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The Impact of Prudential Supervision on Financial Performance of Financial Industry: Take Commercial Banks as The Case Study

Shenghua Feng*, Ruifan Zhou

Shenwan Hongyuan Group Co., Ltd., Beijing 100029, China

Corresponding author: Shenghua Feng, 121423732@qq.com

Abstract: Prudential supervision is the inevitable choice for the sustainable and steady development of commercial banks. This paper uses panel data of 22 "A-share" listed commercial banks from 2014 to 2020 to measure total factor productivity to represent financial performance of commercial banks, and uses systematic generalized method of moments (GMM) estimation method to empirically investigate the impact of major prudential supervision tools on financial performance of Chinese commercial banks. The study finds that the total factor productivity of commercial banks has experienced a decline and then a rise. The capital adequacy ratio and leverage ratio in prudential supervision instruments significantly promote the financial performance of commercial banks, while liquidity ratio and loan provision ratio have significant negative effects on the financial performance of commercial banks.

Keywords: Commercial bank; Prudential supervision; Financial performance; Total factor productivity

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1. Introduction

Prudential supervision is conducive to preventing and resolving financial risks, and can guarantee commercial banks to improve their financial performance from the policy perspective, and promote the development of commercial banks from simple expansion of scale to the pursuit of higher quality.

Domestic and foreign scholars have done a lot of in-depth research on the relationship between the financial performance of commercial banks and prudential supervision. However, scholars have not yet formed a unified view on how prudential supervision affects the financial performance of commercial banks at the micro level. Beck T, Demirgüçkunt A, and Levine R, stated that the way to improve the efficiency of banks is to strengthen the regulation and supervision of supervisory institutions [1]. Domestic experts and scholars represented by Xie Ping and Zou Chuanwei [2], when exploring the impact of prudential supervision on the regulatory efficiency of commercial banks, mostly analyze from the perspective of influencing factors.

According to the strategy of learning from each other, this paper explores the impact of prudential supervision on the financial performance of commercial banks from the perspective of total factor productivity, and sums up the theoretical basis for the financial performance of commercial banks to be affected by prudential supervision.

2. Measurement of the financial performance of commercial banks

Total factor productivity is the best measure of the relative efficiency and change of TFP decisions in output-input units. Charnes first proposed to measure the unit decision efficiency of input-output based on DEA. In the 21st century, the above DEA-Malmquist index method has been widely used in the financial performance system of commercial banks. Based on this, the author takes Caves as a reference to set the index productivity, and then explore and investigate the changing efficiency of the commercial bank operating system [3].

2.1. Measurement method

$$y \equiv (y_1, y_2, \dots, y_n), x \equiv (x_1, x_2, \dots, x_n)$$

Where, i represents the commercial bank output asset vector input asset vector define the Shephard linear distance of the bank output function as: for the technical output.

$$D_i(x_i, y_i) = \inf\{\theta : (y_i/\theta) \in P(x)\}, P(x)t$$

The Malmquist index based on the output perspective period is:

$$M_i^1(x_i^{1+1}, y_i^{t+1}, x_i', y_i') = D_i^1\left(x_i^{1+1}, y_i^{l+1}\right)/D_i^1(x_i^1, y_i') \quad (2\text{-}1)$$

$tt+1$In the above formula, changes to the output Malmquist index, namely TFP (TFP) belong and mean geometric values. The definition is as follows:

$$M_t M_{t+1}$$

$$M_i^{l,t+1} = \left[\frac{D_i^t\left(x_i^{t+1}, y_i^{l+1}\right)}{D_i^1(x_i^L, y_i^1)} \frac{D_i^{t+1}(x_i^{1+1}, y_i^{1+1})}{D_i^{t+1}(x_i^l, y_i^t)}\right]^{1/2} \quad (2\text{-}2)$$

The decomposition index is the index of Progress (TPC) (TEC) with constant remuneration scale:

$$TEC_i^{1,1+1} = \frac{D_{c,i}^{t+1}(x_i^{t+1}, y_i^{t+1})}{D_{c,i}^l(x_i^1, y_i^t)} \quad (2\text{-}3)$$

$$TPC_i^{t,t+1} = \left[\frac{D_{c,i}^t(x_i^{t+1}, y_i^{t+1})}{D_{c,i}^{t+1}(x_i^{t+1}, y_i^{t+1})} \frac{D_{c,i}^t(x_i^t, y_i^t)}{D_{c,i}^t(x_i^t, y_i^t)}\right]^{1/2} \quad (2\text{-}4)$$

Meanwhile, the efficiency Technical Change index (TEC) was further decomposed into the scale efficiency index (SE) with the efficiency Pure technology index (PTE):

$$TEC_i^{t,t+1} = \left[\frac{D_{t,i}^{t+1}(x_i^{t+1}, y_i^{t+1})}{D_{v,i}^t(x_i^t, y_i^t)}\right] \times \left[\frac{D_{v,i}^t(x_i^t, y_i^t)}{D_{c,i}^t(x_i^t, y_i^t)} \div \frac{D_{v,i}^{t+1}(x_i^{t+1}, y_i^{t+1})}{D_{c,i}^{t+1}(x_i^{t+1}, y_i^{t+1})}\right] = PTE_i^{t,t+1} \times SE_i^{t,t+1} \quad (2-5)$$

So, the all-factor commercial bank productivity is:

$$M_i^{t,t+1} = TEC_i^{t,t+1} \times TPC_i^{L,t+1} = PTE_i^{t,t+1} \times SE_i^{t,t+1} \times TPC_i^{t,t+1} \quad (2-6)$$

2.2. Set the output and input indicators and data sources

The output index selects the net interest income, net loan value and net profit (y_3), and the input index selects the number of employees, total deposits, operating expenses and interest expenses.

$$(y_1)(y_3)(x_1)(x_2)(x_3)(x_4)$$

Due to the need to consider the comprehensiveness, authenticity and practicality of the data, 22 annual data boards of commercial banks listed in 2014-2020 were selected, and the data came from the wind database.

2.3. Analysis of financial performance changes of commercial banks

Based on DEA2.1 TFP calculation, the operating system efficiency of listed commercial banks was measured, and the changes of commercial banks were analyzed respectively from the time and cross-section dimensions. The mean of the article belongs to the average geometric value.

Table 1. Total factor productivity and index breakdown of commercial banks

Year	effch	techch	pech	sech	tfpch
2015	0.966	1.01	1.015	0.953	0.977
2016	1.026	1.042	0.994	1.032	1.069
2017	1.037	0.994	1.013	1.023	1.031
2018	0.97	1.011	0.993	0.977	0.981
2019	1.011	0.965	0.988	1.023	0.975
2020	0.981	1.147	0.985	0.996	1.126
Mean	0.998	1.027	0.998	1	1.025

Listed commercial banks were analyzed by using the Malmquist index according to the time dimension. According to **Table 1**, on the average of the observation table, the TFP of listed commercial banks was not higher than 1 from 2015 to 2020 and decreased at a rate of 0.5 percentage points.

Table 2. Full factor productivity indicators and decomposition of 22 commercial banks

Bank name	effch	techch	pech	sech	tfpch
ICBC	1.000	1.260	1.000	1.000	1.260
CCB	0.993	1.056	0.993	0.999	1.048
ABC	1.000	1.042	1.000	1.000	1.042
Bank of China	1.000	1.033	1.000	1.000	1.033
BCM	1.014	1.049	1.013	1.001	1.064
Shanghai Pudong Development Bank	0.983	1.030	0.984	0.999	1.012
China Merchants Bank	1.000	1.068	1.000	1.000	1.068
Everbright Bank	0.996	1.058	1.000	0.996	1.053
CITIC Bank	0.995	1.044	0.999	0.996	1.038
HSBC Bank	0.996	1.057	0.997	1.000	1.053
Minsheng Bank	1.003	1.055	1.000	1.003	1.058
Industrial Bank	1.036	1.031	1.037	0.999	1.068
Ping An Bank	1.000	1.055	1.000	1.000	1.055
Bank of Beijing	1.000	0.951	1.000	1.000	0.951
Bank of Nanjing	1.036	0.975	1.034	1.002	1.010
Bank of Ningbo	1.001	1.052	1.000	1.001	1.054
Hangzhou Bank	0.956	0.949	0.956	1.000	0.908
Shanghai Bank	1.017	0.979	1.014	1.002	0.996
Bank of Zhengzhou	0.918	0.931	0.937	0.980	0.855
Bank of Changsha	1.027	0.993	1.000	1.027	1.020
Bank of Chengdu	1.000	1.005	1.000	1.000	1.005
Bank of Guiyang	0.998	0.958	0.997	1.001	0.956
Mean	0.998	1.027	0.998	1	1.025

Listed commercial banks were analyzed by using the Malmquist index based on the cross-sectional dimension. Referring to the People's Bank of China commercial bank classification criteria, 22 listed commercial Banks for urban commercial Banks, eight joint-stock commercial banks and five large commercial Banks, analysis **Table 2** learned that on the Malmquist index joint-stock and large commercial Banks are more than 1, that is, financial performance still has room to rise, but urban commercial bank TFP value of 0.976, which is the average deceleration of 2.4 percentage points. At the same time, from 2013 to 2017, the TFP of urban commercial banks gradually decreased. At the same time, the TFP of commercial banks in 2014 showed a downward trend, which cannot be separated from macro- economic regulation.

3. Study design and empirical results

3.1. Data description and variable selection

The explained part is the measured TFP and mainly evaluates the efficiency of the operating system of commercial banks. The main explanatory variables are regulatory prudential instruments, selecting the loan provision ratio (LPR) liquidity ratio (LAR), leverage ratio (LR), and capital adequacy ratio (CAR) in terms of loss provision regulatory preparation, liquidity, leverage, and capital. Based on the macro and micro levels, the fixed asset investment index price change (FAIPA), Gross domestic product Growth Rate (GDP), Cost-to-Income Ratio (CIR), return on equity (ROE), and total assets (TA) were selected as the control variables.

Table 3. Descriptive statistical results for the main variables

Variable	Obs	Mean	Std.Dev.	Min	Max
tfp	154	1.031084	0.2089535	0.555	3.22
CAR	154	0.1057344	0.0142328	0.0844	0.1468
LR	154	0.0648835	0.0095448	0.0362	0.1057
LAR	154	1.461485	0.6679277	0.7554	3.0043
LPR	154	2.375244	0.8821957	1.3244	3.2408
size	154	19.42776	1.346216	16.56342	21.82552
roe	154	0.1497543	0.0382523	0.076249	0.323244
CIR	154	0.2943812	0.0647439	0.1998	0.6647
TGDP	154	0.0802641	0.0254863	0.0298738	0.1147394
fdi	154	0.0802641	0.0254863	0.0298738	0.1147394

Table 3 belongs to the descriptive outcome statistics and explanatory key variables. The average value of the explained variable is 0.9974, indicating the overall efficiency of bank sample operation system; the lowest ratio of commercial banks is 9.88% and the average value is 12.66%, indicating that different types of commercial banks meet the most basic regulatory standards; the leverage ratio is 3.66% to 7.46%, reflecting the early occurrence of individual commercial banks that do not meet the regulatory standards.

3.2. Measurement method and model setting

In the static model panel, random effect mode and solid-state effect model inevitably need to explain the endogenous variable problem, the effective estimation is high, considering the GMM system estimation in the current period, the introduction of lag variables to the internal model cannot solve the endogenous problem, can improve the estimation efficiency [4].

The correlation between prudential regulatory instruments and the financial performance of commercial banks can be reviewed through the data model presented in the following dynamic panels:

$$TFP_{i,t} = \alpha_0 + \alpha_1 TFP_{i,t-1} + \alpha_2 CAR_{i,t} + \alpha_3 TA_{i,t} + \alpha_4 ROE_{i,t} + \alpha_5 CIR_{i,t} + \alpha_6 GDP_{i,t} + \alpha_7 FAIPA_{i,t} + \varepsilon_{i,t} \quad (3\text{-}1)$$

$$TFP_{i,t} = \alpha_0 + \alpha_1 TFP_{i,t-1} + \alpha_2 LR_{i,t} + \alpha_3 TA_{i,t} + \alpha_4 ROE_{i,t} + \alpha_5 CIR_{i,t} + \alpha_6 GDP_{i,t} + \alpha_7 FAIPA_{i,t} + \varepsilon_{i,t} \quad (3\text{-}2)$$

$$TFP_{i,t} = \alpha_0 + \alpha_1 TFP_{i,t-1} + \alpha_2 LAR_{i,t} + \alpha_3 TA_{i,t} + \alpha_4 ROE_{i,t} + \alpha_5 CIR_{i,t} + \alpha_6 GDP_{i,t} + \alpha_7 FAIPA_{i,t} + \varepsilon_{i,t} \quad (3\text{-}3)$$

$$TFP_{i,t} = \alpha_0 + \alpha_1 TFP_{i,t-1} + \alpha_2 LPR_{i,t} + \alpha_3 TA_{i,t} + \alpha_4 ROE_{i,t} + \alpha_5 CIR_{i,t} + \alpha_6 GDP_{i,t} + \alpha_7 FAIPA_{i,t} + \varepsilon_{i,t} \quad (3\text{-}4)$$

$TFP_{i,t-1}$itThe model (3-1) - (3-4) is the total factor productivity of the first commercial bank period, and the prudential supervision index of the first commercial bank period, the control variable, the parameter to be estimated, and the random error perturbation term.

$CAR_{i,t}$VLR$_{i,t}$, $LAR_{i,t}$LPR$_{i,t}$itTA$_{i,t}$ROE$_{i,t}$CIR$_{i,t}$, $GDP_{i,t}$FAIPA$_{i,t}$； $\alpha_0\alpha_1$、 $\alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6, \alpha_7\varepsilon_{i,}$

3.3. Analysis of the empirical results

For the preliminary establishment of the model, the systematic GMM estimation method is needed through STATA13.0 software, and **Table 4** is the estimation result of this process.

Table 4. Estimates of the financial performance of commercial banks by the prudential regulatory instrument

	(3-1)	(3-2)	(3-3)	(3-4)
tfp_lag	-0.0062*** (0.941)	-0.0045** (0.957)	-0.0078* (0.925)	-0.0056** (0.947
CAR	0.2750* (0.83)			
LR		1.9971* (0.274)		
LAR			-0.0031*** (0.922)	
LPR				-0.0029*** (0.895)
size	-0.0091*** (0.515)	-0.0123 (0.386)	-0.0094*** (0.556)	-0.0092* (0.526)
roe	-0.1612** (0.744)	-0.2531* (0.606)	-0.1894 (0.704)	-0.1672*** (0.736)
CIR	-0.1376 (0.607)	-0.1468** (0.58)	-0.1422 (0.594)	-0.1333*** (0.632)
TGDP	-1.5565** (0.027)	-1.5701** (0.23)	-1.6108** (0.033)	-1.5952 (0.023)
_cons	1.3750	1.3519*** (0)	1.4256*** (0.001)	1.4150*** (0.000)

The data in **Table 4** show that all the regression coefficients of total factor productivity in the latter phase are significant, which shows that the setting of this dynamic model is reasonable. Model (3-1) Data of the total factor productivity shows that the regression estimation coefficient is significantly positively correlated at 10%, which shows that the former has a positive impact on the latter, which can also reflect that the capital adequacy ratio has a significant impact on commercial banks. In the data of model (3-2), leverage ratio is financial performance and financial performance, which shows that the improved financial performance of commercial banks is effectively benefited from the leverage ratio. As can be seen from the data of model (3-3), the liquidity ratio was a negative significant at 1%, which shows that the higher the bank liquidity, the lower the risk, but it is followed by the problem of declining financial performance. The data results of model (3-4) show that the loan provision ratio is also at 1% is a negatively significant regression coefficient, and this data results suggest that the loan provision ratio has an inhibitory effect on total factor productivity.

3.4. Test of robustness

Robustness is tested by the index substitution method that ensures the robustness of the model data results.

In this robustness test, four indicators were selected to test: Tier 1 capital adequacy ratio to represent capital; financial leverage to represent leverage; liquidity as current assets; provision coverage to represent regulatory indicators for provision loss preparation, using these four indicators to obtain regression results [5].

4. Conclusions

According to the panel data collected by 22 commercial banks listed on "A-share" in China from 2014-2020, it is used to study how the financial performance of commercial banks changes in the context of prudential regulatory, deeply explore the specific ways that prudential regulatory tools act on financial performance, and explore their internal logic, using systematic GMM estimation methods to explore the relationship between different prudential regulatory tools and financial performance.

Disclosure statement

The author declares no conflict of interest.

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