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Bank Efficiency and Regional Economic Growth: Evidence from China

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This paper examines for the first time the relationship between bank efficiency and regional economic growth in China with provincial data over 1995 — 2014. We find consistent and strong evidence that bank efficiency positively affects regional economic growth. Further, bank efficiency exerts a more pronounced impact on economic growth in inland provinces than coastal regions. The insignificant effect of the quantity of credit in our regressions suggests that a mere expansion of financial volume is not effective in promoting regional economic growth, whereas the improvement in the quality of financial intermediation plays an important role in fostering provincial economic growth.

Key Words: Bank efficiency; Financial development; Regional growth; China.
JEL Classification Numbers: G21, O16, O47, O53.

1. INTRODUCTION

A well-functioning financial sector fosters economic growth via capital accumulation and increased capital productivity (Levine, 1997). Banks in China dominate in the financial sector whereas the equity and bond market is relatively small compared to the banking sector (Allen and Qian, 2014; Liu et al., 2018). Over the last two decades, China has witnessed successively soaring economic growth as well as fast expansion in the banking sector, which has drawn significant attention to banking sector development and economic growth in China.

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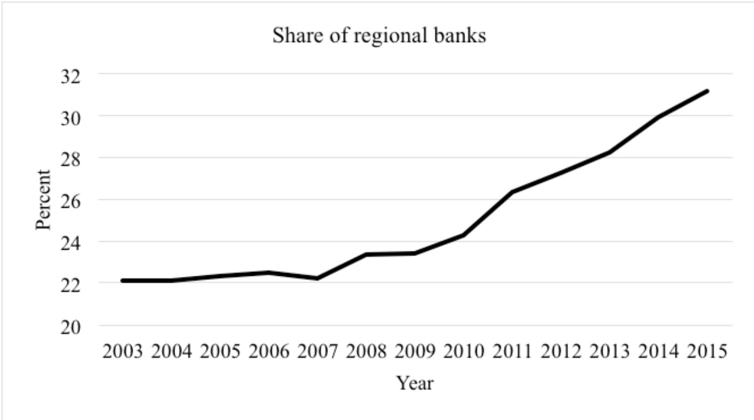
A flourishing body of literature has emerged to help researchers understand the relationship between financial development and economic growth in China. The empirical findings are, however, mixed at best. Some studies provide evidence supporting a positive relationship between finance and economic growth (e.g. Laurenceson and Chai, 2001; Chen, 2006; Ma and Jalil, 2008; Yao, 2010; He, 2012), while others find that the level of financial development in China has an insignificant or even negative impact on provincial economic growth (e.g. Aziz and Duenwald, 2002; Boyreau-Debray, 2003; Chang et al., 2010). Allen et al. (2005) argue that China is a counterexample to the finance-lead-growth literature because of its high economic growth rates and an under-developed financial system.

The above-mentioned studies on China use the ratio of liquid liabilities to GDP or the ratio of loans to GDP to measure financial development. Both variables reflect the quantity of the financial system in the economy. However, the use of quantity measures of financial development in the finance-growth studies are subject to two problems. First, the increases in liquid liabilities or loans in the financial sector as a result of excessive credit creation has a weak relationship with economic growth, suggested by Rousseau and Wachtel (2011). Second, the quantity measures essentially focus on the role of the financial sector in stimulating capital accumulation, while overlooking the efficiency role of the financial sector in improving capital productivity by channeling funds to the most productive projects (Koetter and Wedow, 2010). A fast expansion in the financial system does not necessarily indicate an improvement in the quality of financial intermediations to effectively allocate funds to productive investments. Therefore, a quality measure of the financial system is important for researchers to better understand the impact of financial development on economic growth in China.

In this paper, we examine for the first time the link between bank efficiency and provincial economic growth in China. Bank efficiency measures the ability of banks to convert inputs into financial products and services, which helps to capture the quality of financial development and provides a more meaningful way to assess the impact of financial systems on economic growth (Koetter and Wedow, 2010). Using bank-level financial data from Bankscope and provincial economic and demographic indicators over 1995-2014, we find that bank efficiency positively affects regional economic growth. The positive link is robust to different specifications, various subsamples, and alternative measures of bank efficiency. Our results also show that bank efficiency has a more pronounced impact on provincial economic growth in inland regions of China where there is a lack of alternative sources of financing. Interestingly, after controlling for bank efficiency, we do not see a significant relationship between the volume of credit and economic growth in our regressions. Findings of our study confirm the importance of the quality of financial intermediation, and provide policy implications that a simple expansion of credit is not sufficient to promote economic growth.

FIG. 1. Share of regional banks' assets in total bank assets



Data source: China Banking Regulatory Commission.

Our study contributes to the existing literature in several ways. First, we add to the broad literature of finance-led-growth by providing new evidence on how improvements in the quality of financial sector affect economic growth in a large emerging economy, which has not been systematically researched in the literature. Research exploring the quality measure of financial intermediations in the finance-growth nexus is relatively scant. Existing studies that do look at quality aspect of financial development are either cross-country (Berger et al., 2004; Hasan et al., 2009; Belke et al., 2016; Diallo, 2018) or focus on developed countries (Lucchetti et al., 2001; Koetter and Wedow, 2010). The only exception is Hasan et al. (2017), who examine the effect of bank efficiency on regional entrepreneurial activities in China. We aim to fill the paucity of studies on the finance-growth nexus in China. Second, our paper focuses on the growth impact of regional banks in China. Although the top five largest commercial banks and nationally active joint-stock banks still dominate the banking sector in China, regional commercial banks are playing an increasingly more important role in local economy. As illustrated in Figure 1, the share of regional banks' total assets rose from 22 percent in 2003 to 31 percent in 2015 in China (CBRC, 2015).[1] These regional commercial banks have become a critical part in the Chinese economy by providing financial services for micro and small

[1]Calculated by the authors with data from the China Banking Regulatory Commission 2015 annual report.

enterprises (MSEs), agro-related areas, and other disadvantaged groups who can hardly obtain finance from large banks. As a result, regional banks are essential to support local entrepreneurship and innovation, which are important drivers of economic growth. Third, with data over the period 1995 — 2014, we are able to evaluate the contribution of regional banks to local economic growth with more updated information and a longer time span, compared to Hasan et al. (2017).

The rest of the paper is organized as follows. Section 2 reviews the relevant literature. Section 3 specifies the empirical model and estimation approaches. We describe variables and data sources in Section 4 and present empirical results in Section 5. Conclusions are provided in Section 6.

2. LITERATURE REVIEW

Banks, the deposit-taking entity, are a crucial part in the financial sector by directing savings to lending, selecting projects, and supervising investment. The impact of the banking sector on economic growth takes place through two channels: increased investment through capital expansion and improved capital productivity when deposits are directed to productive investment projects.

There is a large literature on the impact of financial development on economic growth. Examples include King and Levin (1993), Levin (1997), Levine and Zervos (1998), Beck et al. (2000), Levin et al. (2000), Shan et al. (2001), and Rousseau and Wachtel (2011). Most studies focus on financial quantity measures, such as liquid liabilities, aggregate bank credit, or credit to the private sector, which nicely capture the aforementioned first channel through which financial development affects economic growth. However, there are two potential weaknesses associated with these quantity measures of financial development. First, the link between the mere size of financial system and economic growth can be weak (Brunnermeier and Sannikov, 2014) as rapid credit growth can lead to economic distress; second, these quantity measures do not portray the quality aspect of financial development in an economy, or the banking sector's ability to allocate resources to the most productive projects.

Recently, some empirical studies have begun to focus on the impact of banks' quality on economic growth. The quality of banks is often measured by their efficiency in converting inputs into outputs while minimizing costs. Efficient banks are able to fund optimal projects with low costs given a certain level of risks, improving capital productivity and thus contributing directly to economic development (Fries and Taci, 2005). In addition, efficient banks are more resilient to financial crisis (Diallo, 2018). As a result, bank efficiency also makes countries more resilient to financial frictions, which can have a beneficial impact on economic growth. Further, both empirical research (Hasan et al., 2017) and anecdotal evidence (Alfaro et al., 2004) suggest that bank efficiency promotes entrepreneurship and encourage innovations and in turn leads to increased productivity and better economic growth.

To our best knowledge, Lucchetti et al. (2001) is the first paper to look at how the quality of financial development affects economic growth in different regions in Italy. The authors estimate bank efficiency over the period 1982 — 1991 and show that bank efficiency has a positive effect on regional economic growth. Berge et al. (2004) employ data on community banks across 49 countries from 1993 to 2000 and find that countries with more efficient banks experience better economic performance. A study on 11 European countries between 1996 and 2004 by Hasan et al. (2009) indicates that an improvement in bank efficiency promotes economic growth. Using data for 97 economic planning regions and all German banks from 1995 to 2005, Koetter and Wedow (2010) find that the quality of financial development, proxied by bank cost efficiency, has a significantly positive effect on growth, whereas the traditional quantity measure, the ratio of credit volume to GDP, exhibits no significant impact. Belke et al. (2016) use a similar dataset to Hasan et al. (2009) but with an expanded time span over 2000-2013, and find similar results that more efficient banks boost regional economic growth in both normal and crisis periods. Diallo (2018) presents evidence that bank efficiency eased credit constraints and enhanced the output growth rate of industries dependent on external finance during the 2009 financial crisis based on a dataset covering 36 industries in 38 countries.

The above studies are either cross-country or focusing on developed economies where stock and/or bond markets are well developed and active as the banking sector. We propose in this paper to use bank efficiency to evaluate the quality of financial development in China. Being the largest emerging market, China is also a bank-based economy with loans from financial institutions amounting to about 99.35 trillion RMB yuan as of 2015, equivalent to 144.18 percent of nominal GDP.[2]

Empirical studies on finance and growth in China also tend to employ quantity measures of financial development. Empirical evidence regarding the relationship between financial development and economic growth from these studies is mixed. Among time-series studies, Laurenceson and Chai (2001) find a positive relationship between financial intermediation and economic growth over 1981 — 1998 with the ratio of bank loans to GDP as a measure of financial development. Shan and Qi (2006) find a two-way causality between finance and growth over 1978 — 2001 in China. Ma and

[2]Calculated by the authors with data obtained from the World Development Indicators (WDI) of the World Bank, and China Banking Regulatory Commission (CBRC) 2015 Annual Report.

Jalil (2008) show that the hypothesis of finance leading growth is supported only when using the ratio of liquid liabilities to GDP from 1960 to 2006, and the hypothesis is rejected when using the ratio of loans to private sector over GDP in 1977 — 2006. Along the line, using the ratio of bank loans to GDP in China from 1995 to 2001, Liang and Teng (2006) even counter the "finance-led growth" hypothesis and show a unidirectional causality from economic growth to financial development.

Panel data studies on China fail to present consistent results either. Aziz and Duenwald (2002) employ a panel of provincial data over 1988 — 1997 and find that the ratio of bank loans to GDP does not exert a significant impact on economic growth, though the loans to non-state sectors have a significantly positive effect on growth in China. Boyreau-Debray (2003) shows that bank loans have negative growth effects based on provincial data over 1990 — 1999. Chang et al. (2010) find no correlation between state-owned bank loans and regional economic growth using provincial data in 1991-2005. In contrast, Chen (2006) finds a positive relationship between the ratio of loans to state budgetary appropriation and household savings as well as economic growth. Similarly, a positive relationship between loans to the private sector and economic growth is also found in Yao (2010) with province-level data over 2002 — 2007. He (2012) shows that national bank loans, especially those allocated to the industrial sector have positive effects on economic growth using provincial data in 1981-1998.

It is surprising that almost no existing study connects bank efficiency with economic growth in China, despite its economic size and the dominance of banks in China's financial system. The only exception is Hasan et al. (2017) who investigate the effects of bank efficiency on regional entrepreneurial activities in China. With provincial level data on bank financing and new venture formation over 1998-2008, the study suggests a positive relationship between bank profit efficiency and regional new venture formation.

Our paper is the first one to incorporate bank efficiency to assess the effect of financial development on economic growth in China. We focus on the impact of regional banks on local economic performance. Our findings shed light on the rising role of regional banks in provincial economic development and provide important government policy implications.

3. ECONOMETRIC MODEL

This study employs a two-step approach to examine the relationship between the quality of financial development and economic growth in China. In the first step, we estimate bank efficiency with a stochastic frontier approach. In step two, we examine the link between bank efficiency and economic growth with provincial data in China.

3.1. The measurement of bank efficiency

We calculate bank cost efficiency using a stochastic frontier approach. The efficiency scores estimated this way gauge the performance of a bank relative to the best-practice bank producing the same amount of output with the same input. That is, the actual cost of a bank is compared to the minimum cost of the best performers in the sample (Fries and Taci, 2005). We follow Berger et al. (2009) and employ a flexible translog functional form with two inputs and four outputs to estimate the cost frontier function in this study. The empirical model used to estimate cost efficiency is as the following:

$$\begin{aligned}\ln\left(\frac{C}{w_2 z}\right)_{it} &= \alpha + \beta_1 \ln\left(\frac{w_1}{w_2}\right)_{it} + \frac{1}{2}\gamma_{11}\ln\left(\frac{w_1}{w_2}\right)_{it}\ln\left(\frac{w_1}{w_2}\right)_{it} + \sum_{j=1}^{4}\delta_j \ln\left(\frac{y_j}{z}\right)_{it} \\ &+ \frac{1}{2}\sum_{j=1}^{4}\sum_{k=1}^{4}\varphi_{jk}\ln\left(\frac{y_j}{z}\right)_{it}\ln\left(\frac{y_k}{z}\right)_{it} + \sum_{j=1}^{4}\theta_j \ln\left(\frac{y_j}{z}\right)_{it}\ln\left(\frac{w_1}{w_2}\right)_{it} \\ &+ \text{year dummies} + \ln u_i t + \ln v_{it} \qquad (1)\end{aligned}$$

where i and t index the bank and year, respectively; $j, k = 1, \ldots, 4$ index the four outputs (y): total loans, total deposits, liquid assets, and other earning assets. The two input prices (w) include price of funds that is defined as interest expenses to total deposits, and the price of capital measured by the ratio of non-interest expenses to fixed assets. Following the literature, we normalize bank outputs and total costs with total earning assets (z) to reduce heteroscedasticity and allow banks of any size to have comparable residual terms from which the efficiency scores are estimated. The normalization by one of the input price (w_2) ensures price homogeneity. We include year dummies in the estimation to allow a time trend to influence the efficiency of the banks to reflect the impact of technology shifts and other time-dependent effects.

A bank's cost efficiency, lnu, is estimated with truncated normal assumptions. It is determined by the difference between its observed cost and the predicted minimum cost of the best bank for a given scale and mix of outputs and input prices. The cost efficiency score is larger than 1, with higher score representing lower efficiency.[3] All parameters in the stochastic frontier model of equation (1) are estimated with the maximum likelihood procedure. We report the results of equation (1) in Table A1 and summarize the cost efficiency score of each province over the sample period in Table A2.

[3]Similar method is used to estimate bank profit efficiency in the literature. However, with data of Chinese banks over 1995 — 2014, we fail to find significant differences in profit efficiency among Chinese banks.

3.2. Bank efficiency and economic growth

Following Levine et al. (2000), Lucchetti et al. (2001), Hasan et al. (2009), and Koetter and Wedow (2010), we employ a dynamic panel growth model that is estimated with the system generalized method of moments (GMM).

$$\Delta Y_{it} = (\alpha - 1)Y_{it-1} + \beta \text{Efficiency}_{it} + \delta X_{it} + \eta_i + \gamma_t + \varepsilon_{it} \quad (2)$$

where Y_{it} is the natural logarithm of real per capita GDP in province i in year t; $\Delta Y_{it} = Y_{it} - Y_{it-1}$ represents the annual growth rate of real per capita GDP. As the long-term economic growth is conditional on the initial income level, the logarithm of lagged real GDP per capita (Y_{it-1}) is included to account for the convergence effect. Efficiency_{it} is the banking sector cost efficiency in each province over time and used to proxy for the quality of financial development. It is computed from equation (1); X_{it} includes a set of control variables that affect long-term economic growth; η_i captures the unobserved provincial differences that are fixed over time, such as the geographic advantages possessed by the coastal provinces or direct-controlled municipalities such as Beijing, Chongqing, Shanghai, and Tianjin. We also take into account the unobservable fixed effects over time (γ_t); ε_{it} is the random error.

In this model, the independent variable of interest is Efficiency_{it}. Cost efficiency is widely used in the literature to measure 'the quality of banks by their relative ability to intermediate savings efficiently to investors' (Koetter and Wedow, 2010, p. 1533).[4] We estimate cost efficiency for each bank in each year, and then compute the arithmetic mean of all banks' cost efficiency annually for each province to measure the quality of financial intermediation at the provincial level (Hasan et al., 2009; Koetter and Wedow, 2010; Belke et al., 2016).[5]

We include in the model a set of control variables that may be correlated with economic growth. As documented in the literature, the quantity or depth of financial intermediation is one of the determinants of economic growth. Therefore, we use share of loans by financial intermediaries to GDP to control for the quantity of financial intermediation.[6] For the other

[4]Some examples include Lucchetti et al. (2001), Hasan et al. (2009), and Koetter and Wedow (2010).

[5]As Koetter and Wedow (2010) point out, the simple average of cost efficiency for regional bank efficiency is chosen because cost efficiency is a relative measure derived from a benchmark bank that has taken into account of the heterogeneity among banks. Using the weighted average of cost efficiency taking into account the loan or deposit ratio would confuse the quality channel with the quantity channel.

[6]Share of loans by financial intermediaries to GDP is widely used in the finance-growth literature, such as Levine and Zervos (2000), Levine et al. (2000), Lucchetti et al. (2001), Hasan et al. (2009), Koetter and Wedow (2010), and in the context of China, Chang et al. (2010).

growth related control variables, we start with two commonly used variables in the Solow-growth model: the ratio of fixed assets investment to GDP, and the percentage of population growth. The former measures domestic investment in physical capital, and is expected to have a positive effect on economic growth. The latter is proposed to be negatively associated with economic growth as faster population growth may deter economic growth. Then we add additional variables one by one to control for the size of government in the economy, trade openness, and human capital.

The proper estimation of equation (4) needs to address several econometric concerns. First, the inclusion of lagged dependent variable may introduce bias in estimations if per capita GDP is serially correlated. Second, the direction of causality between the quality of financial development and economic growth may flow from the other way. Third, more than one variables are endogenous in equation (4). For example, when the economy grows, the volume of loans distributed by the financial sector expands, and domestic investment increases. Lastly, equation (4) is subject to omitted variable bias that is specific to each province but may be constant over time. To address the above issues, we employ the system GMM estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998) in this study. The system GMM estimator first differences equation (4) to rid provincial fixed effects. Then we specify the lagged real GDP per capita, the quality of financial development (efficiency), the ratio of loans to GDP, and the ratio of fixed assets investment relative to GDP as endogenous variables. The system GMM estimator estimates a system of equations in both first-differences and levels, where the instruments used in the first-differences equations are lagged levels of endogenous variables, and in the levels equations are lagged first-differences of the endogenous variables (Bond et al, 2001). The statistics of Sargan test of over-identifying restrictions and second-order autocorrelation test are reported in Section 5 to confirm the validity of instruments. Furthermore, following Roodman (2009), we only use certain lags, instead of all available lags for instruments and collapse instruments to reduce the concern of instrument proliferation.

4. DATA AND VARIABLES

The bank-level data used to estimate bank efficiency are obtained from Bankscope. We only include commercial banks and exclude other banks such as policy banks, investment banks, etc., from the data. We follow the heuristic approach in Hasan et al. (2009), Koetter and Wedow (2010), and Belke et al. (2016) to match individual banks to their province based on the location of their headquarters. There are three types of banks in the dataset: the five large commercial banks with substantial state ownership (Big Five), joint stock banks, and regional commercial banks. The Big

Five includes Agricultural Bank of China Limited (ABC), Bank of China Limited (BOC), China Construction Bank Corporation (CCB), Industrial & Commercial Bank of China (ICBC), and Bank of Communications Co. Ltd (BOCOM). The first four are headquartered in Beijing while the last one is in Shanghai, China. Similar to the Big Five, joint stock banks are also active nationally with their number ranging from five in 1995 to nine in 2014. Regional banks are much smaller and locally focused. The number of regional banks grew quickly from 12 in 1995 to 140 in 2014, indicating a gradual increase of importance in the Chinese banking sector.

TABLE 1.

Variables and definitions

Variables	Definitions
Dependent variables	
ΔY	Difference in logarithm of real GDP per capita -per capita GDP adjusted with consumer price index- between t and $t-1$
Primary output per capita	The logarithm of the real per capita value added in primary sector
Secondary output per capita	The logarithm of the real per capita value added in secondary sector
Tertiary output per capita	The logarithm of the real per capita value added in tertiary sector
Independent variables	
Cost efficiency	The logarithm of cost efficiency scores estimated with equation (1) and stochastic frontier approach.
Lag of GDP	The logarithm of real per capita GDP of the previous year
Loan ratio	Loans from financial institutions as a percentage of GDP
Investment ratio	Fixed assets investment as a percentage of GDP
Population growth	Percentage growth rate of population
Government expenditure	Ratio of government expenditure to GDP
Trade ratio	Trade as a percentage of GDP
Secondary school enrollment	Secondary school enrollments as a percentage of total population
SOE share	Share of state-owned enterprises (SOE) in industry output

Macroeconomic variables in our model are retrieved from the National Statistical Bureau of China. Provincial real GDP per capita is calculated by dividing per capita GDP with general consumer price index. We measure the quantity of financial intermediation with the ratio of loans to GDP, i.e., total loans in financial institutions as a percentage of GDP. Fixed assets investment is defined as the ratio of fixed assets investment to GDP. Human capital is captured by students enrolled in secondary schools relative to total population.[7] Population growth is the annual percentage change of provincial population. The sizes of government in the economy and trade

[7]We also try to measure human capital with students enrolled in college relative to total population in the regressions, and find qualitatively same results.

openness are measured with government expenditure to GDP and trade to GDP, respectively. Variable definitions are summarized in Table 1 and descriptive statistics of variables are provided in Table 2.

Three provinces — Hainan, Qinghai and Tibet are excluded from the regression analysis due to insufficient observations on bank efficiency. We end up with an unbalanced panel that includes 24 provinces and 4 municipalities with the shortest time span from 2005 to 2014 for Gansu province and the longest time span from 1995 to 2014 for several provinces and municipalities such as Beijing, Fujian, Guangdong, Shanghai and Zhejiang.

TABLE 2.

Descriptive statistics

Variables	No. of Observations	Mean Deviation	Standard	Minimum	Maximum
Growth rate of real GDP per capita (percentage)	560	0.139	0.062	−0.006	0.408
Real GDP per capita (RMB yuan)	560	20790.050	19348.280	1504.119	103239.900
Cost efficiency	367	1.211	0.174	1.037	2.420
Loan ratio (percent)	535	101.739	30.348	53.293	226.539
Investment ratio (percent)	559	49.212	19.928	23.292	115.323
Population growth (percent)	560	0.917	3.526	−30.444	68.725
Government expenditure (percent)	559	15.780	6.976	4.917	40.216
Trade ratio (percent)	558	315.463	397.536	32.049	2043.025
Secondary school enrollment (percent)	560	6.420	2.029	0.238	13.742
SOE share (percent)	465	42.168	18.771	5.185	88.398

Table 2 shows a wide variation in the level of development across provinces in China. The average growth rate of real GDP per capita is 13.9 percent with a standard deviation of 6.2 percent. The mean real GDP per capita in RMB is 20,790.05 yuan with a standard deviation of 19,348.28 yuan. Among all provinces and municipalities in our sample, Guizhou province in 1995 presented the lowest real GDP per capita at 1,504.12 yuan whereas Tianjin municipality in 2014 exhibited the highest real GDP per capita at 103,239.9 yuan. The cost efficiency score is about 1.211 on average and ranges from 1.037 to 2.42 with higher score representing lower cost efficiency. For an average province, the ratio of financial system loans to GDP is approximately 101 percent and the investment in fixed assets is roughly 49 percent of GDP. The average annual population growth is 0.9 percent; the share of government expenditure in GDP is 15.78 percent; average trade openness is about 315 percent of provincial GDP; and the ratio of secondary school enrollment relative to population is about 6.42 percent.[8] State-owned enterprises (SOEs) account for about 42.17 percent of GDP on average, with Zhejiang having the lowest SOE share at 5.19 percent in 2008 and Tibet having the highest share of SOE in 2000 at 88.40 percent.

5. REGRESSION RESULTS

5.1. Baseline results

We begin with estimating equation (2) with all banks in the sample. The estimated results are presented in Table 3. In column (1), we regress the annual growth rate of real per capita GDP on cost efficiency controlling for the logarithm of per capital GDP in the previous year, ratio of loans to GDP, ratio of fixed assets investment to GDP, and population growth. Bank efficiency exhibits a negative and significant coefficient at the 10 percent level. Since a higher cost efficiency score indicates lower bank efficiency in converting inputs to outputs, a negative coefficient suggests a positive effect of bank efficiency on economic growth. Meanwhile, lagged real GDP per capita also shows a significantly negative coefficient, implying a convergence effect that provinces with higher initial development level will grow slower in later years. Coefficients on other control variables, including financial quantity, domestic investment and population growth have the expected signs, although the coefficients are insignificant.

In Table 3, all reported robust standard errors in parentheses are corrected for the finite sample bias considering the small sample size of our study (Windmeijer, 2005).[9] Furthermore, in Table 3, we report instrument count and several post-estimation statistics to ensure the robustness of our estimated results. First, the F test statistics are significant at the 1 percent level, confirming the joint significance of all explanatory variables. Second, the insignificant second order autocorrelation test statistics suggest that the lagged endogenous variables are valid instruments. Third, the Sargan test of over-identification fails to reject the null hypothesis and further confirms the appropriateness of the instruments. Fourth, we compare the coefficient of lagged real GDP per capita estimated by the system GMM estimator with those of the ordinary least square (OLS) estimator and the fixed effects (FE) estimators.[10] The OLS estimate of lagged real GDP per capita could be biased upwards in the presence of individual-specific effects (Hsiao, 1986), whereas the FE estimate is biased downwards in short panels (Nickell, 1981). Thus, a consistent estimate is expected to lie in between the OLS and FE estimates (Bond et al, 2001). The comparison shows that

[8]The secondary education in China covers grades 7—12.

[9]Standard errors reported in all following tables are corrected for finite sample bias as well.

[10]The OLS and FE results are reported in Table A3 of appendix.

the coefficient of lagged real GDP per capita is between the corresponding OLS and FE estimates.

Next, we add additional control variables one by one to ensure robustness. For example, we take into account the percent share of government spending in GDP in column (2), the percent share of trade in GDP in column (3), the percentage of secondary school enrollment in column (4) and a dummy variable for coastal provinces in column (5) to account for geographical difference in economic growth.

TABLE 3.

Regression results with all banks in the sample

	(1)	(2)	(3)	(4)	(5)
Cost efficiency	-0.11238^{*}	-0.15639^{*}	-0.21325^{**}	-0.22158^{*}	-0.20826^{*}
	(0.060)	(0.080)	(0.092)	(0.113)	(0.120)
Lag of GDP	-0.04147^{*}	−0.01531	0.10062	0.09084	0.09722
	(0.024)	(0.037)	(0.095)	(0.076)	(0.066)
Loan ratio	0.00040	0.00012	−0.00038	−0.00006	−0.00020
	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)
Investment ratio	0.00033	−0.00009	−0.00112	−0.00066	−0.00065
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Population growth	0.19544	0.13442	0.12236	−0.04851	0.25987
	(0.356)	(0.387)	(0.221)	(0.283)	(0.305)
Government expenditure		0.00464	0.00942	0.00649	0.00795^{**}
		(0.004)	(0.008)	(0.006)	(0.004)
Trade ratio			−0.00011	−0.00010	−0.00012
			(0.000)	(0.000)	(0.000)
Secondary school enrollment				0.00474	−0.00173
				(0.010)	(0.009)
Coastal					−0.01305
					(0.141)
Constant	0.43916^{**}	0.24806	−0.50645	−0.47525	−0.50471
	(0.187)	(0.277)	(0.617)	(0.496)	(0.506)
F statistics	528.5^{***}	96.16^{***}	4419^{***}	19115^{***}	115.7^{***}
AR(2) p-value	0.714	0.511	0.336	0.136	0.249
Sargan test p-value	0.484	0.640	0.998	0.960	0.622
Instrument count	37	37	41	41	41
Observations	343	343	343	343	343
Number of regions	28	28	28	28	28

Note: This table displays the regression results of per capital GDP on cost efficiency controlling for a set of macroeconomic variables with all banks in the sample. Variable definitions are summarized in Table 1. The two-step system GMM estimation uses six lags starting with the second lag in the collapsed instrument matrix. Year dummies are included in the regressions. Robust standard errors in parentheses. *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

Results across different specifications in Table 3 are qualitatively similar. The coefficient of bank cost efficiency is consistently negative and significant at the 10 percent level or better suggesting that higher bank efficiency is associated with faster economic growth. This is consistent with findings in previous studies that an improvement in bank efficiency spurs local economic growth (Lucchetti et al, 2001; Berger et al., 2004; Hasan et al. 2009; Koetter and Wedow, 2010; Belke et al., 2016). For example, column (4) in Table 3 indicates that a one percent decrease in cost efficiency score is associated with a 0.22 percentage point increase in per capita real GDP growth rate on average, holding other variables constant. This impact of bank efficiency is economically meaningful — given a sample mean growth rate of 13.9 percent, a 0.22 percentage point increase in provincial economic growth rate is equivalent to a 1.6 percent increase of the mean growth rate.

There is little evidence in Table 3 suggesting conditional convergence as the coefficient of lagged per capita GDP is significantly negative in only one out of five regressions. This result is similar to that in Aziz and Duenwald (2002) and Boyreau-Debray (2003). Boyreau-Debray (2003) argues that the phenomenon is due to increased relative dispersion of income per capita in the late 1990s.[11] Since the coefficient of lagged GDP captures the short-run growth effect, the convergence of income is weak in the short time period given the rapid economic growth in China in the 2000s.[12] Coefficients of other control variables are not statistically different from zero. It is especially noteworthy that the ratio of loans to GDP, which measures the quantity aspect of financial development, does not have a significant impact on economic growth. Such results are consistent with those in Koetter and Wedow (2010) and suggest that it is important to look at both the quantity and quality aspects of financial development. Further, a possible explanation for the insignificance of loan expansion in influencing economic growth could be that Chinese banks have a systemic lending bias in favor of SOEs, which generally have lower productivity and higher default risks compared to private enterprises (Lu et al., 2007).

5.2. Results excluding financial centers and nationally active banks

Financial centers in China are likely to have a higher concentration of financial services than other regions in the country. Beijing hosts headquarters of the largest four state-owned banks (ABC, BOC, CCB, and

[11]We compute the coefficient of variation for logarithm of real GDP per capita for 1995-1999, 2000-2004, 2005-2009 and 2010-2014, and find that the coefficient of variation increased in the 2000s despite the slight decline in early 2000s.

[12]The panel data in this study are highly unbalanced with 14 out of 28 provinces having no more than 10 years of observations. There is a large variation in economic growth. The less developed provinces experienced faster growth of per capita GDP in late 2000s or early 2010s.

TABLE 4.

Regression results excluding financial centers

	(1)	(2)	(3)	(4)
Cost efficiency	-0.09469^{*}	-0.11904^{**}	-0.18096^{***}	-0.19713^{**}
	(0.051)	(0.055)	(0.061)	(0.081)
Lag of GDP	−0.03469	−0.01466	0.08058	0.09030
	(0.026)	(0.035)	(0.076)	(0.081)
Loan ratio	0.00037	0.00017	−0.00026	−0.00024
	(0.000)	(0.001)	(0.001)	(0.001)
Investment ratio	0.00047	0.00008	−0.00082	−0.00083
	(0.001)	(0.001)	(0.001)	(0.001)
Population growth	0.13807	0.11004	0.12549	0.11265
	(0.354)	(0.367)	(0.222)	(0.239)
Government expenditure		0.00395	0.00786	0.00719
		(0.003)	(0.006)	(0.007)
Trade ratio			−0.00009	−0.00010
			(0.000)	(0.000)
Secondary school enrollment				0.00376
				(0.012)
Constant	0.39725^{*}	0.25283	−0.34963	−0.41312
	(0.194)	(0.249)	(0.499)	(0.536)
F statistics	421^{***}	133.7^{***}	1356^{***}	2505^{***}
AR(2) p-value	0.630	0.430	0.311	0.320
Sargan test p-value	0.395	0.504	0.995	0.993
Instrument count	37	37	41	41
Observations	287	287	287	287
Number of regions	25	25	25	25

Note: This table displays the regression results of per capital GDP on cost efficiency controlling for a set of macroeconomic variables with a subsample excluding financial centers. Variable definitions are summarized in Table 1. The two-step system GMM estimation uses six lags starting with the second lag in the collapsed instrument matrix. Year dummies are included in the regressions. Robust standard errors in parentheses. *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

ICBC) and other nationally active commercial banks. Shanghai is home for the fifth largest commercial bank in China (BOCOM). Stock exchanges in China are located in Shanghai and Shenzhen, Guangdong province that enable the two regions to have access to more funds that could contribute to local economic growth. To ensure that our results are not driven by such regional imbalances, we re-estimate the growth equation by excluding Beijing, Shanghai, and Guangdong province from the sample and report the results in Table 4. The (positive) growth effect of bank efficiency remains unchanged, as the coefficient of the bank cost efficiency score is negative and significant in all regressions in Table 4. The magnitude of coefficient of cost efficiency, however, is smaller in absolute value in Table 4 compared to that in Table 3.

The Big Five and joint stock banks are nationally active with branches across the country, which makes it difficult to define a single location for their activities. In addition, with countrywide network of branches, these large national banks enjoy higher capital mobility than regional banks that mostly channel local savings to local investment projects. Furthermore, the Big Five are state-owned banks and have strong policy tendencies when allocating loans. In Table 5, we exclude these nationally active banks from our sample and investigate how the efficiency of regional banks contributes to local economic growth. Panel A in Table 5 shows the results including financial centers, and panel B excluding financial centers. By and large, results in Table 5 are qualitatively similar to those reported in Tables 3 and 4. Without nationally active banks in our sample, the coefficient on bank cost efficiency is still negative and statistically significant in all regressions, indicating higher regional bank efficiency is associated with faster local economic growth. Taking results in column (4) as an example where the full set of variables are included, a 1 percent decrease in bank efficiency score is associated with a 0.14 percentage point increase in economic growth on average, holding other variables constant. With a subsample of regional banks in non-financial-center regions, panel B of Table 5 reports similar results as those in panel A. For example, column (8) suggests that with a 1 percent decrease in bank efficiency score, the growth rate of real per capita GDP increases by 0.16 percentage point on average, controlling for other variables.

5.3. Robustness checks

We divide the sample into four five-year periods: 1995-1999, 2000-2004, 2005-2009 and 2010-2014. We use the first available value of real GDP per capita of each province to control for the initial level of development and thereby capture the conditional convergence effect on growth. Next, we calculate five-year averages of economic growth and other independent variables to smooth out short-run fluctuations. Lastly, all independent variables except the initial level of real GDP per capita are lagged by one period to avoid the endogeneity issue. The random effects (RE) estimates of equation (2) are reported in Table 6. We employ cost efficiency scores of all banks in columns (1) and (2). To further control for regional difference, the coastal dummy is included in column (2). We exclude the Big Five and joint stock banks and focus on local bank cost efficiency in columns (3) and (4) with column (4) further excluding financial centers. Results in Table 6 are qualitatively similar to those in Tables 4 and 5 that lagged cost efficiency of all banks as well as local banks has a positive and significant effect on provincial economic growth.

TABLE 5.

Regression results with regional banks only

	Panel A: Regional banks including financial centers				Panel B: Regional banks excluding financial centers			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cost efficiency	−0.11076*	−0.12422*	−0.13634*	−0.14106*	−0.10231*	−0.10373*	−0.14447*	−0.15567**
	(0.062)	(0.071)	(0.071)	(0.073)	(0.058)	(0.056)	(0.071)	(0.075)
Lag of GDP	0.01983	0.02538	−0.00626	−0.00719	0.01689	0.01741	0.00785	0.00414
	(0.039)	(0.047)	(0.037)	(0.041)	(0.041)	(0.043)	(0.035)	(0.038)
Loan ratio	−0.00073	−0.00071	−0.00063	−0.00035	−0.00063	−0.00062	−0.00053	−0.00014
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
Investment ratio	0.00079	0.00049	0.00004	0.00021	0.00071	0.00067	0.00008	0.00009
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Population growth	0.20935	0.22713	0.23631	0.25459	0.14952	0.15435	0.35946	0.41271
	(0.293)	(0.318)	(0.210)	(0.239)	(0.344)	(0.343)	(0.221)	(0.282)
Government expenditure		0.00147	0.00219	−0.00183		0.00021	0.00242	−0.00168
		(0.004)	(0.003)	(0.007)		(0.003)	(0.003)	(0.005)
Trade ratio			0.00002	−0.00000			−0.00000	−0.00003
			(0.000)	(0.000)			(0.000)	(0.000)
Secondary school enrollment				0.00967				0.01150
				(0.014)				(0.014)
Constant	−0.04451	−0.07910	0.29080	0.26667	−0.01675	−0.01948	0.25767	0.16581
	(0.432)	(0.480)	(0.265)	(0.314)	(0.432)	(0.439)	(0.263)	(0.454)
F statistics	232869***	19742***	174.6***	6928***	4793***	80679***	2490***	3232***
AR(2) p-value	0.570	0.530	0.654	0.571	0.576	0.565	0.788	0.871
Sargan test p-value	0.949	0.927	0.882	0.915	0.923	0.882	0.858	0.945
Instrument count	37	37	41	41	37	37	41	41
Observations	343	343	343	343	287	287	287	287
Number of regions	28	28	28	28	25	25	25	25

Note: This table displays the regression results of per capital GDP on cost efficiency controlling for a set of macroeconomic variables with a subsample of regional banks only. Variable definitions are summarized in Table 1. The two-step system GMM estimation uses six lags starting with the second lag in the collapsed instrument matrix. Year dummies are included in the regressions. Robust standard errors in parentheses. *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

For additional robustness checks, we include in our regressions alternative measures of financial volume, bank cost efficiency, and human capital. First, we use the ratio of household deposits relative to GDP to measure financial volume. Second, instead of using the mean cost efficiency, we use the median cost efficiency as suggested by Hasan et al. (2009). Third, we use college enrollment instead of second school enrollment to measure human capital of each province.[13] Our results are robust to all these alternative measures.

TABLE 6.

Robustness checks

	(1) All Banks	(2) All Banks	(3) Regional Banks	(4) Regional Banks Excluding Financial Centers
Initial real GDP	−0.03678***	−0.04037***	−0.03897***	−0.03553**
per capita	(0.010)	(0.011)	(0.011)	(0.016)
Lagged loan ratio	−0.00004	−0.00001	−0.00001	0.00008
	(0.000)	(0.000)	(0.000)	(0.000)
Lagged cost	−0.04375**	−0.04530**	−0.04530**	−0.04194*
efficiency	(0.021)	(0.022)	(0.019)	(0.024)
Lagged investment	0.00074***	0.00076***	0.00079***	0.00049
ratio	(0.000)	(0.000)	(0.000)	(0.000)
Lagged population	−0.40906***	−0.39930***	−0.40583***	−0.37080***
growth	(0.103)	(0.104)	(0.104)	(0.111)
Lagged government	−0.00015	−0.00004	−0.00002	0.00013
expenditure	(0.001)	(0.001)	(0.001)	(0.001)
Lagged trade	0.00002	0.00002	0.00002	0.00002
ratio	(0.000)	(0.000)	(0.000)	(0.000)
Lagged secondary	−0.00098	−0.00125	−0.00104	−0.00020
school enrollment	(0.001)	(0.002)	(0.002)	(0.002)
Coastal		0.00627	0.00595	0.00281
		(0.008)	(0.008)	(0.010)
Constant	0.42912***	0.45376***	0.44038***	0.40428***
	(0.087)	(0.094)	(0.091)	(0.135)
R-square	0.776	0.781	0.786	0.747
Chi-square	153***	152.6***	154***	120***
Observations	56	56	56	47
Number of regions	28	28	28	25

Note: The above results are estimated by the random effects estimator controlling for province fixed effects. Period dummies are included in the regressions to control for time fixed effects. Robust standard errors in parentheses, *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

In summary, with different specifications, various subsamples, and alternative measures of control variables, we find strong and consistent evidence

[13]The average ratio of household deposits to GDP is 133 percent, and the average college enrollment as a percentage of population is 1.15 percent. The results with alternative measures are not included in the paper for the purpose of brevity, but available upon request.

that the bank cost efficiency score is negatively related to per capita GDP growth. This implies that quality of the banking sector, measured by bank efficiency, contributes to provincial economic growth. This evidence is consistent with results in Lucchetti et al. (2001), Berger et al. (2004), Hasan et al. (2009), Koetter and Wedow (2010), and Belke et al. (2016) who find a positive effect of banking quality on regional economic growth. Furthermore, our findings in the context of China align with the beneficial effect of bank quality revealed in Hasan et al. (2017) who suggest a positive relationship between more efficient banks and new ventures using provincial data in China.

Meanwhile, the coefficient of the ratio of loans to GDP is insignificant in all specifications and subsamples, implying that simply expanding the size of loans does not necessarily promote regional economic growth in China. This is in line with Hasan et al. (2009) and Rousseau and Wachtel (2011) who find that a mere deepening of credit market may not foster local economic growth in cross-country studies. Furthermore, these results echo those in Aziz and Duenwald (2002), Boyreau-Debray (2003), and Hasan et al. (2017) that the volume of bank lending has an insignificant or negative effect on provincial growth of GDP per capita or new venture formation in China.

5.4. State share of industrial output

One may ask whether SOEs concentrate in provinces that have a low economic growth rate and a high loan-to-GDP ratio (Aziz and Duenwald, 2002). To address this concern, we include in our regression the share of value added by SOEs in total industrial output in a province to control for SOEs concentration. The data are available from 2000 to 2014. SOEs remain an important part in Chinese economy with them accounting for 42.17 percent of total industrial output over 2000-2014. Yet their share in industrial production indeed declined from 63.37 percent in 2000 to 31.76 percent in 2014, suggesting China's gradual transition from a planned economy to a market-based economy.

Regression results with the share of SOEs in industrial output are reported in Table 7.[14] The coefficient of bank cost efficiency is negative and significant in most regressions, which again indicate that provinces with more efficient banks tend to grow faster. The share of SOE in industrial output has a negative coefficient in all specifications, but the coefficient is

[14]As we focus on the growth effect of regional banks channeling local funds to local investment projects, the data used in Table 6 and after include only regional banks unless explicitly specified. There is a caveat regarding the Sargan over-identifying test statistics. Although the Sargan test statistics of over-identification reject the null hypothesis of no correlation between the instruments and errors, the reported Hansen over-identification test statistics in Table 6 fail to reject the null hypothesis, which mitigates the concern of invalidity of instruments.

not estimated precisely. As prior studies typically find a negative and significant effect of SOEs presence on regional economic growth or the level of provincial output (Chang et al., 2010), the insignificant effect of the share of SOEs seems to indicate the declining state intervention in modern Chinese economy.

TABLE 7.

Regress results including the share of SOEs in industrial output

	(1)	(2)	(3)	(4)
Cost efficiency	−0.12813	−0.16452*	−0.15638**	−0.22152***
	(0.081)	(0.096)	(0.067)	(0.070)
Lag of GDP	0.00366	0.00592	0.01639	0.05771
	(0.019)	(0.024)	(0.050)	(0.041)
Loan ratio	−0.00021	−0.00029	−0.00010	0.00004
	(0.000)	(0.000)	(0.000)	(0.001)
Investment ratio	0.00091	0.00056	−0.00011	−0.00039
	(0.001)	(0.001)	(0.001)	(0.001)
Population growth	−0.17015	−0.08509	0.12233	0.14368
	(0.454)	(0.397)	(0.295)	(0.327)
SOE share	−0.00033	−0.00053	−0.00115	−0.00104
	(0.001)	(0.001)	(0.001)	(0.001)
Government expenditure		0.00354	0.00619	0.00697*
		(0.003)	(0.004)	(0.004)
Trade ratio			−0.00005	−0.00010*
			(0.000)	(0.000)
Secondary school enrollment				0.00275
				(0.013)
Constant	0.00000	0.07238	−0.15649	0.00000
	(0.000)	(0.213)	(0.534)	(0.000)
F statistics	91.95***	301.6***	95.92***	11.20***
AR(2) p-value	0.331	0.327	0.243	0.143
Sargan test p-value	0.000237	$4.41e-05$	0.00229	0.0210
Hasan test p-value	0.747	0.354	0.885	0.943
Instrument count	41	36	43	43
Observations	311	311	311	311
Number of regions	28	28	28	28

Note: This table presents the regression results of per capital GDP on cost efficiency controlling for a set of macroeconomic variables with a subsample of regional banks only. Variable definitions are summarized in Table 1. The two-step system GMM estimation uses five lags starting with the fourth lag in the collapsed instrument matrix. Year dummies are included in the regressions. Robust standard errors in parentheses. *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

5.5. Geographical and industrial breakdown

There is a regional imbalance in economic development between the coastal and inland regions in China. In our sample, the mean real GDP per capita in for coastal provinces is 27,343 RMB yuan while that of inland provinces is 16,045 RMB yuan. A similar regional difference is observed in the quantity and quality of banks in the two regions. The coastal regions are headquarters of an average of 6.82 banks while the inland provinces are headquarters of an average of 3.04 banks. The mean cost efficiency in coastal provinces is 1.20 with a standard deviation of 0.15 whereas the mean cost efficiency in inland provinces is 1.22 with a standard deviation of 0.19. That is, both the quantity and quality of banks in inland regions are inferior to coastal regions. To explore whether there is a differential growth effect of bank efficiency in different geographic locations, we divide the sample into coastal and inland provinces and report the regression results of the growth equation in Table 8. The results show that bank cost efficiency has an insignificant coefficient in regressions for coastal provinces, but exhibits a negative and significant coefficient in regressions for inland provinces. We posit that the insignificant growth effect of bank efficiency in coastal provinces may be caused by differences in development of alternative financial service providers other than banks. With more active economic activities and more financial service companies besides banks located in coastal regions, borrowers have better access to external funds other than loans from the banking sector. In comparison, inland provinces are more restricted to and rely heavily on bank financing. Therefore, the improvement in bank efficiency tends to have a more noticeable impact on the economic growth of inland provinces.

Chinese economy can be broken down into three strata: (1) primary sector including agriculture, forestry, animal husbandry, and fishery industries, (2) secondary sector including mining and quarrying, manufacturing, production and supply of electricity, steam, gas and water, and construction, and (3) tertiary sector covering all other economic activities not included in the primary or secondary industries, and mostly services.[15] We collect data on value added of the three sectors from various issues of the China Statistical Yearbook and construct real per capita output in each sector to explore the impact of bank efficiency on different types of output.[16] The estimated results are displayed in Table 9. The negative and significant coefficient on bank cost efficiency in columns (1) and (2) supports the beneficial growth effect of local bank efficiency on the growth of per capita output in primary

[15]According to the China Statistical Yearbook, tertiary industry includes transportation, storage and post service; wholesale and retail trades; hotels and catering services; financial intermediation; real estate; and others.

[16]The average real per capita value added in the primary, secondary, and tertiary industry are 193, 972, and 904 yuan in RMB yuan, respectively.

TABLE 8.

Geographic breakdown between inland and coastal provinces

	Panel A: inland regions	Panel B: coastal regions
	(1)	(2)
Cost efficiency	−0.17785**	0.02381
	(0.069)	(0.033)
Lag of GDP	0.01077	0.02042
	(0.096)	(0.039)
Loan ratio	0.00071	0.00023
	(0.001)	(0.001)
Investment ratio	−0.00021	0.00085***
	(0.001)	(0.000)
Population growth	−0.16072	0.23508
	(0.219)	(0.259)
Government expenditure	−0.00576	0.00477
	(0.006)	(0.009)
Trade ratio	−0.00005	−0.00005
	(0.000)	(0.000)
Secondary enrollment	0.01403	0.00260
	(0.013)	(0.007)
Constant	−0.16600	−0.00177
	(0.676)	(0.271)
F statistics	36.75***	2.404***
AR(2) p-value	0.447	0.762
Sargan test p-value	0.933	0.760
Instrument count	46	46
Observations	186	157
Number of regions	18	10

Note: This table displays the regression results of per capital GDP on cost efficiency controlling for a set of macroeconomic variables with a subsample of regional banks only. Variable definitions are summarized in Table 1. The two-step system GMM estimation uses six lags starting with the second lag in the collapsed instrument matrix. Year dummies are included in the regressions. Robust standard errors in parentheses. *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

and secondary sectors. Column (3) shows a negative but insignificant effect of bank efficiency on the growth of per capita output in the tertiary sector. The results indicate that the improvement in bank efficiency benefits the growth of primary and secondary industrial production in China. Given the importance of manufacturing sector in Chinese economy and the critical role of agricultural sector in inland provinces, these findings confirm the contribution of bank efficiency to economic development in China.

TABLE 9.

Sectoral breakdown of output

	(1)	(2)	(3)
	Primary Sector	Secondary Sector	Tertiary Sector
Cost efficiency	-0.13684^{*}	-0.10925^{**}	-0.01610
	(0.073)	(0.054)	(0.070)
Lag of GDP	-0.10162	0.02904	-0.03405
	(0.062)	(0.044)	(0.043)
Loan ratio	-0.00083	0.00015	0.00034
	(0.001)	(0.000)	(0.001)
Investment ratio	0.00137	-0.00003	0.00110^{**}
	(0.001)	(0.001)	(0.000)
Population growth	-1.02358^{**}	-1.16740^{***}	-1.14299^{***}
	(0.412)	(0.164)	(0.269)
Government expenditure	0.00166	0.00450	-0.00150
	(0.006)	(0.005)	(0.004)
Trade ratio	-0.00004	-0.00008	0.00008
	(0.000)	(0.000)	(0.000)
Secondary enrollment	-0.00117	-0.00031	0.00205
	(0.009)	(0.008)	(0.006)
Constant	-0.06543	-0.37667	-1.66990^{**}
	(0.412)	(0.405)	(0.695)
F statistics	469^{***}	214.2^{***}	1230^{***}
AR(2) p-value	0.709	0.269	0.495
Sargan test p-value	1.000	1.000	1.000
Instrument count	46	46	46
Observations	343	343	343
Number of regions	28	28	28

Note: This table displays the regression results of real per capital GDP on cost efficiency controlling for a set of macroeconomic variables with a subsample of regional banks only. Variable definitions are summarized in Table 1. The two-step system GMM estimation uses eight lags starting with the second lag in the collapsed instrument matrix. Year dummies are included in the regressions. Robust standard errors in parentheses. *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

6. CONCLUSION

Efficient financial intermediaries can foster economic growth by effectively channeling funds from depositors to borrowers and selecting more productive investment projects while reducing costs of borrowing. A number of empirical studies have examined how the efficiency of financial intermediation affects regional economic growth in developed countries. However, few have explored the relationship in a large emerging economy like

China. This study bridges the gap by focusing on the finance-growth nexus in the context of China that is known for its less developed financial sectors. Using provincial data from 1995-2014, we find strong and consistent evidence that the efficiency of regional banks has a positive and significant effect on regional economic growth in China. This is consistent with Hasan et al. (2017) who find that bank efficiency is positively associated with regional entrepreneurial activities in China, as entrepreneurial activities and innovation have been widely agreed to be a driver of long-run economic development. Considering the regional imbalances in economic development and availability of financing in China, we evaluate the relationship between bank cost efficiency and economic growth for inland and coastal regions separately. The growth effect of bank efficiency is observed in inland regions, but not in the coastal provinces. We also explore the growth effect of bank efficiency by looking at real per capita output in primary, secondary, and tertiary sectors. Our results show that the efficiency of regional banks contributes positively to the growth of primary and secondary sectors while does not have a significant impact on the growth of the tertiary sector.

The findings of this study have several important implications. First, while we find strong evidence that an efficient banking sector is associated with higher economic growth, we do not find a significant relationship between the amount of loans from financial institutions and economic growth. This implies that improving the quality of financial intermediation is very important in promoting economic growth, and simply expanding the quantity of credit is not sufficient.

Second, regional banks are increasingly important in the Chinese economy as indicated in Figure 1 showing a steadily rising share of regional banks' assets in the banking sector. Our findings of the growth effect of regional bank efficiency confirm the essential role of regional banks in facilitating regional economic growth. In inland provinces where there is a heavy reliance on bank financing due to the lack of alternative source of funds, improving the efficiency of regional banks is crucial in promoting local economic growth.

Third, the Big Five and joint stock banks in China tend to favor state-owned enterprises and large companies, making it difficult for small and medium enterprises (SMEs) to obtain loans from large commercial banks. Consequently, SMEs have to turn to regional banks for funds and become the main customer base of regional banks. Policymakers in China hope to drive economic growth with more private investment rather than state spending. As the main source of financing for SMEs, regional banks play an important role in local economic growth. Since most of the new ventures rely on regional banks for financing support, it is critical that the Chinese government further liberalizes the financial market, incentivizes regional banks to improve their efficiency, and streamlines procedures to make it easier for SMEs to obtain funds from regional banks.

APPENDIX

TABLE 1.

Stochastic frontier estimation of equation (1)

	Coefficients	p-value
Intercept	4.934	0.090
$\ln(y_1/z)$	−2.949	0.227
$\ln(y_2/z)$	5.314	0.000
$\ln(y_3/z)$	−5.682	0.000
$\ln(y_4/z)$	2.016	0.263
$0.5\ln(y_1/z)\ln(y_1/z)$	−1.317	0.026
$0.5\ln(y_1/z)\ln(y_2/z)$	3.806	0.000
$0.5\ln(y_1/z)\ln(y_3/z)$	−2.437	0.002
$0.5\ln(y_1/z)\ln(y_4/z)$	2.757	0.153
$0.5\ln(y_2/z)\ln(y_2/z)$	−0.338	0.300
$0.5\ln(y_2/z)\ln(y_3/z)$	0.846	0.002
$0.5\ln(y_2/z)\ln(y_4/z)$	2.803	0.000
$0.5\ln(y_3/z)\ln(y_3/z)$	−0.699	0.000
$0.5\ln(y_3/z)\ln(y_4/z)$	−1.314	0.025
$0.5\ln(y_4/z)\ln(y_4/z)$	0.469	0.002
$\ln(w_1/w_2)$	−0.316	0.424
$\ln(w_1/w_2)\ln(w_1/w_2)$	0.004	0.884
$\ln(w_1/w_2)\ln(y_1/z)$	−0.211	0.374
$\ln(w_1/w_2)\ln(y_2/z)$	0.622	0.001
$\ln(w_1/w_2)\ln(y_3/z)$	0.001	0.992
$\ln(w_1/w_2)\ln(y_4/z)$	−0.141	0.485
No. of observations	1,229	
Wald chi-squared	883.85^{***}	

Note: This table shows the estimation results of equation (1). The dependent variable is $\ln(\frac{C}{w_2 z})$, where C is the total cost of a bank; y_1, y_2, y_3, and y_4 represents the four outputs: total loans, total deposits, liquid assets, and other earning assets, respectively; z is total earning assets; and w_1 and w_2 are the input prices: price of funds, and price of capital. Year dummies are included in the regressions. *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

TABLE 2.

Bank efficiency scores

Province	Efficiency score	Standard deviation
Anhui	1.183581	0.130662
Beijing	1.172957	0.067848
Chongqing	1.284728	0.391506
Fujian	1.187961	0.114054
Gansu	1.073515	0.016911
Guangdong	1.224358	0.066638
Guangxi	1.263507	0.139503
Guizhou	1.208678	0.116408
Hebei	1.176579	0.07814
Heilongjiang	1.129253	0.065192
Henan	1.143844	0.058579
Hubei	1.168314	0.078681
Hunan	1.158606	0.073344
Inner Mongolia	1.40938	0.096
Jiangsu	1.188517	0.074905
Jiangxi	1.307195	0.111362
Jilin	1.397422	0.202921
Liaoning	1.123188	0.048519
Ningxia	1.220035	0.070656
Shaanxi	1.236653	0.294107
Shandong	1.202903	0.173856
Shanghai	1.270733	0.186627
Shanxi	1.121379	0.04532
Sichuan	1.320018	0.360914
Tianjin	1.210887	0.289195
Xinjiang	1.142058	0.107012
Yunnan	1.228997	0.087854
Zhejiang	1.175583	0.101557

TABLE 3.

Benchmark regressions

	(1) OLS	(2) FE
Cost efficiency	−0.00278	−0.00128
	(0.010)	(0.014)
Lag of GDP	−0.00846*	−0.08358***
	(0.005)	(0.023)
Loan ratio	−0.00003	−0.00019
	(0.000)	(0.000)
Investment ratio	0.00103***	0.00168***
	(0.000)	(0.000)
Population growth	−0.14832	−0.08595
	(0.192)	(0.182)
Province fixed effects	No	Yes
Year fixed effects	Yes	Yes
Constant	0.33052***	0.91284***
	(0.042)	(0.171)
R-squared	0.664	0.696
F statistics	27.99***	1861***
Observations	343	343
Number of regions	28	28

Note: Robust standard errors in parentheses. *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

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