Fiscal Stimulus, Deposit Competition, and the Rise of Shadow Banking: Evidence from China*

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Abstract

The rise of shadow banking and attendant financial fragility in China can be traced to fiscal stimulus and deposit competition following the global financial crisis (GFC). To support the government's post-GFC fiscal stimulus, the "Big Four" state-owned banks significantly expanded new loan supply. Exploiting heterogeneity in their access to deposits for supporting the loan growth, in particular that one of the big banks lost deposits due to the slump in the export sectors and competed more aggressively for deposits, we find that small and medium-sized banks with large geographical exposure to this bank increased reliance on shadow banking. Exposed banks issued Wealth Management Products (WMPs)—short-maturity, off-balance-sheet substitutes for deposits—creating rollover risks for the issuers, as reflected by higher yields on new WMPs and higher borrowing rates in the interbank market.

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I. INTRODUCTION

Shadow banking – unregulated or lightly regulated non-bank part of the financial sector lacking an explicit safety net – has evolved into a significant fraction of the overall financial sector in not just developed but also emerging market economies. IMF (2014) notes that under some measures, shadow banking grew not only before the global financial crisis but also after, and in emerging markets, its growth outpaced the growth of the traditional banking system. Understanding the causes and consequences of its growth is thus becoming an important area of research in academia, policy and practice. While the focus in the extant literature has been on monetary policy (the level of interest rates in particular) and on private incentives to arbitrage bank regulation (most notably capital requirements)[1], we show in this paper that large-scale *fiscal* policies can also give rise to a rapid growth of the shadow banking system. As banks dramatically increase lending to implement the fiscal policy, they compete more aggressively for deposits. In turn, some banks – especially the ones vulnerable to deposit competition – shift their funding source from deposits to less-regulated short-maturity shadow banking products which give them greater flexibility in managing on- and off-balance sheet activities while complying with regulations such as deposit-rate ceilings and loan-to-deposit ratios. Given the different maturity structures and safety-net privileges between deposits and deposit-like shadow banking products, such a shift induced by fiscal policy can materially influence the rollover risk of the banking sector.

We establish this mechanism by studying the role of the RMB 4 trillion fiscal stimulus in China following the global financial crisis (GFC) – and its complex interaction with deposit competition and deposit regulations – in spurring growth and fragility in its shadow banking sector.[2] We focus on banks' issuance of Wealth Management Products (WMPs), which are short-maturity deposit-like shadow banking products that took off in scale after 2010 and continued until 2015 (see Figure 1).[3] We exploit the fact that while the "Big Four" state-owned banks, which constitute a lion's share of both the deposit and interbank markets in China, pumped large volumes of new loans into the economy to support the government's post-GFC

[1] Recent research finds – we elaborate in Related Literature (Section 2) – that the shadow banking sector can arise outside the traditional banking system due to tightened regulations on banks (Buchak et al., 2018; Xiao, 2020), or within the banking system in the form of regulatory arbitrage (Acharya et al., 2013a, 2013b; Borst, 2013).

[2] The *Financial Times* reports that according to an analysis of 103 Chinese banks by Wigram Capital Advisors, shadow bank lending accounts for 16.5% of the formal loan book (*FT* May 2 2016, *China financial regulator clamps down on shadow banking*, by Don Weinland and Gabriel Wildau).

[3] China's central bank, the People's Bank of China (PBC), along with other financial regulators, announced a set of regulations to curb further expansion of shadow banking. They first announced the guidelines for "Regulating the Asset Management Business of Financial Institutions" in April 2018 (click here for more details), and the specific rules for the transition period have been modified a few times since then.

fiscal stimulus, one of the big banks, Bank of China (BOC), stood out: BOC, the most predominant financial institution serving the import-export sectors, also suffered disproportionately large losses in foreign currency deposits due to the slump in the export sectors.[4] To stay below the regulatory limit of the loan-to-deposit ratio (LDR), BOC competed more aggressively for deposits. We show that this deposit competition by the BOC, which was induced by the fiscal policy and plausibly an exogenous shock to other banks, had a *causal* effect on small and medium-sized banks' (SMBs) issuance of WMPs: SMBs with high geographical exposure to BOC increased the volume of new WMPs sharply.[5] Finally, we document that this rapid growth imposed substantial rollover risks for the issuing banks, as reflected by higher yields on new WMPs, higher borrowing rates in the inter-bank market, and greater stock market corrections during episodes of inter-bank market stress.

In terms of institutional setting, bank deposits have historically been tightly regulated in China, both in terms of issuance and balance-sheet restrictions. During our sample period of 2007-2015, the People's Bank of China (PBC, China's central bank) set time-varying ceilings on bank deposit rates, which were almost always binding. In addition, the LDR requirement—loan balance *not* to exceed 75% of deposit balance—placed a cap on bank's (on-balance-sheet) lending activities. WMPs help banks to circumvent such on-balance sheet regulations *and* offer them greater flexibility in managing both asset and liability sides of the balance sheet; for instance, investment projects financed by *principal-floating* WMPs are recorded off banks' balance sheets and do *not* raise on-balance-sheet LDR. In addition, WMPs are not subject to any price restrictions so that banks can offer WMPs at higher rates than regulated deposit rates to attract more savings. Moreover, banks can design the structure of WMPs—including the issuing amount and maturity—on a *product* basis to manage their liquidity needs. In contrast, the adjustment of deposit rates would apply to all the depositors including those who are yield insensitive; and banks cannot freely choose a particular maturity structure of deposits.

In our first set of empirical tests, we link the jump in WMP issuance after 2010 to the massive fiscal stimulus and heightened deposit competition that followed. To begin with, we show that among the four large state-owned banks, BOC's distinctive deposit-side activities

[4] The exchange of export-related foreign currency deposits for domestic-currency (RMB) deposits was one of the main channels of M0 increase in China before the slowdown of net exports due to the GFC. See a Reuters report here.

[5] The Big Four banks also increased WMP issuance during the post-stimulus period. The deposit competition mechanism may also apply to these banks, although the magnitude is likely to be smaller due to their advantages in the deposit market. In the Internet Appendix (Table IA3 and Figure IA7) we show that for the big banks, another more important motivation to issue WMPs is the need to roll over stimulus loans extended to sectors to which the on-balance sheet credit supply was restricted during the post-stimulus period.

played an important role in its participating and implementing the post-GFC fiscal stimulus. In addition to the large volumes of new loans issued in support of the stimulus, the shrinking of BOC's foreign-currency deposits led to the swift rising of its LDR, inching close to the 75% ceiling in 2010. As a result, BOC had to compete more aggressively for deposits; the average deposit rates it offered were close to those offered by the other three big banks before 2010, but exceeded the average rates offered by the other banks by 30 basis points (bps) after 2010.

Since the bank deposit market in China, as in many other countries, is mostly local, in that banks operate local branches to source retail deposits, heightened deposit competition from BOC had a significant impact on those SMBs with more branching overlap with BOC across various regions of the country.[6] Accordingly, we use information on branch openings and closings of *all* the commercial banks to construct a SMB's branching overlap variable (with BOC) in 2010 to measure the extent of the SMB's exposure to deposit competition. We then apply a "difference-in-differences" (DID) estimation strategy on the group of SMBs, using annual data between 2007 and 2015, where the treatment is the exposure to BOC competition after 2010, to study the impact on WMP issuance—that is, shifting of funding source away from deposits to shadow banking.

The identification assumption of our DID strategy is that the treated and the untreated groups should exhibit parallel trends if there were no such treatment. To validate this assumption, we estimate the treatment effect year-by-year, with 2010 as the base year, and find no significant difference between banks with differential exposure to BOC competition before 2010 in various dimensions, including deposit-to-assets ratio (DAR), WMP Balance/Assets, WMP expected yields, deposit rates, non-deposit liabilities-to-assets ratios (NDLARs), loan-to-assets ratios (LARs), leverage, size (logarithm of assets), and return on assets (ROA). We also examine the *exogeneity* of BOC exposure—a stronger assumption than the identification of DID estimations—by regressing all these variables (measured in 2010) on the banks' exposure to BOC competition. Only the coefficients for size and ROA are marginally significant.

While there were no significant differences between the two groups before 2010, the treatment effect of enhanced BOC competition became significant after 2010. Banks with higher degrees of exposure to BOC competition experienced lower DARs, higher WMP Balance/Assets, higher NDLARs, higher deposit rates, and lower ROA, which is collectively

[6] SMBs likely also enjoy lower trust and expected safety net, limiting their ability to compete in deposit markets with the largest state-owned banks. Acharya et al. (2020) use a similar variation in competition from state-owned banks to document crowding out of private sector banks by state-owned banks in India.

consistent with deposit competition being the mechanism in play. In contrast, the two groups of banks continued to exhibit parallel trends in the other *non*-deposit related dimensions (LAR, leverage, and size). Moreover, the exposure to competition from the other three large banks (constructed similarly to the BOC exposure variable) had no significant effect on the SMBs' DAR or the other three non-deposit dimensions.

We therefore use the post-2010 BOC competition as an instrument variable (IV) for the post-2010 DAR and establish the likely causal effect of DAR on the bank's WMP issuance—that banks with greater losses in deposits due to BOC competition rely more on WMPs as their funding source. The economic magnitude of the effect is also significant: a one-dollar loss of deposits will lead to a 0.7-dollar increase of WMP balance. We interpret the results from the DID estimation as the treatment effect of deposit competition from BOC. There are two alternative hypotheses we must contend with.

The first is that local positive shocks on the asset side (e.g., higher loan demand) of the banks, which occurred during the fiscal stimulus period, led to an increase in BOC *and* SMBs' demand for funding. To rule out this alternative hypothesis, we explore *within*-bank variations of branch expansions across different cities. If a greater presence of BOC branches in a city is correlated with more fierce deposit competition, banks ought to operate *fewer* branches in the city to avoid such competition. However, if a greater presence of BOC branches in a city is correlated with higher local loan demand, we should observe the same number of or even more branches established by the SMB in the city to capture these lending opportunities. To test for these competing channels, we conduct a within-bank DID estimation on the *number* of *newly* established branches of a bank in a city after controlling for bank-year and bank-city fixed effects, where the treatment is the presence of BOC branch presence in the city in 2010. We find that for a given SMB, the number of new branches decreased by more in cities with more BOC branches after 2010, contradicting the loan demand hypothesis.

The second alternative hypothesis stipulates that *local demand* for WMPs happened to be positively correlated with BOC's branch presence due to some omitted variation. For instance, BOC has stronger presence in the coastal areas, which are more economically developed and hence the local demand for WMPs may be higher there. However, this hypothesis is inconsistent with the findings that SMBs with more branching overlap with BOC use *more non*-deposit liability and offer higher WMP yields. Nevertheless, to further examine this hypothesis, we explore within-city variations of WMP offering across different banks. We conduct within-city DID estimation on the number of WMPs offered by a bank in a city, controlling for city-year and city-bank fixed effects: the city-year fixed effect controls for local

market conditions such as demand for WMPs, and the city-bank fixed effect controls for time-invariant bank heterogeneities in the city. The key explanatory variable is the bank's branch overlap with BOC in *other* cities in 2010.

Under the deposit competition hypothesis, greater exposure to BOC competition leads to a loss of deposits and raises the marginal return of funds for all the branches within the bank, which should lead to more WMP offering by *all* the branches. Under the local WMP demand hypothesis, branching network in other cities should play a minimum role in the local offering of WMPs. Using a city-bank-year panel from 2008 to 2015, we find that in a *given* city, the number of WMPs offered by a bank increased by more after 2010 if the bank has more branching overlap with BOC in *other* cities, again contradicting the WMP demand hypothesis and supporting instead the deposit competition hypothesis.

The next set of questions we address relates to the implications for the issuing banks and the financial markets of the shift from deposits to WMP financing, as well as of the dramatic increase in the total volume of the WMPs. Traditional deposits provide a stable source of funding for banks, while WMPs need to be frequently rolled over due to their shorter maturities (typically three to six months).[7] In contract to the short maturities of WMPs, investment projects financed by WMPs, such as those in real estate and infrastructure, pay off at much longer horizons. Thus, banks face inherently greater maturity mismatch when they switch from deposits to WMPs: they need to roll over the old WMPs, and as the scale of WMPs grows, the rollover risks of WMPs also grow, with potential spillovers in funding stress to all banks. We present three pieces of evidence consistent with the emergence of such financial fragility.

First, we show that when there is a greater amount of WMPs due in a quarter, banks offer significantly higher yields on the *new* products to attract new investors and meet redemption of the maturing products; these results are mainly concentrated on products issued by SMBs and of shorter maturities relative to those of the big four banks or of longer maturities. At the aggregate level, the average WMP yield spread over the deposit rate ceiling closely tracks the amount of WMPs to roll over for the Big Four banks as well as for the SMBs.

Secondly, WMPs also affect banks' behavior in the interbank market. The Big Four banks and the next ten large banks, which submit SHIBOR (Shanghai Inter-Bank Offer Rate) quotes, are able (willing) to borrow (lend) only at higher interest rates when they have more WMPs

[7] One reason for the short maturities is to help banks conduct 'window dressing' before regulatory actions. Regulators monitor LDRs at the quarter end; when WMPs mature, issuing banks can transfer the funds from the investors' WMP accounts to their deposit accounts, which temporarily boosts deposit levels and lowers the LDR. We find that the maturity date of WMPs clusters immediately before the end of a quarter, consistent with this window dressing hypothesis.

approaching maturity. In the aggregate, the one-week SHIBOR rises sharply after 2010, closely tracking the aggregate amount of maturing WMPs issued by the Big Four banks. This result indicates that not only are the WMP yields higher than the deposit rates, but the frequent rollovers of WMPs also impose a significant impact on the aggregate market's liquidity.

Finally, to show that investors appear to 'price' the banks' rollover risks, we examine the stock market's response during episodes of 'credit crunches,' i.e., when the cost of interbank funds unexpectedly rises as measured by incidence of above-threshold levels of SHIBOR quotes. Stock prices drop more for banks with more WMPs maturing in the short run during these episodes of inter-bank liquidity stress, indicating that investors and the market are indeed concerned about the extent of banks' rollover risks.

The rest of the paper is organized as follows. In Section II, we review related literature, and describe China's banking sector and the regulatory framework in Section III. We present our sample of WMPs and their issuing banks, and link the rise of WMPs to the 4-trillion stimulus plan and bank competition in Section IV. In Section V, we study the rollover risk of WMPs and their issuing banks. We conclude in Section VI.

II. Related Literature

To the best of our knowledge, this is the first paper in showing that *fiscal stimulus*—a supply-side shock to bank lending – interacting with bank competition and regulation in unintended ways – can spur the growth of shadow banking and engender financial fragility.

Our work extends the recent literature on the role of bank deposits as a transmission channel of macroeconomic policies. Drechsler et al. (2017, 2018) show that tightening *monetary* policies can trigger loan contraction due to the market power of large banks in the deposit markets. Such credit contraction in the form of mortgage loans can be substituted by riskier, privately funded credit, which appeared to have fueled the housing market boom in the US prior to the GFC (Drechsler et al., 2021). Xiao (2020) finds that some of the deposit outflow will feed the shadow banking sector during periods of tightening monetary policies; specifically, "shadow banks" in the US, including money market funds, raise interest rates more than commercial banks, leading to a shift of deposits from commercial banks to shadow banks. In the context of the residential mortgage market in the US, Buchak et al. (2018) and Gopal and Schnabl (2020) show that the aftermath of the global financial crisis and a tightening of bank regulations led to a contraction of bank credit, and shadow banks, including online, "fintech" lenders, partially filled the gap.

In contrast to these papers, we show that large *fiscal* stimulus carried out by large banks can (also) trigger heightened deposit competition with smaller banks, which in turn led to the growth of shadow banking and more fragility of the financial system. This role of fiscal stimulus has not been examined hitherto, even though fiscal or housing stimulus policies have coincided with the settings explored in these prior studies of shadow banking growth.

Our study also contributes to the literature on the formation and risks of shadow banking products in the pre-GFC period. As the WMPs in China are offered directly by commercial banks and there is recourse to their balance-sheets, they resemble those products packaged with bank loans and sold to investors in the pre-GFC "originate and distribute" model of intermediation in the developed economies. For instance, after financial institutions sold the loans and other (unpackaged) debt products to the underwriters, there remained some connection between the structured products and the originating institutions in the U.S. In this sense, the growth of WMPs in China closely resembles the growth and collapse in the issuance of asset-backed commercial paper in the U.S. due to regulatory arbitrage (see Acharya et al., 2013b, and Borst, 2013, among others).

A growing strand of literature studies the rise of shadow banking in China. Allen et al. (2019a) and Chen et al. (2018) study a large component of the shadow banking sector, i.e., entrusted loans extended by non-bank financial institutions and firms to other firms. Allen et al. (2019b) show that the scale of trust products issued by trust companies—the largest nonbank institutions, began to take off in 2010, with most of the capital raised going to real estate sectors and local government debt.[8] Other papers look at the credit allocation during and the rise of shadow banking products around the large stimulus. For example, Chen et al. (2020) show that local governments financed investment projects through stimulus bank loans in 2009 and then switched to nonbank "shadow banking" debt financing after 2012 when faced with rollover pressure from bank loans coming due. Cong et al. (2019) showed that during 2009-2010 stimulus, bank credit disproportionally favored state-owned enterprises (SOEs), which were less productive than private firms. In contrast to these papers, we focus on the substitution between deposits and WMPs and WMPs' rollover risks.

Finally, Hachem and Song (2021) show – including theoretically – that when there is a tightening in liquidity regulations (on the ratio of long-term lending and short-term funding), a large price-setting bank can boost its deposit levels, while smaller price-taking banks turn to

[8] Ehlers et al. (2018) and Hachem (2018), among others, provide comprehensive description of the background and evolution of shadow banking in China.

off-balance sheet activities to raise funds such as via the WMPs, fueling the growth of the shadow banking sector. In contrast, our identification strategy (DID) that tracks how SMBs responded to the unexpectedly rising deposit competition from local branches of the stimulus-implementing but export-sector-hit large state-owned bank (BOC), allows us to trace the channel from the fiscal stimulus to the growth in WMPs via frictions in deposit markets (competition and regulations). Our results also indicate that the swift rise of WMPs as shadow banking finance increased the overall banking system's fragility due to spillover of rollover risk to the general liquidity conditions.

III. Institutional Background and Data

III.1 Banking System and Regulations

There are four types of banks in China. The first category is the Big Four banks—in addition to Bank of China, they are the Industrial and Commercial Bank of China (ICBC), China Construction Bank (CCB), and Agricultural Bank of China (ABC). The State Council, the highest branch of the government, directly appoints presidents of these banks. In addition to pursuing for-profit strategies as other commercial banks, these banks also serve certain policy goals—typically through lending. The second category is state-owned *policy* banks, including the Export-Import Bank of China, China Development Bank, and the Agricultural Development Bank of China. The third category is joint-equity commercial banks, which include 13 members, whose average size of these banks is about 10% of that of the Big Four banks.[9] They are also market-oriented and most of them are publicly listed. The fourth category is urban and rural commercial banks, which are typically founded and majority-owned or controlled by provincial or city governments. They are typically much smaller than joint-equity commercial banks, and unlike the other three types of banks, most of these banks concentrate their business in a limited number of cities.

China tightly regulates bank deposit rates as part of the macroeconomic policy tool kit (e.g., Song et al., 2011). Prior to June 2012, there was only one rate for each maturity across all banks, and starting from June 8, 2012, the central bank (i.e., PBC) introduced both upper and lower bounds within which banks can set their deposit rates. The lower bounds on deposit rates were non-binding and lifted gradually. The upper bounds on deposit rates, however, were almost always binding and not lifted until the end of 2015. The ceiling on deposit rates led to

[9] The largest one of the group, Bank of Communications, has been recently classified as a "big bank," but its size is only half of the Big Four banks, and hence we still classify it as an SMB in the paper.

a large gap between deposit and loan rates and is considered to have encouraged excessive bank lending. In response, PBC monitors and sets limits on total bank lending through tools including capital ratio requirements and the LDR. The capital ratios of almost all commercial banks have been well above the lower bound. The limit on the LDR prohibits banks from lending more than 75% of their total deposits, and this upper bound on lending was binding for many SMBs.

III.2 The Rise of Shadow Banking

Products such as WMPs can help banks circumvent on-balance sheet regulations, such as the LDR and deposit rate ceilings. On the asset side, loan assets originated by the bank or packaged by other financial institutions are recorded off the bank's balance-sheet, if they are financed with issuing WMPs, especially principal-floating products. Credit supply with WMPs does not increase on-balance-sheet loan balances, and hence can help banks circumvent on-balance-sheet regulations including the LDR requirement. On the liability side, WMPs can serve as a substitute for deposits without 'price control:' the deposit rates are capped by the regulatory ceiling, while the WMP yields face no such restrictions. In particular, principal-guaranteed WMPs are required to be recorded on the balance sheet, just like deposits. Principal-floating WMPs are treated as off-balance-sheet liabilities, and so their maturity structure can be devised to help issuing banks manage LDR requirements. In short, WMPs can help the banks to arbitrage deposit-related regulations.

Despite their differences from the issuing banks' perspective, both deposits and WMPs are safe assets from the standpoint of households/savers. Deposit insurance was formally introduced on May 1, 2015; before that, only two commercial banks went bankrupt during the past 25 years and in both cases the depositors were paid in full. Although there is no such insurance for WMPs, the principal of WMPs has always been paid in full, no matter whether the products are labeled as principal-guaranteed or principal-floating.[10]

As discussed earlier, WMPs offer more options (than deposits) for the issuing banks to manage liabilities. Banks can strategically design the properties of a set of WMPs (issued) over a given time frame, including the issuing amount and maturities, and adjust these dynamically based on market conditions. In contrast, it is much more difficult for the banks to 'discriminate' against different groups of depositors: for instance, if a bank would like to raise deposit rates

[10] Hainan Development Bank went bankrupt in 1998 (the depositors were paid in full), and more recently, Baoshang Bank was taken over by the regulators and emerged from bankruptcy in 2020. A new set of regulations on wealth management industry was announced in April 2018, according to which banks can no longer offer principal-guaranteed products after 2020.

to attract new depositors, it must pay more interests to all the existing depositors, including yield-insensitive investors. Banks typically cannot reject new deposits even after if they have excessive amounts of liquidity; they cannot set or alter a particular maturity structure either, as deposit markets are oriented for retail customers with standardized products.

While our focus is on WMPs, a broad definition of "shadow banking" refers to all investment products that are not on banks' balance sheets. Examples include entrusted loans and the loans offered by trust companies (Allen et al., 2019a; Allen et al., 2019b), both of which are important components of China's shadow banking sector. With the rise of shadow banking, there is a dual-track system of intermediation in China's financial system (Wang et al., 2019; Chen and Lin, 2019). While interest rates on deposits are capped and on-balance-sheet lending is regulated by the capital ratio and LDR, the shadow banking sector is exempt from such requirements. The regulators are aware of both the nature and the scale of bank WMPs and other shadow banking products, and to sustain the effectiveness of the on-balance sheet regulations, a "cat and mouse" game between the regulators (including China Banking Regulatory Committee, CBRC) and the banks has been evolving along with the expansion of the shadow banking sector. In this process, the regulators gradually tightened the restrictions on the targeted assets in which the WMP funds can be invested in, and banks invited more financial institutions to join the credit 'supply chain' among banks, other institutions, and firms, and packaged the loans in different forms.

III.3 Data and Summary Statistics

We focus on the Big Four banks, the 13 joint-equity commercial banks, and the 120 urban commercial banks in our empirical tests. We classify all the 133 non-Big Four banks as SMBs. Our data comes from multiple sources. We first surveyed the largest 25 banks, including the Big Four banks, 13 joint-equity commercial banks, and the 8 largest urban commercial banks, and asked for their Wealth Management Activity Statements of Commercial Banks that they submitted to CBRC on a quarterly basis from 2007 Q4 to 2014 Q4. We also collected year-end WMP balances for publicly listed banks and those that issue public bonds from their financial reports. To supplement the dataset, we downloaded individual WMP information from the WIND database for all the sample banks and added up either the actual or the targeted issuing amount of all the individual WMPs for each bank. The final sample is an annual panel for all the 137 banks from 2007-2015 and a quarterly panel for the 25 largest banks from 2007 Q4 to

2014 Q4.[11]

From our surveys of the largest 25 banks, we obtained their quarterly balance sheets and income statements from 2006 Q4 to 2014 Q4. We then downloaded the annual financial statements for all the 137 banks from 2007 to 2015. Though less than half of the sample banks are publicly listed, most of them have issued public debt (e.g., Negotiable Certificate of Deposits), and hence disclosed their financial reports. To summarize, we compiled a balanced quarterly panel for the 25 largest banks from 2006 Q4 to 2014 Q4, and an unbalanced annual panel for the 137 banks from 2007 to 2015.

To measure bank competition, we collect branching information for all the commercial banks (including those that are *not* in our sample) from the CBRC website. Each branch of any bank must acquire a license from CBRC before operating. Starting from November 2007, CBRC has been publishing information on all bank branch licenses, including the opening date, the closing date (if applicable), address, and affiliation. Finally, we obtained market interest rates (SHIBOR), each participating bank's submitted quotes to the interbank market from the SHIBOR website, and the stock prices of listed banks from WIND.

Table 1 reports the summary statistics of the issuing banks and WMPs. As stated above, we grouped the banks into SMBs and the Big Four banks. Between 2007 and 2015, the average WMP balance for the 133 SMBs was about 2.9% of the issuing bank's assets. This ratio is slightly higher for the Big Four banks (4.6%). The Big Four banks have significant advantages in the deposit markets due to their nation-wide branching networks and standing in the financial system as central SOEs. Their DAR is 79.2%, higher than the value of 75.3% for the SMBs. Not only do they attract more deposits, the Big Four banks also offer lower deposit rates. We estimate the effective average deposit rate as (interest income – net interest margin × total assets)/total deposits. The average deposit rate is 1.9% for the Big Four banks and 2.1% for the SMBs. With lower levels of deposits, SMBs need to pursue other sources of funding; for instance, the NDLAR is 17.7% for SMBs, higher than 14.8% for the Big Four banks. The leverage ratio is similar for the two groups of banks.

On the asset side, SMBs allocate much less assets in loans: LAR is only 46.4% for the

[11] As our measure of WMP balances for most urban commercial banks is based on aggregating individual products, we also obtained the total WMP balances of all the urban commercial banks from CBRC. Figure IA1.1 in the Internet Appendix compares our WMP sample versus actual WMP balances (from CBRC) of these banks: the two lines closely track each other, confirming that our measure is accurate at the aggregate level. Figure IA1.2 compares our sample WMP balances of the Big Four and joint-equity commercial banks with the total bank WMP balances in the CBRC reports, *minus* the balances of all urban commercial banks. Note that the latter includes products issued by the *rural* commercial banks in addition to those issued by the Big Four and joint-equity commercial banks, which explains the small gap between the two lines.

SMBs, but as high as 79.2% for the Big Four banks. Profitability of SMBs, as measured by ROA, is slightly lower than that of the Big Four banks. In terms of the size of total assets, the Big Four banks are typically 10 times of an average joint-equity commercial bank, while an average joint-equity commercial bank is about 10 times of an urban commercial bank.

IV. Deposit Competition and the Growth of WMPs

In this section, we first show the timeline and aggregate trends. We then introduce the identification strategy and examine the reasons behind the rise of WMPs issued by SMBs. Finally, we conduct two robustness checks to examine alternative hypotheses.

IV.1 Aggregate Trends

Figure 1 presents the timeline of main events relating to the rise of shadow banking. As a result of the GFC and abrupt fall in demand for exported goods and services, China's export sectors went into a slump, leading to large volumes of foreign-currency related deposit losses for BOC in 2009. The state council initiated a large scale of fiscal stimulus package and Big Four banks significantly increased lending as part of the stimulus, with BOC being the most aggressive large bank in loan expansion. The combination of the shocks on BOC's assets and liabilities led to a swift increase of its LDR. At the end of the stimulus period, PBC began to tighten monetary policy to cool off overheated sectors (e.g., real estate) and control rising levels of debt, and BOC started to compete more aggressively for deposits, creating more pressure on the SMBs, especially those with greater geographical exposure to BOC branches. As a result, WMP issuance by SMBs began to take off in 2010, so did the WMPs issued by the large banks.

Figure 2 shows the WMP balance over bank assets and DARs for the SMBs and the Big Four banks over time. The level of DARs is indistinguishable between the two groups of banks before 2010; after 2010, both groups experienced a rapid decline in DARs, but the magnitude of the decrease was much more dramatic for the SMBs. Along with the fall in DARs, we observe a swift rise in the WMPs for both groups of banks after 2010.

There are two takeaways from Figure 2. First, the patterns are consistent with the hypothesis that WMPs and deposits are substitutes for banks. Second, the year 2010 appeared to be a turning point for banks and WMP issuance, which also coincided with the ending of the stimulus period.

Figure 3 shows the evolution of the average WMP returns (which are targeted returns specified at issuance), the 3-month deposit rate ceilings and SHIBORs during 2007-2015 (we

pick the 3-month rates because the average maturity of WMPs is around three months).[12] The WMP returns were well above the deposit rate ceilings over the sample period, and closely tracked the three-month SHIBORs. In fact, except for the first half of 2009 when there was substantial liquidity injection by the PBC in response to the GFC, SHIBOR, which measures borrowing cost in the interbank market and another source of funding for banks, was also above the deposit rate ceiling, suggesting that the upper bound on deposit rates was indeed binding for banks.[13]

IV.2 Hypothesis Development and Identification Strategy

While China's financial system was largely closed to the global markets, the economy was adversely impacted by the GFC through trade, among other channels. Total exports fell from US $136.7 billion in September 2008 to $64.86 billion in February 2009; the GDP growth rate fell from 13.9% in 2007 Q4 to 6.2% in 2009 Q1, an unprecedented slowdown since China's entry into the WTO in 2001. We link enhanced BOC deposit competition after 2010 to the export slump due to the GFC, and increased lending due to the implementation of the fiscal stimulus. Our primary hypothesis is that these shocks led BOC to compete aggressively for deposits, driving other banks, especially the SMBs, exposed to BOC competition in the deposit markets, to issue WMPs in the shadow banking sector.

A. Export Slump and Losses in Foreign-currency Deposits

The exporters deposit their revenues in foreign currencies in banks, and may exchange some or all for RMB deposits with the banks, which can then swap currencies with PBC. BOC was initially established to handle foreign exchange transactions and settlement, and remained the most dominant player in the foreign exchange market. For instance, BOC's market share of the net exchange of foreign-currency deposits was 45.4% in 2008, 54.1% in 2009 and 42.6% in 2010, much higher than that of the other three big banks. If we look at the components of deposits, we can see that 23.0% of BOC's deposits are in foreign currencies, while the ratio is only 3.7% for ICBC, 2.7% for CCB, 1.1% for ABC, and even smaller for the average SMB. Therefore, BOC benefited the most from foreign currency deposits before 2008, when the

[12] Huang et al. (2019) show that the realized return equals the target return for 72% of the products, and the average realized return is only 16 basis point below the average target return.

[13] Figure IA2 in the Internet Appendix shows, prior to Oct. 24, 2015 (when the rate ceiling requirement was abandoned), following each deposit rate ceiling adjustment, the percentages of joint-equity and urban commercial banks that offered the ceiling rates and average gap between the ceiling rates and the offered rates. For example, when the rate was adjusted on 22 Nov. 2014, more than 70% of banks offered the ceiling rates; the average gap between the ceiling rates and the offered rates was smaller than 20 bps. After the ceiling requirement was abandoned in 2015, PBC replaced it with 'window guidance' and the "market interest rate pricing self-disciplinary mechanism," and banks remained constrained to some extent in setting deposit rates.

volume of China's total export grew substantially; when the export sectors went into a slump in 2009, BOC's deposit was adversely affected.

To provide some suggestive evidence on the relation between exports and deposit growth, we run cross-sectional regressions of BOC's deposit growth on its share of deposits in foreign currency for each year of the sample period (results are reported in Table IA1 in the Internet Appendix). We use the bank's share of deposits in foreign currency to measure the extent to which they benefit from exports-related deposits, as there is no public data on individual banks' activities in the foreign exchange market (we only managed to obtain the data for BOC). We find that the relation is significantly negative from 2008 to 2009, when exports declined by 18.29%; it was significantly positive in 2010-2011 when exports recovered and increased by 15.15%; it was insignificant in the other years when the export growth was modest.

In Table 2, we conduct some back-of-the-envelope calculations on how much the contraction in exports contributed to BOC's rising LDR in 2009. To do so, we need to calculate the net inflow of foreign-currency deposits to BOC. Note that after depositing the funds (in foreign currencies), the depositors can either keep it in foreign currencies or exchange it for domestic currency (RMB), and so the following equation holds:

Net inflow of foreign-currency deposit = Change of foreign-currency deposit balance + net exchange of foreign-currency deposits by customers

The change in the balances of foreign-currency deposits is taken from BOC's balance sheet, and we obtained BOC's net exchange of foreign-currency deposits by customers in 2008, 2009, and 2010. We then calculate the net inflow of foreign-currency deposit as the summation of the two. Compared to 2008, BOC's net inflow of foreign-currency deposits decreased dramatically (by US$ 43.99 billion) in 2009; it recovered somewhat in 2010, but was still down by US$ 35.01 billion as compared to 2008.

What would BOC's LDR be without the negative shock to exports in 2009-2010? We provide a simple answer by assuming that the annual net foreign-currency deposit inflow during 2009-2010 had remained the same as in 2008, while keeping total loan balance unchanged. Net foreign-currency deposit inflow would increase total deposit balance, including both foreign-currency deposit balance and RMB deposit balance due to currency exchanges (but the currency exchange itself does not affect total deposit balance). Note this approach should give a conservative estimate due to the increasing pre-trend of net exports. The counterfactual LDR would be 69.1% in 2009 and 66.8% in 2010, down by 4.1% and 6.0% (as compared to the actual figures), respectively. Hence, without the slump in total exports and

net foreign-currency deposits, BOC would be in a much better position on the liability side. The decline of net foreign-currency deposit inflow exacerbated BOC's position of LDR and together with the bank's expansion of loan supply, led to more aggressive deposit competition by BOC after 2010.

B. The RMB 4 trillion Stimulus

The Chinese government responded to the export slump and sharp decline in GDP growth by introducing the RMB 4-trillion stimulus plan. The implementation of the stimulus package involved multiple parties. First, the central government would invest RMB 1.18 trillion from fiscal incomes during 2009-2010 in infrastructure, housing, public health and education, energy, and environmental protection to increase domestic demand and improve public services.

Second, local governments, through state-owned City Infrastructure Investment Corporations (CIICs), also made investments. These CIICs raise funds from bank loans and issuing bonds against local governments' land assets (Bai et al., 2016).

Third and important for our identification strategy, banks, especially the Big Four banks, played a crucial role by providing the lion's share of the funds for the investment projects associated with the stimulus, by both issuing bank loans and purchasing CIIC bonds. This led to a large credit expansion in the economy. Many investment projects, such as infrastructure projects, were medium and long-term in nature and financed by medium and long-term loans. From January 2009 to December 2010, Big Four banks' medium and long-term loan balances increased by RMB 5.80 trillion (a 66% increase), while their short-term loan balances increased by RMB 1.26 trillion (a 31% increase). In contrast, both the short- and medium/long-term loan balances of the SMBs grew at relatively milder rates: from January 2009 to December 2010, their medium and long-term loan balances increased by 1.27 trillion RMB (25%) and short-term loan balances increased by 0.82 trillion RMB (18%). These patterns confirm that the Big Four banks were indeed the major lenders during the stimulus period.

While all four banks announced large credit expansion in support of the stimulus, the scale and speed of the expansion were different. Figure 4.1 shows the total loan balances of the Big Four banks: for ease of comparison, we scale each bank's loan balance by its loan balance at the end of 2008, the beginning of the stimulus plan. From 2006 Q4 to 2008 Q4, except for ABC, the other three banks exhibited similar growth rates in loans.[14] The paths of the loan balances

[14] ABC went public in July 2010 (the last IPO of the Big Four banks). To prepare for the IPO, capital was injected and non-performing loans were removed from its balance-sheet (see Allen et al., 2012, for more details). As in Figure 5.1, its loan balance exhibits two jumps leading up to the IPO.

began to diverge in 2009. BOC exhibited a much steeper growth path than the other three banks: from 2009 Q1 to 2010 Q4, its total loan balance increased by 77%, compared to an increase of 60% by ABC, and 48% by both the CCB and ICBC.

The large-scale expansion of credit, along with the losses in foreign-currency deposits, led to a spike in LDR for BOC. From Figure 4.2, none of these banks' LDRs exceeded 65% at the end of 2008 Q4, way below the limit of 75%. Starting from 2009, however, BOC's LDR jumped and touched the 75% threshold by the end of 2009, while the LDR of the other three banks dropped in the same year.

The rapid increase in LDR put pressure on the deposit side for BOC. Figure 4.3 presents the evolution of total deposits of the Big Four banks. Like Figure 4.1, we scale each bank's total deposits by its deposit balance at the end of 2008. From 2006 Q4 to 2008 Q4, all four banks were on similar growth paths for deposits. Starting in 2009, the growth rates of all four banks' deposit balances rose as compared to the earlier period. Since BOC had the highest LDR among the four banks, it became the most aggressive bank in attracting deposits. From 2009 Q1 to 2010 Q4, BOC's total deposits increased by 58%, compared to increases of 47%, 43%, and 35% for ABC, CCB, and ICBC, respectively. Given the average deposit balance of RMB 9,660.8 billion, the magnitude of deposit growth for these large banks (within two years), especially BOC, was substantial and dramatically altered the landscape of the local deposit markets in many regions.

In Figure 4.4, we plot the average interest rates on deposits of the Big Four banks over time. Before 2010, all four banks offered similar deposit rates. After 2010, BOC started to offer an average deposit rate about 0.3% higher than those offered by the other three big banks.[15] The increase of deposit rates suggests that the large credit expansion and deposit growth of BOC were *not* due to an increase in the demand for its services or better access to alternative funding sources.[16]

[15] Although there was no variation in bank deposit rates for each maturity across banks before 2012, banks could adjust the maturity structure of their deposits; hence, the average deposit rates over all the maturities could differ across banks.

[16] One hypothesis for BOC's greater support for the stimulus plan is related to bank executives' career concerns. Executives of the Big Four banks are appointed by the Organization Department of the Central Committee of the Chinese Communist Party (CCP), and they need to balance between political career paths and the banks' commercial goals. The President of BOC at that time was Mr. Xiao Gang. In 2012, among the four top executives of the Big Four banks, Xiao was the only one to become a member of the Central Committee of the CCP. He was further promoted to Chairman of the China Securities Regulatory Commission, a minister-level position. Market observers linked his promotion to his career experience and strong support for PBC's call during the stimulus. In contrast, the Chairman of ICBC, Mr. Jiang Jianqing, widely regarded as one of the best banking executives in the world, was more cautious in extending credit for the stimulus plan; despite the consistently strong performance of ICBC relative to the other big banks, he retired in May 2016 without any further promotion. See Allen et al. (2014) for more details on the ICBC, and Deng et al. (2015) for bank executives' career concerns.

C. Measurement of BOC Competition

We measure an SMB's exposure to BOC deposit competition based on their branch overlap using the branch network information at the end of 2010. As Figure 2 shows, the rise of WMPs occurred after 2010. When the stimulus plan was implemented during 2009-2010, BOC started to pump credit supply into the economy, but it did not immediately face the pressure of deposit shortage due to the massive liquidity support and monetary easing policies. Figure 3 shows that the market rate, SHIBOR, was at its lowest point (during the sample period), and Figure 4.4 shows that the deposit rates offered by BOC were indistinguishable from those offered by the other three big banks.

The BOC competition measure is constructed in two steps. First, we calculate the market share of BOC in each city. Denote $N_{i,j}$ as the number of bank *i*'s branches in city *j* at the end of 2010, and then define the market share of BOC in city *j* as its share of branches:

$$MarSha_{BOC,j} = \frac{N_{BOC,j}}{\sum_i N_{i,j}} \tag{1}$$

Second, we calculate the exposure of bank *i* to the deposit competition from BOC as follows:

$$BOC_i = \frac{\sum_j N_{i,j} \times MarSha_{BOC,j}}{\sum_j N_{i,j}} \tag{2}$$

The variable BOC_i measures the degree to which the bank *i*'s branches overlap with those of BOC. It is the weighted average of BOC's market share ($MarSha_{BOC,j}$) across cities, using the number of bank *i*'s branches in the cities as the weight. To highlight the special role of BOC as compared to the other three big banks, we also construct ABC_i, $ICBC_i$, and CCB_i in the same manner and define $Big3_i = ABC_i + ICBC_i + CCB_i$.

The variation of BOC_i depends on the branching networks of both the SMBs and BOC. If all SMBs proportionally allocate their branches across all cities, or if BOC equally allocates its branches across cities, i.e., $MarSha_{BOC,j}$ does not vary with j, then there will be no variation in BOC_i for different SMBs. First, unlike the Big Four banks, the SMBs usually concentrate their businesses in certain regions. The urban commercial banks are regional, i.e., they only operate in one or a few neighboring provinces. For example, Bank of Chongqing operates in four provinces (Chongqing, Ningxia, Sichuan, and Guizhou), and Huishang Bank operates in only two provinces (Jiangsu and Anhui). These two banks are relatively large, and most urban commercial banks only operate within one province. The joint-equity commercial banks can operate nationwide but they usually concentrate their activities where they were founded. For instance, at the end of 2010, the Guangdong Development Bank locates about 60% of its

branches in Guangdong Province, where the bank was founded. Second, while the BOC and the other three big banks have branches in all the provinces, their network intensities vary. As we show in Figure IA3 of the Internet Appendix, ABC has most of its branches in the western areas, ICBC concentrates in the northern and southern regions, CCB focuses on central China, while BOC has its most presence in the coastal and northern parts of the country. Hence, the two facts that most SMBs are regional and BOC has more presence in some regions than in others provide variations in the exposure to BOC competition across different SMBs.

D. Identification Strategy

In order to tease out the impact of BOC competition on bank-level outcomes, we employ a DID estimation with continuous treatment on the pool of SMBs, where the treatment is exposure to increased deposit competition from BOC after 2010. The key identification assumption is that the SMBs should experience parallel trends in terms of the outcomes that we examine, if BOC hadn't competed aggressively for deposits, regardless of the extent of their geographic exposure to BOC. To test the assumption of parallel trends, we first estimate the treatment effect of BOC competition on various bank variables in each year, using 2010 as the base year. That is, we run the following specification:

$$y_{it} = \sum_{\tau \neq 2010} \beta_\tau \cdot BOC_i \times 1_{y=\tau} + \alpha_{\mathrm{i}} + \alpha_{\mathrm{t}} + \varepsilon_{it},$$

Where y_{it} is the outcome variable of interest, α_{i} captures time-invariant bank fixed effect, α_{t} the time fixed effect, and ε_{it} a stochastic error term. We consider the six most relevant bank variables for ε_{it}, i.e., DAR, WMP/Asset, NDLAR, Deposit rates, WMP yields, and ROA. These variables describe the banks' access to deposit funding, alternative sources of capital, cost of funding, and their profitability. Figure 5 plots the 95% confidence interval for each β_τ. The parallel trend assumption holds in all the six dimensions before 2010, which lends support to our identification assumption. Figure 5 also illustrates the estimated treatment effect after 2010. Banks with more exposure to BOC competition experienced lower DAR, issued more WMPs, used more on non-deposit liabilities, and had lower ROA, all consistent with the hypothesis that greater branching overlap with BOC implies more exposure to deposit competition. In addition, banks seem to fully substitute deposits with other liabilities and there is no significant difference in the leverage ratio; in contract, there is no significant treatment effect on the asset side, including LAR and bank size (see Figure IA4 in the Internet Appendix).

In addition to presenting parallel trends graphically, we also examine the exogeneity of the treatment, a stronger assumption than needed for the DID estimation. To see if the treatment

is correlated with certain bank characteristics, we plot all the nine variables (the six bank variables plus leverage, LAR, and size) against the banks' exposure to BOC competition, all measured at the end of 2010. There is no obvious correlation between BOC exposure and any of these variables. When we regress these characteristics on the BOC exposure variable, only the coefficients for size and ROA are marginally significant. These results, to some extent, assure us that banks would have shown parallel trends regardless of their exposure to BOC competition, if BOC had not become more aggressive in the deposit markets.[17]

We then move on to estimate the following specification:

$$y_{ikt} = \beta \cdot BOC_i \times 1_{t>2010} + \alpha_i + \alpha_{kt} + \varepsilon_{ikt} \quad (3)$$

In Eq. (3), y_{ikt} is the bank variable of interest, such as $WMP_{ikt}/Asset_{ikt}$; i denotes the bank, t is the year, and k denotes the province where an SMB is headquartered. In additional to the standard DID specifications, we allow the year fixed effect to vary across different provinces; we are essentially comparing banks headquartered in the same province and subject to the *same* set of province-specific shocks, and we look at how the changes in the dependent variables are related to the banks' exposure to BOC competition.

The identification assumption for the β estimate to be unbiased is:

$$\mathbb{E}[BOC_i \cdot \varepsilon_{ikt} | \alpha_i, \alpha_{kt}, t > 2010] = 0.$$

The fact that SMBs with differential BOC_i exhibited parallel trends before 2010 lends some support to this assumption. One concern is that there might be some other shocks occurred during the stimulus, which were correlated with BOC_i and had persistent effects on the banks. One example of particular interest is the implementation of the stimulus. If BOC had more branches in places with more stimulus investment, the higher demand for loan financing could lead to deposit shortage and increasing issuance of WMPs by the local banks. To mitigate this concern, we will show below that within each province, the implementation of the stimulus was not correlated with the presence of BOC branches. Hence, the effect of BOC competition on banks within the same province cannot be driven by the stimulus per se.

[17] For most of the urban commercial banks, we estimate their WMP balances by adding up either the actual or the target issuing amounts of all outstanding WMPs. Measurement error in this variable could therefore jeopardize our identification assumption, if the error term does *not* exhibit parallel trends during the sample period for banks with different degrees of exposure to BOC competition. We select the observations with true WMP balances, i.e., the values reported in our surveys or disclosed in the banks' financial statements, and calculate the measurement error as the summation of either the actual or the target issuing amounts of all outstanding WMPs minus the true WMP balances, and scaled by the bank assets. We then calculate the mean and median of the measurement error for the high-exposure and low-exposure banks over time. Figure IA5 of the Internet Appendix shows that, for years before 2015, the two groups did show parallel trends (using both mean and median values).

We measure the intensity of stimulus implementation at the city-level by looking at the stimulus loan and investment, i.e., the abnormal increases in bank loan balances and the city's stock of fixed capital as a result of the stimulus. Bank loan balance describes the financing side of the stimulus, as most of the investment projects were financed by bank credit, and the increase in fixed capital is a direct result of the stimulus. To calculate the abnormal increases, we first estimate the 'normal' increase that would occur without the stimulus using pre-stimulus trends. For each city, we use the time-series of bank loan balances (fixed capital) during 2003-2008 to estimate a loglinear trend, and then apply the trend to predict the bank loan balances (fixed capital) at the end of 2010. We then calculate the differences between the actual and the predicted values, and use these differences as measures for the city-level stimulus loan and investment. Figure IA6 in the Internet Appendix shows that the loglinear trends fit the pre-stimulus time series data well, and the growth rates of the bank loan balance and the stock of fixed capital indeed jumped during the stimulus period.

In Table 3, we regress the estimated stimulus loan and investment on the presence of $MarSha_{BOC,j}$, and do not find any significant correlation with the province fixed effect. Without the province fixed effect, the stimulus investment is negatively correlated with the presence of BOC, which is opposite to what the loan demand hypothesis conjectures. Therefore, allowing the year fixed effect to vary across provinces may in fact be unnecessary especially when the sample size is not large, but we still proceed with $\alpha_{k,\mathrm{t}}$ in the empirical models.

IV.3 Empirical Results

A. Baseline Regression Results

We report regression results based on Eq. (3) in Table 4. In Column (1), the OLS coefficient estimate of DAR in explaining WMP/Asset is negative, but statistically insignificant. In Column (2), we apply the DID estimation, and the treatment effect of BOC_i on DAR is negative and significant, demonstrating the effect of deposit competition on SMBs due to heightened BOC competition after 2010. Note that in Column (2), we also include the interaction term between the post-stimulus indicator and the exposure to competition from the other three big banks. These three big banks also pumped credit into the economy in support of the stimulus, but not as much or as quickly as BOC, and their LDRs fell after the stimulus as shown in Figure 4.2. This difference between BOC and the other big banks is borne out by the insignificant (almost zero) coefficient estimate of the effect of the interaction term on DAR. In Column (3), we exclude the interaction term between the post-stimulus indicator and the

total exposure to the other three big banks, and the estimated treatment effect of BOC_i barely changes.

The DID estimation in Column (3) is also the first stage in the 2SLS (two stage least squared procedure) estimation with the following specification:[18]

$$\frac{WMP_{it}}{Asset_{it}} = \gamma \cdot DAR_{it} + \alpha_{\mathrm{i}} + \alpha_{k,\mathrm{t}} + \varepsilon_{it} \quad (4)$$

The variable DAR_{it} is instrumented with $BOC_i \cdot 1(t > 2010)$. In Column (4) of Table 4, we report the second stage results of the 2SLS estimation. The estimated coefficient of DAR_{it} is significantly negative, with the magnitude of the coefficient much larger than the OLS estimate in Column (1). This result supports the negative and *causal* effect of deposit availability on the SMBs' WMP issuance; that is, banks with less access to local deposit markets will rely more on WMPs to finance their activities. The contrast between the 2SLS estimate and the OLS estimate implies a positive correlation between DAR_{it} and the regression error term ε_{it}. Possible reasons for this correlation include better customer services and/or reputation, which can help an SMB to attract more depositors as well as more WMP investors.

In Column (5), we report results from a 'reduced-form' regression model, which is the treatment effect of BOC competition on banks' WMP issuance. The coefficient estimate is significantly positive, meaning that banks more exposed to BOC competition in the local deposit markets after the stimulus depend more on WMP financing due to deposit shortage.

The economic magnitude of the BOC competition effect is considerable. Based on the estimate in Column (4), a one-dollar loss of deposit will increase the WMP balance by 0.7 dollar. In 2015, the standard deviation of DAR is 0.097 and the standard deviation of WMP/Assets is 0.096, implying that DAR can explain 50% ($= 0.7^2 \times \frac{0.097^2}{0.096^2}$) of the variation of WMP/Assets in the cross-section.[19]

[18] In previous versions of the paper, we used LDR to measure SMBs' need to raise deposits and examined its impact on these banks' WMP issuance. There are two problems with this measure. First, during the stimulus period, LDR was binding for most SMBs and the little variation of LDR across banks was not indicative of different degrees of deposit shortage. Second, for every dollar of WMP issuance, issuing banks can move one dollar of loans off their balance-sheet, and hence LDR fell subsequently as WMP balances rose and the 75% ceiling became non-binding.

[19] It remains a challenging task to use the non-structural estimates to gauge how much the deposit competition channel can explain the growth of WMPs from 2010 to 2015, because we cannot say much about the 'general equilibrium' effects. From 2010 to 2015, the average DAR for sample SMBs decreased by 13.3% (from 79.7% to 66.3%); without general equilibrium effect, this would translate to an increase in WMP/Assets by 8.5% (= 13.3% × 0.634). However, when all the banks, including the Big Four banks, issue WMPs to compete for funding, any individual bank would lose some funding to the other banks, i.e., the general equilibrium effect is expected to be negative, and hence the deposit competition channel should lead to an increase in WMP/Assets by less than 8.5%. In fact, the average WMP/Assets increased by 6.0% (from 0.7% to 6.7%).

B. BOC Competition Effects in Other Dimensions

The effects of deposit shortfall on SMBs due to BOC competition are not limited to WMP issuance. As shown in Figure 5, BOC competition also affects these banks' deposit rates and financing with on-balance sheet non-deposit liabilities. This is verified in Table 5, as we estimate Eq. (5) with different dependent variables. More exposure to BOC competition after the stimulus leads to significantly higher use of non-deposit liabilities and higher deposit rates to compete for deposits, both of which are consistent with the deposit competition hypothesis. The magnitude of the effects is also economically important. In 2015, moving from the 25th percentile to the 75th percentile of BOC_i, the non-deposit liability-to-asset ratio (NDLAR), which includes borrowing from other "shadow banking" sector like Yue'bao and other money market funds, would increase by 2.1% (its standard deviation is 10%), and the deposit rate would increase by 0.3% (its standard deviation is 1.7%).

In Column (3) of Table 5, we examine the treatment effect on the bank's average WMP yield, which is calculated based on individual WMPs collected from WIND. The estimated effect of BOC competition on WMP yields is positive, although statistically insignificant. We conjecture that this is because there are not many banks issuing WMPs before 2010 and even fewer within each province, and thereby, we do not have the statistical power to establish the significance. For example, in 2009 there are 41 banks with non-missing data for WMP average yield, who are headquartered in 20 different provinces. When we replace the province-by-year fixed effect with the year fixed effect and allow comparison of banks headquartered in different provinces, there is a significantly positive effect of BOC competition on the WMP yields, which is consistent with the deposit competition hypothesis that banks supply more WMPs with higher yields to compete for deposits.

In Column (4), we examine the treatment effect on the banks' ROA. The estimated treatment effect of BOC competition on ROA is negative, although insignificant (but significant when we replace the province-by-year fixed effect with the year fixed effect). The negative coefficient is consistent with the deposit competition mechanism as banks facing more deposit competition raised deposit rates and turn to other more costly source of funding.

In Column (5), there is marginally significant treatment effect on the bank's total leverage ratio. Banks seem to fully substitute the lost deposits with non-deposit funding.

On the asset side, there is no significant treatment effect on bank size or their LAR. These results reject the loan demand hypothesis that the BOC effect works through higher loan demand. If the branching overlap with BOC captures the effect of higher loan demand, and if these loans are written on the banks' balance sheet, then we should see a higher growth of bank

size and an increase in LAR for banks exposed to BOC competition. If these loans are written off the balance sheet and do not affect the bank's asset, then we shall not see an effect on the bank's DAR, the average deposit rates or the NDLAR.

One follow-up question is, why don't banks compete for deposits by raising interest rates? Recall that during the sample period, the ceilings on deposit rates were almost always binding, and banks had limited room to manage the composition of deposits by, for example, attracting more long-term time deposits. At the same time, WMPs offer greater flexibility for banks to manage the liability side of their balance sheets as we discussed above.

C. Heterogeneous Treatment Effects

In the US, shadow banks offer deposit substitutes outside the traditional banking sector (Xiao, 2020; Drechsler et al., 2017), while in China the WMPs are offered within the traditional banking sector. The WMPs are offered at local branches to retail customers, including those with deposit accounts at the issuing bank. In this regard, the WMPs would not only attract depositors away from other banks, but they may also attract the bank's own depositors, which would increase its funding cost but not the total amount of funding. In this regard, banks should offer less WMPs when the adverse effect on their own deposits is greater relative to the benefit of deposits attracted from the other banks. We conjecture that this adverse effect should be higher if the bank has a higher fraction of deposit funding, that is, banks with a higher *initial* level of DAR should issue less WMPs facing BOC's deposit competition. To test this prediction, we add to Equation (4) the interaction between BOC_i the bank DAR in 2010:

$$y_{ikt} = \beta \cdot BOC_i \times 1_{t>2010} + \gamma \cdot BOC_i \times 1_{t>2010} \times DAR_{2010} + \alpha_{\mathrm{i}} + \alpha_{\mathrm{t}} + \alpha_{k,t} + \varepsilon_{ikt} \qquad (5)$$

We predict γ to be negative if the dependent variable is WMP/Asset in Eq. (5). Table 6 shows the results. We demean DAR_{2010} so that the coefficient of β is comparable to that in Table 4. In Column (1), there is a significantly positive treatment effect of BOC competition on WMP issuance, and the magnitude of the coefficient is similar to that in Table 4. More importantly, the treatment effect is significantly smaller for banks that have a higher share of deposit funding in 2010. When DAR_{2010} moves from the 25th percentile to the 75th percentile, the treatment effect decreases by 19% [= 1.709× (0.071-(-0.044))].

In the second column, we use the bank's NDLAR as the dependent variable. Unlike WMPs that could jeopardize the bank's deposit, the use of non-deposit liabilities, such as bonds and interbank borrowing, would not endanger the bank's deposits, as they target a different group of investors. Therefore, the treatment effect of BOC competition on NDLAR does *not*

depend on the bank's initial DAR, which is consistent with the results in Column (2). Also, the estimated treatment effect on NDLAR barely changes from Table 5. In the last column we use the bank's average deposit rate as the dependent variable, and the treatment effect does not depend on the bank's initial DAR, either.

One concern is that DAR_{2010} may capture the bank's ability to attract deposits, and that is why banks with higher DAR_{2010} will use less WMPs facing the deposit competition from BOC. However, if this were true, it would also predict that the banks with higher DAR_{2010} should use *less* non-deposit liability and increase deposit rates by smaller amounts when facing the BOC deposit competition, which are not supported in Table 6, Columns (2) and (3).

To summarize, we have documented so far that SMBs issue WMPs due to loss of deposits resulting from more fierce deposit competition from BOC; this hypothesis is supported by the significant effects on deposit-related variables (i.e., WMP, non-deposit liability, and deposit rate) through SMBs' geographic exposure to BOC's branching network. There are two main alternative hypotheses. First, there may be some local shocks to loan demand (beyond what we capture with the stimulus loan supply and fixed asset investment) that caused both BOC and (some overlapping) SMBs to expand on the asset side and to compete on the liability side, and the measure BOC_i happens to capture the exposure to these shocks. Second, since BOC has more branches in the coastal areas, there may be some regional shocks to WMP demand that is correlated with the measure BOC_i. We examine these alternative hypotheses next.

IV.4 Loan Demand and Within-Bank Estimations

As discussed above, the first concern about our interpretation of the results is that they may be driven by the possible correlations between BOC branch presence and the availability of investment opportunities, such as loan demand, rather than deposit losses. If these loans were included on the bank's balance sheet, we should see the direct effect on the bank's LAR, which is not found in Table 5, Column (6). Even if these loans were written off the bank's balance sheet (which is inconsistent with the aggregate increase of bank loan balances following the stimulus) and did not affect the bank's LAR, there should be no effect on the bank's DAR, either. We have tried to address this concern by including the province-year fixed effects and shown that within each province, the BOC presence is not correlated with loan demand resulting from the stimulus across different cities.

In this section, we provide additional evidence that BOC presence is associated with greater deposit competition rather than higher loan demand by exploring the within-bank variations of branching expansion across cities. We measure SMBs' exposure to BOC

competition based on the overlap of their branch networks in 2010, because the post-stimulus branch networks may also respond to increased deposit competition. If deposit competition from BOC is the force behind the effect of BOC_i, then to avoid direct competition from this large bank, SMBs would prefer to operate fewer branches in cities with more BOC presence. In contrast, if a greater presence of BOC branches in a city is associated with *more* investment opportunities, we should expect to see the same or even *more* SMB branches as the banks try to capture these opportunities.

Adjustments of branch networks require the approval of the local bureaus of CBRC. The urban commercial banks are defined as regional banks. Even when defined as national banks, many joint-equity commercial banks concentrate their businesses in certain regions. Both groups of banks are subject to the supervisory rules in adjusting branch networks, and are discouraged from expansion on the 'extensive margin'—establishing branches in cities with *no* pre-existing branches, as compared to expansion on the 'intensive margin'—setting up new branches in cities with pre-existing branches. About 20% of the new branches of joint-equity and urban commercial banks are in the same city as the bank headquarter; for branches outside the headquarter city, around 43% of the branches are in the headquarter province, confirming that these banks are indeed local. In both the headquarter and non-headquarter provinces, most new branches are in cities with pre-existing branches. In total, only 10% of the new branches are network adjustments on the extensive margin.[20]

We study the effects of BOC presence on branch adjustments on the intensive margin.[21] Specifically, we consider bank-city pairs such that the bank operates at least one branch in that city at the end of 2007. For all these bank-city pairs, we calculate the number of new bank branches established by the bank in the city in each year during 2007-2015. We then conduct the following *within*-bank DID estimation:

$$NBranch_{ijt} = \gamma \cdot MarSha_{BOC,j} \times 1_{t>2010} + \alpha_{it} + \alpha_{ij} + \varepsilon_{ijt} \qquad (6)$$

In Eq. (6), the dependent variable $NBranch_{ijt}$ is the number of new branches established by bank i in city j and year t, α_{it} is the time-varying bank fixed effect, α_{ij} is the bank-city

[20] In February 2006, CBRC issued "Urban Commercial Bank Nonlocal Branching Management Act," which laid out the regulatory principles on branch expansion on the extensive margin; for intensive margin, branch expansion is subject to the "Commercial Bank Local Branching Management Act." Table IA2 of the Internet Appendix reports the number of new branches of the joint-equity and urban commercial banks based on the cities where the branches are located.

[21] It is not straightforward how to study branch expansion on the extensive margin. One may pair each bank with all the cities; but since most bank only operates in a few cities, the matrix will be sparse ($NBranch_{ijt}$ is zero for more than 98% of the observations). Nevertheless, the result survives if we estimate Equation (6) on all the bank-city pairs.

fixed effect, and $MarSha_{BOC,j}$ is the percentage of BOC branches in city j at the end of 2010. This specification estimates for a given bank, whether the bank establishes a greater or smaller number of branches in cities with higher BOC branch presence after 2010.

Table 7 reports the regression results. In the first column, there is no significant treatment effect. Since branch establishment is a major decision, banks may not change their branching expansion if the deposit competition is modest. Only in cities with substantial presence of BOC will the bank consider cutting branching expansion to avoid competition. Therefore, we sort $MarSha_{BOC,j}$ and divide the sample into two equal groups. In Column (2), when the BOC branch share is modest, there is no significant treatment effect; in Column (3), when the BOC branch share is high, there is a significantly negative effect of BOC presence on the new branch expansion.

To test the parallel trend assumption as well as the timing of the treatment effect, in Column (4) we estimate the effect of the BOC branch share year-by-year using 2007 as the base year. There is no significant difference between different cities prior to 2010, supporting the parallel trend assumptions. This also confirms that our measure of competition exposure based on branching information in 2010 does not suffer from endogenous branching adjustment in response to the deposit competition. After 2010, the effect becomes statistically significant in 2014 and 2015 (but not before), in part because branching expansion may not respond to local market conditions immediately. SMBs finally decide to adjust their branching strategies when realizing that enhanced deposit competition will persist for quite a few years. With respect to the magnitude of the effect, based on the estimate in Column (3), if the BOC market share increases by 10%, banks will establish 1.5 fewer branches in the city annually. As a comparison, the average number of newly established branches after 2010 is 2.6.

To summarize, greater presence of BOC branches does not appear to capture better lending opportunities, as SMBs establish less new branches in cities with more BOC branching after 2010.

IV.5 WMP Demand and Within-City Estimation

The second concern about our interpretation of the results is that they may be driven by the correlation between BOC branch presence and the demand for WMPs from local investors—that is, in places with more BOC presence, the demand for WMPs happens to be higher and banks respond by issuing more WMPs. However, if the WMP demand were the driving force, we should observe a negative effect on WMP yields and the use of non-deposit liabilities; in addition, we should not observe a positive effect on the deposit rates. None of

these results implied by the loan demand hypothesis is supported in the data (see Table 5, Columns (1)-(3)). In this section, we provide additional evidence against the WMP demand hypothesis by exploring within-city variations of WMP offerings across different cities.

When a bank offers a new WMP, it does not have to make the product available in all of its branches. We collect information on the list of cities that an individual WMP is offered from WIND. Among all the WMPs in the dataset, about 80% of them are offered in all the issuing bank's branches, and the rest are only available in a limited number of cities or provinces. Under the deposit competition hypothesis, the overall loss of deposits increases the marginal return of funds across *all* the branches through the bank's internal capital market, and all the branches shall respond by issuing more WMPs, regardless of the status of deposit competition faced by a branch in its local market.[22] Under the WMP demand hypothesis, however, the issuance of WMPs should mostly depend on local factors. If there is any spillover effect across branches through the bank's internal capital market, the effect should be *negative*. This is because more WMP demand from investors in other cities increases the WMP issuance by the branches in other cities, thus lowers the marginal return of funds for all branches, and, therefore, should reduce the bank's issuance of WMPs.

To examine and contrast these two hypotheses, we empirically study the effect of the bank's exposure to BOC competition in the *other* cities on the bank's WMP issuance in a given city. We estimate the following specification:

$$NWMPOffer_{ijt} = \beta \cdot BOC_{i,-j} \cdot 1_{t>2010} + \alpha_{jt} + \alpha_{ji} + \varepsilon_{ij} \quad (7)$$

In Eq. (7), the dependent variable is the number of WMPs offered by bank *i* in city *j* in year *t*. We do not use the issuance amount as the dependent variable, because the information on this variable is not available at the product-city level. The key independent variable, $BOC_{i,-j}$, is bank *i*'s exposure to BOC competition measured with branching overlap in cities except city *j*:

$$BOC_{i,-j} = \frac{\sum_{j' \neq j} N_{i,j'} \times MarSha_{BOC,j'}}{\sum_{j' \neq j} N_{i,j'}}$$

We include the city-by-year fixed effect to control for the time-varying local market conditions and the city-by-bank fixed effect to control for the bank's time-invariant

[22] There may be some heterogeneity in WMP supply across branches in response to the local deposit market competition. In unreported results of DID estimation controlling for bank-by-year and bank-by-city fixed effects, we do find that the same bank offers significantly more WMPs in cities with more BOC competition after 2010, but the magnitude of the effect is small.

characteristics. With the city-by-year and city-by-bank fixed effects, the specification in Eq. (7) examines that within a given city, whether banks experience different paths of WMP offering due to their exposure to BOC competition anywhere else after 2010.

The total number of WMPs in the WIND database was 4,080 in 2008, and rose to 55,910 in 2015 (there were only 1,170 WMPs in 2007 and less than 500 annually before 2007). Therefore, we choose the sample period to be 2008-2015. We construct bank-city pairs such that the bank operated at least one branch in the city at the beginning of 2008. We then count the number of WMPs offered by the bank in the city in each year during 2008-2015. There are altogether 1,845 bank-city pairs between 2008 and 2015. Among 52% of the bank-city-year observations, no single WMP was offered; and among the rest, the mean and the standard deviation of $WMPOffer_{ijt}$ are 696 and 1,191, respectively.

Table 8 reports the results. In the first two columns, we include all the banks in the estimation. To verify the parallel trend assumption, we use year 2008 as the base year and report the estimated effect year-by-year. Column (1) shows that the parallel trend assumption holds; that is, in a given city, there is no significant difference in the growth of WMP offering between banks with differential exposure to BOC competition before 2010. The effect becomes statistically significant starting in 2011. In Column (2), we pool the post-treatment years together and obtain an average treatment effect estimate. To interpret the magnitude of the effect, moving $BOC_{i,-j}$ from the 25th percentile to the 75th percentile, the predicted number of WMPs offered annually would increase by 306. As a comparison, during the post-2010 period, the average and standard deviation of the number of WMPs offered annually are 834 and 1,386, respectively. These results are consistent with the deposit competition hypothesis and against the WMP demand hypothesis.

Another concern is that, if banks respond to the overall demand of WMPs in cities where they operate, but offer WMPs uniformly across all the branches, then we shall still find a positive significant effect of exposure to BOC competition anywhere else on the local WMP offering under the WMP demand hypothesis. To check if the results are driven by these banks, in Columns (3) and (4), we only include those banks that do not offer all the WMPs in all the branches. The parallel trend assumption still holds, and the estimated treatment effect remains positive and significant, and the magnitude of the coefficients barely changes (as compared to those in Columns 1 and 2) .

To summarize, we find that for a bank branch operating in a given city, the bank's greater exposure to BOC branching in other cities lead to more offering of WMPs in this city after

2010. This result supports the deposit competition hypothesis, and is inconsistent with the WMP demand hypothesis.

V. ROLLOVER RISKS OF WMPS

Given the shift from deposit funding to WMP funding, the next question is: what are the implications of this shift on the issuing banks and the banking sector? There are at least two types of risks associated with WMP financing as compared to deposit financing. First, WMPs need to be rolled over frequently due to their shorter maturities, which impose challenges to the issuing banks' liquidity management. Second, while banks offer explicit guarantees on deposits, they could only offer implicit (and non-binding) guarantees on WMPs. Failure to honor the guarantees may hurt investors' confidence in the bank's strength in the future, leading to a sudden freeze of the banks' ability to issue new WMPs and/or other financing channels (Huang et al., 2019). In this section, we focus on the first type of risk and provide empirical evidence on how the rollover of WMPs affects the banks' behavior and the financial markets.

V.1 Maturity Mismatches of WMPs

A large fraction of the assets financed by the WMPs are long-term, but WMPs usually have short maturities (the average maturity is 3-4 months). One reason for setting short maturities is to boost the issuing banks' deposit balances at the time of the LDR inspection. When WMPs mature, banks transfer funds from the investors' WMP accounts to their saving/deposit accounts at the bank, temporarily boosting the bank's deposit balance. Because the inspection of LDR is conducted by the CBRC at the end of each quarter, by setting the maturity dates close to quarter end, banks can boost total deposit balances on days when LDR inspections are performed.

To examine the distribution of the maturity dates of WMPs, we collect information on individual WMPs from the WIND database and count the number of WMPs that mature on each day within a quarter. Figure 6 shows the total number of WMPs issued by the SMBs that mature on each day of the quarter. There is significant clustering of WMPs maturing exactly on the last day of the quarter, but no such strong clustering of maturity dates near the end of the first two months of the quarter. Clustering at the quarter end is not driven by the end-of-year effect, as the patterns remain when we exclude the fourth quarter. These results support the notion that banks use maturing WMPs to help manage deposit-related requirements such

as the LDR regulation.[23]

Short maturities of WMPs introduce rollover risks for the issuing banks, in that when a large amount of WMPs mature on a particular day, banks will need to raise capital within a short time window to meet redemption of funds. To examine the resulting rollover risk associated with WMPs, we construct a variable *WMPdue*, which is the amount of WMPs due in a quarter over bank assets at the end of the previous year, and study its impact on the issuing bank's behavior. We focus on short time windows (quarters) to match the typical maturity of WMPs.

V.2 Yields on New Products

One way to refinance the maturing WMPs is to issue new products. With the growth in scale of these products, the amount of WMPs that need to be rolled over also rises and the cost of issuing WMPs may increase. We calculate the WMP return spread, $WMPreturn\_d$, as the difference between the annualized target yield on a new WMP and the ceiling of bank deposit rate of the same maturity. We next study the effect of *WMPdue* on the WMP return spread with the following empirical model:

$$WMPreturn_{d_{ikt}} = \beta_1 \cdot WMPdue_{it} + \beta_2 \cdot WMPdue_{SMB,t} + \beta_3 \cdot WMPdue_{Big4,t} + bank_i + YieldType_k + Maturity_k + e_{ikt} \quad (8)$$

The dependent variable is the return spread of product k issued by bank i in quarter t. There are three key explanatory variables. The first captures bank i's own need to roll over maturing WMPs in quarter t. For regressions on principal-floating (guaranteed) WMPs, "*WMPdue*" is the total amount of principal-floating (guaranteed) WMPs due in the same quarter over bank assets (in the previous year). To capture the 'equilibrium effect' of *WMPdue*, we calculate the *average* WMPdue of the Big Four banks and of all the sample SMBs. We also control for bank, WMP yield type and maturity fixed effects. We do not include quarter fixed effect, as otherwise $WMPdue_{SMB}$ and $WMPdue_{Big4}$ would not be identified.

Table 9 presents the results. In Column (1), we report the coefficient estimates of the three key explanatory variables. All three variables have a positive and significant effect on the WMP return spread: when an issuing bank has more WMPs to roll over, or the aggregate amount of WMPs to roll over is large, the bank will offer a higher WMP yield (spread). In terms of the

[23] Figure IA8 in the Internet Appendix shows the patterns of maturity dates of WMPs issued by the Big Four banks. One concern is that the timing of the WMP maturities may contaminate our measure of WMP amount with quarter-end WMP balances. But Figure 6 (and Figure IA8) shows that the clustering around quarter end is not substantial (in terms of total amount), and thus it is unlikely to impact our results.

magnitude, one standard deviation increase of *WMPdue*, $WMPdue_{SMB}$, and $WMPdue_{Big4}$ will increase the WMP return spread by 6, 39, and 12 bps, respectively.

To explore the heterogenous effects of these variables on different WMPs, we first run the regressions by bank type. The effect of *WMPdue* is concentrated among WMPs issued by SMBs. Big Four banks do not need to offer higher rates to attract WMP investors, possibly due to their reputation in the credit markets and extensive retail networks. The aggregate rollover of WMPs imposes similar equilibrium effect on WMPs issued by both SMBs and Big Four banks. We then run the regressions by WMP types. The effects of *WMPdue* on principal-floating and principal-guaranteed products are both significantly positive, and the aggregate rollover of WMPs imposes similar effects on both types of products. Lastly, we look at WMP maturities. All three variables have greater effects on shorter-term products. These results are consistent with the hypothesis that banks use short-term products to manage liquidity.

In the aggregate, since 2010, both $WMPdue_{SMB}$ and $WMPdue_{Big4}$ increased sharply, so did the WMP return spread; in 2012, the growing trend of $WMPdue_{Big4}$ reversed, so did the WMP return spread; then all three variables went up and down together until 2015. The strong positive correlation between WMP return spread with the aggregate WMP to roll over is consistent with an outward shift of the supply curve. That is, with more WMPs to roll over, banks supply more WMPs, and as a result the equilibrium WMP spread increases. The higher cost of (liability) funding with the growth of WMPs brings more challenges for the banks and more risks for the entire financial system, which we explore further next.

V.3 The Interbank Market Rates

The rollover of WMPs affects the banks' demand for liquidity, which could also be reflected in the banks' behavior in the interbank market. If a bank has more WMPs approaching maturity (and need to roll over), it should submit a higher ask rate at which they are willing to lend and a higher bid rate at which they are willing to borrow; in other words, more maturing WMPs increase the banks' marginal value of capital. To examine whether and how the rollover of WMPs affects the banks' SHIBOR ask rate, we estimate the following equation:

$$Ask_{it} = \alpha + \beta_1 WMPdue_{it} + \beta_2 WMPdue_{SMB_t} + \beta_3 WMPdue_{BIG4_t} + \beta_4 Cap_{i,t-1} + \beta_5 LDR_{i,t-1} + e_{it} \quad (9)$$

In Eq. (9), the dependent variable is a SHIBOR-participating bank's average ask quotes within quarter *t*. As in Eq. (8), we include the bank's own liquidity condition ($WMPdue_{it}$) and the market liquidity condition due to WMP rollover of the Big Four banks ($WMPdue_{BIG4}$) and

of the SMBs ($WMPdue_{SMB}$) in the regressions. Once again, we do not include quarter fixed effect because otherwise $WMPdue_{SMB}$ and $WMPdue_{BIG4}$ cannot be identified; we do not include bank fixed effect, either.

We use quarterly observations of banks that participate in the SHIBOR bid and ask processes from 2008 Q1 to 2014 Q4 and estimate the model in Eq. (10) for the Big Four banks and SMBs separately.[24] We standardize the three variables—*WMPdue*, $WMPdue_{BIG4}$, and $WMPdue_{SMB}$—by scaling them with their standard deviations. There are only fourteen banks in the regression sample, and clustering standard errors by bank would dramatically reduce the statistical significance of the coefficients. We cluster standard errors by quarter.

Table 10 reports the results. The liquidity condition of the Big Four banks is a much more important determinant of the market liquidity than that of the SMBs. The coefficient on $WMPdue_{SMB}$ is statistically insignificant in all the regressions, while the coefficient on $WMPdue_{BIG4}$ is positive and significant for both the Big Four banks and SMBs. A one-standard-deviation increase in $WMPdue_{BIG4}$ increases the large bank's ask rates for the overnight SHIBOR by 81 bps (Column 1), and the participating SMB's ask rates for the overnight SHIBOR by 73 bps (Column 7). The effects on different rates with various maturities are close, but seem to be the greatest for the 1-month SHIBOR. The amount of a large bank's maturing WMPs does not affect its own quotes, while a one standard deviation increase in the amount of an SMB's maturing WMPs increases their ask quotes by around 3-7 bps.[25]

The asymmetric effects of the liquidity condition between the Big Four banks and the SMBs are in line with the fact that the Big Four banks are the main liquidity providers and the price setters in the interbank market, while SMBs are typically net borrowers and price takers. When large banks have more maturing WMPs, SMBs are forced to submit higher ask quotes.

The results from Table 10 show that the liquidity condition of the Big Four banks affects the individual bank's interbank ask rates, but does that also hold for the market (equilibrium) rate, SHIBOR? To see this, in Figure 7, we plot $WMPdue_{SMB}$ and $WMPdue_{Big4}$ against the one-week SHIBOR. We can see a clear rising trend in the one-week SHIBOR over our sample period, and it closely tracks the average *WMPdue* of the Big Four banks (Figure 7.1). In contrast, the average *WMPdue* of the SMBs has a weak relationship with SHIBOR. These patterns again support the notion that the Big Four banks' activities—the amounts of maturing WMPs as one

[24] We have survey data for all the SHIBOR-participating banks until 2014; we did not include noisy estimates of WMPdue for the year 2015 (perhaps we should explain why this year's estimates were noisy??) in the tests to avoid contaminating the estimation procedure.

[25] When we include bank fixed effect, *WMPdue* does not have a significant effect on the SMB's quotes either, while everything else remains mostly unchanged.

key factor—play an important role in determining the interbank rates.

To summarize, the greater rollover pressure of WMPs, especially those issued by the Big Four banks, tightens the interbank liquidity and leads to higher interbank interest rates.

V.4 The Stock Market's Response to Rollover Risk

Finally, we look at the stock market's response to an unexpected change of funding costs for the 17 listed banks during 2009-2014. Since banks tap the interbank market for liquidity when their WMPs mature, a sudden increase in SHIBOR would increase their funding cost if they have large amounts of WMPs to roll over. This should be reflected in changes in their stock prices if investors are aware of the rollover risks.

We calculate the daily changes in the overnight and 1-week SHIBORs and regard the changes as unexpected if changes in both the overnight and one-week rates are high. A large increase in SHIBOR should be unexpected, because banks could arbitrage by borrowing one day in advance and lending on the next day otherwise. The SHIBOR is announced at 11:30am (9:30am starting from 08/01/2014) everyday; if the announced rates are much higher than those on the previous day, the stock prices ought to reflect this negative news before stock trading ends. Specifically, we estimate the following model:

$$return_{it} = \alpha + \beta WMPdue_{it} + \varepsilon_{it} \quad (10)$$

The dependent variable $return_{it}$ is the end-of-day stock return of the WMP issuing bank from the previous trading day to the current day. We choose days on which the changes in both the overnight and one-week SHIBOR are above a certain threshold. The independent variable $WMPdue_{it}$ is the amount of WMPs that mature in the current *month t*, scaled by the issuing bank's equity at the end of the previous quarter. In the analysis of the previous subsection, we use the amount of WMPs maturing in a quarter as the regressor, but what is more relevant here is the amount of WMPs needed to be rolled over within a short time window around the date when SHIBOR increases unexpectedly, as the SHIBOR event affects the short-term funding cost the most. Therefore, we use the amount of WMPs maturing in the current month. We scale WMP amount due by (book) equity instead of total assets because the dependent variable in the current model is the (market) return on equity. The coefficient β is expected to be negative for dates with sufficiently large changes in the overnight and one-week SHIBORs.

Table 11 reports the results. We choose four different thresholds to classify the SHIBOR change as unexpectedly high, with the largest one (in SHIBOR) c = 1%. During our sample period, there were nine trading days on which both the overnight and one-week SHIBOR

jumped by 1% or more. The second, third, and fourth thresholds are 0.8%, 0.6%, and 0.4% with 16, 25, and 48 trading days, respectively. The first row in Table 11 reports estimation results using raw returns on the bank stocks. We find that the coefficient on *WMPdue* is negative and statistically significant when the threshold is greater than or equal to 0.6%.[26]

We also use three risk-adjusted stock returns as the dependent variable in Table 11: raw daily return minus the market return (second row), the residual from a linear projection of raw daily returns on market returns for the past 60 trading days (third row), and the residual from a CAPM model (with the 3-month SHIBOR as the risk-free rate) using observations for the past 60 trading days (fourth row). We continue to find a negative relationship between the amount of WMPs due and the banks' stock returns on days when the SHIBOR rises sharply. The economic magnitude of the effect is also large: a one-standard-deviation increase in *WMPdue* leads to a drop in raw returns by 0.64% during the trading days when the SHIBOR spiked by 1% or higher.

To summarize, the results in this section show that the rollover risks of WMPs put pressure on banks' liquidity management and increase their funding cost, and the amount of maturing WMPs of the Big Four banks is an important determinant of the interbank market rates. As the Big Four banks and SMBs all issue more WMPs, the amount to roll over increases, so does the scale and rollover risks, which poses a threat to the stability of the entire financial system.

VI. CONCLUSION

Much attention has been paid to the rise of shadow banking as a result of "regulatory arbitrage" by financial institutions and its impact on the stability of the overall financial system. However, there is little academic research on how shadow banking arises in emerging markets. In this study, we examine one of the largest components of China's shadow banking sector—Wealth Management Products (WMPs) issued by banks, which can be regarded as short-maturity, off-balance-sheet substitutes for deposits. We first link the rapid rise in the scale of WMPs after 2010 to the sudden slump in export due to the 2008-2009 Global Financial Crisis, which resulted in substantial losses of foreign-currency deposits of a large state-owned bank. At the same time, this large bank pumped large volume of new loans into the economy, as part of the implementation of the government's massive fiscal stimulus. The combination of deposit losses and increase in loans forced the bank to compete more aggressively for deposits, as its

[26] Figure IA9 in the Internet Appendix presents the scatter plot of raw returns against *WMPdue* with c = 1%; a negative relationship between bank stock prices and *WMPdue* emerges.

loan-to-deposit ratio approached the regulatory upper limit.

We then show that heightened deposit competition in local markets led the smaller banks, especially those with more geographical exposure to the large bank's branching network, to shift from deposit financing to shadow banking finance, in the form of WMPs. We also study the rollover risk of the WMPs by studying issuing banks' behavior when these products mature and in the context of the interbank market as well as bank stock prices.

Overall, our tests and results shed light on how deposit competition can arise and matter in unexpected ways to increase bank reliance on fragile deposit-like substitutes in shadow banking. Such migration can be the result of a complex interaction of regulatory arbitrage and competition for deposit funding in the wake of a fiscal stimulus, with consequences for fragility of the financial system.

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Table 1 Summary Statistics

The sample of banks includes yearly observations of the Big Four banks and the 133 SMBs from 2007 to 2015. The WMP balances are first based on our survey data and then on the banks' financial reports from the WIND database, and finally complemented by adding up either the actual or the target issuing amounts of the outstanding individual WMPs available in WIND. All the other bank-year-level variables are directly collected from the issuing banks' financial statements. Deposit rate of a bank is estimated as (Net interest income – Net Interest Margin × Assets)/Deposits. The measures of competition exposure are based on the branching information from the CBIRC website. Individual WMPs are collected from WIND and city-year level data are from China City Statistic Yearbook.

Observation	Var	Mean	Median	St. Dev.	Obs
SMB-Year	WMP/Asset	0.029	0.000	0.059	1058
	Deposit/Asset	0.753	0.766	0.111	1033
	Deposit Rate	0.021	0.019	0.017	919
	Non-Deposit Lia./Asset	0.177	0.165	0.113	1032
	Leverage	0.930	0.935	0.031	1056
	Loan/Asset	0.464	0.476	0.107	1022
	ROA	1.158	1.120	0.453	1052
	size	6.567	6.379	1.548	1058
	WMP Yield (%)	4.759	4.920	0.882	637
SMB	BOC	0.071	0.071	0.021	131
	Big3	0.369	0.368	0.082	131
SMB-Quarter	WMPdue_float	0.042	0.007	0.152	2244
	WMPdue_guarantee	0.017	0.002	0.046	2244
Big Four-Year	WMP/Asset	0.046	0.051	0.032	36
	Deposit/Asset	0.792	0.793	0.058	36
	Deposit Rate	0.019	0.019	0.004	36
	Non-Deposit Lia./Asset	0.148	0.144	0.039	36
	Leverage	0.941	0.936	0.035	36
	Loan/Asset	0.792	0.793	0.058	36
	ROA	1.205	1.200	0.181	36
	size	11.690	11.734	0.366	36
City-Year	log(Loan Balance)	5.431	5.432	0.989	2211
	log(Fixed Investment)	5.268	5.286	1.028	2199
City	MarSha_BOC	0.064	0.061	0.033	339
	MarSha_Big3	0.400	0.381	0.134	339
SMB-City-Year	NBranch	2.010	1.000	3.765	3978
	NWMPOffer	497.111	280.000	672.527	4072
WMP	WMP Yield (%)	3.128	2.940	1.311	215401
Quarter	WMPdue_SMB	0.046	0.046	0.032	32
	WMPdue_Big4	0.071	0.062	0.046	32

Table 2 Foreign-Currency Deposit Inflow and Loan-to-Deposit Ratio (LDR)

This table estimates to what extent the decline of net foreign-currency deposit inflow contributed to the rising LDR of Bank of China (BOC). Net foreign-currency deposit inflow (first row) leads to the net exchange of foreign currency for RMB deposits (second row) plus an increase of foreign-currency deposit balance (third row) if not exchanged for RMB deposit. So, the first row is calculated as the sum of the second and third row. The counterfactual total deposit balance and LDR are calculated by assuming BOC's net foreign-currency deposit inflow in 2009 (X-43.99) and 2010 (X-35.01) had remained at the same level as in 2008 (X+7.76). We conceal the values with X due to data confidentiality. All numbers are in billion USD.

Year	2008	2009	2010
Net foreign-currency deposit inflow	X+7.76	X-43.99	X-35.01
Net Exchange of Foreign currency for RMB deposits	X	X-64.54	X-37.90
Increase of Foreign-currency deposit balance	7.76	20.56	2.89
Actual:			
Total Loan Balance		644.91	769.34
Total Deposit Balance		881.46	1056.69
LDR		73.2%	72.8%
Counterfactual:			
Total Loan Balance		644.91	769.34
Total Deposit Balance		933.21	1151.21
LDR		69.1%	66.8%

Table 3 BOC Market Share and the Implementation of the Stimulus

This table examines whether BOC branch presence is correlated with the supply of stimulus loans or the stimulus investment in fixed capital across cities within the same province. Robust *t*-statistics are shown in the parentheses. *** p<0.01, ** p<0.05, and * p<0.1.

Dep Var:	stimulus loan		stimulus investment	
	(1)	(2)	(3)	(4)
$MarSha_{BOC}$	-0.125	-0.402	-1.014*	-0.210
	(-0.279)	(-1.099)	(-1.779)	(-0.367)
Province FE	No	Yes	No	Yes
Observations	260	258	257	255
R-squared	0.000	0.374	0.012	0.396

Table 4 BOC Competition, Deposit Availability and WMP Balance

This table shows the DID estimation results where the treatment is SMBs' exposure to BOC competition in local deposit markets, which intensified after 2010, and the 2SLS estimation results by regressing an SMB's WMP balance over assets on its DAR, using the exposure to BOC competition as the IV. The sample includes all the joint-equity commercial banks and the 120 urban commercial banks from 2007 to 2015. All the standard errors are clustered by bank. Robust *t*-statistics are shown in the parentheses. *** p<0.01, ** p<0.05, and * p<0.1.

	(1)	(2)	(3)	(4)	(5)
Dep Var:	WMP/Asset	DAR	DAR	WMP/Asset	WMP/Asset
DAR	-0.0226			-0.700*	
	(-0.726)			(-1.831)	
BOC*1(t>2010)		-0.671**	-0.568**		0.702**
		(-2.255)	(-2.264)		(2.081)
Big3*1(t>2010)		0.0679			
		(0.520)			
Bank FE	Yes	Yes	Yes	Yes	Yes
Province-Year FE	Yes	Yes	Yes	Yes	Yes
Observations	961	961	961	961	987
R-squared	0.693	0.826	0.826	-0.635	0.697
Spec	OLS		First Stage	Second Stage	Reduced Form
N of banks	126	126	126	126	126
F-stat				8.00	

Table 5 Effects of BOC Competition on SMBs' Other Activities

This table shows the DID estimation results where the treatment is SMBs' exposure to BOC competition that intensified after 2010, and the dependent variable includes Non-Deposit Labilities-to-Asset Ratio (NDLAR), deposit rate, WMP expected yields, Return on Asset (ROA), leverage, Loan-to-Asset Ratio (LAR) and size. The sample includes all the joint-equity commercial banks and 120 urban commercial banks from 2007 to 2015. Standard errors are clustered by bank. Robust *t*-statistics are shown in the parentheses. *** p<0.01, ** p<0.05, and * p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. Variable	NDLAR	Deposit Rate	WMP Yield(%)	ROA	leverage	LAR	size
BOC*1(t>2010)	0.713***	0.121**	2.380	-2.963	0.146*	0.00824	1.992
	(2.731)	(1.995)	(0.360)	(-1.441)	(1.769)	(0.0236)	(1.116)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	960	841	566	982	985	948	987
R-squared	0.816	0.718	0.866	0.707	0.626	0.825	0.987
N of banks	126	123	108	126	126	123	126

Table 6 WMPs' Adverse Effect on Deposits and Heterogeneous Treatment Effect

This table shows the DID estimation results where the treatment is SMBs' exposure to BOC competition intensified after 2010 and its interaction with the bank's (demeaned) Deposit-to-Asset Ratio (DAR) at the end of 2010. The sample includes all the joint-equity commercial banks and 120 urban commercial banks (except those with missing DAR in 2010) from 2007 to 2015. Standard errors are clustered by bank. Robust *t*-statistics are shown in the parentheses. *** p<0.01, ** p<0.05, and * p<0.1.

	(1)	(2)	(3)
Dep Var:	WMP/Asset	NDLAR	Deposit Rate
BOC*1(t>2010)	0.687*	0.648**	0.128**
	(1.824)	(2.466)	(2.064)
BOC*1(t>2010)*DAR_{2010}	-1.709*	0.421	-0.296
	(-1.954)	(0.454)	(-1.552)
Bank FE	Yes	Yes	Yes
Province-Year FE	Yes	Yes	Yes
Observations	905	884	783
R-squared	0.695	0.822	0.721
N of banks	108	108	106

Table 7 Within-Bank Estimation of New Branch Opening

This table examines a given bank's branching decision—opening new branches in cities—when facing more fierce deposit competition from BOC after 2010. The sample includes all the joint-equity and urban commercial banks and goes from 2007 to 2015. We choose bank-city pairs such that the bank operated at least one branch at the end of 2007 in the city. Low (High) indicates that the market share of BOC in the city falls below (exceeds) the sample median. Standard errors are clustered by both bank and city. Robust *t*-statistics are shown in the parentheses. *** p<0.01, ** p<0.05, and * p<0.1.

Exposure to BOC Competition		All	Low	High	High
Dep Var: #New Branches		(1)	(2)	(3)	(4)
$MarSha_{BOC}$*	1(t>2010)	-5.025	13.71	-17.39**	
		(-1.270)	(0.920)	(-2.131)	
	1(t=2008)				-8.189
					(-0.883)
	1(t=2009)				-5.205
					(-0.572)
	1(t=2010)				-6.519
					(-0.754)
	1(t=2011)				-6.528
					(-0.759)
	1(t=2012)				-4.529
					(-0.520)
	1(t=2013)				-3.483
					(-0.331)
	1(t=2014)				-49.00**
					(-2.468)
	1(t=2015)				-48.31*
					(-1.899)
Observations		3,978	2,025	1,791	1,791
R-squared		0.630	0.651	0.659	0.666
Bank-Year FE		Yes	Yes	Yes	Yes
Bank-City FE		Yes	Yes	Yes	Yes
#City		146	82	55	55
#Bank		45	34	18	18

Table 8 Within-City Estimation of Local WMP Offering

This table studies banks' WMP issuance decision: whether a bank issues a greater number of WMPs in a given city after 2010, when facing more intense BOC deposit competition due to its branching overlap with BOC in *other* cities. The sample goes from 2008 to 2015 and includes all non-Big Four bank-city pairs such that the bank operated at least one branch in the city at the end of 2007. In Column (3)-(4) we include only bank that do not offer all WMPs in all the branches. Standard errors are clustered by both bank and city. Robust *t*-statistics are shown in the parentheses. *** p<0.01, ** p<0.05, and * p<0.1.

Dep Var: NWMPOffer		(1)	(2)	(3)	(4)
BOC'*	1(year=2009)	2,986		246.6	
		(1.403)		(0.421)	
	1(year=2010)	6,486		1,255	
		(1.532)		(0.993)	
	1(year=2011)	10,816*		3,882	
		(1.895)		(1.406)	
	1(year=2012)	11,846**		10,914	
		(2.507)		(1.542)	
	1(year=2013)	27,917***		33,485**	
		(2.819)		(2.333)	
	1(year=2014)	48,190***		49,315***	
		(2.667)		(3.083)	
	1(year=2015)	51,074*		22,244**	
		(1.885)		(2.236)	
	1(year>2010)		26,811**		23,468***
			(2.577)		(3.103)
Observations		7,832	7,832	2,928	2,928
R-squared		0.653	0.639	0.677	0.658
City-Year FE		Yes	Yes	Yes	Yes
City-Bank FE		Yes	Yes	Yes	Yes
#City		187	187	63	63
#Bank		150	150	52	52

Table 9 WMP Rollover Risks and WMPs' Expected Yields

This table reports coefficient estimates and t-statistics of regressing *WMPreturn_d* on the three rollover variables, *WMPdue*, *WMPdue_SMB* and *WMPdue_Big4*. To explore the heterogeneity of the effects, we run the regression by issuer bank types, WMP yield types and maturities separately. All regressions include WMP yield type, maturity and bank fixed effects. The sample includes all the WMPs issued by the Big Four banks and the SMBs from 2008 to 2015. The dependent variable "WMPReturn_d" is the WMP's expected annualized yield minus the bank deposit rate ceiling of the same maturity. For regressions on principal floating (guaranteed) WMPs, "WMPdue" is the total amount of principal floating (guaranteed) WMPs due in the same quarter over the bank assets in the last year. Standard errors are clustered by banks. Robust t-statistics are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	(1)	(2)		(3)		(4)			
WMPs:	All	Bank Type		WMP Yield Type		Maturity			
		SMB	Big4	Guarantee	Floating	0-3months	3-6months	6-12months	1y-
WMPdue	0.213***	0.197***	0.0874	0.871*	0.175***	0.232***	0.235***	0.0987***	0.164*
	(6.333)	(7.763)	(0.0763)	(1.844)	(9.079)	(5.039)	(7.464)	(5.231)	(1.663)
WMPdue_SMB	16.83***	17.29***	14.98***	15.26***	17.31***	22.09***	14.07***	9.396***	0.679
	(8.870)	(7.757)	(4.423)	(6.799)	(10.41)	(9.624)	(12.72)	(12.09)	(0.303)
WMPdue_Big4	3.234***	2.537***	6.118***	5.123***	2.262***	7.154***	-0.478	0.472	0.689
	(7.638)	(7.010)	(5.495)	(2.624)	(3.651)	(12.11)	(-0.902)	(0.993)	(0.591)

Table 10 WMP Rollover Risks and SHIBOR Quoted Rates

The sample includes quarterly observations for banks that submit SHIBOR quotes from 2008 Q1 to 2014 Q4. Both Capital Ratio and LDR take values at the end of the last quarter, and *WMPdue* takes the value in the current quarter. We standardize WMPdue, $WMPdue_{BIG4}$, and $WMPdue_{SMB}$ by dividing them over their standard deviations. Standard errors are clustered by quarter. Robust t-statistics are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

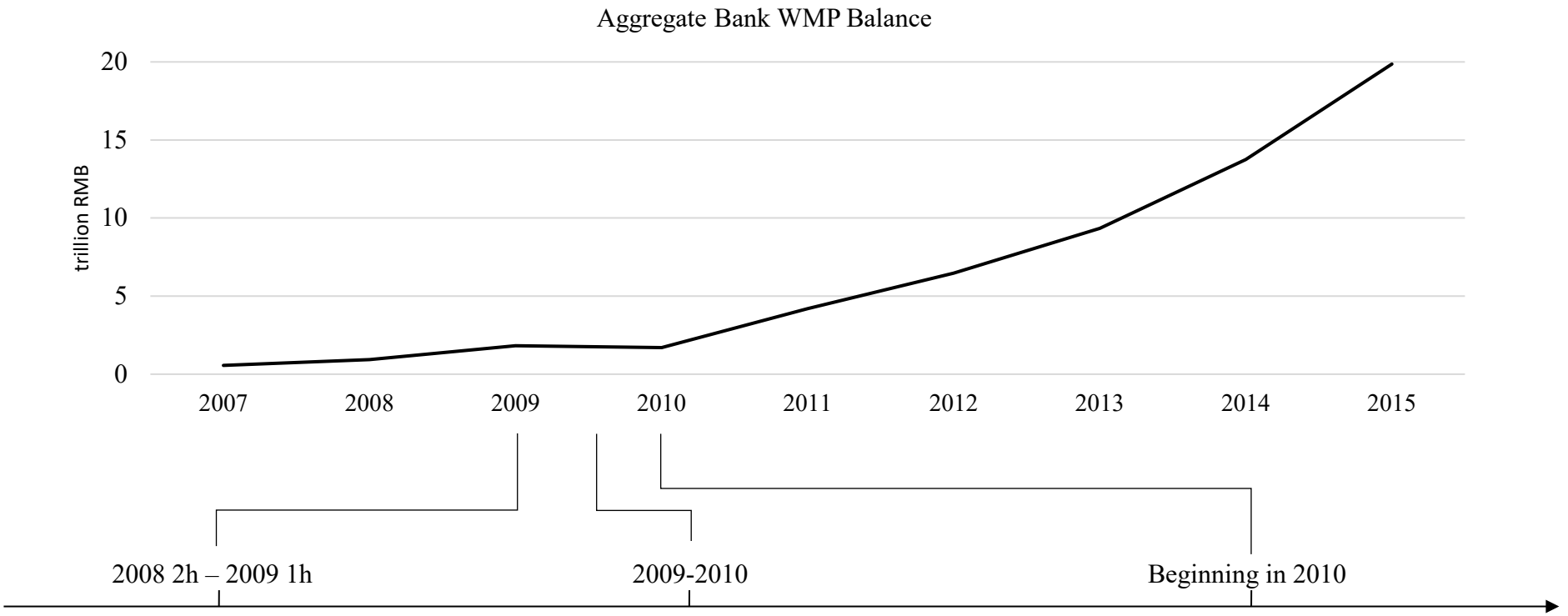
	Big Four Banks						SMBs					
	o/n	1wk	2wks	1mth	3mths	6mths	o/n	1wk	2wks	1mth	3mths	6mths
Dep Var: Ask Rate (%)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
WMPdue	-0.0270	-0.0127	-0.0138	-0.0195	-0.0527	-0.0263	0.0330*	0.0301*	0.0304**	0.0297*	0.0492**	0.0689***
	(-1.155)	(-0.475)	(-0.496)	(-0.693)	(-1.488)	(-0.625)	(1.968)	(1.923)	(2.096)	(1.838)	(2.313)	(3.090)
$WMPdue_{BIG4}$	0.805***	0.787***	0.800***	0.851***	0.771***	0.675***	0.728***	0.725***	0.740***	0.794***	0.638***	0.569**
	(3.971)	(3.866)	(3.970)	(4.115)	(3.434)	(3.050)	(3.696)	(3.610)	(3.706)	(3.857)	(2.794)	(2.489)
$WMPdue_{SMB}$	0.0271	0.0544	0.0460	-0.00455	0.0379	0.113	0.0121	0.0379	0.0357	-0.0154	0.0346	0.0704
	(0.143)	(0.318)	(0.278)	(-0.0271)	(0.234)	(0.764)	(0.0638)	(0.220)	(0.214)	(-0.0903)	(0.213)	(0.452)
Capital Ratio	-4.073***	-4.526***	-4.278***	-3.814***	-5.562***	-6.075***	-0.869	-0.974	-0.930	-0.725	-0.563	0.0788
	(-2.834)	(-2.959)	(-2.903)	(-2.866)	(-3.486)	(-3.737)	(-0.646)	(-0.752)	(-0.741)	(-0.589)	(-0.410)	(0.0540)
LDR	1.134*	1.290*	1.479**	1.445**	1.683**	1.419*	-1.345***	-1.288**	-1.230**	-0.898	-1.301*	-1.430*
	(1.805)	(1.915)	(2.256)	(2.390)	(2.304)	(1.808)	(-3.057)	(-2.633)	(-2.382)	(-1.657)	(-1.799)	(-1.920)
Bank FE	No	No	No	No	No	No	No	No	No	No	No	No
Quarter FE	No	No	No	No	No	No	No	No	No	No	No	No
Constant	1.335***	1.331***	1.063***	0.895**	1.203***	1.720***	2.721***	2.730***	2.537***	2.145***	2.751***	3.070***
	(3.543)	(3.310)	(2.788)	(2.578)	(2.966)	(3.833)	(5.450)	(4.937)	(4.417)	(3.758)	(3.566)	(3.707)
Observations	112	112	112	112	112	112	271	271	271	271	271	271
R-squared	0.610	0.636	0.653	0.664	0.537	0.513	0.591	0.616	0.636	0.649	0.502	0.473

Table 11 WMP Rollover Risks and the Stock Market's Response

The sample includes daily stock return observations from 2009 to 2014 for the 17 listed banks. We choose the (trading) days during which the changes in the one-week and overnight SHIBOR are both above a specified threshold c. For these days, we regress the individual stock returns on WMP amounts due in the current month over its (book) equity and report the coefficient in each cell in the table. The first row uses raw returns and the second row uses stock returns minus market returns. In the third row, we apply a linear projection of raw daily returns on market returns for the past 60 days and use the estimated residual today as the dependent variable. In the fourth row, we estimate CAPM using observations for the past 60 trading days and use the estimated residual today as the dependent variable. Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Threshold	c=1%	c=0.8%	c=0.6%	c=0.4%
Raw	-0.950***	-0.754***	-0.683***	-0.0690
	(-3.806)	(-4.204)	(-5.285)	(-0.755)
Deduct market	-0.296**	-0.201*	-0.264***	-0.0345
	(-1.986)	(-1.790)	(-2.746)	(-0.478)
Projection	-0.246**	-0.157*	-0.281***	-0.0801
	(-2.043)	(-1.653)	(-3.309)	(-1.122)
CAPM	-0.246**	-0.157	-0.281***	-0.0800
	(-2.039)	(-1.650)	(-3.306)	(-1.120)
Observations	159	253	397	765

Figure 1 Timeline of Events



US and European crises
=> demand for Chinese exports fell sharply
=> Bank of China (BOC)'s export-related deposits dropped substantially in 1st half of 2009.

China initiated a large-scale fiscal stimulus
=> People's Bank of China (PBC) conducted monetary easing
=> Big Four banks began issuing large volumes of new loans to support the stimulus.
=> BOC was the most aggressive large bank in increasing loan supply, and along with losses of export-related deposits, resulted in spikes of its LDR.

PBC began tightening monetary policies in 2010, and interest rates began to rise
=> In order to manage its Loan-to-Deposit Ratio (LDR), BOC competed more aggressively for deposits
=> Deposit competition among banks intensified, and the issuance of WMPs by SMBs and the Big Four banks began to take off.

Figure 2 Big Four Banks and SMBs' WMP vs Deposit Balances

This figure plots the average WMP balances over assets and DAR (deposit-to-asset ratio) for the 133 SMBs and Big Four banks from 2007 to 2015. Data are from our bank surveys and WIND. WMP balances are first based on our survey data on the Big Four, joint-equity and the eight largest urban commercial banks, then on the banks' financial reports available from WIND, and complemented by adding up either the actual or the targeted issuing amounts of all outstanding individual WMPs in WIND.

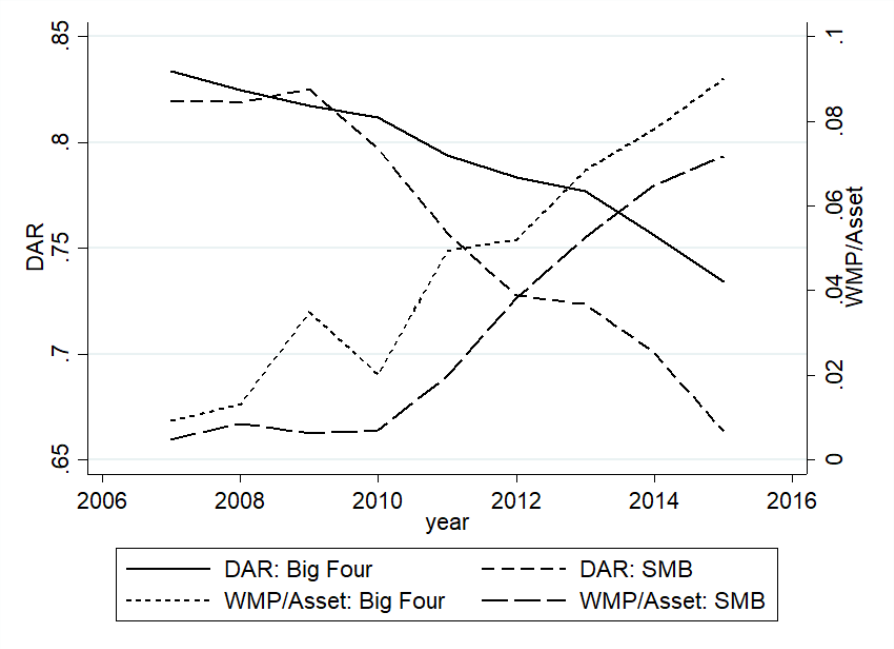


Figure 3 Deposit Rates, SHIBOR, and Average WMP Yields during 2007-2015

This figure plots the three-month SHIBOR, three-month deposit rate ceilings, and the average target returns of WMPs issued in each month during 2007-2015. Data on the target returns of all WMPs is from WIND.

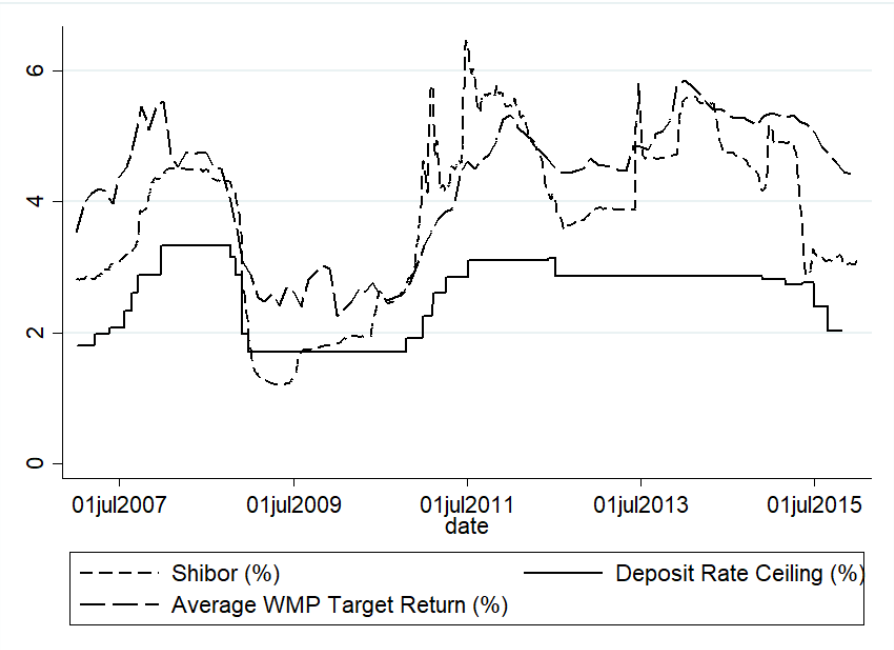


Figure 4 Banks' Activities around the RMB 4-trillion Stimulus Plan

Figure 4.1 presents the total loan balances of the Big Four banks. For comparison, we scale loan balances by the bank's loan balance at the end of 2008, the beginning of the stimulus. Figure 4.2 plots the Big Four Banks' LDRs, and Figure 4.3 exhibits their total deposit balances (scaled by the initial value in 2008). Finally, Figure 4.4 shows their average deposit rates calculated using annual deposit interest expenses divided by the average deposit balance.

Figure 4.1: Total Loan Balances of the Big Four Banks

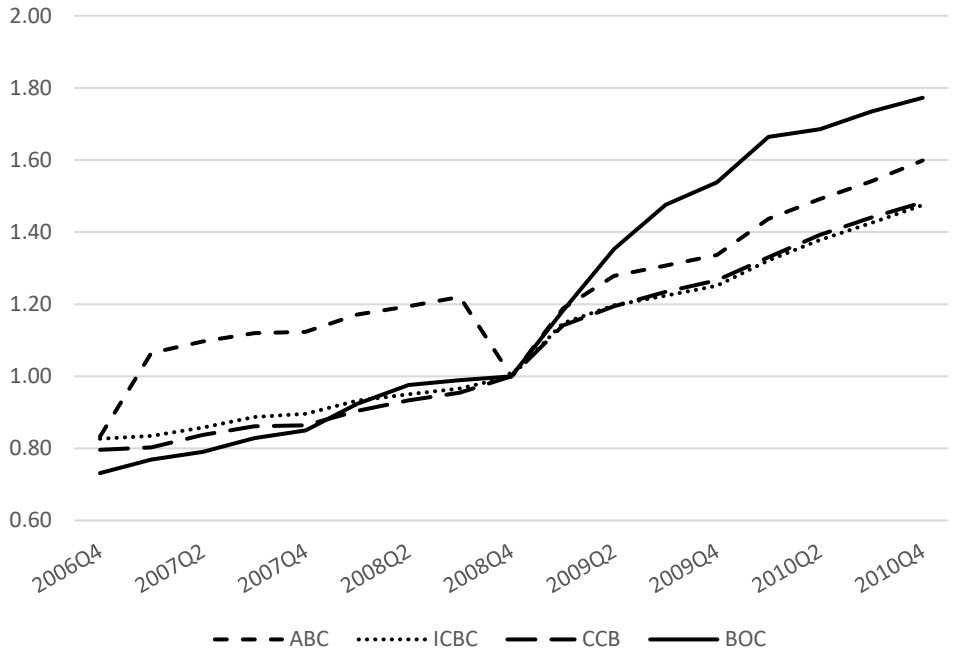


Figure 4.2: LDRs of the Big Four Banks

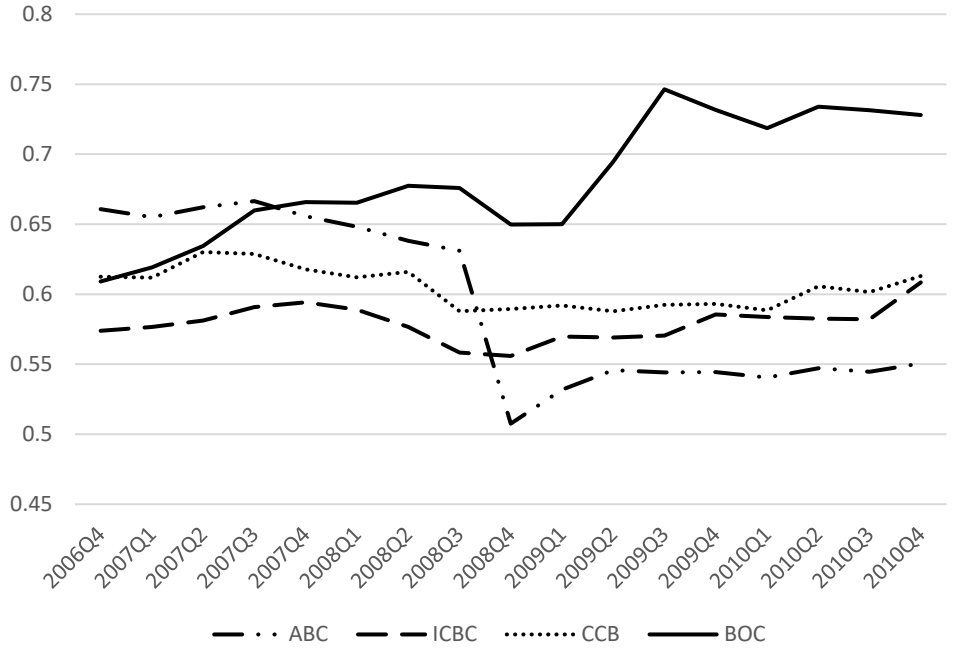


Figure 4.3: Total Deposit Balances of the Big Four Banks

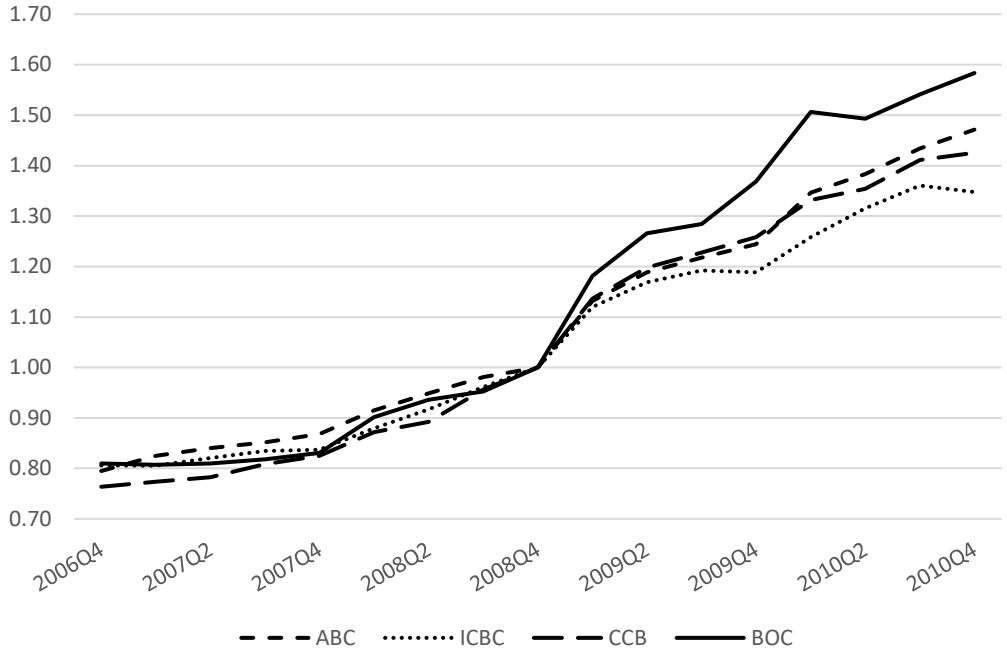


Figure 4.4: Average Deposit Rates (%) of the Big Four Banks

Figure 5 Parallel Trends between the Treated vs. Untreated Groups

The graphs below plot the 95% confidence interval for the coefficient estimates of BOC treatment effect on the corresponding bank variables in each year (using 2010 as the base year). The sample includes all joint-equity and urban commercial banks with data available in 2010. Standard errors are clustered by bank.

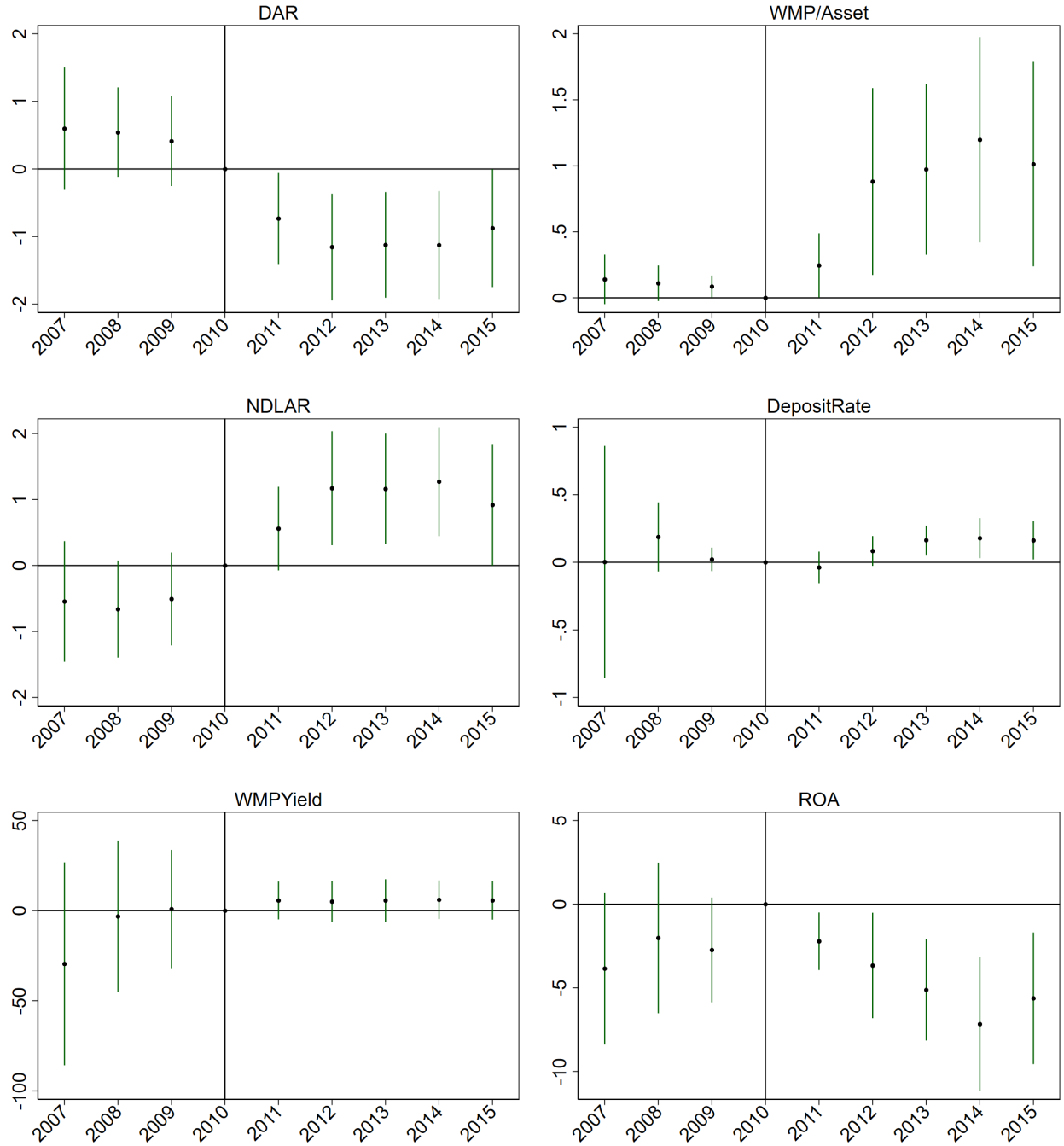


Figure 6 Distribution of WMP Maturity Dates within a Quarter

This figure shows the total number of WMPs issued by the SMBs maturing on each day of a quarter; we label the last day of each quarter as the 90th day and label the other days backwards. Data of individual WMPs is collected from WIND.

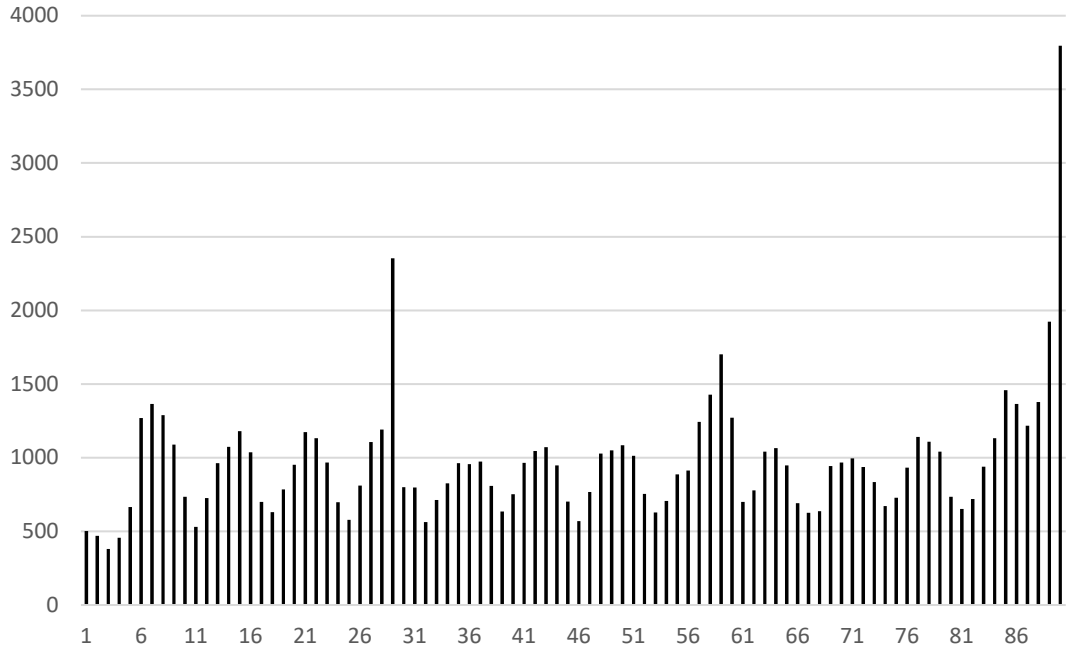


Figure 7 Comparing Maturing WMPs and the One-week SHIBOR Over Time

The figure shows the average *WMPdue* of the Big Four banks and all the sample SMBs vs the average one-week SHIBOR for each quarter over time.

Figure 7.1: Average WMPdue of the Big Four Banks and 1-week SHIBOR

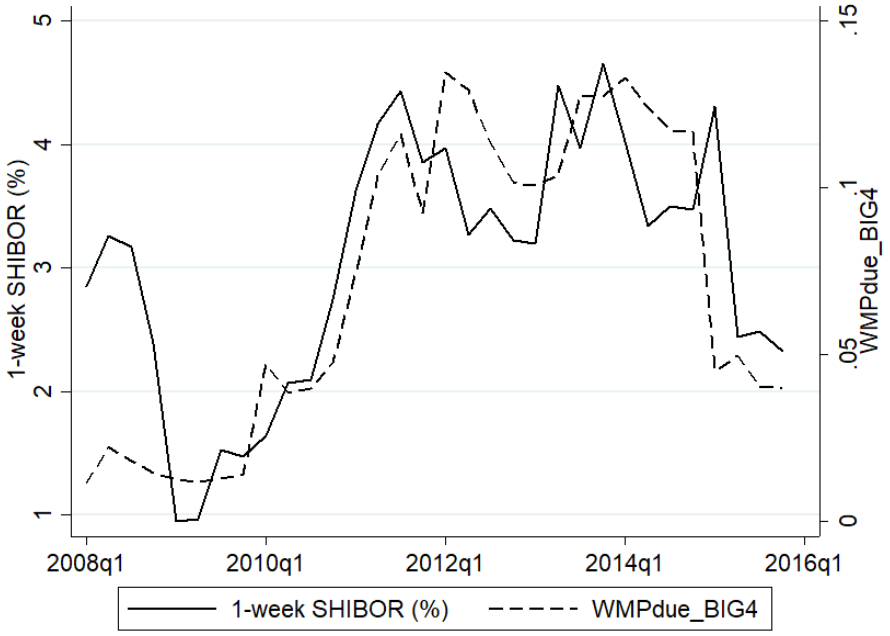
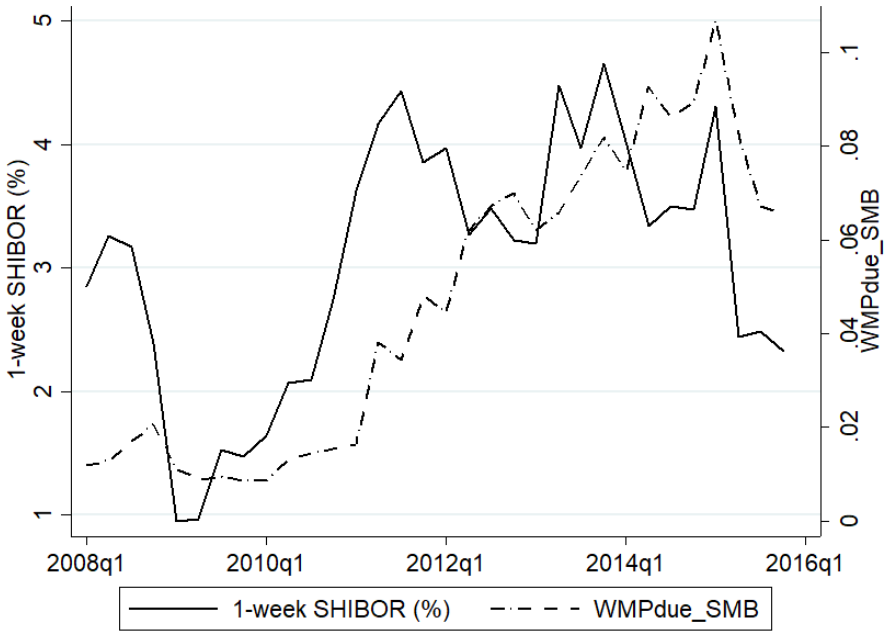


Figure 7.2: Average WMPdue of the SMBs and 1-week SHIBOR



Internet Appendix to "Fiscal Stimulus, Deposit Competition, and the Rise of Shadow Banking: Evidence from China"

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This internet appendix includes 9 sections of tables/figures as robustness tests and additional results related to the empirical results reported in the paper.

1. Correlation between the share of foreign-currency deposit and the bank's deposit growth: Table IA1
2. Distribution of new branches of joint-equity and urban commercial banks: Table IA2
3. Refinancing stimulus loans and the growth of WMPs: Table IA3 and Figure IA7
4. Measuring WMPs issued by certain types of banks and examining the measurement errors: Figures IA1 and IA5;
5. Bank deposit rates and rate ceilings: Figure IA2
6. Branching intensities of the Big Four banks: Figure IA3
7. Parallel trends between treated and untreated bank groups: Figure IA4
8. Predicted vs. the Actual Values of Loan Balances and Fixed Capital: Figure IA6
9. Rollover risks of WMPs: Figures IA8 and IA9.

Table IA1 Export, Foreign-Currency Deposit and Deposit Growth

This table shows the correlation between the share of BOC's foreign-currency deposit and the bank's deposit growth, and how such correlation depends on the total export growth. Robust *t*-statistics are shown in the parentheses. *** p<0.01, ** p<0.05, and * p<0.1.

Year t	2007	2008	2009	2010	2011	2012	2013	2014	2015
Dep Var: $\log(deposit_{t+1}/deposit_t)$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Foreign-currency deposit share at t	-0.0721	-0.381***	-0.215	0.334**	-0.192	0.673	0.738	-0.550	-0.0449
	(-0.382)	(-3.212)	(-1.524)	(2.404)	(-0.787)	(1.117)	(1.386)	(-1.296)	(-0.144)
Constant	0.211***	0.332***	0.266***	0.153***	0.192***	0.170***	0.118***	0.177***	0.168***
	(7.152)	(17.89)	(14.57)	(13.20)	(14.97)	(12.94)	(8.162)	(11.89)	(11.17)
Observations	34	45	51	56	64	71	73	82	90
R-squared	0.002	0.050	0.020	0.111	0.013	0.090	0.071	0.045	0.000
Export Growth t to t+1	7.23%	-18.29%	30.47%	15.15%	4.96%	6.01%	4.92%	-1.89%	-1.95%

Table IA2 Distribution of New Branches of Joint-Equity and Urban Commercial Banks

This table reports the number of new branches established by the joint-equity and urban commercial banks during 2007-2015 based on the cities where the branches are located. The first column corresponds to the branches located in the city where the bank is headquartered, and for the remaining branches, we group them by whether the branch is located in the headquarter province and whether the bank operates branches in the city in the previous years. Branching information is from CBRC's website.

	Headquarter City	Different Province		Headquarter Province		
Year		No Pre-branch	Pre-branch	No Pre-branch	Pre-branch	Total
2007	269	33	247	36	177	762
2008	238	77	392	104	64	875
2009	229	116	415	303	102	1165
2010	232	186	486	155	152	1211
2011	242	135	533	71	221	1202
2012	266	90	760	42	377	1535
2013	348	95	991	120	420	1974
2014	1027	99	3493	97	847	5563
2015	934	94	2894	65	1103	5090
Total	3,785	925	10,211	993	3,463	19377

Table IA3 Refinancing of Stimulus Loans and the Growth of WMPs

This table reports results on the relationship between the estimated stimulus loans extended by a bank and its subsequent WMP balances. We first estimate the linear trend of quarterly loan balances for each of the largest 25 banks from 2006 Q4 to 2008 Q4, then predict the loan balance in 2010 Q4 if such trend continues, and use the difference between the actual loan balances and the predicted loan balances in 2010 Q4 as the estimated stimulus loan. The top (bottom) panel uses principal-floating (principle-guaranteed) WMP balance as the dependent variable. Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Year t	2010	2011	2012	2013	2014
WMP Yield type	floating	floating	floating	floating	floating
Dep Var: (WMP Balance in year t)/(Loan Balance in 2008)	(1)	(2)	(3)	(4)	(5)
Estimated stimulus loan/Loan balance in 2008	0.0237	-0.000119	1.227***	1.364***	2.093***
	(0.354)	(-0.00240)	(5.547)	(5.174)	(3.068)
Constant	0.0463	0.0865***	-0.116	-0.0959	-0.0997
	(1.637)	(3.287)	(-1.022)	(-0.744)	(-0.383)
Observations	25	25	25	25	25
R-squared	0.006	0.000	0.448	0.485	0.391

Year t	2010	2011	2012	2013	2014
WMP Yield type	guarantee	guarantee	guarantee	guarantee	guarantee
Dep Var: (WMP Balance in year t)/(Loan Balance in 2008)	(1)	(2)	(3)	(4)	(5)
Estimated stimulus loan/Loan balance in 2008	-0.00646	0.00559	0.252	0.398	0.202
	(-0.708)	(0.149)	(1.233)	(1.166)	(0.558)
Constant	0.0149**	0.0316*	0.0230	0.0227	0.234
	(2.322)	(1.950)	(0.280)	(0.173)	(1.570)
Observations	25	25	25	25	25
R-squared	0.004	0.001	0.161	0.150	0.029

Figure IA1 Sample WMP Balances vs Actual Aggregate WMP Balances

Figure IA1.1 compares the sample WMP balances with the actual WMP balances reported by CBRC for all urban commercial banks. Figure IA1.2 compares the sample WMP balances of Big Four and joint-equity commercial banks with the total WMP balances in the government reports minus the total WMP balance of urban commercial banks reported by CBRC.[1] The sample WMP balances is first based on our survey data on the Big Four, joint-equity and the eight largest urban commercial banks, then on the banks' financial reports available from WIND, and complemented by adding up either the actual or the targeted issuing amounts of all outstanding individual WMPs in WIND.

Figure IA1.1: Sample WMP vs. Actual WMP Balances for Urban Commercial Banks

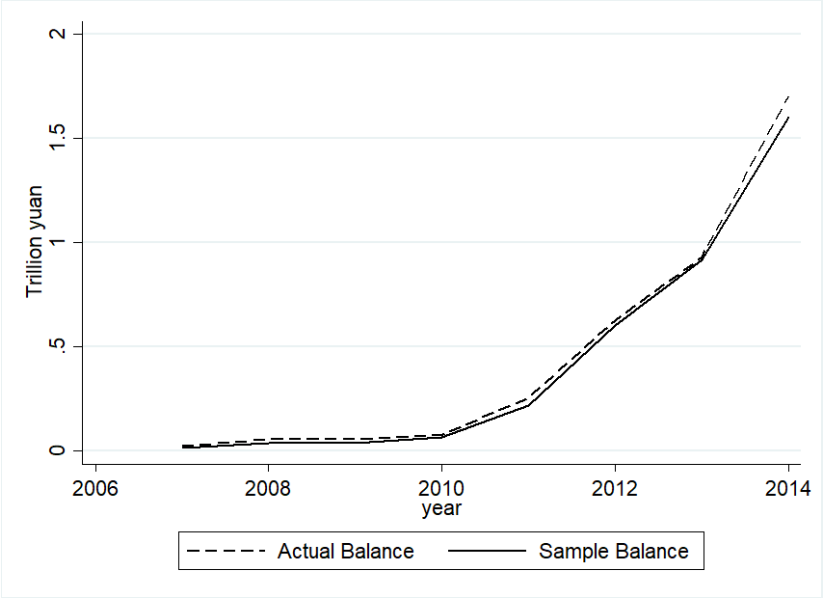
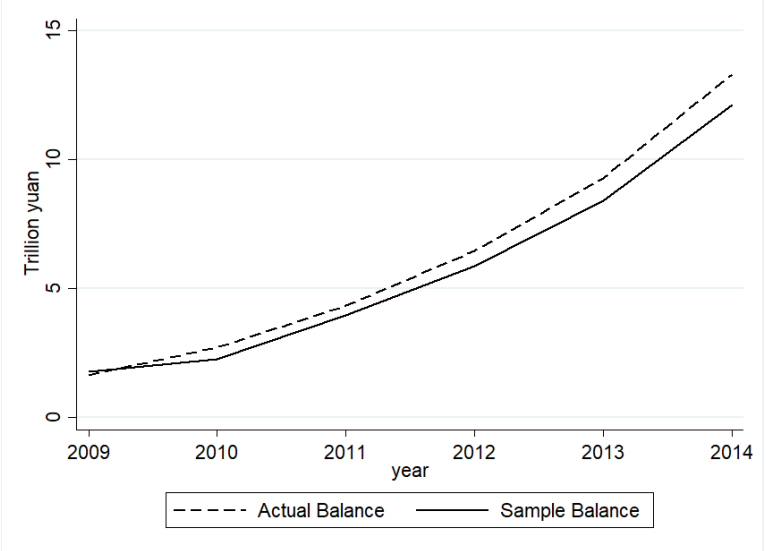


Figure IA1.2: Sample WMP vs Actual WMP Balances for Big Four and Joint-Equity Commercial Banks



[1] Note that the latter group includes not only WMPs issued by the Big Four and joint-equity commercial banks, but also those issued by other types of banks such as rural commercial banks.

Figure IA2 Offered Deposit Rates vs Deposit Rate Ceiling

Figure IA2.1 plots, following each adjustment of the deposit rate ceiling, the percentage of banks who offered the ceiling rates for each maturity of deposit products. Figure IA2.2 plots, following each adjustment of the deposit rate ceiling, the average gap between the ceiling rates and the offered rates for each maturity of deposit products.

Figure IA2.1: Percentage of Deposit Products Offered with Ceiling Rates

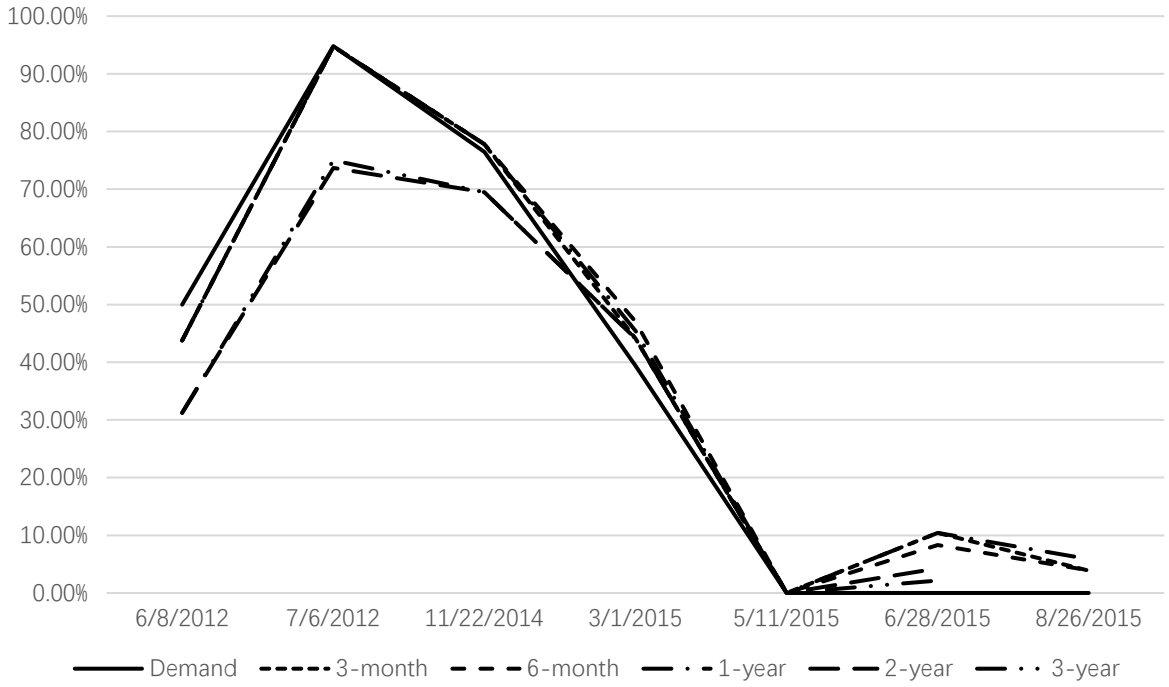


Figure IA2.2: Average Ceiling Rates minus Offered Rates

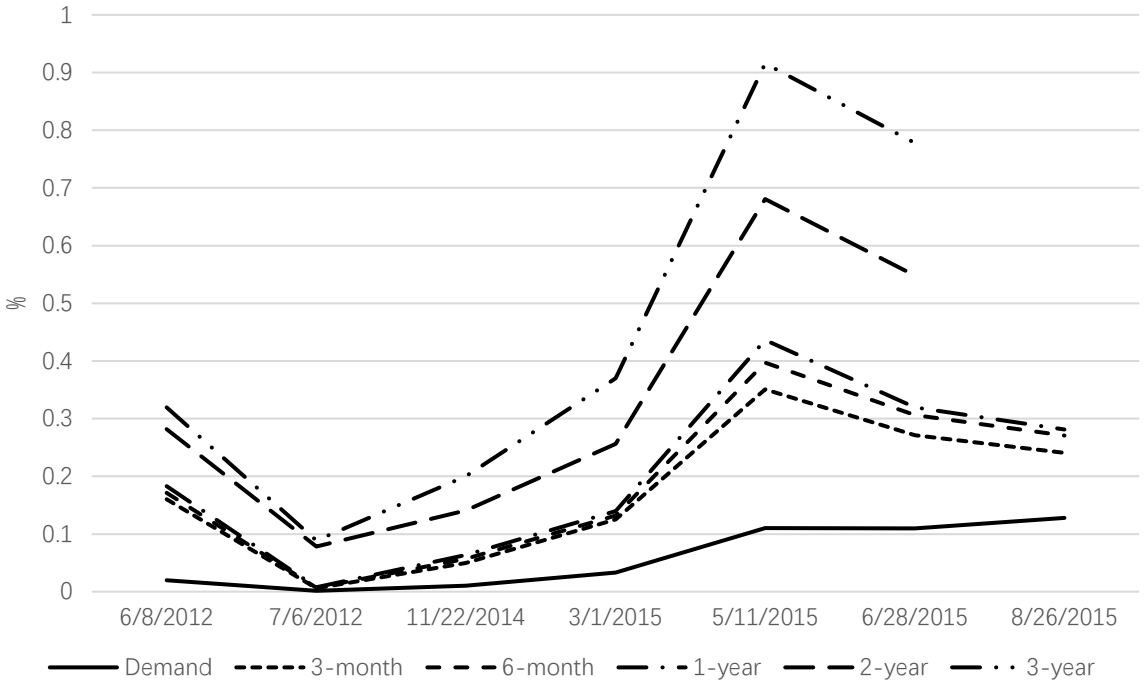
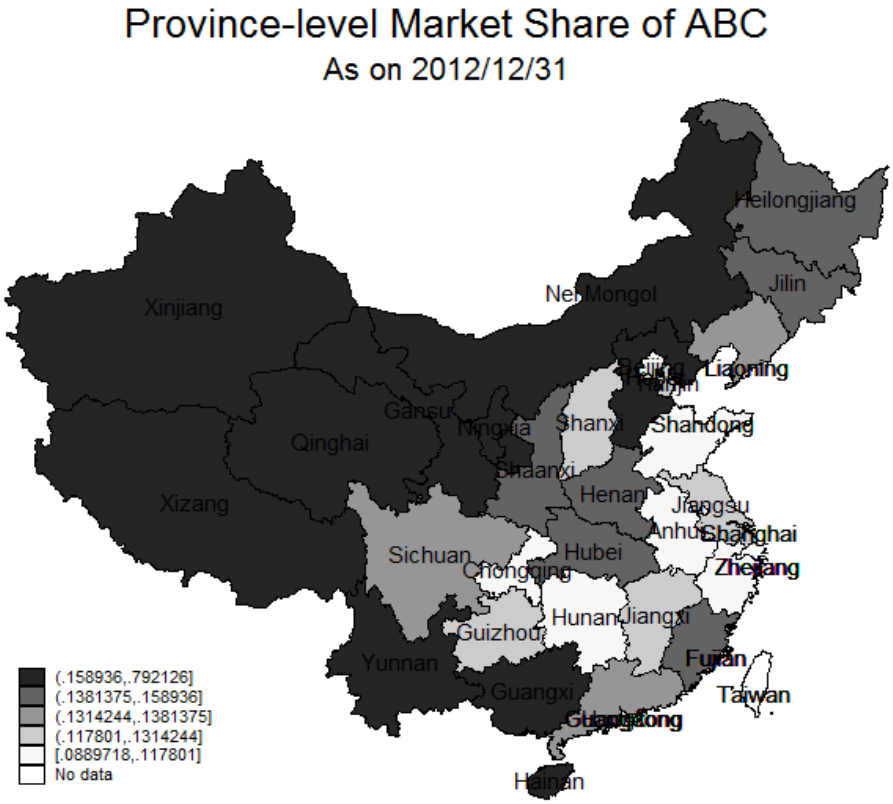
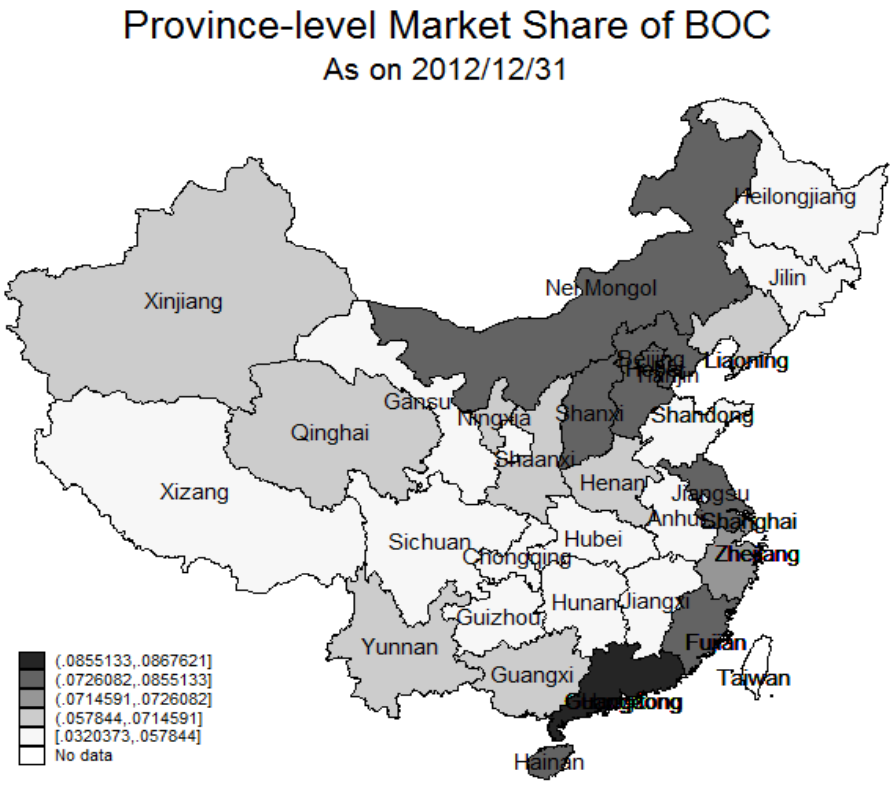


Figure IA3 Province-level Market Share of the Big Four Banks

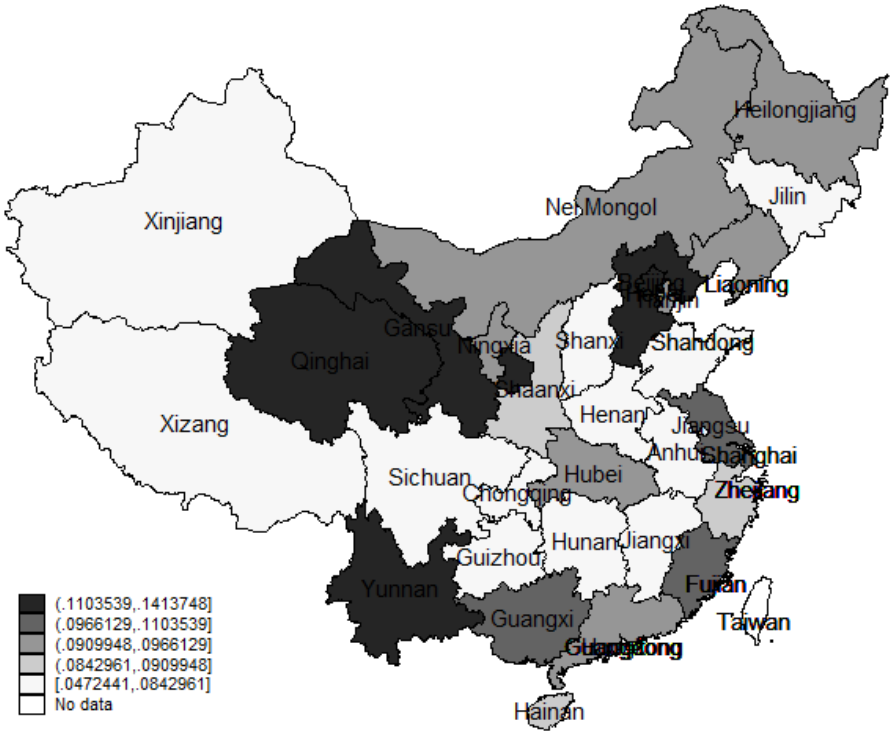
The following four figures present the province-level market share (branch intensity) of the Big Four Banks, ABC, BOC, CCB, and ICBC, respectively.





Province-level Market Share of CCB

As on 2012/12/31



Province-level Market Share of ICBC

As on 2012/12/31

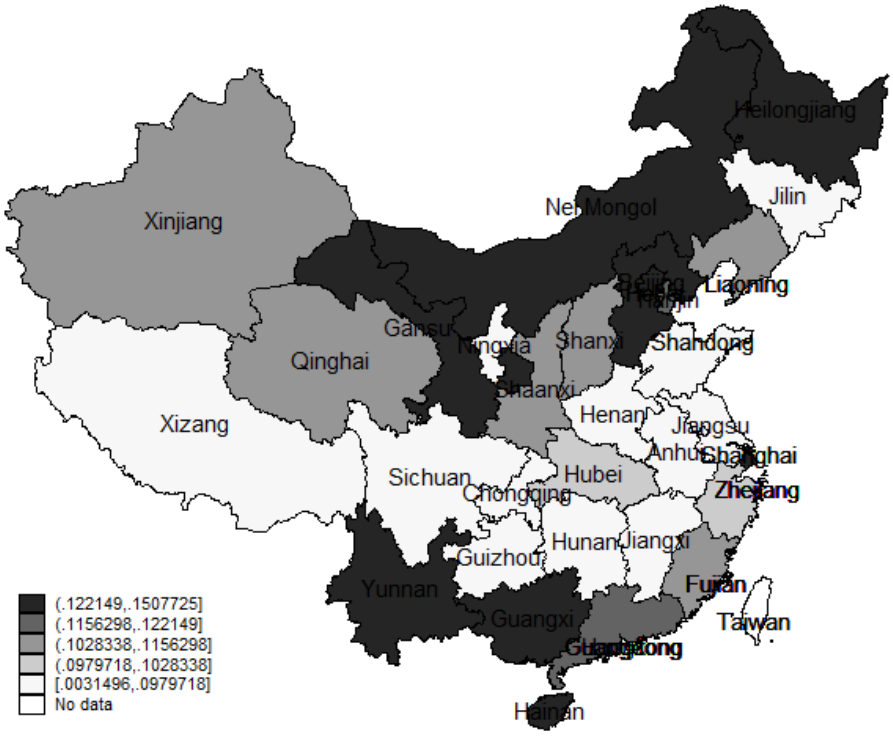


Figure IA4 Parallel Trends between the Treated vs. Untreated Groups

The graphs below plot the 95% confidence interval for the coefficient estimates of BOC treatment effect on the corresponding bank variables in each year (using 2010 as the base year). The sample includes all joint-equity and urban commercial banks with data available in 2010. Standard errors are clustered by bank.

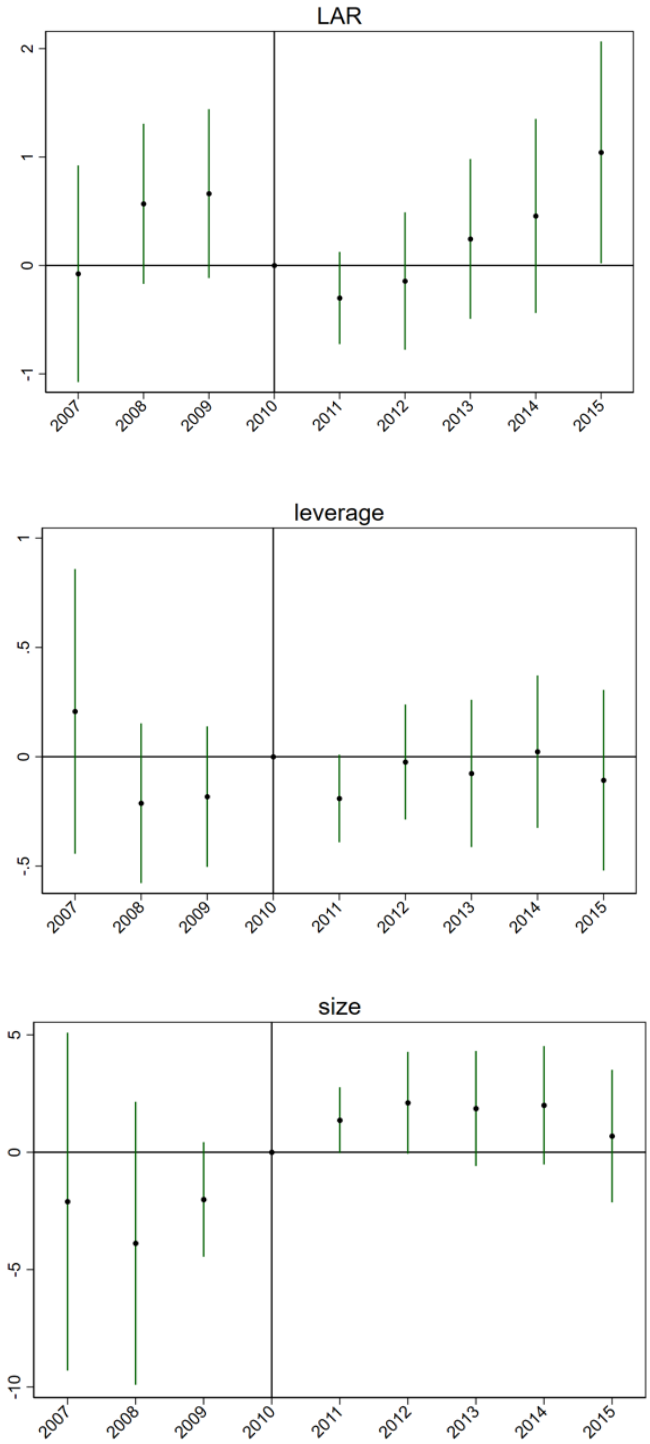
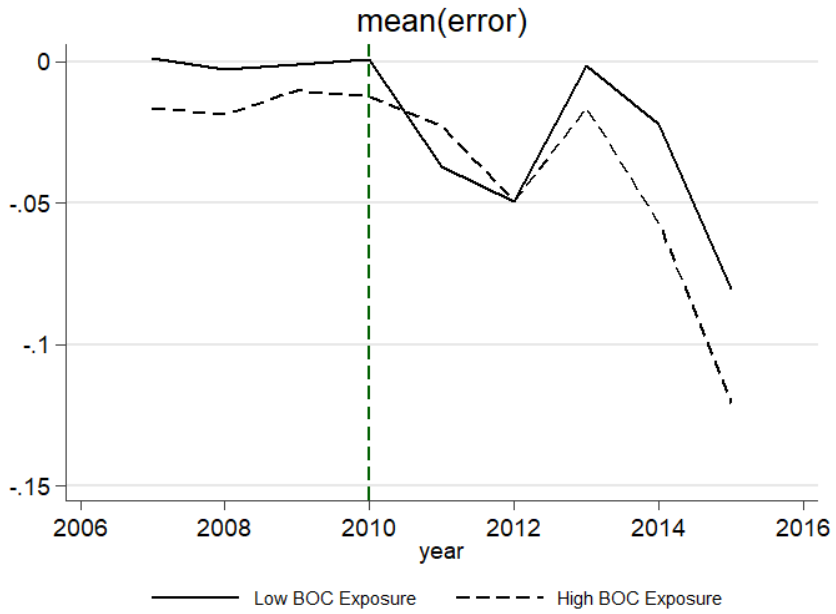


Figure IA5 Measurement Errors of SMBs' WMP Balances

We calculate the "measurement error" variable using the sum of either the actual or the targeted issuing amount of WMPs issued by the SMBs minus the true WMP balance, i.e., the value reported in our surveys or disclosed in the bank's financial statements, and divided by the bank's assets. We group the SMBs equally into two groups: high BOC exposure and low BOC exposure, and then for each group, we plot the mean and median of the error term over time.



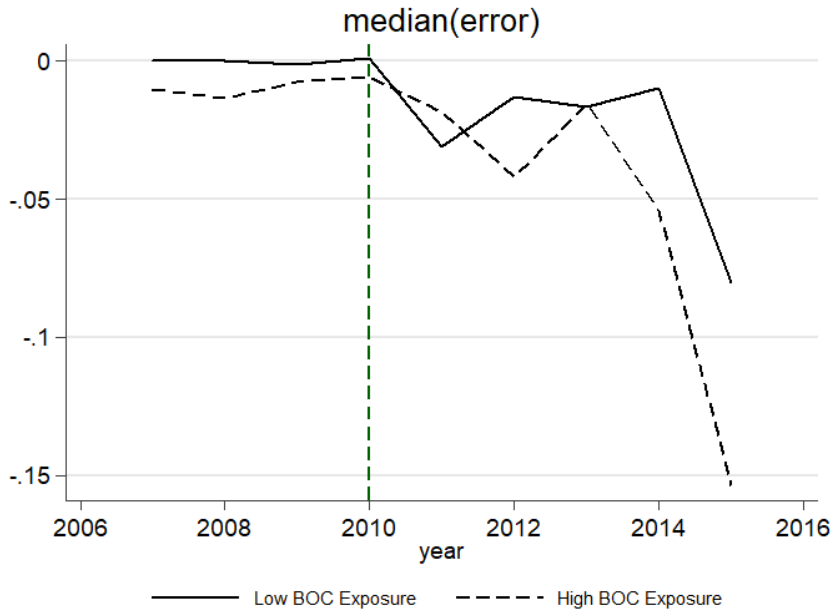
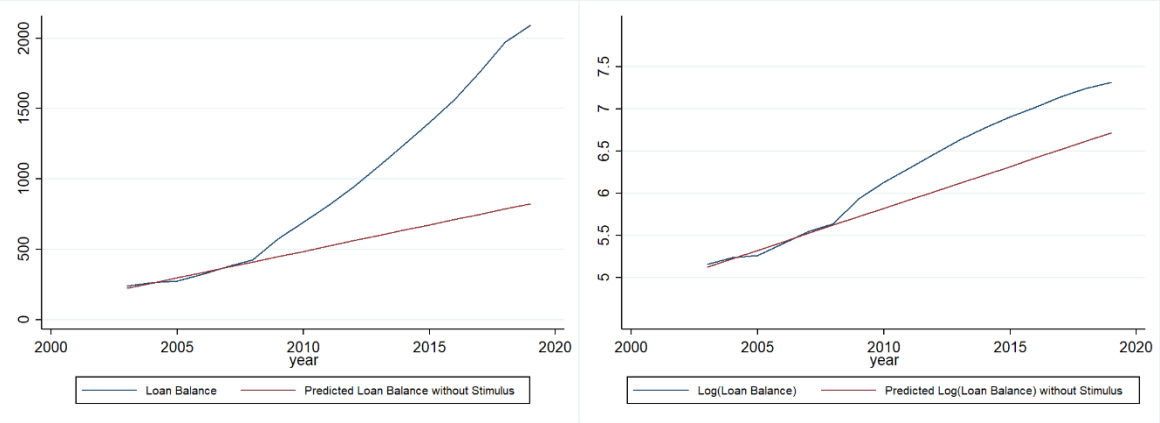


Figure IA6: The Predicted vs. the Actual Values of Loan Balances and Fixed Capital

For each city, we use the time series of bank loan balances (fixed capital) during 2003-2008 to estimate a linear (loglinear) trend, and then apply the trend to estimate the bank loan balances (fixed capital) at the end of 2010 if such pre-trends continued. We can calculate the difference between the actual and the predicted values. In case of a linear trend, we scale the difference by the value in 2008. We use the difference as a measure for the city-level intensity of the stimulus. Panel A shows the average trend and actual values for bank loan balances, and Panel B shows the average trend and actual values for fixed capital.

Panel A: Bank Loan Balances



Panel B: Fixed Capital

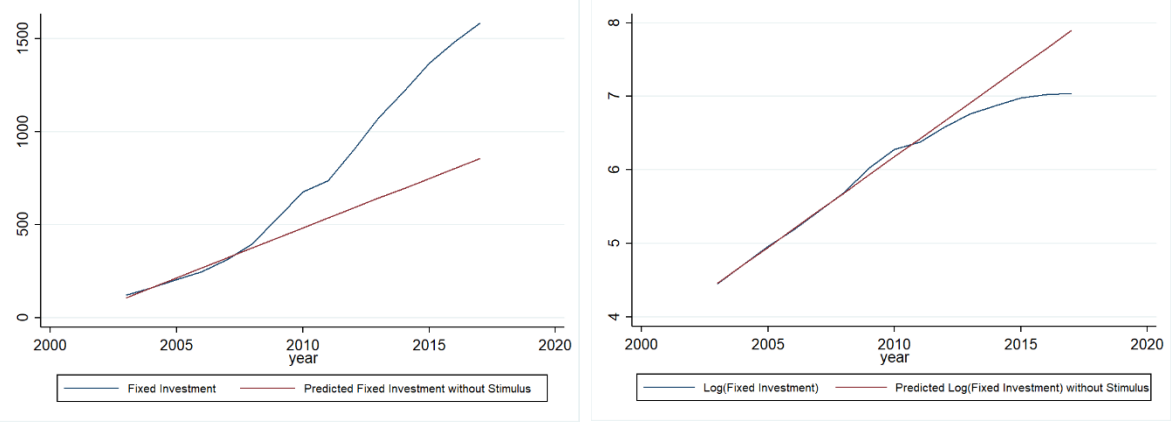


Figure IA7 Bank Loans and WMP Balances Before and After the Stimulus

Figure IA5.1 plots the percentages of medium- and long-term bank loans from 2009 to 2014 for all banks and for the Big Four banks only. Figure IA5.2 shows for the largest 25 banks, the relationship between a bank's WMP balance at the end of 2013 and its estimated stimulus loan, both scaled by the loan balance at the end of 2008. Data for Figure 8.1 is from PBC.

Figure IA7.1: Percentages of Medium and Long-term Bank Loans Over Time

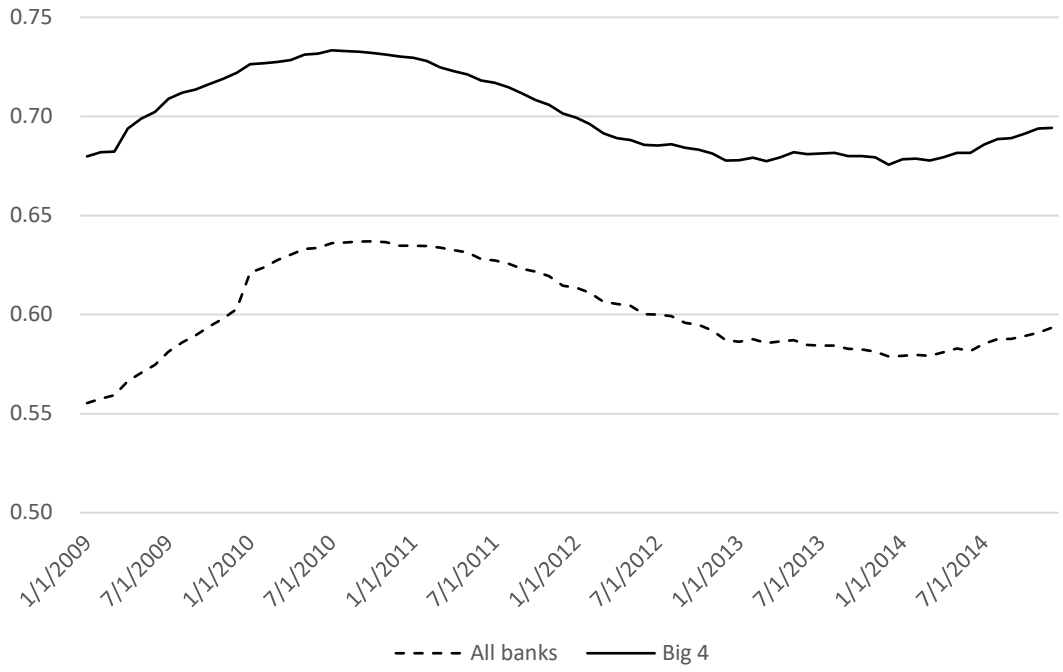


Figure IA7.2: Relation between WMP Balances in 2013 and Estimated Loan Increases

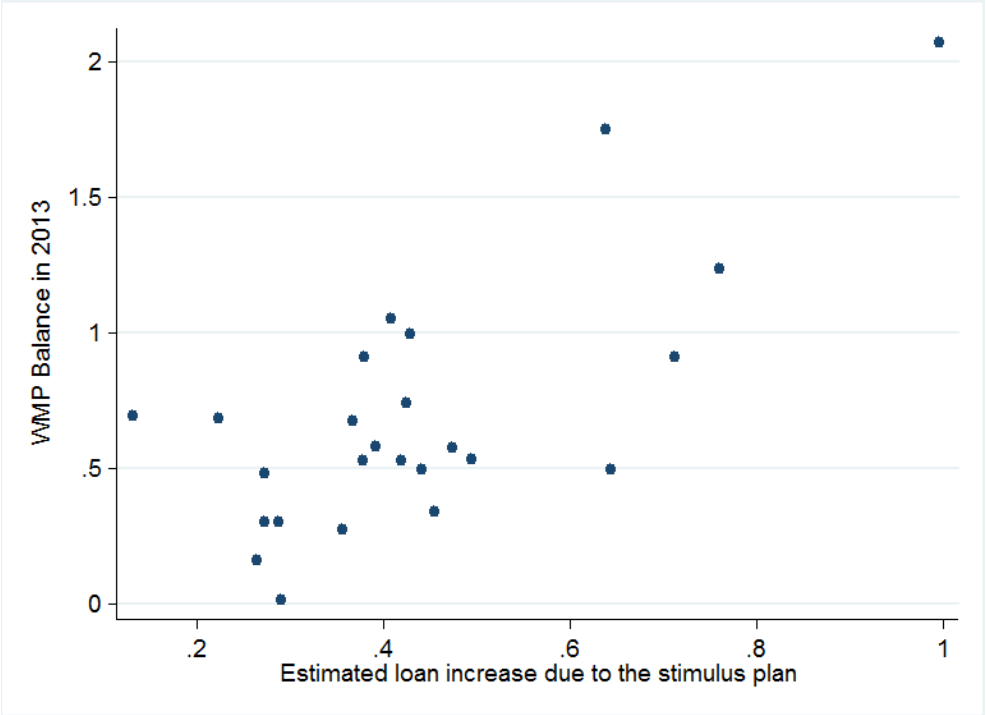


Figure IA8 Distribution of WMP Maturity Dates within a Quarter

This figure shows the total number of WMPs issued by the Big Four banks on each day of a quarter; we label the last day of each quarter as the 90th day and label the other days backwards. Data of individual WMPs is collected from WIND.

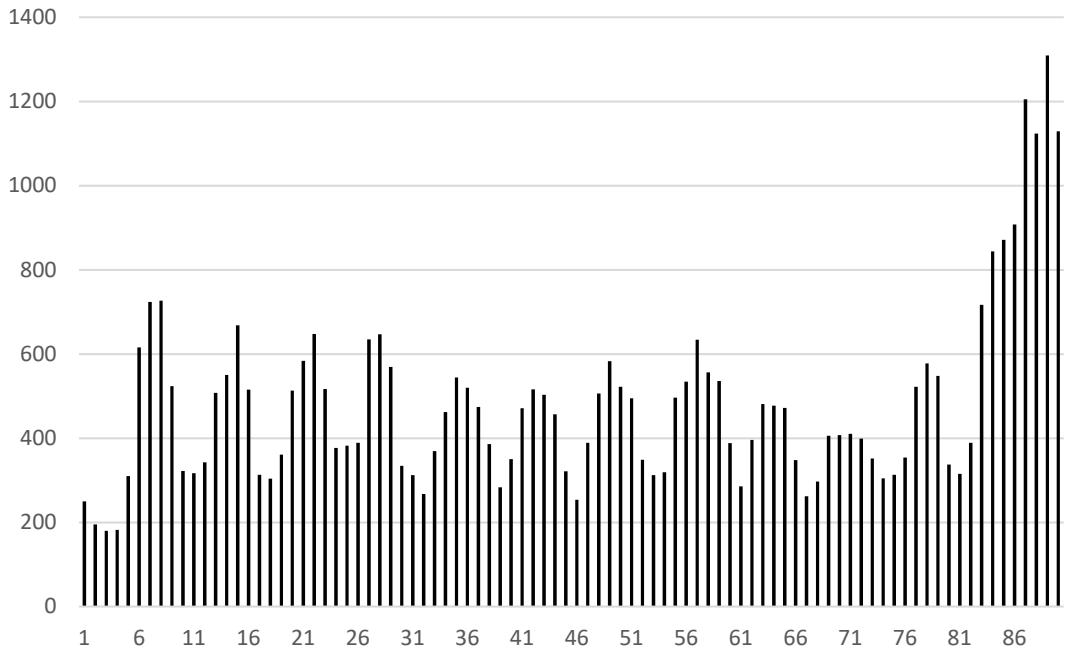


Figure IA9 Rollover Risks and Stock Market Response

This figure shows the stock returns versus WMP amount due/Equity on days when both the overnight and one-week SHIBOR increase by more than 1% compared to the previous day during 2009-2014. Stock returns are calculated as (today's closing price/yesterday's closing price) minus 1. The explanatory variable is the total WMP due in that month over bank equity at the end of the last month.