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Banking reforms, performance and risk in China

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Abstract

We investigate the impact of the banking reform started from 2005 on ownership structures in China on commercial banks' profitability, efficiency and risk over the period 2000-2012, providing comprehensive evidence on the impact of banking reform in China. We find that banks on average tend to have higher profitability, lower risk and lower efficiency after the reforms, and the results are robust with our difference-in-difference approach. Our results also show that the Big 5 state-owned banks underperform banks with other types of ownership when risk is measured by non-performing loans (NPLs) over the entire study period, but tend to have fewer NPLs than other banks during the post-reform period. Our results provide some supporting evidence on the ongoing banking reforms in China, suggesting that attracting strategic foreign investors and listing state-owned banks on stock exchanges appear to be effective ways to help state-owned banks deal with the problem of NPLs and manage their risk.

Key words: Bank reforms, performance, efficiency, risk, ownership structure

JEL classification: G21, G28, G32

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1. Introduction

The Chinese economy has global significance, and the banking system in China plays a crucial role in maintaining a healthy economy. Since 1978, the Chinese banking sector has undergone significant reforms to transform the sector into a modern banking system based on market and profitability functions (García-Herrero, Gavilá, and Santabárbara 2009). The process of reform has been accelerated after China joined the WTO at the end of 2001.

Differing from banking reforms in transition economies in Central and Eastern Europe, where new banking systems were created, Chinese banking reform tends to be more gradual (Jiang, Yao, and Feng 2013). Because the banking reform in China appears to have tremendous success in risk management and performance and efficiency improvement (e.g., Wang et al. 2014; Allen et al. 2014), experiences and lessons from China will be of particular interest to other transition economies (Jiang, Yao, and Feng 2013).

A number of studies have examined how Chinese banks' performance has responded to banking reforms. However, most of them used data prior to the great financial crisis of 2007. Since 2005, remarkable changes of ownership structure (e.g., encouraging foreign investments and public listing) have been seen in major Chinese banks, but little is known about the impact of such reform. Although a few studies have investigated how Chinese banks performed after 2005, they tend to focus on large, either state-owned or joint-stock commercial banks (e.g., Allen et al. 2014; Wang et al. 2014). This paper attempts to address the changes in the performance and risk levels of different types of Chinese banks over the period of 2000-2012, with particular interest in the year of 2005 when radical reform measures were adopted. It contributes to the literature in several ways.

First, previous studies of banking reforms focus mainly on the profitability and/or efficiency of Chinese banks (e.g., Heffernan and Fu 2010; Deng, Guo, and Kong 2011; Jiang, Yao, and Feng 2013), and lack evidence of their levels of risk-taking. One of the most

significant problems for the Chinese banking sector is the state-owned banks' level of non-performing loans (NPLs), which has been largely overlooked until very recently (Allen et al. 2014; Jiang, Yao, and Feng 2013). This paper addresses this under-researched area and assesses Chinese banks' risk-taking by using the measures of NPLs and Z-score.

Second, our study provides comprehensive and up-to-date evidence on the impacts of banking reforms in China. It uses a bigger sample of more Chinese commercial banks than previous empirical studies, and also takes into consideration the effect of the 2007-09 financial crisis to which little attention has been paid. This study, therefore, enriches our understanding of the impacts of banking reforms and offers important implications for policy makers in China and other developing countries. Our results indicate that the banking reforms in 2005 had a significant impact on Chinese banks' performance. Specifically, banks tend to have improved profitability and lower risk, but have lower efficiency scores after 2005, suggesting that the reform measures adopted since 2005 are steps in the right direction of Chinese banking reform, but further reforms should be taken to improve the efficiency of Chinese banks.

Third, we provide further evidence on bank ownership reform. Our results show that the Big 5 state-owned banks outperform banks with joint-stock ownership and city commercial banks in terms of overall risk as measured by Z-score, but underperform them over the entire study period when risk is measured by the NPLs. However, employing the difference-in-difference approach (DiD), we find that the Big 5 have lower NPLs than other banks during the post-reform period. This suggests that the "Chinese model" (Allen et al. 2014) of banking reforms, which attracts strategic foreign investors and lists state-owned banks on stock exchanges yet keeps control ultimately in the hands of the government, appears to be an effective way of helping state-owned banks deal with the problem of NPLs.

The remainder of the paper is organized as follows. Section 2 reviews the process of Chinese banking reform, and Section 3 discusses the literature related to the study. Our data, empirical models and variables used in the regression analysis are presented in Section 4. Section 5 reports the empirical results. Section 6 concludes the paper.

2. The reform of the Chinese banking sector

Established in 1949, the Chinese banking system initially followed a mono-bank model, in which the central bank, the People's Bank of China (PBOC), also played the role of commercial banking to serve the nation's centrally-planned economy (Berger, Hasan, and Zhou 2009; Zhang et al. 2013). In order to transform a policy-driven and monopolistic banking system into a competitive, market-oriented one (Dong et al. 2014), China has adopted a gradual reform approach since 1978.¹ Four state-owned banks (SOCBs), namely the Bank of China (BOC), the China Construction Bank (CCB), the Agricultural Bank of China (ABC) and the Industrial and Commercial Bank of China (ICBC), were split from the PBOC,² and took over the commercial bank business, such as lending functions.

From 1985 to 1992, a more intensely competitive environment was created by allowing the entry of new domestic banks and the expansion of the business sector of the four SOCBs. A number of joint-stock commercial banks (JSCBs) were established, and Rural Credit Cooperatives (RCCs) and Urban Credit Cooperatives (UCCs) were launched to serve individuals and small and medium-sized rural/urban enterprises. In 1994, three policy banks were established to separate policy lending from commercial lending, and the role of SOCBs as 'commercial banks' were clearly defined by the Commercial Bank Law of China. The government took several steps to help the SOCBs clean up their deteriorated balance sheets and promote commercial lending, e.g., establishing four state-owned asset management companies (AMCs) in 1999 to take nonperforming loans off the SOCBs at book value.

Since joining the WTO in December 2001, China has committed to opening up its banking sector to foreign competitors. The process of reform has been accelerated since 2003, and several significant policies have been implemented in order to improve the corporate governance and capital structure of state-owned banks, as well as to encourage foreign investment. The year 2005 is particularly remarkable, as it marked further opening up to foreign investors and the accelerated privatization of the SOCBs.

In December 2005, China Bohai Bank was established, the first Chinese bank to be set up with a foreign minority stake. Around this time, foreign strategic investors also made deals to take on minority foreign ownership in SOCBs. For instance, in October 2005, a US\$3.1 billion investment in the BOC was announced by the Royal Bank of Scotland, which accounted for approximately 10% of the BOC's ownership. By the end of 2006, about 30 foreign financial institutions had purchased stakes in 21 Chinese commercial banks, with a total investment of US\$19 billion (Okazaki 2007). Moreover, foreign banks have been treated similarly to domestic banks in many aspects since 2006, and the number of foreign bank entities has grown rapidly, almost doubling from 2004 to 2012 (Luo et al. 2015).

The Chinese government encouraged the privatization of SOCBs not only by attracting foreign institutional investors as minority shareholders but also by listing them on stock exchanges. The Bank of Communications (BOCOM)³ was the first to take this route, issuing an IPO in Hong Kong in June 2005 (Berger, Hasan, and Zhou 2009). After that, all SOCBs undertook successful IPOs and were listed on stock exchanges by 2010.⁴ By opening to foreign investors and going public, the wholly state-owned Chinese banks diversified their ownership and became joint-stock commercial banks.

At present, the Chinese banking sector is dominated by the five largest SOCBs: ABC, BOC, CCB, ICBC and BOCOM. Apart from the Big 5 (previously the Big 4), 12 national domestic JSCBs and more than 100 regional city or rural commercial banks (CCBs or

RCBs)⁵ comprise the domestic commercial banking system, which also includes newly established foreign banks, including Chinese-foreign joint-equity banks and banks with exclusively foreign ownership.

A number of studies have examined how Chinese banks' performance was affected by financial reforms, though most have used data prior to 2005 (e.g., Ariff and Can 2008; García-Herrero, Gavilá, and Santabábara 2009; Berger, Hasan, and Zhou 2009; Lin and Zhang 2009; Jiang, Yao and Zhang 2009; Yao et al. 2007). Although banking reform in China is happening gradually, more radical reform measures have been adopted since 2005, such as further opening up to foreign investors and accelerated privatization of SOCBs. This paper attempts to fill this research gap by examining how different types of Chinese banks performed in terms of profitability, efficiency and risk before and after 2005, providing important evidence that is of interest to both academics and policy makers.

This paper also attempts to assess the impact of the 2007-2009 financial crisis on the performance impact of banking reforms, for which there is very little evidence in China. Wang et al. (2014) argue that the "Chinese model" of banking reform shows its positive impact on maintaining systemic stability during the global financial crisis. However, their study focuses only on large state-owned banks in China and does not present a full picture of how performance and risk in Chinese banks changed during periods of economic fluctuation.

This paper, therefore, attempts to provide more comprehensive evidence on the impact of banking reforms in China by examining changes in the performance and risk of banks with different ownership structures before and after the 2005 reforms, and incorporating the effects of the 2007-2009 financial crisis.

3. Literature review

3.1 Reform and bank performance

One of the main objectives of banking reform in both developed and developing countries is to improve the efficiency and profitability of banks (Berger and Humphrey 1997). Privatization of banks is expected to enhance the level of competition in the banking sector and in turn improve overall performance (Clarke, Cull, and Shirley 2005). Literature on whether banking reforms can achieve these initiatives has not, however, reached agreement. Early research in the US reveals unchanged or even decreased bank efficiency post-reform (e.g., Berger and Mester 1997), and similar results are found by several cross-country studies (e.g., Boubakri et al. 2005).

On the other hand, Brissimis, Delis, and Papanikolaou (2008) find a positive impact of banking reform on efficiency in newly acceded EU countries from 1994 to 2005. Improved cost efficiency brought about by banking reforms has also been reported in other countries, such as Australia (Sturm and Williams 2004). These results are consistent with the belief that banking reforms should be able to help banks achieve efficiency gains. In a less competitive market, banks are likely to behave inefficiently, as they can avoid minimizing cost without being forced out of the market (Fu and Heffernan 2009). Privatization and foreign bank penetration increase the level of competition in the banking sector and therefore encourage banks to operate more efficiently. Demirguc-Kunt and Huizinga (1999) examine the effects of the entry of foreign banks into different countries, and find that in most cases foreign entry forces domestic banks to improve their efficiency.

Evidence on whether banking reform can improve profitability of banks is also ambiguous. Humphrey and Pulley (1997) find that deregulation of interest rates reduced profitability of US banks, while Boubakri et al. (2005) show that profitability of banks increases during post-privatisation period in 22 developing countries. Chronopoulos, Liu, McMillan, and Wilson (2015) examine how key regulatory events in the US affect the profitability of banks over the period 1984–2010. The authors find that adoption of the

Riegle–Neal IBBEA Act that eliminated federal restrictions on interstate banking resulted in reduced profits persistence and bank profit levels, while the introduction of GLB Act which allowed banks to diversify across business segments increased profits persistence and profit levels.

Bank performance during the reform process appears to differ depending on its ownership structure. State-owned banks are found to underperform private banks in many countries (e.g., Cornett et al. 2010; Weintraub and Nakane 2005). Foreign-owned banks tend to outperform domestically owned banks in general, as they have the advantages of serving multinational customers, access to capital and use of technology (Berger 2007). However, contradictory evidence is provided by Naaborg and Lensink (2008), who find a negative relationship between foreign ownership and bank profitability in a cross-section study in Central and Eastern Europe and Central Asia.

Whether the banking reforms in China have been an effective way to improve the performance of Chinese commercial banks remains doubtful, as empirical evidence tends to be limited and the impact of recent reforms is unclear (Berger, Hasan, and Zhou 2009, Luo and Yao 2010). Berger, Hasan, and Zhou (2009) argue that minority foreign ownership may increase Chinese bank efficiency through improving corporate governance, technological advancement and risk management. Listing on stock exchanges can place market pressure on banks and encourage them to maximize value and improve information transparency, which in turn will result in efficiency gains. The authors find a strong favourable effect on efficiency from reducing state ownership of banks and increasing the role of foreign ownership in China during the period of 1994 to 2003. Similarly, Luo and Yao (2010) find that over 1999-2008, after listing, Chinese bank efficiency increased by almost 5%. Luo et al. (2015) show that foreign bank penetration is associated with improved profitability and efficiency for domestic banks in China during the period 2002 to 2011. Wang et al. (2014)

find that the overall efficiency of the Chinese banking system improves over the period 2003-2011 because of the reforms. However, Fu and Heffernan (2009) provide contradictory evidence, showing that the X-efficiency of Chinese banks on average declines significantly during the period 1985 to 2002, and that most banks are operating below scale efficient levels.

Conclusions regarding the difference in performance between banks with different ownership are also mixed (Wang et al. 2014). Lin and Zhang (2009) find that the Big 4 state-owned banks are less profitable than other types of banks in China, and banks undergoing a foreign acquisition or public listing record better pre-event performance over the period of 1997-2004. Ariff and Can's (2008) study shows that SOCBs on average are less cost- and profit-efficient than JSCBs over the period of 1995-2004. Nevertheless, using data for Chinese commercial banks from 1998 to 2007, Firth, Li, and Wang (2013) show that the financial performance of the Big 4 is not inferior to other banks. Wang et al.'s (2014) findings suggest that SOCBs appear to be overall more efficient than JSCBs, but such an efficiency difference is only seen in the pre-reform period, and is reduced over the post-reform period.

3.2 Reform and bank risk

The traditional structure-conduct-performance (SCP) hypothesis predicts that higher levels of market concentration are likely to lead to an increase in the market power of banks, which allows them to enjoy higher loan rates and lower deposit rates (Fu and Heffernan 2009). A more competitive banking sector resulting from privatization could result in a decline of bank chart value, which encourages bankers to take excessive risks and in turn increases banks' default risk (Keeley 1990). Moreover, private shareholders are likely to engage in higher risk activities so as to maximize the value of the option/share (Boubakri et al. 2005), and to lend recklessly, as they will not bear the entire loss if the bank becomes insolvent (Clarke, Cull,

and Shirley 2005). The entry of foreign ownership will further enhance competition in the banking sector and increase banks' risk. The positive relationship between foreign ownership and bank risk-taking has been confirmed by some empirical studies (e.g., Lee and Hsieh 2014).

Nevertheless, privatization is also likely to change banks' risk-taking behaviour in a favourable way, as new shareholders will be better at monitoring the management of risk-taking (Boubakri et al. 2005). State-owned banks are argued to be associated with high risk due to political interference (Clarke, Cull, and Shirley 2005; Dong et al. 2014), and the privatization of state-owned banks is likely to limit harmful government interference and improve the quality of lending through improved screening (Clarke, Cull, and Shirley 2005). Some empirical evidence shows that state-owned banks tend to have higher default risk than privately owned banks (e.g., Berger et al. 2005; Cornett et al. 2010). Moreover, foreign banks may have a positive influence on the stability of emerging market banking systems, as the entry of foreign investors is accompanied by advanced knowledge, skills and technology, and therefore contributes to an improved control and risk management environment in the domestic banking sector (Crystal, Dages, and Goldberg 2001).

Extant literature on the effect of Chinese banking reforms mainly focuses on performance measures such as efficiency and profitability. Very few studies have investigated the impact of ownership structure on Chinese banks' risk-taking behaviour during the reform process (e.g., Allen et al. 2014; Dong et al. 2014; Jia 2009), and their findings are contradictory. Dong et al. (2014) find that government-controlled banks tend to take more risks than other types of banks due to political intervention and weak risk management practice. Allen et al. (2014), on the other hand, argue that the government can impose non-profit goals via the state-owned banks, such as systemic stability of the financial system, and ensure continued lending in an adverse economic environment. This appears to

be of importance to the overall risk control of Chinese banking system. The authors suggest that the privatization of Chinese state-owned banks via listing on stock exchanges has been successful in improving their performance and risk management.

As can be seen from the above discussion, empirical evidence on the impact of banking reforms in China is insufficient and inconclusive. Moreover, with the exception of Allen et al. (2014), there is a lack of research on the changes in bank performance and risk during and after the global financial crisis. We intend to add more evidence to this under-researched issue, focusing on an examination of how banking reforms in China affect Chinese banks' performance and risk before and after 2005 and incorporating the 2007-2009 financial crisis. This paper, therefore, is intended to extend knowledge of banking reforms in developing economies by providing comprehensive and up-to-date evidence.

4. Methodology

4.1 Data

The data used in this study is mainly collected from the BankScope database. It covers the period of 2000 to 2012, with more than 1,200 observations for a sample of 184 Chinese commercial banks. It includes data for 94 banks during the pre-regulation period (2000-2005) and for 172 banks during the period of 2006 to 2012.

4.2 Model

We apply OLS regressions with clustered standard errors at the bank level to examine the impact of banking reforms in 2005 on Chinese banks' profitability, efficiency and risk-taking, comparing banks with different types of ownership structure. Six bank ownership indicators are used to differentiate Chinese banks, namely, the Big 5, joint-stock commercial banks (JSCBs), city commercial banks (CCBs), rural commercial banks (RCBs), foreign banks and

banks with minority foreign ownership. We also introduce a dummy variable to examine whether listing on stock exchanges impacts bank performance and risk. Furthermore, variables of bank-specific characteristics and macroeconomics are included in the models since they are shown to be the determinants of bank performance and stability by previous studies. The basic regression model is specified as below:

$$\begin{aligned} \text{Bank performance/risk measure} = & \text{Constant} + \beta_1 * \text{banking reform dummy} \\ & + \beta_2 * \text{ownership indicators} \\ & + \beta_3 * \text{bank-specific characteristics} \\ & + \beta_4 * \text{crisis dummy} + \text{Error term} \end{aligned}$$

Where the banking reform dummy is 1 for the years after 2005 and 0 otherwise.

Detailed definitions of the variables used in the model are shown in Table 1.

[Insert Table 1 Here]

4.3 Bank performance measure

Bank efficiency is normally measured by the distance of the financial institutions from a best-practice frontier (Berger and Humphrey 1997; Brissimis, Delis, and Papanikolaou 2008), using various parametric or non-parametric approaches.⁶ One of the most widely used non-parametric methods is data envelopment analysis (DEA), which is based on a linear programming input-output technique and yields a convex production possibility set (Berger and Humphrey 1997; Brissimis, Delis, and Papanikolaou 2008). The advantage of DEA approach is that it does not require the explicit specification of the functional form of the production frontier (Berger and Humphrey 1997). In view of the characteristics of the dataset such as the relatively small number of Chinese banks, the DEA approach is employed in our study to estimate the efficiency score of Chinese banks. It is calculated by three inputs (customer deposits and short-term funding, total costs, and equity capital, to adequately

account for the impact of risk) and three outputs (loans, other earning assets, and non-interest incomes).

We use two measures of bank risk: the ratio of impaired loans to total assets and Z-score. Z-score has been widely used in empirical literature to measure overall bank risk (e.g., Berger, Hasan, and Zhou 2009; Dong et al. 2014; Liu and Wilson 2013; Soedarmono, Machrouh, and Tarazi 2013); it reflects the extent to which banks have enough capital to absorb losses (Liu, Molyneux, and Wilson 2013). The higher the Z-score value, the lower a bank's risk and the greater its stability. In order to capture the dynamics of bank risk, we follow the work of Liu and Wilson (2013), using a three-year rolling window to calculate the standard deviation of return on assets. Because the Z-score is highly skewed (Laeven and Levine 2009, Liu et al. 2013), the natural logarithm of it is used in our models. We also employ the ratio of impaired loans to total assets to measure non-performing loans (NPLs). The NPLs problem is a crucial issue in Chinese banking sector, but has been overlooked by existing studies (Jiang, Yao, and Feng 2013). During the reform process, the Chinese government has taken several steps to help SOCBs clean up deteriorated balance sheets. It would be of interest to see whether the banking reforms have lowered the level of NPLs in China.

Return on assets (ROA) and return on equity (ROE) are commonly used to measure bank profitability. As ROE disregards the greater risks associated with high leverage (low equity), which is determined to some extent by regulation (Athanasoglou, Brissimis, and Delis 2005), ROA is used to measure the profitability of banks in this study.

Figure 1 shows the trend of bank performance over the sample period.

[Insert Figure 1 Here]

We also employ a difference-in-difference approach (DiD) (Meyer 1995; Angrist and Krueger 1999), which is widely used in applied economics to estimate the effect of policy intervention (Athey and Imbens 2006). DiD estimation identifies a specific intervention or treatment, and then compares the difference in outcomes before and after the intervention for groups affected by the intervention with the corresponding difference for unaffected groups (Bertrand, Duflo, and Mullainathan 2004). It has the potential to circumvent many of the endogeneity problems that typically arise when making comparisons between heterogeneous individuals (Bertrand, Duflo, and Mullainathan 2004; Meyer 1995). We use the year 2005 as the intervention and the Big 5 as the affected group, because some radical reform measures adopted in 2005 mainly applied to the privatization of SOCBs (see discussion in Section 2).

4.4 Other control variables

We consider a range of bank-specific characteristics that are likely to affect bank performance and risk, including market power of banks, bank size, cost ratio, diversification and liquidity.

The previous literature has shown that competition can affect banks' risk-taking, although the sign of the relationship is not agreed upon. One school of thought, which is well-known as "competition-fragility", argues that an increase in competition encourages excessive risk-taking and a reduction in capital, thereby increasing the risk of bank failure (Keeley 1990). On the other hand, the "competition-stability" view argues that declined competition induces banks to offer loans at high rates and therefore increases the bankruptcy risk for bank borrowers, which in turn increases the risk of banks through risk-shifting mechanisms in the overall market (Soedarmono, Machrouh, and Tarazi 2013). Studies such as Boyd, De Nicoló, and Jalal (2006) and Soedarmono, Machrouh, and Tarazi (2013) provide empirical evidence in support of the competition-stability view. More recent literature finds

that the link between competition and bank risk is more complicated than a linear positive or negative relationship (e.g., Liu, Molyneux, and Wilson 2013).

Considering the aforementioned literature, we incorporate a proxy of bank competition in our investigation. Following Liu and Wilson (2013), we use the Lerner index to measure the market power of banks. The higher the Lerner index value, the more market power a bank has and the lower the level of competition it faces.

Bank size is likely to affect bank profitability, but the direction of influence tends to be ambiguous. Large banks have a competitive edge due to economies of scale and therefore tend to be more profitable (e.g., Goddard, Molyneux, and Wilson 2004). However, large size may be related to an aggressive growth strategy and may make it hard to manage the bank (García-Herrero, Gavilá, and Santabárbara 2009). Likewise, literature on the risk effect of bank size offers contradictory suggestions. Larger banks are likely to be more stable than smaller banks due to the benefits of economies of scale and market power (Berger 1995), but they may have an incentive to increase their risk of operations (O'Hara and Shaw 1990).

Cost-to-income (CI) ratio is expected to be negatively related to bank profitability and efficiency, and positively related to bank risk (e.g., Liu and Wilson 2010, 2013; Berger 1995). If managers choose less profitable assets and high-cost liabilities, profitability should decrease with a high cost ratio, thereby leading to low managerial efficiency and encouraging banks to take on more risk in order to increase returns (Boyd, De Nicoló, and Jalal 2006; Liu and Wilson 2013). Nevertheless, profits would decrease if banks with higher operational efficiency pass the low cost on to their customers in the form of lower loan rates and/or higher deposit rates (Liu and Wilson 2010).

Diversification is argued to be associated with improved bank performance via economies of scale and scope, as well as the reduction of idiosyncratic risk (Stiroh 2010). However, Laeven and Levine's (2009) study suggests that volatile revenue streams generated

from less traditional financial activities may offset the positive risk-spreading benefits of diversification. Liu and Wilson (2013) find that diversified banks in Japan tend to be riskier than their focused counterparts.

Bank liquidity may impact positively on bank profitability and efficiency, while impacting negatively on bank risk. Banks with a lower level of liquidity tend to carry more risk because they are more likely to make a fire-sale of their assets to meet demand for liquidity (Liu and Wilson 2010). However, Berger et al. (2005) claim that bank liquidity is affected to varying degrees by characteristics such as size and market power.

We also include several macro environmental variables. The first is inflation. Liu and Wilson (2013) argue that higher inflation is likely to adversely affect the soundness of financial systems by distorting decision-making, exacerbating information asymmetry and introducing price volatility. GDP growth (GDPG) is another important determinant of bank performance. Liu and Wilson (2010) suggest that high economic growth improves business environment and lowers bank entry barriers, which may dampen banks' profitability. With regard to bank risk, improved economic conditions provide banks with more investment opportunities. As a result, banks may have incentives to take on riskier investment projects (Liu and Wilson 2013).

We introduce a dummy variable to capture the impact of the 2007-2009 financial crisis on Chinese banks' performance. Research shows that the performance of banks in some developed countries is negatively affected by adverse economic conditions (e.g., Kanas, Vasiliou, and Eriotis 2012). Compared with banks in developed countries, banks in China were much more conservative in derivatives investment and therefore were less influenced by the crisis (Luo et al. 2011). State-ownership may be also an advantage during the financial crisis (Liu 2009; Allen et al. 2014). Liu (2009) argues that the health of the Chinese banking sector during the financial crisis was largely due to the government's involvement of setting

strict restrictions on financial institutions from avoiding inferior investments and cutting interest rates so as to encourage banks to expand lending. Allen et al. (2014) suggest that government ownership of Chinese banks enabled better enforcement of some non-profit goals (e.g., systemic stability and continued lending activity) in state-owned banks than in private banks during the recession and crisis period.

4.5 Summary statistics and correlation

The summary statistics for the dependent and independent variables for all sample banks and univariate tests of differences between pre-regulation and post-regulation periods are shown in Table 2.

[Insert Table 2 Here]

The table shows that there were 94 banks in China during the pre-reform period (2000-2005); this increased to 172 during the post-reform period (2006-2012), indicating that banking reforms in 2005 and afterwards allowed more newly established domestic and foreign banks to enter the sector, thereby boosting the level of competition. The ratio of mean Impaired Loans/TA is significantly higher before 2005 (5.20) than after (1.09), suggesting that there was a decline in the level of NPLs in Chinese banks after the 2005 banking reforms. The overall profitability of Chinese banks as measured by ROA appears to have improved after 2005, as the mean ROA increases from 0.49 to 1.02.

As for bank specific characteristics, the mean value of the Lerner index increases after regulation change in 2005 (from 30.44 to 40.33). This may suggest that state-owned banks gained more market power after the 2005 financial reform, and appears to be consistent with Fungáčová, Pessarossib, and Weilla (2013), who also find that the mean Lerner index increases in the Chinese banking industry over the period of 2002 to 2011.

We also observe that the mean values of both cost-to-income ratio and liquidity decrease after 2005, suggesting that Chinese banks in general have improved operational efficiency but lowered their level of liquidity during the post-reform period.

Table 3 reports the correlation matrix among all variables.

[Insert Table 3 Here]

5. Empirical results

5.1 Main results

We first examine the impact of the 2005 banking reforms on bank performance measures by comparing the Big 5 with non-Big 5 banks.⁷ Dummy variables for banks with foreign minority ownership and listing on stock exchanges are also included in the regression model to assess whether the strategy of encouraging foreign investments and public listing significantly affected bank performance. Table 4 provides the baseline regression results.

[Insert Table 4 Here]

The coefficient on the post-2005 dummy variable is statistically significant at the 1% level in all models, suggesting that the banking reforms in 2005 significantly affected Chinese banks' profitability, efficiency and risk. Chinese banks in general tend to have improved profitability as measured by ROA, higher equity levels and lower risk as measured by both NPLs and Z-score after 2005. Deng, Guo, and Kong (2011) observe that the overall profitability of Chinese banks over the 2001-2007 period improved, due to the presence of foreign banks. Our results show that the profitability for Chinese banks went up and stayed up after the banking reform in 2005. This provides further evidence supporting the strategies of attracting foreign investment and privatizing SOCBs to improve the profitability of Chinese banks in general.

However, the efficiency of Chinese banks appears to decline significantly after 2005, indicating that the privatization and foreign investment strategies did not achieve the objective of improving the overall efficiency of Chinese banks. Similar findings are reported by Fu and Huffernan (2009) for Chinese banks during earlier reform periods. They argue that state lending policies and a lack of clarity about bankruptcy procedures contributed to rising amounts of bad debt, thereby resulting in inefficient reform from 1985-2002. Our results suggest that despite the radical reform measures adopted after 2005, the above problem seems to have persisted within the Chinese banking sector, and the overall efficiency level of Chinese banks failed to improve.

Regarding ownership structure, it is noteworthy that banks with foreign minority ownership became more efficient and less risky than other banks. This is consistent with Berger, Hasan, and Zhou (2009), who argue that minority foreign ownership may increase Chinese bank efficiency through improving corporate governance, technological advancement and risk management. We also find that public listing is associated with higher profitability, greater equity level and lower risk as measured by Z-score, supporting the argument that listing on stock exchanges can substantially reduce the adverse effects of government ownership (Allen et al. 2014).

We then conduct bank performance analysis prior to and after 2005 by comparing joint-stock, foreign, city and rural banks with the Big 5. Table 5 presents the results of the analysis.

[Insert Table 5 Here]

Findings related to the post-2005 dummy variable, banks with foreign minority ownership and public listing are consistent with previous analysis. There is no significant difference in the efficiency levels of Big 5 banks and joint-stock banks, foreign banks, city

banks and rural banks. The Big 5 appear to be more profitable than joint-stock banks, but no difference is observed compared with other types of banks in terms of ROA. Our findings contradict some previous empirical studies on Chinese banks (e.g., Lin and Zhang 2009; Ariff and Can 2008), which observe a lower efficiency level for SOCBs than for other types of banks. Although the Big 5 are adversely affected by government intervention, they may benefit from government support (e.g., capital injection and non-performing loan removal) and scale economies. After accepting strategic foreign investment and listing on stock exchanges, the adverse impact of government intervention appears to be reduced. This may partially explain why the Big 5 are not inferior to other banks in terms of their profitability and efficiency.

With regard to risk, the Big 5 appear to have a higher risk than joint-stock, foreign and city banks when risk is measured by NPLs during the entire study period. NPLs have been one of the most significant problems for Chinese banks, especially SOCBs. The total amount of NPLs within the Chinese banking sector was about 20-23% of GDP in 2000 and 2001, which is much higher than in other large economies (Allen et al. 2014). Although steps have been taken to reduce the level of non-performing loans in state-owned banks (e.g., the establishment of AMC's in 1999), the Big 5 tend to behave less prudently in lending due to political intervention and low levels of accountability. The problem is more pronounced in rural commercial banks, as government intervention tends to be even stronger in rural China. Therefore, it is not surprising that rural commercial banks perform the worst in the abovementioned risk measure compared with other banks.

However, the Big 5 tend to outperform joint-stock and city commercial banks in their overall risk level as measured by Z-score, suggesting that the Big 5 have more capital to absorb losses compared with joint-stock and city commercial banks. This can also be seen from the coefficient on the variable of equity to total asset.

We also observe that the dummy variable of the 2007-09 financial crisis is negatively related to Z-score and efficiency, indicating that Chinese banks experienced higher levels of overall risk and lower levels of efficiency during the period of the 2007-09 financial crisis than they did in non-crisis periods. During the financial crisis, the Chinese government cut interest rates twice and stimulated banks to expand their lending activities (Liu 2009), resulting in a large amount of bad debts in Chinese domestic banks, especially state-owned banks as they made most of the loans during the crisis. This may have worsened the overall risk level of Chinese banks. However, the increase in loans issued may have enhanced banks' capacity to earn more in the market and therefore resulted in higher levels of profitability (Khan et al. 2011). This is confirmed by the positive relationship between the 2007-09 financial crisis dummy and the ROA in both models.

With regard to control variables, one notable observation is the impact of competition on bank performance and stability. We observe that, in both the two models, the Lerner index has a significant negative impact on NPLs and significant positive impacts on Z-score, ROA and the efficiency measure. This suggests that the more market power a bank has, the more profitable, more efficient and less risky it is. These results support the “competition-fragility” view, and also provide evidence on the relation between competition and efficiency in the Chinese context where only a few empirical studies being conducted (e.g., Fu and Heffernan, 2009; Fungáčová et al. 2013).

5.2 Difference-in-Difference approach analysis

The year 2005 is considered an exogenous shock after which more radical reform measures were adopted to accelerate the privatization of state-owned banks. We therefore expect the impact of the 2005 banking reforms on bank performance to be higher for the Big 5 than for their counterparts. To investigate this difference, we employ a difference-in-difference

approach, where the Big 5 are defined as the treatment group, and all other banks are defined as the control group. To account for time trends unrelated to the intervention, the change experienced by the treatment group is adjusted by the change experienced by the control group (Athey and Imbens 2006). We introduce a new variable $Post*Big\ 5$, which is the cross product of the two dummy variables of $Post-2005$ and $Big\ 5$. The coefficient of this interaction term is the key interest of this analysis. It represents the difference in the difference in outcome measures between the Big 5 and other banks before and after the 2005 banking reform. Results of the DiD analysis are reported in Table 6.

[Insert Table 6 Here]

The interaction term $Post*Big\ 5$ is negatively related to the ratio of impaired loans to assets. It suggests that although the Big 5 have higher risk as measured by NPLs than other non-state-owned banks during the entire time period of 2000-2012 (as discussed above), their level of NPLs tends to be reduced after the 2005 banking reforms. This could be a consequence of both government intervention and privatization of SOCBs. After first transferring NPLs to AMCs in 1999, additional transfers eventually brought the total NPLs of nearly 3.6 trillion yuan (\$566 billion) off the SOCBs to the AMCs (Martin 2012). In addition, the involvement of foreign investors and public listing in 2005 helped the SOCBs to strengthen their corporate governance and risk management, thereby making their lending activities more prudent. Our findings suggest that, as long as the government remain the controlling shareholder of the SOCBs, attracting strategic foreign investors and going public can help state-owned banks to better deal with the problem of NPLs.

The interaction term $Post*Big\ 5$ is also negatively related to the Z-score and the equity to asset ratio, indicating that the differences in bank stability and equity ratio between Big 5 and other banks also decreased after the 2005 banking reforms. These results confirm

the impact of banking reform on bank outcome, as we observe reduced differences across different outcome measures between Big 5 and other more privatized banks after the banking reforms.

6. Conclusion

Over the past several decades, the Chinese banking sector has undergone significant reforms. The year 2005 is remarkable in the process of reform; this year saw the adoption of some radical reform measures, such as significant liberalization to foreign ownership, listing on stock exchanges and other strategies. This paper aims to investigate the impact of banking reforms in 2005 on Chinese banks' profitability, efficiency and risk, comparing banks with different ownership structures. It also takes into consideration the 2007-2009 financial crisis.

Our results suggest that Chinese banks in general have improved their profitability and lowered their risk, but have also lowered their efficiency during the post-2005 period. It implies that the steps taken in Chinese banking reform since 2005 appear to be the right direction in terms of making banks more profitable and less risky, but that further reforms should be adopted to improve bank efficiency.

We also provide evidence on the difference in performance and risk of Chinese banks with different ownership structures, showing that the Big 5 state-owned banks are not inferior to other types of banks in profitability and efficiency. One interesting finding is although the Big 5 underperform other banks in terms of the level of NPLs during the entire study period, they appear to perform better than their competitors over the post-reform period. This suggests that the "Chinese model" of banking reform can help improve risk management for state-owned banks. Compared with other developing countries, the Chinese banking sector is experiencing more gradual reform. Even with the accelerated privatization of state-owned banks, the Chinese government remains the majority controlling shareholder for the Big 5.

By attracting strategic foreign investors and going public, state-owned banks are better able to deal with their NPL problems and improve risk management. In addition, such a model appears to work well in maintaining Chinese banks' profitability during financial crisis, though they might be riskier because of government intervention. Consistent with some previous studies (e.g., Allen et al. 2014), our results provide supporting evidence of the positive effects of the ongoing banking reforms in China and offer important suggestions for policy makers in China and other developing countries.

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Figure 1

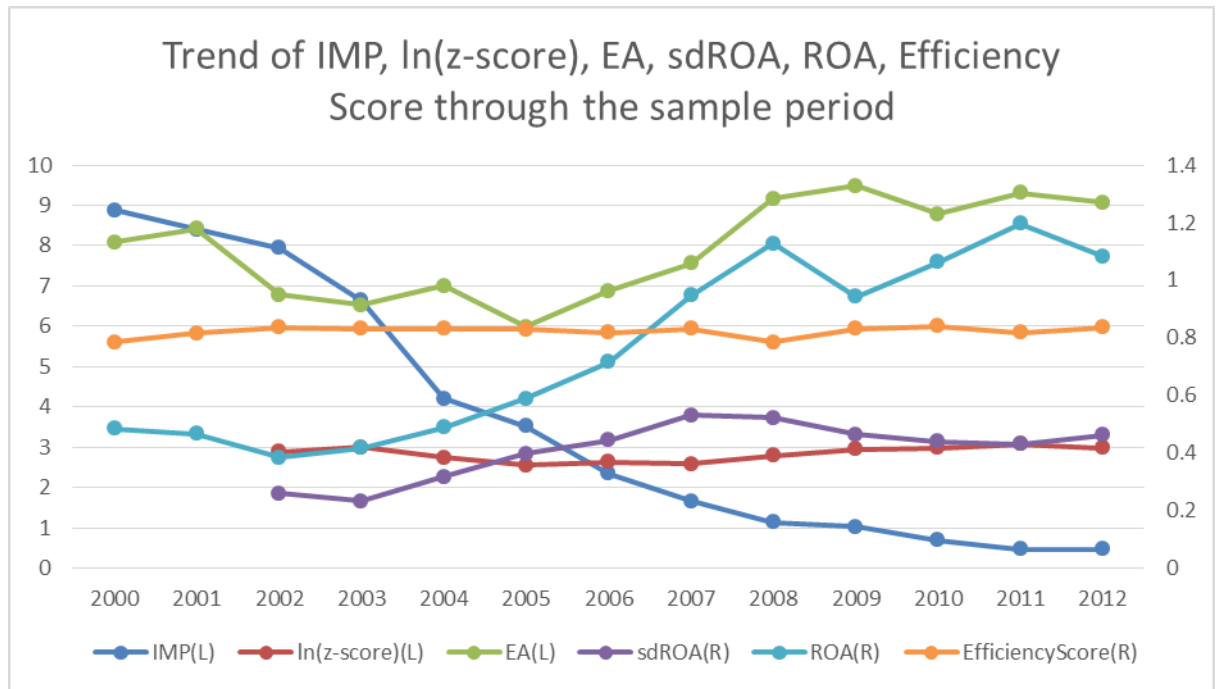


Table 1. Definition of Variables

Variable	Definition
<i>Bank performance variables</i>	
Impaired loans to total assets	The ratio of impaired loans to total assets.
ln(z-score)	Logarithm of Z-score. A measure of how many standard deviations a bank is away from exhausting its capital base. A higher value indicates higher overall bank stability. It is calculated at the three-year rolling time window.
Equity to assets	The ratio of bank equity to total assets
Return on assets	The ratio of bank net income after tax to total assets
Standard deviation of ROA	The standard deviation of return on assets, calculated at the three-year rolling time window.
Efficiency	Efficiency score is calculated from the DEA model, with three inputs (customer deposits and short-term funding, total costs, and equity capital, to adequately account for the impact of risk) and three outputs (loans, other earning assets, and non-interest incomes).
<i>Ownership indicators</i>	
Big 5	A dummy variable that equals 1 if the bank is one of the biggest five state-owned commercial banks and 0 otherwise.
Joint	A dummy variable that equals 1 if the bank is a joint-stock commercial bank and 0 otherwise.
City	A dummy variable that equals 1 if the bank is a city commercial bank and 0 otherwise.
Rural	A dummy variable that equals 1 if the bank is a rural commercial bank and 0 otherwise.
Foreign	A dummy variable that equals 1 if the bank is a foreign bank and 0 otherwise.
Foreign minority	A dummy variable that equals 1 as from the year a bank has foreign minority ownership and 0 otherwise
List	A dummy variable that equals 1 if the bank is publicly listed on a stock exchange and 0 otherwise.
<i>Bank-specific characteristics</i>	
Size	The natural logarithm of total assets.
Lerner	The Lerner index measuring the mark-up of price over marginal costs. The higher the value, the more market power the bank has.
Diversification	The ratio of non-interest income to total operating income.
Cost to income ratio	The ratio of operating expenses over operating income.
Liquidity	The ratio of the sum of cash and for-sale securities to total assets.
<i>Other variables</i>	
2007-09 financial crisis	A dummy variable for the 2007-09 global financial crisis that equals 1 for the years 2007 to 2009 and 0 otherwise.
GDP growth	Real GDP growth – the percentage change of real GDP.
Inflation	Inflation ratio – the percentage change of Consumer Price Index.

Table 2**Summary Statistics for All Sample Banks and Univariate Tests of Differences between Pre-Reform and Post-Reform Periods**

Variable	Full Sample			Before Regulation Change			After Regulation Change			Difference in Means	
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD	(abs)	p-value
Dependent Variables											
Impaired loans/TA	1.81	0.75	2.86	5.20	3.97	4.30	1.09	0.56	1.74	4.11	0.00
Ln(Z-score)*	2.84	2.76	0.57	2.76	2.66	0.71	2.87	2.78	0.53	-0.11	0.01
standard deviation	0.44	0.44	0.08	0.32	0.32	0.07	0.47	0.46	0.04	-0.15	0.00
ROA	0.88	0.90	0.51	0.49	0.41	0.35	1.02	1.07	0.49	-0.53	0.00
Equity/TA	8.19	6.02	7.77	6.91	4.30	9.11	8.64	6.40	7.20	-1.73	0.00
Efficiency	0.82	0.82	0.11	0.83	0.83	0.10	0.82	0.82	0.11	0.00	0.87
Independent Variables											
Lerner	37.79	40.33	11.93	30.44	31.44	11.46	40.33	42.34	11.01	-9.90	0.00
Size	10.83	10.64	1.97	10.55	10.15	2.18	10.93	10.80	1.88	-0.38	0.00
Cost-to-income ratio	44.61	40.26	16.16	54.04	50.10	15.97	41.34	37.98	14.90	12.70	0.00
Diversification	15.55	11.34	13.81	17.26	11.21	15.52	14.96	11.36	13.13	2.30	0.01
Liquidity	12.36	10.71	9.86	16.72	17.25	9.69	10.85	8.13	9.47	5.87	0.00
GDP growth	10.29	9.60	1.87	9.87	10.00	1.08	10.43	9.60	2.05	-0.56	0.00
Inflation	4.65	3.93	2.98	3.44	2.61	2.05	5.07	6.68	3.13	-1.63	0.00
Dummy Variables											
Big 5	0.04	0.00	0.20	0.08	0.00	0.27	0.03	0.00	0.17	0.05	0.00
Joint	0.12	0.00	0.33	0.19	0.00	0.39	0.10	0.00	0.30	0.09	0.00
Foreign	0.12	0.00	0.33	0.06	0.00	0.23	0.15	0.00	0.36	-0.09	0.00
City	0.71	1.00	0.45	0.68	1.00	0.47	0.72	1.00	0.45	-0.04	0.20
Listed	0.17	0.00	0.38	0.29	0.00	0.46	0.13	0.00	0.34	0.16	0.00
Foreign minority	0.27	0.00	0.45	0.13	0.00	0.33	0.32	0.00	0.47	-0.20	0.00
2007-09 financial crisis	0.31	0.00	0.46	0.00	0.00	0.00	0.42	0.00	0.49	-0.42	0.00
Observations	1206			310			896				

Note: This table presents descriptive statistics for: (i) all sample banks (184 banks); (ii) the pre-reform period (2000-2005) (94 banks); and (iii) the post-reform period (2006-2012) (172 banks). Mean, Median and SD stand for the cross-sectional mean, median and standard deviation values of the individual bank time-series averages, respectively. The last two columns report the comparison analysis of dependent and control variables between pre- and post-reform periods. Difference in means is calculated as the difference between two periods' means in absolute (abs) values, with the p-values of the t-test on the equality of means reported in the last column.

*The mean values of Z-score for the full sample, before regulation change and after regulation change are 17.12, 15.80 and 17.64, respectively, showing that the overall risk measured by Z-score increases by 1.84 during the post-reform period.

Table 3

Correlation Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1)ROA																	
(2)ln(Z-score)	0.198***																
(3)Efficiency	-0.025	0.026															
(4)Post-2005	0.452***	0.290***	-0.005														
(5)Lerner	0.645***	-0.061**	0.165***	0.363***													
(6)Size	0.013	0.254***	0.388***	0.085***	0.332***												
(7)Cost-to-income ratio	0.646***	0.051*	0.092***	0.344***	0.846***	0.221***											
(8)Diversification	0.076***	0.041	0.104***	-0.073**	0.201***	0.108***	0.188***										
(9)Liquidity	0.154***	0.195***	0.295***	0.260***	-0.043	0.042	0.083***	0.124***									
(10)GDPGrowth	-0.067**	0.137***	0.022	0.132***	0.084***	0.176***	0.123***	-0.065**	-0.010								
(11)Inflation	0.209***	0.046	-0.044	0.240***	0.169***	-0.022	0.190***	-0.040	-0.068**	0.404***							
(12)Big 5	-0.045	0.134***	0.290***	0.099***	0.135***	0.498***	-0.016	0.012	0.033	-0.029	-0.041						
(13)Joint	0.142***	0.159***	0.228***	0.114***	0.021	0.441***	-0.010	0.105***	0.103***	-0.029	-0.043	0.080***					
(14)Foreign	0.113***	0.379***	0.063**	0.124***	0.320***	0.250***	0.317***	0.184**	0.198***	-0.074**	0.011	0.080***	0.142***				
(15)City	0.205***	0.097***	0.341***	0.037	0.156***	0.361***	0.216***	-0.062**	0.203***	0.087***	0.041	0.331***	0.586***	0.588***			
(16)List	0.075***	0.187***	0.373***	0.187***	0.150***	0.643***	0.076***	0.106***	0.004	-0.060*	0.080***	0.468***	0.573***	0.171***	0.500***		
(17)Foreign minority	-0.046	0.231***	0.253***	0.194***	0.103***	0.172***	0.089***	0.042	-0.207	-0.031	0.037	0.081***	0.200***	0.615***	0.628***	0.251***	
(18)2007-09 financial crisis	0.159***	0.076***	-0.042	0.397***	0.098***	-0.072	0.101***	-0.050*	0.139***	0.280***	0.054*	-0.038	-0.042	0.043	0.016	-0.074**	0.083***

Table 4 Bank Performance Analysis Prior to and After China's Banking Reforms in 2005, Comparing Big 5 and non-Big 5 banks

	(1)	(2)	(3)	(4)	(5)	(6)
	Impaired loan/TA	ln Z-score	Std. Dev. ROA	ROA	Equity/TA	Efficiency
Post-2005	-3.268*** (-7.785)	0.218*** (3.932)	0.114*** (41.482)	0.267*** (7.447)	3.811*** (5.129)	-0.034*** (-3.207)
Big 5	3.101*** (3.985)	0.607*** (4.522)	-0.002 (-0.738)	0.101* (1.774)	8.548*** (5.315)	0.028 (1.251)
Size	0.092 (0.730)	-0.241*** (-9.718)	0.002*** (3.261)	-0.078*** (-7.671)	-3.323*** (-6.482)	0.016*** (3.276)
List	0.023 (0.045)	0.255*** (2.604)	-0.016*** (-5.751)	0.094* (1.861)	4.538*** (2.849)	0.024 (1.357)
Foreign minority	-1.244*** (-4.270)	0.305*** (6.010)	0.008*** (4.132)	-0.024 (-0.698)	3.440*** (5.554)	0.036*** (3.989)
2007-09 financial crisis	0.095 (0.742)	-0.160*** (-6.084)	0.059*** (101.336)	0.062*** (2.698)	-0.746** (-2.059)	-0.014*** (-2.655)
Lerner _{t-1}	-0.060*** (-3.751)	0.012*** (4.317)	-0.000** (-2.156)	0.017*** (7.836)	0.096** (2.061)	0.002*** (3.486)
Cost-to-income ratio _{t-1}	-0.001 (-0.110)	0.008*** (3.565)	-0.001*** (-5.222)	-0.010*** (-6.249)	0.116*** (3.296)	0.001 (1.425)
Diversification _{t-1}	0.002 (0.193)	0.000 (0.281)	-0.000 (-0.555)	0.002* (1.909)	0.010 (0.564)	0.002*** (5.069)
Liquidity _{t-1}	0.002 (0.230)	-0.006*** (-2.715)	-0.000*** (-4.750)	-0.002 (-1.347)	-0.132*** (-3.981)	-0.004*** (-8.956)
GDP growth _{t-1}	0.199*** (3.896)	-0.114*** (-13.846)	0.005*** (16.909)	-0.079*** (-10.875)	-0.950*** (-9.255)	0.009*** (5.252)
Inflation _{t-1}	-0.084*** (-5.110)	0.009*** (2.866)	0.003*** (24.109)	0.025*** (7.700)	0.153*** (3.447)	-0.004*** (-5.407)
Constant	6.895*** (3.553)	3.962*** (12.116)	0.371*** (30.132)	1.057*** (5.480)	28.968*** (4.783)	0.608*** (9.445)
Obs.	912	1135	1135	1206	1206	1195
adj. R-sq	0.402	0.397	0.794	0.537	0.475	0.340

Notes: This table reports the evidence of the impact of banking reforms in 2005 on banks' performance and risk in China, comparing Big 5 state-owned banks with non-state-owned banks. The dependent variables are impaired loans to total assets ratio, logarithm of Z-score (rolling at the three-year window) and its three components, i.e., return on assets (ROA), standard deviation of ROA (rolling at three-year window) and Equity/TA ratio, and Efficiency Score. T-statistics are based on standard errors clustered at the bank level, where *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively. Check Table 1 for detailed definitions of variables.

**Table 5 Bank Performance Analysis Prior to and After China's Banking Reforms in 2005
Comparing Joint, Foreign, City and Rural Bank with the Big 5**

	(1)	(2)	(3)	(4)	(5)	(6)
	Impaired loan/TA	ln Z-score	Std. Dev. ROA	ROA	Equity/TA	Efficiency
Post-2005	-3.220*** (-7.894)	0.200*** (3.782)	0.113*** (41.570)	0.263*** (7.444)	3.958*** (5.500)	-0.036*** (-3.347)
Joint	-3.314*** (-4.013)	-0.552*** (-3.746)	0.001 (0.311)	-0.133** (-2.405)	-7.806*** (-4.928)	-0.024 (-1.136)
Foreign	-4.425*** (-3.874)	-0.215 (-1.039)	0.005 (0.831)	-0.098 (-1.164)	-8.060** (-2.358)	0.010 (0.246)
City	-3.751*** (-4.194)	-0.576*** (-3.458)	0.004 (1.161)	-0.059 (-0.862)	-10.902*** (-4.537)	-0.015 (-0.466)
Rural	0.908** (2.109)	-0.015 (-0.282)	0.004** (2.160)	0.104* (1.701)	0.231 (0.320)	-0.004 (-0.413)
Size	-0.010 (-0.073)	-0.225*** (-7.291)	0.002*** (3.091)	-0.079*** (-6.953)	-3.420*** (-5.595)	0.018*** (3.053)
List	-0.133 (-0.233)	0.303*** (3.977)	-0.014*** (-4.677)	0.141*** (2.972)	3.533*** (3.011)	0.032 (1.506)
Foreign minority	-0.825* (-1.875)	0.129** (2.327)	0.009*** (2.935)	0.011 (0.221)	2.053*** (3.347)	0.024** (2.221)
2007-09 financial crisis	0.062 (0.476)	-0.153*** (-5.759)	0.059*** (99.447)	0.062*** (2.702)	-0.740** (-1.979)	-0.013** (-2.513)
Lerner _{t-1}	-0.066*** (-4.199)	0.012*** (4.178)	-0.000** (-2.391)	0.016*** (7.533)	0.096** (2.001)	0.002*** (3.364)
Cost-to-income ratio _{t-1}	-0.001 (-0.115)	0.006*** (2.640)	-0.001*** (-5.094)	-0.010*** (-6.428)	0.099*** (2.663)	0.001 (1.208)
Diversification _{t-1}	0.004 (0.404)	-0.000 (-0.355)	-0.000 (-0.471)	0.002** (2.088)	0.005 (0.273)	0.002*** (4.865)
Liquidity _{t-1}	0.005 (0.602)	-0.005** (-2.255)	-0.000*** (-4.617)	-0.002 (-1.356)	-0.111*** (-3.351)	-0.004*** (-8.857)
GDP growth _{t-1}	0.179*** (3.567)	-0.108*** (-12.588)	0.005*** (16.588)	-0.079*** (-10.767)	-0.951*** (-8.071)	0.010*** (5.209)
Inflation _{t-1}	-0.081*** (-5.240)	0.007** (2.434)	0.003*** (23.698)	0.025*** (7.657)	0.148*** (3.171)	-0.004*** (-5.409)
Constant	12.026*** (5.316)	4.218*** (8.863)	0.384*** (25.558)	0.982*** (3.978)	38.873*** (4.489)	0.632*** (7.062)
Obs.	912	1135	1135	1206	1206	1195
adj. R-sq	0.414	0.426	0.794	0.543	0.487	0.340

Notes: This table reports the results of the impact of banking reforms in 2005 on banks' performance and risk in China, comparing joint, foreign, city and rural commercial banks with Big 5 state-owned banks. The dependent variables are the ratio of impaired loans to total assets, the logarithm of Z-score (rolling at three-year window) and its three components, i.e., return on assets (ROA), standard deviation of ROA (rolling at three-year window) and Equity/TA ratio, and Efficiency Score. T-statistics are based on standard errors clustered at the bank level, where *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively. Check Table 1 for detailed definitions of variables.

Table 6 Dif-in-Dif Analysis of Bank Performance Prior to and After China's Banking Reforms in 2005

	(1)	(2)	(3)	(4)	(5)	(6)
	Impaired loan/TA	ln Z- score	Std. Dev. ROA	ROA	Equity/TA	Efficiency
Post-2005	-2.961*** (-6.846)	0.231*** (4.077)	0.113*** (39.619)	0.261*** (7.144)	3.935*** (5.213)	-0.033*** (-3.059)
Big 5	5.253*** (3.643)	0.771*** (4.046)	-0.009*** (-3.156)	0.034 (0.488)	9.931*** (5.115)	0.039 (1.336)
Post*Big 5	-3.776*** (-2.988)	-0.255** (-2.056)	0.012*** (3.980)	0.125 (1.485)	-2.551** (-2.007)	-0.020 (-1.047)
Size	0.084 (0.663)	-0.242*** (-9.724)	0.002*** (3.279)	-0.078*** (-7.639)	-3.328*** (-6.486)	0.016*** (3.266)
List	0.070 (0.136)	0.256*** (2.610)	-0.016*** (-5.766)	0.093* (1.834)	4.558*** (2.856)	0.024 (1.366)
Foreign minority	-1.135*** (-4.129)	0.310*** (6.094)	0.008*** (4.060)	-0.028 (-0.794)	3.509*** (5.632)	0.037*** (3.992)
2007-09 financial crisis	0.079 (0.617)	-0.160*** (-6.090)	0.059*** (101.529)	0.063*** (2.705)	-0.749** (-2.066)	-0.014*** (-2.658)
Lerner _{t-1}	-0.056*** (-3.630)	0.012*** (4.303)	-0.000** (-2.145)	0.017*** (7.806)	0.098** (2.094)	0.002*** (3.501)
Cost-to-income ratio _{t-1}	-0.001 (-0.040)	0.008*** (3.522)	-0.000*** (-5.166)	-0.010*** (-6.256)	0.116*** (3.289)	0.001 (1.426)
Diversification _{t-1}	0.004 (0.441)	0.000 (0.355)	-0.000 (-0.620)	0.002* (1.812)	0.012 (0.647)	0.002*** (5.125)
Liquidity _{t-1}	0.000 (0.046)	-0.006*** (-2.726)	-0.000*** (-4.692)	-0.002 (-1.341)	-0.132*** (-3.984)	-0.004*** (-8.956)
GDP growth _{t-1}	0.209*** (4.246)	-0.114*** (-13.759)	0.005*** (16.877)	-0.079*** (-10.925)	-0.947*** (-9.179)	0.009*** (5.256)
Inflation _{t-1}	-0.083*** (-5.031)	0.009*** (2.867)	0.003*** (24.092)	0.025*** (7.697)	0.153*** (3.444)	-0.004*** (-5.407)
Constant	6.525*** (3.388)	3.958*** (12.084)	0.371*** (30.074)	1.062*** (5.513)	28.837*** (4.747)	0.607*** (9.415)
Obs.	912	1135	1135	1206	1206	1195
adj. R-sq	0.420	0.399	0.794	0.537	0.476	0.340

Notes: We consider China's banking reforms in 2005 as an exogenous shock and employ a difference-in-difference approach (Meyer 1995; Angrist and Krueger 1999) to study the causal effects of banking reforms in 2005 on bank performance and risk. The Big 5 state-owned banks are defined as the treatment group, while all other non-state-owned banks are defined as the control group. The third dummy variable reported in the table, Post*Big 5, is the cross product of the two dummy variables of post-reform and Big 5. The dependent variables are the ratio of impaired loans to total assets, logarithm of Z-score (rolling at three-year window) and its three components, i.e., return on assets (ROA), standard deviation of ROA (rolling at three-year window) and Equity/TA ratio, and Efficiency Score. T-statistics are based on standard errors clustered at the bank level, where *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively. Check Table 1 for detailed definitions of variables.

Appendix Bank Performance Analysis Prior to and After China's Banking Reforms in 2005

	Fixed effects						Random Effects					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Impaired loan/TA	ln Z-score	Std. Dev. ROA	ROA	Equity/TA	Efficiency	Impaired loan/TA	ln Z-score	Std. Dev. ROA	ROA	Equity/TA	Efficiency
Post-2005	-1.761*** (-3.665)	0.141** (2.481)	0.077*** (16.362)	0.254*** (5.582)	2.568*** (3.692)	-0.060*** (-5.791)	-2.526*** (-6.870)	0.170*** (3.794)	0.114*** (41.684)	0.281*** (8.779)	2.903*** (5.861)	-0.040*** (-4.517)
Size	-0.403 (-1.407)	-0.188*** (-3.308)	0.017*** (6.814)	0.000 (0.007)	-2.440*** (-2.903)	0.039*** (5.038)	-0.030 (-0.197)	-0.214*** (-7.460)	0.002*** (3.398)	-0.056*** (-4.908)	-2.741*** (-5.068)	0.023*** (5.316)
Foreign minority	-2.308** (-2.520)	0.078 (0.887)	0.039*** (4.624)	-0.046 (-0.678)	1.991** (2.419)	0.005 (0.368)	-1.973*** (-4.049)	0.222*** (3.911)	0.008*** (4.148)	-0.029 (-0.774)	2.982*** (5.125)	0.023** (2.307)
2007-09 financial Crisis	-0.086 (-0.573)	-0.126*** (-4.396)	0.064*** (55.406)	0.081*** (3.542)	-0.065 (-0.165)	-0.009** (-1.993)	0.042 (0.347)	-0.144*** (-6.228)	0.059*** (101.717)	0.066*** (3.089)	-0.284 (-0.888)	-0.014*** (-3.049)
Lerner _{t-1}	-0.066*** (-2.995)	0.014*** (4.424)	-0.001* (-1.870)	0.012*** (4.542)	0.157*** (3.183)	0.003*** (5.694)	-0.061*** (-3.512)	0.014*** (5.566)	-0.000** (-2.268)	0.014*** (7.100)	0.154*** (3.479)	0.003*** (5.242)
Cost-to-income ratio _{t-1}	0.012 (0.654)	0.004 (1.386)	-0.001*** (-4.577)	-0.011*** (-3.847)	0.087*** (2.976)	0.001*** (2.790)	0.011 (0.809)	0.007*** (2.826)	-0.001*** (-5.371)	-0.011*** (-6.044)	0.103*** (4.143)	0.001** (2.354)
Diversification _{t-1}	0.014 (1.107)	-0.003* (-1.687)	-0.000* (-1.969)	0.002* (1.837)	-0.024* (-1.679)	0.000 (1.277)	0.011 (1.107)	-0.001 (-1.072)	-0.000 (-0.596)	0.002** (2.206)	-0.017 (-1.303)	0.001** (2.447)
Liquidity _{t-1}	0.004 (0.316)	-0.001 (-0.683)	-0.000*** (-3.128)	-0.002 (-1.315)	-0.039* (-1.799)	-0.004*** (-10.116)	0.001 (0.162)	-0.003* (-1.758)	-0.000*** (-4.772)	-0.003* (-1.945)	-0.057*** (-2.916)	-0.004*** (-10.889)
GDP growth _{t-1}	0.093 (1.294)	-0.084*** (-8.353)	0.008*** (12.721)	-0.068*** (-7.771)	-0.527*** (-4.520)	0.015*** (8.666)	0.152*** (2.710)	-0.095*** (-12.663)	0.005*** (17.184)	-0.075*** (-10.395)	-0.635*** (-7.633)	0.012*** (7.910)
Inflation _{t-1}	-0.039** (-2.383)	0.002 (0.869)	0.002*** (13.329)	0.025*** (7.192)	0.050 (1.467)	-0.005*** (-6.932)	-0.056*** (-4.024)	0.005* (1.894)	0.003*** (24.146)	0.025*** (8.040)	0.075** (2.351)	-0.004*** (-6.875)
Constant	9.578** (2.415)	4.981*** (6.402)	0.139*** (3.613)	1.292** (2.486)	28.401*** (2.993)	0.158 (1.559)	4.932** (1.980)	5.160*** (12.360)	0.280*** (24.743)	1.860*** (8.939)	31.166*** (5.534)	0.374*** (5.620)
Obs.	912	1135	1135	1206	1206	1195	912	1135	1135	1206	1206	1195
adj. R-sq	0.459	0.222	0.829	0.581	0.171	0.303						

Notes: This table reports the results of the impact of regulation change in 2005 on bank's performance in China. We use both fixed effects and random effects method to estimate the regressions. The dependent variables are impaired loans to total assets ratio, logarithm of Z-score (rolling at three year window) and its three components, i.e., return on assets (ROA), standard deviation of ROA (rolling at three year window) and Equity/TA ratio, and Efficiency Score. T-statistics are based on standard errors clustered at the bank level, where *, **, *** denote statistical significance at the 10%, 5%, and 1% levels respectively. Check Table 1 for detailed definitions of variables.

Notes:

¹ For more detail on the process of Chinese banking reforms refer to Berger, Hasan, and Zhou (2009), Dong et al. (2014), Fu and Heffernan (2009) and Okazaki (2007).

² The Bank of China was established as a private bank in 1912, but also had central bank responsibility before 1979. It was separated from the PBOC in 1979. The China Construction Bank was established in 1954 and the Agricultural Bank of China was re-established in 1979. In 1984, the Industrial and Commercial Bank of China was established and the role of the PBOC as the central bank was clearly defined, indicating that the “two-tier” banking system (Fu and Heffernan 2009) was preliminarily created.

³ BOCOM used to be classed as a JSCB, but was redefined by the CBRC as a SOCB in 2006, considering that it is much larger than the other JSCBs and its share ownership is spread among different state-owned entities (Dong et al. 2014).

⁴ CCB issued IPOs in Hong Kong in October 2005, BOC issued IPOs in Hong Kong in June 2006 and then listed A-shares on the Shanghai Stock Exchange in July 2006, ICBC issued its IPOs in both Shanghai and Hong Kong in October 2006, and ABC listed on the Shanghai Stock Exchange and the Hong Kong Stock Exchange in July 2010.

⁵ Regional city or rural commercial banks are owned by local government, local enterprises and households, offering commercial banking services to city-based or rural small to medium-sized enterprises and residents (Fu and Heffernan 2009). Some were created based on the restructuring and consolidation of urban or rural credit cooperatives (UCCs or RCCs) (Dong et al. 2014).

⁶ There are three main parametric approaches, including the stochastic frontier approach (SFA), the distribution-free approach and the thick frontier approach (TFA), and two commonly used non-parametric approaches: the data envelopment analysis (DEA) and the free disposal hull approach (FDH). For a detailed discussion of methods used to measure bank efficiency refer to Berger and Humphrey (1997).

⁷ The results for both fixed and random effects are shown in the appendix. The results are consistent with our main results. The main reason we do not use fixed effects model in the first place is that the ownership dummy variables, e.g., Big5, etc., which are constant at firm level, will be dropped from the fixed effects regressions.