

Research Article

Market Concentration, Market Power, and Firm Growth of Construction Companies

Yumou Wang ¹ and Shilong Li ^{1,2}

¹School of Management Science and Real Estate, Chongqing University, Chongqing 400045, China

²Research Center of Construction Economy and Management, Chongqing 400045, China

Correspondence should be addressed to Shilong Li; lishilong@cqu.edu.cn

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China's economy has been transitioning from a phase of rapid growth to a stage of high-quality development that is called "new normal," and China's construction industry plays a pillar part in China's economy. Nevertheless, the industry is large but not strong. This labour-intensive industry suffers from low concentration and fierce competition. Based on the organizational theory, which shows how market structure contributes to the growth of industry, this study aims to explore the impact of market concentration and market power on firm's turnover and profit. Using statistical analysis and panel data of 37 China's construction companies from 2009 to 2018, this study proposes and calculates the market concentration (CR) and the market power (MP) of China's companies. Then the augmented Cobb–Douglas production function and OLS regression are used to explore the growth factors of China's construction industry. The results show that the market concentration increases both the turnover and profit of construction firms. However, market power increases the profit of construction firms while decreases the turnover. In addition, the companies that are China's non-state-owned have overseas income or are civil engineering and construction have more advantages in the growth of the construction industry in "quality". This study provides a reference to understand the structures of the construction industries and the structural effect on the growth of different types of firms and could be replicated in other countries with the similar situation.

1. Introduction

The world economy has witnessed a rapid increase of China's economy that has become the second largest one in the world since 2010. According to National Bureau of Statistics of China (NBSC) (2019), China's construction industry companies (referred to as general and professional contracting construction companies with qualification grade, excluding labour subcontracting construction companies) completed the total output value of the construction industry of CNY 235085.53 billion with an increase of 9.88% year-on-year. The construction companies employ 55.633 million people, accounting for 7.17% of the total employment of the whole society, which indicate that the construction industry is the pillar industry in China's economy.

In recent years, Chinese construction companies have played an important part in the global construction market.

Latest statistics from Engineering News-Record (ENR) (2020) show that there are 74 Chinese construction companies on the ENR's Top 255 International Contractors (TIC225) and gain a total contracting revenue of \$120 billion from their overseas construction market in 2019, which accounted for 25.4% of the total international sales of the TIC225. China has not only become the largest construction market in the world but also become a powerful competitor in the world construction market. Therefore, topics related to the China's construction industry have received more academic interests in English-language literature.

China's construction industry can be described as a giant of output value but a dwarf in profit-making. Many researchers in the construction industry focus on the concentration studies to investigate the relationship between market concentration and firm growth because this labour-intensive industry usually suffers from low concentration

and fierce competition [1]. The extent of concentration of a particular industry provides useful information on the degree and nature of market competition. The market concentration index (MCI) has often used as an indicator or parameter to describe the market concentration and the structure of a market. MCI is the sum of the percentages of market shares of the top n largest companies in the industry. Many researches count a small number of largest firms (commonly the top four companies) and their market shares [2]. A market can be defined as perfect competition, oligopoly, duopoly, monopoly, or other according to the index [3]. The index close to zero means that no firms control substantial shares of the market. MCI is often used to represent market power in empirical research, as the existence of market power is often presumed if a firm's market share persistently exceeds some predetermined threshold in the absence of evidence to the contrary [4], which allows a higher price above the marginal cost.

But concentration is not synonymous with market power [5], the positive correlation between market concentration and market power only holds under very specific market structure. On one hand, recent studies have showed that both market concentration and market power are increased in American firms. On the other hand, there are also evidences that the link between market concentration and market power is by no means clear in euro area [6]. There is far less agreement on how they influence firm growth, and the purpose of this investigation is to explore the impact of market concentration and market power on firm's turnover and profit using the data on China's construction industry by regression analysis. Furthermore, we seek to find out the factors keeping Chinese companies evolve rapidly. The main hypothesis of this research is that the market concentration increases both the turnover and profit of construction firms. However, market power increases the profit of construction firms while decreases the turnover. Other countries that have with low market concentration can find this study helpful in addressing issues that their construction industry is facing.

The results of model estimation provide the empirical evidence, which contributes to understanding the relationship between market concentration and market power. In addition, it helps to understand the relationship about market structure and firm growth. Moreover, the research results might explain how factors affect firm growth in different market, which could lead to the strategies changes.

The rest of the paper is organized as follows: the second part reviews the literature on market structure and the growth of the construction industry, the third part constructs the measurement models, the fourth part analyses the current situation of China's construction industry structure, and the fifth part conducts empirical analysis. Finally, summarize the full text and make comments.

2. Literature Review

2.1. Different Views on Market Concentration and Performance. The relationship between market structure and performance has been a crucial topic in industrial organization. The market power theory was first introduced by

Mason and refined by Bain [7, 8]. It argues that market structure affects the conduct of firms in that market and then the corporate performance. It is believed that market concentration has a positive effect on corporate profitability by structure-conduct-performance (SCP) analysis because a more highly concentrated market structure is assumed to be conducive to more effective collusion and an increase in entry barriers increases the optimal price-cost margin for leading firms [9]. However, the efficient structure theory explains the positive relationship between market concentration and market performance in terms of enhanced efficiency, which is normally associated with Chicago School. As Demsetz explained, if firms are enjoying higher levels of efficiency, they can gain market share and increase their size, which will gradually foster a more concentrated market structure [10].

Contrary to previously mentioned theories, some theoretical models suggest a negative relationship between market concentration and corporate performance [11]. The possible explanations might be that the market leaders would lose the motivation to reduce costs in the absence of the competitive pressure [12], the excess production capacities [13], or the profitability is undermined due to the presence of high sunk costs [14]. What is more, Brozen presented a theory implying that there is no significant relationship between market concentration and profitability [15]. Finally, Lee and Mahmood attempted to formulate a model integrating both positive and negative relationships between market concentration and profitability [16].

The researchers have paid more attention to market concentration and market power, as some literature found that both rise in US firms [17]. And lots of studies indicated that there is a tendency that they are still rising at global level [18]. Some authors calculated that the rise in market power may reflect more positive development as the firms earn it by cutting cost and improving their productivity [19, 20], while other authors were worried about that they worsened the lobbying and rent seeking [21].

2.2. Researches on Market Concentration and Growth in Construction Market. A large number of construction structure literature show that construction industry usually suffers from low concentration and fierce competition, and lots of research studies of concentration have been conducted in the construction industry of different countries. McCloughan found little concentration phenomenon in the British construction market [22]. Kim and Reinschmidt computed the concentration ratio for construction contractors on the basis of the sum of the top four contractors' gross revenues and the total industry revenues in U.S. and found that the construction industry was very fragmented [23]. Liu use the Panzar–Rosse model to assess the market structure, revealing that China's construction industry operates under conditions of monopolistic competition with free-entry equilibrium [24]. Zhao explored the market structure of international engineering contracting construction industry, calculated the market concentration index and the competitive intensity, and predicted how they would change in the future [25].

As for the quantitative study between market concentration and its effect on firm growth, there are not the consistent conclusions. Akintola and Martin showed that there was a positive relationship between companies' size and profitability in U.K. construction contractors [26]. And Liu found out that both structure and total revenue are positively correlated, and performance is more greatly affected by market structure than by ownership structure in China [27]. While Yee and Cheah conducted that there was no relationship between firm size and profitability in some large international engineering and construction firms [28]. And Kim had the same conclusion that firm growth was independent from firm size and market diversification by analysing the business information published by ENR [23]. In addition, using the event history analysis method and data of Jiangsu Province, Yang concluded that the increasing concentration of the Jiangsu construction industry has a negative effect on the survival of construction companies [1].

3. Methodology

3.1. Empirical Analysis Method. To achieve the objective of this study, the augmented Cobb–Douglas production function was used for exploring the dependence between production inputs and outputs. The market concentration and market power are included in the equation as the explanatory variables; it can be written as follows:

$$Y_{it} = A_{it} \cdot MC_{it}^{\alpha_1} \cdot CR_{it}^{\alpha_2} \cdot LE_{it}^{\alpha_3} \cdot K_{it}^{\alpha_4}, \quad (1)$$

where A stands for the level of technology; Y_{it} denotes the turnover or profit of each company; MC_{it} is market power; K_{it} represents capital investment; and LE_{it} indicates labour force. The subscripts i and t denote i company and t year, respectively. The output elasticities of market power, market concentration, labour force, and capital are denoted by α_1 , α_2 , α_3 , and α_4 , respectively.

To linearize the relationship between the economic growth and the explanatory variables, equation (1) is transformed into a logarithmic form:

$$\begin{aligned} \ln Y_{it} &= \alpha_0 + \alpha_1 \ln MC_{it} + \alpha_2 \ln CR_{it} \\ &+ \alpha_3 \ln LE_{it} + \alpha_4 \ln K_{it} + \mu_{it}, \quad (2) \\ LE_{it} &= L_{it} \cdot E_{it}, \end{aligned}$$

where α_0 is constant, $\alpha_1 - \alpha_4$ are the output elasticity of market power, market concentration, labour force, and capital, respectively, and μ_{it} is the usual white noise residual. L_{it} is the labour force quantity and E_{it} is the average labour quality. The descriptive statistics after taking logarithm of the explanatory variables are shown in Table 1.

3.2. Samples and Variables. Consider the availability of data, 37 construction companies that have not been delisted since going public before 2009 are taken as the research objects. The data come from the annual reports of the companies and the CSMAR database from 2009 to 2018. The turnover of the companies with constant prices in 2009 is used as the explanatory variable [29]. The GDP Deflator Index is used to

TABLE 1: Statistical description of variables.

Variable	Obs	Mean	Std. dev.	Min	Max
lnY	370	22.92	1.887	17.84	27.83
lnCR	370	-7.370	1.846	-12.39	-2.872
lnMC	370	-1.955	0.429	-2.976	-0.300
lnLE	370	11.05	1.902	6.040	15.33
lnK	370	23.44	1.677	19.53	28.27

reduce the operating income and capital investment to eliminate the impact of inflation. The calculation methods of other explanatory variables are as follows.

3.2.1. Market Power. After Demsetz proposed the relationship between efficiency and market power, the calculation method of market power and its impact on firms' performance have become a long-term research in industrial organization. The main proxy of measuring market power is the Lerner Index; in addition, the reciprocal of price flexibility coefficient [30] and advertising density [31] are also used to measure market power. Referring to the work of Kale [32] and Chen [33], the Lerner Index is used to measure market power at the companies' level, namely:

$$MC_{i,t} = \frac{P_{i,t} - C_{i,t}}{P_{i,t}}, \quad (3)$$

where $MC_{i,t}$ represents the market power of i company in t year, $P_{i,t}$ represents the turnover of i company in t year, and $C_{i,t}$ represents the operating cost of i company in t year.

3.2.2. Market Concentration. Market concentration index has often used as an indicator or parameter to describe the market concentration and the structure of a market, but it cannot reflect a certain company's concentration in the industry. So we use market share as the proxy of each company's concentration in this article.

3.2.3. Capital. Capital is a concept corresponding to labour, which has a great influence on firm growth [34]. In the existing research on the construction industry, the fixed asset value and the total investment in fixed assets are widely used as capital inputs. Only a few studies involve it at companies' level. And the investment of an industrial capital in the Cobb–Douglas production function is the sum of all funds invested to realize the total output of the industry [35]. So we take total enterprise assets as capital investment at the companies' level, which includes current assets and non-current assets.

3.2.4. Labour Force. Labour force has played an important role in the growth of corporate turnover. The new economic growth theory recognizes the role of human capital and technological progress in economic growth and begins to attach importance to education and the accumulation of human capital, namely the quality of labour [36, 37]. We also divide the labour force improvement into "quality" and "quantity". Because of that the statistical methods in

counting employee education level are not completely consistent in different companies' annual reports of various companies, that the number of employees multiplied by

average education attainment is used to measure the labour force. Schooling years per capita are measured by the specific formula as follows:

$$\text{schooling years per capita} = \frac{\left(\begin{array}{l} \text{the number of employees with the degree of high school, technical secondary school or below} \\ * 12 + \text{the number of the employees with the degree of college} \\ * 15 + \text{the number of the employees with the degree of undergraduate and above} * 16 \end{array} \right)}{\text{the number of total employees}} \quad (4)$$

4. The Structure of China's Construction Industry

In this part, the concentration ratio, Lorenz curve market power are applied to explore the profile of the structure of the construction industry.

4.1. Concentration Ratio. The industry concentration ratio (CR_n) reflects the leading companies' concentration. It is the cumulative market share of the relevant indicators of the top n companies in the industry. Figure 1 reflects the market concentration of the top 4 and top 8 listed construction companies in China in terms of turnover from 2009 to 2018. According to the critiques of competitions and monopolies suggested by Bain, it can be inferred that there is no concentration in the Chinese construction industry, meaning that the competition in the construction industry is very acute.

As indicated previously, the concentration of leading construction companies has only increased slightly in recent years. During the decade, the concentration of China's construction industry fluctuates greatly. The concentration continuously rises during 2009--2010. It ended since 2011 when China Communications Construction merged with Road & Bridge International Co as well as the China's state-owned Assets Supervision and Administration Commission and the State Council funded Power China. The CR_4 in the construction industry has fallen to a status at the 14-year level, and CR_8 also declined in 2012. Subsequently, CR_4 and CR_8 stabilized at 14% and 17%, respectively, which shows that the market structure of the construction industry has changed little and the competition is still fierce. Meanwhile both the competition barriers for companies and the economic efficiency of the entire industry are low.

4.2. Lorenz Curve. The Lorenz Curve represents the relationship between market share and the cumulative percent of companies in the market. Compared with the industry concentration rate, it can directly reflect the scale of the entire construction market. The horizontal axis of the curve shows the percentage of enterprises cumulated from smallest to largest (0 to 100 per cent), while the vertical axis shows the percentage of enterprises output (ranging from 1 to 100 per cent). The 45° inclined line is referred to the line of absolute

equality, where firms are distributed with equal market shares and thus inferring an acute competition. The calculation results of the Lorenz Curve between China's construction companies in 2002 and 2017 and that of the United States in 1997 are shown in Figure 2.

Figure 2 shows that the structure of China's construction industry has barely changed in recent years. The difference in scale among construction companies is relatively small and the hierarchy of companies is not distinct, inferring that the construction firms in China are having a relatively equal market share and with lower industrial concentration. The market structural optimization is not as good as that of American construction industry in 1997.

4.3. Market Power. The Lerner index (ranging from 0 to 1) is commonly used in the industrial organization literature as a proxy for market power and is defined as the difference between price and marginal cost divided by price. We measure a firm's market power as the ratio of operating profit to turnover. Figure 3 reveals that the average market power rises to a high point and peaked in 2012. The average market reaches its approximate steady-state level of 0.15 after 2013, indicating the fierce competition among companies.

Overall, China's construction industry has a low concentration and is in a state of fierce competition. In another word, the construction companies have small differences in scale, the hierarchy among companies are not distinct, and the structure still needs to be optimized.

5. Results and Findings after Regression

After find out the current situation of China's construction industry, we introduce the market concentration and market power into the regression to analyze their effects on firm growth. The regression equations are estimated by applying conventional panel data models, it is necessary to determine whether the model should use fixed effects or random effects. The results of the Hausman test indicate that the fixed effects model should be used. The VIF for the independent variables is 5.28, which is less than 10, indicating that the independent variables can provide a unique and reliable regression result [38].

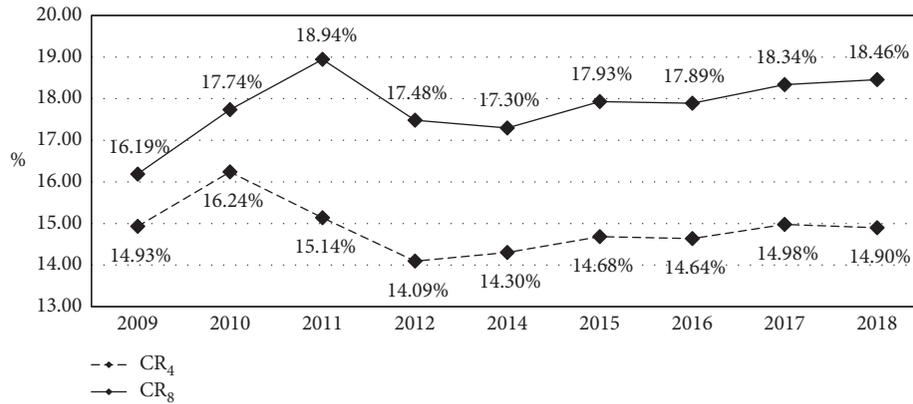


FIGURE 1: CR_n from 2008 to 2018 in China's construction.

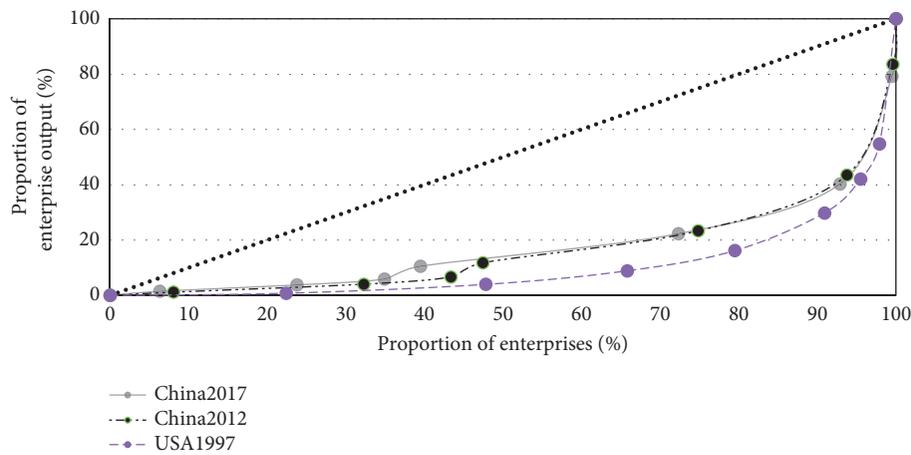


FIGURE 2: The Lorentz curve between China and the US construction industry.

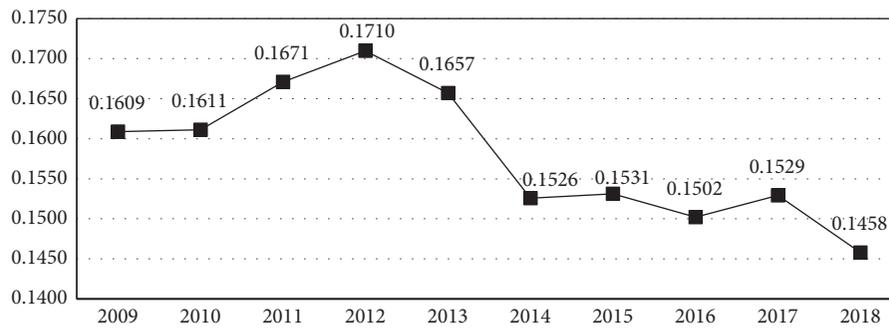


FIGURE 3: Average market power of 37 construction companies from 2008 to 2018.

The regression results for turnover equations are shown in Table 2. It shows that there is an inverse relationship between market power and construction companies' turnover. It can be found from Table 2 that market power is at a significance level of 1%. For every 1% increase in market power, companies' turnover drops by 0.18%, which shows a negative effect on firm growth. Labour force is significant at 1% level. For every 1% increase in labour force, corporate turnover improves by 0.08%. Capital investment is

significant at 1% level, for every 1% increase in capital investment, corporate turnover increases by 0.54%.

The regression results for profit equations are shown in Table 3. It shows that market power and construction companies' profit are positively correlated. Table 3 shows that market power is at a significance level of 1%. For every 1% increase in market power, companies' profit improves by 0.86% when market power increases 1%. For every 1% increase in labour force, corporate profit improves by 0.1%.

TABLE 2: Estimation results for turnover equations.

	lnY						
	—	SOC	NSOC	OIC	NOIC	CEC	ADC
lnMC	-0.184*** (0.000)	-0.162*** (-0.001)	-0.211*** (-0.009)	-0.0571 (-0.206)	-0.227*** (0.000)	-0.197*** (0.000)	-0.142* (-0.063)
lnCR	0.560*** (0.000)	0.499*** (0.000)	0.641*** (0.000)	0.459*** (0.000)	0.650*** (0.000)	0.538*** (0.000)	0.531*** (0.000)
lnLE	0.0810*** (0.000)	0.0968*** (-0.001)	0.0582* (-0.085)	0.0000961 (-0.997)	0.175*** (0.000)	0.131*** (0.000)	-0.0994** (-0.042)
lnK	0.542*** (0.000)	0.566*** (0.000)	0.497*** (0.000)	0.646*** (0.000)	0.390*** (0.000)	0.518*** (0.000)	0.580*** (0.000)
_cons	13.08*** (0.000)	11.89*** (0.000)	15.10*** (0.000)	11.11*** (0.000)	16.29*** (0.000)	12.86*** (0.000)	14.24*** (0.000)
N	370	240	130	204	166	300	70

p-values in parentheses, **p* < 0.1, ***p* < 0.05, and ****p* < 0.01.

TABLE 3: Estimation results for profit equations.

	lnQ						
	—	SOC	NSOC	OIC	NOIC	CEC	ADC
lnMC	0.859*** (0.000)	0.734*** (0.000)	1.412*** (0.000)	1.261*** (0.000)	0.592*** (-0.002)	0.979*** (0.000)	0.706** (-0.046)
lnCR	0.636*** (0.000)	0.426*** (0.000)	1.135*** (0.000)	0.864*** (0.000)	0.529*** (0.000)	0.658*** (0.000)	0.397 (-0.153)
lnLE	0.0965 (-0.157)	0.13 (-0.132)	0.07 (-0.521)	-0.163 (-0.104)	0.247** (-0.015)	0.184*** (-0.007)	-0.443* (-0.06)
lnK	0.566*** (0.000)	0.651*** (0.000)	0.349*** (-0.001)	0.748*** (0.000)	0.411*** (0.000)	0.519*** (0.000)	0.735*** (0.000)
_cons	11.87*** (0.000)	7.652*** (0.000)	22.31*** (0.000)	12.69*** (0.000)	12.74*** (0.000)	12.34*** (0.000)	11.88*** (-0.009)
N	346	234	112	188	158	289	57

p-values in parentheses, **p* < 0.1, ***p* < 0.05, and ****p* < 0.01.

But labour force is not significant statistically, the results can only explain the contribution bought by labour force of 84% construction companies. Capital investment is significant at 1% level, for every 1% increase in capital investment, corporate profit increases by 0.57%.

The results show that capital investment contributes most to construction firm growth, while labour force contributes less. And we can draw a conclusion from the results comparison above that the market concentration increases both the turnover and profit of construction firms while market power increases the profit of construction firms while decreases the turnover. This different marginal effects of market concentration and market power on firm growth may be explained by the fact that the large companies can use scale merit to obtain higher efficient, and gain market share and increase their size. As a consequence, the companies would get more turnover and profits. On the other hand, the market power represents the ability to gain a higher price above the marginal cost, which might cause the loss of potential customers. Therefore, the companies would get less turnover and more profits.

In order to examine the effect of features of the ownership on the firm growth, divided the sample into China's state-owned company (SOC) and China's non-state-owned company (NSOC). As can be seen from the table, the growth of SOCs depends more on the improvement of capital investment than labour force. Tables 2 and 3 show the margin effects of capital investment and labour force on SOCs' turnover and profit with coefficients of 0.57 and 0.10, 0.65, and 0.13, respectively. The coefficients are both higher than that of NSOCs with the coefficients of 0.50 and 0.06, 0.35 and 0.07, respectively. However, the margin effect of market concentration of

SOCS' turnover is lower than that of NSOCs. A possible explanation is that mergers and reorganizations of China's construction companies have been interfered by government. Inefficiency caused by government has weakened internal resource allocation capabilities, making it difficult to leverage scale economies. At the same time, the margin effect of market power that represents the ability to gain a higher price above the marginal cost on SOCs' profit is also lower than that of NSOCs'.

In the comparison of whether construction companies have the overseas income, we hope to make feasible suggestions for China's construction companies to expand overseas markets. The overseas income of companies comes from CSMAR database. According to these data, we can find that 25 construction companies have the overseas income (OIC), accounting for 67% of the samples, and 8 construction companies do not have the overseas income (NOIC), accounting for 23% of the samples. It can be seen from the data in the table that China's OICs rely more on capital investment to obtain turnover with regression coefficient of 0.65. The coefficient of labour force on OICs' growth is not significant, one of the reasons might be that there is a shortage of personnel who are familiar with the profession and international project management. The companies are lacking in well-trained human resources particularly in the areas of project management, contract administration, risk management, finance management, and international conventions and laws [39, 40]. The coefficient of market power on OICs' profit is higher, as there might be less distortion caused by government in overseas construction sites. While the construction companies that focus on the home country market rely more on labour force in firm growth.

Finally, this paper further examines the growth of different submarkets of the construction industry [11]. Referring to the category of the China Securities Regulatory Commission (2012), we divide the construction industries into two categories, which are civil engineering and construction company (CEC), architectural decoration and other construction industries company (ADC). There are 30 CECs and 7 ADCs according to the categories. It can be seen from the table that ADCs' growth relies more on capital investment. The coefficients of labour force on ADCs' turnover and profit are negative. In another word, the ADCs have experienced surplus labour, which makes the marginal benefit of total output diminish. This result indicates that the internal resource allocation capability of ADCs is significantly lower than that of CECs. Consequently, the government should focus on speeding the development of ADCs to promote the sound development of China's construction structure and to improve the submarket structure as well as promote the holistic development of the construction industry.

6. Conclusions

Panel data of 37 listed construction companies in China from 2009 to 2018 are used to explore the impact of market concentration and market power on firm's turnover and profit. Based on the organizational theory and production function model, we use statistical analysis and regression to conduct an empirical study on the growth of China's construction companies and its influencing factors. The analysis results are as follows:

Preliminary results indicate that the construction industry is still in a state of fierce competition with a low concentration rate and little scale difference. The market structure of China's construction industry has a little change during the last decade that is out of expectation. As a result, China's construction companies only have a little market power. Furthermore, by calculating the market power of various companies, the results show that the market power of construction companies is weak. What is more, the market concentration increases both the turnover and profit of construction firms. While market power increases the profit of construction firms while decreases the turnover. The capital investment and labour force are still the main factor contributing to enterprise development. In the classification study of the construction industry, NSOCs, NOICs, and CECs have more advantages in the growth of the construction industry in "quality," as their margin contribution of the level of technology and market concentration are mostly higher.

The results above reflect that due to the construction industry playing a pillar part in China economy, the government is still at the leading position in the construction industry during the transition time from a planned economy to a market economy. And it results in insufficient marketization of the construction industry as well as an unreasonable market structure because of that the industry structure is affected by government policies.

The above findings provide some policy implications for policy formulation to adjust the construction market structure and promote the sound development of China's construction industry. First, the government needs to cultivate some leading companies and make favourable policies to strengthen and enlarge the companies, such as providing more services and supports in firms' talented people introduction, enterprise financing, favourable tax policy and so on. Second, encourage and support the development of each submarket of the construction industry. It is recommended to develop building decoration and other construction industries in order to promote the structure of the construction industry. Third, the government should alleviate the distortion of the construction industry market and establish a more efficient market allocation mechanism in construction industry. A fair and open market rules is necessary for sound development of the companies. The government should standardize the laws for construction market access and remove the inferior construction enterprises to ensure a high-quality and orderly competitive construction market.

The results obtained from empirical research are subject to some limitations. First, samples are only focused on the public-listed companies, which means that we ignore the small construction firms. Second, there might be measurement error because we use the operating cost instead of margin cost when we define market power, as is the case in most prior research. Third, when examining the growth of different submarkets of the construction industry, we only divide them into two categories. But specific econometric techniques may be considered preliminary and instructive. What is more, these results provide important evidence and feasibility suggestions for the government to promote the marketization of the construction industry and the "going out" policy.

As for possible further empirical research, various topics can provide additional research: First, investigate the effect of market concentration and market power on each submarket of construction industry. Second, investigate the effect of market concentration and market power on construction industry rather than construction companies. Third, investigate the relationship between market concentration, market power, and TFP of construction companies.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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