

# **Bank Competition and Industrial Investment —Theoretical Analysis and Empirical Test Based on OLG Model**

Mingyi Gong<sup>1,a</sup>, Jiadong Chen<sup>2,b,\*</sup> and Zhengyang Han<sup>3,c</sup>

<sup>1</sup>Jinan Foreign Language School, Jinan, Shandong, China

<sup>2</sup>Hangzhou No.14 High School, Hangzhou, Zhejiang, China

<sup>3</sup>Jinan Foreign Language School, Jinan, Shandong, China

<sup>a</sup>Gongmingyi020513@126.com, <sup>b</sup>1581313657@qq.com, <sup>c</sup>2642934460@qq.com

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**Abstract.** The development of the banking industry has a major impact on long-term economic growth, and the degree of competition in the banking industry has an important impact on banking industry. On the basis of the fast development of banking and financial industry, studying the impact of banking competition on the economy has become more and more significant. Based on Overlapping Generation Model (OLG) model about banking system for modeling analysis, this paper theoretically studies the impact of bank competition on physical investment, and finds that as long as the banking industry has monopoly market power, it will cause crowding-out effects for industrial investment: the greater the monopoly of the banking industry, the greater the crowding-out effect on industrial investment. Furthermore, this paper uses the data of China's A-share non-financial industry listed companies and the data of Chinese provinces and cities to empirically explore the crowding-out effect of bank competition on corporate industrial investment. By utilizing theoretical model, this paper empirically test theory that the degree of bank competition does influence the crowding effect on industrial investment based on empirical results of data in China. We also constructed the Herfindahl-Hirschman Index (HHI) of the banking industry for robustness analysis, providing more evidence to support that the crowding-out effect of investment is affected by the degree of bank competition.

## **1. Introduction**

As one of pillars of economic development, banking industry has a major impact on economic development. The government attaches great importance to the development of the banking industry and the entire financial industry. Also, many scholars study the banking industry from different angles, including but not limited to the impact of the efficiency in the banking industry on the economic cycle, economic growth, and borrowing costs, etc.

There are many previous studies in this field, but few of them are involved in the crowding out effect of banking growth on the real economy. We have specifically extended the OLG model to analyze the basic characteristics of banking industry. In the traditional banking industry, the bank, after the depositor provides the deposit, will lend the deposit to other companies for investment, so as to obtain profits from the loan interest rate paid by other companies and the interest margin given to the depositor. The value of the bank's ownership appreciated because of the profits generated by bank's interest margin, and then a large amount of money is invested in the banking industry and the entire financial industry due to the attraction of profits. According to the current research, the resource investment of ownership in the banking industry has a crowding out effect on the investment in the real economy.

We have extended the setting of the OLG growth model: in each period, the younger generation makes choices between industrial investment, bank ownership investment, and consumption. As an older generation, they may take out bank loans and sell bank ownership to support consumption. Based on derivation, the model shows that market equilibrium does not necessarily present Pareto Optimality. The reason is that when the difference between the lending rate and the borrowing rate is large enough, the younger generation will lose the motivation to invest in other real economy because

of the high profits of the bank and turn to pursue bank equity. The data we studied include the balance sheet and profit statement of companies and banks in CSMAR and the financial license information published on the website of CBRC. In the OLG model, these data are also fully reflected in crowding out effect of the real economy that the competition of banking industry can reduce or partially solve a large number of funds flowing into the financial industry. The principle is that the competition in the deposit market is intensified. To attract funds, banks will raise interest rates and reduce their profits, which will reduce the attraction of bank ownership to the younger generation, decrease the investment in bank ownership, and ease the crowding out effect on the real economy. Based on the empirical regression results of OLG theoretical model and the changes of HHI index in each province, it can be verified that if the competition degree of banking industry is weak and the profit is high, the industrial investment of non-financial enterprises will be reduced, thus decelerating the economic growth. The contributions of our research are as follows: 1) the research on the economic impact on banks can be traced back to Petersen & Rajan and Berlin & Meister, who study the impact of bank competition on corporate financing channels mainly by the debtor-creditor relationship theory. The difference is that previous scholars focused more on theory, but this study is the first one that combines OLG model with Chinese entity data [1]. Based on the trade-off that OLG reflects physical investment and ownership of investment bank, the paper emphasizes the impact of banking competition degree on Chinese enterprises. 2) The study establishes the relationship between HHI index and entity investment growth in each province. The importance of HHI index has been discussed in many literatures. However, the paper makes a regression analysis from the macro perspective of the province, which shows the correctness of the government's attention to banks and the overall financial industry, that is to say, the competitive banking industry can reasonably reduce and control the crowding out effect of capital inflow on the real economy and industrial investment.

The structure of this paper is as follows. In Section 2, the previous related literatures are summarized. In Section 3, OLG model is introduced. The contents in Section 4 are demonstration and robustness test, and Section 5 is conclusion.

## **2. Literature review**

It is a long term for research on the impact of bank competition on macro-economy. Many scholars have explored the impact of bank competition on economic growth from different perspectives. Petersen & Rajan and Berlin & Meister mainly studied the influence of bank competition on corporate financing channels from debtor-creditor relationship theory, and pointed out the indirect influence of bank competition on long-term economic growth [1]. Rajan et al. believed that the monopoly of market structure is conducive to the formation of long-term relationship between banking sector and borrowing enterprises, thus alleviating the problem of information asymmetry, so the monopoly of banking industry may be beneficial for long-term economic growth. However, Guzman said that if the banking industry presents a monopoly structure, the condition that costs are higher than benefits appears and is not conducive to economic growth [3]. At the same time, Boot&Thakor believe that fierce banking competition always brings higher economic growth, because the competitive banking system can provide more credit for enterprises at a lower interest rate [4].

Smith analyzed the macro-economic cost of incomplete competition in banking industry by establishing an equilibrium model, and pointed out that during economic downturn, the deterioration of the balance sheet of enterprises would rapidly increase the cost of direct financing, while the cost of indirect financing was inversely related to the level of competition in banks [5]. In addition, the improvement of the inter-bank competition degree could reduce the agency cost of indirect financing, so as to ease the financing restriction of enterprises, prevent the economy from further depression. Therefore, the increase of bank competition can improve the income level and reduce the economic fluctuation.

The problem of low efficiency brought by banks was first studied by Simons, who believes that the credit behavior of traditional banks will enlarge the economic fluctuation, because it is to increase the borrowing in the economic boom, and to reduce the borrowing rapidly in the economic depression, so

as to expand the impact of the economic cycle [6]. Krainer also recognized the ineffectiveness for the allocation of actual productive investment brought by the deposit creation function of some reserve banks [7].

Based on the OLG model used in this paper, the impact of market competition in the economy is first studied by Laitner, who constructs a two sectors' production economy composed of competitive and monopoly manufacturers [8]. In the OLG model, he shows how incomplete competition affects total output and capital accumulation. Gersbach & Wenzelburger also indicates that under the framework of OLG, even incorporating risk premium into loan price is not enough to prevent banking crisis [9]. By introducing banking system into the OLG model, Shy proves that the strengthening of market power in banks will increase bank profits and bank value, thus improving the resource ratio needed by representative young consumers to acquire bank shares in intergenerational transmission, which leads to the crowding out effect of industrial investment, and the crowding out effect mentioned above will be enlarged by higher overall economic growth rate and industrial investment income [9].

Levine indicates that large financial sectors improve industrial investment and promote economic growth through various channels: Information production, productive allocation of capital, investment management, risk dispersion, and risk control [11]. In addition, Levine also uses empirical evidence to show that the developed financial system alleviates the external financing constraints faced by enterprises and clarifies a mechanism that financial development affects economic growth. Jiang Fuxiu, Cai Wenjing, Cai Xinni and Li Xingtian believe that the impact of bank competition on a country's economic activities is not only reflected in whether it promote the stable growth and development of the macro-economy, but reflected in the role of micro level in business operation and development [12]. To further understand the impact of banking competition on macro-economy, we should study the impact of banks on corporate behavior. From information asymmetry, Jiang Fuxiu et al., based on the Monti-Klein model, study the impact and mechanism of bank competition on corporate financing constraints at the micro level, and combine with empirical evidence to show that bank competition makes banks collect and mine more corporate information, thus, reducing information asymmetry, and releasing corporate financing constraints.

Rakshit & Bardhan conducts an empirical analysis on the actual data of some countries in South Asia [13]. The research shows that bank competition and the stability of the banking system are the decisive factors for the long-term economic growth of countries in South Asia. The interaction between them reveals the positive and significant role of bank competition in economic growth. Rakshit et al. propose to increase the competition degree of banks in South Asian countries through more flexible financial supervision methods, such as reducing restrictions on bank activities, and access policies of foreign bank, etc., which is because the higher the competition degree of banks, the higher the efficiency of resource allocation, thus promoting economic growth.

In terms of the literatures that analyze the impact of the growing size of the financial sector on the economy, it is generally considered that the overlarge financial sector is inefficient, because they tend to hire more human and buy more material resources that should be used for direct production and innovation with higher productivity. Arcand uses different empirical methods to point out that if the proportion of private sector debt to GDP is high enough, the constant deepening of the financial sector will reduce the growth rate of total output [14]. Cecchetti & Kharroub shows theoretically and empirically that the growth of the financial sector will disproportionately benefit the sectors with low productivity and high collateral, thus reducing the growth rate of total factor productivity in the economy [20].

Orangazi, at the corporate level, analyzes the relationship between economic and financial deepening and industrial investment in the United States, and finds a significant negative correlation [23]. He also proposed two possible mechanisms: One is that the opportunity of financial investment and the increase of return rate will squeeze out industrial investment by changing the incentives of the company's managers and transferring funds out of the actual investment; the other is that the excessive investment in the financial market will reduce the company's available internal funds, shorten the company's management vision, and increase uncertainty, thus squeezing out industrial

investment. Li Wei'an and Ma Chao analyzes the impact of holding financial institutions on the investment efficiency of enterprises by taking the data of A-share non-financial listed companies in China as an example, and finds that holding financial institutions has reduced the investment efficiency of enterprises [17]. Zhang Chengsi indicates that China's industrial investment rate shows a continuous downward trend, and the capital and scale of the financial sector have been expanding [18, 19]. Under the bank-based financial system, the trend of economic financialization may be increasing, and will significantly reduce the industrial investment rate of enterprises. At the same time, his findings show that the investment in financial markets to obtain profits has gradually become the dominant mode of corporate profits, and the risk return mismatch of financial assets has also inhibited the industrial investment rate.

Taking example by Shy's theoretical model [10], this paper, based on the introduction of the OLG framework of banking system, solves and analyzes the model, theoretically studies the impact of bank competition on entity investment, and empirically explores the crowding out effect of bank competition on corporate industrial investment by using the data of listed companies in China's A-share non-financial industry and bank data of various provinces and cities.

### 3. Theoretical model

To study the impact of bank competition on industrial investment, this section, based on the study of shy [10], reconstructs the Dimond OLG model that is introduced into the banking system. Under the framework of OLG, the paper theoretically deduces the impact of bank competition on industrial investment, and builds a regression model based on the theoretical results and the actual data in China to verify the model conclusion.

#### 3.1 Model specification

Based on the basic setting of OLG model [10], it is assumed that time is discrete and defined as  $t = 0, 1, 2, \dots$ . In each period,  $t (t = 0, 1, 2, \dots)$ , there are only two types of consumers (one is young consumers and the other is old consumers) and a representative bank. In the economy, there is the replacement of the old and the new, that is, the new economic individual is born continuously, while the old economic individual is declining constantly, and each economic individual only survives in two periods of young and old. It is assumed that there are  $L_t$  young people born in the  $T$  period, and the population growth rate is  $n$ , so  $L_T = (1 + n) L_{t-1}$ . For people only survive two periods, there is the first period of life for  $L_t$  people in the  $t$  period, and  $L_{t-1} = L_t / (1 + n)$  people in the second period of life. In addition, in phase 0, there are  $L - 1 = L_0 / (1 + n)$  elderly consumers in the economy.

It is assumed that the representative bank is initially jointly owned by  $L-1$  elderly consumers, while the elderly consumers transfer the ownership of the bank to the young consumers at the end of each period, and the young consumer  $i$  obtain the endowment  $\omega_{i,t}$  when he born in  $t$  period, and  $\omega_{i,t}$  satisfies the formula (1).

$$\omega_{i,t} = \omega(1 + \gamma)^t \tag{1}$$

In above formula,  $\gamma \geq 0$  is the endowment growth rate. The parameter  $\omega > 0$  indicates each young consumer's endowment when  $t = 0$ .

The young consumers' endowment can be distributed in three ways: Consumption, bank account deposit, and purchase of bank ownership (stock) when customers are young. Specifically, the budget constraints of young consumers  $i$  born in the  $t$  period are expressed as formula (2):

$$c_{i,t}^y + d_{i,t} + b_{i,t}q_t = \omega_{i,t}, \quad t = 0, 1, \dots \tag{2}$$

In above formula,  $c_{i,t}^y$  is the consumption of consumer  $i$  when  $i$  was young in  $t$  period,  $d_{i,t}$  is the total bank deposit of consumer  $i$  in  $t$  period,  $q_t$  is the total value of the bank equity purchased by the new generation of consumers from the old consumers in  $t$  period.  $b_{i,t}$  ( $0 \leq b_{i,t} \leq 1$ ) is the proportion that consumer  $i$  bought bank equity in  $t$  period. The value  $q_t$  of a bank in period  $t$  is the present value of the sum of its future profits discounted (starting from period  $t + 1$ ).

Consumer  $i$  enters the old age in  $t + 1$  period, and its income comes from bank deposit and interest in  $t$  period as bank depositor, bank profit dividend in  $t + 1$  period as bank equity owner, and equity transfer income from selling bank shares to young consumers of  $t + 1$  period.

Consumer  $i$  uses all assets for consumption in old age. Suppose  $r \geq 0$  denotes the interest rate paid by the bank for the  $t$ -period deposit in  $t + 1$  period. Therefore, the consumption of consumer  $i$  in the  $t + 1$  period is shown in formula (3):

$$c_{i,t+1}^o = d_{i,t}(1 + r) + b_{i,t}(\pi_{t+1} + q_{t+1}), \quad t = 0, 1, \dots \quad (3)$$

In above formula,  $c_{i,t+1}^o$  refers to the consumption of consumers born in  $t$  period when they are old in  $t + 1$  period, that is, the sum of deposit and interest, the bank profit dividend obtained in  $t + 1$  period by holding  $b_{i,t}$  sized bank equity, and the income from selling bank equity to the young generation in period  $t + 1$ .

So, a maximum two-stage utility function of young customer  $i$  in  $t(t = 0, 1, 2, \dots)$  period is obtained:

$$U_i^t = U(c_{i,t}^y, c_{i,t+1}^o) = \ln(c_{i,t}^y) + \delta \ln(c_{i,t+1}^o) \quad (4)$$

In above formula,  $\delta(0 < \delta \leq 1)$  is the discount coefficient. In  $t$  period, young consumers fully foresee bank profit  $\pi_{t+1}$  and bank value  $q_{t+1}$  in  $t + 1$  period. In addition, when the initial elderly consumers are  $t = 0$  (they can be regarded as  $t = -1$  generation of young people), the second part of formula (4) is maximized, which is equivalent to selling all resources and maximizing consumption of  $c_0$  according to formula (3).

Assuming that the representative bank has the investment technology, so that it can use the obtained consumer deposits for a project with an investment return, the loan based on the successful screening of funded projects is the natural explanation for this investment technology. Therefore, if the total deposit of young consumers obtained by the bank in  $t$  period is  $d_t = \sum_{i=1}^{L_t} d_{i,t}$ , the bank's financial support for investment projects is  $d_t$ , the return in  $t + 1$  period is  $d_t \rho$  and the bank's relevant financing cost is the interest  $d_t r$  of the total deposit  $d_t$  in  $t$  period.

**Assumption 1**

- (a) The growth rate  $\gamma$  and population growth rate  $n$  of endowment sequence  $\omega_{i,t}$  meet:  $(1 + r) > (1 + \gamma)(1 + n)$ ;
- (b) The deposit interest rate shall not exceed the bank's investment income, specifically:  $\rho \geq r$ ; If we assume that 1(a) is violated, the present value of bank value in equilibrium will not converge to a finite value. Assuming that 1(b) ensures that there is a non-negative interest margin in bank investment, the profit obtained by the bank in  $t + 1$  period through the deposit in  $t$  period is as follows:

$$\pi_{t+1} = \sum_{i=1}^{L_t} d_{i,t} (\rho - r) \quad (5)$$

We want to analyze the impact of banking competition on industrial investment, thus

**Definition 1** banking is considered to be

- Complete competition: if the competition drives the deposit rate  $r = \rho$ , the banking industry can only obtain zero profit;
- Incomplete competition: If the deposit rate paid by the bank is lower than the deposit rate during complete competition, that is,  $r < \rho$ ,  
Therefore, the bank gains positive profits;

**3. 2 Model solution and balance**

In the equity market, bank ownership is traded between generations. In this model, consumers can expect infinite periods in any period. Therefore, in the  $r$  period, the bank value is as follows:

$$q_r = \sum_{t=r+1}^{\infty} \left(\frac{1}{1+r}\right)^{t-r} \pi = \frac{1}{1+r} (\pi_{t+1} + q_{t+1}) \quad (6)$$

For consumer  $i$  ( $i = 1, 2, \dots, L_t$ ), the utility maximization problem is to maximize its lifetime utility formula (4) under the constraints of formula (2) and formula (3). Constraints in each period are written as inter-temporal budget constraints. The utility maximization problem of consumer  $i$  is as follows:

$$\max_{b_{i,t}, d_{i,t}} U_i^t = \ln \overbrace{(\omega_{i,t} - d_{i,t} - b_{i,t}q_t)}^{c_{i,t}^y} + \delta \ln \overbrace{(d_{i,t}(1+r) - b_{i,t}(\pi_t + 1 + q_{t+1}))}^{c_{i,t+1}^o} \quad (7)$$

Its inter-temporal budget constraint is obtained by multiplying  $(1+r)$  by formula (2) and adding with formula (3), as shown in formula (8):

$$(1+r)c_{i,t}^y + c_{i,t+1}^o = \omega_{i,t}(1+r) + b_{i,t} \overbrace{(\pi_{t+1} + q_{t+1} - q_t(1+r))}^{\text{Excess return} = e_t} \quad (8)$$

It should be noted that, on the premise that all consumers in the market are rational and can get all the information, the optimization problem for any  $t$ -period young consumers  $i$  is to choose one between two types of savings, that is, to choose to save by purchasing bank equity  $b_{i,t}q_t$  and by interest-bearing deposit  $d_{i,t}$ .  $e_t$  in formula (8) represents the excess return of purchasing bank's equity deposit relative to the interest-bearing deposit. Therefore, if  $e_t > 0$ , consumers choose to make savings through bank equity, then  $d_{i,t} = 0$ ; if  $e_t < 0$ , then consumers choose to make savings through interest bearing deposits, then  $b_{i,t} = 0$ . In both cases, the bank will not exist in the equilibrium, so we consider the equilibrium of  $e_t = 0$ . In this case, consumers have no difference in the two types of savings. In this case, the inter-temporal constraint formula (8) is simplified as:

$$(1+r)c_{i,t}^y + c_{i,t+1}^o = \omega_{i,t}(1+r) \quad (9)$$

To solve the utility maximization problem of consumer  $i$  ( $i = 1, 2, \dots, L_t$ ), the following two first-order conditions are obtained:

$$0 = d_{i,t}(1+r)(1+\delta) + b_{i,t}(\pi_{t+1} + q_t\delta(1+r) + q_{t+1}) - \delta\omega_{i,t}(1+r) \quad (10)$$

$$0 = (1+\delta)b_{i,t}q_tq_{t+1} + (1+\delta)b_{i,t}q_t\pi_{t+1} + d_{i,t}(q_t(1+r) + \delta(\pi_{t+1} + q_{t+1})) - \delta\omega_{i,t}(\pi_{t+1} + q_{t+1}) \quad (11)$$

In the representative bank equity market, if the young people in each period acquire the bank ownership from the old people in the current period, the clearing conditions of the bank equity market are as follows:

$$\sum_{i=1}^{L_t} b_{i,t} = 1 \quad (12)$$

Therefore, formulas (1), (5), (6), (10), (11) and (12) constitute the equilibrium conditions of the OLG model. The last equation assumes that the value of bank ownership grows steadily in the equilibrium path, that is,  $q_{t+1} = (1+r)(1+n)q_t$ . Under this condition, we can get the following equilibrium solution:

$$\begin{aligned} d_{i,t} &= \frac{\delta\omega(1+\gamma)^t(r-\gamma-n-\gamma n)}{(\rho-\gamma-n-\gamma n)(1+\delta)} \quad i = 1, 2, \dots, L_t \\ \pi_{t+1} &= \sum_{i=1}^{L_t} d_{i,t}(\rho-\gamma) = \frac{\delta L_0\omega(1+n)^t(1+\gamma)^t(r-\gamma-n-\gamma n)(\rho-\gamma)}{(\rho-\gamma-n-\gamma n)(1+\delta)} \\ q_t &= \frac{\delta L_0\omega(1+n)^t(1+\gamma)^t(\rho-\gamma)}{(\rho-\gamma-n-\gamma n)(1+\delta)} = \frac{q_t + 1}{(1+\gamma)(1+n)} \\ b_{i,t} &= \frac{1}{L_t} \quad i = 1, 2, \dots, L_t \\ c_{i,t}^y &= \frac{\omega_{i,t}}{1+\delta} = \frac{\omega(1+\gamma)^t}{1+\delta} \quad i = 1, 2, \dots, L_t \\ c_{i,t+1}^o &= \frac{\delta(1+r)\omega_{i,t}}{1+\delta} = \frac{\delta(1+r)\omega(1+\gamma)^t}{1+\delta} \quad i = 1, 2, \dots, L_t \end{aligned} \quad (13)$$

### 3.3 Crowding out effect of industrial investment

The investment technology owned by representative banks makes the deposit  $d_t$  in  $t$  period increase to  $d_t(1+\rho)$  in  $t+1$  period. Therefore, a higher rate of return on bank investment projects means a higher bank profit, while a higher bank profit means a higher bank equity value. Therefore, it means that for the young consumers, while the attraction of obtaining high bank profits through investment banks is increasing, it needs more resources to purchase bank ownership, so the deposit, that is,

industrial investment, is less. To quantify this crowding out effect, we define the measurement index  $k_t$  of industrial investment's crowding out effect as:

$$k_t = \frac{\sum_{i=1}^{L_t} b_{i,t} q_t}{\sum_{i=1}^{L_t} d_{i,t} + \sum_{i=1}^{L_t} b_{i,t} q_t} \tag{14}$$

Measurement formula (14) of crowding out effect of industrial investment captures how to crowd out industrial investment for the resources needed to acquire bank ownership, i.e. deposits. It is the source of promoting real output growth in this economy. In this sense,  $k_t$  can be regarded as a measure of dynamic inefficiency due to the resources spent to obtain bank ownership to support the consumption of the older generation, noting that definition  $0 \leq k_t \leq 1$  shall be followed. Substituting the equilibrium solution given by equation (13), we get the formula below:

$$k_t = \frac{\rho - \gamma}{\rho - \gamma - n - \gamma n} = k = \frac{(1 + \rho) - (1 + \gamma)}{(1 + \rho) - (1 + \gamma)(1 + n)} \tag{15}$$

It should be noted that  $k \geq 0$  can be seen from hypothesis 1, so the measurement index of crowding out effect of industrial investment in the equilibrium path is negatively correlated with bank deposit rate  $r$ , that is to say, sufficient bank competition in the deposit market can reduce crowding out effect of industrial investment  $k$ .

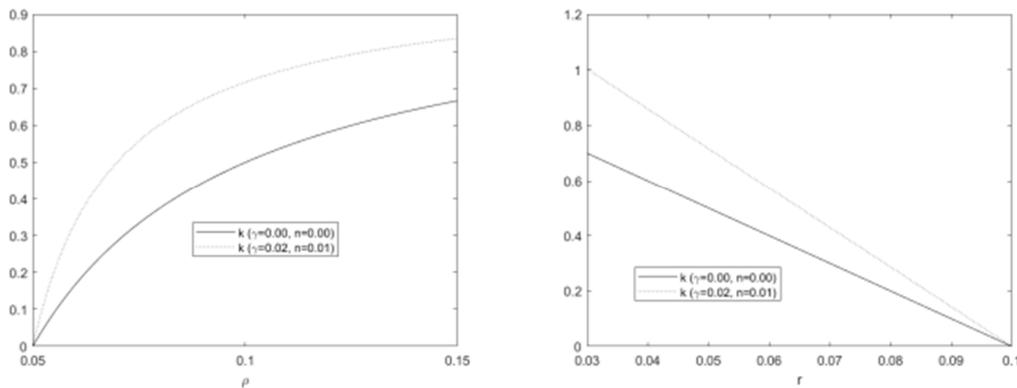


Fig. 1. The value of measurement index  $k$  for industrial investment's crowding out effect at the mean value, where  $\gamma = 0$ ,  $n = 0$  (solid line),  $\gamma = 0.02$ ,  $n = 0.01$  (dotted line). Left figure: When  $r = 0.05$ ,  $k$  is a function of bank investment return  $\rho$ ; right figure: When  $\rho = 0.1$ ,  $k$  is a function of bank deposit rate  $r$ .

Based on the above analysis and the derivation of theoretical model, this paper puts forward the hypothesis to be tested empirically, that is, the smaller the competition incentive degree of the banking industry is, the higher the profit of the banking industry is, the more the consumer investment is obtained, and the less the industrial investment is.

#### 4. Empirical research design

##### 4.1 Variable definition and measurement

###### 4.1.1 Measurement index of bank competition degree and industrial investment level

(I) Bank competition:

The existing literatures mainly measure the level of bank competition from the proportion of branches of major banks in major regions [20, 21]; Zhou Minjun indicates that the market concentration of the banking industry is in direct proportion to the profitability of the banking industry [22]; the Adjusted Lerner index uses the difference value between the marginal cost and the income of the bank to reflect the market power of banking industry [23]. This paper takes example by the existing literature and combines the OLG model of introducing the banking system to innovate the degree of competition in the banking industry from the profit of the banking industry. This paper specifically considers the ratio of bank profit to total owner's equity and bank profit to total assets, which are as follows:

$$\begin{aligned} \text{Return on equity: } ROE_i &= \frac{\text{profit}_i}{\text{equity}_i} \\ \text{Return on Assets: } ROA_i &= \frac{\text{profit}_i}{\text{asset}_i} \end{aligned} \tag{16}$$

$ROE_i$  and  $ROA_i$  respectively represent the return on equity and return on assets of the  $i$ -th bank, while  $profit_i$ ,  $equity_i$ ,  $asset_i$  respectively represent the total profit, owner's equity, and total assets of the bank.

In this paper, the weight of the return on equity of each bank is obtained by multiplying the proportion of the total equity of each bank in the banking market by the return on equity of the bank, and then added them to get the first standard D1 for measuring the degree of competition in the banking market from the perspective of profit.

$$D1_i = \sum_{i=1}^n \left( \frac{equity_i}{\sum_{j=1}^n equity_j} \times ROE_i \right) = \sum_{i=1}^n \left( \frac{equity_i}{\sum_{j=1}^n equity_j} \times \frac{profit_i}{equity_i} \right) = \frac{\sum_{i=1}^n profit_i}{\sum_{j=1}^n equity_j} \quad (17)$$

In the same way, we treat the return rate of each bank's assets in the same way, so as to get the second standard D2 for measuring the degree of competition in the banking industry from the perspective of profit.

$$D2_i = \sum_{i=1}^n \left( \frac{asset_i}{\sum_{j=1}^n asset_j} \times ROA_i \right) = \sum_{i=1}^n \left( \frac{asset_i}{\sum_{j=1}^n asset_j} \times \frac{profit_i}{asset_i} \right) = \frac{\sum_{i=1}^n profit_i}{\sum_{j=1}^n asset_j} \quad (18)$$

According to the definition, D1 and D2 are all negative indicators, the larger the value of D1 and D2, the lower the competition degree of banks will be. After getting the results of D1 and D2, we use the growth rate of industrial investment to make regression analysis on the two calculation results. According to the existing literature and the theoretical deduction of this paper, we know that the smaller the degree of bank competition, the greater the crowding out effect on industrial investment. Therefore, we put forward a conjecture: When controlling other factors, the bigger the index (D1 and D2) of measuring bank competition degree, the slower industrial investment growth should be, that is to say, the regression coefficient of the bank competition degree index will be significantly negative in theory.

(II) Industrial investment: The explained variable is the investment growth rate ( $df\_inv$ ). According to our theoretical derivation, too low degree of bank competition will make industrial investment crowd out. Therefore, the growth rate of industrial investment can meet the purpose of the study that industrial investment is crowded out. At the same time, it is also consistent with the OLG model assumed in this paper. Specifically, the paper will add one to obtained fixed net investment of listed enterprises and take the natural logarithm (to prevent the result from not being obtained within the range of real number, add one to the fixed net investment; at the same time, for the specific value in the sample is too large, "adding one" will not have a substantial impact on the result):

$$X = \ln(1 + net\ fixed\ investrment) \quad (19)$$

The investment growth rate is obtained by making a difference values got in the adjacent years:

$$df\_inv_t = X_{t+1} - X_t \quad (20)$$

Of which, the subscript  $t$  represents the year.

#### 4. 1. 2 Other control variables

1. Bank variables: the bank's profit ( $ln\_profit$ ): obtained by taking the logarithm of the profits made by the bank;

2. Enterprise variables:

- Liabilities undertaken by the enterprise ( $ln\_totaldebt$ ): obtained by taking the logarithm of the total liabilities undertaken by the enterprise;

- Assets owned by the enterprise ( $ln\_totalasset$ ): obtained by taking the logarithm of the total fixed assets owned by the enterprise;

- Enterprise's operation ( $ln\_total\_revenue$ ): obtained by taking the logarithm of the profits made by the enterprise;

- Enterprise's cash flow ( $ln\_net\_cash\_flow$ ): obtained by taking the logarithm of the cash flow in the enterprise;

- Enterprise's profits ( $ln\_net\_profit$ ): shown by the net profit made by the enterprise;

- Intangible assets of the enterprise ( $ln\_intangibleasset$ ): shown by the total intangible assets of the enterprise;

- Final cash assets in the enterprise ( $ln\_final\_cash$ ): obtained by taking the logarithm of the final cash and balance of the cash equivalent;

- Fixed investment of the enterprise ( $\ln\_fix\_inv$ ): obtained by taking the logarithm of the net fixed investment in a year;

#### 4. 2 Measurement model

In accordance with the current documents and theoretical derivation, the hypotheses in this paper is assumed that in the financial market, bank competition is not severe and market monopoly is existed; meanwhile, equity value is relatively huge, then “old people” in the financial market starts to sell their bank equity in order to change their assets into negotiable currency and then use the negotiable currency; on the contrary, “young people” in the financial market starts to invest large amounts of capital into the financial market in order to get high profits from the bank monopoly. In this case, capital which used by “young people” to do industrial investment will be deducted, therefore, industrial investment will be lowered.

According to the hypothesis and derivation mentioned above, the regression model was set up to verify the hypothesis. Here below is the regression model:

$$Investment_i = \beta_0 + \beta_1 bank\_competition_i + \theta' Controls_i + \varepsilon_i \quad (21)$$

In this mode, the explaining variable is the measurable indicator (like D1 and D2) showing the bank competition at the period of  $i$ ; explained variable is the investment growth at the period of  $i$ ;  $Controls_i$  is a group of control variables (like enterprise liability, enterprise asset, enterprise fixed investment etc.). In formula (2), if the estimated value of the regression coefficient showing the bank competition is significantly negative, it means that when other control factors are not changed, the decrease of D1 and D2 will help with the investment growth. That is the more severe bank competition is, the faster industrial investment will grow.

#### 4. 3 Sample selection and data source

In this paper, all the data is mainly from CSMAR: including the enterprise income statement / balance statement, bank balance statement and bank income statement. Besides, location information of the bank head office was obtained from the financial permit issued on the CBRC (China Banking Regulatory Commission) website, as well as the regional information obtained from Joint Quant. The sample period was from 2008 to 2018. Basic information about the listing companies were obtained by different ways; the stock code information was combined by language R.

It should be noted that because of the special features of bank industry, the banking data obtained in this paper was processed by:

1. Information issued by CBRC includes the state administrative functional information (like national policies), which is not consistent with our study purpose, which is not able to represent the bank competition at a region. As a result, only commercial bank information was selected by this paper;

2. In some regions, financial market is not completely developed or information is unable to be directly obtained etc., it is mandatory to kick out the financial information of some provincial administrative institutes (including Xinjiang Uygur Autonomous Region, Tibet Autonomous Region, Taiwan Province, Hong Kong Special Administrative Region, Macao Special Administrative Region and Inner Monggol Autonomous Region);

3. Scale of the four state-owned banks are too huge and regional difference is not obvious, which cannot show the regional competition in different regions, so only regional bank information was kept (like: Shanghai XXX Bank).

On the basis of basic data about listing enterprises and banks, as well as the method issued in Article 4.1 “Variable Definition and Measurement”, process the data by language R, then relevant data was obtained by the calculation. In additional, in order not to be bothered by the singular value existed in the financial data, this paper made a winsorize to the iso-continuous variables (the level was 1%) by referring to the methods mentioned in relevant documents. See Table 1 for the variable definitions and descriptive statistics.

Table 1. Variable definitions and descriptive statistics

Statistic	N	Mean	St. Dev.	Min	Max
df_inv	20,820	0.138	0.418	-1.222	2.125
D1	20,820	0.230	0.221	0.002	3.960
D2	20,820	0.016	0.014	0.0002	0.209
ln_totaldebt	20,820	21.078	1.677	17.296	25.499
ln_totalasset	20,820	22.029	1.394	0.000	28.509
ln_total_revenue	20,820	21.321	1.540	16.838	25.329
ln_net_cash_flow	20,820	14.341	8.363	0.000	23.138
ln_net_profit	20,820	16.838	5.746	0.000	22.624
ln_intangibleasset	20,820	17.938	3.426	0.000	25.815
ln_final_cash	20,820	19.900	1.461	15.394	23.761
ln_fix_inv	20,820	20.094	1.770	14.658	24.550
ln_profit	20,820	22.825	1.097	17.062	24.240

From Table 1, we can see that the sample size is 20820, indicators used to measure the bank competition in different regions: lnprofit, which means the absolute size of the footing of bank profit; D1 and D2 are the relative measurement indicators, whose calculation were defined in Article 4.1. Average value of D1 and D2 was 0.23 and 0.016, the reason why their value was different was that D1's calculation is based on ROE and D2's calculation was based on return on assets, and there is a significant difference between total bank capital and total assets. Standard deviation between D1 and D2 was 0.221 and 0.014, which represented that different regions are significant different from other regions in bank competition. Df invrepresents the investment growth of an enterprise, which is the explained variable of the regression analysis, whose average value is 0.138 and standard difference is 0.418, the minimal value is -1.222 and maximal value is 2.125. This shows that growth of fixed asset investment in different enterprises was in great difference. Other variables are the log value of financial variables, see Article 4.1 for their definitions.

## 5. Empirical result

### 5.1 Crowding-out effect of bank competition and industrial investment

In this paper, a regression was made by the industrial investment quantity, bank profit and other control variables. See Table 2 for the regression results of non-financial enterprise samples.

Table 2. Regression Result of Enterprise Investment and Bank Profit

Dependent variable:ln_fix_inv		
	(1)	(2)
ln_profit	-0.126*** (0.006)	-0.094*** (0.009)
ln_totalasset	0.712*** (0.017)	0.659*** (0.015)
ln_totaldebt	-0.024** (0.012)	0.062*** (0.010)
ln_total_revenue	0.374*** (0.010)	0.268*** (0.010)
ln_intangibleasset	0.118*** (0.002)	0.074*** (0.002)
ln_net_profit	-0.023*** (0.001)	-0.016*** (0.001)
ln_net_cash_flow	0.032*** (0.001)	0.018*** (0.001)
ln_final_cash	-0.278*** (0.009)	-0.151*** (0.008)
Constant	3.143*** (0.178)	2.284*** (0.239)

province	Not controlled	Controlled
industry	Not controlled	Controlled
Observations	20,820	20,820
R2	0.681	0.780
Adjusted R2	0.681	0.778
Residual Std. Error	1.000 (df = 20811)	0.833 (df = 20711)
F Statistic	5,551.923***(df = 8; 20811)	678.240***(df = 108; 20711)
<i>Note:</i>		*p<0.1; **p<0.05; ***p<0.01

In Table 2, the first column is the regression by industrial investment and bank profit, which controls the enterprise feature; in the second column, a control to the province and industry is done, the estimated coefficient of  $ln\_profit$  (bank profit variable) is -0.126 and -0.094, which was significant negative at a significance of 1%. That is to say, the higher bank profit is, the less fixed investment can be obtained by non-financial enterprise. According to the bank competition mentioned above, when the bank competition is weak, there will be no need for the bank to increase deposit interest rate to get more clients. Only in this way can the bank keep a high profit. If the bank gets a high profit, industrial investment will be decreased accordingly. Then a crowding-out effect of bank competition and industrial economy will come out. In the 2nd column of Table 2, the regression result shows that after the province, industry and enterprise feature are controlled, if bank profit is increased by 1%, the industrial investment obtained by non-financial enterprise will be decreased by 0.094% accordingly.

In the regression model shown in Table 2, regression data was selected as the total -- total bank profit and investment obtained by all non-financial enterprise. After thinking about the model, the regression model was perfected in order to control the deviation resulted in by missing variables and bank scale differences.

Regression was done by formula (21), here below are the details:

$$df\_inv_i = \beta_0 + \beta_1 D1_i + \theta' Controls_i + \varepsilon_i \tag{22}$$

$$df\_inv_i = \beta_0 + \beta_1 D2_i + \theta' Controls_i + \varepsilon_i \tag{23}$$

In the formula, the explained variable is the enterprise's industrial investment growth ( $df\_inv_i$ ), the major explaining variable is the indicator used to measure the bank competition (defined in Article 4.1) --  $D1_i$  and  $D2_i$ ; the higher  $D1$  and  $D2$  are, the less severe bank competition is.  $Controls_i$  is a series of control variables. See Table 3 for the regression results.

In Table 3, pay great attention to  $D1$  in the first column, which can be used to verify the impact on enterprise investment by bank competition, the estimated value of  $D1$  coefficient is -0.0324, which is significant at the significance of 5%. This shows that this item has a negative impact to the explained variable. That is to say, the more severe bank competition is, the less bank profit will be and the less funds can be invested to the bank and financial enterprises. If so, crowding-out effect to industrial investment will be weakened and non-financial enterprise will get more investment. That is investment to non-financial enterprises will be decreased by 0.0324% if  $D1$  is increased by 1%. In the second column in Table 3, pay great attention to  $D2$ , which can verify the impact on enterprises by bank profit, being able to represent the bank competition. Estimated value of  $D2$  coefficient is -0.5170 and it is significant at the significance of 5%, which shows that a significantly negative impact will be made by the bank profits to enterprise investment. That is the investment to non-financial enterprises will be decreased by 0.517% if  $D2$  is increased by 1%.

Other control variables basically comply with the forecast. Take total asset as an example, the estimated value of coefficient is 0.0491% and the significance is 1%, which mean that enterprises with more assets will get more investment. This is consistent with the description of weakening of crowding-out. The total balance also complies with the tendency of other data. When the significance is 1%, the coefficient is -0.0167. If bank competition is weak, non-financial enterprise will get less industrial investment and the enterprise will get more liabilities.

Table 3. Regression Result of Investment Growth and Bank Competition

<i>Dependent variable: df inv</i>		
	(1)	(2)
D1	-0.0324** (0.0132)	-
D2	-	-0.5170** (0.2097)
ln_totalasset	0.0491*** (0.0076)	0.0492*** (0.0076)
ln_totaldebt	-0.0167*** (0.0057)	-0.0168*** (0.0057)
ln_total_revenue	-0.0296*** (0.0058)	-0.0296*** (0.0058)
ln_intangibleasset	0.0073*** (0.0015)	0.0073*** (0.0015)
ln_net_profit	0.0071*** (0.0006)	0.0071*** (0.0006)
ln_net_cash_flow	-0.0016*** (0.0004)	-0.0016*** (0.0004)
ln_final_cash	0.0140*** (0.0040)	0.0140*** (0.0040)
Constant	-0.4766*** (0.0707)	-0.4777*** (0.0707)
province	Controlled	Controlled
industry	Controlled	Controlled
Observations	20,820	20,820
R2	0.0379	0.0379
Adjusted R2	0.0329	0.0329
Residual Std. Error (df = 20711)	0.4114	0.4114
F Statistic (df = 108; 20711)	7.5583***	7.5576***
<i>Note:</i>		*p<0.1; **p<0.05; ***p<0.01

## 5. 2 Robustness analysis

During the empirical study, a regression analysis among industrial investment growth, D1 and D2 was made. The regression estimated coefficient is 0.0132 (significant when the significance is 5%) and 0.2097 (significant when the significance is 5%) (see Table 3), which means that the empirical study successfully verified the theory about the relation between bank competition and industrial investment described in this paper). However, the empirical study result is a kind of simulation and regression based on the model which is set up in accordance with the theory mentioned in this paper. In order to verify the robustness of the study conclusion in this paper, the following empirical verification is done:

This paper referred to the current documents and reflected the bank competition by the quantity of bank branches existed in secondary market [24]. The data used in this paper to calculate the bank competition is the financial permit information issued on the CBRC website. It should be noted that by referring to Chong et al. [21] and Chen Xiongbing [24], the financial data collected in this paper only includes the information about commercial bank while special bank information about financial market and enterprise loans related to policy bank, rural competitive bank and rural / urban credit cooperative. Regarding the special reasons existed in special cities (including the immature financial market, different economic entity, special political position or data unable to be obtained directly etc.), the data referred to by this paper was processed by: (1) the data used in this paper excluded the ones existed in Tibet, Xinjiang, Hainan, Taiwan, Hong Kong and Macao. (2) In Beijing and Shanghai, only

data in primary bank branches was selected for processing. (3) In other cities and provinces (including provinces, direct-controlled municipality and autonomous region), information in secondary bank was selected for processing.

What needs to be specified is that after manually processing the data issued by CBRC, the calculation result in this paper cannot only reflect the severity of bank competition in different regions but also directly shows the historical change of bank competition. In this case, this paper is able to realize the purpose of studying OLG model and the impact on industrial investment by bank competition.

Specifically, by referring to [24]the financial permit information issued on CBRC website, this paper calculated the quantity of secondary banks in provincial administrative institutions, by which HHI of banking industry in each region is figured out. According to HHI, the bank competition in each region is able to be directly reflected by numbers. Here below is the calculation:

$$HHI = \sum_{i=1}^n (Branch_i / Total\_Branches)^2 \tag{24}$$

In this formula,  $Branch_i$  represents the quantity of secondary branches in type  $i$  bank in a region,  $Total\_Branches$  is the quantity of secondary branches in the region. HHI's range is (0, 1) and it is a negative index. The higher it is, the less severe the bank competition is.

After calculating HHI in each province, Fig. 2 shows the change of HHI in different provinces.

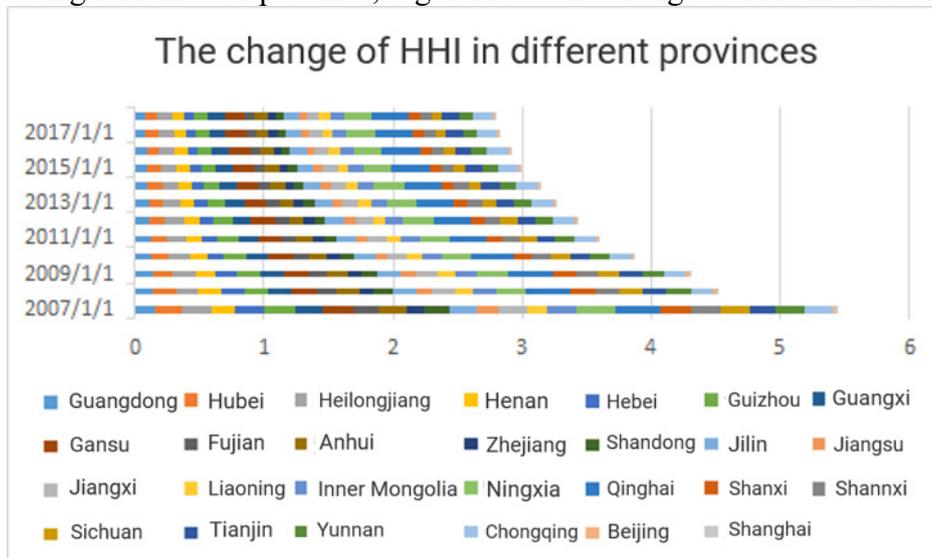


Fig. 2.HHI Indexes

After obtaining the HHI from 2008 to 2018 in most provinces, controlling the logarithm of enterprise cash flow and logarithm of enterprise total profits, a regression is done to the the industrial investment growth and the HHI.

According to the regression result, we can see that there is a negative correlation between HHI and industrial investment growth. HHI coefficient, the major explaining variable, estimated value is -0.087, which is significant when the significance is 10%, showing that the lower HHI is, the more severe bank competition will be and the faster industrial investment growth will be. According to what is mentioned above, this paper verified HHI index by regression analysis. After the regression, the result is consistent with the result that D1 and D2 can be measured by bank competition. Therefore, the study result in this paper is robust, D1 and D2, indexes of bank profits, are rational.

## 6. Conclusion

This paper utilizes the OLG theoretical model to theoretically study the bank competition's impact on industrial investment by maximizing consumer effectiveness and analyzing market clearing conditions. It is found that as long as the bank has monopoly market, it will crowd out industrial investment. There is a phenomenon that the severer bank market competition is, the more industrial investment will be crowded out. By studying balance statements and income statements of enterprises

and banks existed in CSMAR and disclosed information issued by CBRC website, we find that bank competition is able to lower or partially solve the crowding-out effect on entity economy by financial industry.

Besides, by using the data of Stock A non-financial listing enterprises and bank data in different provinces and cities, an empirical study is made in this paper, which studies the crowding-out effect to industrial investment by bank competition. From the view of bank profit, this paper set up two indexes D1 and D2 to measure the bank competition, then a regression analysis is done to D1 and D2 by enterprise investment growth, by which the regression coefficient is -0.0324 and -0.5170. The two indexes are significant when the significance is 5%. This tells us that in China, bank competition has a crowding-out effect to the industrial investment. By the measurement to bank competition existed in current documents, this paper makes a robustness analysis to HHI, the regression coefficient is -0.087, which is significant when the significance is 10%. This tells us that the study conclusion in this paper is relatively robust. According to what is mentioned above and the regression result of OLG model, as well as HHI change, it is able to verify that if bank competition is not severe and the bank profit is high, industrial investment obtained by non-financial enterprise will be lowered and the enterprise will get more liabilities.

This paper shows that the more severer bank competition is, the more efficient resource distribution will be, which will help with the economic growth. Therefore, it is necessary for the government to pay attention to the correctness of bank and the whole financial industry. Bank shall be provided with competition because rational competition can lower the funds going to the bank and well control the crowding-out effect on the entity economy investment.

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