Can Foreign Capital Participation Enhance Commercial Banks' Market Efficiency? - A Two-Stage DEA Test on the Chinese Listed Banks

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The role of foreign capital participation in the recipients' efficiency has long been discussed, but so far no consensus has been reached on the impact of foreign capital participation on the commercial banks' efficiency. Even less literature has studied the mechanism in which the foreign capital participation has influenced the commercial banks' efficiency. To investigate the mechanism, this paper has employed Ho & Zhu (2004) two-stage Data Envelopment Analysis (DEA) method to decompose banks' efficiency into operational efficiency (ability to expand their business with given inputs), and market efficiency (ability to make maximum profits with given business scale), and test the impacts of foreign capital participation on sixteen Chinese listed commercial banks' market efficiency. The Tobit regression method has been employed since the market efficiency measured with the two-stage DEA approach is always positive and hence not random. The findings indicate that the foreign capital participation has significant and positive impact on the Chinese listed commercial banks' market efficiency even as a minority shareholder, while the weight of the foreign ownership is not so important. Besides, the banks are all significantly influenced by macroeconomic fluctuations. These findings are important for both China and the other transitional economies and developing economies to improve the policies of financial liberalisation.

Keywords: *Listed Commercial Banks; Foreign Capital Participation; Market Efficiency; Two-Stage DEA.*

Introduction

With more foreign capital participation in the developing economies (Bonin *et al.,* 2005), its effect on the efficiency of domestic banks is of great concern (O'Sullivan & Ozsoz, 2010). Among all the banks from the developing economies, the Chinese listed commercial banks have drawn huge attention with their increasing extent of opening and outstanding performance in the recent decade.

The formerly solely state-owned Chinese commercial banks experienced a rapid foreign capital participation in the early 2000s against the background of the country's increasing level of open-door policy and the Chinese banks' decreasing efficiency. To comply with the WTO requirements, the Chinese banking regulatory authority began to relax the regulation concerning the foreign capital participation. On the other hand, the inefficient Chinese banks had just experienced a terrible non-performing asset problem in the late 1990s. The Chinese government resorted to the foreign financial institutions in hope that their participation can enhance the Chinese commercial banks' efficiency. Since 2008, the Chinese listed commercial banks have produced the most profits among the banks worldwide. Therefore, it is important to investigate the impacts of the foreign capital participation on the Chinese commercial banks' efficiency.

The research on this problem is important both theoretically and practically. Firstly, the research can help to clarify the conflicting research findings of the impacts of foreign capital participation on the commercial banks' efficiency (Caves, 2007; Dunning & Lundan, 2008; Parinduril, & Riyanto, 2014). Secondly, the research is relevant to the mechanism of foreign capital participation's impacts on the Chinese commercial banks' efficiency, which can provide lessons not only for China but also for the other developing economies, which are now experiencing financial liberalisation too. This paper will test the impact of the foreign capital participation on the Chinese commercial banks' efficiency.

The research question of this paper is how the foreign capital participation has influenced the Chinese listed commercial banks' efficiency through a particular component-the market efficiency.

The aim of this paper is to measure the components of the Chinese listed commercial banks' efficiency and test the impacts of foreign capital participation on the most important component of the Chinese listed commercial banks' efficiency. The objective is to investigate the different roles played by the foreign capital participation as a minority shareholder from that as a majority shareholder.

To keep the research robust, this paper will decompose the Chinese listed commercial banks' efficiency and focus on the component which is likely to be influenced by the foreign capital participation. The two-stage data envelopment analysis (DEA) will be used to decompose the banks' overall efficiency into the efficiency in expanding the business ("operational efficiency") and the efficiency in making maximum profits

with given business ("market efficiency"), as proposed by Ho & Zhu (2004). Two different proxies of foreign capital participation have been used to test the signaling effect) produced by the participation of the foreign capital ("indirect effect"), and the effect produced by the foreign participation in the Chinese listed commercial banks' management ("direct effect"), so the overall effect will not be masked by the possible conflicting individual effects.

This paper has two major contributions. Firstly, it is the first effort to investigate the impact of the foreign capital participation on the commercial banks' market efficiency with a two-stage DEA. Secondly, the direct and indirect impacts of the foreign capital participation have been distinguished in the Chinese listed commercial banks.

Literature Review

Literature cannot be found on the impact of foreign capital participation on commercial banks' market efficiency. The relevant literature is on banks' overall efficiency.

There is no consensus on whether foreign capital participation can improve bank efficiency (Sengupta, 2007; Detragiache *et al.,* 2008). But most of the empirical studies support the notion that foreign ownership has a positive impact on bank efficiency. Both single-country studies (Nikiel & Opiela, 2002; Hasan & Marton, 2003; Bokpin, 2013) and most of the cross-country studies have found a positive association between foreign ownership and bank efficiency. Bonin et al. (2005) report that the participation of foreign investors can improve banks' cost efficiency. On the contrary, Borovicka, J. (2007) reveals that the foreign ownership has a negative impact on the European banks' efficiency.

The impacts of foreign capital participation may depend on the manner of participation (Berger & Humphrey, 1997; Awdeh & Moussawi, 2009). Fries and Taci (2005) suggests that privatised banks with majority foreign ownership are the most efficient and those with domestic ownership are the least. Thi & Vencappa (2008) find that on average, greenfield banks are superior in efficiency to M&As, but no cost efficiency difference has been found between M&As and domestic banks. Moon, W. (2009) finds that compared with the simple equity holding, foreign management control affects the Korean banks'

performance differently. Modebadze, G. (2011) proposes that banks with foreign strategic ownership or international financial institutions involvement are more cost efficient than their domestic counterparts.

Some researchers have pioneered the studies on the Chinese banks' efficiency. Leigh and Podpiera (2006) and Hope and Hu (2006) have discussed the possibility of introducing minority foreign capital to help reform the Chinese banking system. Laurenceson & Feng (2008) find there is only a marginally significant and positive impact of foreign capital participation on cost efficiency of the Chinese banks. Other researches have measured the Chinese banks' efficiency with various methods (Barros, Chen, Liang & Peypoch, 2011; Xu, 2013; Dong, Hamilton, & Tippett, 2014)

But the extant literature seldom discusses the market efficiency of the commercial banks, and has not analysed the impacts of foreign capital participation on the market efficiency of banks.

Methodology

Two-Stage DEA Analysis

Data Envelopment Analysis (DEA) has been used widely in measuring efficiency of banks (Burki & Niazi, 2010; Andries, 2011; Paradi & Zhu, 2013). Recently, researchers have been keener to measure the efficiencies of different stages in the production process. Among them, Seiford and Zhu (1999) have measured the operational and market efficiencies of U.S. commercial banks. Their approach has later been modified by Chen & Zhu (2004) as so-called "two-stage DEA", in which the DMUs' profit making process has been decomposed into two stages.

Following the extant literature (Seiford & Zhu, 1999), this paper will decompose the banks' profit-making process into two stages. In the first stage, the banks will expand their business with given inputs, while in the second stage the banks will maximise their profits with given business scale. In our paper, the inputs of the first stage include net asset, total asset and the employee. The outputs of the first stage (also called "intermediate measures") are the deposits, the loans, the service income, which are the inputs for the second stage too. The net income, ROA (return on asset) and ROE (return on equity) are the output of the second stage (see Figure 1).
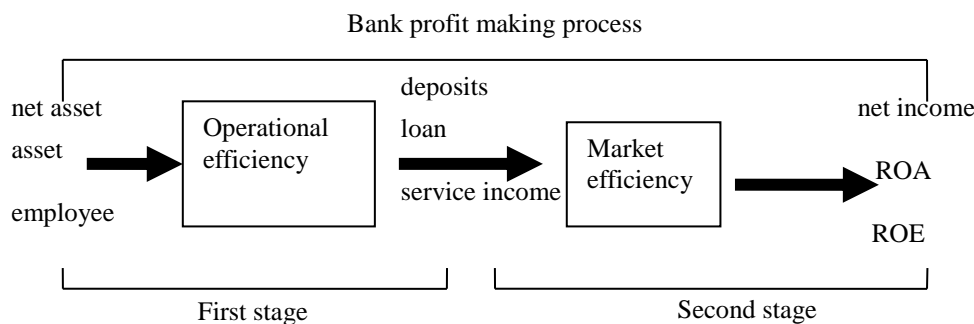
Bank profit making process

Figure 1. Two-stage process for Chinese banks

If the two stages are equally important for the Chinese listed commercial banks, and if there are n listed commercial banks, m kinds of inputs, D kinds of intermediate measures and s kinds of outputs of the second stage, the banks' operational efficiency and market efficiency can be measured by solving the following linear programming problem:

$$\min_{\alpha,\beta,\lambda_j,\mu_j,\tilde{z}} \alpha - \beta \qquad (1)$$

Subject to

(stage 1) $\sum_{j=1}^{n} \lambda_j x_{ij} \leq \alpha x_{ij_0}$, i=1, 2, ……, m.

$\sum_{j=1}^{n} \lambda_j z_{dj} \geq \tilde{z}_{dj_0}$, d=1, 2, ……,D.

$\sum_{j=1}^{n} \lambda_j = 1$; $\lambda_j \geq 0$.

(stage 2) $\sum_{j=1}^{n} \mu_j z_{dj} \leq \tilde{z}_{dj_0}$, d=1,2,……,D.

$\sum_{j=1}^{n} \mu_j y_{rj} \geq \beta y_{rj_0}$, r=1,2,……s.

$\sum_{j=1}^{n} \mu_j = 1$; $\mu_j \geq 0$

where the symbol "~"reflects the unknown decision variables.

According to Chen &Zhu (2004), the bank is inefficient in the first stage if $\alpha < 1$. On the contrary, a smaller value (β) indicates a higher market efficiency. To make the results more straightforward, we have calculated the reciprocal value of the market efficiency, so a larger value means higher efficiency.

Tobit Model

Our market efficiency measure is always positive, hence not random, which would make the ordinary least square method inappropriate in regression. Following Leigh, D., Hall, M. J. B. & Simper, R. (2006), the Tobit model (Tobin, 1958) will be employed in this paper by setting a latent variable. The observed variable would equal 0 when the latent variable is non-positive.

$$y_i = \begin{cases} y_i^* & if \ y_i^* > 0 \\ 0 & if \ y_i^* \leq 0 \end{cases} \qquad (2)$$

where y_i^* is a latent variable for commercial banks' market efficiency. The relationship between the banks' market efficiency and the independent variables is as follows:

$$y_i^* = \beta x_i + u_i, \quad u_i \sim N(0, \sigma^2) \qquad (3)$$

where x_i is independent variable, while u_i is the error term which follows a zero-mean normal distribution.

Data Description

According to Charnes et al. (1994), in DEA analysis, the number of observations should be greater than three times of the sum of the inputs and outputs. For the panel data, an identical object in different years can be treated as different DMUs (Charnes *et al.,* 1978). In our study, there are 16 Chinese listed commercial banks and 7 years from 2007 to 2013, so there are totally 102 observations. The sum of the inputs and outputs is only 9, so the above condition has been satisfied.

The sample banks are: China Construction Bank (CCB), Agricultural Bank of China (ABC), Industrial and Commercial Bank of China (ICBC), Bank of China (BOC), China Minsheng Banking Co., Ltd (CMBC), China Merchants Bank Ltd (CMB), Industrial Bank Co., Ltd (CIB), Bank of Beijing (BOB), Bank of Communications (BCM), China Everbright Bank (CEB), China CITIC Bank, Shanghai Pudong Development Bank (SPDB), Shenzhen Development Bank (SDB), Huaxia Bank (HB), Bank of Nanjing (BON), Bank of Ningbo (NBCB).

The variables include the data for two-stage DEA and the data for Tobit regression. In accordance to the existent literature (Chen & Zhu, 2004), the data for two-stage DEA include the number of employees, the assets, the net assets, the deposits, the loans, the services income, the net income (profits), ROA and ROE. The number of employees, the assets and the net assets are considered as the necessary inputs for the commercial banks' operation. The net income, ROA and ROE are the banks' output which are their objectives of operation. The deposits, the loans and the services income are both the outputs of the banks' operation and the inputs for the banks' profit-hunting activities.

Our dependent variable in the Tobit model is the market efficiency of the listed commercial banks. The independent variables in the Tobit model include two foreign capital participation proxies, i.e. the dummy variable whether there are foreign strategic investors in the top five shareholders (FORD) and the weight of shares held by the foreign strategic shareholders (FORAT). To depict the impacts of both the bank specific characteristics and the economic environment, some control variables have been included. The control variables have covered both banks' individual factors and the macroeconomic factors, including banks' capital structure (weight of the five largest shareholders' shares) (TOP5), real GDP, money supply growth rate (MSR), and bank loans' weight in the total capital formation (BANKW). To keep the data clean, I have excluded all the data used to measuring the banks' efficiency. Besides, the dummy of state-ownership (STATD) has been included to control the possible influence on the banks' market efficiency. I have used the weight of employees with bachelor degree (BW) to control the impact of the human capital. Table 1 shows the summary statistics.

Table 1

Summary Statistics

		mean	median	max	min	Standard deviation
DEA Data	Employee (I_{11})	111074.20	31599.50	478980.00	1629.00	152141.30
	Asset (I_{12})	40351.34	19798.41	189177.50	755.11	46308.79
	Capital (I_{13})	2715.44	1171.06	15722.65	84.36	3370.14
	Deposit (O_{11}, I_{21})	30914.95	13815.78	146208.30	509.32	36936.88
	Loan (O_{12}, I_{22})	20252.43	10403.79	99223.74	306.29	23374.25
	Services income (O_{13}, I_{22})	207.98	75.01	1223.26	0.66	285.28
	Profits (O_{21})	466.89	208.26	2629.65	6.14	580.02
	ROA (O_{22})	0.01	0.01	0.02	<0.01	<0.01
	ROE (O_{23})	0.20	0.20	0.37	0.04	0.04
Tobit Regression Data	Top 5 (%)	43.55	41.51	100.00	0.35	35.22
	FORAT (%)	12.03	10.00	40.56	<0.01	12.26
	real GDP growth rate (%)	9.81	9.20	14.60	7.70	2.21
	MSR (%)	17.56	16.70	27.70	13.60	4.71
	BANKW (%)	64.49	62.69	75.63	54.72	7.28

Note: The asset, capital, deposit, loan, income and profit are in 100 million Yuan RMB, while the employment is measured by persons. All the other variables are measured as percentage.

Variable definition: Top 5: the weight of the shares held by the top five shareholders; FORAT: the weight of foreign shares; MSR: money supply growth rate; BANKW: the weight of banks' loans in the total capital formation.

Table 1 indicates that some banks have much larger scales of assets and employees than the others do, and their profits vary a lot too. As far as the foreign capital participation is concerned, the highest weight of foreign ownership has reached 40.56 %, while the lowest is nearly 0. The listed commercial banks include large, medium and even relatively small banks.

Empirical Analysis

Market Efficiency Estimation

Before estimating market efficiency, to verify that the banks' outputs should grow with the increase of their inputs, I performed the isotonicity test to check the correlation coefficients for all the inputs, the intermediates and the outputs. All the correlation coefficients in Table 2 are positive. The correlation coefficients between the inputs and the intermediate inputs are higher than those between the intermediate inputs and the outputs. This indicates that the increase of the first-stage input variables will enhance the intermediate output (the inputs of the second stage) variables, while the increase of the second-stage input variables will in turn increase the output variables. The results of the isotonicity test indicate the two-stage DEA approach is applicable.

Table 2

Test of Isotonicity

	I_{11}	I_{12}	I_{13}	O_{11}, I_{21}	O_{12}, I_{22}	O_{13}, I_{23}	O_{21}	O_{22}	O_{23}
I_{11}	1								
I_{12}	0.92**	1							
I_{13}	0.87**	0.98**	1						
O_{11}, I_{21}	0.94**	0.99**	0.97**	1					
O_{12}, I_{22}	0.90**	0.99**	0.99**	0.99**	1				
O_{13}, I_{23}	0.87**	0.98**	0.98**	0.97**	0.98**	1			
O_{21}	0.85**	0.98**	0.99**	0.97**	0.98**	0.98**	1		
O_{22}	0.21*	0.33**	0.37**	0.32**	0.34**	0.39**	0.41**	1	
O_{23}	0.10	0.14	0.13	0.14	0.13	0.15	0.17	0.34**	1

*Note: * indicate significance at 5 % level.*

Table 3 has presented the market efficiency and the operational efficiency estimated with the two-stage DEA approach. The standard deviation of the market efficiency is 0.1752, while it is only 0.0817 for the operational efficiency. The smaller standard deviation of the operational efficiency indicates that the Chinese commercial banks are quite similar in their operational abilities. It is the market efficiency that makes difference for the Chinese listed commercial banks' performance. Without the ability to find good projects (namely, the market efficiency), the bank cannot have a satisfactory performance. Hence, it is important to examine how the foreign capital participation may influence the banks' market efficiency of the Chinese commercial banks.

Table 3

Estimate of the Market Efficiency and Operational Efficiency

	Market efficiency							Operational efficiency						
	2007	2008	2009	2010	2011	2012	2013	2007	2008	2009	2010	2011	2012	2013
ABC	0.43	0.41	0.40	0.48	0.55	0.57	0.59	1.00	0.85	0.87	0.89	0.89	0.91	0.91
BCM	0.51	0.60	0.51	0.55	0.62	0.80	0.76	0.88	0.83	0.86	0.87	0.86	0.86	0.86
BOB	0.55	0.72	0.54	0.65	0.72	0.81	0.80	0.87	0.90	1.00	1.00	0.99	0.98	1.00
BOC	0.57	0.52	0.41	0.56	0.58	0.62	0.63	0.85	0.85	0.93	0.89	0.90	0.88	0.89
BON	1.00	1.00	0.65	0.71	0.81	0.79	0.72	0.78	0.80	0.81	0.76	0.71	0.75	0.75
CCB	0.54	0.64	0.59	0.64	0.67	0.67	0.69	0.89	0.90	0.89	0.92	0.98	0.98	0.97
CEB	0.40	0.49	0.39	0.49	0.64	0.88	0.84	0.94	0.89	0.81	0.87	0.80	0.81	0.83
CIB	0.70	0.74	0.61	0.66	0.99	1.00	0.97	0.74	0.74	0.81	0.74	0.69	0.70	0.75
CITIC	0.43	0.53	0.44	0.51	0.85	0.74	0.78	0.93	0.93	0.93	1.00	0.87	0.93	0.91
CMB	0.64	0.67	0.46	0.54	0.64	0.70	0.71	0.87	0.95	0.93	0.96	0.98	0.92	0.87
CMBC	0.38	0.41	0.44	0.65	0.88	0.84	0.78	0.88	0.92	0.95	0.95	0.92	0.71	0.84
HB	0.21	0.27	0.34	0.43	0.57	0.67	0.70	0.94	0.80	0.85	0.88	0.86	0.84	0.86
ICBC	0.51	0.60	0.57	0.67	0.72	0.69	0.71	0.87	0.89	0.90	0.87	0.89	0.94	0.94
NBCB	1.00	0.83	0.60	0.68	0.77	0.85	0.80	0.86	0.86	0.80	0.67	0.81	0.65	0.68
SDB	0.46	0.07	0.49	0.46	0.58	0.53	0.49	0.99	0.90	1.00	0.96	0.79	0.79	0.80
SPDB	0.30	0.54	0.41	0.63	0.76	0.84	0.86	1.00	0.92	0.98	0.90	0.88	0.91	0.95

Note: The market efficiency is the multiplicative inverse value of the raw estimate, so a higher value indicates high efficiency.

Tobit Model Estimation

To avoid the collinearity problem in Tobit model estimation, we first test the correlation between all the independent variables. The results indicate that there is no high correlation between all these independent variables. Only the correlation coefficient between BANKW and the two-year lagged real GDP is a little higher, so they have also been used in two regressions just for robustness. The results in Model 2 and Model 3 indicate that the inclusion of the one-year lagged BANKW difference and the two-year lagged real GDP doesn't change the results, so there is no collinearity problem.

To avoid poor-quality instrumental variable selection, the potential endogenetiy problem has been addressed with the lag identification method, i.e. lagging the independent variables (Clemens, Radelet, Bhavnani and Bazzi, 2012). I have included the 2-year lagged data for the independent variables except the dummy variables. Since the lagged data have already been employed to calculate the change of the banking sector's weight in all social capital (BANKW), only one-year lagged data has been used for banking sector's weight. Besides, Wooldridge's method (2010) has been further applied and the robustness of the lag identification has been verified. There is no endogeneity problem with the lag identification. Table 4 illustrates the Tobit regression results.

Table 4

Test of the Impact of Foreign Capital Participation on Market Efficiency

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	0.6210**	1.1016**	1.050**	0.9910**	0.9944**	0.7965**
FORD	0.0798**	0.0978**	0.1002**	0.1173**	0.1162**	0.1096**
FORAT(-2)	0.0027*	0.0022	0.0022*	0.0022	0.0023	0.0024
TOP5(-2)	-0.0014	-0.0148*	-0.0015*	-0.0014	-0.0014	-0.0009
DBANKW(-1)	-0.0087*		-0.0017	0.0009	0.0009	0.0011
RGDP(-2)		-0.0431**	-0.0389**	-0.0430**	-0.0428**	-0.0396**
MSR(-2)				0.0050*	0.0050*	0.0057**
STATD					-0.0191	-0.0131
BGW(-2)						0.0020
Wald Chi_2	53.51**	69.33**	59.59**	46.07**	73.74**	89.03**
Log likelihood	56.2295	69.5784	70.0265	71.2260	71.344	72.1801

*Note: * and ** indicate significance at 5% and 1% level. Slash (/) means the variable has not been used in the model.*

According to Table 4, the weight of foreign ownership (FORAT(-2)) has a positive coefficient but is not significant in all the five models, however, the coefficients of the dummy variable of the existence of foreign capital participation (FORD(-2)) are significant and positive. Its values are much larger than the estimates of FORAT(-2). It indicates that the foreign capital

participation can increase the Chinese listed commercial banks' market efficiency even as a minority shareholder, while a slight increase in the weight of the foreign ownership is not so important. Even when foreign investors have only one or two board seats on Chinese banks, corporate governance and risk management improves significantly (Berger, Hasan & Zhou, 2009). In

some cases, the Chinese banks with minority foreign ownership are also able to send employees to the foreign bank's headquarters for advanced training (Berger, Hasan & Zhou, 2009). So their market efficiency can increase. On the other hand, since nearly all the listed commercial banks have the state as the dominant shareholder, the slight increase of foreign ownership cannot change the ownership structure fundamentally. Hence, what's more important for the Chinese listed commercial banks' market efficiency is whether there is foreign capital participation, not how many shares are held by the foreign investors.

For the control variables, the coefficients of RGDP are negative and very significant. It indicates that when the economy grows fast, the Chinese listed commercial banks' market efficiency would be worse. When the economy booms, the banks would ignore the risk and select many unprofitable projects, which will lower their market efficiency. On the other hand, the money supply growth rate has positive coefficients though only significant at 5%. The central bank issues more money usually in the recession period, so the increase of money supply would provide a message of higher risk. Hence, the banks would put more effort on risk control, which will increase the quality of the banks' projects and hence improve the Chinese listed commercial banks' market efficiency. The other control variables are not significant in all the five models. The weight of shares owned by the five largest shareholders is only significant at 5 % level in two of the five models. Banks' role in the overall social capital formation is only significant in one model.

Conclusion

This paper has analysed the impacts of the foreign capital participation on the Chinese listed commercial banks' market efficiency. With the empirical analysis, this paper has reached the following conclusions.

Firstly, foreign capital participation has significant and positive impact on the Chinese listed commercial banks' market efficiency. Their participation can update the management and accumulate the human capital in the Chinese listed commercial banks and then improve the banks' ability of seeking more profitable projects.

Secondly, the participation as a minority shareholder can increase the Chinese listed commercial banks' market efficiency, while the increase of the weight of foreign shares is not important. This result indicates that the invitation of foreign capital participation is a very important symbol of the Chinese banks' determination to update their management style. This can send an important signal to their employee to improve their efficiency. Hence, what is important is not to what degree the foreign capital participates but whether there is foreign capital participation.

Thirdly, the Chinese listed commercial banks' market efficiency is significantly influenced by the macroeconomic situation and monetary policy. This finding has provided the evidence that the Chinese banks still depend heavily on the economic environment. Despite the market efficiency improvement incurred by the foreign capital participation, there is still a lot for the Chinese listed commercial banks to do to maintain a stable profitability.

The findings have contributed to the extant literature in two aspects. Firstly, this paper is the first to verify the positive impact of the foreign capital participation on banks' market efficiency. Secondly, the evidence has been found that the foreign capital participation as a minority shareholder can increase the banks' market efficiency, while the weight of foreign ownership doesn't make differences in the present situation.

Further studies should focus on extending the samples, either adding the non-listed banks in China or the branches of foreign banks.

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