Banking Market Structure and Enterprise's Technological Innovation --Evidence from Chinese Provincial Panel Data

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Abstract. With Chinese provincial panel data, this article examines the relationship between banking market structure and enterprise's technological innovation. Based on fixed effects Estimator and SGMM estimator of the regression, results show that banking market structure have a significantly negative impact on enterprises ' technological innovation, increasing concentration in the banking is not conducive to enterprise's technical innovation. Direct implication of this conclusion is, devoting major efforts to developing small and medium banks, improving the market share of small and medium banks, building a sound banking market structure to match the structure of real economy are essential for improving the ability of technological innovation of Chinese enterprises.

1. Introduction

Holding the dominant position among a variety of financial systems in China all the time, banking allocates a large fund into different regions and industries. Optimal financial structure believes that whether the banking market structure could match the real economic structure would have an impact on the efficiency of banking credit fund allocation, which would cause significantly affect the economic growth. Furthermore, the paper believes that the banking market structure not only influences whether the credit fund of the bank could be allocated to regions and industries with the most efficiency and vitality but also affects the technological innovation of enterprises in the real economy in all different regions. Previous researches on the impact of banking market structure on the economy focused on the relations between banking market structure and economic growth. The paper, extending the topic, analyzes the impact of banking market structure on enterprises' technological innovation.

Though related to the research on "financial development and technological innovation", the paper takes a different perspective. The literature on financial development and technological innovation mainly discusses the impact of financial deepening on technological innovation, while the paper emphasizes the relations between banking market structure and technological innovations. With Chinese provincial panel data, the paper empirically analyzes the impact of banking market structure on enterprises' technological innovation. After controlling all other major factors that influence technological innovation, the banking market structure shows a great impact on technological innovation. An increase in banking concentration makes against technological innovation. Evaluated results obtained by the system GMM proves the hypothesis in the paper.

The following parts are arranged as below: the second part is the literature review; the third part is a model specification, variation selection, and data sources; fourth part is evaluation result and corresponding analysis; fifth part is the conclusion.

2. Literature review

Theoretically, researches related to the impact of banking market structure on the economy at home and abroad mainly focuses on the discussion on the relations between banking market structure and economic growth. These discussions could be separated into the Partial equilibrium

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model and the general equilibrium model. Partial equilibrium model, through analyzing the impact of banking market structure on the relationship between bank and borrowers, discusses how to guide borrowers to take proper actions to overcome converse options and moral risk caused by information asymmetry. They believe that a monopolistic banking market structure is good for the economy(Petersen and Rajan,1995; Caminal and Matutes,1997). General equilibrium model, on the basis of Partial equilibrium model, taking banks' credit activities and residents' saving behavior into consideration, analyzes the impact of banking market structure on economic growth, and drew a conclusion different from that of Partial equilibrium model, e.g, economic cost caused by monopolistic banking market structure may outweigh its benefit. (Guzman,2000; Cetorelli and Peretto,2000)

Due to this theoretical difference, many researchers attempt to examine the relations between banking market structure and economic growth in empirical researches. Foreign empirical researches mainly seek after experimental evidence of the impact of banking market structure on economy growth on industrial level, represented by Rajan and Zingales (1998), Cetrorell and Gambera (2001), Bonaccorsi and Dell'Ariccia (2000), Black and Strahan (2002), Cetorelli and Strahan (2006), etc.) Rajan and Zingales((1998), creatively classify industries following their reliance on external finance and analyze the impact of banking market structure on industry growth. Empirical results show that industry with a higher reliance on external finance could develop faster in the country with lower banking concentration.

Research of Bonaccorsi and Dell'Ariccia(2000), through the study on different industries in different regions, found that higher banking concentration could promote the establishment of start-ups, especially in industries where information is not transparent. Black and Strahan (2002), with American cross-state data, concluded that lower banking concentration would help the forming of startups. Cetorelli and Strahan (2006), also based on American cross-state data, analyzed the relations of banking market structure and numbers as well as the scale and distribution of enterprises in the industry. The results showed that the decline of banking concentration and banking deregulation could increase the number of enterprises in the industry and lower the scale of the enterprise.

Empirical researches on the impact of banking market structure on economic growth based on Chinese are mainly carried out from three aspects: Firstly, use provincial panel data to analyze the impact of banking market structure on the whole economy growth from macro perspective, like Lin Yifu and Jiang Ye (2006), Lin Yifu and Sun Xifang (2008), Jia Chunxin, Xia Wuyong and Huang Zhangkai (2008), etc. Lin Yifu and Jiang Ye (2006), Lin Yifu and Sun Xifang (2008) measured banking market structure with banking concentration and the market share of the small and medium bank, concluding the same conclusion, that the market share of small and medium banks have a significant positive effect on economic growth. Jia Chunxin, Xia Wuyong and Huang Zhangkai (2008) used the growth of banking branches to represent the competition level in banking, finding that increases in competition in banking promote economic growth. Secondly, use data on an industrial level to examines the impact of bank market structure on industrial growth. For example, Gao Wei (2010), with data of 14 manufacture departments in China, found that the increase of competition in the banking market could help the development of the manufacturing industry with a higher reliance on external finance.

Thirdly, use enterprise data to analyze the impact of banking market structure on the growth of enterprises. For example, Li Bin and Jiang Wei (2006), with the data of Chinese quoted companies, found that the decreasing of banking concentration would help the development of enterprises;Lei Zhen and Peng Huan (2010), with Chinese provincial panel data, analyze the relations between the banking market structure and small and medium enterprises, finding that the increase of market share of small and medium bank would help the forming of small and medium enterprises.

In summary, researches at home and abroad focus on relations between banking market structure and economy growth, and prove the theories from multiple aspects, while the paper extends the view to technological innovation to analyze the impact of banking market structure on enterprises' technological innovation.

3. Model and data

3.1 Model specification

Basis metrology model in this paper is as below:

$\ln INV_{it} = \beta_0 + \beta_1 \ln CKCH_{it} + \beta_2 FD_{it} + \phi X_{it} + \eta_i + \mu_t + \varepsilon_{it}$,

In which, INV represents the enterprise's technological innovation level. Currently, it is represented by the number of patent applications. Because Yearbook of Science and Technology Statistics in China mainly provides science and technology statistics in large and medium industrial enterprises, INV is the number of the patent application of large and medium enterprises in different regions. CKCH is banking market structure, represented by the banking concentration, the proportion of outstanding obligation of four major state-owned banks in all different regions in that of all financial institutions. Technological innovation and banking market structure are all processed with logarithm in the model. FD is banking scale in all different regions, represented by the ratio of outstanding obligation of all financial institution in all regions to GDP. It represents the financial development level in the region.

X is a control variable which would influence technological innovation, mainly including variables in the following: the scale of enterprises SIZ, represented by the sales income of large and medium industrial enterprises in all different regions divided by the number of enterprises; FGYH is the degree of denationalization, represented by the number of employees in non-state-owned unit divided by the number of all employees in the region; EDU is the level of human capital, represented by average years of education in the region; level of economic openness is reflected by TRADE and FDI, respectively represented by the ratio of total export-import volume to GDP and actual foreign investment to GDP.

Among control variables, the enterprise scale is mainly used to control the feature of industrial enterprises; local denationalization degree, human capital, the openness of economy are mainly used to control the feature of regions. Enterprises' technological innovation is not isolated. The local system environment would also significantly influence enterprises' technological innovation.

Variable 1 in the model represents the coefficient of elasticity of the impact of banking market structure on technological innovation; 2 represents the coefficient of elasticity of impact of banking scale on technological innovation. I means region; t means time; η_i represents regional effect varying with time; μ_t represents time effect that would never vary with the region, and ε_{it} is random error item.

3.2 Data description

The number of patent application of large and medium enterprises in the paper comes from the Yearbook of science and technology of China; original data of banking market structure and banking scale come from Yearbook of China's finance; data of denationalization come from Statistical yearbook of China; data of total export-import volume and foreigners' direct investment are measured at by annual average exchange rate of RMB against dollar, and the data comes from Statistical yearbook of China; data of enterprises' scale comes from Statistical Yearbook of China, in which the revenue from product sales has been deflated by the index of ex-factory price of industrial products in each region in each year; data of human capital comes from China demographic Yearbook.

Since 2005, the Yearbook of China's finance no longer calculate deposit and loan in four state-owned banks in each province and city, so the data after 2005 are estimated by the feasible least square method. Meanwhile, the Yearbook of Science and Technology Statistics in China before 1997 didn't calculate the number of the patent application of large and medium enterprises in each region, therefore, to ensure the consistency of data, the paper set the year from 1996 to 2013 as the time quantum. As there are many missing values in Tibetan financial data, Tibet was excluded from the sample, and data of Chongqing city was integrated into that of Sichuan Province.

Definition of variables and descriptive statistics are as shown in Table 1 and Table 2.

Table 1 definition of variable

Variables	Symbol	Definition
Technological innovation	INV	The number of patent application of large and medium enterprises in each region
Banking market structure	CKCH	Ratio of outstanding obligation of four state-owned banks in the region to that of all financial institutions in the region
Banking scale	FD	Ratio of outstanding obligation of four state-owned banks in the region to GDP
Enterprises scale	SIZ	Ratio of revenue from product sale of large and medium enterprises in each region to the number of enterprises
Denationalization	FGYH	Proportion of the number of employees in non-state-owned unit in total employees
Openness of economy	TRADE,FDI	Proportion of total export-import volume to GDP and actual foreign direct investment to GDP
Human capital	EDU	Average education year of people in the region

Table 2 Descriptive statistics of variables

Variables	Mean value	standard deviation	Minimum value	Maximum value
lnINV	5.268	1.468	1.386	9.056
lnCKCH	-0.449	0.153	-0.868	-0.134
FD	1.324	0.679	0.591	5.590
SIZ	0.025	0.014	0.001	0.083
FGYH	0.302	0.412	0.032	1.843
TRADE	0.038	0.037	0.000	0.169
FDI	0.289	0.110	0.104	0.608
EDU	7.570	0.996	4.693	10.559

4. Regression estimation results and discussion

4.1 Basic regression result

Estimate the model. See the regression result in Table 3. List (3.1) in Table 3 is the result of estimation taking baking market structure as the only explanatory variable; list from (3.2) to (3.5) is the estimation result after adding other control variables. Because total export-import volume and foreign direct investment are strongly related(correlation coefficient up to 0.662), they are not placed in the model at the same time to estimate. In list 3.2 and 3.4, the openness of the economy is represented by the ratio of total export-import volume to GDP; in list 3.3 and 3.5, the openness of the economy is represented by the ratio of foreign direct investment to GDP. Hausman test shows that list (3.1)-(3.5) adopts the fixed effect model.

From the estimated result in Table 3, list (3.1)-(3.5) shows that the banking market structure has a sTable negative impact on technological innovation, which supports the previous hypothesis. Take list 3.5 as an example, the elasticity coefficient of banking market structure to technological innovation is -0.791, which means that f banking deposit concentration increase by 1%, enterprises' technological innovation level decreases by 0.791%. The estimated result shows that the increase of the four state-owned market share counts against enterprises' technological innovation. On the contrary, higher market share of other banks including Joint-stock commercial banks, city commercial bank and so on would promote enterprises' technological innovation.

While analyzing the impact of financial structure and financial development on the industrial growth, Beck and Levine(2002) place financial structure and development into the model, concluding that the financial structure's impact on industrial growth is not significant and it is the financial development that is a significant determinant of industrial growth. Based on their method,

we firstly estimated the model without the banking scale representing the financial development degree(as shown in list 3.2 and 3.3), and then estimate the model with all control variables(as shown in list 3.4 and 3.5). Result of list 3.4 and 3.5 shows that even the banking scale is added to the model, the banking market structure remains significant, and the significance level and coefficient change little, which shows that the impact of banking market structure on technological innovation is not due to the financial development degree which is represented by the banking scale in the region. On the contrary, the result reflects that the impact of the banking scale on technological innovation is insignificant.

Table 3 Basic regression result of impact of banking market structure on technological innovation

	(3.1)	(3.2)	(3.3)	(3.4)	(3.5)
Constant C	3.898***	-1.296*	-1.087	-1.261*	-1.044
	(0.265)	(0.743)	(0.749)	(0.746)	(0.754)
lnCKCH	-3.049***	-0.733*	-0.808**	-0.706*	-0.791**
	(0.578)	(0.391)	(0.406)	(0.394)	0.408
SIZ		12.359***	14.545***	12.303***	14.537***
		(4.579)	(4.381)	(4.586)	(4.387)
FGYH		5.231***	5.696***	4.706***	5.229***
		(1.146)	(1.152)	(1.394)	(1.409)
EDU		0.558***	0.526***	0.553***	0.520***
		(0.110)	(0.108)	(0.110)	(0.109)
TRADE		0.609		0.623	
		(0.392)		(0.393)	
FDI			-0.020		-0.145
			(2.374)		(2.388)
FD				0.129	0.113
				(0.194)	(0.196)
Hausman P	0.005	0.000	0.001	0.000	0.006
model	FE	FE	FE	FE	FE
R^2	0.338	0.538	0.5730	0.506	0.5475
F	27.820	91.410	89.970	76.060	74.810

Note: value in brackets is standard deviation; ***, ** and * represent significance level of 1%, 5% and 10%,respectively.

It can also be seen from Table 3.2-3.5 that the enterprise's scale, local denationalization degree, and human capital level have a great positive impact on technological innovation. This is consistent with the literature, e.g, the larger the enterprises are, the higher the local denationalization degree and regional human capital level is, the better for enterprises' technological innovation. But Table 3 also shows, whether represent the openness of economy with the ratio of total export-import volume to GDP or actual foreign direct investment, the impact of the openness of economy on technological innovation is insignificant.

The estimated result of the banking scale and economy openness is insignificant. This might be caused by the failure to control the endogeneity of variables. It is normally believed that the banking scale is the endogenous variable in the development of the economy, and the openness of the economy is always related to the banking scale representing the degree of financial development. Therefore, the paper would further examine symbols of all variables in the robustness examination as below.

4.2 Robustness test-estimation of dynamic panel data

While estimating the model above, though factors in aspects of industrial enterprises and regional environment are controlled, there might be some important variables missing, which might cause error in estimated result, for example, enterprises' technological innovation might have

cumulative effect-- the last technological innovation might affect the technological innovation in the current period(Zhou Li’an, Luo Kai, 2005) Meanwhile, there might be certain bidirectional bias in banking market structure itself: lower market share of state-owned banks might decrease technological innovation; while technological innovation also might cause a lower market share of state-owned banks. Because economy in regions with higher level of technological innovation is more developed, and enterprises’ financing demand is also higher, other banks like Joint-stock commercial banks, city commercial bank and so on tend to choose such regions to found their branch to extend the market, therefore, regions with a higher level of technological innovation might have a lower banking market structure. Besides, as mentioned before, there might also be certain endogeneity in variables like banking scale and economic openness.

To eliminate the endophytic problem caused by banking market structure and other explanatory variables, based on the model above, the paper introduces into the one-period lag item of technological innovation, and conduct robustness examination on the model with GMM estimation. GMM estimation is cataloged into differential GMM estimation and system GMM estimation. Differential GMM estimation is calculated the one-order difference of regression equation to eliminate the impact of individual effect; while system GMM estimation is to add a horizontal equation based on differential GMM estimation, with the first difference lagged item of explanatory variable as its instrumental variable.

Table 4 Regression result of dynamic panel of banking market structure to enterprises’ technological innovation

	(4.1)	(4.2)
Constant C	0.502***	0.164
	(0.143)	(0.165)
lnINV(-1)	0.629***	0.512***
	(0.019)	(0.019)
lnCKCH	-0.511**	-0.853***
	(0.224)	(0.173)
FD	-0.204***	-0.167***
	0.031	(0.025)
SIZ	11.890***	9.361***
	(1.469)	(1.631)
FGYH	2.655***	3.975***
	(0.422)	(0.271)
EDU	0.071***	0.150***
	(0.023)	(0.035)
TRADE	0.172**	
	(0.081)	
FDI		-3.513***
		(1.276)
Hansen test	0.939	0.946
AR(1)	0.008***	0.012**
AR(2)	0.236	0.190

Note: value in brackets is standard deviation; ***, ** and * represent significance level of 1%, 5% and 10%,respectively. Hansen test, AR (1) and AR (2) test all provide significance probability p.

With limited sample, system GMM estimation is featured with higher efficiency and fewer errors compared with differential GMM estimation. Therefore, the paper adopts system GMM estimation, re-validating the impact of banking market structure on technological innovation. The estimated result has been shown in Table 4. List 4.1 and 4.2 are the estimated result in the model in which the economic openness is represented by the ratio of total export-import volume to GDP and ratio of actual foreign direct investment to GDP, respectively. As mentioned previously, after adding banking scale into the model, the impact of banking market structure on technological innovation

remains significant, thus, list 4.1 and 4.2 directly added all control variables including the banking scale.

The estimated result in Table 4 shows that technological innovation lagging one phase is significantly positive, which means that there indeed is cumulative rather than convergence effect existing in enterprises' technological innovation. The last technological innovation would promote technological innovation in the current period. Regions with enterprises with a high level of technological innovation could produce more innovation. Under all conditions, compare with static panel data estimation before, the banking market structure has a significantly negative impact on technological innovation, which reflects that the increase in banking concentration would restrain enterprises' technological innovation. Say, the decrease in the market share of four state-owned banks could greatly promote enterprises' technological innovation, which further supports the hypothesis in this paper.

Because system GMM estimation better handles the endogeneity of the model, estimated result in Table 4 is more validate compared with Table 3. therefore, we rely more on the estimated result in Table 4. but both static panel data estimation and regression result of system GMM estimation show that banking market structure indeed have a significant negative impact on enterprises' technological innovation. The increase in banking concentration would restrain enterprises' technological innovation.

5. Conclusion

Based on the research on relations between banking market structure and economy growth, the paper explores the relations between banking market structure and enterprises' technological innovation. With Chinese provincial panel data, the paper found that the banking market structure has a significant negative impact on enterprises' technological innovation. The increase in banking concentration goes against enterprises' technological innovation while the rise of the market share of other medium and small banks like joint-stock commercial banks and city commercial banks would promote enterprises' technological innovation. Both estimations of the fixed-effect model and regression result of system GMM estimation supports the hypothesis in this paper.

The research result of the paper is consistent with the opinion that the banking market structure should match the structure of the real economy in the optimal financial structure theory. The paper also proves that the banking market structure not only influences banking's fund allocation efficiency but also affects enterprises' technological innovation in the real economy.

At present, China takes enhancing enterprises' self-innovation capability as the key part to adjust industry structure and transfer mode of economic growth. The conclusion in the paper directly implies that focusing on developing medium and small banks to improve their market share thus to establish a banking market structure match to the structure of the real economy is a necessary condition for Chinese enterprises' to improve their ability of technological innovation.

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Reference

[1]Petersen, M.A. and R.G.Rajan.The Effect of Credit Market Competition on Lending Relationship[J].Quarterly Journal of Economics, 1995,Vol.110(2):407-443.

[2]Caminal, R. and C.Matutes.Bank Solvency, Market Structure, and Monitoring Incentives[R].Centre for Economic Policy Research, Discussion Paper,1997,No.1665.

[3]Guzman Mark.G. Bank Structure,Capital Accumulation and Growth:A Simple Macroeconomic Model[J].Economic Theory,2000,Vol.16: 421-455.

[4]Cetorelli, N. and P.E.Peretto. Oligopoly Banking and Capital Accumulation[R].Federal Reserve Bank of Chicago Working Paper,2000,No.2000-12.

[5]Rajan, R.G. and L.Zingales. Financial Dependence and Growth[J].American Economic Review, 1998,Vol.88:559-586.

[6]Cetorelli, N. and M.Gambera. Banking Market Structure, Financial Dependence and Growth: International Evidence from Industry Data[J].Journal of Finance,2001,Vol.56:617-648.

[7]Bonaccorsi, E. and Dell'Ariccia. Bank Competition and Firm Creation[J].Journal of Money, Credit and Banking, 2004,Vol.36:225-251.

[8]Black, S.E. and P. Strahan. Entrepreneurship and Bank Credit Availability[J].Journal of Finance, 2002,Vol.57:2807-2833.

[9]Cetorelli, N. and P. Strahan. Finance as a Barrier to Entry: Bank Competition and Industry Structure in Local U. S. Markets[J].Journal of Finance,2006,Vol.61:437-461.

[10]Lin Yifu, Jiang Ye. Economic structure, banking structure and economic development: an empirical analysis based on provincial panel data [J]. Financial Research, 2006 (1): 7 / 22.

[11]Lin Yifu, Sun Xifang. Banking structure and economic growth[J]. Economic Research,2008 (9):31-45.

[12]Jia Chunxin, Xia Wuyong, Huang Zhangkai. Bank branches, state-owned banks competition and economic growth [J]. Manage the world, 2008 (2): 7 / 14.

[13]Gao Wei.Dependence on external financing, Banking Competition and Economic growth: an Analysis based on China's Manufacturing Industry[J].Contemporary finance and economics,2010(4):79-86.

[14]Li Bin, Jiang Wei. Financial development, financing constraints and enterprise growth [J]. Nankai Economic Research, 2006 (3): 68 / 78.

[15]Lei Zhen, Peng Huan. Banking market structure and the formation of small and medium enterprises: evidence from China 1995 / 2006 [J]. World economy, 2010 (3): 109 / 125.

[16]Wu Yanbing. Which type of ownership enterprise in China is the most innovative [J]. World economy, 2012 (6): 3 / 27.

[17]Zhang,A., Y.Zhang, and R.Zhao. A Study of the R&D Efficiency and Productivity of Chinese Firms[J].Journal of Comparative Economics, 2003,Vol.31(3):444-464.

[18]Hu, A.G.Z. and G.H. Jefforson. A Great Wall of Patents:What Is behind China's Recent Patent Explosion?[J].Journal of Development Economics,2008,90:57-68.

[19]Wu Yanbing. A study on the double efficiency loss of state-owned enterprises [J]. Economic research,2012,3:15-27.

[20]Allen,F., J. Qian, and M.Qian. Law, finance and economic growth in China[J].Journal of Financial Economics, 2005,Vol.77(1):57-116.

[21]Lin Yifu, Sun Xifang, Jiang Yi. A Preliminary Study on the Theory of the Optimal Financial Structure in the Economic Development[J]. Economic Research,2009 (8):4-17.

[22]Beck, T. and R. Levine. Industry growth and capital allocation: does having a market- or bank-based system matter?[J].Journal of Financial Economics,2002,64:147-180.