in the narrower measure of shadow credit, as well as an increase in the issuance of wealth management products. The latter finding poses some implications for the conduct of complimentary macroprudential and monetary policies. This implication will be further discussed in the concluding remarks.

6.4 Net Effect on Shadow Credit: Back of the Envelope Calculation

To get a sense of scale of the amount of credit that would be generated as a result of a 1 unit reserve requirement shock, I do a quick back of the envelope calculation of the dynamic growth of credit over 12 months, starting with WMPs, under the following guidelines:

1. My WMP data does not have outstanding balances separated between non-guaranteed and guaranteed WMPs. So, given the estimates of the share between non-guaranteed and guaranteed (roughly 67% of WMPs were non-guaranteed in 2014), I construct non-guaranteed and guaranteed WMP balances by taking 67% and 33% of the total outstanding WMP balance.

2. Because the median WMP maturity is roughly 3 months, I take a 3 month average for the last 3 months of 2014. This value is the 3 month average WMP outstanding balance by type of WMP.

3. Taking this average outstanding balance, I divide it by the December 2014 number of WMP issued to get a measure of the per unit WMP value.

4. Using the December 2014 values for initial number of issued guaranteed and non-guaranteed WMPs, I use the percentage changes given from the LP-IV(6) specification (Table 5) and multiply the period impulse with the initial values.

5. This new generated value is the next period forecasted WMP issuance. I then multiply this value by the constructed per unit WMP balance from Step 3 to get an estimated value of WMPs being added to the Chinese economy for every period in H.

This construction is due to not having WMP balances data separated between non-guaranteed and guaranteed WMPs, which requires some heavy-handed assumptions to get a quick estimate of the value of credit generated via WMPs after a shock. The large caveat is that I am using the average end of 2014 outstanding balance of WMPs (in terms of 1 billion CNY). This assumes that the balance stays fixed during the forecast horizon, which is unlikely, but at the minimum allows for a lower-bound estimate relative to that 3 month average. For the other shadow variables, the process was easier since those variables are already in terms of outstanding balances growth. Table 6 details the back of envelope credit calculations over 6 periods, using December 2014 as the initial period and $h = 0$ as shock period.

Period	EL	TL	UBA	WMPN	WMPG	Shadow	Loans
Initial	9.33	5.35	6.87	10.21	5.03	36.79	84.95
0	9.40	5.337	6.56	11.26	4.98	37.53	84.77
1	9.52	5.35	6.38	12.43	4.77	38.45	84.59
2	9.60	5.40	6.42	13.42	4.82	39.66	84.39
3	9.65	5.43	6.60	14.57	4.83	41.08	84.03
4	9.68	5.52	7.01	16.14	5.31	43.65	83.67
5	9.58	5.68	7.18	17.67	5.56	45.68	83.34
6	9.41	5.85	7.05	17.80	4.16	44.27	83.03

Table 6: Back of Envelope Calculation of Credit Growth Post Shock (1 Trillion CNY)

Notes: EL are entrusted loans, TL are trust loans, UBA are undiscounted bankers' acceptances, WMPU are non-guaranteed WMPs, WMPG are guaranteed WMPs, shadow credit is the sum of EL, TL, UBA, WMPN, and WMPG. Loans includes foreign currency bank loans and domestic currency bank loans as measured under the Total Financing to the Real Economy measure published by the PBOC.

From the back of envelope calculations, we can see that the non-guaranteed WMP growth dominates in CNY terms all other measures of shadow credit. Intuitively this makes sense, since the largest off-balance sheet product in China are non-guaranteed WMPs. The other measures of shadow credit show modest contributions to the overall change in shadow credit. On impulse, the reserve requirement increase caused a net increase in total shadow credit by roughly 740 billion CNY, with non-guaranteed WMPs contributing roughly 1.5 trillion CNY, undiscounted bankers' acceptances contributed roughly -310 billion CNY, trust loans contributing -13 billion CNY, and entrusted loans adding 70 billion CNY.

Compared with shadow credit, traditional loans represent a little over double of the total amount of credit in the Chinese economy. Even with the modest decreases in response to the contractionary monetary policy shock, on impulse the overall contribution to traditional loans is -180 billion CNY. From these results, it is clear that focusing on WMPs, considering the magnitude of the effect (in trillions of CNY), is important, considering the lighter regulatory environment surrounding WMPs. In this case, monetary policy is driving the growth behavior of WMPs, potentially increasing systemic risk to the Chinese financial system.

Robustness

For robustness, I repeat both the baseline and dis-aggregated set ups, but use the alternate instrument. The corresponding F^{HAC} for the alternate baseline is 5.23, so the instrument can be considered weak. However, with the exception of the inflation and industrial production results, the policy and credit variables responded in a manner consistent with the primary baseline specification. The inflation and industrial production results are puzzling, potentially suggesting that the alternate instrument does not adequately identify monetary policy. In the dis-aggregated set up, the corresponding F^{HAC} is 10.35, indicating a strong instrument. However, the results mirror the alternate baseline case. This potentially could point to the alternate

measure of the monetary policy surprises as picking up too much extra information after policy announcements. Alternatively, it could indicate that a majority of policy announcements were made *prior* to the close of trading day. This could suggest that the alternate instrument is not the cleanest identification of monetary policy, causing the results on industrial production and inflation, which could be less affected by surprises than the financial variables (since financial variables would not be able to "price in" surprises), to be somewhat puzzling. Figures 25, 26, 27, 28, 29, 30, and 31 show the impulse responses for the equivalent of LP-IV(3) from Table 4 and LP-IV(6) from Table 5 and can be found in supplemental online appendix B.2 and B.3.

Additionally, given the strong response of the lending rate in the main results, I run an LP using the lending rate as the policy indicator but using the alternate measure given its higher F^{HAC}. The associated F^{HAC} is 10.46, so the monetary policy surprises identification passes the weak-instrument threshold. The impulse responses are consistent with those of the first two cases, with some slightly puzzling results from output and inflation. Take for example the response of the narrow shadow credit and WMPs in Figures 14, 15, and 16:

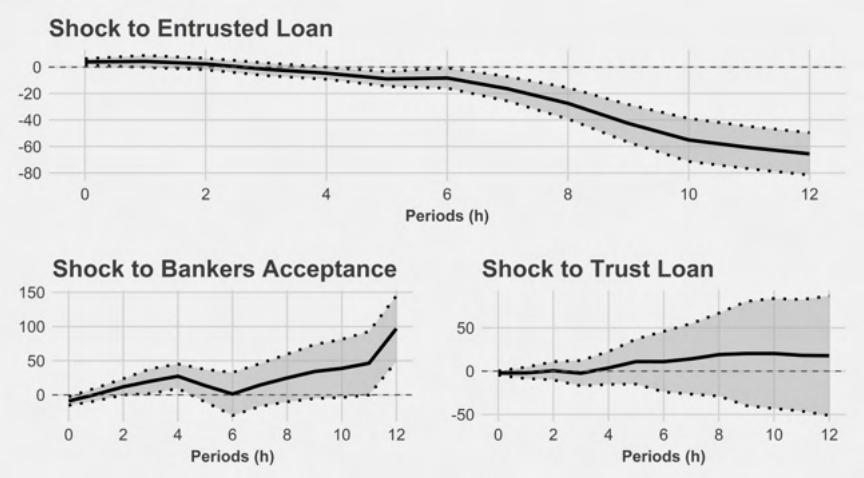

Figure 14: 1 Unit Increase in Lending Rate on Narrow Credit Measures

Notes: Responses in terms of growth rates. Error bands at the 68% confidence interval.

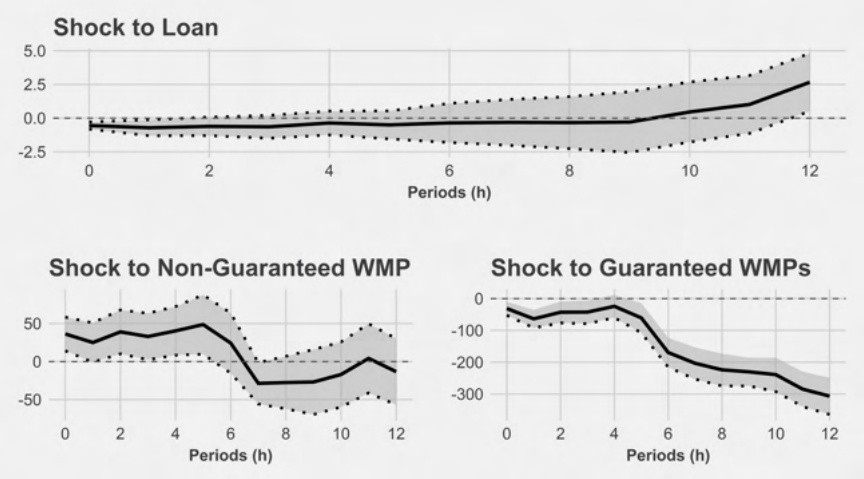

Figure 15: 1 Unit Increase in Lending Rate on WMPs

Notes: Responses in terms of growth rates. Error bands at the 68% confidence interval.

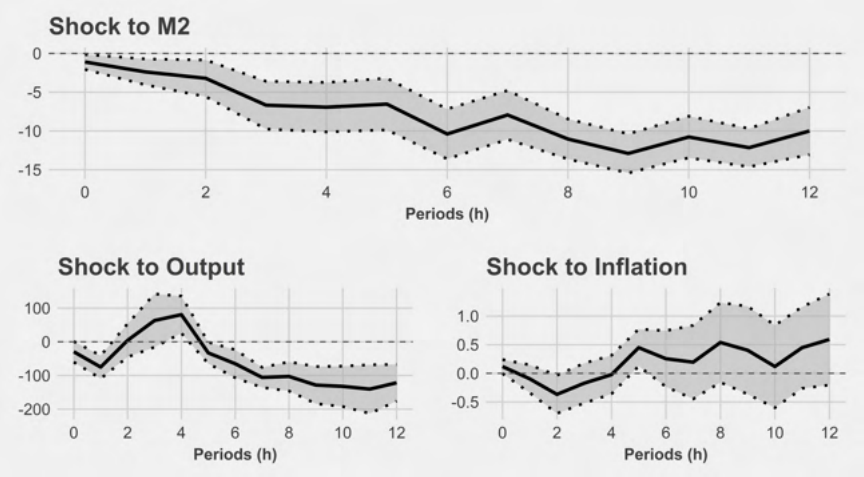

Figure 16: 1 Unit Increase in Lending Rate on Macro Indicators

Notes: M2 and Output responses in terms of growth rates. Error bands at the 68% confidence interval.

We can see there is consistency with the credit responses in response to a 1% increase in the lending rate. These results provide additional robustness to the story in the main results, where contractionary monetary policy restricts liquidity from traditional products so banks increase their off-balance sheet activity by expanding shadow products such as wealth management products and entrusted loans.

7 Conclusion

This paper examines the interaction between monetary policy and the shadow banking sector in China. Specifically, it examines the linkages between tighter liquidity and capital requirements (through an increase of the reserve requirement) on off-balance sheet lending activities undertaken by Chinese banks. Utilizing an updated measure of surprise monetary policy shocks

as an instrumental variable, the impulse responses are estimated using a two-stage local projection using HAC standard errors. The expansion of the shadow banking sector in China can be partially explained by attempts by banks to bypass liquidity and capital requirements. I find that a 1 unit increase in the reserve requirement increases the issuance of off-balance sheet wealth management products by 11% at peak. Alternative forms of credit, such as guaranteed wealth management products also expands to a peak of roughly 10%. A back of the envelope calculation suggest that a 1% increase in the reserve requirement would increase shadow credit by roughly 740 billion CNY, which is primarily driven by non-guaranteed WMPs. Combined with the decline in loan volume and an increase in interest rates in response to contractionary monetary policy, there is empirical evidence that a regulatory avoidance mechanism (on top of the existing interest rate channel) drives some of the behavior of the Chinese banking system into expanding more shadow credit in the presence of tighter regulation. Additional results show that the interest rate channel is alive and well in The People's Republic, where the transmission of monetary policy appears through a few different channels. First, interest rates play a role – credit is directly affected by a tightening of interest rates in response to contractionary policy. Second, the traditional bank lending channel is upended by the expansion of shadow lending, in the form of WMPs. And third, banks appear to substitute away from traditional credit products in favor of off-balance sheet credit products designed to avoid the regulatory burdens imposed by Chinese regulators.

The rapid expansion of wealth management products in China can be partially explained by tighter regulatory burdens imposed by the regulatory authorities. Because the regulatory authorities view WMPs as a source of system wide risk, it is important to understand the role that monetary policy plays in conjunction with the macroprudential policies implemented by the CBIRC. In this case, the expansion of bank off-balance sheet credit products, especially non-guaranteed WMPs is exacerbated by tighter regulatory and credit environments. This suggests that macroprudential policy in China may be hampered by monetary policy, potentially increasing the system wide risks associated with off-balance sheet shadow credit products. To be clear, the story painted by this paper revolves around the supply of shadow credit, where financial intermediaries respond to tighter liquidity and regulatory requirements by increasing the supply. Additional analysis examining the demand side for shadow credit would be an interesting extension, in light of private firms' limited access to external finance through traditional means. Further studies examining the role of bank type and shadow credit growth, given the differences in bank size, customer base, and relationship with the state, may prove interesting and useful for our growing understanding of the interaction between monetary policy and the financial system in China.

A Supplemental Appendix — For Publication

A.1 Narrow Shadow Credit Size

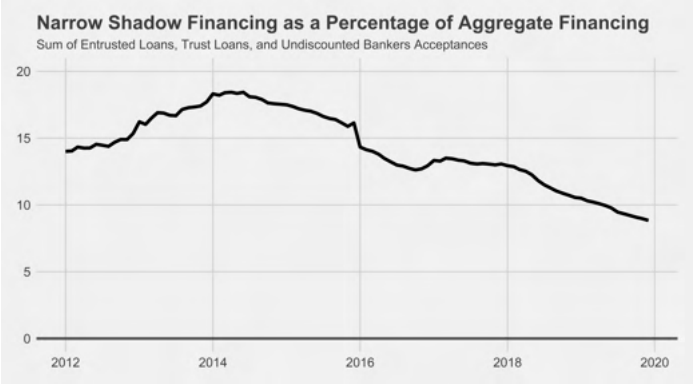

Figure 17: Narrow Shadow Credit as a Percentage of Total Loans

Notes: Narrow shadow is defined here as the sum of entrusted loans, undiscounted bankers' acceptances, and trust loans. Source: CEIC Asia Database

A.2 Capital Market Exposure by Trust Firms

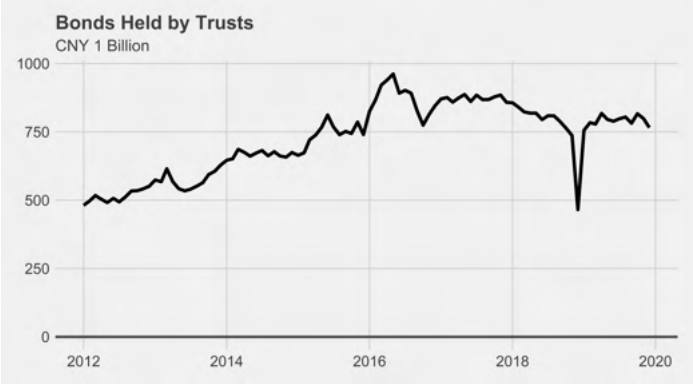

Figure 18: Bond Holdings by Trust Firms

Notes: Source: CEIC Asia Database

A.3 P2P Lending Balance

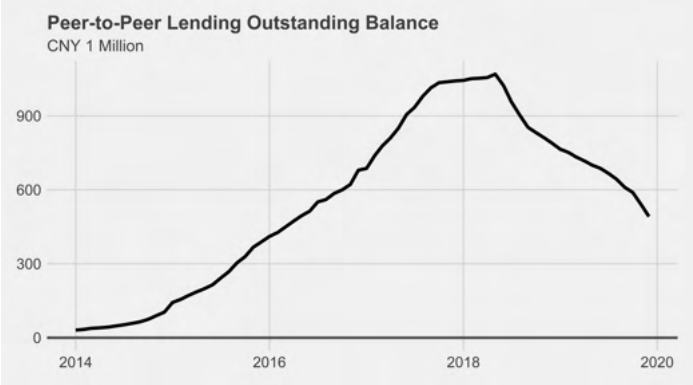

Figure 19: Peer-to-Peer Lending Balance

Notes: Source: Wang Dai Zhi Jia and CEIC Asia Database

A.4 Baseline Local Projection – Alternative Specification Using Total Government Expenditure as Control

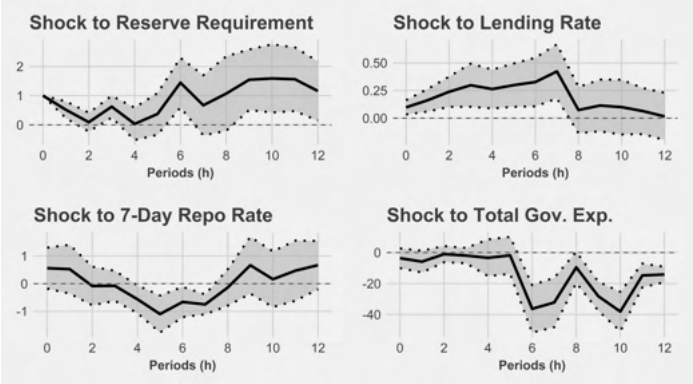

Figure 20: 1 Unit Reserve Requirement Shock on Policy Indicators

Notes: Government Expenditure response in terms of growth rates. Error bands at the 68% confidence interval.

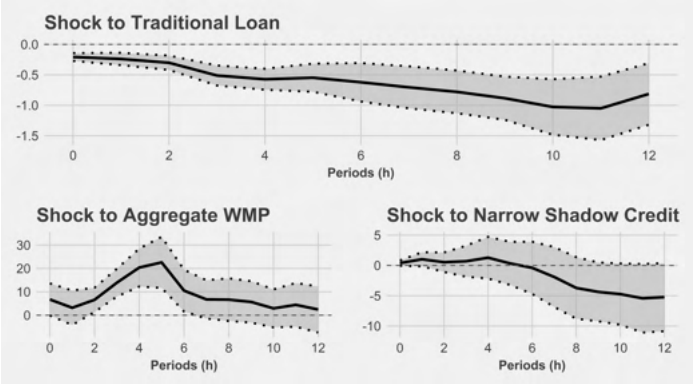

Figure 21: 1 Unit Reserve Requirement Shock on Credit Indicators

Notes: Responses in terms of growth rates. Error bands at the 68% confidence interval.

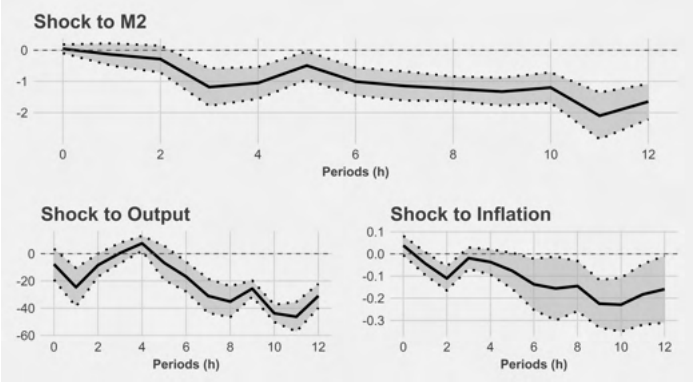

Figure 22: 1 Unit Reserve Requirement Shock on Macro Indicators

Notes: M2 and Output responses in terms of growth rates. Error bands at the 68% confidence interval.

A.5 Policy Responses for LP-IV(5) from Table 5

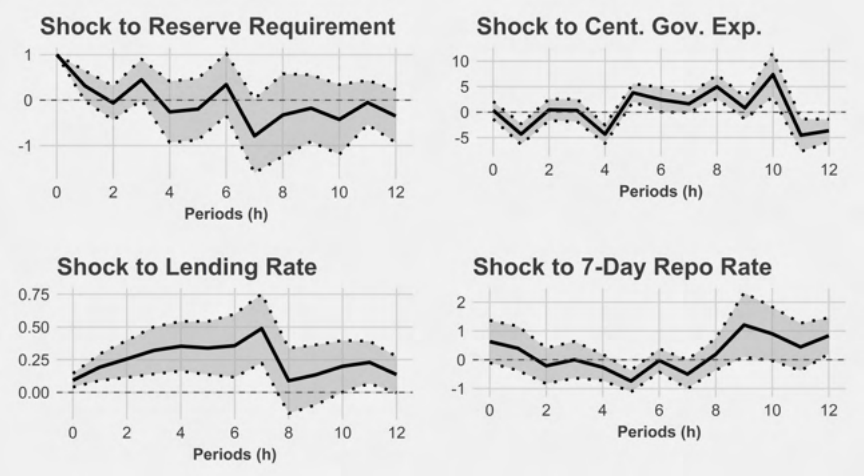

Figure 23: 1 Unit Reserve Requirement Shock on Credit Indicators

Notes: Central Government Expenditure response in terms of growth rates. Error bands at the 68% confidence interval.

B Supplemental Online Appendix — Not For Publication

B.1 Alternative Instrument

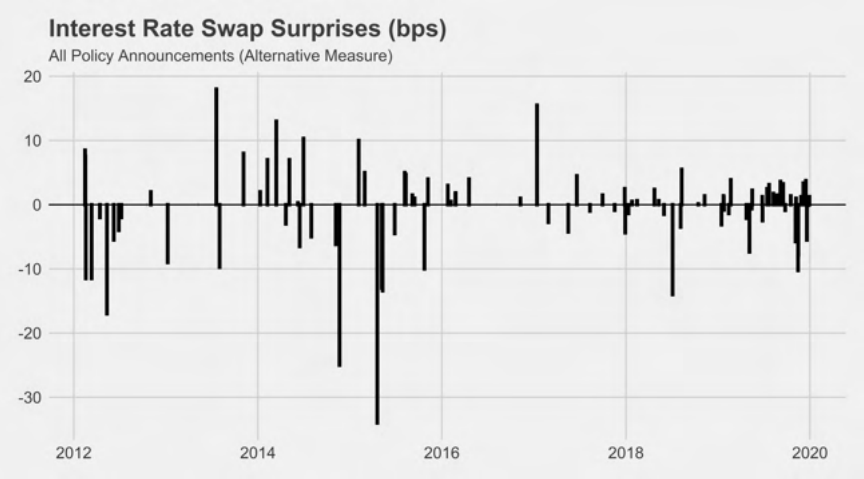

Figure 24: Alternative Surprise Measure

B.2 Robustness: Baseline with Alternate Instrument

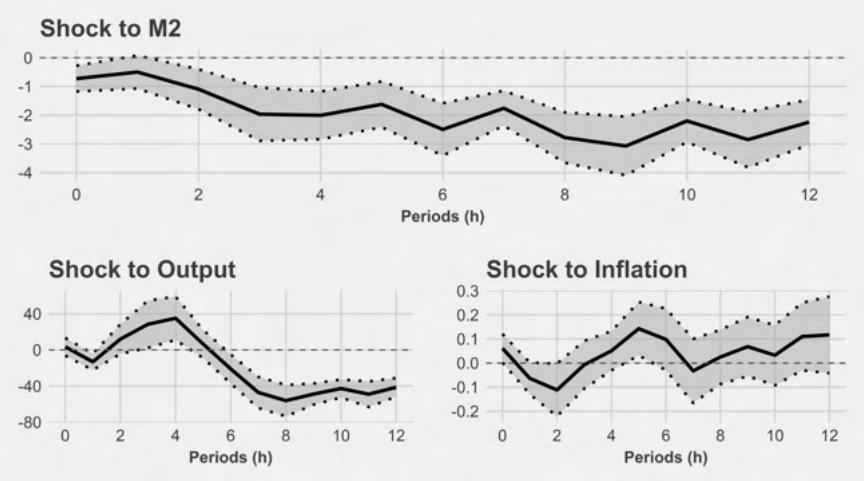

Figure 25: 1 Unit Reserve Requirement Shock on Macro Aggregates

Notes: M2 and Output responses in terms of growth rates. Error bands at the 68% confidence interval.

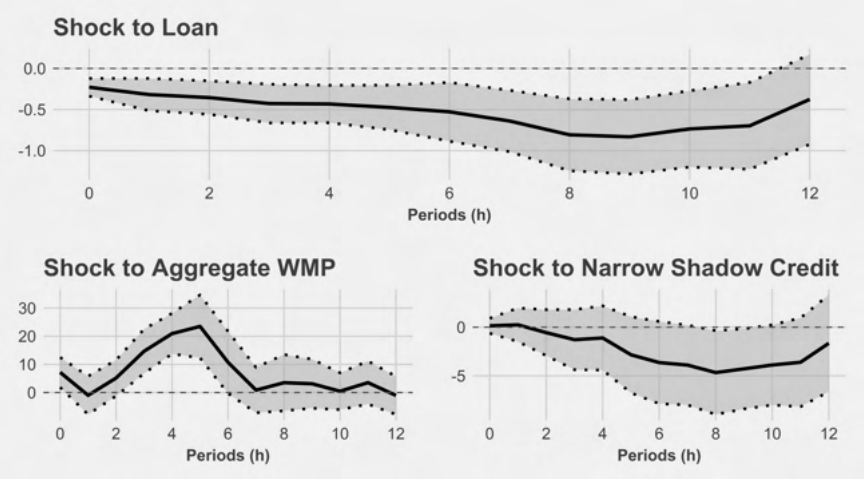

Figure 26: 1 Unit Reserve Requirement Shock on Credit Indicators

Notes: Responses in terms of growth rates. Error bands at the 68% confidence interval.

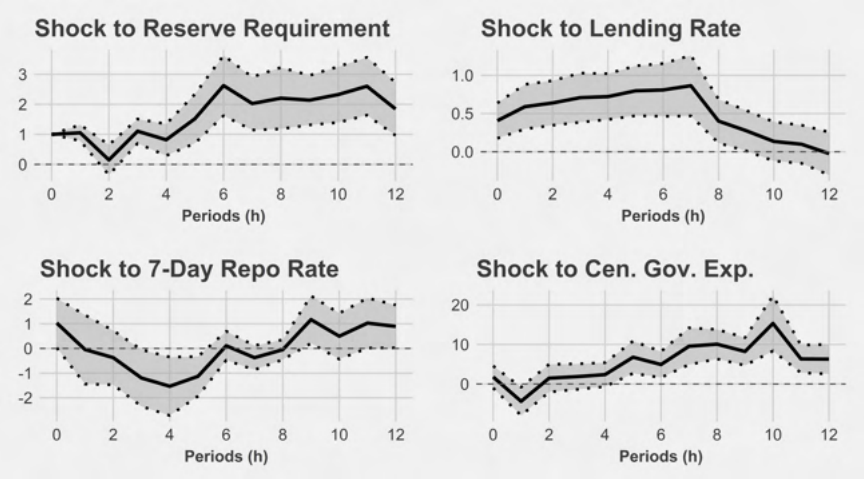

Figure 27: 1 Unit Reserve Requirement Shock on Policy Indicators

Notes: Central Government Expenditure in terms of growth rates. Error bands at the 68% confidence interval.

B.3 Robustness: Dis-Aggregated with Alternate Instrument

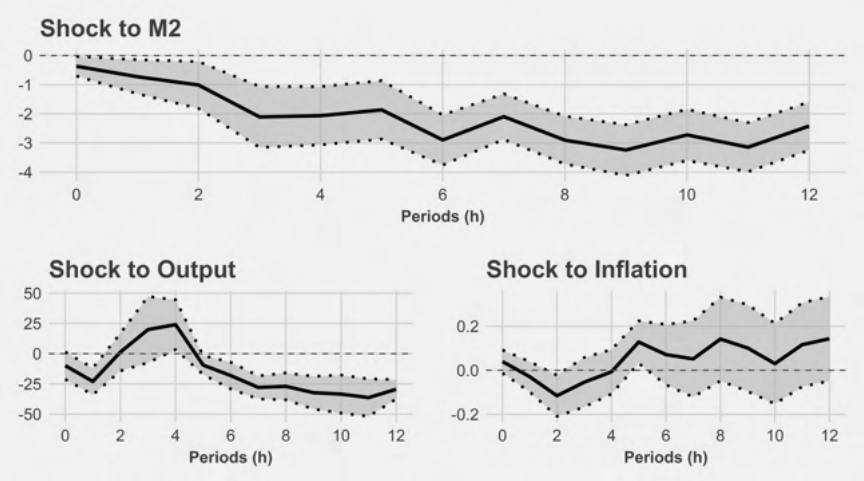

Figure 28: 1 Unit Reserve Requirement Shock on Macro Aggregates

Notes: M2 and Output responses in terms of growth rates. Error bands at the 68% confidence interval.

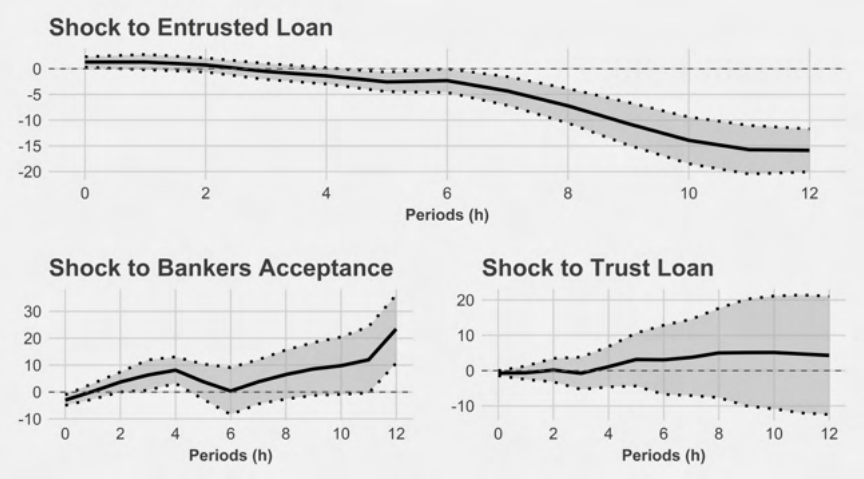

Figure 29: 1 Unit Reserve Requirement Shock on Credit Indicators

Notes: Responses in terms of growth rates. Error bands at the 68% confidence interval.

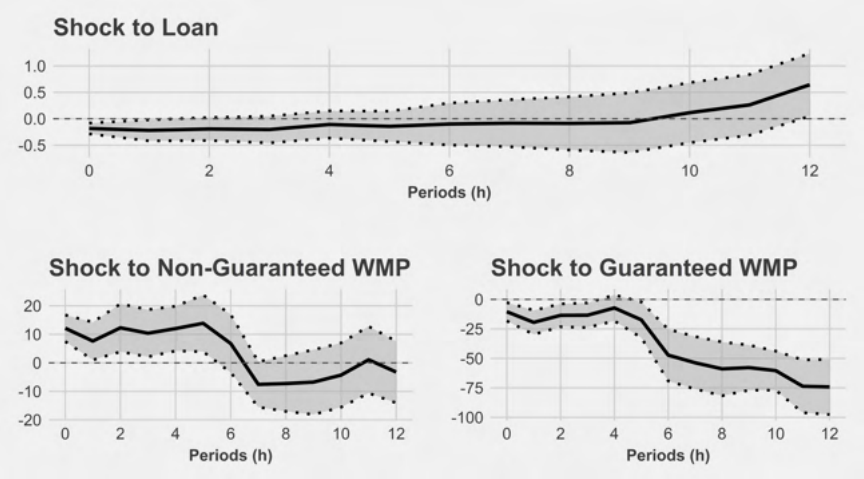

Figure 30: 1 Unit Reserve Requirement Shock on Policy Indicators

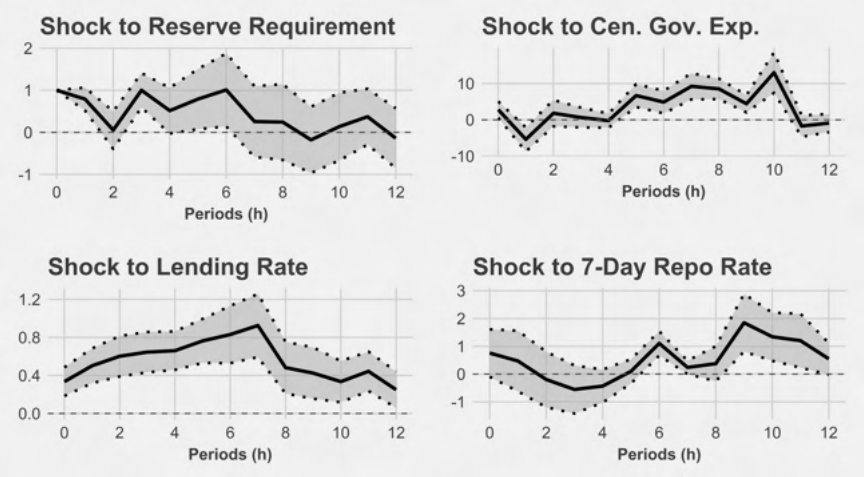

Figure 31: 1 Unit Reserve Requirement Shock on Policy Indicators

Notes: Central Government Expenditure in terms of growth rates. Error bands at the 68% confidence interval.

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