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

Chunxia Jiang[a*], Shujie Yao[b,c], Genfu Feng[c]

[a] Middlesex University Business School, Hendon Campus, London, NW4 4BT, UK

[b] School of Contemporary Chinese Studies, University of Nottingham, NG8 1BB, UK

[c] School of Economics & Finance, Xi'an Jiaotong University, Xianning West Road, Xi'an, Shanxi, 710049, China

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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 in the short- or long-run (initial public offerings). The positive long-run effect is more relevant and significant for banking institutions with minority foreign ownership. Moreover, this paper innovatively estimates interest income efficiency and non-interest income efficiency at the same time. The results suggest that Chinese banks are much more efficient in generating interest income than raising non-interest revenue, although the latter aspect has improved significantly during the sample period.

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

JEL: G21; G28; C30

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* Corresponding author: Chunxia Jiang, Tel: +44 (0) 20 8411 5874, Fax: +44 (0)20 8411 6011.
E-mail addresses: c.jiang@mdx.ac.uk (C.Jiang); Shujie.yao@nottingham.ac.uk (S. Yao); fgf@mail.xjtu.edu.cn (G. Feng)

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 experience in China was 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. This nevertheless gives rise to an interesting research question: what are the main driving forces 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 privatized via attracting foreign investors and going public strategies. Foreign investors reacted positively by acquiring minority stakes in all types of banks and the capital market investors also reacted to these bank initial public offerings (IPOs) positively. Successful IPOs and their subsequent extraordinary performance in stock markets provided a sound cornerstone for the overall success of

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[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. China's accession to the World Trade Organisation in 2001 has accelerated banking reforms even further. The government injected $45 billion into Bank of China (BOC) and China Construction Bank Corporation (CCBC) in 2003 (each received $22.5 billion), $15 billion into Industrial and Commercial Bank of China (ICBC) in 2005, and $19 billion into Agricultural Bank of China (ABC) in 2009.

China's further banking reform. These key reforms were along with structural deregulation and prudential re-regulation processes. For example, China's accession to the World Trade Organization (WTO) in 2001 accelerated the opening up process of its banking market to foreign competitors, and the launch of the China Banking Regulatory Commission (CBRC) in 2003 marked a change in the regulatory environment towards a more prudential regulation regime.

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: Does bank ownership structure matter? How have privatization strategies affected bank performance? What impacts have China's WTO accession and regulatory changes had on bank performance?

The paper makes a number of contributions to the literature. Firstly, 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 (e.g., 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.

Secondly, this study breaks down profit efficiency by innovatively 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 efficiency and profit efficiency analysis. Findings will be more informative and relevant to both policy makers and practitioners.

Finally, the paper also makes advances in methodological terms. It addresses the exogeneity problem of input prices when estimating cost (profit) efficiency − an overlooked methodological issue in the literature. Most efficiency studies use endogenously determined bank-specific input prices[2], which 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, starting from DeYoung and Hasan (1998), to Berger and Mester (2003), Patti and Hardy (2005), Bos and Kool (2006), and Koetter (2006). Of course, the choice of input prices would not matter if bank-specific and market average input prices provide similar cost (profit) efficiency estimates. But if they do not yield similar results, the measurement of input prices can influence the interpretations of bank efficiency studies.

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

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So far, only Koetter (2006) and Mountain and Thomas (1999) investigate the potential impact of misspecification of input prices in Germany and the US. This study enriches this rather thin strand of literature by estimating bank efficiencies using both bank-specific and market average input prices to probe whether, if any, how the alternative measurement of input prices affect efficiency estimates.[3]

Combining the static effect of ownership and the dynamic effect of privatization [4] on bank performance in China over 1995-2010, this paper reports a significantly higher performance by private intermediaries – joint stock commercial banks and city commercial banks – relative to state-owned commercial banks. Publicly traded banks operating in capital markets subject to multiple monitoring and vetting are more efficient regardless of the nature of owners. Chinese banks' non-interest income efficiency level is rather low, compared with cost efficiency, profit efficiency and interest income efficiency. We find that the privatization of banks has improved performance: attracting foreign investors strategy has improved bank efficiency in the long-run, partly due to the transfer of new technology and know-how in financial intermediation; and IPOs strategy has delivered immediate efficiency gains but at a diminishing pace in the long-run. Moreover, China's WTO entry has brought about bank efficiency losses perhaps due to more

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[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.

[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.

prudent regulation, while changes in regulatory environment seem to have helped banks improve profitability.

The rest of this paper proceeds 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 and transitional economies. Bank ownership and governance structure are two important and well-explored topics of study. In these centrally planned economies, state ownership of banks was pervasive and banks usually dominated the financial sectors but played a very limited economic role. It is believed that governments could channel funds to sectors (projects) with low financial returns but high social benefits. Governments could act "benevolently" when there is a desire to promote industrialization and development but lack of sufficient private (venture) capital to finance 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. Firstly, 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

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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 documents negative impacts of state ownership. Some studies (e.g., Bonin, Hasan and Wachtel, 2005a; Fries and Taci 2005; Yao, Jiang and Feng 2007) find under-performance of state-owned banks compared with their private counterparts. La Porta, Lopez-de-Silanes and Shleifer (2002) argue that politicians may use government-owned banks to further their own political goals leading to lower subsequent economic growth, and Dinc (2005) provides evidence of political influences on lending and distributing rents. Moreover, state ownership in banks is also found to be associated with a lower level of financial development (e.g., Barth, Caprio and Levine, 1999) and higher likelihood of banking crises (e.g., Caprio and Peria, 2000).

Becoming aware of the negative impacts of state ownership, 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 face a hardened budget constraint and bank managers are under pressure to improve efficiency in order to satisfy existing shareholders and attract potential investors. Meanwhile, shareholders are expected to exercise due diligence to monitor management performance and to safeguard their investments. Empirical evidence shows clear performance improvements after privatization (e.g., Berger, Clarke, Cull, Klapper and Udell, 2005; 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 that banks with foreign ownership are significantly more efficient (e.g., Hasan and Marton 2003; Fries and Taci 2005) and therefore strategic foreign investors are desirable during banking privatization (e.g., 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 (e.g., Berger and Mester 1997) and China (e.g., Jiang, Yao and Zhang, 2009), for example.

The Chinese banking sector had been largely neglected until it started to attract worldwide attention from academics a few years ago. Existing literature generally suggests that JSCBs outperform SOCBs and bank efficiency has improved (e.g., Berger, Hasan and Zhou 2009; Yao, Jiang and Feng 2007; 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) suggests that banks with minority foreign ownership experienced significant improvement in efficiency for the period 1994-2003. Examining the impact of governance changes on bank technical efficiency, Jiang, Yao and Zhang (2009) finds that minority 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, it controls for NPLs which was overlooked by existing studies perhaps due to the lack of data.[5] NPLs

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[5] The NPLs problem was a crucial issue of the banking reform in China. Policy lending to loss making SOEs, together with other factors (e.g., economic overheating/bubble in the early 1990s), led to NPLs amounted to $398 billion by 1999. This estimate was under a four-category loan classification system that underestimates NPLs than the internationally accepted five-category loan classification system. These NPLs were essentially the costs of the transition from a planned economy to a market-oriented one for maintaining social stability and sustaining high economic growth. Detailed data on NPLs had been unavailable until 2002 all banks were required to disclose information on NPLs. In 1998, by the first time,

should be included in the cost and (alternative) profit functions for controlling 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 (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 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, as well as the influences of China's WTO entry and regulatory changes.

3. Methodology, model and data

A preferred estimation technique is stochastic frontier analysis (SFA) (Aigner, Lovell and Schmidt, 1977), in particular, a one-step estimation model proposed by Battese and Coelli (1995). When defining bank inputs and outputs, the intermediation approach (Sealey and Lindley 1977) is modified by defining deposits as an output (Bonin, Hasan and Wachtel, 2005a, b). This paper defines three outputs, namely gross loans, other earning assets and deposits, and two inputs, namely cost of fund and cost of labour. Equity is included as a

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the government disclosed the SOCBs' NPL ratio of less than 30%. However, by reconciling publically available data, our estimate was about 42% in 1999, accounting for 40% of China's GDP for the year.

quasi-fixed input (netput) so that our models not only take into account the cost of debt but also the cost of equity (Hughes and Mester 2010). NPLs is treated as a control variable following Berger and Mester (1997) rather than an undesirable output as in Park and Weber (2006) since the main causes of NPLs in Chinese banking industry are considered to be exogenous to any individual banks.

This study uses market average input prices that are exogenous to any individual banks and therefore complies with the competitive factor market assumption of the cost (profit) functions, while using bank-specific input prices for gauging the impacts of mis-measurement of input prices. The use of bank-specific input prices is expected to underestimate cost inefficiency as it fails to take account of possible high costs caused by a bank's inability to acquire inputs at lower market average prices – the allocative inefficiency.

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 (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 based on the fact that the interest rates were under tight control by the Central Bank and commercial banks were strictly restricted in setting interest rates in the data period, although the control was

slightly relaxed in the last few years. The market average prices of fund are computed as the un-weighted average of the prices of the other banks excluding the banks' own price.

Data are mainly collected from BankScope, complemented by data from the *Almanac of China's Finance and Banking* (1986-2010) and the *China Statistical Yearbook* (1995-2010). Data on individual banks' NPLs are largely unavailable prior to 2001, for which this study uses authors' own estimates by reconciling relevant information from various sources.[6] This study focuses on domestic commercial banks and classifies them into three categories: SOCBs, JSCBs, and CCBs.[7] The final sample consists of 49 banks (4 SOCBs, 13 JSCBs, and 32 major CCBs) for 16 years with 529 observations, accounting for more than 85% of total banking assets in China.[8] All commercial banks with data for at least 5 consecutive years are selected, of which 28 banks have minority foreign ownership and 16 banks are listed on the capital markets. Table 1 provides the summary statistics of the sample.

[Table 1 around here]

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[6] Sources include *The Banker* (1996-2011), individual banks' website, press release, and government officials' speeches

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

[8] Although our dataset only include 32 CCBs with data available out of more than 110 CCBs, they are the most influential CCBs accounting more than 50% of CCBs' total assets.

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 using the price of fund (w_2). 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 frontier and the non-interest income frontier – 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).

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\begin{aligned}
\ln(TC/w_2 TA) = {}& \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 \ + \ln v_{it} + \ln u_{it} \quad (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 (w_1: labour and capital, w_2: fund price); Z_r are netputs; NPL is the NPL ratio; 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; and $\alpha, \beta, \psi, \phi, \tau, \varpi, \kappa, \sigma, \rho\, \eta, a,\, and\, b$ are parameters to be estimated.

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.

As defined in Table 2, the inefficiency effect model includes indicators for the static effect of ownership, the dynamic effect of privatization, and a set of environmental variables. Six static effect indicators proxy the ownership structure in two dimensions: the nature of owners (*CCB, JSCB, SOCB,* and *Foreign minority*); and the degree of ownership concentration (*Share of foreign ownership* and *Listed banks*). *CCB, JSCB,* and *SOCB* are used to examine whether banks' performance varies with different type of banks. *Foreign minority* detects how minority foreign ownership affects bank performance and we expect a positive impact via the transfer of technology and knowhow in financial intermediation. *Share of foreign ownership* captures how the degree of foreign ownership involvement affects bank efficiency. *Listed banks* is to see whether banks perform differently with dispersed ownership structure and subject to multiple monitoring. We expect a positive association between listing status of banks and efficiency. For all periods, dummy variables equal one for such a bank and zero for all other banks. Four dynamic effect variables capture the short- and long-term influences of attracting foreign investors and IPOs by comparing bank efficiency before and after the implementation of these privatization strategies. Following Berger, Clarke, Cull, Klapper and Udell (2005), two short-term dynamic variables – *Underwent Foreign Acquisition (ST)* and *Underwent IPOs (ST)* – 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)* – equal zero prior to foreign investors taking stakes or going public for all banks and the number of years starting from one after their implementation. A set of environmental variables include *GDP growth*, *WTO entry,*

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CBRC Launch, and a time trend *t*. *GDP growth* represents the macroeconomic environment in which banks operate and a positive impact is expected. China's WTO entry in 2001 has triggered significant changes in the Chinese banking industry, while the launch of CBRC in 2003 as the banking supervisory and regulatory body marked a change in the regulatory environment for all banks. Dummies − *WTO entry* and *CBRC Launch* − take a value of one after these events and zero before. The time trend *t* is for capturing the catching up effect of efficiency.

[Table 2 around here]

4. Empirical results

4.1. Results from frontier estimations (Eq. 1)

Maximum-likelihood (ML) estimates of parameters are obtained using FRONTIER4.1 (Coelli, 1996). Table 3 reports estimation results from the cost frontier (Panel A), profit frontier (Panel B), interest income frontier (Panel C), and non-interest income frontier (Panel D), using both market average and bank-specific input prices.[9] 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]

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

As expected, the measurement of input price matters – the use of alternative market input prices leads to lower cost efficiency but less influential on profit efficiency, consistent with Koetter (2006). Estimated average cost efficiency and profit efficiency using market average input prices are 76% and 78%, compared with those of 88% and 74% using bank-specific input prices, respectively. The use of bank-specific input prices overestimates cost efficiency by 12 percentage points and underestimates profit efficiency by 4 percentage points. As shown in Fig.1, the use of bank-specific input prices distorts cost efficiency evenly throughout the sample period but affecting profit efficiency more significantly in the first half of the sample period when Chinese banks relied more on interest income. In addition, bank-specific input prices result in a slightly downward bias in interest income efficiency but an upward bias in non-interest income efficiency. It is evident that input price measurement matters, and hence the following analysis will focus on estimations using market average input prices.

[Fig.1 around here]

The estimated mean cost efficiency and profit efficiency are 76% and 78%, respectively. Breaking down total profits into interest income and non-interest income, we obtain mean interest income efficiency and non-interest income efficiency of 80% and 33%, suggesting that bank profitability is mainly driven by interest income. Fig. 2 plots mean cost efficiency, profit efficiency, interest income efficiency, and non-interest income efficiency by year.

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Over the sample period, cost efficiency improved by 16 percentage points from 75% in 1995 to 91% in 2010. The efficiency level remained relatively stable close to 80% up to 2001, which, however, is not in line with the considerable efforts made by the authorities on cutting costs. In fact, during this period, the central bank reduced interest rates significantly to help the real economic sector reforms. For example, the interest rate on one-year deposits decreased by two-thirds from 10.98% in 1995 to 3.78% in 1998.[10] Meanwhile, SOCBs closed branches and dismissed labour to reduce non-interest costs. The cost efficiency level remained stable regardless of these cost-cutting efforts, which implies a decrease in cost efficiency. In 2002, cost efficiency experienced a sudden drop by 9 percentage points. One possible explanation is the tightened regulatory requirements on loan loss provision. To reflect assets quality, loan loss provisions could be up to 100% of loans concerned, compared with the previous requirement of 1%, resulting in a substantial increase in costs for major banks. From 2003, cost efficiency increased steadily and peaked at 91% in 2010, attesting the positive impacts of more recent banking reforms.

[Fig.2 around here]

Bank profit efficiency has also improved by 10 percentage points from 75% in 1995 to 85% in 2010. As shown in Fig.2, profit efficiency encountered two significant shocks in 1998 and 2008, coinciding with the 1997-98 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 64% in 1998 to 86% by 2007.

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[10] Data are from the People's Bank of China statistics.

The turnaround in 1998 was largely attributable to the first round of SOCBs' bailout in 1998-99 and the subsequent improvement was due to ongoing banking reforms. After the 2008-09 crisis, banks recovered rapidly and profit efficiency reached 85% in 2010, only 1 percentage point below the pre-crisis peak level. This recovery from crisis occurred for two main reasons. The first reason is the positive effect of the ongoing banking reforms, such as improved bank management and privatization. The second reason is the Chinese government's aggressive measures to stimulate the economy during the 2008-09 crisis. Major commercial banks were encouraged to extend new loans without strict restrictions. These new loans are profitable in the short-term but their long-term performance may be questionable.

The evolution of interest income efficiency over the sample period is similar to that of profit efficiency, rising 15 percentage points from 68% in 1995 to 91% in 2010. Interest income efficiency is slightly more resistant to financial crises than profit efficiency. For instance, during the 1997-98 Asian Financial Crisis, profit efficiency dropped by 9 percentage points in one year, while interest income efficiency declined by only 5 percentage points. Over the sample period, non-interest income efficiency improved significantly although there was ample room for improvement as the highest efficiency level was only 45%.

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

Results from the inefficiency effect model (shown in Table 4) are of particular interest as they offer insights into the impacts of ongoing banking reforms in China. [11]

[Table 4 around here]

In the cost efficiency model, the coefficients of SOCBs (δ_1) and JSCBs (δ_2) are negative and significant, indicating that SOCBs and JSCBs are more efficient than the control group of CCBs. JSCBs are the most efficient banks at an average cost efficiency of 87%, followed by SOCBs of 84% and CCBs of 72%. As shown in Fig.3 (a), the efficiency level of JSCBs was more stable relative to SOCBs and CCBs over the sample period. The cost efficiency of CCBs struggled at low level between 60-70% in the first half of the sample period and then steadily improved from 2002. Fig. 3 (a) shows a converging trend in cost efficiency levels across different types of banks.

[Fig.3 around here]

In the profit efficiency model, the positive and significant coefficients of SOCBs (δ_1) and JSCBs (δ_2) suggest that CCBs are more profitable than JSCBs and SOCBs. The average profit efficiency of CCBs is 85%, higher than JSCBs by 10 percentage points and

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[11] Addressing the possible multicollinearity in the inefficiency effect model, we have examined pair-wise correlations among regressors. Results suggest very low correlations among these indicators. One exception is the high correlation (0.86) between *Dynamic Foreign acquisition – Short Term* and *Share of Foreign Ownership*. By dropping *Share of Foreign Ownership*, the results do not change significantly – neither the signs nor the significance level of other variables.

SOCBs by 30 percentage points. As shown in Fig.3 (b), the performance of JSCBs and CCBs were stable over the sample period. In contrast, the profit efficiency level of SOCBs experienced a dramatic drop from 61% in 1997 to 23% in 1998, stagnated around 20-30% in the following four years, and then recovered rapidly after 2002. Profit efficiency was also converging across different types of banks in the second half of the sample period. The drastic downturn experienced by SOCBs in 1998 was mainly caused by the NPLs problem. Awakened by the severity of the 1997-98 Asian Financial Crisis, the Chinese government started to envisage the NPLs problem in the banking system. In the 1990s, SOCBs were the main financier to SOEs, of which two-third were loss making and unable to pay interests on their borrowings. It had been common practices 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 and making new loans to SOEs. It became very difficult for most loss-making SOEs to meet their borrowing obligations and the NPL problem came to the surface.

In the interest income efficiency model, JSCBs are the most efficient banks as only its coefficient (δ_2) is negative and significant. The average interest income efficiency of JSCBs is 84%, followed by SOCBs at 78% and CCBs at 75%. Fig.3 (c) shows that the interest income efficiency levels of CCBs and SOCBs experienced more fluctuations than that of JSCBs with a clear converging trend in the second half of the sample period. In the non-interest income efficiency model, bank performance is rather disappointing. CCBs are the most efficient banks as the coefficients of SOCBs (δ_1) and JSCBs (δ_2) are

positive and significant. The estimated non-interest income efficiency for CCBs is at a rather low level of 41%, which is still far ahead that of JSCB at 13% and SOCBs at 4%. As shown in Fig.3 (d), CCBs made impressive progress in the first half and consolidated gains in the second half of the sample period, contributing significantly to its outstanding performance in term of profit efficiency. In contrast, SOCBs and JSCBs seemed to have made almost no efforts on improving non-interest income efficiency. Our results suggest that Chinese banks should focus on improving non-interest income efficiency thereby improving profit efficiency.

Our results clearly suggest that bank ownership matters. JSCBs are the most efficient banks in terms of cost efficiency and interest income efficiency, while CCBs are the best in terms of profit efficiency and non-interest income efficiency. SOCBs are the second best in terms of cost efficiency and interest income efficiency but the least efficient in terms of profit efficiency and non-interest income efficiency.

The coefficients on *Foreign acquisition* (δ_3) is negative and significant in the profit and interest income efficiency models, indicating that on average banks with minority foreign ownership are more profit efficient, especially in earning interest income. As shown in Fig.4, compared with pure domestic banks, banks with minority foreign ownership were cost inefficient prior to 2001 and became more efficient afterwards. These banks were significantly more profitable until 2001 when domestic banks quickly caught up. This result is consistent with findings in Berger, Hasan and Zhou (2010) that foreign ownership helps mitigate loss of profit or increase in costs from diversification.

The level of minority foreign ownership involvement (δ_4) has different impacts on different efficiency measures. It is positively associated with cost efficiency and interest income efficiency but negatively correlated with profit efficiency and non-interest income efficiency. The higher the shares of foreign ownership, the higher are the levels of cost efficiency and interest income efficiency but the lower the levels of profit efficiency 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 inefficient in generating non-interest income than unlisted ones, regardless of the nature of owners. The finding is consistent with other studies in the literature (e.g., Berger and Mester 1997; Jiang, Yao and Zhang 2009).

[Fig.4 around here]

All minority foreign 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 results suggest strong selection effects that more efficient banks are selected by foreign investors and for going public.

Turning to indicators for the dynamic effect of privatization, although foreign investors have chosen better performing banks to invest, minority foreign ownership has led to

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efficiency losses in the short-term (δ_6) but gains in the long-term (δ_7) in terms of cost, profit and interest income efficiency. It seems to take 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 (e.g., Bonin, Hasan and Wachtel 2005b). Non-interest income efficiency has been improved in the short-term but declined in the long term after foreign ownership involvement. The IPOs have improved cost efficiency and profit efficiency in the short-term (δ_8). In the long term (δ_9), IPO strategy has led banks to higher profit efficiency and interest income efficiency. In contrast, short term gains in cost efficiency through IPO did not hold in the long term. IPO appears to have little influence on non-interest income efficiency, both short and long term.

Results from a set of environmental variables show some 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. In a favourable macroeconomic condition (δ_{12}) banks are more profit efficient and interest income efficient, consistent with expectations. The time trend (δ_{13}) in the inefficiency effect model captures temporal changes in efficiency against the shifting frontiers. The estimated coefficients suggest a strong catching up effect with the passage of time in terms of cost efficiency, interest income efficiency and non-interest income efficiency.

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, ownership structure matters to bank performance. Banks with minority foreign ownership are more profitable. SOCBs are associated with low efficiency. In contrast, JSCBs are the most cost efficient banks and CCBs are the most profit efficient banks partially benefited from their outstanding performance in the non-interest income efficiency. In terms of the degree of ownership concentration, listed banks with more dispersed owners are significantly more efficient than unlisted ones. Secondly, privatization via IPO has improved bank performance with respect to revenue and efficiency in both short and long terms. These results are more relevant and significant in the long term for banking institutions with minority foreign ownership. Thirdly, Chinese banks have endured efficiency losses from China's WTO entry but benefited from more dedicated prudential regulation and supervision by the newly established CBRC. Finally, our results show that 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.

This study provides evidence in support of the ongoing bank privatization in China. It is an essential step in China's long march to modernize its banking system. However, some concerns regarding the Chinese banking sector require policy makers' attention and future research. Firstly, after banking modernization, effective monitoring and enforceable

measures are needed to ensure well-established corporate governance mechanisms functioning in the long term. Secondly, with the upper limits of foreign ownership in domestic banks (25 per cent for all investors and 20 per cent for a single investor), it is questionable that to what extent foreign investors have the ability to influence decision-making and to transfer superior operational and managerial skills to domestic Chinese banks. Thirdly, the government retains a controlling stake in partially privatized SOCBs, facilitating government intervention. The ongoing banking reform aims to promote commercial banks to operate on business principles, while whether persistent government intervention could retreat in the near future is uncertain. Finally, concerns have been raised about a possible NPL crisis in the near future. During the 2008-2009 crisis, the Chinese government undertook a fiscal stimulus package (about USD 586 billion) through the banking system. Meanwhile, local governments were encouraged to increase investment, assisted by SOCBs via loosening credit policy without proper credit risk assessment, totalling about USD 4.8 trillion. This poses a potential threat to the future financial stability in China.

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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
Share of foreign ownership	4.16	7.66	0	24.99

Note: All variables in RMB million except for input prices, NPLs ratio, and share of foreign ownership. 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 interest income 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 non-interest income 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 Cost and profit efficiency using different factor input prices (1995-2010)
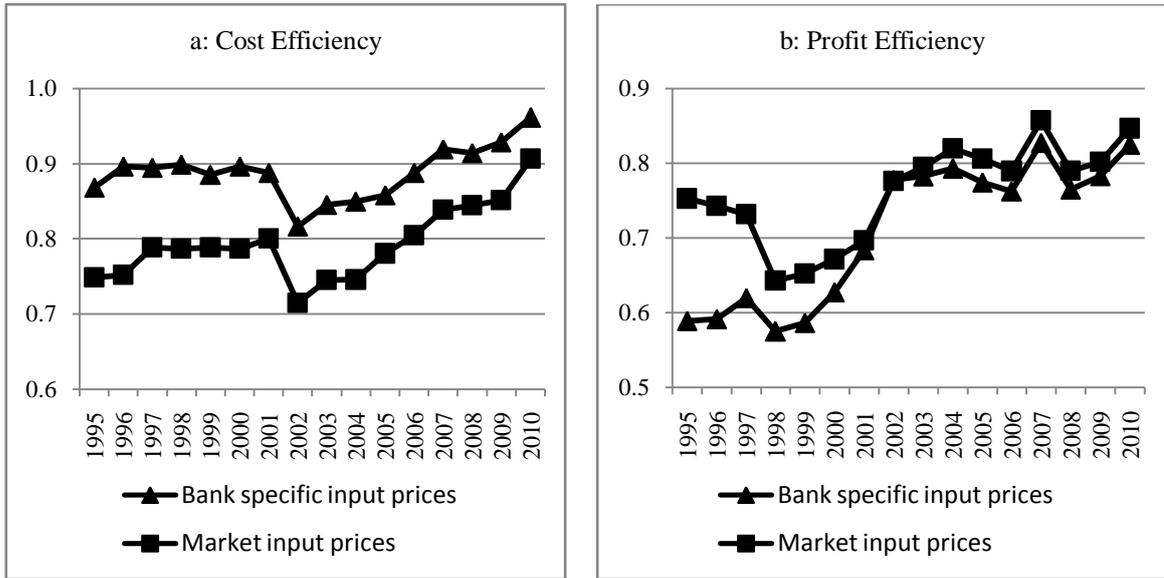

a: Cost Efficiency

b: Profit Efficiency

Fig. 2 Mean efficiency levels of Chinese banks (1995-2010)
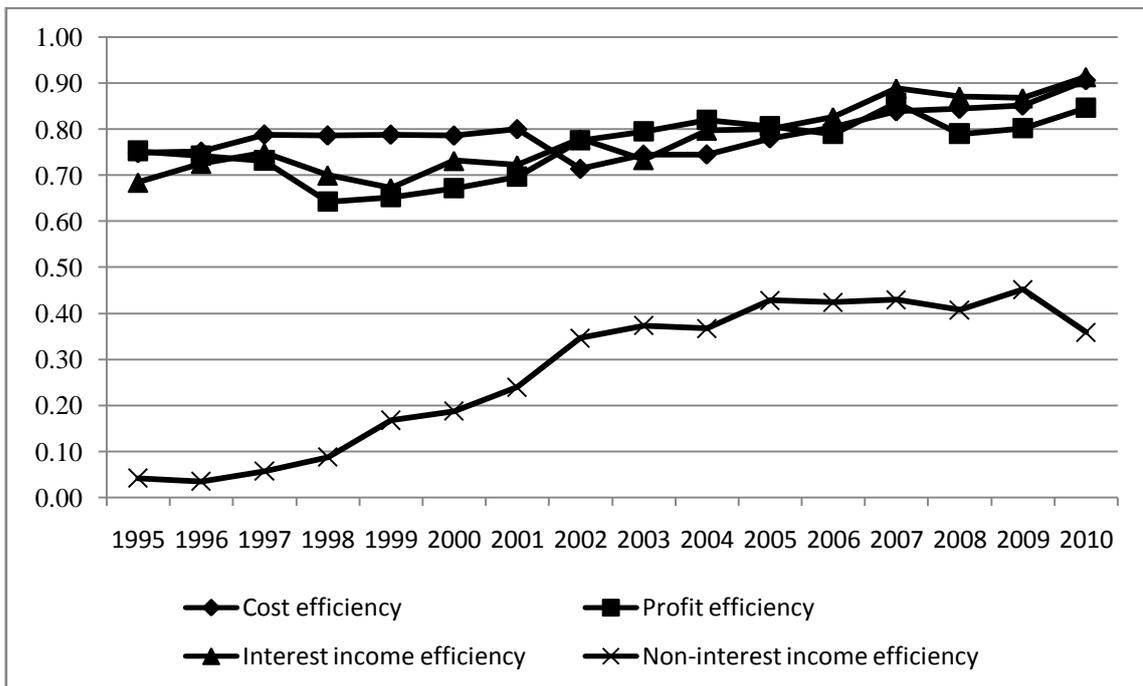
Fig. 3 Mean efficiency levels by bank types (1995-2010)

a: Cost efficiency

b: Profit eficiency

c: Interest Income Efficiency

d: Non-interest income efficiency
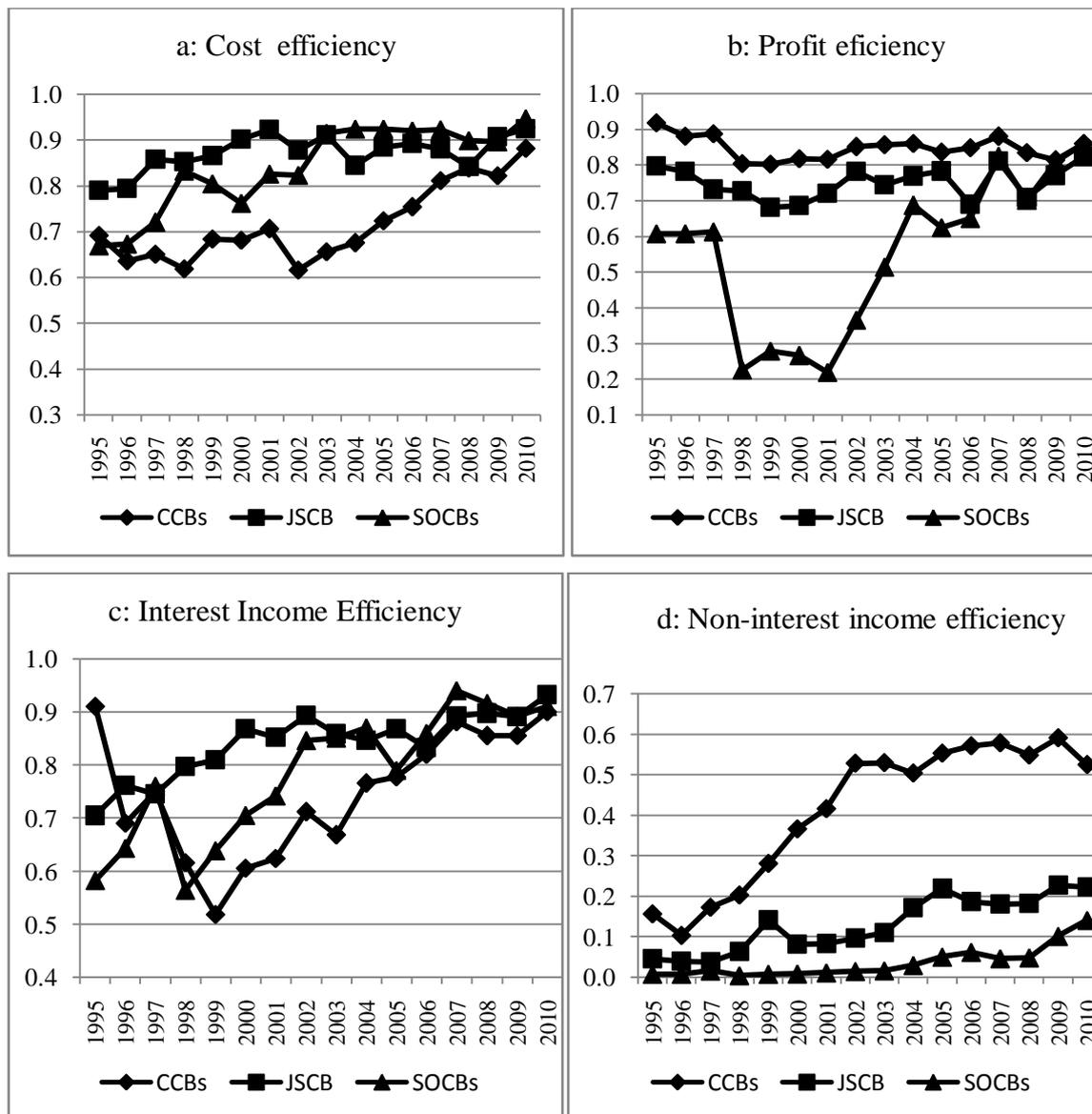
Notes: CCB = city commercial bank, JSCB = joint-stock commercial bank,

SOCB = state-owned commercial bank.

Fig.4 Bank efficiency and minority foreign ownership (1995-2010)