

Monetary Policy and Bank Loan Supply in China

by

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Abstract

This paper investigates the propagation of monetary policy through the banking system in China by analyzing the effect of policy instruments on banks' loan supply. Using bank level data for major commercial banks over the past twenty years, I examine the supply side of the narrow credit channel: loan level responses of commercial banks to monetary policy tools of the central bank. I find that banks have disparate but strong responses to different policy levers depending on their type and level of capitalization. Moreover, the major banking reform in the 1990s has changed some characteristics of the bank-dependent propagation mechanism without diminishing its central role in monetary transmission.

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I welcome any comment on the paper. The views and opinions expressed in this paper are entirely those of the author and do not reflect the views and opinions of the People's Bank of China or the Party. Any resemblance is purely (well, not really) coincidental. All errors are my own.

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1 Introduction

During the recent episode of global financial crisis, the People's Bank of China (PBC)¹ announced a 586 billion USD stimulus plan in 2008. In the year that followed, the banking sector saw its total credit exploding with more new loans extended in the first four months of 2009 than in all of 2008². Intriguingly, neither the require reserve ratio nor the centrally administered loan and deposit interest rates has changed significantly during that period, at least not nearly as enough to prompt such a gargantuan scale of lending frenzy from a profit maximizing standpoint. This is but one of the many baffling scenarios where the conventional framework for market economies like the US does not seem to explain the behavior of Chinese banks under a command economy. So how are monetary policies implemented in China and what are the commercial banks' reactions in the form of loan supply?

This paper sets out to address these puzzles by investigating the response of bank lending to monetary policies in the context of China. In other words, I explore the effectiveness of the narrow credit channel in translating monetary policies to changes in bank loan supply. As pointed out by Agenor & Montiel (2008), the credit channel is of paramount significance in a vast majority of developing countries that lack mature securities markets and whose financial systems are dominated by mega state banks. The relative importance of the credit channel among all transmission mechanisms in China has also been established in Xie (2004), Zhou & Li (2006) and Park & Sehart (2001). The propagation of China's monetary policy through the credit channel is unique from many other countries in two aspects: the Chinese central bank has frequently made use of a heterodox combination of monetary instruments such as excess reserve interest rate, required reserve ratio and window guidance, and the

¹The People's Bank of China has assumed the role of Central Bank since 1984.

²Source: "Chinese Banks Lend Now, May Pay Later", The Wall Street Journals, May 2009

experience of a major banking reform in mid-1990s that have potentially huge impact on the conduct of monetary policies. However, the existing literature has not delved into the responses of different types of banks to each monetary instrument and the impact of the reform on these nuances. The focus of this paper is to provide an analysis of the effectiveness of monetary policy tools on the loan supply of major commercial banks. I assess the relative responsiveness of the banks both cross-sectionally between large and small banks, as well as intertemporally spanning 10 years before and after the on-set of the reform. Understanding the implications of monetary policy for different banks will allow the central bank to design more effective monetary policies and by analyzing the impact of the reform, the groundwork can be laid out for the optimal path of future reform agenda.

First, I briefly explain the essence of the narrow credit channel, which has been discussed at length in the context of the United States by Romer & Romer (1994), Kashyap & Stein (1993) and Kishan & Opiela (2000). The classical bank lending channel consists of mainly four stages. The first stage links the central bank and the monetary base through monetary policies like open market operations. Changes in monetary base then transform into changes in banks' deposit holdings through the constraint of required reserves. In the next stage, deposit fluctuations cause loan supply to vary accordingly, assuming banks cannot costlessly substitute between loans and other forms of securities. Lastly, total investment is affected by the fluctuations in loans available, especially for small and medium sized enterprises that rely heavily on bank loans for external finance.

In the context of China, the credit channel plays a pivotal role. The People's Bank of China wields a heterodox combination of monetary policy instruments that influ-

ence deposits and loans directly, such as credit quota³, window guidance⁴, benchmark loan and deposit rates, rediscount rate and required reserve ratio. In mid-1990s, the central bank started a major overhaul of the banking sector which changed the way monetary policies were crafted and transmitted. Given the existence of an oligopolistic group of State-owned Commercial Banks, the implication of the reform on the effectiveness of the credit channel for different banks is particularly intriguing. I find that distinctions in responses of different types of banks to monetary policy instruments do exist and some of these disparities can be attributed to the characteristics of the Chinese banking system. The reform has transformed the functions of some policy instruments such as the relending rate, and changed the way banks react to some others such as the loan interest rate or the required reserve ratio.

The remainder of the paper is organized as follows. In section 2, I provide some background information on China's financial intermediation. In section 3, relevant literature is discussed. Section 4 establishes a model based on profit maximization behavior of banks tailored to the context of China. Section 5 outlines the specifications of the data. The empirical analysis, interpretation of results as well as a brief discussion of limitations are presented in section 6. Section 7 concludes.

2 Background

The People's Bank of China (PBC), the Chinese central bank, possesses a variety of monetary policy instruments which could be used to provide stabilization of the economy through the banking sector. The direct quantitative instruments, mainly

³The credit quota under China's context is a directional credit target which dictates the amount and the direction (to which sector or which area) of loans a bank has to extend in a given year.

⁴Window Guidance is often termed 'moral suasion', it has been used to persuade banks and other financial institutions to keep to official guidelines. The 'moral' aspect comes from the pressure for 'moral responsibility' to operate in a way that is consistent with furthering the good of the economy.

credit plans, direct PBC lending and window guidance, stem from the legacies of a centrally planned economy before the 1980s. The PBC also has at its disposal the indirect instruments, the most influential of which are required reserve ratios, a full set of heavily regulated interest rates and open market operations. To adjust to a new financial and economic environment in preparation for deeper integration into the global market, the tools and implementation of monetary policies in China have undergone many changes over the last twenty years, with the most fundamental reforms taking place in mid 1990s. During this “reform era”, the PBC’s aimed at transforming the financial framework from one in which direct quantitative control was predominant to a more market-oriented structure. Figure 1 summarizes the movements of major PBC policy instruments⁵.

2.1 The characteristics of China’s banking system

In analyzing the monetary policy instruments in China, it is important to acknowledge China’s unique financial environment. First, similar to many developing countries, China’s financial market has been dominated by four large State-Owned Commercial Banks (SOCBs): Industrial and Commercial Bank of China, Agricultural Bank of China, Bank of China and China Construction Bank. The “Big Four” possess more than 80 percent of the entire banking sector’s assets, absorb around 70 percent of the total deposit and extend over 80 percent of the total lending (Geiger, 2008). The SOCBs do not face much competition from the smaller banks, thus forming a de-

⁵Several characteristics of the graph is worth noting: 1. Instead of adjusting just one policy instrument at a time, the PBC tend to move a combination of policy levers simultaneously; 2. The required reserve ratio has stayed constant before 1998 and has been used most frequently in recent years; 3. The law of No Arbitrage failed in early 1987 and mid 1993 when the excess reserve interest rate exceeded the relending rate. The banks could in theory borrow indefinitely from the PBC and deposit the borrowed fund as excess reserve in the PBC again and make an arbitrage profit. This indicates that there are other non-pecuniary costs or constraints that prevented the banks from borrowing excessively from the central bank.

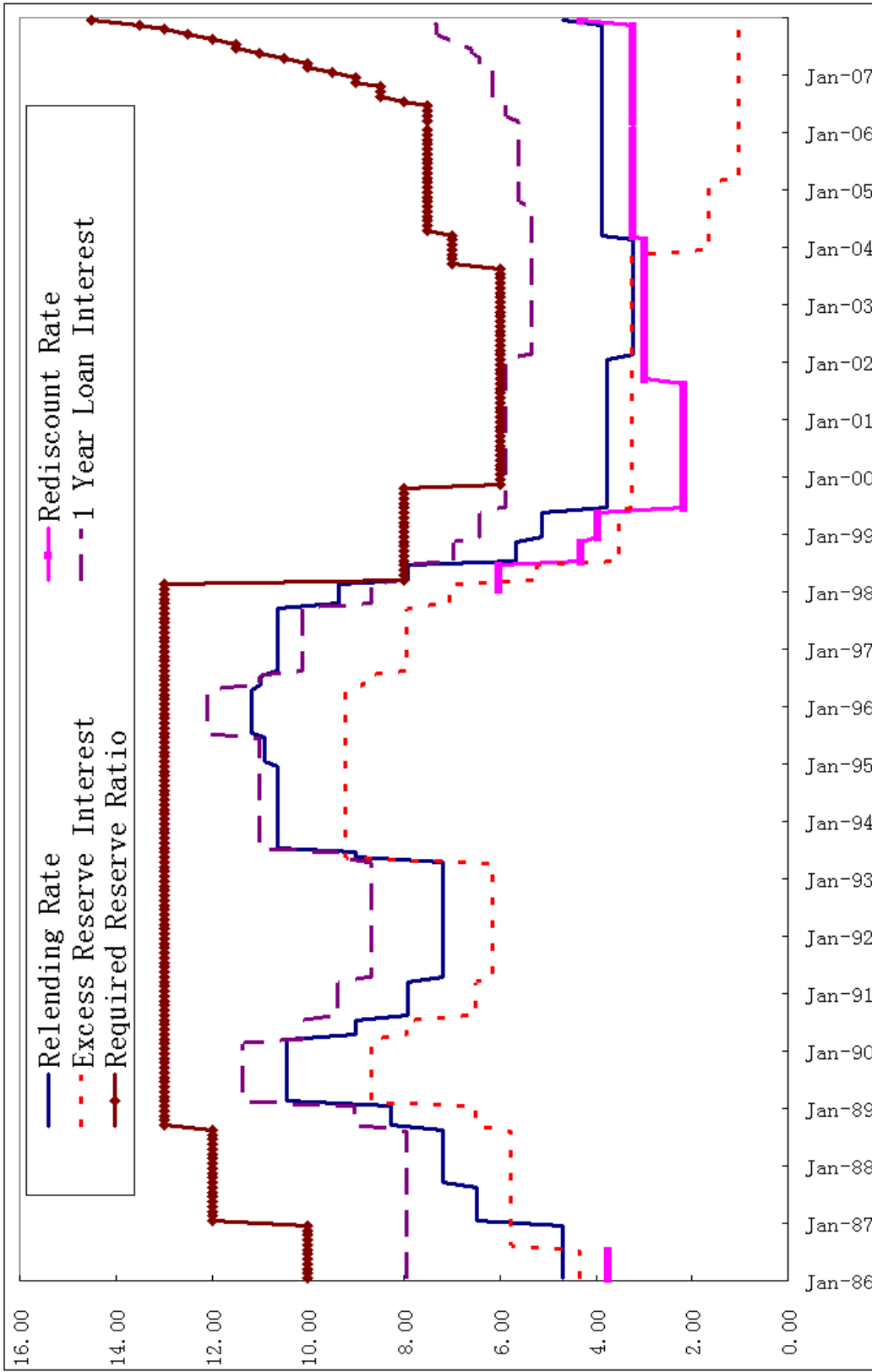
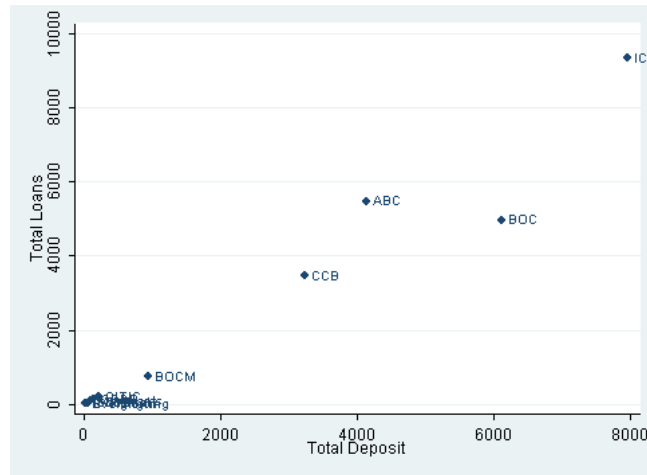
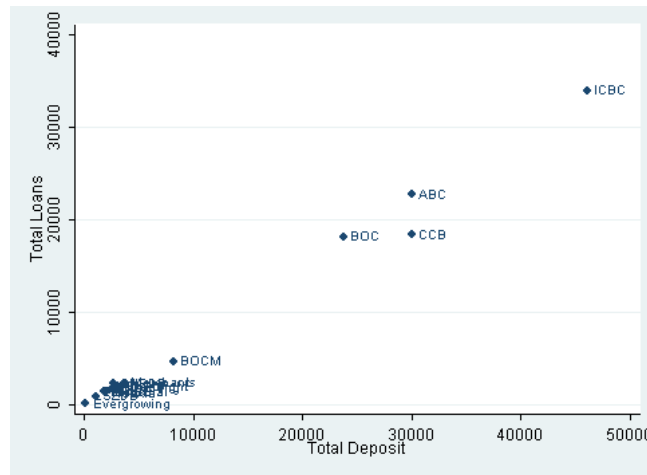


Figure 1: Monetary Policy Indicators

facto oligopoly. Furthermore, given their segregated lending targets conveyed partly in their names, the four banks do not compete against each other in all businesses. The scatter plots in Figure 2 of banks in two representative years illustrate the dominant position of the four SOCBs described above.



(a) Major banks in 1992 (Pre-reform)



(b) Major banks in 2003 (Post-reform)

Figure 2: Plots of Banks' Total Loans versus Total Deposits (Unit: 100 Million Yuan)

Second, the balance sheets of Chinese banks consist mainly of loans on the asset side (more than 60 percent in 2002) and deposits on the liability side (around 90

percent in 2002 for the SOCBs)⁶. The dependency on deposits as source of funding indicates that Chinese banks do not have means of large-scale external finance from foreign capital markets.

Third, the asset quality of Chinese banks has been historically lower than their foreign counterparts (Barnett, 2004). An unhealthy level of non-performing loans (NPL) persists within the banking system. For example, the share of NPL in total loans for SOCBs in 2004 was 19.15 percent⁷. Moreover, the ratio was much higher before the banking reform, when the majority of bank lending took place as preferential policy lending to specific industries/areas supported by the government.

Fourth, as the Central Bank Law states “The People’s Bank of China shall, under the leadership of the State Council, formulate and implement monetary policies”, government intervention is still prevalent despite the reform efforts to steer away from direct control. Before 1990, the captivity of the central bank is most conspicuously manifested in the “credit plans” that enforced commercial banks to allocate preferential policy loans to industries the government wished to support. Although the use of credit plans has been discontinued after reforms, interest rates are still heavily regulated by the authorities despite slow progress made towards liberalization. Window guidance, which was modeled from Japan’s experience, has also played an important role.

Fifth, the banks keep a high ratio of excess reserves, which was well above 10 percent in the 1990s and only gradually dropped to around 5 percent after 2003. Unlike central banks in the developed world, the PBC pays exorbitant interest rates on reserves as well as excess reserves. In mid 1990s, the excess reserve interest rate was at one time as high as 9 percent⁸. Such high rates on excess reserves predictably

⁶Both figures are author’s calculation from PBC official statistics at *www.pbc.gov.cn*.

⁷China Banking Regulatory Commission (CBRC) Statistics

⁸This is in relative terms to the international standard. For example, the Federal Reserve paid

dampened the response of financial intermediations to other interest rate fluctuations when banks had the option of using excess reserves as a risk-free investment. Nevertheless, it also played its unique role in that the Central Bank was able to use excess reserve interest rate as an active policy tool.

2.2 The reforms of China's monetary policy

Before a series of reforms that took place in mid 1990s, China's monetary policy makers aimed for the total credit as the intermediate target, exhibiting the characteristics of a centrally planned economy. PBC and government agencies were the only sources of funding available besides deposits. The common monetary tools used then included credit plans, relending policies and administered interest rates.

Credit plans were used extensively in the 80s and 90s, where the central bank designed and dictated the quantity and direction of loans extended by banks according to its policy objectives. The World Bank has estimated that 60% to 80% of the bank lending went to policy loans (Dickinson, Liu, 2005). Relending policies of the central bank reflect such plans. As was usually the case, large gaps existed between the available funding of the SOCBs through deposit and their assigned loan quota. PBC therefore extended direct lending to the banks through a process called "relending". The relending rate was the interest rate earmarked for funds provided to SOCBs for policy purposes in the case of deposit shortfalls (Park, Sehart, 2004). In 1993, PBC refinanced about 40% of the loans from SOCBs. The smaller, non-state-owned commercial banks did not have to shoulder such heavy policy lending responsibilities to state-owned enterprises. Therefore they either did not have to use the PBC relending facility, or could not access central bank funds as easily as the SOCBs⁹.

zero interest on excess reserves before 2008 (banks did not keep any excess balance anyways) and is now paying only 0.25% on the nearly 1 trillion excess reserves in the banking system.

⁹The balance sheet data of non-SOCBs demonstrates that they did not borrow from the PBC

Despite having a large proportion of lending directed towards policy loans, banks still had some flexibility in allocating loans. The relending rate as the price of funds from the central bank was the marginal cost of supplying loans. This means that before the reforms, relending policies could have the potential to affect bank's credit decisions.

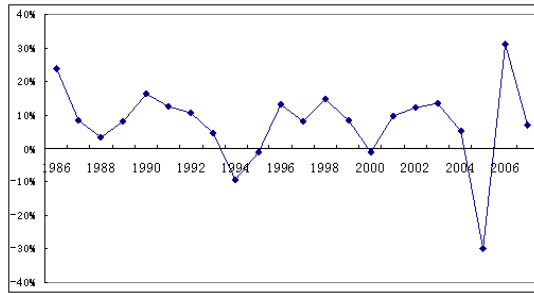
Before the 1990s, massive government intervention, low asset quality and low capitalization characterized the Chinese banking system (Garcia-Herrero, et al, 2006). The first wave of reforms took place in 1994-1995 and the notable changes include: relaxation of binding credit plans; adoption of a new Commercial Bank Law to improve managerial incentives and prudential financial regulation; establishment of policy banks to separate policy from commercial lending¹⁰ (Figure 3); as well as the establishment of a national, unified interbank market. The purpose of the reform was to converge to the global standard and steer the banks to becoming more commercially oriented.

In 1998, explicit credit quotas were eliminated once and for all. In its place, PBC started to adopt a policy of "window guidance", compelling banks to stick to official guidelines (Geiger, 2008). Also since 1998, the required reserve ratio started to assume its importance as a monetary policy instrument and was used frequently in the following years.

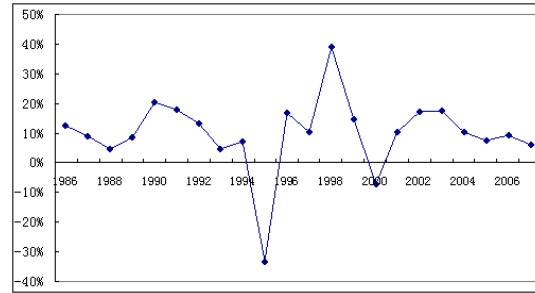
Before mid 90s, PBC relending was the main channel of monetary control. After the reforms, open market operations (OMO) were used as the primary tool to manage monetary base (Bennett, Dixon, 1998). Since 2000, however, as increasing volume of capital inflows rushed into China, OMOs were used mainly to withdraw liquidity from

at all besides for emergency cash clearing purposes which only amounted to a miniscule portion of their liabilities.

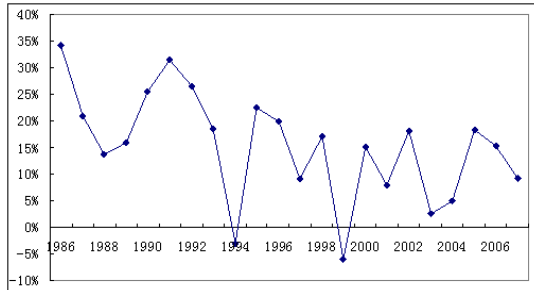
¹⁰The large drop in SOCBs' loan growth demonstrated in Figure 3 around 1994-1995 was justified by the purpose of the policy banks that took over some policy loan responsibilities.



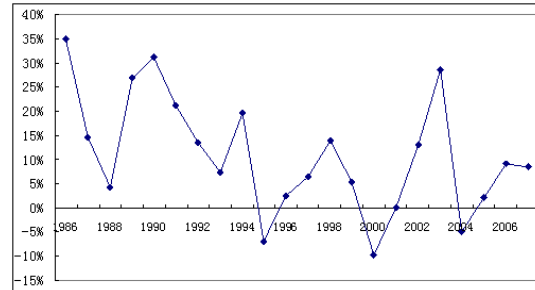
(a) Industrial and Commercial Bank of China



(b) Agricultural Bank of China



(c) China Construction Bank



(d) Bank of China

Figure 3: Real Loan Growth of SOCBs

the financial system and maintain the de facto peg of the RMB¹¹. -dollar exchange rate(Liu, Xie, 2006). Until late 2005 when the peg was relaxed into a crawling peg, repurchase operations (repos)¹² remained an important sterilization tool. The OMOs have a special implication for loan supply and the credit channel. In order to cope with an increasing pressure from the foreign exchange market, the PBC started issuing Central Bank Bills since the 90s. Although commercial banks acquire such bills at a discount rate through price bidding, some large commercial banks are subjected to directional insurance. That is, they were required to acquire a certain amount of Central Bank Bills by PBC mandate. The acquisition of the bills directly removes

¹¹The Renminbi (RMB), or the Yuan, is China's currency which is traded with the US dollar at 6.8 to 1 exchange rate at the moment.

¹²Repo operation is an important arsenal of the PBC which usually consists of the PBC raising yields on its bills and draining liquidity by selling more bonds.

excess liquidity from banks and reduces their ability to make loans. The interest rate paid on the short-term Central Bank Bills thus establishes a floor for the rediscount rate.

After the discontinuation of direct central bank lending in 1994 (Geiger, 2008), central bank loans were transformed from a main source of funds for SOCBs' policy loans to a lender of last resort and a subsidy for policy-oriented activities (Xie, 2004). The reserve requirement that stayed at 13 percent from 1988 to 1998 started to be seen as an effective and direct instrument to manage the liquidity level in the banking system. It has become one of the active tools of monetary adjustments, together with open market operations, rediscount rate and benchmark interest rates.

2.3 The working of monetary transmission channels in China

Given the predominance of finance by bank loans in China, it is natural to analyze the effects of monetary policies within the context of the bank lending channel of monetary transmissions. The PBC explicitly states that quantitative credit planning, along with monetary policies, is an important component of its macroeconomic management¹³. As a means to “fine tune” financial structure, credit policies in China are closely connected with monetary policies and mainly carried out in the following forms: (1) setting aggregate growth targets of credit in the economy (credit quota); (2) directing preferential credit to areas and industries that are in need of development and supported by government policies (policy lending); (3) limiting excess commitment of credit to certain industries through “window guidance”; (4) establishing laws and regulations to promote financial reform and innovation, as well as minimizing potential credit risk. Bank lending as the sole carrier of credit policies becomes all-important.

¹³PBC Homepage, *www.pbc.gov.cn*, Credit Policy, Mission Statements

For the bank lending channel to work effectively, the following premises need to be satisfied. First, banks cannot costlessly substitute loans with securities and other types of asset on their balance sheet. This condition is generally true in China for the past twenty years with loans consisting of a large portion of China banks' assets, approaching 65% in the year 2002, while bonds only made up about 7% of the balance sheet¹⁴. Second, firms depend predominantly on loans as a source of fund. In 2004, bank loans represented 83 percent of the total fund raised by non-financial sector, while stocks were 5 percent and bonds 12 percent (Garcia-Herrero, et al, 2006). This is again confirmed in Liu & Xie (2006), where the authors find bank loans took up 80.2% of the total financial resources in 2006. In short, I am well-grounded to hypothesize that the bank lending channel plays the predominant role in China's monetary policy transmission.

The interest rate channel has gained importance as China's financial reform deepens. Despite the progress made in interest rate liberalization, however, the current set of price-based instruments are still subject to heavy government intervention. All benchmark interest rates are still monitored by the central bank and only allowed to fluctuate in a narrow band. The channel of monetary transmission thus deviates greatly from the textbook interest rate model. Furthermore, the effectiveness of the interest rate channel anchors on the responsiveness of the firms and households' consumption level to interest rate fluctuations. Given the lack of alternative investment options and a historically high propensity to save, most household consumers are insensitive to benchmark interest rates. While firms are expected to react to changes in loan rate, if the loan market is supply constrained as I will illustrate later, the aggregate level of investment depends more on the availability of bank loans through

¹⁴A significant portion of banks' securities holding is Central Bank bills which cannot be easily substituted even at the margin. PBC Statistics, Aggregate Data for Year 2003

the credit channel.

China has maintained a de facto peg of the nominal exchange rate of RMB to the dollar for two decades, only after 2005 was the regime changed to a crawling peg. Therefore, the classical exchange rate channel has been virtually blocked. Zhang (2009) provides further analysis into the impact of changes in effective exchange rate. By adopting a VAR model, he finds that the movements of the real effective exchange rate¹⁵ do not influence the output in a statistically significant way, but the sign of the coefficient is in agreement with the arguments of the exchange rate channel, i.e. a decrease in the effective exchange rate causes a corresponding increase in output.

China is in the league of a vast majority of developing countries characterized by the lack of a well-functioning capital market (Agenor, Montiel, 2008). As discussed above, Chinese firms depend predominantly on bank loans for external finance, while Chinese customers are more accustomed to holding deposit in banks rather than equities or securities (although in the developed world, similar examples do exist as in the case of Japan). A policy-induced change in asset prices is incapable of significantly affecting the value of a firm's collateral or the wealth of a typical household. The effect of wealth channel and the balance sheet channel are thus severely undermined.

3 Overview of Existing Literature

3.1 On different channels of transmission mechanisms

Studies on monetary policy transmission have seen most progress in the 80s and 90s, with the emergence of influential literature establishing the different channels of the

¹⁵The real effective exchange rate is the weighted average of a country's currency relative to an index or basket of other major currencies adjusted for the effects of inflation. The weights are determined by comparing the relative trade balances, in terms of one country's currency, with each other country within the index. Source: *Investopedia*

monetary transmission mechanism. Ireland (2005) gives a succinct overview of the notable research on this topic. I provide a brief summary below.

The most basic interest rate channel originates from the core of the Keynesian IS curve, although the response of consumption and investment that is markedly larger than estimated interest rate elasticity suggests that other mechanisms besides the narrow interest rate channel might be at work (Kuttner & Mosser, 2002; Bernanke & Gertler, 1995). The empirical study of Bernanke and Blinder (1992) has not only validated the existence of the interest rate channel but also asserted that it is the major monetary transmission mechanism in the US. In an open economy, the exchange rate channel works through the uncovered interest rate parity (Mishkin, 1995; Kuttner & Mosser, 2002). Monetary policy can also propagate through asset prices via two channels. The monetarist channel illustrated by Meltzer (1995) focuses on relative asset prices. According to Meltzer, the importance of the interest rate channel established in earlier works (Bernanke & Blinder, 1992; Friedman & Kuttner, 1992) can also be interpreted as the cyclic change of relative asset prices. It is notable that Meltzer argues that the monetarist channel is operative even if a country does not have an effective financial market, as in the case of China. The wealth channel, on the other hand, stems from Ando and Modigliani's (1963) consumption and saving life-cycle hypothesis illustrated in standard macroeconomics textbooks. The broad credit channel, or the balance sheet channel, emphasizes the role of borrowers instead of banks (Bernanke & Blinder, 1989; Bernanke & Gertler, 1995). Monetary policy that affects the net worth of firms and their cash flow is capable of influencing investment spending due to adverse selection and moral hazard issues.

The focus of this paper, however, will be the narrow credit channel, or the bank lending channel. Bernanke and Blinder (1988) extended the traditional IS/LM model with the integration of bank lending into the LM curve, allowing the roles of both

money and “credit”. In their paper, Bernanke and Blinder replace the IS curve with a CC curve, denoting the clearance of both the credit and commodity markets. In this model, investment is determined by interest rates of both non-risky bonds and bank loans. It is important to note the assumption that these two sources of funds are not perfect substitutes, so that borrowers cannot costlessly switch away from their dependence on bank loans due to external finance premium (Liu, Xie, 2006). Therefore, the model encapsulates three kinds of financial instruments: money, bonds and bank loans. A simple illustration of the transmission mechanism goes as such: contractionary monetary policy reduces reserves; banks constrained by required reserve ratio will see their deposit level drop; banks face constraints of their balance sheet and their ability to make loans decreases; firms are unable to obtain bank loans or have to pay higher interest on loans, investment is cut back, which reduces total output.

Liu & Xie (2006) conclude in their paper that the Chinese monetary transmission is typically a “credit channel”, but also acknowledge its limitations: constraints in open market operations due to large volumes of foreign exchange swap; oligopolistic competition pattern formed by the SOCBs; abuses of window guidance that causes fluctuations in loan supply and the disproportionately large impact of the credit channel on small and medium sized enterprises. They describe the mechanism through which different monetary tools affect bank lending, but fails to account for the strategic usage of a combination of tools by the PBC.

The transmission mechanisms have been discussed at length in many Chinese studies. However, most of the empirical papers make use of simplistic models, rendering their results unconvincing. Ran & Mo (2005) make use of only the aggregate GDP, loans and M2 figures. By conducting Granger causality test and regressing GDP on both loans and M2, they conclude that the credit channel is more prevalent

than the monetarist channel in China, where changes in total loans represent the credit channel and money base represents the monetarist channel. It is premature to arrive at the conclusion so casually with such limited empirical evidence. Zhou & Li (2006) conduct similar research with a few more variables such as price, industrial output, M1 and interest rate. Their analysis, however, includes only the Granger causality test. Besides the gross generalization of a transmission channel to one aggregate variable, most Chinese papers fail to distinguish between loan demand versus loan supply which both drive changes in aggregate loans. The demand and supply side each encompass the interest rate channel and the credit channel respectively. Such identification of supply and demand sides is crucial if we hope to understand the working of various transmission channels, especially in an economic framework as complex and nebulous as China's.

3.2 On China's banking system and its reforms

The existing western literature has mainly taken interest in the financial reforms of the 90s and their impact on the effectiveness of monetary policies. Geiger (2008) notes that the intermediate target of the PBC has shifted from total credit to money supply after the reform, which is echoed in Liu & Xie (2006). The paper also makes an attempt at investigating the PBC's usage of multiple monetary policy instruments simultaneously. By analyzing the actual and targeted level of credit, money supply, inflation and economic growth, Geiger finds that the application of a heterodox mixture of monetary policies has allowed China to reach its final target of price stability and economic growth, even though the intermediate targets were consistently missed. Using two or more instruments concurrently creates various distortions that prevent the interest rate channel of monetary transmission from functioning effectively.

Geiger thus proposes a sudden change that suspends all quantity-based instruments like credit quotas, window guidance and capital controls in order to achieve the original goal of the reforms, that is, restructuring the financial system anchored around interest rates and other market-based instruments.

Garcia-Herrero et al. (2006) identify three centerpieces of China's reform effort: bank restructuring, mainly aiming at the SOCBs and cleaning their unsustainable level of NPLs; financial liberalization, where credit plans and direct controls of interest rates should be gradually relaxed; and strengthening of supervision and regulation. Similar to Geiger (2008), they also point out that the progress of reforms, albeit commendable, is not fast enough and more radical changes need to take place. Barnett (2004), on the other hand, holds back on his evaluation of the reforms and notes that its full impact will only become clear in a few years. Nonetheless, Barnett supports improvement in banking regulation and transparency.

3.3 On banks' behavior models in developing countries

Agenor & Montiel (2008) analyze the framework of monetary policy in small open economies where bank loans are the only source of external finance. The paper acknowledges that in many developing countries with an immature securities market, the credit channel becomes all-important. This analysis is relevant for China where firms (especially small and medium enterprises) do resort to bank loans as their main source of funds. The paper proposes a macroeconomic model involving equilibrium in both the financial and goods market, with firms, households, commercial banks and central banks as players. The part of the analysis of commercial banks is of particular interest to my paper. In their model, banks are assumed to have two assets: lending and required reserves; and two liabilities: central bank borrowing and

deposits. Borrowing from the central bank is perfectly elastic at the official refinance rate (the relending rate in China's context), and banks choose the level of deposit and loan interest rate to maximize their profit subject to balance sheet constraint.

While Agenor & Montiel's model puts forth a basic framework in analyzing bank behavior in developing countries, we have to be aware of some caveats before applying it to China's case. *First*, Chinese banks hold a large amount of excess reserves. Even in recent years after a decade's reform, SOCBs still hold around 3 percent excess reserves for which the PBC pays interest. It is an important source of income that affects banks' lending decisions. *Second*, I need to take into account the constraint of credit plans in the pre-reform era, which were usually binding for the banks. With the credit quotas to meet, banks were not simply maximizing their profit based on interest rates. *Third*, the most distinct departure of the Chinese banking system from that in Agenor & Montiel's model is that all benchmark interest rates, including the central bank relending rate and loan/deposit interest rates, are actively administered by the central government. Banks thus cannot use interest rates as a tool to adjust their balance sheets. Instead Chinese banks choose the level of borrowing, loans and excess reserves at the exogenously determined rates.

Another notable paper on behaviors of Chinese banks is Park and Sehart (2001). It argues that the importance of policy lending by Chinese state banks did not fall after the reform and that lending by financial institutions did not respond to economic fundamentals such as sector output and output growth rate. The innovation of their work lies in the development of a bank intermediation model that attempts to incorporate policy lending. The bank intermediation model developed in their paper provides great insight into the behavior of Chinese banks. The incorporation of policy lending into bank's objective functions implies the existence of window guidance.

Although the paper has shown commendable promise under the constraint of

data to model policy lending, it still falls short in several aspects. *First*, banks should not be able to choose the level of policy lending before the reforms. As discussed earlier, strict lending quotas in the form of credit plans dominated the pre-reform banking system in China. Banks usually were given no alternative but to meet the lending targets, even if it meant borrowing directly from the PBC. Even after reform where window guidance, or moral suasion, replaced credit quotas, it is hard to fathom that banks had much freedom in choosing whether to obey the official guidelines. The legacy of centrally planned economy would have incurred too high a non-pecuniary cost on banks to not abide by the PBC ruling. Indeed more often than not, as demonstrated in Liu & Xie (2006), banks acted according to window guidance in the special period but reversed their actions as soon as window guidance expired, creating undesirable fluctuations in the financial system. *Second*, the three policy variables in the regression: grain production (GRAIN), state-owned enterprise output (SOEY) and state-owned enterprise profit (SOEP) are insufficient to capture the entire objective function of the PBC in designing the optimal monetary policy or credit targets. Production of different commodities is highly specialized in China. For example, southern China has much higher grain production due to its geographic and climate advantages, while northern China produces more steel. Other factors such as efficiency of transportation in the form of railroads or highways will perceivably also affect the amount of policy lending. *Third*, it is rather simplistic to infer government's policy lending objectives from policy variables alone. Besides industrial and area considerations, unobservable factors such as environmental changes and government tastes will all have an impact on the allocation of preferential policy loans.

4 A simple model for Chinese banks

The banking reform in the mid 1990s has profound implications on the behavior of Chinese commercial banks. Before the reform, the PBC set explicit credit plans and banks were subject to loan quotas. There were large volumes of direct lending from the PBC to the SOCBs, implying that the credit quota was binding for banks that resorted to the PBC for funding. A functional interbank market did not exist and banks held large amounts of excess reserves (more than 10 percent).

After the reform, explicit credit quotas were lifted by the PBC. An interbank market was set up where banks could borrow or lend at the interbank offer rate. Although implicit window guidance took place of the credit plans, it was no longer as binding. This is partly because deposit growth has outstripped loan growth in the 1990s for all the SOCBs¹⁶ and banks were flooded with liquidity. Direct borrowing from the PBC discontinued. The banks, however, continued to hold high levels of excess reserves relative to the international norm, exceeding 5 percent entering the year 2000¹⁷. Therefore I propose separate bank profit maximization models before and after the reform.

4.1 A bank model for the pre-reform era, 1986-1997

Bank's liability side consists of deposit, D , and borrowing from the central bank, B . Deposit is assumed to be exogenous. The asset side consists of loans, L , required reserves, αD where α is the required reserve ratio determined by the central bank, and excess reserves, E . As the level of required reserves is exogenous, I can assume no interest rate paid on them without compromising the analysis of the model. Therefore the balance sheet constraint is such that

¹⁶See Appendices, Figure 10.

¹⁷PBC Homepage, www.pbc.gov.cn, Aggregate Statistics of 2001, author's calculation

$$E + L + \alpha D \leq D + B \quad \text{or} \quad E + L \leq (1 - \alpha)D + B$$

Naturally, the level of excess reserves cannot be negative, neither is the level of borrowing from the PBC. Banks face the set of exogenous interest rates that is centrally administered and a credit quota L^* imposed by the PBC. They can choose the levels of L , B , and E to maximize their objective function:

$$\max_{L,B,E} U = r_L L + r_E E - r_D D - r_B B$$

$$\text{s.t. } E + L \leq (1 - \alpha)D + B$$

$$E \geq 0, B \geq 0, L \geq L^*$$

where: $r_L(L, i_L)$ is the return on loans that depends negatively on L and positively on i_L , the loan interest rate. The negative partial derivative on L captures the fact that risk assessment becomes more difficult and the ratio of NPLs tend to become higher the larger amount of loans a bank extends (Stiglitz & Weiss, 1981).

$r_E(E, i_E)$ is the return on excess reserves that depends positively on the excess reserve interest rate, i_E . The non-pecuniary return of holding excess reserves also captures the 'safety factor' a bank gains so that they are less likely to face a liquidity crisis. The more excess reserves, the less marginal 'safety' it offers the bank¹⁸. Hence r_E depends negatively on E .

$r_D = i_D$ is the cost of holding deposits which is assumed to be equal to the deposit interest rate and exogenously determined.

$r_B(B, i_B)$ is the cost of borrowing from the PBC. First it depends positively with the relending rate, i_B . We would also expect greater non-pecuniary cost incurred

¹⁸Banks that fail to meet the reserve requirement after running out of excess reserves usually face hefty fines. The PBC can, for example, force the bank to acquire central bank bills at a below-market interest rate.

on a bank the more it tries to borrow from the central bank. Such costs can take the forms of, for example, ceding more of the bank's autonomy to the PBC in order to obtain loans. Therefore r_B is positively correlated with B .

From the set up it is clear I have assumed that banks are not "pure" profit maximizers because returns on assets and costs on liabilities are not completely pecuniary. Solving the first-order conditions in this case requires us to invoke the Kuhn-Tucker conditions for the nonnegativity constraints. The cases where E, B are binding will yield rather uninteresting results. Also in reality, excess reserves and direct borrowing from PBC were definitely not zero before the reforms. I only consider the case where neither E or B is binding.

If L^* is non-binding, first-order conditions yield:

$$r'_L L + r_L = \lambda$$

$$r'_B B + r_B = \lambda$$

$$r'_E E + E = \lambda$$

where

$$r'_L = \frac{\partial r_L}{\partial L}, r'_B = \frac{\partial r_B}{\partial B}, r'_E = \frac{\partial r_E}{\partial E}$$

In short, $MRL = r'_L L + r_L$ is the marginal return of loans, $MCB = r'_B B + r_B$ is the marginal cost of borrowing from the PBC and $MRE = r'_E E + E$ is the marginal return of holding excess reserves. Therefore the first-order conditions require $MRL = MRE = MRB$, keeping in mind the constraint $L + E = B + (1 - \alpha)D$. See Figure 4 for a simple graphical illustration.

$r_B(0) = i_B$ is the marginal cost of borrowing when banks just start to borrow and it equals the relending rate. $r_E(0)$, on the other hand, is the marginal return of excess

reserves when $E = 0$. It is higher than the excess reserve interest rate i_E because the non-pecuniary 'safety factor' is the highest when $E = 0$. The negative slope of MRE is steeper than that of MRL because otherwise banks will start holding excess reserves as soon as $MRL = r_E(0)$. In the above graph, I assume that the level where $MRL = MRE$ is lower than $r_B(0)$. Therefore B becomes binding and the bank splits its resources $(1 - \alpha)D$ between loans and excess reserves, extending loans up to the point where the marginal return of holding excess reserve becomes higher. The levels of L and E are shown in the graph.

Under this scenario, an increase in the loan interest rate i_L shifts MRL upwards, raising the level of loans and decreasing excess reserves provided B is still binding. Decreasing the excess reserve interest i_E shifts the MRE curve down and produces the same effect. If B remains binding, the relending rate that changes the level of $r_B(0)$ does not have any effects on bank loans. Increases in the deposit rate i_D , although exogenous in this model, will tend to induce the level of deposit, D , to increase accordingly, thus moving the MCB curve horizontally to the right. Both loan and excess reserve will increase. An decrease in official required reserve ratio gives the same result.

However, the assumption that $L = L^*$ is non-binding does not necessarily represent the context of China before reforms. From Appendices, Figure 10, it is clear that banks in the pre-reform era usually had higher lending than their resources from deposit. The deficiency can only be filled with borrowing from the PBC. Therefore, I shall look at the scenario where $L = L^*$ is binding, and the level of credit quota, L^* , is greater than the costless available resource, $(1 - \alpha)D$. Figure 5 below plots a similar graph under the new constraints.

Now we have $L = L^*$ fixed. The shortage of funds of the banks is covered by direct lending from the central bank. The bank then hold excess reserves up to

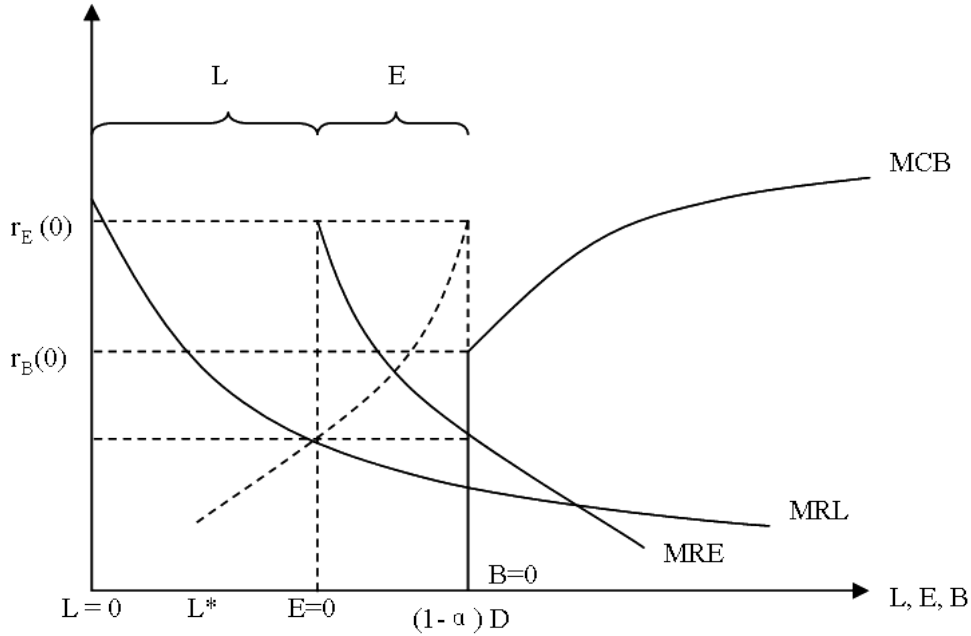


Figure 4: L^* non-binding, B binding

the point where the marginal return on excess reserves equals the marginal cost of borrowing. As Chinese banks always hold a certain amount of excess reserves, I can set the level of $r_E(0)$ to be an upper bound of the MCB curve with negative second order derivative w.r.t. B .

From the graph I can again interpret the implications of monetary policy before reforms. First note that the level of loans is exogenously determined as banks will always lend at the minimum required level L^* . Loan interest rate, by shifting the MRL curve, does not have any impact on the level of loans, excess reserves or borrowing. Borrowing is determined first by the difference between L^* and $(1-\alpha)D$, then by the MCB and MRE curves. All excess reserve holdings are financed by central bank borrowing. Hence if L^* increases, L increases accordingly, B increases, but E will decrease as MRE curve shifts horizontally to the right, intersecting MCB at a lower level of excess reserve. If the relending rate i_B increases, MCB shifts vertically

upwards, resulting in a decrease in both E and B . Lower required reserve ratio and larger total deposit (possibly induced by an increase in i_D) shifts MCB horizontally to the right, resulting in an increase in both E and B .

The figure only represent but one possible regime a specific bank could be in given its objective function and non-pecuniary costs associated with its transactions. Different types of banks, or the same group of banks with different sizes, may well fall in disparate regimes where monetary policies will have distinctive effects. In Figure 5, for example, if a bank has higher marginal rate of return from loans at a given level of loan supply, its higher MRL curve could cut the MCB curve beyond the credit quota constraint. Under this scenario, loan interest rate and relending rate will have an impact on loan supply. One of the purpose of this paper is to identify the regimes different banks, or the same bank in different eras, belong, thus drawing conclusions about their responses to monetary instruments.

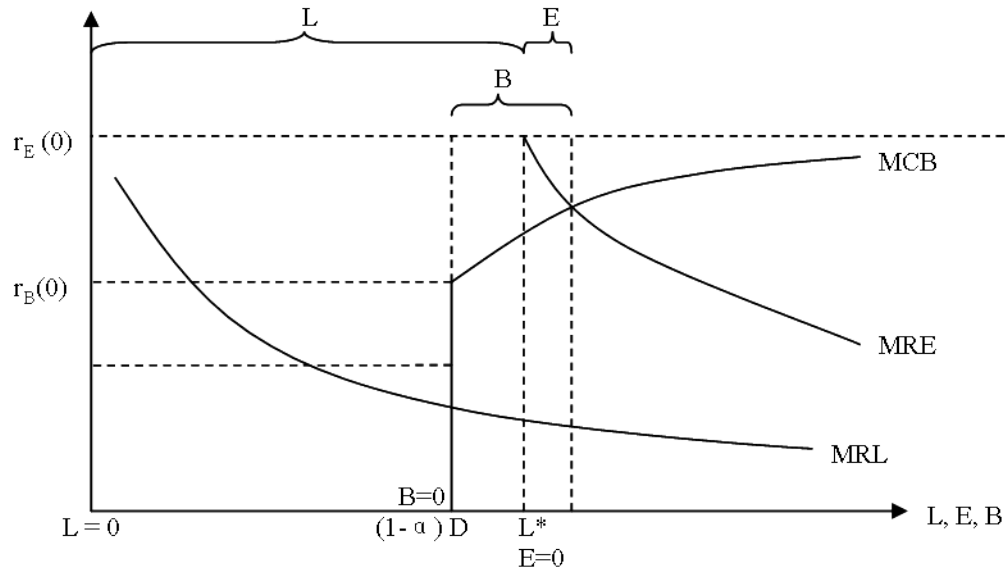


Figure 5: L^* binding, B, E non-binding, $L^* > (1 - \alpha)D$

4.2 A bank model for the post-reform era, 1998-2008

After the banking reform, credit plans no longer exist. Banks have the new option of transaction in the interbank market at the interbank offer rate. I take the basic form of the previous model and make the necessary adjustments. Banks now have net interbank lending I on their asset side. If I is negative, it indicates net interbank borrowing. Assume the interbank rates for lending and borrowing are the same, the banks' profit maximization problem then becomes:

$$\max_{L,I,E,B} U = r_L L + r_E E + r_I I - r_D D - r_B B$$

$$\text{s.t. } E + L + I \leq (1 - \alpha)D + B$$

$$E \geq 0, L \geq 0, B \geq 0$$

where $r_I = i_I$ is the interbank offer rate, the universal rate at which banks borrow and lend in the interbank market¹⁹. This rate can be perceived as the marginal return of lending and the marginal cost of borrowing in the interbank market at the the same time, i.e. $MRI = MCI = i_I$.

Assume that none of the nonnegativity constraints are binding (In reality, B is closest to be binding, but some SOCBs still borrow small amounts from the PBC as a source of emergency funding). The first-order conditions yield:

$$r'_L L + r_L = \lambda$$

$$r'_E E + r_E = \lambda$$

$$r'_B B + r_B = \lambda$$

¹⁹I assume that there is no transaction or administrative costs in the interbank market, thus the interest on borrowing and lending is the same.

$$r_I = i_I = \lambda$$

where the notations are the same as before. Solving the FOCs gives I have the relationship $MRL = MRE = MCB = i_I$, which is illustrated graphically in Figure 6:

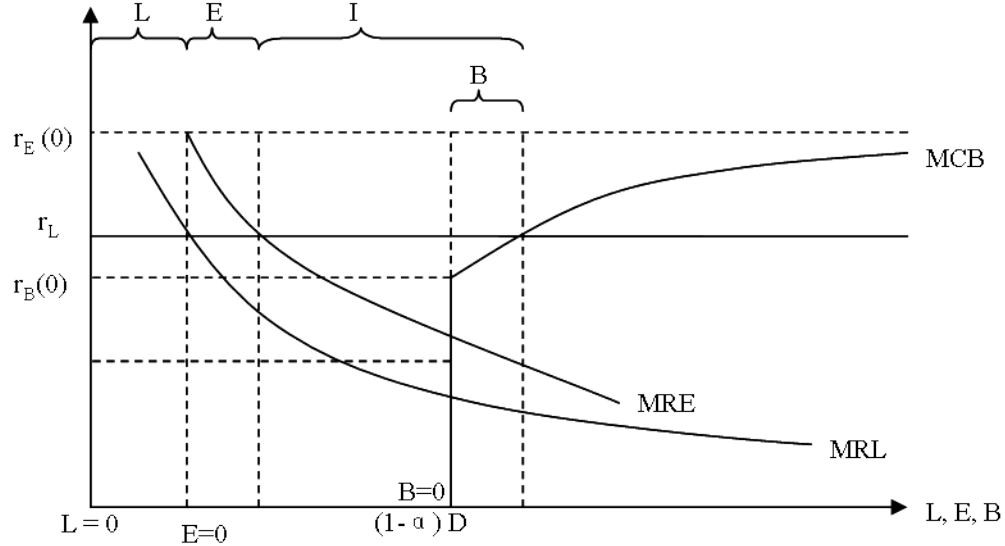


Figure 6: L, B, E non-binding, $r_L = i_L$, I is positive

The implication of the model can be clearly seen on the graph. The amount of loans banks choose to lend depends solely on the interbank interest rate i_I and the return on loans r_L . Banks keep excess reserves until the marginal return on reserves drops below the return on interbank lending. Banks then lend all resources in the interbank market and even borrow from the PBC if the interbank offer rate is higher than the relending rate²⁰. Under this framework, the offer rate becomes all important. Although it seems unrealistic that variables such as relending rate, required reserve ratio, excess reserve interest rate all have no bearings on bank lending, we need to

²⁰Of course in reality, the non-pecuniary cost of non-collateralized borrowing from the PBC may be infinitely high if the banks are using the relending facility for purposes other than policy lending or emergency funding.

keep in mind that the interbank offer rate is affected by the whole set of interest rates administered by the PBC. The relending rate and excess reserve interest rate are particularly important as they constitute the upper and lower limit for the offer rate (Xie, 2004).

For smaller commercial banks, they are thought of being more market-oriented than the SOCBs. In addition, as the smaller banks are not usually burdened with the task of carrying out policy lending, we would expect the proportion of NPLs for them to be much lower than that of the SOCBs. This means that those banks have a much higher *MRL* curve, which could intersect the *MCB* curve above $r_B(0)$. This scenario is plotted in Figure 7:

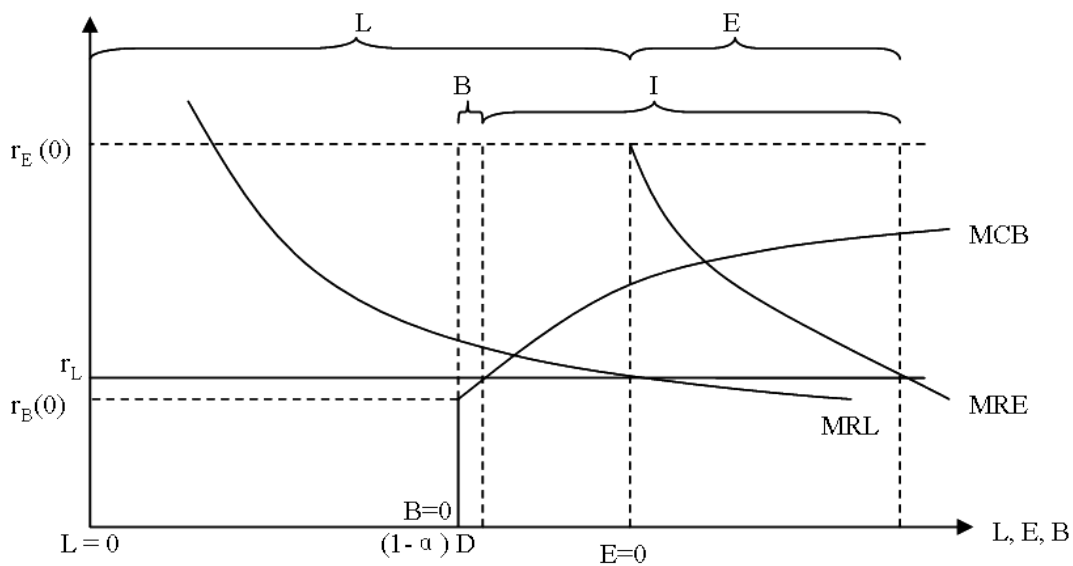


Figure 7: L, B, E non-binding, $r_L = i_L$, I is negative

When the return of loans is high, banks borrow from the interbank market and lend them in the form of bank loans. Excess reserves are also funded by borrowing from the interbank market until the cost of borrowing exceeds the return on reserves.

Deriving from the graph alone, interbank offer rate is still the only determinant of the level of L , B , and E . This model is more consistent with the western banking framework, where the interbank market plays the predominant role in influencing bank lending. This result may, to some extent, demonstrate the progress made by the Chinese banking reforms towards a more global standard²¹.

It is important to keep in mind that based on the maintained assumption that loan level is supply constrained, my model is restricted to the partial equilibrium on the “supply side”, or the banks’ response to monetary policy in the form of loan supply changes. To model the demand side, thorough knowledge and understanding of the objectives functions of Chinese firms are required as well as firm-level data which is difficult to obtain. However, I argue that modeling from the supply side is sufficient in most cases in the empirical section.

5 Data

The sample of bank data is compiled from the People’s Bank of China Statistics, China Finance and Banking Almanac 1986-2008, and various other published sources available online²². It contains comprehensive annual data of important macroeconomic indicators and bank level data for the major banks. The set of data I have compiled and will be using extensively is the annual balance sheet data of the four SOCBs and eleven smaller commercial banks over a twenty year span, from 1986 to

²¹I have intentionally left out the rediscount rate from the model, which is thought to be one of the most important monetary policy instruments. This is because the MCB curve effectively captures the cost of borrowing from the central bank, which if we assume no direct borrowing post-reform, is substitutable for a marginal cost of collateralized borrowing (rediscount rate) curve. The slope of this curve is then determined by the rediscount rate in the same way as the MCB curve depends on the relending rate.

²²Sources: People’s Bank of China Homepage, www.pbc.gov.cn; Financial Research Resource Center, www.rripbc.com.cn; Renmin University of China Economic Forum, www.pinggu.org; individual bank’s websites and other available (free) data bases online.

2007. A summary of the characteristics of the banks is presented in Table 1 below.

In the previous sections I have outlined the two aspects of the Chinese banking system that motivate the thesis of this paper: the oligopolistic nature of the four dominant State-Owned Commercial Banks (SOCBs) versus the smaller commercial banks and the pre-reform era of direct PBC control versus the post-reform era of indirect market-oriented guidance. Having these objectives in mind, I divide the bank data from 1986-2007 accordingly: by the nature of the banks and whether it is in the pre-reform or post-reform periods.

It is easy to separate the data by banks as the SOCBs have always consisted the “Big Four”: Industrial and Commercial Bank of China, Agricultural Bank of China, China Construction Bank and Bank of China, each of which focuses on a different sector, namely industry and commerce, agriculture, construction and foreign currency transactions²³. These four banks will be grouped together under “SOCBs” in my regression analysis. All other banks in the data set are either much smaller national banks such as Bank of Communications and CITIC Bank, or local commercial banks such as Shanghai Pudong Development Bank. They will be categorized under the “non-SOCBs” group.

Separating the two decades from 1986-2007 into pre-reform and post-reform era, however, is not as straightforward. The reform started since early 1990s as described earlier. Although the most groundbreaking steps have taken place before the year 2000, I still cannot assert that the reform has completed²⁴. The most significant policy changes by the PBC did not happen within a short period of time, but rather spanned

²³In recent years, Bank of Communications has grown both in size and importance to that comparable to the “Big Four”, and indeed has been considered a SOCB by many. However, PBC statistics still categorize the bank under “Other Commercial Banks”. I follow this official classification in this paper.

²⁴The agenda of liberalizing interest rate and exchange rate has until now stagnated, as argued in Mehran & Quintyn (1996).

Table 1: Summary Statistics of Banks

Bank Abbrev.	Years Data Available	Total Assets *	Total Liabilities*	Total Loans*	Total Deposits*	Total Reserves*
ICBC [†]	1985 - 2007	3287-86843	3062-81400	2963-39575	1935-68984	325-11423
ABC [†]	1985 - 2007	1990-60501	1990-59614	1687-34801	912-52833	290-9346
BOC [†]	1985 - 2007	2605-50102	2512-46194	947-23360	1162-36178	3-7877
CCB [†]	1985 - 2007	1688-65981	1504-61758	552-31832	576-53403	317-9673
BOCM	1987 - 2007	201-21036	175-19748	66-10827	93-15558	87-2596
CITIC	1987 - 2007	87-10112	87-9270	38-5658	49-7872	0-1233
Everbright	1992 - 2007	26-7393	18-7146	16-3951	8-5406	0-1206
Huaxia	1996 - 2007	227-5925	198-5793	102-2985	162-4388	47-830
Minsheng	1996 - 2007	86-9198	72-8491	19-5473	40-6712	11-1103
GDDB	1989 - 2007	35-4375	35-4221	22-1938	8-2891	0-616
SZDB	1987 - 2007	4-3525	4-3395	3-2158	4-2813	1-407
CMB	1988 - 2007	24-13106	24-12426	19-6544	16-9435	0-1526
CIB	1991 - 2007	32-8513	25-8124	18-3930	13-5054	8-939
SHPDB	1994 - 2007	178-9195	165-8867	98-5357	133-7635	37-1414
Evergrowing	1992 - 2007	9-1074	9-1054	7-369	7-556	1-156

Note. 1. All bank level data are compiled from China Finance and Banking Almanac 1986-2008.

2. Total reserve data come from documented results and author's calculation, which might be prone to errors.

3. All values are the current year value, not adjusted to a base year, rounded off to zero decimal place.

4. Bank Abbreviations stand for: ICBC, *Industrial and Commercial Bank of China*; ABC, *Agricultural Bank of China*; BOC, *Bank of China*; CCB, *Construction Bank of China*; BOCM, *Bank of Communications*; CITIC, *China CITIC Bank*; Everbright, *China Everbright Bank*; Huaxia, *Huaxia Bank*; Minsheng, *China Minsheng Bank*; GDDB, *Guangdong Development Bank*; SZDB, *Shenzhen Development Bank*; CMB, *China Merchants Bank*; CIB, *China Industrial Bank*; SHPDB, *Shanghai Pudong Development Bank*; Evergrowing, *Evergrowing Bank*.

*: All values are of unit 100 million RMB (1 Yi), displaying minimum and maximum value over the years available.

†: State Owned Commercial Banks (SOCB).

across at least five years in mid-1990s. Table 2 (Park & Sehart, 2004) summarizes the timeline of major policy changes during the reform.

Due to the fact that some of the PBC's policy instruments did not become fully operational until late 1990s, it is difficult to analyze the entire data set with a reform dummy. The strategy of this paper is to split the data into two periods: pre and post reform, and apply empirical analysis specifically suited to that period. Although the reform has been a gradual, and indeed ongoing, process, our strategy requires us to identify a threshold year that distinguishes the pre and post reform eras.

I have several candidates to choose from based on the reform summary table. In 1994, the PBC centralized relending and prohibited local PBC branches from making direct lending decisions. This prevented excessive lending arising from the political influence of local government officials on the branch managers. In the same year, the PBC initiated a new method of managing approved credit volume of banks. From a "quantitative management" of setting administrative credit targets, the PBC switched to a "ratio management" of assigning credit volume based on a maximum ratio between deposits and loans (Xie, 1997). Banks were granted more flexibility in allocating funds by drawing on interbank transfers. Also in that year, three policy banks were set up to take away part of the policy loan obligations from the SOCBs, lending them more autonomy in pursuing commercial goals. Another year of interest is 1996. The new commercial bank law aiming at improving managerial incentives were in full swing (it was legislated in May, 1995). A fully functional interbank market was established and CHIBOR (China Interbank Offer Rate) were officially documented since then. The year 1998 was also marked by exceptional policy turning points. The explicit credit quota was eliminated and central bank relending discontinued its role as a tool of managing total credit and became a lender of last resort. The rediscount rate became an independent monetary policy instrument and started to

play a significant role in steering the economy. Before 1998, it was set to float around 5-10% below the ongoing loan interest rate.

In light of the above discussion, I choose 1998 as the first year of the post-reform era noting that the timing of several reforms does not agree exactly with such division.

Table 2: Financial Reform Summary: 1991-1998

Policy Reform	1991	1992	1993	1994	1995	1996	1997	1998
1. Guidance, rather than binding credit plans	yes	yes	no July	no	yes	yes	yes	yes
2. Centralized relending	no	no	no	yes June	yes	yes	yes	yes
3. Ratio management	no	no	no	yes Feb	yes	yes	yes	yes
4. Commercial Bank Law	no	no	no	no	yes May	yes	yes	yes
5. Policy banks	no	no	no	yes* Dec	yes	yes	yes	yes
6. Interbank market	yes	yes	no July	no	no	yes	yes	yes
7. Indep. rediscount rate	yes	yes	no	no	no	yes	yes	yes

Notes Sources for reform dates: 1. Zhu Rongji's 16 point program.

2. Announced May 9, implemented June 21, 1994. Yinfa[PBC Regulation] no. 43 (1994) in PBC ed., *1994 nian xindai zijin guanli wenjian huibian* [Compendium of Documents on Loan Fund Management 1994] (Beijing: Zhongguo jinrong chubanshe), pp. 92-98.

3. Announced February 15, implemented later in the year. Yinfa [PBC Regulation] no. 38 (1994) in PBC,ed., *1994 nian jinrong guizhang zhidu xuanbian* [Selected Financial Rules and Regulations 1994] (Beijing: Zhongguo jinrong chubanshe), vol. 1: pp. 25-31.

4. "Zhongguo renmin gongheguo shangye yinhangfa." [Commercial Bank Law of the People's Republic of China] in PBC(1996). *1995 nian jinrong guizhang zhidu xuanbian*. [Selected Financial Rules and Regulations 1995] (Beijing: Zhongguo jinrong chubanshe), vol. 1, pp. 8 ff.

5. Policy banks established gradually beginning mid-year. China Development Bank established April 14th, Import-Export Bank established July 1, and Agricultural Development Bank of China branches established mostly in late 1994. PBC(1995). *Zhongguo jinrong nianjian 1995*. [China Financial Yearbook] (Beijing: Zhongguo jinrong chubanshe), p. 145.

6. PBC Department for Monetary Policy (1997). *1996 Quanguo tongyi de yinhang jian tongye chajie shichang nianbao*. [1996 Annual Report of the National Interbank Market]. (Beijing: Zhongguo renmin yinhang huobi zhengcesi)

* Policy banks were established gradually throughout the year. Most ADBC branches were established in late 1994.

6 Empirical Analysis and Results

6.1 Empirical Strategy

In the previous section I have outlined the method of dividing the data set into four subsets: pre-reform SOCBs, pre-reform non-SOCBs, post-reform SOCBs and post-reform non-SOCBs. From the bank maximization model developed in earlier sections, I can identify the endogenous variables as the quantities of loans, excess reserves and borrowing from PBC, while the exogenous variables are centrally administered interest rates²⁵ and the level of deposit²⁶. Banks choose the level of loans, excess reserves and borrowing from PBC to maximize profit (objective function). To analyze the working of the credit channel, I posit bank loans as the dependent variable, with independent variables being the various exogenous interest rates and the level of deposit.

Before regression analysis, I take first difference of the loan, excess reserve, PBC borrowing and deposit levels to eliminate the potential non-stationarity in the panel time series. The difference in levels are normalized by the previous year's total assets to mitigate the cross sectional heterogeneity of levels. Furthermore, bank fixed effects are controlled for in the regressions. This is because the State-owned Commercial Banks each have their own preferential sectors to which they extend loans. The smaller banks, on the other hand, face different loan situations according to geographical locations or specialized functions²⁷. Therefore, there are bank level idiosyncratic

²⁵They include, but are not limited to: loan rates of different maturities, deposit rates of different maturities, relending rate, excess reserve interest rate, rediscount rate, required reserve ratio.

²⁶As the banks cannot autonomously adjust their deposit rate, it is safe for us to assume that they cannot determine the level of deposit in our simple model. I also assume that the depositors in China are generally not sensitive to banks' balance sheet conditions. As a centrally planned economy, China has never allowed any major commercial banks to go into default, hence there should be very little concern from the depositors over the safety of their assets. Furthermore, since the central bank mandates the required reserve ratio, banks effectively face an exogenous required reserve level too.

²⁷For example, Shanghai Pudong Development Bank was established to support the development

characteristics that affect their loan supply.

Although the data set has been divided into SOCBs and smaller commercial banks, banks within the same group still exhibit dissimilar constraints. One of the constraints that directly influences lending decisions and hence the effectiveness of the credit channel is the level of capitalization, or in other words, the shareholders' equity given by the difference between total assets and total liabilities. Kishan and Opiela (2000) find that from 1980 to 1995, small and under-capitalized banks were most significantly affected by monetary contractions. Without the luxury of a large data set for finer divisions by capital-asset ratio, I propose to include interaction terms between banks' normalized capitalization and the policy variables in order to explore the cross-sectional differences within a group.

From the earlier discussions of characteristics of the Chinese banking system in the pre-reform era, I hypothesize that credit quotas were not a hard constraint for banks (especially SOCBs which carried the obligation of majority of the policy loans). In other words, although the SOCBs needed to utilize heavily the PBC relending facility to meet the policy lending quotas, they were still able to pursue some degree of commercial lending after meeting the credit targets. This restricted flexibility allowed them to respond to changes in interest rates. The credit quotas were determined by the government's policy objectives, the state of development of different sectors of the economy and regional preferential policies, which were intangible characteristics that could not be captured by my model. Thus, for state-owned large banks heavily constrained by the credit quota, they should be much more responsive to the relending rate than to the loan interest rate.

In the pre-reform period, the main policy instruments of the PBC were credit

of the Pudong pioneer economic zone. China Merchants Bank, on the other hand, is a nation-wide bank founded with the mission of providing retail services.

plans, relending policies and benchmark interest rates. Although the required reserve ratio was at the disposal of the PBC, it was never used for most of the 1986-1995 period, staying constant at 13%²⁸. I propose the following estimation equation for both SOCBs and non-SOCBs:

$$\begin{aligned} \Delta L_{it} = & \beta_0 + \beta_1 r_{Bt} + \beta_2 r_{Et} + \beta_3 r_{Lt} + \beta_4 \Delta D_{it} + \beta_5 year \\ & + \beta_6 cap_{it} + \beta_7 cap_{it} * r_{Bt} (+\beta_8 cap_{it} * r_{Et})(+\beta_9 cap_{it} * r_{Lt}) \\ & + \lambda_i + u_{it} \end{aligned} \tag{1}$$

Where just as in my earlier models, ΔL denotes change in loans normalized by previous year's asset, λ_i is a vector of bank dummy variables, r_B is the relending rate, r_E denotes excess reserve interest rate, r_L is the weighted average loan interest rate, ΔD is normalized change in deposit, $year$ represents the time trend, and cap is bank's capitalization which is interacted with each policy instrument in separate regressions. The variable cap is calculated as follows²⁹:

$$cap_{it} = \text{capitalization}_{it} = \frac{\text{total assets}_{it} - \text{total liabilities}_{it}}{\text{total asset}_{it-1}}$$

The parenthesis in the regression model indicates that the interaction terms are applied one at a time and separately estimated. A summary of the variables are reported in Table 3 below³⁰.

²⁸This is because with heavy quantity management like credit plans in place, the usage of another quantity policy instrument such as the required reserve ratio became redundant.

²⁹The *capitalization* variable is similar to the capital-asset ratio, except that total equity is divided by past year's assets instead of current year's assets to avoid potential endogeneity issues.

³⁰Due to inconsistencies in balance sheet format, some non-SOCBs categorized owners' equity under liabilities, thus creating equal amount of total asset and total liabilities. This explains the minimum value of zero for the capitalization of non-SOCBs.

Table 3: Pre-Reform Summary Statistics: 1986-1997

State-owned Commercial Banks				
Variable	Obs	Mean	Minimum	Maximum
Change in Loans (ΔL)	48	0.112	-0.111	0.270
Change in Deposits (ΔD)	48	0.118	0.0296	0.290
Capitalization (cap)	48	0.0559	0.0	0.125
Other Commercial Banks				
Variable	Obs	Mean	Minimum	Maximum
Change in Loans (ΔL)	68	0.275	-0.0583	1.184
Change in Deposits (ΔD)	68	0.376	-0.104	2.165
Capitalization (cap)	68	0.0936	0.0	0.463
Policy Instruments				
Variable	Obs	Mean	Minimum	Maximum
Relending Rate (r_B)	12	8.73	4.68	11.03
Excess Reserve Interest (r_E)	12	7.31	4.92	9.18
Loan Interest (r_L)	12	9.65	7.92	11.52

After the reforms, direct credit control was discontinued and a large portion of the policy lending obligations were transferred to policy banks. Commercial banks were given more flexibility in making their own credit allocations to pursue greater commercial gains. As a result, changes in loan levels would then respond to a slightly different set of PBC policy instruments.

Besides the usual policy tools such as loan rate, relending rate and excess reserve interest, the rediscount rate became an effective arsenal of the central bank. More importantly, the rediscount rate can be actively managed by the PBC to influence interbank offer rate in the interbank market. The required reserve ratio as a monetary policy instrument has reassumed its importance after the reforms. It has been used frequently to drain excess liquidity from the banking system (Xie, 2004). Thus I propose the following estimation equation in the post reform period for both SOCBs and non-SOCBs:

$$\begin{aligned}
\Delta L_{it} = & \beta_0 + \beta_1 r_{Bt} + \beta_2 r_{Et} + \beta_3 r_{Lt} + \beta_4 r_{Rt} + \beta_5 \Delta RRR_t \\
& + \beta_6 \Delta D_{it} + \beta_7 year + \beta_8 cap_{it} + \beta_9 cap_{it} * r_{Bt} (+\beta_{10} cap_{it} * r_{Et}) \\
& (+\beta_{11} cap_{it} * r_{Lt})(+\beta_{12} cap_{it} * r_{Rt})(+\beta_{13} cap_{it} * \Delta RRR_t) + \lambda_i + u_{it} \quad (2)
\end{aligned}$$

Where r_R is the weighted average rediscount rate and $\Delta_R RR$ is the change in official reserve requirement. Similar to the pre-reform estimation equation, I interact capitalization with each policy instrument in separate regressions. Table 4 reports a summary of the variables³¹.

Table 4: Post-Reform Summary Statistics: 1998-2007

State-owned Commercial Banks				
Variable	Obs	Mean	Minimum	Maximum
Change in Loans (ΔL)	40	0.0571	-0.183	0.246
Change in Deposits (ΔD)	40	0.107	-0.0490	0.193
Capitalization (cap)	36	0.0561	0.0166	0.0985
Other Commercial Banks				
Variable	Obs	Mean	Minimum	Maximum
Change in Loans (ΔL)	110	0.143	-0.0892	0.412
Change in Deposits (ΔD)	110	0.217	-0.286	0.794
Capitalization (cap)	99	0.0486	-0.0139	0.165
Policy Instruments				
Variable	Obs	Mean	Minimum	Maximum
Relending Rate (r_B)	10	4.09	3.24	6.99
Excess Reserve Interest (r_E)	10	2.55	0.99	4.67
Loan Interest (r_L)	10	5.96	5.31	7.50
Change in Reserve Ratio (ΔRRR)	10	-0.14	-4.17	3.59
Rediscount Rate (r_R)	10	3.13	2.16	5.15

³¹The culprit for the seemingly impossible negative minimum capitalization for non-SOCBs is the Everbright Bank. From 2004 to 2006, the bank reported negative owners' equity. Clearly the government has allowed the bank to survive when it was effectively bankrupt.

Before discussing the results, I will briefly review the interpretation of coefficients according to the predictions of my earlier model. Before the reforms took place, large banks borrow heavily from the central bank. In addition to meeting the credit quota, PBC loans also helped to fund the limited autonomous loans which the banks could pursue to maximize profit. Therefore, large banks' loan levels should be strongly affected by fluctuations in relending rate. Loan interest rates may have an impact too, but it is expected to be smaller than the effect of relending rate, depending on the degree of flexibility individual bank enjoys. Non-SOCBs on the other hand should not respond to the relending rate since they barely borrowed from the PBC. Unencumbered by heavy policy lending responsibilities, the smaller commercial banks were expected to be more profit oriented.

One of the most notable impacts of the reform on the banks is the elimination of credit quotas and discontinuation of PBC direct lending as a means of controlling the total credit in the market. If the reform has achieved its goals, banks would become more market-oriented and react more aggressively to a broader set of interest rates. Rediscount rate affects a bank's ability to obtain collateralized funds from the central bank and acts as a beacon for the interbank market. Increases in required reserve ratio should directly constrain the resources available for banks to make loans. Even though most banks keep a substantial level of excess reserves which acts as a buffer to such policy shocks, their loan levels would decrease nonetheless if banks are reluctant to allow their excess reserves to shrink substantially.

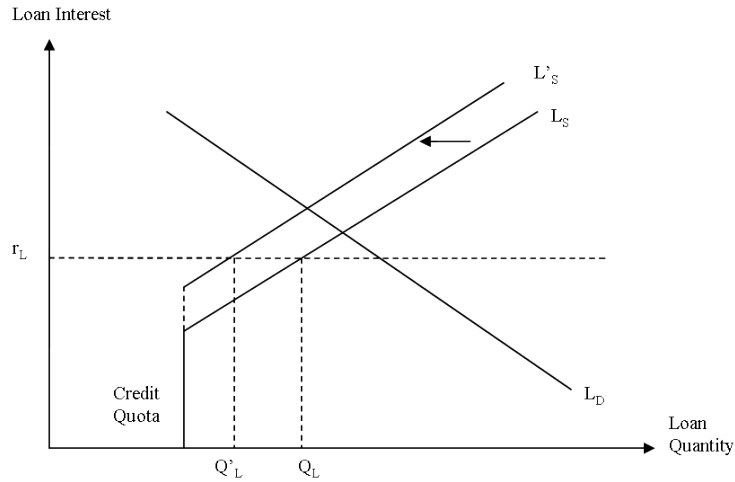
The story outlined in Kishan and Opiela (2000) should also be true in China's case. Both before and after the reforms, small banks with low capital-asset ratio would have trouble securing other types of funds when monetary policies are contractionary. Monetary policies would then have the most notable impact on their loan supply. Compared to well-capitalized SOCBs, such banks would be more prone to using

the PBC's relending facility as a lender of last resort in the post reform era, hence become more exposed to relending rate fluctuations. Kishan and Opiela identify similar mechanisms that serve as evidence of the existence of the narrow credit channel in the US. Through empirical analysis, I would like to test if such mechanism is at work in China's context, and whether the large, liquid banks are affected as well.

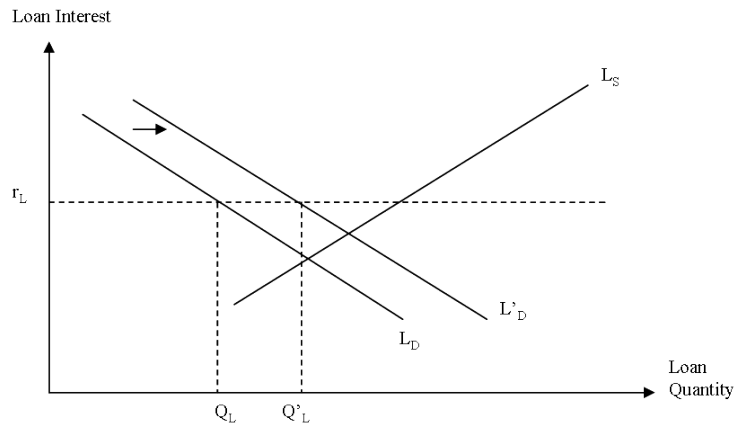
6.2 Results

Table 5 reports the estimation result of equation (1) for pre-reform period. The effect of the loan interest rate behaves according to our predictions. Increases in the loan interest rate result in increases in the loans by SOCBs, although the coefficients are not statistically different from zero as shown in column 1. The lack of significance suggests that those banks were subject to heavy state control and credit quotas so that they did not respond to market interest rates as one would expect commercial banks to. The non-SOCBs were subject to fewer policy lending obligations and were more profit oriented. Not surprisingly, the loan interest rate has an impact on their loan supply which is significant at 5% level as column 5 and 6 of Table 5 demonstrates. Interestingly, the coefficients are negative for the non-SOCBs: 1 percentage point increase in loan interest rate decreases the level of loans by more than 10% of past year's asset. The characteristic structure of the Chinese banking system before reforms could be invoked to explain this phenomenon. Before late 1990s, the state-owned enterprises were the largest consumers of loans and were supported by policy loans from the SOCBs. As a result, large state banks dominated the loan market (Geiger, 2008). Their loan supply was the binding constraint that determined the eventual level. Hence increases in loan interest has a positive effect on loan level through influencing the supply side. For small banks, however, loan demand was bind-

ing as their customers were either small enterprises or regional businesses. Increase in loan interest depresses demand, thus reducing the loan levels of the non-SOCBs.



(a) SOCB in response to an increase in r_B



(b) Non-SOCB in response to the spillover from SOCBs

Figure 8: Pre-reform Loan Market Equilibrium for Different Banks

Figure 8 is a simple illustration of the above discussion. As price takers facing exogenous loan interest rate, higher demands for loans from the SOCBs resulted in the market equilibrium above the loan level, while the equilibrium was below the same loan level for non-SOCBs. The figure on the left also shows that credit quotas for the state banks were not a hard constraint.

As expected, positive changes in the relending rate are associated with negative changes in SOCBs' loan supply. The large state banks extended enormous amount of policy loans which were mainly supported by the relending facility. This explains their sensitivity towards the interest rate charged on the borrowed funds from PBC. A one percentage point increase in the relending rate is associated with a decrease in the level of loans equivalent to roughly 2.5% to 3% of previous year's asset. Given the fact that loans comprised more than 70% of the total asset on banks' balance sheets before 1998, the impact is relatively mild. This result demonstrates the effectiveness of credit quotas even when they are not strictly binding. The state banks did not have much flexibility in utilizing the relending facility to fund their commercial lendings.

Surprisingly, non-SOCBs' loan supply is positively associated with relending rate with a larger elasticity than the SOCBs. The coefficients are only weakly significant, echoing the fact that they did not have any access to the relending facility as the SOCBs. A possible explanation for the positive coefficients is the spillover effect from the impact of relending rate on SOCBs. If the market equilibrium loan interest rate for SOCBs remained constantly above the exogenously set rate as hypothesized earlier, loan supply from them was binding. A supply-side shock such as an increase in relending rate would cause SOCBs to issue less loans. The state-owned enterprises as well as small and medium sized enterprises that fell victim to this drop in loan supply would possibly turn to smaller commercial banks. As loan demand was the binding constraint for those banks, their loan level would increase in response to the contractionary relending rate shock. Given the much smaller size of their balance sheets, the positive coefficient is rather large. Figure 8 also illustrates the working of this mechanism. In the left graph, the loan supply curve for the SOCBs shifts to the left due to an adverse shock from increases in relending rate, creating an additional $Q'_L - Q_L$ of excess loan demands. Some of these excess demands spill over

Table 5: Pre reform Determinants of Loan Changes

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	SOCB	SOCB	SOCB	SOCB	non-SOCB	non-SOCB	non-SOCB	non-SOCB
Loan Interest (r_L)	0.0111 (0.0210)	0.00739 (0.0205)	0.00670 (0.0219)	-0.00895 (0.0387)	-0.129** (0.0503)	-0.124** (0.0519)	-0.0886* (0.0509)	-0.135** (0.0540)
Relending Rate (r_B)	-0.0240** (0.00954)	-0.0246** (0.00998)	-0.0315** (0.0144)	-0.0311*** (0.0108)	0.0793* (0.0412)	0.0797* (0.0471)	0.0456 (0.0484)	0.0774* (0.0446)
Change in Deposit (ΔD)	0.324* (0.168)	0.333* (0.173)	0.315 (0.202)	0.296 (0.209)	0.394*** (0.143)	0.353** (0.151)	0.339** (0.141)	0.337** (0.133)
Capitalization (cap)		0.235 (0.183)	-0.320 (1.365)	-1.949 (3.043)		0.303 (0.257)	-3.648** (1.651)	-5.945** (2.607)
$cap*r_B$			0.0749 (0.170)				0.427** (0.177)	
$cap*r_L$				0.246 (0.335)				0.620** (0.256)
Observations	48	48	48	48	68	68	68	68
R-squared	0.280	0.288	0.294	0.312	0.706	0.719	0.753	0.760
Number of Banks	4	4	4	4	11	11	11	11

Notes 1. Robust standard errors in parentheses, interest rates in percentage points.

2. Panel data unbalanced for non-SOCBs and balanced for SOCBs.

3. * significant at 10%, ** significant at 5%, *** significant at 1%.

to the demand for non-SOCB loans, causing an outward shift of the demand curve in the right graph. The quantity of loans given by the small commercial banks thus increases. However, this spillover mechanism is unverified and this idea will be left to future research.

The level of deposits has a positive coefficient for both types of banks, reflecting the role of deposit as a source of funding for bank loans. Nevertheless, the coefficient is much more significant for non-SOCBs than SOCBs. This is because state banks could also borrow from the PBC through relending (and they did borrow heavily), while small banks depended almost exclusively on deposits to support loans.

The interaction terms shed light on how capitalization, a measure of a bank's financial health, influences the scale of impact monetary policies have on a bank's lending decisions. The interaction terms are statistically insignificant for SOCBs, which can be caused by either the small sample size, or that those banks, directly supported by the state, had little worry about under-capitalization. The opposite signs between the coefficients of loan interest and its interaction term with capitalization for non-SOCBs (both significant at 5% level) indicate that high capitalization served as an effective buffer for adverse monetary policy shocks. In other words, when monetary policy becomes contractionary, a small bank with healthier capital leverage would be able to lessen the reduction in lending. It also means that under-capitalized small banks would face most difficulty raising funds to maintain loan growth in a contractionary environment, coinciding with the findings of Kishan and Opiela (2000).

Post reform estimation results are reported in Table 6 and Table 7. Compared to the pre-reform era, the striking difference in the banks' responses to relending rate suggests that credit quota elimination has fundamentally transformed the role of direct central bank lending. SOCBs became insensitive to changes in relending rate,

because they no longer needed direct PBC relending to meet loan targets³². The relending rate was still managed by the state although central bank direct lending only acted as a lender of last resort which the banks drew on when they were in a tight position, or short on cash. The state-owned commercial banks, with their deposit holdings burgeoning since 1990s, did not have much need for emergency PBC lending³³. However, the smaller banks, especially those with low liquidity, would be more concerned with the availability of this emergency fund. The fact that on average SOCBs kept a much lower level of excess reserves than non-SOCBs is an indicator of the aforementioned situation. Therefore, higher relending rate represents an increased marginal cost of obtaining such funds, which may cause the under-capitalized banks to become more cautionary in making loans. Table 7 indicates that 1 percentage point increase in relending rate reduces loan supply equivalent to nearly 20% of past year's asset. Given that the relending rate stayed below 4% after 1999, a 1 percentage point increase represents a highly contractionary monetary policy. Such a scale in loan reduction is hence plausible.

The coefficient on the loan interest rate remains statistically insignificant for SOCBs, although the sign of the coefficients has changed from positive in the pre-reform era to negative. Despite the discontinuation of explicit credit plans, state control on the “Big Four” was by no means lax. Credit quotas were taken over by implicit Window Guidance modeled after Japan's experience (Geiger, 2008), which could possibly explain the persisting unresponsiveness of SOCBs to loan rate changes.

It is intriguing to note that although the interest rates in the regression are each statistically insignificant, they are jointly very significant³⁴, which is an indica-

³²See Appendices, Figure 9, Borrowing from the PBC for those banks has decreased sharply since mid-1990s and practically stopped completely after 2000.

³³See Appendix 2. The surplus of deposits net loans has been widening drastically since the onset of the reform.

³⁴An F-test on the joint significance of relending rate, excess reserve interest, loan interest and

Table 6: Post Reform Determinants of Loan Changes for SOCBs

VARIABLES	(1)	(2)	(3)	(4)	(5)
Relending Rate (r_B)	0.141 (0.0924)	0.213 (0.136)	0.209 (0.137)		
Loan Interest (r_L)	-0.0780 (0.0532)	-0.122** (0.0620)	-0.102 (0.0639)	0.0387*** (0.0147)	0.0282** (0.0138)
Rediscount Rate (r_R)	-0.0702 (0.0666)	-0.0685 (0.0706)	-0.0744 (0.0987)		
Change in RRR (ΔRRR)	0.0338 (0.0258)	0.0277 (0.0291)	0.0288 (0.0305)	0.0174 (0.0160)	0.0227 (0.0189)
Change in Deposit (ΔD)	0.910* (0.497)	0.858* (0.521)	0.843 (0.561)	0.823 (0.508)	0.978** (0.498)
$cap*r_L$		0.354 (0.473)			
$cap*r_R$			0.127 (1.726)		
$r_L - r_R$				-0.0327 (0.0216)	
$r_L - r_B$					-0.0349 (0.0325)
Observations	40	36	36	40	40
R-squared	0.430	0.390	0.387	0.292	0.263
Number of Banks	4	4	4	4	4

Notes 1. Robust standard errors in parentheses, interest rates in percentage points.

2. RRR stands for required reserve ratio.

3. The spread variables are calculated as presented in the table.

4. * significant at 10%, ** significant at 5%, *** significant at 1%.

tion that the major post-reform policy instruments are highly correlated with each other³⁵. This finding echos one of the unique characteristics of the PBC's approach to monetary policies as outlined in Geiger (2008): the central bank would quite often

rediscount rate rejects the null hypothesis at 5% level.

³⁵This can also be seen in Figure 1, where major monetary policy instruments move in a roughly synchronized manner.

make use of a combination of monetary policy tools simultaneously to achieve the fine tuning of the economy.

Although the variable levels do not contain large amount of information, it is likely that the spread between different interest rates could have a significant impact (Friedman & Kuttner, 1992). Therefore, I reestimate the regression with less policy variables and the addition of spreads between loan rate and other interest rates. The results are reported in column (4) and (5). Despite the spread terms still being insignificant, we can now clearly see the significantly positive relationship between loan interest rate and loan supply, reinstating the result in the pre-reform case.

The restriction of window guidance on smaller banks was probably much looser, allowing them to adjust loan supply based on market interest rates in pursuit of maximizing profit. As the result demonstrates, loan rate affects non-SOCBs' loan level and is significant at 1%. Interestingly, the correlation between loan rate and changes in loan level of the non-SOCBs becomes positive, suggesting that the officially established loan rate was below the market equilibrium and loan supply became binding. This is confirmed by the historical movement of loan interest, which stayed above 8% before 1998 and was kept below 6% after the reforms took place. Furthermore, the growth of non-SOCBs and their increasing shares in the banking system compared to the "Big Four" have made them more attractive to enterprises seeking loans. The taking-off of the economy in late 1990s has also sparked off higher growth in demand for loans, especially from the burgeoning small and medium enterprises that found it hard to obtain loans from the SOCBs, thus outstripping the growth in banks' ability to supply. Both mechanisms likely contributed to the rightward shift of loan demand, making loan supply the constraining factor.

Deposits are still an important source of funding for loans. Both the coefficient and the significance level of changes in deposit remain roughly the same compared

to the pre-reform regression for non-SOCBs. Interestingly, the impact of deposits on loans has increased substantially for SOCBs with coefficients increasing from around 0.3 to well above 0.8, representing more than 80% of the changes in deposits manifested as changes in loans on the other side of the balance sheet. One reason could be that SOCBs used to raise funds from both deposit and PBC relending, which are two substitutable sources (Appendices, Table 8)³⁶. After the major reforms took place, PBC direct lending was terminated. Coupled with ballooning deposit growth and limited other external finance options, banks had to depend predominantly on deposits.

Both large state banks and smaller commercial banks encountered similar limitations in sources of external finance other than deposits. One may wonder why changes in deposit level had a much larger impact for the SOCBs. One explanation can be derived from the differences in their excess reserve responses to deposit change. Historically, almost all Chinese banks kept a high level of excess reserves. While the SOCBs was able to gradually lower the level to below 3% after the reform, smaller banks still maintained their excess reserve level above 5%. For non-SOCBs, it is possible that a larger portion of the changes in deposit contributed to changes in excess reserves, resulting in a smaller change in loans. To test this theory, I run a similar post reform regression on normalized changes in excess reserve (Appendices, Table 9). I find that the portion of changes in deposit that turned into changes in excess reserves is roughly 25% higher on average for non-SOCBs, consistent with my explanation.

³⁶To test the substitutability, I run a pre-reform regression with borrowing from PBC as the dependent variable and the same set of exogenous covariates and interaction terms. From the results presented in Table 8, I find that only deposit has a statistically significant impact. Changes in deposits are negatively correlated with changes in borrowed funds from PBC, reaffirming my hypothesis that the two sources of funds are substitutable.

Table 7: Post Reform Determinants of Loan Changes for non-SOCBs

VARIABLES	(1)	(2)	(3)	(4)
Relending Rate (r_B)	-0.181*** (0.0478)	-0.279*** (0.0906)	-0.227*** (0.0881)	-0.181*** (0.0478)
Loan Interest (r_L)	0.108*** (0.0377)	0.201*** (0.0696)	0.128*** (0.0471)	
Rediscount Rate (r_R)	0.0984*** (0.0308)	0.108*** (0.0311)	0.173*** (0.0521)	0.207*** (0.0643)
Change in RRR (ΔRRR)	-0.0390*** (0.0101)	-0.0287** (0.0123)	-0.0327*** (0.0116)	-0.0390*** (0.0101)
Change in Deposit (ΔD)	0.282*** (0.0807)	0.281*** (0.0841)	0.276*** (0.0854)	0.282*** (0.0807)
$cap*r_L$		-1.348* (0.719)		
$cap*r_R$			-1.378** (0.669)	
$r_L - r_R$				0.108*** (0.0377)
Observations	110	99	99	110
R-squared	0.396	0.420	0.424	0.301
Number of Banks	11	11	11	11

Notes 1. Robust standard errors in parentheses, interest rates in percentage points.

2. RRR stands for required reserve ratio.

3. The spread variables are calculated as presented in the table.

4. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 7 demonstrates that non-SOCBs reduced their loan supply by little more than 3% of total asset when the required reserve ratio is increased by 1 percentage point. This finding is consistent with both my model and economic intuition: holding everything else constant, banks' ability to extend loans is reduced if they have to allocate a bigger portion of their assets to required reserve deposits at the central bank. Given the high base level of required reserve ratio (around 8% post reform and well over 10% in 2007) and the high level of excess reserve holdings in non-SOCBs

that acts as a buffer to such shocks, the relatively small impact is plausible.

On the other hand, the SOCBs' loan supply is positively correlated with changes in required reserve ratio, although the coefficients are not statistically different from zero. The existence of reverse causality could be the reason behind this counter-intuitive phenomenon. To check for evidence of reverse causality, I run the same regression again with one period lagged change in required reserve ratio as an additional regressor. I find that although the contemporary change still has a positive slope, the coefficient of the lagged change is negative. This provides some evidence that the positive coefficient in the original regression is inconsistent, possibly attributable to contemporary reverse causation effect. While the changes in aggregate loans from non-SOCBs did not have a huge impact on the condition of the economy, an excessive growth of credit from the SOCBs is influential enough to induce the PBC to react with contractionary monetary policies: a hike in required reserve ratio in this case.

The positive relationship between the rediscount rate and non-SOCBs' loan changes is puzzling, as an increase in the rediscount rate usually signals a contractionary monetary stance of the PBC. I could not provide an intuition for this observation and further research with a more comprehensive data set is warranted.

In exploring the cross-sectional differences between banks within the same group, analysis of the interaction effects yields similar results as that of the pre-reform regression. Coefficients of loan interest rate and rediscount rate have opposite signs to their interaction terms with capitalization for both groups of banks, although they are statistically more significant for non-SOCBs than SOCBs for the same reason as in the pre-reform era. This result reaffirms our hypothesis and the findings of Kishan and Opiela (2000): the smaller the size and the lower the capital-asset ratio of a bank, the harder it is for them to solicit external finance and maintain a consistent loan

growth after contractionary monetary policy shocks. In other words, contractionary monetary policies generally affect non-SOCBs more than large state banks.

6.3 Robustness

In the regression strategy, I normalize first difference in levels of loans, deposits, excess reserves and PBC direct lending by last year's total assets. As a robustness check for the potential endogeneity arising from total assets, I reestimate the fixed effect model in Equation (1) and (2) with real growth rate of loans and deposits. That is, I divide the first difference of the levels by the level of the same variable in the previous year and adjust the growth rate to take into account of inflation. The results are reported in Appendices, Table 10 (pre-reform) and Appendices, Table 11 (post reform). One of the differences between the two models is that the balance sheet identity holds with normalized first differences of levels which are our original dependent variables. With real growth rates, however, the balance sheet identity only holds when I multiply the growth rates with the lagged level of respective variables. The findings of the new models are consistent with the original ones, with slight changes in significance and generally larger absolute value of coefficients.

I have assumed fixed effects in the OLS regressions under the belief of the existence of bank heterogeneity³⁷. It could be argued, however, that bank fixed effects would have been mitigated by categorizing them under SOCBs and non-SOCBs, effectively distinguishing them by their size and functionality. Especially for the group of SOCBs, where the entities are all nation-wide banks with minimum heterogeneity arising from geographical locations, there is a strong case for adopting random effects model. Furthermore, since the size of the data set is limited, using a fixed effect model incorporating bank dummy variables incurs the risk of leaving too few degrees

³⁷Hausman Tests on the regression models have a clear preference for fixed effect model as well.

of freedom for consistent and rigorous regression analysis. As a check for robustness, I also run the same regressions of equation (1) and (2) with a random effects model. The results are presented in Appendices, Table 12 (pre-reform) and Appendices, Table 13 (post reform). The random effect model yields consistent results: the signs, absolute values and significance levels of the coefficients are all comparable to those in the fixed effect model.

The choice of the threshold year can potentially create bias in the estimation as the major reform measures have spanned over many years in the 1990s. I check the consistency of the results by reestimating the regression models with 1994 and 1996, instead of just 1998, as the threshold year. The outcome is presented in Table 14 and Table 15 in Appendices. It is clear that both the sign and significance of the new estimation coefficients in the pre-reform period for both types of banks are largely in agreement with my original result. However, we have to be aware that the post reform estimation with new threshold years is essentially identical to the original model. This is because the variable “Rediscount Rate” has only missing values prior to 1998³⁸ therefore not estimated. We also need to exercise extraordinary conservation when interpreting the pre-1994 behavior of non-SOCBs. Indeed, the panel data for small commercial banks is highly skewed and sparse before 1994, as very few commercial banks besides the “Big Four” even existed at that time. The high R-squared value (> 0.9) is a manifestation of such drawbacks in using too early a cut-off year. In fact, this robustness check effectively serves to support my choice of 1998 as the reform threshold.

Figure 2 demonstrates that although the four official SOCBs are in a dominant position over smaller commercial banks, Bank of Communications (BOCM) comes

³⁸Before 1998, rediscount rate is set to float within 5% to 10% of the ongoing weighted average loan rate. It only became an independently administered monetary policy instrument after 1998.

close. With its loan and deposit level towering over all other non-SOCBs, BOCM is perceived by many as one of the mega state banks. Therefore I check the consistency of my model by categorizing BOCM under SOCB and present the results in Table 16. The signs of coefficients for non-SOCBs are generally consistent with my original estimation and the significance level has improved in the post reform period after removing BOCM as an “outlier” of the small commercial banks. The new SOCB estimations, however, yields results that are insignificant. This suggests that BOCM, despite having a large balance sheet compared to other non-SOCBs, essentially still behaves like a small bank and the inclusion of which in the already small SOCB group would introduce too much noise.

Lastly, my theoretic model predicts that loan *levels* respond to fluctuations in interest rate *levels*. It should naturally follow that *changes* in loan level, which is the dependent variable in my estimation model, respond to *changes* in interest rates. Nevertheless, I use interest rate levels instead of changes as my independent variables. The strategy is motivated by my belief that monetary policy instruments have a long-run lasting effect on the growth rate of loan supply. In other words, banks may have a loan growth target that is dependent on the *levels* of various interest rates. To provide support to this hypothesis, I reestimate the regression model with a lag on loan interest and test the null hypothesis that changes in interest rate levels do not have an impact on changes in loan levels (Sum of coefficients of r_{Lt} and r_{Lt-1} is zero). As the result in Table 17 demonstrates, I cannot reject the null hypothesis at conventional significance levels for all estimations besides the post reform regression on non-SOCBs, where I can reject the null at 1% significance (column 7 and 8). I conclude, therefore, that it is more appropriate to use interest rate *levels* instead of *changes* as regressors.

6.4 Caveats

In section 4, I have identified the possible behaviors of different banks in response to various monetary policy shocks with a profit maximization model. It is also imperative for us to be aware of the limitations associated with the model. Fundamentally, the model only captures the supply side equilibrium in which banks maximize their profits by choosing the level of loans they extend. In terms of describing real life behaviors, this set-up would only be appropriate if loan supply is the binding constraint. As can be seen from the empirical results and discussions of Figure 8, such an assumption does not always hold. Similarly, I cannot simply assume the central bank's relending or rediscount facilities are only determined by the demands of commercial banks. The PBC's supply curve may very well be subjected to shifts and become constraining without it actively manipulating one of its monetary policy tools. The shifts could be caused by the PBC managing non-pecuniary costs on its lending facilities, such as the strictness of window guidance. Therefore, to construct a general equilibrium involving firms, commercial banks and the central bank, thorough knowledge about the objective functions of the different entities is required. This warrants further research.

One should also keep in mind the quality of data available while fashioning empirical strategy and interpreting the results. *First*, the limited size of the data set poses enormous challenge for consistent and rigorous statistical analysis. The small time dimension (20 years) does not allow me to test for stationarity or serial correlation. The small number of observations also leaves little room to include lags of the policy variables. Our interpretation is thus restricted to the contemporaneous effects of the covariates where reverse causality is highly likely. *Second*, the data only contains annual observations at the bank level. This is an immediate concern as banks

usually respond promptly to monetary policy shocks, and some policy instruments, required reserve ratio for example, are adjusted several times a year³⁹. In order to accurately capture the nuances of the financial sector, quarterly or even monthly data would be more suitable for my purposes. *Third*, due to inconsistencies in the format of documenting balance sheets both cross-sectionally across banks and intertemporally across time, many numbers are cryptic in nature⁴⁰ and some variables, such as Total Excess Reserves, are based on the author’s calculations. The reader needs to bear in mind the inaccuracies of the observations and exercise greater caution when interpreting empirical results.

7 Conclusion

The main focus of this paper is to analyze the effectiveness of monetary policy instruments on Chinese banks both cross-sectionally and intertemporally, incorporating the impact of the banking reform. I find that in the pre-reform period, large state banks and smaller commercial banks’ responses to changes in relending rates and loan interest rates were directly opposite. This result can be explained by the existence of credit quotas for SOCBs and the PBC relending facility that was designed to help the SOCBs meet their targets. I deduce from the sign of loan interest rates that loan supply was the binding constraint for SOCBs while non-SOCBs were demand constrained. This gives rise to a “spillover” effect of loans which provides an explanation for the weakly significant positive relationship between relending rate and non-SOCB’s loan levels.

³⁹See Figure 1.

⁴⁰An example would be the required reserves a bank holds at the central bank. Some banks accumulate required reserves with interbank deposits, while some accumulate reserves with cash. After 1997, a new central bank rule states that excess reserves should be merged with required reserves into a single “Reserves” account, which changed the appearance of bank balance sheets across the board.

The fact that relending rate stopped having an effect on SOCB's loans after the reforms confirms the success of one major reform agenda: the elimination of credit quotas. However, SOCBs persisting unresponsiveness to loan interest rate suggests that credit quota might be replaced by a softer constraint: window guidance. The relending rate did not disappear from the PBC's arsenal though as the non-SOCBs are demonstrated to be very sensitive to its fluctuations. Central bank direct lending continues to act as a monetary signal as well as a lender of last resort and affect smaller banks more due to greater liquidity concerns.

The deposit level, which I assume to be exogenous to the banks, has a significantly positive impact on all banks at all times. In the post reform period, nearly 90% of the total changes in loans by SOCBs are funded by changes in deposits after PBC relending becomes obsolete. This serves as evidence of a unique feature of the Chinese banking system: that the banks do not have much access to external finance options such as foreign capital markets. Although deposit⁴¹ holdings have exploded across all banks after the reform, which were brought about by economic growth and stoked by the lack of other capital investment options. Loan supply was still the binding constraint as manifested in the positive coefficients of loan interest rates. The phenomenon that banks exercise great caution in extending loans is consistent with another two characteristics of the financial intermediation in China: banks have lower asset quality⁴² than their foreign counterparts and banks keep high levels of excess reserve.

There is no evidence that shows banks are more sensitive to the spread between various centrally administered interest rates than their levels. Nevertheless, I was able to separate the post-reform loan interest impact on the SOCBs by reestimating

⁴¹See Appendices, Figure 10.

⁴²Ratio of non-performing loans (NPL) is estimated to be 19.15 percent in 2004 and much higher before reforms by CBRC Statistics.

the regression model with spreads. The interaction terms between capitalization ratio and policy variables investigate cross-sectional differences within a group. From interpreting the interaction results, I reach a similar conclusion as Kishan and Opiela (2000) that banks with smaller size and less capitalization tend to be affected more by contractionary monetary policy shocks. SOCBs, for example, being well-capitalized and “too big to fail”, are insensitive to the interactions.

Overall the reform has achieved certain progress such as the departure from credit planning and direct quantity management. The replacement by window guidance and the monopolistic nature of the SOCBs, however, have mitigated the impact of the reform on the state banks. While generally very effective, the credit channel does exhibit a larger effect on small commercial banks. Because most benchmark interest rates are still centrally administered by the PBC, banks as price takers usually face a disequilibrium in the loan market due to their inability to influence the loan demand curve. To slowly eliminate such market distortions, a gradual deepening of reforms in interest rate liberalization is desirable, however the central government sees fit.

8 References

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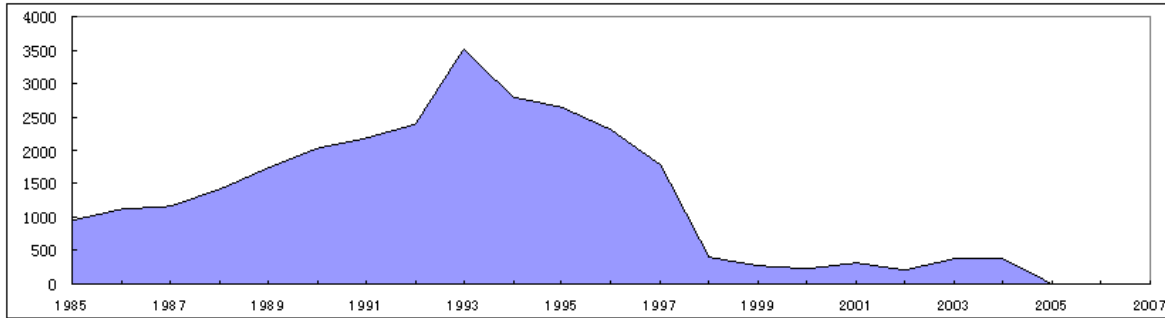
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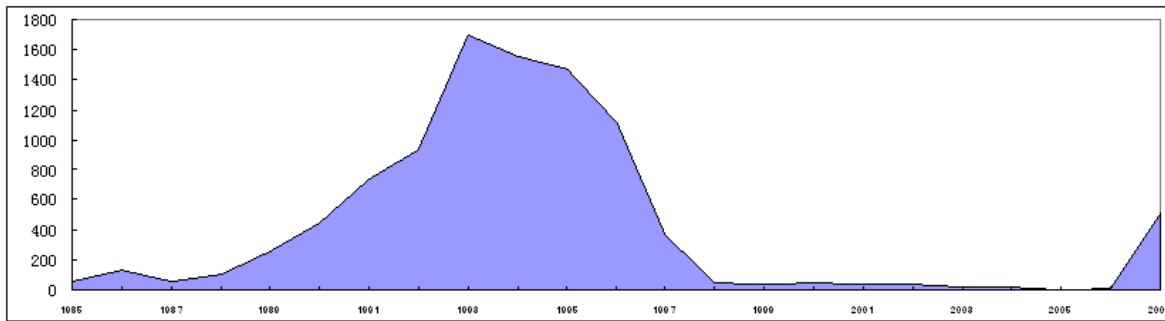
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9 Appendices

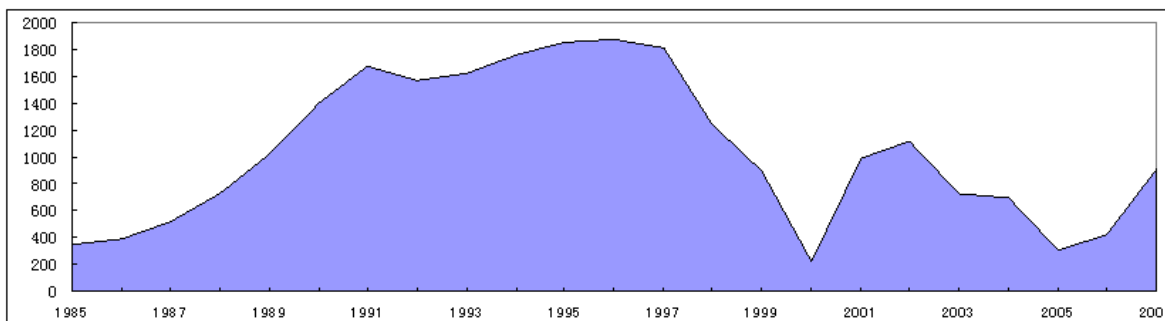
Figure 9: Direct Lending of the PBC to Major SOCBs (Unit: 100 Mil Yuan)



(a) Industrial and Commercial Bank of China

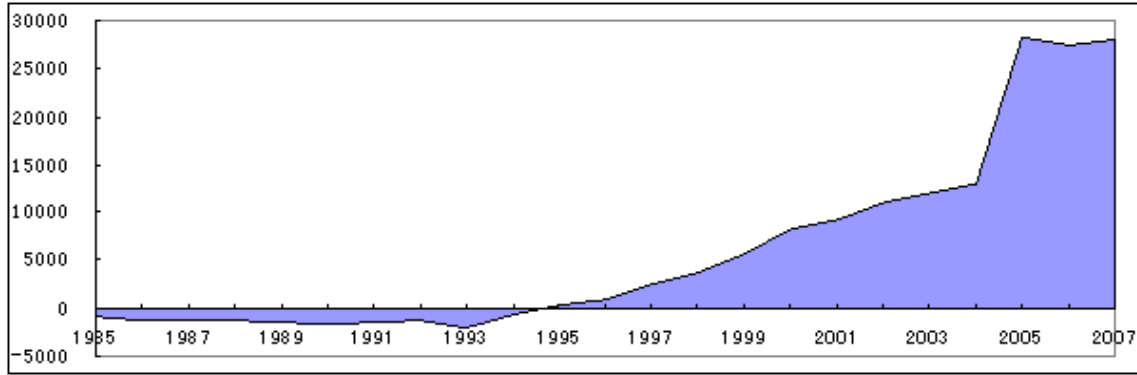


(b) China Construction Bank

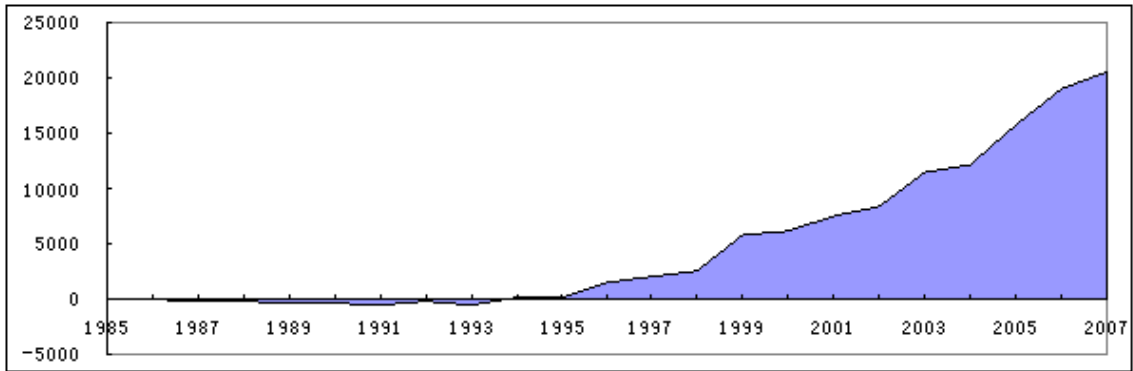


(c) Bank of China

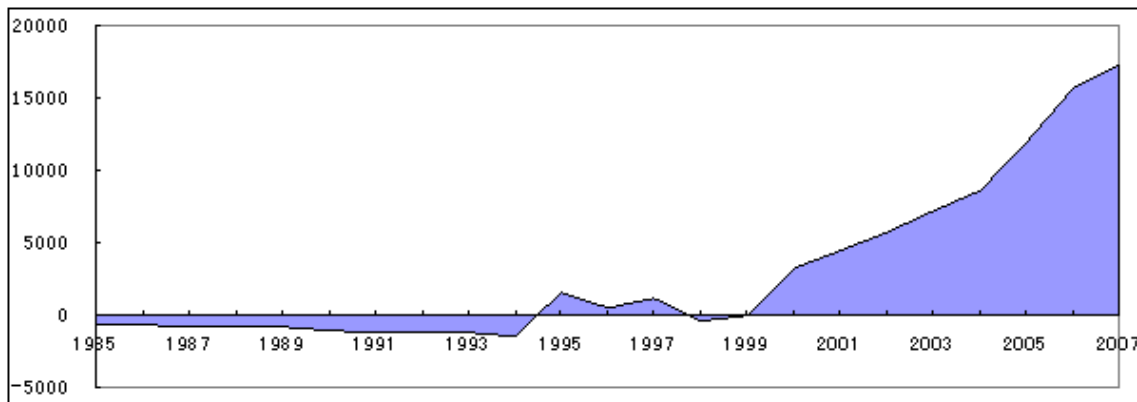
Figure 10: Deposit Surplus (Total Deposits - Total Loans) for SOCBs (Unit: 100 Mil Yuan)



(a) Industrial and Commercial Bank of China



(b) China Construction Bank



(c) Agricultural Bank of China

Table 8: Pre Reform Determinants of Changes in Borrowing from PBC

VARIABLES	(1) SOCB	(2) SOCB	(3) SOCB	(4) SOCB	(5) SOCB
Relending Rate	-0.0145 (0.0214)	-0.0139 (0.0220)	-0.0205 (0.0274)	-0.0187 (0.0238)	-0.0193 (0.0235)
Loan Interest	0.0504 (0.0369)	0.0541 (0.0423)	0.0526 (0.0430)	0.0512 (0.0429)	0.0409 (0.0453)
Change in Deposit	-0.447** (0.191)	-0.463** (0.199)	-0.474** (0.205)	-0.476** (0.207)	-0.475** (0.210)
Capitalization		-0.170 (0.401)	-0.643 (1.170)	-0.998 (1.440)	-1.635 (1.917)
$cap * r_B$			0.0654 (0.127)		
$cap * r_E$				0.132 (0.191)	
$cap * r_L$					0.167 (0.197)
Observations	39	39	39	39	39
R-squared	0.259	0.264	0.270	0.274	0.277
Number of Banks	4	4	4	4	4

Notes 1. Robust standard errors in parentheses.

2. Borrowing from PBC data liable to errors due to inconsistent balance sheet formats

3. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 9: Post Reform Determinants of Excess Reserve Changes

VARIABLES	(1) SOCB	(2) SOCB	(3) SOCB	(4) non-SOCB	(5) non-SOCB	(6) non-SOCB
Relending Rate	-0.0109 (0.0212)	0.0108 (0.0359)	0.0113 (0.0366)	-0.0640 (0.0499)	0.110 (0.0808)	0.110 (0.0814)
Exc. Reserve Interest	-0.000951 (0.00700)	0.0108 (0.0183)	0.00720 (0.0164)	-0.0463** (0.0227)	0.0563 (0.0398)	0.0551 (0.0404)
Loan Interest	0.0223 (0.0140)	0.0137 (0.0158)	0.0134 (0.0165)	0.0629** (0.0320)	0.0141 (0.0390)	0.0146 (0.0393)
Rediscount Rate	-0.000901 (0.0143)	-0.00111 (0.0129)	-0.00205 (0.0139)	0.0268 (0.0345)	0.0240 (0.0345)	0.0241 (0.0348)
Change in RRR	0.00196 (0.00438)	0.00116 (0.00508)	0.00150 (0.00484)	-0.00642 (0.00962)	-0.0184* (0.0102)	-0.0182* (0.0103)
Change in Deposit	0.0579 (0.0812)	0.0553 (0.0814)	0.0664 (0.0880)	0.0648 (0.0717)	0.0865 (0.0646)	0.0854 (0.0646)
Capitalization		0.154 (0.216)	0.0501 (0.415)		0.0509 (0.210)	-0.0373 (0.464)
$cap * r_E$			0.0673 (0.175)			0.0347 (0.174)
Observations	40	36	36	110	99	99
R-squared	0.337	0.431	0.436	0.268	0.344	0.344
Number of Banks	4	4	4	11	11	11

Notes 1. Robust standard errors in parentheses, interest rates in percentage points.

2. Panel data unbalanced for non-SOCBs and balanced for SOCBs.

3. * significant at 10%, ** significant at 5%, *** significant at 1%.

4. Excess reserve levels are author's calculation, which are subject to impreciseness.

Formula: Excess Reserves = Total Reserves - Total Deposit * Required Reserve Ratio

Table 10: Pre Reform Determinants of Real Loan Growth

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	SOCB	SOCB	SOCB	SOCB	non-SOCB	non-SOCB	non-SOCB	non-SOCB
Relending Rate	-0.00810 (0.0238)	-0.0130 (0.0217)	-0.0273 (0.0305)	-0.0292 (0.0230)	0.169 (0.111)	0.176 (0.113)	0.139 (0.122)	0.179 (0.114)
Loan Interest	0.0707 (0.0473)	0.0522 (0.0424)	0.0534 (0.0421)	0.0177 (0.0620)	-0.378** (0.163)	-0.342** (0.154)	-0.295* (0.160)	-0.350** (0.154)
Real Deposit Growth	0.339** (0.132)	0.341*** (0.113)	0.308** (0.146)	0.257* (0.156)	0.0641 (0.0853)	-0.0215 (0.0820)	-0.0101 (0.0817)	-0.00940 (0.0806)
Capitalization		1.229*** (0.334)	0.0730 (2.192)	-4.296 (5.024)		1.471*** (0.517)	-3.434 (3.236)	-5.640 (5.982)
$cap * r_B$			0.157 (0.277)				0.522 (0.335)	
$cap * r_L$				0.624 (0.555)				0.698 (0.579)
Observations	48	48	48	48	68	68	68	68
R-squared	0.422	0.474	0.479	0.506	0.443	0.531	0.548	0.548
Number of Banks	4	4	4	4	11	11	11	11

Notes 1. Robust standard errors in parentheses.

2. Panel data unbalanced for non-SOCBs and balanced for SOCBs.

3. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 11: Post Reform Determinants of Real Loan Growth

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	SOCB	SOCB	SOCB	SOCB	non-SOCB	non-SOCB	non-SOCB	non-SOCB
Relending Rate	0.256 (0.178)	0.396 (0.249)	0.400 (0.251)	0.396 (0.255)	-0.500*** (0.139)	-0.672** (0.266)	-0.723*** (0.272)	-0.552** (0.250)
Loan Interest	-0.139 (0.103)	-0.182 (0.120)	-0.200* (0.119)	-0.182 (0.123)	0.303*** (0.116)	0.355** (0.153)	0.582** (0.229)	0.346** (0.145)
Rediscount Rate	-0.141 (0.124)	-0.120 (0.132)	-0.121 (0.135)	-0.0941 (0.182)	0.271*** (0.0883)	0.277*** (0.0919)	0.302*** (0.0906)	0.517*** (0.165)
Change in RRR	0.0550 (0.0480)	0.0362 (0.0588)	0.0352 (0.0588)	0.0378 (0.0619)	-0.105*** (0.0293)	-0.0921*** (0.0353)	-0.0770** (0.0378)	-0.0903*** (0.0347)
Real Deposit Growth	1.237** (0.612)	1.035 (0.630)	1.041 (0.651)	1.063 (0.721)	0.402*** (0.151)	0.453** (0.191)	0.467*** (0.178)	0.458** (0.182)
Capitalization		0.886 (0.931)	-0.994 (6.247)	2.437 (10.88)		-0.112 (1.088)	25.80** (12.55)	12.34** (5.216)
$cap * r_L$			0.312 (0.942)				-4.382** (2.177)	
$cap * r_R$				-0.507 (3.520)				-4.533** (2.161)
Observations	40	36	36	36	110	99	99	99
R-squared	0.416	0.380	0.381	0.381	0.302	0.361	0.401	0.408
Number of Banks	4	4	4	4	11	11	11	11

Notes 1. Robust standard errors in parentheses.

2. Panel data unbalanced for non-SOCBs and balanced for SOCBs.

3. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 12: Pre Reform Determinants of Loan Changes with Random Effects

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	SOCB	SOCB	SOCB	SOCB	non-SOCB	non-SOCB	non-SOCB	non-SOCB
Relending Rate	-0.0226** (0.0101)	-0.0235** (0.0104)	-0.0320** (0.0141)	-0.0311*** (0.0113)	0.0653* (0.0353)	0.0688* (0.0388)	0.0396 (0.0411)	0.0664* (0.0378)
Loan Interest	0.0101 (0.0211)	0.00606 (0.0224)	0.00510 (0.0235)	-0.0129 (0.0367)	-0.0933* (0.0502)	-0.0895* (0.0520)	-0.0730 (0.0511)	-0.105* (0.0542)
Change in Deposit	0.363** (0.169)	0.368** (0.168)	0.344* (0.193)	0.322 (0.200)	0.435*** (0.118)	0.407*** (0.123)	0.361*** (0.120)	0.377*** (0.111)
Capitalization		0.263 (0.202)	-0.406 (0.967)	-2.214 (2.237)		0.231 (0.255)	-2.765* (1.587)	-5.159** (2.287)
$cap * r_B$			0.0914 (0.141)				0.331* (0.175)	
$cap * r_L$				0.281 (0.267)				0.544** (0.228)
Observations	48	48	48	48	68	68	68	68
R-squared	0.279	0.287	0.293	0.311	0.701	0.712	0.748	0.753
Number of Banks	4	4	4	4	11	11	11	11

Notes 1. Robust standard errors in parentheses.

2. Panel data unbalanced for non-SOCBs and balanced for SOCBs.

3. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 13: Post Reform Determinants of Loan Changes with Random Effects

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	SOCB	SOCB	SOCB	SOCB	non-SOCB	non-SOCB	non-SOCB	non-SOCB
Relending Rate	0.133* (0.0744)	0.206* (0.121)	0.209* (0.122)	0.205* (0.123)	-0.181*** (0.0534)	-0.243** (0.0949)	-0.253*** (0.0965)	-0.204** (0.0912)
Loan Interest	-0.0742* (0.0427)	-0.100* (0.0561)	-0.114** (0.0512)	-0.0996* (0.0567)	0.110*** (0.0404)	0.122*** (0.0464)	0.171*** (0.0625)	0.117*** (0.0452)
Rediscount Rate	-0.0644 (0.0538)	-0.0638 (0.0581)	-0.0640 (0.0588)	-0.0411 (0.0764)	0.102*** (0.0339)	0.102*** (0.0343)	0.107*** (0.0337)	0.176*** (0.0424)
Change in RRR	0.0313 (0.0200)	0.0271 (0.0257)	0.0262 (0.0264)	0.0278 (0.0269)	-0.0381*** (0.0114)	-0.0326** (0.0134)	-0.0294** (0.0146)	-0.0320** (0.0134)
Change in Deposit	0.823*** (0.294)	0.793** (0.338)	0.792** (0.347)	0.812** (0.369)	0.379*** (0.0865)	0.371*** (0.0900)	0.375*** (0.0861)	0.356*** (0.0862)
Capitalization		0.388 (0.389)	-1.079 (2.608)	1.675 (4.630)		0.159 (0.339)	5.733 (3.895)	4.091*** (1.329)
$cap * r_L$			0.247 (0.401)				-0.942 (0.654)	
$cap * r_R$			-0.413 (1.428)					-1.413*** (0.511)
Observations	40	36	36	36	110	99	99	99
R-squared	0.429	0.386	0.389	0.385	0.387	0.377	0.402	0.412
Number of Banks	4	4	4	4	11	11	11	11

Notes 1. Robust standard errors in parentheses.

2. Panel data unbalanced for non-SOCBs and balanced for SOCBs.

3. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 14: Determinants of Loan Changes with 1994 as the Threshold Year

VARIABLES	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	Pre	SOCB	Pre	SOCB	Pre	non-SOCB	Pre	non-SOCB	Post	SOCB	Post	SOCB	Post	non-SOCB	Post	non-SOCB
Relending Rate	-0.0326***	(0.0100)	-0.0263***	(0.00959)	0.441	(0.359)	0.642**	(0.324)	0.141	(0.0924)	0.137	(0.0963)	-0.181***	(0.0478)	-0.175***	(0.0502)
Loan Interest	0.0103	(0.0107)	0.0450*	(0.0236)	-0.224***	(0.0632)	-0.262***	(0.0575)	-0.0780	(0.0532)	-0.129**	(0.0626)	0.108***	(0.0377)	0.117***	(0.0416)
Rediscount Rate									-0.0702	(0.0666)	-0.0673	(0.0685)	0.0984***	(0.0308)	0.0988***	(0.0310)
Change in RRR									0.0338	(0.0258)	0.0337	(0.0271)	-0.0390***	(0.0101)	-0.0380***	(0.0103)
Change in Deposit	0.489***	(0.103)	0.488***	(0.116)	0.515***	(0.0454)	0.485***	(0.0478)	0.910*	(0.497)	0.854*	(0.512)	0.282***	(0.0807)	0.274***	(0.0844)
$cap * r_L$									-0.357*	(0.214)	0.204	(0.640)	0.768	(0.284)	-0.284	(0.284)
Observations	32		32		31		31		40		40		110		110	
R-squared	0.729		0.764		0.925		0.943		0.430		0.483		0.396		0.400	
Number of Banks	4		4		8		8		4		4		11		11	

Notes 1. Robust standard errors in parentheses.

2. Panel data unbalanced for non-SOCBs and balanced for SOCBs.

3. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 15: Determinants of Loan Changes with 1996 as the Threshold Year

VARIABLES	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	Pre	SOCB	Pre	SOCB	Pre	non-SOCB	Pre	non-SOCB	Post	SOCB	Post	SOCB	Post	non-SOCB	Post	non-SOCB
Relending Rate	-0.0364** (0.0172)		-0.0459** (0.0218)		0.403*** (0.119)		0.407*** (0.135)		0.141 (0.0924)		0.137 (0.0963)		-0.181*** (0.0478)		-0.175*** (0.0502)	
Loan Interest	-0.00262 (0.0241)		-0.0290 (0.0480)		-0.341*** (0.105)		-0.348*** (0.119)		-0.0780 (0.0532)		-0.129** (0.0626)		0.108*** (0.0377)		0.117*** (0.0416)	
Rediscount Rate									-0.0702 (0.0666)		-0.0673 (0.0685)		0.0984*** (0.0308)		0.0988*** (0.0310)	
Change in RRR									0.0338 (0.0258)		0.0337 (0.0271)		-0.0390*** (0.0101)		-0.0380*** (0.0103)	
Change in Deposit	0.385* (0.230)		0.313 (0.288)		0.341** (0.139)		0.260** (0.126)		0.910* (0.497)		0.854* (0.512)		0.282*** (0.0807)		0.274*** (0.0844)	
$cap * r_L$			0.367 (0.420)				0.532** (0.219)				0.768 (0.640)				-0.284 (0.284)	
Observations	40		40		48		48		40		40		110		110	
R-squared	0.284		0.338		0.707		0.790		0.430		0.483		0.396		0.400	
Number of Banks	4		4		9		9		4		4		11		11	

Notes 1. Robust standard errors in parentheses.

2. Panel data unbalanced for non-SOCBs and balanced for SOCBs.

3. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 16: Determinants of Loan Changes with BOCM Classified as SOCB

VARIABLES	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		
	Pre	SOCB	Pre	SOCB	Pre	non-SOCB	Pre	non-SOCB	Post	SOCB	Post	SOCB	Post	non-SOCB	Post	non-SOCB	
Relending Rate	0.0100 (0.0211)	0.00686 (0.0197)	0.0727 (0.0530)	0.0663 (0.0527)	0.0406 (0.0541)	0.0406 (0.0541)	0.102 (0.119)	0.102 (0.119)	0.0406 (0.0541)	0.0406 (0.0541)	0.0406 (0.0541)	0.102 (0.119)	0.102 (0.119)	-0.187*** (0.0509)	-0.187*** (0.0509)	-0.291*** (0.0969)	-0.291*** (0.0969)
Loan Interest	-0.000881 (0.0268)	0.00367 (0.0399)	-0.127** (0.0601)	-0.118* (0.0606)	-0.0283 (0.0333)	-0.0283 (0.0333)	-0.0381 (0.0510)	-0.0381 (0.0510)	-0.0283 (0.0333)	-0.0283 (0.0333)	-0.0283 (0.0333)	-0.0381 (0.0510)	-0.0381 (0.0510)	0.111*** (0.0402)	0.111*** (0.0402)	0.188*** (0.0674)	0.188*** (0.0674)
Rediscount Rate					-0.00133 (0.0392)	-0.00133 (0.0392)	0.000455 (0.0409)	0.000455 (0.0409)	-0.00133 (0.0392)	-0.00133 (0.0392)	-0.00133 (0.0392)	0.000455 (0.0409)	0.000455 (0.0409)	0.102*** (0.0332)	0.102*** (0.0332)	0.111*** (0.0332)	0.111*** (0.0332)
Change in RRR					0.00415 (0.0155)	0.00415 (0.0155)	8.33e-05 (0.0157)	8.33e-05 (0.0157)	0.00415 (0.0155)	0.00415 (0.0155)	0.00415 (0.0155)	8.33e-05 (0.0157)	8.33e-05 (0.0157)	-0.0418*** (0.0109)	-0.0418*** (0.0109)	-0.0329** (0.0131)	-0.0329** (0.0131)
Change in Deposit	0.638*** (0.231)	0.587*** (0.189)	0.389*** (0.149)	0.322** (0.135)	0.0488 (0.115)	0.0488 (0.115)	0.0111 (0.106)	0.0111 (0.106)	0.0488 (0.115)	0.0488 (0.115)	0.0488 (0.115)	0.0111 (0.106)	0.0111 (0.106)	0.358*** (0.0923)	0.358*** (0.0923)	0.364*** (0.0915)	0.364*** (0.0915)
$cap * r_L$		-0.146 (0.337)		0.779*** (0.261)		0.779*** (0.261)						-0.237 (0.474)	-0.237 (0.474)			-0.922 (0.630)	-0.922 (0.630)
Observations	58	58	58	58	50	50	45	45	50	50	50	45	45	100	100	90	90
R-squared	0.486	0.522	0.697	0.775	0.235	0.235	0.218	0.218	0.235	0.235	0.235	0.218	0.218	0.473	0.473	0.491	0.491
Number of Banks	5	5	10	10	5	5	5	5	5	5	5	5	5	10	10	10	10

Notes 1. Robust standard errors in parentheses.

2. Panel data unbalanced for non-SOCBs and balanced for SOCBs.

3. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 17: Determinants of Loan Changes with Lagged Loan Rate

VARIABLES	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		
	Pre	SOCB	Pre	SOCB	Pre	non-SOCB	Pre	non-SOCB	Post	SOCB	Post	SOCB	Post	non-SOCB	Post	non-SOCB	
Relending Rate	-0.0209** (0.00894)	-0.0283** (0.0114)	0.0783* (0.0428)	0.0818* (0.0467)	0.141 (0.115)	0.141 (0.119)	0.141 (0.115)	0.141 (0.119)	0.141 (0.115)	0.141 (0.119)	0.141 (0.119)	0.141 (0.119)	0.141 (0.119)	-0.235** (0.0943)	-0.247** (0.0963)	-0.235** (0.0943)	-0.247** (0.0963)
Loan Interest r_{Lt}	0.000716 (0.0235)	-0.0360 (0.0493)	-0.134** (0.0634)	-0.112* (0.0628)	-0.240* (0.141)	-0.261* (0.152)	-0.240* (0.141)	-0.261* (0.152)	-0.240* (0.141)	-0.240* (0.141)	-0.240* (0.141)	-0.261* (0.152)	-0.261* (0.152)	0.185*** (0.0716)	0.264*** (0.0905)	0.185*** (0.0716)	0.264*** (0.0905)
Lagged Loan Interest r_{Lt-1}	0.00367 (0.00520)	0.00699 (0.00725)	0.00298 (0.0217)	-0.0140 (0.0195)	0.134 (0.102)	0.131 (0.107)	0.134 (0.102)	-0.0140 (0.0195)	0.134 (0.102)	0.134 (0.102)	0.134 (0.102)	0.131 (0.107)	0.131 (0.107)	-0.0505 (0.0556)	-0.0579 (0.0557)	-0.0505 (0.0556)	-0.0579 (0.0557)
Rediscount Rate					-0.224 (0.164)	-0.220 (0.172)	-0.224 (0.164)		-0.224 (0.164)	-0.224 (0.164)	-0.224 (0.164)	-0.220 (0.172)	-0.220 (0.172)	0.158** (0.0724)	0.175** (0.0733)	0.158** (0.0724)	0.175** (0.0733)
Change in RRR					0.0635 (0.0485)	0.0624 (0.0501)	0.0635 (0.0485)		0.0635 (0.0485)	0.0635 (0.0485)	0.0635 (0.0485)	0.0624 (0.0501)	0.0624 (0.0501)	-0.0473** (0.0216)	-0.0447** (0.0219)	-0.0473** (0.0216)	-0.0447** (0.0219)
Change in Deposit	0.254 (0.192)	0.193 (0.243)	0.394*** (0.145)	0.335** (0.135)	0.848* (0.471)	0.831* (0.493)	0.848* (0.471)	0.335** (0.135)	0.848* (0.471)	0.848* (0.471)	0.848* (0.471)	0.831* (0.493)	0.831* (0.493)	0.266*** (0.0867)	0.269*** (0.0858)	0.266*** (0.0867)	0.269*** (0.0858)
$cap * r_L$		0.391 (0.375)		0.649** (0.266)		0.388 (0.556)		0.649** (0.266)		0.388 (0.556)		0.388 (0.556)		-1.386* (0.726)	-1.386* (0.726)		-1.386* (0.726)
Prob > Chi2	0.54	0.54	0.92	0.99	0.38	0.22	0.92	0.99	0.38	0.22	0.22	0.22	0.0027	0.032	0.0027	0.032	0.032
Observations	44	44	68	68	36	36	68	68	36	36	36	36	99	99	99	99	99
R-squared	0.157	0.227	0.706	0.763	0.439	0.447	0.706	0.763	0.439	0.447	0.447	0.447	0.394	0.427	0.394	0.427	0.427
Number of Banks	4	4	11	11	4	4	11	11	4	4	4	4	11	11	11	11	11

Notes 1. Robust standard errors in parentheses.

2. Panel data unbalanced for non-SOCBs and balanced for SOCBs.

3. * significant at 10%, ** significant at 5%, *** significant at 1%.

4. Null hypothesis of Chi-Square test: $\beta(r_{Lt}) + \beta(r_{Lt-1}) = 0$.

“Prob > Chi2” is the significance level that the null hypothesis is rejected, or that $\beta(r_{Lt}) + \beta(r_{Lt-1}) \neq 0$.