Bank Ownership, Privatization, and Performance: Evidence from a Transition Country

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Abstract: This paper combines the static effect of ownership and the dynamic effect of privatization on bank performance in China over 1995-2010 reporting a significantly higher performance by private intermediaries – joint stock commercial banks and city commercial banks – relative to state-owned commercial banks. However, publicly traded banks, subject to multiple monitoring and vetting in capital markets, perform better regardless of ownership status. The privatization of banks has improved performance with respect to revenue inflow and efficiency gains, both in the short- and long-run (initial public offerings). These results are more relevant and significant for banking institutions with minority foreign ownership.

Key words: Bank performance; Privatization; Minority Foreign Ownership; Efficiency.

JEL: G21; G28; C30

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1. Introduction

China, one of the fastest growing countries in transition, is leaping from its socialist past to its current market-oriented environment. In fact, much of the double-digit type growth experiences in China were achieved without a modern banking system in place. Starting only in 2005, the largest Chinese banks entered the capital markets shattering the previous market capitalization records for financial intermediaries in the initial offering markets, making China home to four of the world's 10 biggest banks by market capitalization. Notably, the Chinese banking sector withstood the storm wave of the global financial crisis in 2008-09 without bank failures. This nevertheless gives rise to an interesting research question: what are the main drivers for Chinese banks' rapid catching up in performance?

To improve bank efficiency and pave the way to a modern banking system, the central government commenced more radical reforms since the end of the 1990s. The first step was to recapitalize the largest state-owned commercial banks (SOCBs) and billions of dollars were injected while eliminating non-performing loans (NPLs) from their books.[1] Subsequently, SOCBs were partially privatised via attracting foreign minority ownership and going public strategies. Foreign investors reacted positively by acquiring minority stakes in all types of banks and the capital market investors reacted to these bank initial

[1] The central government injected $32.6 billion (CNY 270 billion) capital into SOCBs in 1998 and stripped off their NPLs by $169 billion (CNY 1.4 trillion) in 1999. The membership in the World Trade Organisation (WTO) in 2001 sped up the banking reforms further. The government injected $45 billion into Bank of China (BOC) and China Construction Bank Corporation (CCBC) in 2003, $15 billion into Industrial and Commercial Bank of China (ICBC) in 2005, and $19 billion into Agricultural Bank of China (ABC) in 2009.

public offerings (IPOs) positively. Successful IPOs and their subsequent extraordinary performance in stock markets provided a sound cornerstone for the overall success of China's further bank reform. These key reforms were along with structural deregulation and prudential re-regulation processes. For example, the China's accession to World Trade Organization (WTO) in 2001 sped up the pace to open up the banking market to foreign competitors, while the launch of the China Banking Regulatory Commission (CBRC) in 2003 marked a change in the regulatory environment with more prudential re-regulation.

This paper attempts to address the proposed research question by answering the following specific questions thereby providing information for policy makers regarding further reform of the Chinese banking system: How have privatization strategies affected bank performance? Does bank ownership structure matter? What impacts have the China's WTO accession and regulatory changes had on bank performance?

The paper makes a number of contributions to the literature. First, it investigates the effects of reforms on bank performance, enriching the literature from the perspective of transitional as well as developing countries. In particular, it focuses on the static effect of ownership and the dynamic effect of privatization on bank efficiency and goes beyond the findings and explanations of the existing literature (Berger, Hasan and Zhou 2009; Berger, Hasan, and Zhou 2010). It should be noted that China has adopted a gradual reform approach, which is different from banking reforms in other transition economies in Central and Eastern Europe where foreign banks played a vital role, and in the former Soviet Union block where a "sudden death" approach prevailed by creating new banking

systems. Experiences and lessons from China will be of particular interest to policy makers in other developing countries, e.g., Vietnam, Cambodia, Bolivia, Angola and to some extent Malawi that have similarities to the "Chinese Model" when implementing new economic and financial reforms in recent decades.

The paper also makes advances in methodological terms. It addresses the exogeneity of input prices when estimating cost and profit efficiency—an overlooked methodological issue by literature. Most efficiency studies use endogenously determined bank-specific factor input price.[2] This is in contradiction with the assumption of the cost (profit) function that firms face exogenous input prices in competitive factor markets. Poor measurement of explanatory variables could substantially distort efficiency estimates (Greene 1993), which is empirically supported by Mountain and Thomas (1999). However, so far, only a few studies use market average input prices when estimating economic efficiency, starting from DeYoung and Hasan (1998), followed by Berger and Mester (2003), Patti and Hardy (2005), Bos and Kool (2006), and Koetter (2006). Of course, the choice of factor input prices would not matter if bank-specific and market average input prices provide similar cost and profit efficiency estimates. But if they do not yield similar results, the measurement of input prices can influence the interpretations of bank efficiency studies. So far, only Koetter (2006) and Mountain and Thomas (1999) employ alternative input prices to investigate the potential impact of misspecification of input prices in Germany and US, respectively. This study enriches this rather thin strand of literature by providing new evidence from a transitional country's perspective. It estimates bank efficiencies using both bank specific and market average input prices to

[2] It is derived from dividing total factor expenses by the total units of factors employed.

investigate whether, if any, how the different measurements of input prices affect efficiency estimates.[3]

Finally, this study innovatively breaks down profit efficiency by estimating interest income efficiency and non-interest income efficiency. Modern banks have increasingly engaged in more profitable fee related activities while diversifying income sources to minimise unsystematic risks. More detailed efficiency analysis on different income generating activities is complimentary to cost and profit efficiency analysis, and therefore findings will be more informative and relevant to both policy makers and practitioners.

Our results show that joint-stock commercial banks (JSCBs) and city commercial banks (CCBs) outperform SOCBs. Banks' non-interest income efficiency level is rather low, compared with cost, profit, and interest income efficiency. Publicly traded banks operating in capital markets subject to multiple monitoring are more efficient regardless of the nature of owners. Furthermore, we found a strong positive impact of privatization on bank performance. Minority foreign ownership has improved bank efficiency in the long-term, partly due to the transfer of new technology and know-how in financial intermediation. IPOs deliver immediate efficiency gains though at a diminishing pace in the long-term.

[3] Employing a one-step stochastic frontier approach (SFA), the paper reveals that the use of bank-specific input prices tends to overestimate cost efficiency while underestimating profit efficiency.

The rest of this paper is organized as follows. Section 2 reviews literature on bank efficiency. Section 3 discusses research methodologies. Section 4 analyzes empirical results, and section 5 concludes.

2. Literature review

During the last decade or so research interests in bank efficiency have extended to developing countries and transitional economies. Bank ownership and governance structure is an important and well-explored topic. In these centrally planned economies, state ownership of banks was pervasive and banks usually dominated the financial sectors but playing a very limited economic role. It is believed that governments could channel funds to sectors (projects) with low financial returns but high social returns. Governments could act "benevolently" when there is a desire to promote industrialization and development but lack of sufficient private (venture) capital to finance the growth. Therefore, state ownership is economically efficient by balancing social and economic objectives (Megginson, 2005).

On the other hand, state ownership is argued to be inherently inefficient. First, the agent-principal problem becomes more prominent under state ownership. When there is a separation between ownership and management controls, managers (agents) may pursue their own interests rather than acting in the best interest of owners (principals) (Bearle and Means 1932), which may result in negative effects on performance. Secondly, the free-rider problem also becomes more common. State ownership theoretically means that all citizens are co-owners who in practice have no power and incentive to influence and monitor the management of state banks, leaving governments as the only effective

representative (Huibers 2005). Governments, however, have multiple (often conflicting) goals. Thirdly, soft-budget constraints faced by state banks may induce moral hazard problems leading to poor performance. State banks act as government agents to finance state-owned enterprises (SOEs) based on political preference rather than commercial considerations. When banks are in difficulties, they expect help from governments. Therefore, managers of state banks have little incentive to minimise costs or maximise profit. Finally, other reasons also explain poor performance of state banks, including the general view of "too big (important) to fail", the "quiet life" hypothesis, poor monitoring, and lack of market discipline (Megginson 2005). Empirical research generally reports that state-owned banks underperform their private counterparts (Bonin, Hasan, and Wachtel 2005a; Fries and Taci 2005; Yao, Jiang, and Feng 2007).

Bank privatization has been prioritized on the policy agenda in developing countries and transitional economies. It is seen as the ultimate way to improve bank performance by constructing good governance structure to solve agent-principal problems more efficiently. Privatized banks will face a hardened budget constraint and bank managers will be under pressure to improve efficiency in order to satisfy existing shareholders and to attract potential investors. Meanwhile, shareholders are expected to exercise due care to monitor management performance to safeguard their investments. Empirical evidence shows clear performance improvements after privatization (Berger *et al.* 2005 and Williams and Nguyen 2005).

Attracting foreign investors and going public are two commonly used strategies to privatize state banks. Foreign investors are expected to bring in not only much needed

capital infusion but also highly desired advanced technology and know-how, modern banking techniques, and superior managerial skills in financial intermediation. Foreign investors have also embraced the policy of ownership participation in domestic banks, which allows them to share local partners' soft information and extensive network. Empirical studies suggest banks with foreign ownership are significantly more efficient (Hasan and Marton 2003; Fries and Taci 2005) and therefore strategic foreign investors are desirable during banking privatization (Bonin, Hasan, and Wachtel 2005b). On the other hand, banks going public are subject to market discipline that is believed to encourage managers to improve efficiency in order to remain in the market. IPOs may also serve as strategic moves and increase the publicity or reputation of the firm (Bradley, Jordan, and Ritter 2003). Empirical evidence shows that publicly traded firms are more efficient in the US (Berger and Mester 1997) and China (Jiang, Yao, and Zhang, 2009).

The Chinese banking sector had been largely neglected until it started to attract worldwide attention from academics a few years ago. Relatively thin literature generally suggests that JSCBs outperform SOCBs and bank efficiency has improved (Berger, Hasan, and Zhou 2009; Yao, Jiang, and Feng 2007; and Jiang, Yao, and Zhang 2009). Two exceptions are Fu and Heffernan (2007) that reports banks efficiency declined during 1993-2002 compared with 1985-1993, and Chen, Skuly, and Brown (2005) that finds SOCBs were more efficient than JSCBs. Berger, Hasan, and Zhou (2009) suggest that foreign banks were more efficient and banks with minority foreign ownership experienced significant improvement in efficiency for the period 1994-2003. Jiang, Yao, and Zhang (2009) examine the impact of governance changes on bank technical

efficiency and they find that foreign ownership participation may benefit domestic banks in the long-run but IPOs only have some short-term effects.

This study extends existing literature in the following directions. Firstly, this study controls for NPLs which was a key problem of the banking reform in China but was overlooked by existing studies perhaps due to the lack of data. NPLs should be included in cost and (alternative) profit functions controlling for assets quality if they are exogenous to any individual banks (Berger and Mester 1997). Secondly, this paper is the first study analyzing bank interest income efficiency and non-interest income efficiency. Thirdly, this paper is the first study in China using market average input prices when estimating cost and profit frontiers, which would improve the quality of efficiency estimates and thereby the reliability of policy implications. Finally, our dataset is so far the largest for Chinese banks with 49 banks for the period of 1995-2010. It covers most significant changes in the Chinese banking system, including banking commercialization in 1995, the recapitalization of state banks and financial liberalisation in the late 1990s, China's WTO entry in 2001, regulatory changes and bank privatization in 2003, and the 2008-09 global financial crisis. It allows us to carry out more comprehensive analysis on not only the static effect of ownership but also the dynamic effect of privatization, [4] as well as the influences of China's WTO entry and regulatory changes.

[4] The static ownership effect examines whether banks' performance varies with different ownership structures, while the dynamic effect reveals the short-term and long-term influences of privatization strategies on bank efficiency.

3. Methodology, model and data

A preferred estimation technique is stochastic frontier analysis (SFA) (Aigner, Lovell, and Schmidt 1977), that pre-specifies a functional form and decomposes error terms into a random error (v_i) and inefficiency (u_i). This separation makes SFA more appropriate over the non-parametric method (i.e. data envelopment analysis) in transition and developing countries where problems of measurement errors and uncertain economic environments are more likely to prevail (Fries and Taci 2005). This study chooses a one-step estimation model following Battese and Coelli (1995).

Employing the intermediation approach (Sealey and Lindley 1977) modified by defining deposits as an output as in Bonin, Hasan, and Wachtel (2005a, b), this paper defines three outputs—gross loans, other earning assets, and deposits; two inputs—cost of fund and cost of labour; one netputs (quasi-fixed input)—equity, and one control variable—NPLs ratio. Recent literature (Hughes and Mester 2010) highlights the importance of bank risk taking and equity capital on bank performance and their omissions can result in biased efficiency measurement. By including equity capital as a quasi-fixed input, the resultant cost function takes into account not only the cost of debt but also the cost of equity. NPLs, as a proxy for asset quality, have been treated differently in literature, i.e. as an environmental control variable (Berger and Mester 1997), or as an undesirable output along with other outputs (Park and Weber 2006). This study follows the former as we consider the main causes of NPLs in Chinese banking industry were exogenous to any individual banks. In China, although banks were legally defined as commercial banks in 1995, their operations were frequently intervened by central and local governments to lend to loss making SOEs, resulting in a huge volume of NPLs.

Due to the lack of separate data on labour, the price of labour and physical capital is defined as the ratio of non-interest expenses to total assets as in Hasan and Marton (2003). Labour and physical capital markets are defined by bank types. Market average prices of labour and physical capital are calculated as the un-weighted average of the prices of banks belonging to the same bank type excluding the banks' own price (Koetter 2006). The price of funds is defined as the ratio of total interest expenses to total interest bearing funds. A single national fund market is defined for all domestic banks. This is because the interest rate structure is set by the central bank and commercial banks have been strictly restricted in setting interest rates on deposits and borrowings in China. The market average price of fund is computed as the un-weighted average of the prices of the other banks excluding the banks' own price.

These market average inputs prices are exogenous to any individual banks and therefore comply with the competitive factor market assumption of the cost (profit) functions. Bank specific input prices tend to underestimate cost inefficiencies as it takes no account of the possibly higher costs due to failing to obtain factor inputs at lower market average prices. In contrast, market average input prices tend to increase the unexplained regression variations showing up as greater measured inefficiencies, which actually is the allocative inefficiency caused by a bank's inability to acquire inputs at optimal prices in factor markets. On the other hand, bank specific input prices may underestimate profit efficiency as the higher costs of acquiring factor inputs would distort profit downward.

The empirical specification of the cost frontier in translog form is shown in Equation (1). The standard restriction of linear homogeneity in input prices is imposed. Total costs, profits, output variables and netputs are normalized by total assets to control for scale biases and heteroskedasticity. The alternative profit frontier and its two variations – the interest income and non-interest income frontiers – are also estimated to further scrutinise detailed information on the banks' profitability. These frontiers are estimated by replacing total costs with total profit, total interest income, and total non-interest income with necessary adjustments to error terms in equation (1).

$$\begin{aligned}\ln(TC/w_2TA) = {} & \alpha + \sum_{i=1}^{3}\beta_i \ln(Y_i/TA) + \sum_{k=1}\psi_k \ln(W_k/w_2) + \sum_{r=1}\phi_r \ln(Z_r/TA) + \rho_1 NPL + \tau_1 T \\ & + \frac{1}{2}\sum_{i=1}^{3}\sum_{j=1}^{3}\beta_{ij}\ln(Y_i/TA)\ln(Y_j/TA) + \frac{1}{2}\sum_{k=1}\sum_{m=1}\psi_{km}\ln(W_k/w_2)\ln(W_m/w_2) \\ & + \frac{1}{2}\sum_{r=1}\sum_{s=1}{}_{rs}\ln(Z_r/TA)\ln(Z_s/TA) \\ & + \sum_{i=1}^{3}\sum_{k=1}\varpi_{ik}\ln(Y_i/TA)\ln(W_k/w_2) + \sum_{i=1}^{3}\sum_{r=1}\kappa_{ir}\ln(Y_i/TA)\ln(Z_r/TA) \\ & + \sum_{k=1}\sum_{r=1}\sigma_{kr}\ln(W_k/w_2)\ln(Z_r/TA) + \rho_2 NPL^2 + \tau_2 T^2 \quad + \ln v_{it} + \ln u_{it} \qquad (1)\end{aligned}$$

where *TC* is the total costs of a bank in a given year; *TA* is the total assets of a bank in a given year; Y_i are outputs; w_k are input prices; Z_r are netputs; *NPLs* ratio controls for asset quality; *T* is a time trend; v_{it} are identical and independently distributed random errors, which are independent of u_{it}; u_{it} are non-negative inefficiencies; X_n are adjusted values of logged outputs so that they fall within the interval $[0.1\times 2\pi, 0.9\times 2\pi]$[5] and $\alpha, \beta, \psi, \phi, \tau, \varpi, \kappa, \sigma, \rho\ \eta, a, and\ b$ are parameters to be estimated.

[5] $\ln(Y_i/TA)$ are rescaled so that each x_n term falls into the interval [0,2π]. Following Berger and Mester (1997), each end of the interval [0,2π] are cut off by 10% so that x_n to span the interval of

The empirical inefficiency effect model is shown in Equation (2).

$$u_{it} = \delta_0 + \sum_{a=1}^{13} \delta_a X_{it} + \delta_{14} t + \varepsilon_{it} \qquad (2)$$

where t is a time trend; X_{it} is a vector of variables defined in Table 2.

Data are mainly collected from BankScope, with complementary data from the *Almanac of China's Finance and Banking* (1986-2010) and the *China Statistical Yearbook* (1995-2010). Data on NPLs are collected from various sources, including *The Banker* (1996-2011), CBRC's website, individual banks' website, press release, and government officials' speeches. The NPLs ratio of major banks can be found back to 2001. Prior to 2001, NPLs data on individual banks are largely unavailable and this study uses the authors' own calculations and estimates based on relevant information obtained from various sources, such as the Central Bank's survey. This study focuses on domestic commercial banks and classifies them into three categories: SOCBs, JSCBs, and CCBs.[6] The final sample consists of 49 banks for 16 years with 529 observations. It covers all major commercial banks in China, accounting for more than 85% of total banking assets.

$[0.1\times 2\pi, 0.9\times 2\pi]$ for reducing approximation problems near the endpoints. According to Berger and Mester (1997), the rescaling formula is $0.2 - \mu_i \times a_i + \mu_i \times \ln(Y_i / z_2)$ where [a, b] is the range of $\ln(Y_i / z_2)$ over the entire 11-year time interval, and $\mu_i = (0.9\times 2\pi - 0.1\times 2\pi)/(b_i - a_i)$.

[6] CCBs have been constructed as joint-stock commercial banks from the mid-1990s by restructuring and consolidating the former urban credit cooperatives. They are restricted to operate within their municipalities' localities and subject to certain local government intervention until recently some of them have been allowed to operate cross their municipalities' regions.

In addition, although our dataset only include 32 CCBs out of more than 110 CCBs, they are the most influential CCBs accounting more than 50% of CCBs' total assets. Table 1 provides the summary statistics of the sample.

[Table 1 around here]

The inefficiency effect model relates efficiency estimates to various factors that may explain some of the differences in efficiency across banks. As defined in Table 2, this study focuses on the static effect of ownership, the dynamic effect of privatization, and the influences of a set of environmental variables. Six static ownership effect indicators are defined to proxy the ownership structure in two dimensions: the nature of the owners by *CCB, JSCB, SOCB,* and *Foreign minority*; and the degree of ownership concentration by *Share of foreign ownership* and *Listed banks*. *CCB, JSCB,* and *SOCB* are used to examine whether banks' performance varies with different type of banks. Based on literature in transition countries, we expect state ownership to be negatively associated with bank efficiency. *Foreign minority* detects how foreign minority ownership affects bank performance. We expect a positive impact due to the role of foreign investors in the transfer of technology and knowhow in financial intermediation. As more and more domestic banks have attracted foreign minority ownership, it becomes necessary to see how the degree of foreign ownership involvement, measured by *Share of foreign ownership,* affects bank performance. *Listed banks* is to see whether banks perform differently with dispersed ownership structure and subject to multiple monitoring. From literature, we expect a positive association between listed banks and efficiency. For all periods, dummy variables equal one for such a bank and zero for all other banks.

[Table 2 around here]

Following Berger et al. (2005), four dynamic effect variables are defined to capture the short- and long-term influences of the foreign ownership participation and bank IPOs on performance. In particular, these variables are employed to examine the effectiveness of those two privatization strategies adopted by Chinese government by comparing bank performance before and after their implementation. Two short-term dynamic variables – *Underwent Foreign Acquisition (ST)* and *Underwent IPOs (ST)* – measure the timing of the privatization. Dummies equal zero prior to foreign investors taking stakes or going public and one after. Two long-term dynamic variables – *Underwent Foreign Acquisition (LT)* and *Underwent IPOs (LT)* – measure the number of years following the implementation of the privatization strategies. The dummies equal zero prior to foreign investors taking stakes or going public for all banks and one starting from the year of their implementation.

A set of environmental variables are also included, namely *GDP growth*, *WTO entry, CBRC Launch*, and a time trend *t*. *GDP growth* is a proxy of the macroeconomic environment in which banks operate. It is expected to have a positive impact on bank profit efficiency while its influence on cost efficiency is less clear as banks may in good time spend more. China's WTO entry in 2001 has had significant implications on the Chinese banking industry. Indeed, it sped up the ownership reform of state banks via partial privatization. Shortly after, CBRC was launched in 2003 by taking over the banking supervisory and regulatory responsibilities from the Central Bank. This marked a

change in the regulatory environment for all banks—more prudential regulation and concrete supervision. These events are included in the inefficiency effect model as dummies— *WTO entry* and *CBRC Launch*, taking a value of one after these events and zero before. The time trend *t* is for capturing the catching up effect of efficiency.

4. Empirical results

4.1. Results from frontier estimations (Eq. 1)

Table 3 reports estimation results of efficiency frontiers, including the cost, profit, interest income, and non-interest income frontiers, using both market average and bank specific input prices.[7] Results indicate that all models are of good fit and estimated parameters and LR test confirm a large part of the total composite error term attributable to inefficiencies.

[Table 3 around here]

As expected, models using bank-specific input prices yield higher cost efficiency of 88% and lower profit efficiency of 74%, compared with 76% and 78% when using market average prices, respectively. The results are consistent with findings in Koetter (2006) that the use of alternative market input prices leads to lower cost efficiency estimates but less influential on profit efficiency. In addition, bank specific input prices appear to result in slightly downward biased interest income efficiency estimates but upward biased non-interest income efficiency estimates.

[7] As the interpretation of single coefficient is not straightforward when employing a translog functional form, we focus on estimated parameters.

As it is evident that input price measurement matters, this analysis is based on estimations using market average input prices, which complies with the perfect competitive factor markets assumption of cost and profit functions. The estimated mean cost and profit efficiency are 76% and 78%, respectively. Banks on average spend 24 % more than the minimum possible costs while their profits fall short by 22% than the potential maximum profits. Breaking down total profits into interest income and non-interest income, we find that bank profit efficiency is mainly driven by interest income efficiency because the non-interest income efficiency is rather low (33%).

Fig.1 plots mean cost efficiency, profit efficiency, interest income efficiency, and non-interest income efficiency by year. Over the sample period, cost efficiency improved by 16% from 75% in 1995 to 91% in 2010. The efficiency level remained relatively stable around 80% up to 2001, which, however, is not in line with the considerable efforts made by the Chinese government on cutting costs. In fact, during this period, the central bank reduced interest rates significantly to help real sector reforms. For example, the interest rate on one-year deposits was cut by two-thirds from 10.98% in 1995 to 3.78% in 1998.[8] Meanwhile, SOCBs also closed branches and dismissed labour to reduce non-interest costs. In 2002, cost efficiency experienced a sudden drop by 9%. One possible explanation is the tightened regulatory requirements on loan loss provisions to reflect the quality of assets quality. Loan loss provisions could be up to 100%, compared with the previous requirement of 1%, resulting in a substantial increase in costs for major banks.

[8] Data sourced from the People's Bank of China statistics.

From 2003, cost efficiency increased steadily and peaked at 91% in 2010, attesting the positive impacts of recent banking reforms.

[Fig.1 around here]

Similar to cost efficiency, bank profit efficiency has also improved but at a slower pace by 10% from 75% in 1995 to 85% in 2010. As shown in Fig.1, profit efficiency encountered two significant shocks in 1998 and 2008, coinciding with the 1997 South East Asian Financial Crisis and the 2008-09 global financial crisis. Profit efficiency appears more sensitive to a financial crisis than cost efficiency. Profit efficiency regained steady growth from the bottom of 64% in 1998 to a peak of 86% in 2007. This turnaround was largely attributable to the first round of SOCBs' bail out in 1998-99. After the 2008-09 global financial crisis, banks recovered rapidly and profit efficiency reached 85% in 2010, only 1% below the pre-crisis peak level. This improvement occurred for two main reasons. The first is the positive effect of the ongoing banking reforms, such as improved bank management and bank privatization. The second reason is the Chinese government's aggressive measures to stimulate the economy during the 2008-09 crisis. The major commercial banks loosened the credit market by extending new loans by about $1.6 trillion. These new loans are profitable in the short-term while their long-term performance is questionable, posing potential NPLs in the future.

The evolution of interest income efficiency over the sample period is similar to that of profit efficiency, with an increase by 15% from 68% in 1995 to 91% in 2010. We find that interest income efficiency is slight more resistant to financial crises than profit

efficiency. For example, during the 1997 South East Asian Financial Crisis, profit efficiency dropped by 9% from 1997 to 1998, while interest income efficiency only declined by 5% during the same time. Over the sample period, non-interest income efficiency has improved significantly although there are still ample room for improvement.

4.2. Results from the inefficiency effect model (Eq. 2)

Results from the inefficiency effect model are of particular interest as they offer insights into ongoing banking reforms in China (shown in Table 4). We first analyze the static effects of ownership, and then turn to the dynamic effects of privatization, followed by an overview of the effects of other environmental variables.

[Table 4 around here]

In the cost efficiency model, the coefficients on SOCBs (δ_1) and JSCBs (δ_2) are negative and significant, indicating that SOCBs and JSCBs are more cost efficient than the control group—CCBs. In fact, JSCBs are the most cost efficient banks at an average efficiency level of 87%, followed by SOCBs at 84% and CCBs at 72%. As shown in Fig.2, the efficiency levels of SOCBs and JSCBs are relative stable over the sample period. CCBs have steadily improved cost efficiency after touching the bottom in 2002. The cost efficiency levels of different types of banks have converged since 2002.

[Fig.2 around here]

In the profit efficiency model (shown in Fig.3), the positive and significant coefficients on SOCBs (δ_1) and JSCBs (δ_2) suggest that CCBs outperform JSCBs and SOCBs. The average profit efficiency of CCBs is 85%, outperforming JSCBs by 10% and SOCBs by 30%. The performance of JSCBs and CCBs is stable over the whole sample period. SOCBs experienced a dramatic drop in profit efficiency from a moderate level of 61% in 1997 to 23% in 1998, which stagnated for three years and then recovered rapidly since 2002. During the second half of the sample period, profit efficiency also shows a converging trend across different types of banks.

[Fig.3 around here]

The downturn experienced by SOCBs is mainly caused by NPLs problems. Awakened by the severity of the 1997 South East Asian Financial Crisis, the Chinese government started to envisage NPLs problems in banking. In the 1990s, SOCBs were the main financier to SOEs, for which two-third were loss making and unable to pay interests on their borrowings. It had been common practice that SOCBs rolled over existing loans and made new loans to SOEs that were taken back immediately as interest payments on those extended existing loans. On SOCBs' accounts, there were no overdue loans with prompt receipt of interest payments. In 1997, the Central Bank tightened the terms of rolling over existing loans as well as making new loans to SOEs. It became rather difficult for most loss-making SOEs to meet their borrowing obligations and the NPLs problems rose to the surface.

In the interest income efficiency model, JSCBs are the most efficient banks as its coefficient (δ_2) is negative and significant, while SOCBs' performance is statistically indifferent from CCBs. All banks on average operate at a similar efficiency level with JSCBs leading ahead at 84%, followed by SOCBs at 78% and CCBs at 75%. As shown in Fig.4, CCBs and SOCBs encountered more fluctuations than JSCBs during the first half of the sample period, while the efficiency gap narrowed and converged during the second half of the sample period.

[Fig. 4 around here]

In the non-interest income efficiency model, bank performance is disappointing. CCBs are the most efficient banks as the coefficients on SOCBs (δ_1) and JSCBs (δ_2) are positive and significant. The estimated non-interest income efficiency for CCBs is 41%, which is rather low but still far ahead of JSCBs (13%) and SOCBs (4%). As shown in Fig.5, CCBs made good progress in the first half of the period and the gains were consolidated in the second half of the sample period, contributing to CCBs' overall outstanding performance in profit efficiency. In contrast, SOCBs and JSCBs seemed to have made almost no efforts on improving non-interest income efficiency. Ample room exists for Chinese banks to improve non-interest income efficiency thereby improving profit efficiency.

[Fig.5 around here]

The coefficient on *Foreign acquisition* (δ_3) is positive and significant in the cost efficiency model but negative and significant in the profit model and the interest income model. It implies that banks with foreign ownership are more profit efficient, especially in earning interest income, but they are cost inefficient. This is consistent with the foreign investors' main goal of profit maximisation and also the previous study of Berger, Hasan, and Zhou (2009). The level of foreign ownership involvement (δ_4) has different impacts on different efficiency measures. It is positively associated with cost and interest income efficiency but negatively associated with profit and non-interest income efficiency. The higher the share of foreign ownership, the higher are the banks' cost and interest income efficiency but the lower are the banks' profit and non-interest income efficiency. The coefficient on *Listed banks* (δ_5) is negative and significant in all models except for the non-interest income efficiency model. This indicates that listed banks are more cost, profit and interest income efficient but more non-interest income inefficient than unlisted ones, regardless of the nature of owners. The finding is consistent with literature on Chinese banks (Berger and Mester 1997; Jiang, Yao, and Zhang 2009).

In fact, all foreign minority ownership acquisitions and IPOs took place during the sample period except for Shenzhen Development Bank that was listed on the Shenzhen Stock Exchange prior to the sample period. Therefore, *Foreign acquisition* (δ_3) and *Listed banks* (δ_5) can be alternatively interpreted as the selection effect indicators to detect whether better performing banks are selected by foreign investors or for going public. The estimated coefficients in all models (except for non-interest income efficiency model) are all negative and significant, suggesting strong selection effects.

Foreign investors have chosen more efficient banks to invest and more efficient banks are selected for going public.

Turning to the dynamic effect of privatization indicators,[9] although foreign investors have chosen better performing banks to invest, foreign ownership has led to efficiency losses in the short-term (δ_6) in terms of cost, profit, and interest income efficiency. But the results show efficiency gains from foreign ownership in the long-term (δ_7), suggesting that it takes more time to benefit from the transfer of advanced technology and know-how in financial intermediation. This finding is consistent with recent literature in developing and transitional economies (i.e. Bonin, Hasan, and Wachtel 2005b). Interestingly, non-interest income efficiency behaves oppositely to other efficiency measures: improved in the short-term but declined in a longer term after foreign ownership involvement. The dynamic effect indicators of IPOs show that both cost and profit efficiency have improved in the short-term (δ_8). In a longer term (δ_9), profit efficiency keeps improving at a diminishing rate but gains in cost efficiency have turned into losses. After IPOs, banks have improved their ability to earn interest income in the long-term, perhaps a reflection of better asset quality control, while IPOs seem have little influence on non-interest income efficiency.

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[9] One might raise concerns over the multicollinearity problem in the inefficiency effect model. We have tested alternative specifications by dropping some of the variables, i.e. *Underwent Foreign Acquisition (LT), Underwent IPOs (LT),* and *the share of foreign minority ownership*. The results show that the magnitude of estimated coefficients changed slightly while no changes in signs and significance levels. Therefore, our results and policy implications wherefrom are robust, given our main goal is not for precise predictions. The results of these tests are available on request from the authors.

Results from a set of environmental variables show interesting findings. China's WTO entry (δ_{10}) is found to have a significantly negative impact on cost efficiency and interest income efficiency. Higher costs are partially due to more prudential practice, i.e. the authority tightened regulatory requirements on loan loss provision. The launch of CBRC (δ_{11}) has led to significant improvement in profit efficiency and its impacts on other efficiency measures remain to be seen, a credit to CBRC in building a sound and stable banking system via prudential regulation and supervision. In a favourable macroeconomic condition (δ_{12}) banks are more profit and interest income efficient, consistent with expectations. The time trend in the inefficiency effect model captures temporal changes in efficiency against the shifting frontier. The coefficient on the time trend variable (δ_{13}) suggest a strong catching up effect in cost efficiency, interest income efficiency and non-interest income efficiency with the passage of time.

5. Conclusion and policy implications

This study has examined the static effect of ownership and the dynamic effect of privatization on bank performance in China over the period 1995-2010. The main findings are as follows. Firstly, we find that the mis-measurement of input prices leads to biased efficiency estimates. Bank-specific input prices tend to overestimate cost efficiency but underestimate profit efficiency. The use of market average input prices is recommended because it accords with the perfect factor markets assumption of cost and profit functions. Secondly, bank efficiency has improved over the sample period. CCBs are the most profit efficient banks, partially benefited their outstanding performance in the non-interest income efficiency. JSCBs are the most cost efficient banks and SOCBs

are the least profit efficient banks. Listed banks are significantly more efficient than unlisted ones. Finally, bank privatization is found to have a positive impact on bank efficiency. The foreign ownership involvement tends to benefit banks in a longer term, while IPOs strategy brings banks immediate efficiency gains. Findings from this study provide strong evidence in support of the ongoing bank privatization reform in China.

Banking reforms have made considerable progress and privatization is an essential step in China's long march to modernize its banking system. However, there are some concerns regarding the further reform of the banking sector in China, which requires close attention from policy makers. Fundamental change in bank management and operations is a complex process. Change in the decision-making process from policy-oriented to profit-driven cannot happen overnight. This requires effective and enforceable steps to ensure well-established corporate governance mechanisms functioning in the long-term and to prevent SOCBs from stepping back to their previous managerial and operational behaviours.

Moreover, the upper limit of foreign ownership in domestic banks is 25 per cent (for a single foreign investor it is 20 per cent) while the central government holds a majority controlling stake. It is doubtful whether foreign investors have the ability to influence decision-making processes and to apply their superior operational and managerial skills. Evidence from 15 East European counties shows privatized banks with majority foreign ownership are the most efficient and those with majority domestic ownership are least efficient (Fries and Taci 2005).

Furthermore, the government has partially privatized SOCBs, retaining a controlling stake, which facilitates government intervention in SOCBs' operations. Chinese banks actually operate under two contradictory forces. The ongoing banking reform aims to promote commercial banks to operate on business principles, while existing evidence suggests that government intervention still persists and whether it could be reversed in the near future is uncertain. The key to bank reform success is a fundamental shift in banks' management and operations away from a policy orientation. This is unlikely to happen as long as the government has an incentive and the ability to intervene in SOCBs' operations.

Finally, concerns have been raised about a possible new NPLs crisis in the near future in the Chinese banking system for two reasons. The first is that the Chinese government undertook a fiscal stimulus package (about USD 1.6 trillion) through its banking system by loosening credit policy during 2007-2008 crisis. The credit risks associated with these new loans are unknown. The second reason is that central and local government have financed their debts through the banking system, which may also pose a threat to the stability of the banking system.

Note: This research complies with current laws of the UK and China. There is no conflict of interest

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Table 1 Sample Descriptive Statistics (1995-2010)

	Mean	SD	Min	Max
Total costs	28,610	74,815	93	774,029
Pre-tax Profit	8,769	26,037	-231	236,910
Net Interest Income	17,079	41,649	51	303,833
Net Non-Interest Operating Income	2,869	9,462	-3,108	73,457
Gross Loans	425,848	962,197	1,186	6,790,506
The volume of NPLs	46,542	145,700	1	1,121,782
NPLs ratio	0.10	0.12	0.00	0.55
Other Earning Assets	330,543	854,272	1,138	6,510,179
Total deposits	621,522	1,506,717	1,940	11,145,557
Equity	39,450	104,576	-267*	821,657
Total Assets	781,481	1,832,528	2,516	13,458,622
Bank specific price of fund	0.02	0.02	0.01	0.28
Market price of fund	0.02	0.01	0.01	0.07
Bank specific price of labour	0.01	0.00	0.00	0.03
Market price of labour	0.01	0.00	0.01	0.02

Note: All variables in RMB million except for input prices and NPLs ratio. All values have been deflated to 1995 price level. *The negative equity is due to the written off of SCOBs' NPLs before financial restructuring in 2003.

Table 2 The definitions of variables in the inefficiency effect model

The Static Effect of Ownership	
CCBs	Equals 1 for CCBs and 0 otherwise.
JSCBs	Equals 1 for JSCBs and 0 otherwise.
SOCBs	Equals 1 for SOCBs and 0 otherwise
Foreign minority	Equals 1 for banks with foreign minority ownership and 0 otherwise.
Share of foreign ownership	Share of foreign ownership in the bank by year
Listed banks	Equals 1 for listed banks and 0 otherwise
The Dynamic Effect of Privatization	
Underwent foreign acquisition --ST	Equals 1 after foreign acquisition, 0 before acquisition and all other banks
Underwent IPOs--ST	Equals 1 after IPOs, 0 before IPOs and all other banks
Underwent foreign acquisition --LT	Number of years since foreign acquisition, 0 before acquisition and all other banks
Underwent IPOs--LT	Number of years since IPOs, 0 before IPOs and all other banks
Other Environmental Factors	
GDP growth	GDP growth rate
WTO entry	1 for after WTO entry in 2001 and 0 before
CBRC launch	1 for after CBRC launch in 2003 and 0 before
Time trend	

Note: the first indicator—*CCBs* is excluded from the estimation for comparison purposes.

Table 3 Estimation results of efficiency frontiers

	Market Average Prices	Bank specific prices
Panel A: The cost frontier		
Gamma ($\gamma \equiv \sigma_u^2 / \sigma_v^2 + \sigma_u^2$)	0.94***	0.91***
Sigma-squared ($\sigma^2 \equiv \sigma_v^2 + \sigma_u^2$)	0.16***	0.02***
Log likelihood function	118	522
LR test of one-sided error	187	211
Mean cost efficiency	0.76	0.88
Panel B: The alternative profit frontier		
Gamma ($\gamma \equiv \sigma_u^2 / \sigma_v^2 + \sigma_u^2$)	0.95***	0.95***
Sigma-squared ($\sigma^2 \equiv \sigma_v^2 + \sigma_u^2$)	1.1***	1.15***
Log likelihood function	-183	-220
LR test of one-sided error	362	277
Mean profit efficiency	0.78	0.74
Panel C: The interest income frontier		
Gamma ($\gamma \equiv \sigma_u^2 / \sigma_v^2 + \sigma_u^2$)	0.95***	0.97***
Sigma-squared ($\sigma^2 \equiv \sigma_v^2 + \sigma_u^2$)	0.26***	0.33***
Log likelihood function	56	49
LR test of one-sided error	162	232
Mean profit efficiency	0.80	0.78
Panel D: The non-interest income frontier		
Gamma ($\gamma \equiv \sigma_u^2 / \sigma_v^2 + \sigma_u^2$)	0.91***	75***
Sigma-squared ($\sigma^2 \equiv \sigma_v^2 + \sigma_u^2$)	0.67***	0.63***
Log likelihood function	-535	-537
LR test of one-sided error	561	555
Mean profit efficiency	0.33	0.36

Notes: '***' signifies significance at 1 % levels

Table 4 Results of the inefficiency effect model

	Cost efficiency	Profit efficiency	Interest income efficiency	Non-interest income efficiency
The static effect of ownership				
SOCBs (δ_1)	-0.2*	6.36***	-0.1	2.43***
JSCBs (δ_2)	-0.72***	3.8***	-0.46***	1.01***
Foreign acquisition (δ_3)	0.09*	-1.19***	-0.12**	-0.17
Share of foreign ownership (δ_4)	-0.28**	0.84***	-0.22*	0.54***
Listed banks (δ_5)	-0.44***	-1.36***	-0.46***	1.09***
The dynamic effect of privatization				
Foreign acquisition-ST (δ_6)	0.84**	1.06*	0.81*	-0.9**
Foreign acquisition-LT (δ_7)	-0.1***	-0.1**	-0.08*	0.1**
Underwent IPOs-ST (δ_8)	-1.36**	-2.0***	-0.32	0.16
Underwent IPOs-LT (δ_9)	0.05**	-0.22***	-0.15***	0.013
Other environmental factors				
WTO entry (δ_{10})	0.41***	-0.44	0.21*	-0.08
CBRC Launch (δ_{11})	0.11	-1.4**	-0.13	-0.05
GDP growth (δ_{12})	-0.04	-2.6***	-0.91**	-0.036
t (δ_{13})	-0.11***	0.06	-0.12***	-0.2***

Notes: a. JSCB = joint-stock commercial bank, SOCB = state-owned commercial bank, IPOs = initial public offerings; b. *, **, *** signifies significance level at 10 per cent, 5 per cent and 1 per cent respectively; c. Negative sign of the estimated coefficient indicates that the particular variable has a positive effect on cost or profit efficiency and *vice versa*; d. *CCBs* is excluded from the estimation for comparison purposes.

Fig. 1 Mean efficiency levels (1995-2010)

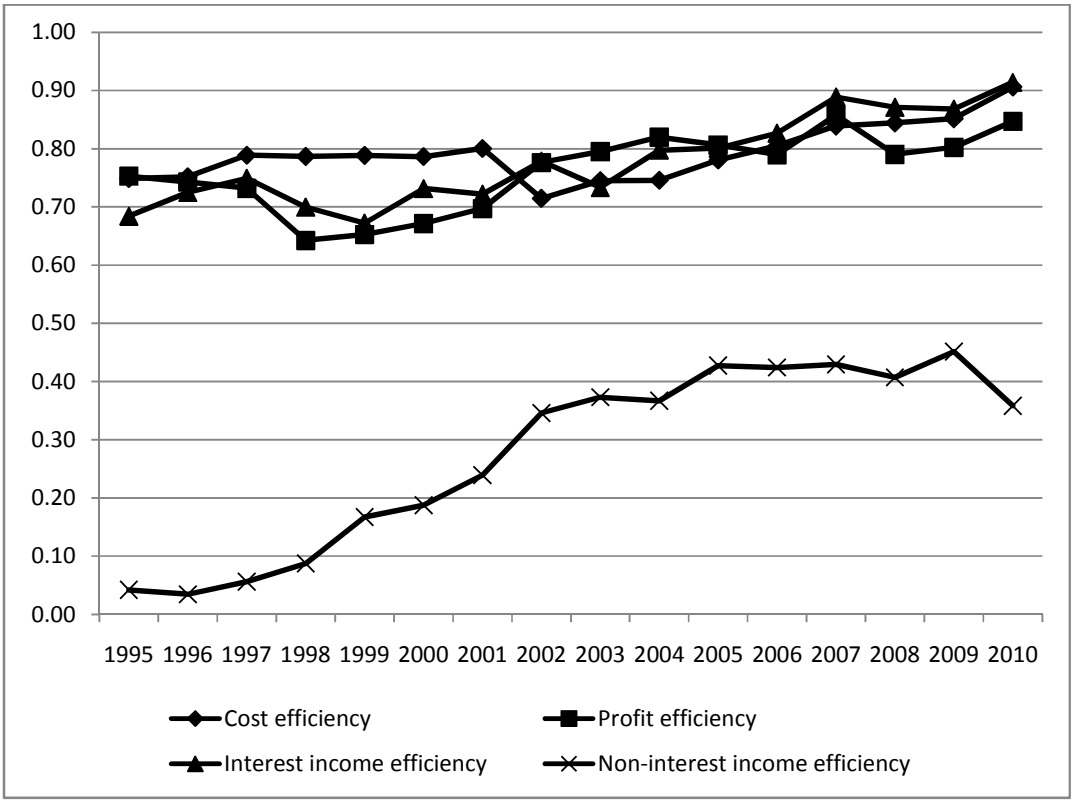
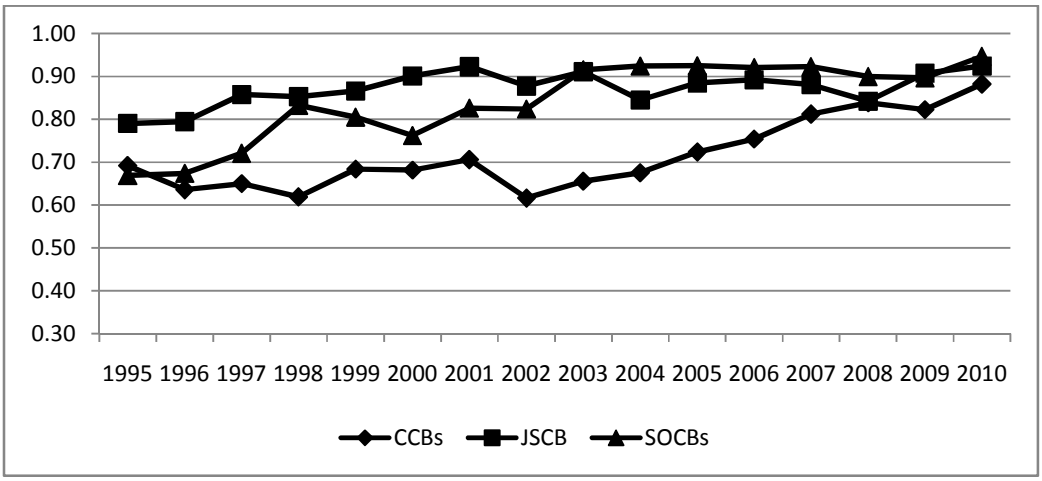


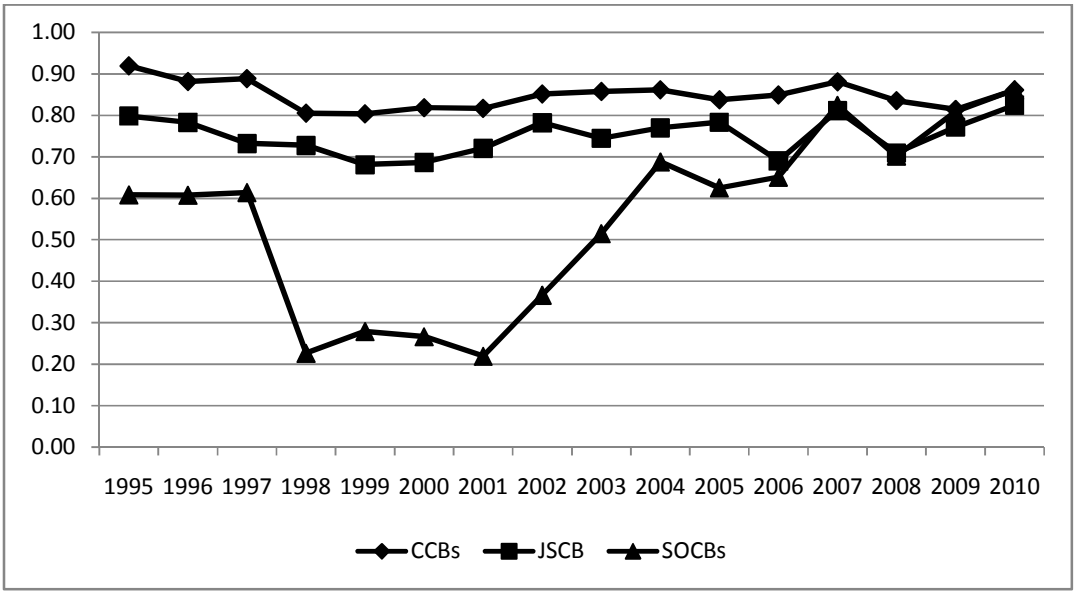
Fig. 2 Mean cost efficiency by bank types (1995-2010)



Notes: CCB = city commercial bank, JSCB = joint-stock commercial bank,

SOCB = state-owned commercial bank.

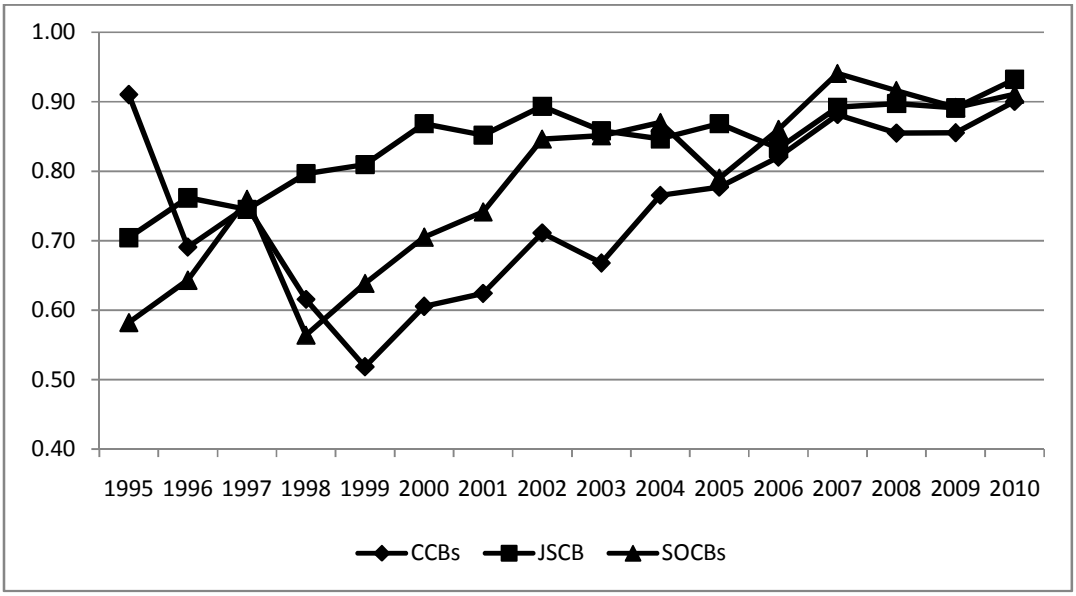
Fig. 3 Mean profit efficiency by bank types (1995-2010)



Notes: CCB = city commercial bank, JSCB = joint-stock commercial bank,

SOCB = state-owned commercial bank.

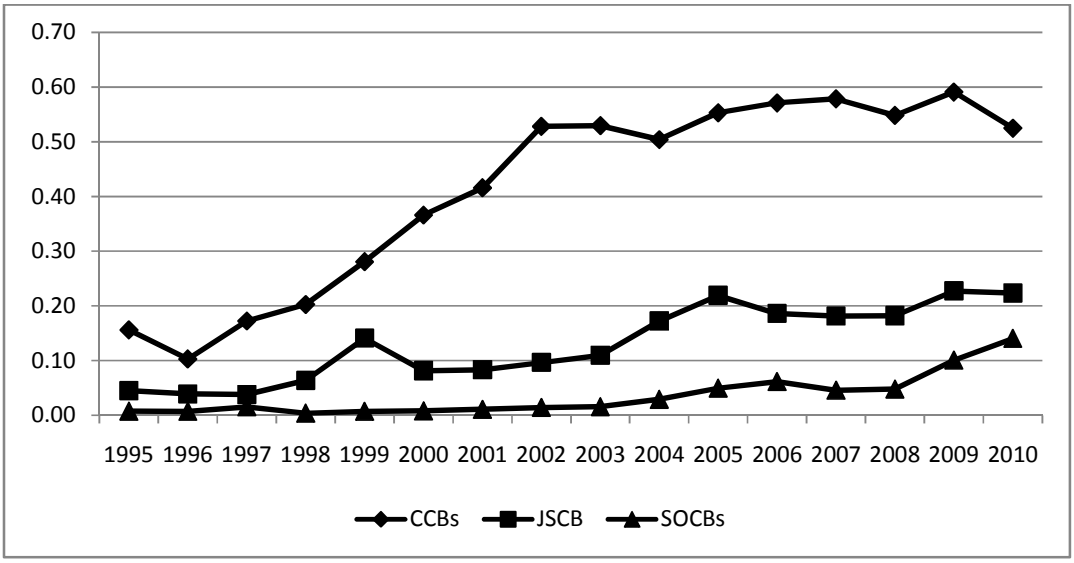
Fig. 4 Mean interest income efficiency by bank types (1995-2010)



Notes: CCB = city commercial bank, JSCB = joint-stock commercial bank,

SOCB = state-owned commercial bank.

Fig. 5 Mean non-interest income efficiency by bank types (1995-2010)



Notes: CCB = city commercial bank, JSCB = joint-stock commercial bank,

SOCB = state-owned commercial bank.