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Financial development and productivity growth

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by

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ABSTRACT

The propose of this paper is to test the relationship between financial development and productivity growth in 30 Chinese provinces from 2005 to 2013. Financial development is essential for economies' economic growth when productivity growth is a crucial indicator of economic growth. To estimate the productivity of provinces, 2SLS and IV are applied to calculate the provincial TFP. Three independent variables (Credit, Deposit, Saving) that are the traditional indicators of financial development are used. The result implies that the credit Index has a strong correlation with productivity growth, while the other two have a negative relationship. Serval policies are suggested. First, keeping and enlarging the size of financial intermediation is essential. Attracting financial investment and financial institutions is crucial for expanding the size of financial intermediation. Second, Policies encourage households to invest instead of saving should be applied. More researches on the depth of financial intermediation are required.

Keywords: *Productivity, TFP, Financial Intermediation, Financial Development,*

Table of Contents

Introduction

In the last two decades, China has been growing at a high speed in the financial sector. Such a dualist performance is the result of the increasing input of labour and investment, which could be observed through the continuous growing GDP. However, whether the TFP always kept a high level is an important question to evaluate the country's productivity efficiency. Firms, industries, states, or other economies could significantly increase output by only using more input or equipping workers with better tools and knowledge, and using more efficient production techniques. The former type of economic growth is widely recognized as the input-driven growth, and the other one is known as the productivity-driven growth. The input-driven growth has the limitation of unsustainable, which led economists to focus on the total factor productivity (TFP). TFP, an index to evaluate the productivity level, is the portion of the unexplained output to the number of inputs in production. Moreover, calculating both province-sector level and city-sector level TFP through Cobb-Douglas production function and two-stage least squares (2SLS) method by applying one year lag for both capital and labor and using them as the instrumental variables to avoid endogeneity threats. Differently from previous studies, this study extends the research object from 30 provinces through an original cross-multiply method.

Financial development could be estimated through three variables when financial intermediation is the most approachable way to get the data in China. To measure the overall depth of provincial financial intermediation, credit ratio of provincial financial

system is applied. The deposit ratio is applied to test the total size of financial intermediaries. And Savings ratio is used to represent China's financial development in terms of mobilising household savings.

This research mainly tests the relationship between the productivity level of 30 provinces and the three financial development indictors through OLS estimation. Productivity level as an essential element to generate GDP should be highly recognised. Therefore, the result of this study helps to improve provincial TFP of the financial sector. Then it could be applied to improve the financial structure of provinces to increase the overall TFP level and economic growth.

Literature Review

Financial performance is a crucial part of the development of economic growth. For an extended period, economists hold different opinions. Lucas (1988) stated that the market over-stressed the importance of the influence of financial development on economic growth, While Levine (2005) suggested the two main functions of the financial development: (1) the better functioning banking and financial market, the faster the country grow; (2) better-functioning financial system would help firms in that market to ease the constraint of industrial expansion. Amid such disagreements, a lot of empirical works continues to expand with new models and indicates to test the relationship between financial development and economic growth. Recently, plenty of economists suggest that develop the financial sector in a region would pull up the economic growth in that region.

Variable theoretical models have been applied to test the impact of financial development on economic growth. Zhang, et al. (2012) used a GMM model to examine the relationship between economic growth and financial development at the city level in China. Their result suggested that the depth and size of the financial sector would help the economic growth, while the household savings which serves as an indispensable part of the market finance are unclear on economic growth. To evaluate the city level economic growth and financial development, Zhang, et al. (2012) used the per capita GDP (Gross domestic productivity) growth as the indicator of economic growth and five another traditional indicator such as the credit ratio, household savings as the indicator of financial development. Similarly, Yang and Zhang (2018) used a threshold model to test the relationship between financial structure and economic development. They suggested that financial development

would spur economic development as long as the financial structure fit with the industrial structure.

Focusing on economic growth, such as GDP growth may raise the problem of ignorance of different productivity among cities due to other performing factors. The result of financial development would have an impact on sector productivity directly, which then affects GDP growth instead. Therefore, economists have been widely used another indicator which is the TFP (Total Factor Productivity) of financial sector. Firms, industries, countries, or other economies could significantly increase output by only using more input or equipping workers with better tools and knowledge, and using more efficient production techniques. The former type of economic growth is widely recognized as the input-driven growth, and the other one is recognized as the productivity-driven growth. The input-driven growth has the limitation of unsustainable, which led economists to focus on the total factor productivity (TFP). TFP, an index to evaluate the productivity level, is the portion of the unexplained output to the number of inputs in production. Solow (1957) introduced a macro-economic model interrelated with Cobb-Douglas production function. The method to calculate TFP, correlated with output and input including working hours and capital invested, is widely measured by the Solow residual:

$$\mathrm{TFP}growth = g_Y - \alpha * g_K - (1 - \alpha) * g_L \qquad (1)$$

where g_Y, g_K, g_L, α refers to the growth rate of aggregate output, capital, labor, and the capital share, respectively. However, this method to calculate the sectors' productivity suffer from the endogenous problem. To solve that, Marrocu, Paci, Usai (2013) suggested two-stage least squares (2SLS) method by applying one year lag for both capital and labor and using them as the instrumental variables.

Comparing with directly testing the economic growth through GDP growth, productivity growth should be considered as a better indicator to evaluated the influence of financial development on regional growth. Calderón and Liu (2003) exam the causality relationship between economic growth and financial development by decomposing 109 developing and industrial countries' data from 1960 to 1994. They suggested that finance development motivate mainly productivity growth and capital accumulation and then lead to an increase in economic growth, while the productivity channel performs better. Therefore, using TFP to evaluate the influence of financial development on economic growth is accepted. Zhuang, et al. (2009) suggested that financial sector development help economic growth not only through the sector itself but also supporting other public sectors to invest in infrastructure and enabling the household to labor and consumption. These kinds of advantages or impact that financial development creates would all contribute to economic growth. However, it could cause bias to estimate the relationship between financial development and economic growth when it is not possible to capture all these direct and indirect features.

Serval works have been studied using TFP as a financial development indicator to examine the relationship between the two main targets. Chen (2009) used TFP as the financial development indicator to test the impact of financial structure, efficiency, and the quality on the productivity growth in Anhui Province in China. He suggested that financial scale growth would not help financial productivity growth while improving financial efficiency. Then the structure could increase productivity and lead to an increase in economic growth.

In conclusion, according to Levine (1997), strong evidence from both empirical and theoretical works show that the development of a financial system by increasing the size and depth of the financial sectors, household savings, and allocating resources to its best uses would spur the capital accumulation and higher productivity growth.

Methodology

In this section, the method of calculating province-level TFP and the basic regression model are mainly discussed.

Capital Stock

The initial capital stock is an important element to calculate TFP, which is computed from the perpetual inventory method which suggests that the incremental fixed investments entered the economy remain there perpetually with certain decrease along with time. The amount of capital stock falls per year is the annual depreciation rate. The capital stock of the ending of one-period t, K_t, can be written as a function of the ending capital stock of the previous period t-1 and add the incremental fixed investment in period t:

$$K_{it} = (1 - \delta_j)K_{it-1} + I_{it} \tag{2}$$

where δ_j is the depreciation rate of the financial intermediation sector and I_{it} refers to the incremental investment in the city *i* in year *t*. To computed the overall capital stock, we divided this section into four parts. Here, we mainly introduced the calculation of initial capital stock, and the other parts will be discussed in the following Data part.

Initial capital stock

The initial capital stock is widely estimated by many scholars while the different methods may cause large variation with each other. Based on the limited dataset, we

could only compute that from the incremental fixed asset investment from 2005 to 2013. Here, find out the value of K_{2005} by assuming that for each industry the increase of incremental fixed asset investment follows a certain pattern. For a specific industry, the pattern shows as follow:

$$I_{2005+t} = I_{2005}e^{\theta t} \tag{3}$$

where I_{2005} refers to the incremental fixed asset investment of the specific industry in 2005, and t=0, 1, 2, …,10. Then we can compute K_{2005} through:

$$K_{2005} = \int_{-\infty}^{0} I_{2005+t}\,dt = \int_{-\infty}^{0} I_{2005}e^{\theta t}\,dt = I_{2005}\int_{-\infty}^{0} e^{\theta t}\,dt$$
$$= \frac{I_{2005}}{\theta}(1-0) = \frac{I_{2005}}{\theta} \tag{4}$$

Then transferred equation (8) into the log-linearized form:

$$lnI_{2005+t} = lnI_{2005} + \theta t \implies ln\frac{I_{2005+t}}{I_{2005}} = \theta t \tag{5}$$

By applying regression based on the incremental fixed asset investment of each sector of the whole country:

$$lnI_{2005+t} = lnI_{2005} + \theta t + u_t \tag{6}$$

where lnI_{2005} is a constant number for the financial intermediation sector. By using the whole country's incremental fixed asset investment of each sector, estimating the coefficient θ and used that to compute the initial capital stock in 2005.

TFP

TFP is computed based on a time series dataset from 2005 to 2013, which contains the financial intermediation sector in 30 provinces. estimating the sector within a

traditional Cobb-Douglas production function model in the log-linearized form:

$$\ln(GDP_{it}) = \beta_1 + \beta_2 \ln(K_{it}) + \beta_3 \ln(L_{it}) + D_t + \varepsilon_{it} \tag{7}$$

where the number of provinces i= 1, …,30, t refers to the number of years, D_t refers to the dummy variable of year, and ε_{it} refers to the error term. Thus, we could get a pair of β_2 and β_3 for the sector. However, considering the endogeneity problem within the production function, the instrumental method is applied. Specifically, using K and L in the previous year as the instrumental variable, and then applying the two-stage least squares (2SLS) as follow:

$$\ln(\hat{K}_{it}) = \alpha_0 + \alpha_1 \ln(K_{it-1}) + \alpha_2 \ln(L_{it-1}) + D_t + u_{it} \tag{8}$$

$$\ln(\hat{L}_{it}) = \gamma_0 + \gamma_1 \ln(K_{it-1}) + \gamma_2 \ln(L_{it-1}) + D_t + v_{it} \tag{9}$$

where $\hat{K}_{it}$ and $\hat{L}_{it}$ are the estimated value of capital stock and labor invested in the city i and year t. Then the second stage of estimating illustrates as follow:

$$\ln(GDP_{it}) = \beta_1 + \beta_2 \ln(\hat{K}_{it}) + \beta_3 \ln(\hat{L}_{it}) + D_t + \varepsilon_{it} \tag{10}$$

Then, using the two estimated coefficients in the original Cobb-Douglas production function as follow:

$$\mathrm{TFP}_{it} = \frac{GDP_{it}}{K_{it}^{\beta_2} * L_{it}^{\beta_3}} \tag{11}$$

The Basic Regression Model

Using the dependent variable(TFP) as the measurement of productivity growth of the financial intermediation sector, and using the other three variables of interest as the measurement of financial development. The basic regression model with OLS method is:

$$\mathrm{TFP}_{it} = \alpha_{it} + \beta \mathrm{Credit}_{it} + \gamma Deposit_{it} + \delta Saving_{it} + CONTROLS + DUMMY + \varepsilon_{it} \quad (12)$$

where the three variables of interest are estimated, and ε_{it} refers to the error term. Control variables such as provincial practical road area and population and eight dummy variables of the year are added in the OLS model.

Variables and Data

In this section, variables and data sources are introduced.

Dependent Variable (TFP)

To calculate Province-sector level TFP, we use the following data.

GDP (Gross Domestic Production) of provinces' financial intermediation sector is derived from China Statistical Yearbook, which offers the exact number of GDP. Employment at the province-sector level is derived from the China Statistical Yearbook.

Here, we discuss the other three elements in the capital stock calculation. Considering the part of fixed asset investment should be directly or indirectly used to produce, the capital stock that calculated by applying the Incremental fixed asset investment is more proper to be put in the Cobb-Douglas production function. The province-sector incremental fixed asset investment is derived from multiplying the province-sector fixed asset value and fixed asset delivery rate of that sector. To transfer the nominal value into the real one, we applied FAIPI (Fixed Asset Investment Price Index) index, which reflects the price fluctuation of all kinds of investment and charging project that involved in the fixed asset investment. The index can be used to eliminate the influence of price change and transfer the nominal fixed-asset investment into the real value. China Statistical Yearbook provides the FAIPI of each province over the years. Here, we set 2005 as the based year and calculated FAIPI for the latter eight years. Considering different sectors may have different depreciation rates. Tian (2016) used

China Input-Output Table to compute the depreciation rate of 3 main industries and 19 sectors by computing the amount of depreciation of sub-items in each sector and comparing that with the fix asset investment in few short periods. Here, we applied the depreciation rate from his research**.**

Using the 2SLS method to estimate the elasticities at the province-sector level. The result of the estimation is shown below:

Table 1. *Province-sector Level Production Function Estimated Elasticities*

Sectors	β_2	β_3
Financial Intermediation	0.106**	1.121***

*Notes: For the sector estimates (Financial Intermediation[1]) are obtained from a balanced provincial panel (N=30[2]), N × T =270. The result passes the Hausman Test at the 10 per cent level. *** p<0.01, ** p<0.05, * p<0.1.*

Independent Variables

The three independent variables that are the traditional indicators of financial development are illustrated as follow:

1 The government policy led the hugh investment amount invested in serveral provinces in few years. For example, Financial sectroral investment of Tianjin increased 613 percent in 2011. The kind of investment did not work, therefore should not be put into the production function. Hence, we expurgate five abnormal invested cities including Tianjin, Liaoning, Anhui, Jiangsu, and Shanxi when we estimate the elasticities for the sector "Financial Intermediation".

2 Due to data missing, Xinjiang province is excluded.

(1) Credit is the ratio of total loans of the province in the financial system to provincial GDP, which measures the overall depth of provincial financial intermediation.

(2) Deposit is the ratio of total deposits of the province in the financial system to provincial GDP, which measures the overall size of financial intermediaries.

(3) Savings is the ratio of total household savings of the province deposited in the financial system to provincial GDP. It serves as a proxy of China's financial development in terms of mobilising household savings.

All the data of these three variables are obtained from China City Statistic Yearbook from 2005 to 2013.

Descriptive Statistics

Table 2 presents the descriptive statistics and Table 3 shows their correlations for the dependent variable, financial indicators, and control variables.

Table 2. *Descriptive statistics.*

	(1)	(2)	(3)	(4)	(5)
VARIABLES	N	mean	sd	min	max
TFP	270	0.338	0.0819	0.178	0.579
debit	270	2.318	0.647	0.814	4.220
deposit	270	3.488	0.893	1.764	6.084
saving	270	1.752	0.560	0.641	3.891
lnpopulation	270	6.907	0.793	4.520	8.260
lnroad	270	9.117	0.923	6.312	10.87
Number of id	30	30	30	30	30

Table 3. *Variables correlation form.*

	TFP	debit	deposit	saving	lnpopulation	lnroad
TFP	1.0000					
debit	-0.0394	1.0000				
deposit	0.0176	0.6251	1.0000			
saving	-0.0997	0.0865	0.6071	1.0000		
lnpopulation	-0.0316	0.0198	0.2728	0.3084	1.0000	
lnroad	-0.0117	0.0172	0.2052	0.2383	0.9393	1.0000

Result

Table 3 summarizes the least-squares results with different independents put in. The result indicates a strong association between the development of financial intermediation and productivity growth. Each of the three economic indicators significantly correlated with productivity growth at the 5% significance level.

Table 3. Regression result

	(1)	(2)	(3)	(4)
	OLS1	OLS2	OLS3	OLS4
VARIABLES	TFP	TFP	TFP	TFP
lnroad	0.0856***	0.0973***	0.0914***	0.0952***
	(1.44e-09)	(0)	(0)	(0)
lnpopulation	-0.0934***	-0.111***	-0.0984***	-0.105***
	(4.52e-09)	(0)	(9.45e-10)	(9.52e-11)
deposit		0.0175***	0.0349***	0.0468***
		(0.000193)	(4.22e-08)	(4.58e-08)
saving			-0.0536***	-0.0564***
			(0.000124)	(3.40e-05)
Credit				-0.0212**
				(0.0161)
Dummy_year	YES	YES	YES	YES
Constant	0.107***	0.0584	0.0483	0.0768*
	(0.00947)	(0.172)	(0.264)	(0.0812)
Observations	270	270	270	270
R-squared	0.413	0.444	0.491	0.501

Robust pval in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The result implies several pieces of advice for the monetary policy in China. First, a provincial deposit would encourage productivity growth, which tells us that the size of financial intermediation positively influences on productivity growth. For provinces, keeping and enlarging the size of financial intermediation is essential. Attracting financial investment and financial institutions is crucial for expanding the size of financial intermediation.

As for the Saving and Credit indicators, strong negative correlations are shown. This result suggests that the increase in household savings and provincial credit amounts would cause a decrease in productivity growth. For the former conclusion, it is reasonable. Money used to invest in technical innovation decreased, and households tried to keep their money on banks other than invest in the physical industry. It causes harm to productivity. For the latter result, if people borrow more money, productivity would decrease. One explanation of that could be that when companies borrow money to invest in their business, an industrial or scale transformation could happen. When the transformation happens, the productivity gets lower than its stable situation. Especially from2009 to 2013 in china, an enormous industrial transformation from the second industry to tertiary industry occurred. A significant gap in GDP growth happened after 2014 could be observed. Therefore, for the long-term, credit could help for economic growth. More researches are needed.

In summary, the size of financial intermediation has a positive correlation with

productivity. Hence, provinces could attract more investment to help increase the size of financial intermediation. Policies encourage households to invest instead of saving should be applied. More researches focusing on the influence of the depth of financial intermediation on long-term and short-term productivity growth are needed.

Conclusion

This study measured the relationship between the three common and crucial indexes of reginal overall financial development and regional productivity. The result suggests that the size of financial intermediation has a positive correlation with productivity, while the size of financial intermediaries and household saving scale would negatively affect TFP growth. Productivity level is not directly related to GDP growth. Things like capital input and labor could also affect the regional GDP growth. Instead, the it could be used to pursuit a sustainable development for a province or country.

Limitation

The limitation of this study is that the calculation of TFP is varied from reviews to studies. Here, only one general method is applied, which can cause different results when using a different way. A different non-parameter method, such as DEA-Malmquist could be applied to test the robustness of TFP. Besides, Model searching could be improved. Here, we only discussed the linear model with OLS. However, nonlinear models, threshold models, and other models could also be applied.

Contribution

Many previous studies have studied the relationship between GDP per capita and the traditional financial indicators. However, few pieces of researches focused on financial performance and productivity. In China, due to the data limitation, merely no studies investigated the range of all provinces but only concentrate on one specific region.

Therefore, this study offers a broader range of research objects. Besides, the result suggests several suggestions for China's policy improvement.

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