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Research Article

Centralization and Firm Performance: New Evidence on the Role of Firm Size

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Centralization has been regarded as an important factor in corporate governance in the academic and business communities. Although several studies have examined the relationship between centralization and firm performance, the conclusions remain mixed. We extend existing research by introducing firm size as a threshold variable into our model to explicate the complicated effects of centralization on firm performance. We found that a high degree of centralization can promote firm performance significantly in small- and medium-scale firms while inhibiting firm performance in large-scale firms. Using heterogeneity analysis, we found that centralization has a more significant positive impact on firm performance in private firms, family firms, and manufacturing firms than others. Furthermore, we explored the factors influencing the nexus between centralization and firm performance and found that centralization can improve the level of cost allocation management and technology innovation, driving firm performance but possibly resulting in overinvestment, which is harmful to firm performance. Our research provides guidance for companies to establish a decision-making power allocation that meets their scale-appropriate development needs.

1. Introduction

Centralization has attracted attention in academia [1]. The definition of corporate centralization is the degree to which corporate authority is concentrated at the top of an organizational structure [2]. This means that the greater number of decisions made by a single individual, the greater the centralization, and vice versa. On the one hand, centralized management can coordinate enterprise resources to play a positive role in the internal market to improve the management efficiency of current enterprise resources. On the other hand, decentralization has a positive influence on the use of a combination of decision-making power and exclusive knowledge to enact specific management, where managers might cause overinvestment, which is potentially harmful to firm performance because of a lack of sufficient professional knowledge and effective limitations [3]. Based on these studies, we can conclude that it is essential for enterprises to weigh the degree of centralized management and the separation of centralization in corporate governance.

From existing research, we find that shortcomings remain in understanding the nexus between centralization and firm performance, roughly dividable into three aspects. First, we find that conclusions on the centralization and firm performance nexus differ. Most studies only consider the linear relationship between centralized management and firm performance. Some scholars argue that centralization can drive firm performance while others hold the opposite view [4] . Only a few scholars find a nonlinear relationship between centralized management and firm performance [5]. We believe that the reason why views vary is that most studies have ignored the importance of the firm size effect and only have used it as a control variable. Second, we observe that studies on the influence mechanisms of centralization on firm performance do not have clear results. Most scholars are concerned about which factors can drive or limit firm performance, but few scholars have studied how centralization affects firm performance by considering specific mechanisms of influence. Third, almost all existing studies on the relationship between centralization and

corporate performance neglect Chinese firms. Due to China's economic development in recent years, conducting systematic research on the centralization and firm performance nexus and its internal influence mechanisms without considering China is incomplete.

Our primary contribution to the literature and empirical studies is a comprehensive and econometrically defensible analysis of the centralized management and firm performance nexus. We take firm size as a threshold variable of the centralization and firm performance nexus. We find that there is a size-threshold effect on the centralization and firm performance nexus; that is, a high degree of centralization can significantly promote firm performance in small- and medium-scale enterprises but has no significantly positive impact on firm performance in large-scale firms. Furthermore, we conducted a comprehensive and systematic heterogeneity analysis among property rights, industry, and family corporations based on Chinese firm data from 2009 to 2018. The data are comprehensive and complex, and we find that centralization has a more significant positive impact on firm performance for private firms, family firms, and manufacturing firms than for others. We investigate the factors influencing the previously unstudied centralization and firm performance nexus and explore how centralized management can improve corporate governance to promote firm performance and find that centralization can improve the level of cost allocation management and technology innovation to drive firm performance but may result in overinvestment, which is harmful to firm performance.

The structure of our study is as follows: Section 2 reviews the existing literature on the relationship between centralization and firm performance and finds that the relationship is nonlinear based on firms of different scales. Section 3 introduces the sample data, the definition of variables, and descriptive statistics for the samples. Section 4 presents the data analysis in threshold regressions. Section 5 reports a robustness test based on empirical data and affecting mechanism analysis. Section 6 includes the conclusions and empirical and theoretical contributions of this study.

2. Literature Review

2.1. The Relationship between the Degree of Centralization and Firm Performance. Views in current research on the relationship between the degree of centralization and firm performance are mainly divided into three categories: irrelevant relationships, linear relationships, and nonlinear relationships. Adams et al. [6] argue that the degree of centralization does not have an obvious effect on firm performance because of the uncertainty of managerial fallibility. For linear correlation theory, views differ. Some researchers, such as Heitor [7], and Cheng [8], hold the positive linear correlation theory view that centralized management can significantly drive firm performance. For views in favor of negative linear correlation, studies such as Mauricio J et al. (2019), Madhavi et al. (2016), and Madhavi et al. (2016) argue that removal of corporate centralization can raise the efficiency of investments and improve firm performance. On the other hand, some think that the relationship between the degree of centralization and firm performance is nonlinear; that is, when the degree of centralization is proper for corporations, it can improve productivity and promote firm performance significantly, while overcentralized management may harm firm performance [9–11].

We can rely on these studies to understand why their views differ. First, most studies have ignored the firm size effect on the degree of centralization and firm performance nexus or simply set firm size as a control variable during their empirical tests. Thus, we can infer that the influence of centralization on firm performance might vary across scales of corporations. In small-scale or medium-scale corporations, a high degree of centralization means a decrease in organization layers, which can save the cost of decision-making and result in a more direct command execution; that is, a high degree of centralization can drive firm performance [12]. In large-scale corporations, a high degree of centralization might inhibit employee motivation and cause information asymmetry, which might cause overinvestment and the possibility of fallibility during the product process to weaken the positive effect on firm performance [13, 14]. Second, there is scarce research using Chinese evidence to study the relationship between centralization and firm performance, while Chinese listed firm data are among the most comprehensive and systematic in the world. With the enterprise governance revolution in China in recent years, it is unreasonable to ignore Chinese data. Therefore, we introduce firm size as a threshold variable in our model to explore the size-threshold effect on the centralization-firm performance nexus using Chinese firm data, which might fill this research gap. We propose our hypothesis as follows.

Hypothesis 1. There is a firm size-threshold effect on the centralization-firm performance nexus, and centralized management will drive firm performance in small-scale and medium-scale firms but has no significantly positive effect on firm performance in large-scale firms.

2.2. The Effect of Centralization on Firm Performance. The promotion mechanism of firm performance has been discussed for years. There are some factors driving firm performance that might be affected significantly by centralization. Cost allocation management as an important strategy in corporate governance is usually regarded as a determinative factor for firm performance by many, such as Li and Li [15], Banker et al. [16], and Mamidu [17]. Enterprise centralization will also affect the decision-making efficiency of the enterprise and the consistency of its goals to varying degrees, and these will affect the cost of the corporate governance process. Based on this, we can infer that cost allocation management is a mechanism of centralization influencing firm performance.

Hypothesis 2. Centralization may have a positive impact on firm performance by improving cost allocation management.

Innovation investment is a major factor affecting firm performance in the existing literature. Faems et al. [10]

suggest that technology alliance portfolios promote internal innovation efforts that significantly increase firm performance. Gunday et al. [18], Antoncic et al. [19]proposed an important promoting relationship between R&D and firm performance. Although a high degree of centralization might have a negative impact on the amount of innovation investment to avoid fallibility in management decisions, the quality of innovation results might be raised for increased decision-making caution. Thus, we can propose that centralized management might have a positive impact to varying degrees on firm performance through innovation investment.

Hypothesis 3. Centralization may have a positive impact on firm performance by improving technology innovation.

Investment efficiency is a considerable factor of firm performance that is always considered by stakeholders and scholars. Several scholars believe that overinvestment will harm corporate financial performance, such as Muscarella [20], and Richardson S (2006). Huang and Xu (2016) suggested that if the scale of investment deviated from a reasonable interval, firm performance would decline. However, Ma and Jin [21] evaluated data from Chinese listed firms and found that investment efficiency rather than investment scale drives firm performance. Therefore, we can deduce that a high level of investment efficiency and scaled investment can drive firm performance because the quality of investment efficiency might have a significant impact on free cash management and the quality of financial management in corporations, which is common in corporate governance. Thus, we can put forward the first hypothesis in this study as follows.

Hypothesis 4. Centralization may have a negative impact on investment efficiency thus harming firm performance.

3. Data and Methodology

3.1. Sample and Data. We collected data on listed firms from China's A-share market except for financial and real estate business groups. New accounting standards were put into effect in China in 2007, and we excluded some data on future continuous operations and noted a serious lack of data on the main research variables or ST companies. Finally, we constructed a balanced panel database of 1849 listed companies from 2009 to 2018, with an observation value of 18,490, to serve this study as a needed threshold effect model. Companies' patent data were obtained from the *iFinD* database. Other basic information on companies, financial data, and stock income data are all from the Eastern Fortune Choice database.

3.2. Variables

3.2.1. Independent Variable

(1) Degree of Centralization (Cen). Determination of our independent variable refers to the ideas of Pan et al. [3], and we used the concentration of salaries paid to employees by enterprise groups to describe the degree of centralization. It is believed that the concentration of salaries paid by enterprise groups reflects the parent company's control of group personnel rights. Thus, it can reflect the degree of control of the parent company over the decision-making powers of the group. The specific construction ideas are shown in Figure 1.

Personal control includes salary decisions, appointments, and removal rights. There is a correlation between the proportion of the salary paid by the parent company and the degree of control of the parent company over the personnel rights if the payer also has the relevant personnel rights. Compared with other decision-making powers, personal control is more fundamental. Therefore, centralized management is inseparable from the concentration of personal control. In reality, enterprise groups usually achieve centralized management by centralizing personal powers. For instance, it is very common for a parent company to appoint directors, supervisors, or financial officers to its subsidiaries. The parent company usually retains the power of assessment and salary decision for the assigned personnel and requires the assigned personnel to play a supervisory role in the management of the subsidiary company and be responsible for executing the orders from the parent company to strengthen the control of subsidiaries over personal control of these assigned personals. The definition of centralization in this study is to measure the degree of centralization of the enterprise group by the proportion of the salary paid by the parent company of the group.

The salary arrangement is more stable than the distribution of other resources. This is because salary contracts are usually signed when employees are hired, and the definition of assessment indicators and salary payment (parent company or subsidiaries) has a certain degree of rigidity. Thus, it is rare that salary levels change over short periods as the operating conditions of the enterprise group change. Thus, this independent variable is exogenous relative to firm performance, which provides convenience for discussing the economic consequences of centralized management from the perspective of personal control.

The uniqueness of the data from Chinese listed companies is conducive to calculation of the degree of centralization index defined in our study. On the one hand, Chinese listed companies must simultaneously disclose the financial statements of the parent company and the consolidated financial statements. In addition, the cash flow statement of Chinese listed companies contains the item "cash paid to and paid for employees." We used the cash paid by the parent company and the group for employees to construct an indicator of the degree of centralization. Specifically, we performed a regression on the model shown in Formula (1) by year and industry and used the estimated residual as a measure of the degree of centralization, Cen. This means that the greater the value of this variable, the higher the proportion of salary paid by the parent company under the condition that the parent company accounts for the same proportion of the group size; that is, the degree of its

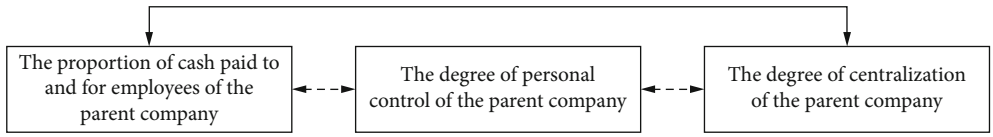


Figure 1: Construction idea of centralization.

personal control and other decision-making powers is greater, similar to the degree of centralization of the group:

$$Psalary_{i,t} = \beta_0 + \beta_1 Passet_{i,t} + u_i + v_t + \varepsilon_{i,t}. \quad (1)$$

The independent variable of Formula (1) is the proportion of employee salary paid by the parent company (*P*salary), that is, the item "cash paid to and for employees" in the cash flow statement of the parent company divided by the corresponding item in the consolidated statement. The dependent variable is the percentage of assets of the parent company (*P*asset), which is equal to the total assets of the parent company divided by the total assets of the consolidated statement. The reason why we use the proportion of assets as the independent variable is that compared to the proportion of operating income and operating cash flow, the proportion of assets can reflect the group's allocation of resources better and is much less directly affected by the difference in the nature of the market, the business nature of the parent and subsidiary companies, and the merger offset. To avoid the influence of outliers on the regression results, before the regression, we narrowed *P*salary and *P* asset by the interval [0, 1] and excluded samples with negative net assets and the year of listing.

3.2.2. Dependent Variable

(1) Firm Performance. On the subject of the selection of specific corporate performance measurement indicators, since the return on equity (ROE) is directly related to shareholder equity in data measurement, it is one of the key indicators of many listed companies, so may admit the possibility of fraud. In addition to ROE, Tobin's *Q* is more suitable for the complete financial market. Nevertheless, it is likely to be affected by the weak effectiveness of the Chinese stock market and cannot fully reflect the true situation of corporate performance in our calculations. Return on total assets (ROA_1) and net profit on total assets (ROA_2) are used as additional indicators to reflect the profitability and input-output status of the company, reflecting the competitiveness and development capabilities of the company more comprehensively. It is worth noting that previous studies on multimarket exposure and corporate performance have mostly adopted these two indicators to measure firm performance [11, 22, 23]. Therefore, we chose return on total assets (ROA_1), total net interest rate (ROA_2), and return on net assets (ROE) as dependent variables to reflect the level of firm performance. The specific measurement methods are shown in Table 1.

(2) Enterprise Scale. We used the natural logarithm of total assets at the end of the year to measure the enterprise scale.

3.2.3. Control Variables. We summarized the selection of the dependent and independent variables in 15 representative studies in the academic field. According to much relevant research, such as Ibhagui and Olokoyo [24] , we selected the relevant variables with a higher frequency of use and wider coverage as our control variables, including the number of years on the market (age), sales growth (growth), financial leverage (Lev), initial cash holdings (cash), percentage of parent company shareholders' net profit (Pnpf), current debt ratio (CRa), and a variable related to corporate governance, the proportion of the largest shareholder (FirstShr).

The definition and measurement method for each variable are shown in Table 1. We adjusted the nominal value of all values of all variables to the actual value in this study by the current year's price index (CPI), and all continuous variables at the 1% and 99% quantiles underwent winsorized operations.

3.3. Models. We built a panel threshold model to conduct empirical research on the relationship among the degree of centralization, firm performance, and the scale of enterprises. To facilitate analysis, we used a single threshold model to illustrate the principle of threshold regression. The model is as follows:

$$\begin{aligned} Y_{i,t} = {} & \beta_0 + \beta_1 Cen_{i,t} I(\tau_{i,t} \le \gamma_1) + \beta_2 Cen_{i,t} I(\tau_{i,t} > \gamma_1) \\ & + \beta_n X_{i,t} + u_i + v_t + \varepsilon_{i,t}, \end{aligned} \quad (2)$$

where $Y_{i,t}$ is the firm performance index, Cen is the degree of centralization in the company, and γ is the true threshold to be estimated. $\tau_{i,t}$ is the threshold variable, the scale of the enterprise in our study; $I(\cdot)$ is the indicator function. When the conditions in the brackets are established, $I(\cdot)$ is 1; otherwise, it is 0; $X_{i,t}$ are other control variables, and u_i, v_t are firm and time fixed effects. We performed regression with any value of $\tau_{i,t}$ as the threshold value and define $\widehat{\gamma}$ as the threshold estimated value. Then, when the value $\tau_{i,t} = \widehat{\gamma}$ is closer to the true threshold value $\widehat{\gamma}$, the sum of squared residuals of the model is smaller. After that, we performed a point-by-point regression and obtained $\widehat{\gamma}$ that makes $SSR(\widehat{\gamma})$ the smallest as the threshold estimate, $\widehat{\gamma} = \text{argmin}SSR(\widehat{\gamma})$. The important step of threshold regression also includes the determination of the number of threshold values. Several scholars have used a grid search to determine other thresholds that minimize the sum of squares of residuals. Threshold regression also requires solving the problem of the validity of the threshold value by building a maximum likelihood function to test its significance and validity. The null hypothesis H_0 of the hypothesis test is $\theta_1 = \theta_2$, and the alternative hypothesis H_1 is $\theta_1 \neq \theta_2$. Under the original hypothesis, we record the residual sum of squares of the regression

Table 1: Variable definition.

Variable category	Variables	Definition of variables
Dependent variables	Return on equity (ROE)	After-tax profits + profit appropriation/owners ' equity + minority stockholder 's interest
	Return on total assets (ROA_1)	EBITDA/average total assets; note: EBITDA = profit before tax + interest expense, average total assets = (total assets at the beginning of the year + total assets at the end of the year)/2
	Net profit on total assets (ROA_2)	Net profit/average total assets
Independent variables	Degree of centralization (Cen)	Formula (1): regression by industry and year to take residuals
Threshold variables	Firm scale (size)	The natural logarithm of total assets at the end of the year
Control variables	The number of years on the market (age)	Current year-the year of listing, taking the natural logarithm
	Initial cash holdings (cash)	Cash and equivalents/total assets
	The proportion of the largest shareholder (FirstShr)	Number of shares held by the largest shareholder/total number of shares
	Leverage (Lev)	Interest bearing debt/total assets
	Net profit in parent company's owners (Pnpf)	Net profit in parent company's owners/net profit
	Current liability ratio (CRa)	Current liability/total liability
	Growth in sales (growth)	Revenues of the period/revenues of the previous period-1
	State-owned enterprise (Soe)	State-owned enterprise, dummy variables, state-owned enterprises taking 1 and other enterprises taking 0
	Family enterprise (Fae)	Family enterprise, dummy variables, family enterprises taking 1 and other enterprises taking 0
Other variables	Investment (Inv)	Taking natural logarithm of (cash for acquired to fixed assets, intangible assets, and other long-term assets + net cash acquired to subsidiaries and other business units – net cash received from fixed assets, intangible assets, and other long-term assets – net cash received from subsidiaries and other business units)
	Tobin's Q (TB)	(Market value of floating stocks + book value of nontradable stocks + debt)/total assets
	Investment effectiveness (InvEff)	Formula (1): regression by industry and year to take absolute value of residuals
	Numbers of patents (ItN)	Total number of company patents
	The cost profit margins (Costta)	(Profits from tax /total cost) × 100%
	Proportion of parent company's salary (Psalary)	The company's cash flow statement "cash paid to and for employees"/corresponding items in the consolidated statement
	Proportion of assets in parent company (Passet)	Total assets in parent company/total assets in consolidated financial statement

results of the model as S_0, and the statistic of the likelihood ratio test is $LR=[S_0 - S(\widehat{\gamma})]/\widehat{\sigma}^2$. Then, we obtain the asymptotic validity interval of LR statistics using the self-sampling method (bootstrap). We set the confidence level to α. When $LR \le -2\log(1-\sqrt{1-\alpha})$, the original hypothesis holds, indicating that the model has a threshold effect. There may be double thresholds or multiple thresholds in practical empirical analysis, and we can use similar methods to search for these. When estimating Formula (2), the entire sample is divided into two subsets based on the threshold variable being less than or greater than the threshold value. The heterogeneity of the relationship between the independent variables of the two subsets is represented by slopes β_1 and β_2.

3.4. Descriptive Statistics. Table 2 reports descriptive statistics for the variables involved in our regression analysis.

4. Empirical Results and Discussion

4.1. Specification Test Results. Combined with the description of the model setting part, we set the bootstrap for 300 iterations, searched 100 sample points in turn to obtain the simulated distribution, and tested the threshold effect. We designated the threshold variable affected by the threshold as the scale of the enterprise (size). After that, we set the return on equity (ROE), return on total assets (ROA_1), and net profits on total assets (ROA_2) as dependent variables in Model 1, Model 2, and Model 3 regressions. The results

Table 2: Descriptive statistics for the variables.

Variable	N	min	p25	Mean	p50	p75	max	sd
ROA_2	18,490	-185.9	1.663	5.079	4.186	7.816	92.85	7.116
ROA_1	18,490	-184.0	3.187	6.939	5.824	9.683	123.3	7.823
ROE	18,490	-1277	3.464	8.699	8.013	13.73	448.5	19.43
Cen	18,490	-0.927	-0.165	-0.0320	-0.0180	0.112	0.937	0.208
Age	18,490	-10	4	9.602	9	15	28	7.122
Growth	18,490	-0.986	0.00300	1.146	0.126	0.299	14883	107.9
Lev	18,490	0	23.60	44.26	47.26	65.21	101.9	26.00
Cash	18,490	-0.0230	0.0770	0.177	0.132	0.227	0.954	0.145
CRa	18,490	0.0380	0.723	0.818	0.880	0.967	1.217	0.185
Pnpf	18,490	-265000	90.42	81.07	99.08	100.0	12518	1937
FirstShr	18,490	0	23.15	35.40	33.50	45.80	99	15.39

are shown in Table 3, showing the impact of the degree of corporate centralization on the return on total assets (ROA_1) and the net profits on total assets (ROA_2). From Table 3, we can see that the F values corresponding to the single-threshold tests of the three models are all 0.000, so that the original hypothesis that the model does not have a threshold value can be rejected at the 1% significance level. Additionally, the F values of the dual-threshold tests of Model 2 and Model 3 are 41.82 and 43.28, and the corresponding P values are both 0.00, so the original hypothesis that the model has a single threshold is also rejected at the 1% significance level. However, the F value of the dual-threshold test of Model 1 is 15.47, and the corresponding P value is 0.090, so the original hypothesis that the model has a single threshold is rejected at the 10% significance level. The triple threshold effects of the three models failed the test; that is, the three models all have two thresholds at the 10% significance level. Therefore, the dual-threshold model in this study is expressed as

$$\begin{aligned} Y_{i,t} = {} & \beta_0 + \beta_1 \mathrm{Cen}_{i,t} I(\tau_{i,t} \le \gamma_1) + \beta_2 I(\gamma_1 < \tau_{i,t} \le \gamma_2) \\ & + \beta_3 \mathrm{Cen}_{i,t} I(\gamma_2 < \tau_{i,t} \le \gamma_3) + \beta_4 \mathrm{Cen}_{i,t} I(\tau_{i,t} > \gamma_3) \\ & + \beta_n X_{i,t} + u_i + \nu_t + \varepsilon_{i,t}. \end{aligned} \quad (3)$$

Table 4 reports the estimation results of the size threshold and confidence interval. The above threshold estimations passed the authenticity test. To provide more intuitive and detailed test information, the construction of the double threshold confidence interval of the three models is shown in Figures 2–4. Figures 2(a) and 2(b) are the confidence intervals of the single threshold value and double threshold value of Model 1. Figures 3(a) and 3(b) are the confidence intervals of the single threshold value and double threshold value of Model 2. Figures 4(a) and 4(b) are the confidence intervals for the single threshold and double threshold of Model 3, the horizontal dashed line is the 95% confidence level, and the curve is the connection of the threshold search points. The ordinate corresponding to any point on the curve represents the likelihood ratio of that point as the threshold. The intersection of the curve and the dotted line is the confidence interval at the 95% confidence level, and if the confidence interval is narrower, the influence of unobservable factors is less; that is, the threshold estimate is more accurate.

4.2. Size-Threshold Effect Test Results. Table 5 reports the test results of the relationship between the size-threshold effect and the degree of the enterprise centralization-firm performance nexus. From the regression results, we can see that the impact of the degree of enterprise centralization on firm performance is divided into three intervals. When the scale of the enterprise is less than the first threshold, improvement in the degree of enterprise centralization in these three models has a significant positive impact on firm performance, with a significance level of 1%, with regression coefficients of 36.923, 24.077, and 18.352. When the scale of the enterprise is within the second interval, that is, the firm size is between the first and the second thresholds, the regression coefficients of the three models are all significantly positive at the 1% level, and the regression coefficients are 5.422, 3.048, and 2.703. Compared with the first interval, there is a significant decline, indicating that the degree of enterprise centralization has a weaker positive effect on firm performance. When the size of the enterprise is larger than the second threshold, that is, it is located in the third interval, the regression coefficients of enterprise centralization on firm performance are all negative and the specific values are -1.696, -1.152, and -1.06, which fail the significance test. The impact of other control variables on firm performance is basically in line with theories in the existing literature [6, 9, 25] and relevant study conclusions [25–27].

By analyzing the threshold regression results of the three models, it is reasonable to believe that there is a nonlinear relationship between size-threshold effects and the enterprise centralization-firm performance nexus, and its impact will change due to the scale of the enterprise. For low-scale group companies, that is, enterprises whose scale is smaller than the first threshold, the centralized management of enterprises drives firm performance significantly. With the expansion of the scale of enterprises, although the degree of centralization exhibits a positive relationship with firm performance, the promotion effect and the level of significance decline. This phenomenon is basically consistent with the characteristics of enterprise governance. Through

Table 3: Specification test results.

Model	(1) ROE		(2) ROA_1		(3) ROA_2		*bs*
	*F*_stat	Prob	*F*_stat	Prob	*F*_stat	Prob	
Single threshold	53.50***	0.001	64.19***	0.001	67.19***	0.001	300
Double threshold	15.47*	0.090	31.82**	0.012	24.28**	0.035	300
Triple threshold	31.82	0.217	19.97	0.292	22.83	0.261	300

Standard errors in parentheses. *$P < 0.10$, **$P < 0.05$, and ***$P < 0.01$.

Table 4: Estimated threshold and confidence intervals.

Estimator	(1) ROE		(2) ROA_1		(3) ROA_2	
	Thre	95% Conf.	Thre	95% Conf.	Thre	95% Conf.
Th-1	19.638	[19.460, 19.798]	19.460	[19.241, 19.638]	19.638	[19.350, 19.798]
Th-2	22.082	[21.974, 22.161]	22.082	[21.938, 22.119]	22.082	[21.938, 22.119]

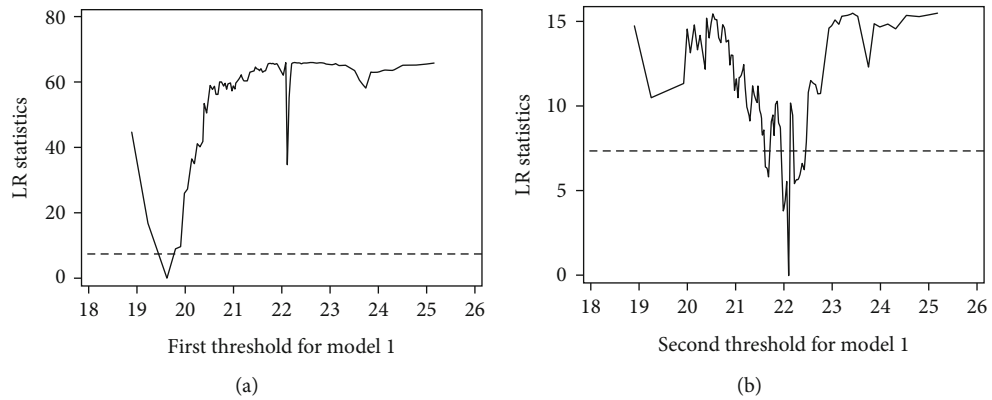


Figure 2: Confidence interval construction in double threshold Model 1.

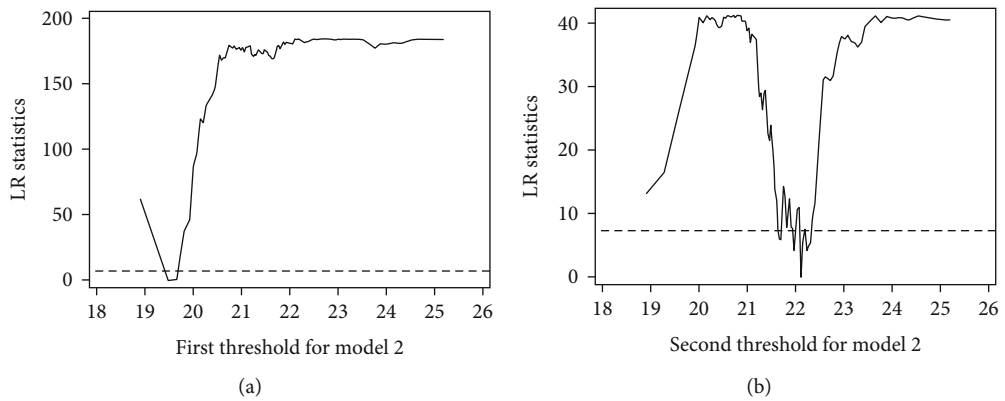


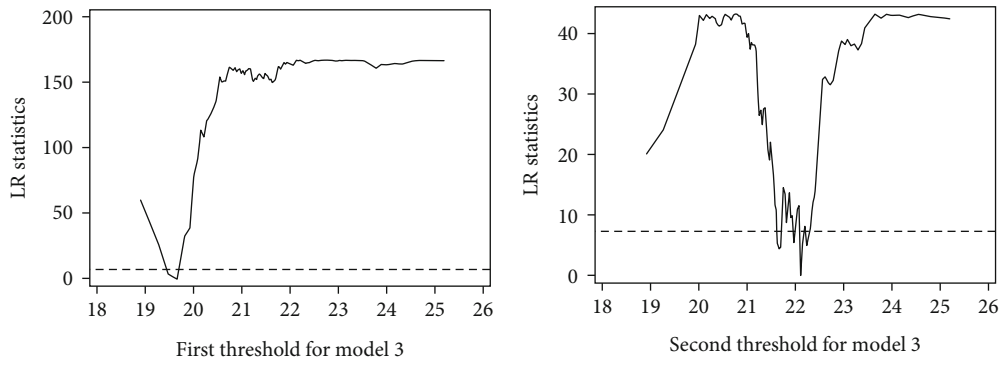
Figure 3: Confidence interval construction in double threshold Model 2.

comparative analysis, it is found that the degree of centralization in each interval has a greater impact on ROE than the other two dependent variables, similar to the value of ROE in descriptive statistics, and the degree of impact is higher. However, as the scale of the enterprise expands, the level of significance decreases. This agrees with the conclusion of the previous analysis of dependent variables that ROA is a more robust enterprise performance measurement indicator, as it is affected less by uncertain factors.

5. Further Analysis

5.1. Robustness Test

5.1.1. Endogenous Variable Control. This study introduces one-period lagging independent variables as instrumental variables in the independent variables, constructs dynamic panels for correlation analysis, and estimates the full sample and grouped samples based on the system GMM to realize



(a) (b)

Figure 4: Confidence interval construction in double threshold Model 3.

Table 5: Panel threshold model regression results.

Variables	(1) ROE	(2) ROA_1	(3) ROA_2
Age	-1.078*** (0.069)	-0.603*** (0.027)	-0.504*** (0.024)
Growth	0.002 (0.001)***	0.001 (0.001)	0.001 (0.001)
Lev	-0.035** (0.015)	-0.027*** (0.006)	-0.037*** (0.005)
Cash	4.815*** (1.386)	4.384*** (0.725)	5.546*** (0.628)
CRa	1.160 (1.423)	1.453** (0.586)	1.277** (0.517)
Pnpf	0.001 (0.001)	-0.001 (0.001)***	-0.001 (0.001)***
FirstShr	0.189** (0.526)	0.237** (0.513)	0.251** (0.548)
Cen ($\tau^o \le \widehat{\gamma}_1$)	36.923*** (7.525)	24.077*** (4.565)	18.352*** (3.149)
Cen ($\widehat{\gamma}_1 < \tau^o \le \widehat{\gamma}_2$)	5.422*** (1.884)	3.048*** (0.857)	2.703*** (0.787)
Cen ($\tau^o > \widehat{\gamma}_2$)	-1.696 (2.017)	-1.152 (0.928)	-1.006 (0.819)
_cons	18.832*** (1.583)	11.989*** (0.673)	9.556*** (0.594)
N	18490	18490	18490
R^2	0.045	0.119	0.124
R^2_a	0.044	0.119	0.123

Standard errors in parentheses. $^*P < 0.10$, $^{**}P < 0.05$, and $^{***}P < 0.01$.

the robustness test and endogenous problem processing. The measurement models are shown in

$$\mathrm{ROE}_{i,t} = \alpha_0 + \alpha_1 \mathrm{ROE}_{i,t-j} + \beta \mathrm{Cen} + \theta_1 \mathrm{Size} + \theta_2 \mathrm{Size}^2 + \varphi X_{i,t} + u_i + v_t + \varepsilon_{i,t}, \tag{4}$$

$$(\mathrm{ROA}_1)_{i,t} = \alpha_0 + \alpha_1 (\mathrm{ROA}_2)_{i,t-j} + \beta \mathrm{Cen} + \theta_1 \mathrm{Size} + \theta_2 \mathrm{Size}^2 + \varphi X_{i,t} + u_i + v_t + \varepsilon_{i,t}, \tag{5}$$

$$(\mathrm{ROA}_2)_{i,t} = \alpha_0 + \alpha_1 R(\mathrm{ROA}_2)_{i,t-j} + \beta \mathrm{Cen} + \theta_1 \mathrm{Size} + \theta_2 \mathrm{Size}^2 + \varphi X_{i,t} + u_i + v_t + \varepsilon_{i,t}. \tag{6}$$

The definition of each variable is the same as described above, and the regression process controls the fixed effects of time and individual firms. Among these, the quadratic term of the enterprise scale is introduced into the model to test the nonlinear relationship between enterprise scale and the degree of enterprise centralization. Table 6 reports the test results. The regression results show that the quadratic coefficients of firm size are 2.217, 0.889, and 0.736, and they are all significant at the 1% level, indicating that firm size and firm performance have a positive U-shaped relationship; that is, when the scale of the firm is small, it has a strong promotion effect on firm performance. However, with the continuous expansion of the scale of enterprises, the promotion effect has been weakened. After exceeding a certain threshold, the effect of the enterprise scale on firm performance is not obvious. This conclusion verifies the rationality of the theoretical deduction process of this study. In addition, we use the value of the size-threshold estimation tested above as the grouping basis to test the impact of the degree of centralization on firm performance within different threshold intervals. The test results are consistent with the threshold model regression results. All the above models passed the second-order perturbation term autocorrelation test, and the effectiveness of the instrumental variables passed the test; that is, the research conclusions are strongly robust.

Table 6: Dynamic panel robustness test results.

Variables	(4) ROE	(5) ROA_1	(6) ROA_2
hROE	-1.783 (10.601)		
$hROA_1$		-0.008 (0.587)	
$hROA_2$			0.005 (0.529)
Cen	11.987 (9.819)	1.607** (0.669)	1.751*** (0.609)
Size	-92.890*** (21.289)	-39.554*** (4.038)	-32.802*** (3.636)
$Size^2$	2.171*** (0.527)	0.889*** (0.092)	0.736*** (0.082)
_cons	1000.753*** (216.534)	448.542*** (44.326)	372.101*** (39.898)
Control variable	Yes	Yes	Yes
Firm	Yes	Yes	Yes
Year	Yes	Yes	Yes
N	18,490	18,490	18,490
R^2_a	0.0043	0.151	0.135

Standard errors in parentheses. $^*P < 0.10$, $^{**}P < 0.05$, and $^{***}P < 0.01$.

5.1.2. Replacement of Independent and Dependent Variables. We replaced the independent variable measurement index from previous studies [28] to increase the robustness of the conclusion of this study and reduce the influence of inaccurate index measurement on the conclusion. To control the possible impact of executive compensation, we used the proportion of the largest shareholders to calculate the degree of centralization (Cen_1) and repeatedly tested the threshold effect as above. Except for minor changes in the correlation coefficient between the regression coefficient and the control variable, the conclusion is basically unchanged. These regression results are shown in the first column of Table 7.

If the samples where the variables *P*asset or *P*salary outside the interval $[0, 1]$ are excluded, Formula (1) is used to calculate the degree of centralization (Cen_2), the sample is reduced by 950, and the conclusion is basically unchanged. These results are shown in Table 7, Column (2).

If we use the method shown in Formula (8) to calculate the degree of management centralization (Cen_3) and repeated the test, Table 7 Column (3) is the regression result, and the conclusion obtained is basically unchanged:

$$\text{Degree of centralization} = \frac{\text{Cash paid to and for employees by the parent company/total assets in the parent company}}{\text{Cash paid to and for employees by the consolidated statement/total assets in the consolidated statement}}. \tag{7}$$

5.2. Heterogeneity Analysis

5.2.1. The Mediating Effect of Property Rights. Table 8 reports the threshold value and size-threshold regression results of samples with different property rights. Columns (1), (2), and (3) are the regression results for state-owned enterprises, and Columns (4), (5), and (6) are the regression samples for private enterprises. The regression method is the same as for the basic regression. We used return on equity (ROE), return on total assets (ROA_1), and return on total assets (ROA_2) as three independent variables in simultaneous regression analysis to increase the robustness of the results. From Table 8, we can see, when combining the regression results of the three models, that private enterprises have passed the existence test of the double threshold, and the threshold effect test results are consistent with the conclusions of the basic regression. When size $\le \widehat{\gamma}_1$ and $\widehat{\gamma}_1 <$ size $\le \widehat{\gamma}_2$, the regression coefficients are all significantly positive at the level of 1%; that is, for small-scale and medium-scale private enterprises, centralized management is conducive to the improvement of corporate performance, and as the size of the enterprise increases, the effect gradually weakens.

Due to differences in social welfare goals and resource dependence between state-owned enterprises and private

Table 7: Panel threshold model regression results.

Variables	(1) ROA_1	(2) ROA_1	(3) ROA_1
Cen_1 $(\tau^o \le \widehat{\gamma}_1)$	22.030*** (3.30)		
Cen_1 $(\widehat{\gamma}_1 < \tau^o \le \widehat{\gamma}_2)$	1.593 (1.58)		
Cen_1 $(\tau^o > \widehat{\gamma}_2)$	-0.869 (-0.94)		
Cen_2 $(\tau^o \le \widehat{\gamma}_1)$		26.031*** (4.38)	
Cen_2 $(\widehat{\gamma}_1 < \tau^o \le \widehat{\gamma}_2)$		3.581*** (3.81)	
Cen_2 $(\tau^o > \widehat{\gamma}_2)$		-0.726 (-0.75)	
Cen_3 $(\tau^o \le \widehat{\gamma}_1)$			7.732*** (5.92)
Cen_3 $(\widehat{\gamma}_1 < \tau^o \le \widehat{\gamma}_2)$			0.749** (0.68)
Cen_3 $(\tau^o > \widehat{\gamma}_2)$			-1.081 (-2.09)
Constant	10.624*** (14.96)	11.642*** (16.67)	10.630*** (11.88)
Threshold	19.3484***	19.8792***	19.3313***
	21.9209*	20.1544*	22.0892***
Control variable	Yes	Yes	Yes
Observations	18,490	17,540	18,490
R-squared	0.093	0.124	0.109
F	61.93	86.44	64.26

Standard errors in parentheses. $^*P < 0.10$, $^{**}P < 0.05$, and $^{***}P < 0.01$.

Table 8: Regression results by property rights.

	Soe = 1			Soe = 0		
Variables	(1) ROE	(2) ROA_1	(3) ROA_2	(4) ROE	(5) ROA_1	(6) ROA_2
Cen $(\tau^o \le \widehat{\gamma}_1)$	5.938 (0.90)	5.567 (0.58)	-4.969 (-1.19)	46.117*** (4.44)	60.429*** (2.73)	56.984** (2.58)
Cen $(\widehat{\gamma}_1 < \tau^o \le \widehat{\gamma}_2)$	-40.797 (-1.11)	-13.035** (-2.35)	-3.321 (-1.50)	7.221*** (3.40)	16.945*** (3.78)	15.222*** (3.48)
Cen $(\tau^o > \widehat{\gamma}_2)$	-1.436 (-0.52)	-0.110 (-0.13)	0.301 (0.38)	-4.951 (-1.63)	1.067 (0.94)	1.268 (1.24)
Constant	11.962*** (3.78)	8.580*** (7.13)	6.669*** (6.02)	24.199*** (14.68)	12.077*** (5.62)	9.532*** (4.52)
Threshold	20.389	20.283	21.1364**	19.350***	18.656***	18.656***
	20.201	19.911	20.283	22.091***	19.677***	19.677***
Control variable	Yes	Yes	Yes	Yes	Yes	Yes
N	7670	7670	7670	10,820	10,820	10,820
R^2_a	0.019	0.057	0.059	0.115	0.100	0.096
F	27.61	5007	7063	69.60	73.52	73.24

Standard errors in parentheses. $^*P < 0.10$, $^{**}P < 0.05$, and $^{***}P < 0.01$.

enterprises, there are differences in the nature of property rights in the threshold effect of the enterprise scale between centralization and enterprise performance. Specifically, centralized management has a significant effect on improving the performance of small- and medium-sized private enterprises, while it is less sensitive to the scale of state-owned enterprises and has no significant impact on their financial performance. Due to the special nature of Chinese state-owned enterprises, they often face greater pressure from public opinion and government supervision while pursuing economic benefits and sustainable growth. Therefore, the managerial layers are more restrained and balanced and more sensitive to external issues. Especially for large-scale state-owned enterprises, the rationality and legitimacy of their decision-making in the production and management process are more supervised, and the problem of the allocation of decision-making power has less impact on the growth and profit increase of the enterprise; that is, centralized management will not bring higher performance to the enterprise. Compared with state-owned enterprises, private enterprises are more sensitive to the mechanisms of centralized governance due to the diversity of their property rights. Especially when the scale of private enterprises is small, centralized management will be more effective in the governance of private enterprises and a positive effect on corporate performance is evident.

5.2.2. Sample Analysis by Industry. Table 9 reports the threshold value and size-threshold regression results in different industries. We used the first letter of the new version of the China Securities Regulatory Commission to classify the entire sample. Since several industry classifications are involved, we only use ROA_1 as the dependent variable in regression tests. We built a threshold regression model that is similar to the basic regression model in this study. Since the threshold regression needs to fully balance panel data, we excluded from the sample relevant industries that did not meet the conditions. The sample size was too small between 2009 and 2018 and yielded the following results showing that six industries, including mining; manufacturing; wholesale and retail; transportation, warehousing, and postal services; information transmission, software, and information technology services; and water conservancy, environment, and public facilities management industries, passed the double threshold effect test. The changes in regression coefficients within the threshold interval of four industries—mining; manufacturing; information transmission, software, and information technology services; and water conservancy, environment, and public facilities management—are largely consistent with the basic regression, but only two industries—manufacturing and information transmission, software, and information technology services—passed the significance test. By observing the sample size, it is not difficult to find that these two industry samples largely represent the results of the full sample. Among the industries that passed the threshold existence test, the wholesale and retail industries are most notable. The change in the regression coefficients within the threshold interval is completely opposite to the basic regression structure. That is, for small-scale enterprises, centralized management has no significant impact on corporate performance. Once the scale of an enterprise exceeds the first threshold, its positive impact on performance is significant at the level of 1%, with a regression coefficient of 24.27, and as the scale continues to increase, the degree of influence will continue to increase. When the size of the enterprise exceeds the second threshold, the regression coefficient of centralized management affecting corporate performance is 68.70, with a significance of 5%.

5.2.3. Family Enterprise vs. Nonfamily Enterprise. According to relevant literature [12, 29, 30], family business has a greater impact on the degree of corporate centralization, so this study uses family business as a grouping basis to analyze the heterogeneity of the main regression. The grouping variable selected is the type of family business; that is, in addition to the actual controller, at least one family member with a family relationship who holds shares, manages power, and controls power in a listed company or a controlling shareholder company is a family business, and the rest are nonfamily businesses. Table 10 reports the size thresholds and threshold regression results for family and nonfamily businesses. Columns (1), (2), and (3) are the regression results for family businesses, and Columns (4), (5), and (6) are the regression samples for nonfamily businesses. Similarly, the regression method is the same as the basic regression, not repeated here. Since the two grouped samples only passed the existence test of a single threshold, the threshold regression equation is

$$Y_{i,t} = \beta_0 + \beta_1 \mathrm{Cen}_{i,t} I(\tau_{i,t} \le \gamma_1) + \beta_2 \mathrm{Cen}_{i,t} I(\tau_{i,t} > \gamma_1) + \beta_n X_{i,t} + u_i + v_t + \varepsilon_{i,t}. \quad (8)$$

From the regression results, regardless of whether it is a family business or a nonfamily business, the degree of centralization of small-scale companies has a significant positive effect on business performance, and the impact on family businesses is higher than that on nonfamily businesses, but the level of significance of the impact is lower than that for family businesses. For larger-scale companies, centralized management can still have a positive impact on the performance of family companies at a level of at least 1%, but the impact is even lower for smaller-scale companies; its impact on nonfamily companies is not significant. This might be because the family business itself is under a higher degree of centralized management, and in the process of its development, the unique nature of the family business provides natural convenience for decision-making and management centralization, and business development is more dependent on the relevant decisions of family members. As the scale of the enterprise expands, the degree of influence gradually decreases. For nonfamily businesses, when the scale of the business is expanded to a certain extent, the impact of centralized management on performance disappears, further supporting the conclusion of the return of the foundation. Moreover, the regression coefficients and significance results

Table 9: Regression results by industry.

Variables		Cen ($\tau^o \le \widehat{\gamma}_1$)	Cen ($\widehat{\gamma}_1 < \tau^o \le \widehat{\gamma}_2$)	Cen ($\tau^o > \widehat{\gamma}_2$)	Threshold	CV	Obs.	R^2_a
	I-A	17.65 (13.44)	182.2 (204.9)	7.530 (14.80)	20.533 20.652	Yes	290	0.093
	I-B	158.8 (123.0)	6.180 (12.52)	-14.83 (11.83)	19.502** 22.225*	Yes	540	0.186
	I-C	33.56*** (6.551)	6.913*** (2.470)	-0.530 (2.719)	19.904** 22.012**	Yes	11780	0.052
	I-D	-9.736 (9.214)	18.73 (23.74)	2.569 (8.085)	23.557 23.882	Yes	760	0.037
	I-E	-0.537 (14.19)	93.30 (61.13)	-4.210 (4.093)	21.191 21.086	Yes	560	0.250
ROA_1	I-F	7.158 (5.511)	24.27*** (6.681)	68.70** (32.74)	22.850* 24.236*	Yes	1180	0.078
	I-G	1.901 (4.803)	-6.670 (5.354)	8.910* (4.924)	22.330 23.183	Yes	710	0.136
	I-I	61.24** (29.25)	11.40* (5.805)	-5.759 (5.106)	18.770*** 20.595**	Yes	1390	0.267
	I-L	-1.562 (13.65)	-111.9*** (13.89)	-27.34 (28.31)	22.816 22.896	Yes	280	0.281
	I-N	28.27 (55.33)	6.812 (9.901)	-4.931 (6.153)	19.658* 21.766*	Yes	270	0.114
	I-R	11.72 (13.35)	105.8*** (10.72)	-15.33 (10.36)	18.794*** 19.610	Yes	250	0.211

Standard errors in parentheses. $^*P < 0.10$, $^{**}P < 0.05$, and $^{***}P < 0.01$.

Table 10: Regression results for family and nonfamily businesses.

	Family businesses			Nonfamily businesses		
Variables	(1) ROE	(2) ROA_1	(3) ROA_2	(4) ROE	(5) ROA_1	(6) ROA_2
Cen ($\tau^o \le \widehat{\gamma}_1$)	196.773* (1.85)	36.598** (2.16)	32.377** (2.20)	24.556*** (3.30)	15.711*** (3.18)	14.382*** (3.44)
Cen ($\tau^o > \widehat{\gamma}_1$)	7.156** (2.10)	2.765* (1.86)	3.040** (2.38)	1.851 (0.77)	1.388 (1.14)	1.104 (1.50)
Constant	21.339*** (6.64)	13.587*** (7.48)	11.291*** (7.25)	22.016*** (11.03)	13.143*** (15.58)	10.533*** (14.05)
Threshold	19.751***	19.751***	19.750***	19.855**	19.656***	19.395***
Control variable	Yes	Yes	Yes	Yes	Yes	Yes
N	1800	1800	1800	9738	9738	9738
R^2_a	0.143	0.149	0.155	0.052	0.107	0.116
F	10.35	14.74	16.62	66.80	51.77	61.54

Standard errors in parentheses. $^*P < 0.10$, $^{**}P < 0.05$, and $^{***}P < 0.01$.

of the three models are not much different, which demonstrates the robustness of the regression results.

5.3. Analysis of Influence Mechanisms

5.3.1. Perspective of Cost Allocation Management. According to theoretical analysis, the degree of centralized management will bring about a cost allocation effect on the enterprise to a certain extent and then have a related impact on firm performance. The cost profit margins can reflect the operating results of an enterprise and are the ratio of the total profits of the enterprise in a certain period to the total costs and expenses. If this variable is higher, it means that the price paid by the company for profit is smaller, the quality of cost control is better, and the profitability is stronger. Thus, we selected the cost profit margins (Costta) as the variable to test the effect of the degree of enterprise centralization and the scale of the enterprise on cost allocation management. The specific regression equation is as follows:

$$\text{Costta}_{i,t} = \beta_0 + + \beta_1 \text{Cen} + \beta_2 \text{Size} + \beta_3 \text{Cen} \times \text{Size} + \varphi X_{i,t} + u_i + \nu_t + \varepsilon_{i,t}. \quad (9)$$

Table 11: Regression results for the cost allocation management influence mechanism.

	(1)	(2) ($\tau^o \le \widehat{\gamma}_2$)	(3) ($\tau^o > \widehat{\gamma}_2$)
Variables		Costta	
Cen	6.521** (2.644)	3.309** (1.591)	1.336 (1.284)
Size	-0.149 (0.143)	-0.008 (0.018)	0.008 (0.017)
c.Cen#c.Size	-0.293** (0.119)	-0.154** (0.078)	-0.057 (0.056)
_cons	3.219 (2.887)	0.402 (0.382)	0.082 (0.405)
Control variable	Yes	Yes	Yes
Firm	Yes	Yes	Yes
Year	Yes	Yes	Yes
N	18,490	11,730	6760
R^2	0.006	0.008	0.030
R^2_a	0.005	0.007	0.028

Standard errors in parentheses. $^*P < 0.10$, $^{**}P < 0.05$, and $^{***}P < 0.01$.

Among these, because the degree of enterprise centralization has a threshold effect on the enterprise scale, we added the crossover term of the degree of centralization and enterprise size to the model to test the nonlinear relationship between the degree of centralization and the cost allocation effect of the enterprise. $X_{i,t}$ is the control variable, the same as above; both the individual enterprise effect and the time fixed effect are controlled. The regression results are shown in Table 11 Column (1). To further explore the difference in the degree of centralization on the cost allocation of enterprises of different sizes based on the relevant conclusions of the basic regression, we used the second threshold (ROA_1 regression result) as the demarcation point and divided the sample into two groups: small- and medium-sized enterprises and large-scale enterprises; that is, enterprises that are affected by the degree of centralized management and those that are not affected carried out the relevant regression analysis, and the results are shown in Table 11 Columns (2) and (3).

In the full-sample regression results, the degree of enterprise centralization at the level of 5% is positive for the cost profit margins; that is, centralization management has a positive correlation with the cost allocation effect of the enterprise. The enterprise can reduce the cost of profit by increasing the degree of centralized management. Moreover, the crossover between the degree of centralization and the size of the enterprise is also significant at the level of 5%, further proving the nonlinear relationship between the cost profit margins of the enterprise and the enterprise performance. From the group regression results, the conclusions of small- and medium-sized enterprises are the same as above, but for large-scale enterprises, the degree of centralized management and its crossover items are not significant, which once more proves the validity of the threshold regression conclusion. Therefore, the centralized management of enterprises can reduce the operating costs of enterprises to a certain extent and improve the profitability of enterprises, and this effect is mainly reflected in small- and medium-sized enterprises.

5.3.2. Perspective of Technology Innovation. The level of technology innovation is a key factor determining the development potential of an enterprise and is one of the key reasons for the continuous improvement of enterprise performance. Because the measurement standard of the technology innovation level is relatively abstract, we used the availability of data to choose the number of patents (ItN) of enterprises from several related studies as the measure of enterprise technology innovation for influence mechanism analysis. Due to the lack of patent data, the regression sample was reduced to 15,176. We constructed the following formula for this influence mechanism:

$$ItN_{i,t} = \beta_0 + + \beta_1 \mathrm{Cen} + \beta_2 \mathrm{Size} + \beta_3 \mathrm{Cen} \times \mathrm{Size} + \varphi X_{i,t} + u_i + \nu_t + \varepsilon_{i,t}. \tag{10}$$

All independent variables in the model are the same as above. The regression results are shown in Table 12. It is worth noting that the results of the group regression are different from the above. The regression results show that the regression coefficient of centralized management for the number of patents of large-scale enterprises is positive, and it is significant at the 1% level, but it is not a significant effect on small- and medium-sized enterprises. In the full-sample regression results, the cross-multiplication term is also significant at the 1% level, indicating that the centralized management of enterprises has an impact on the level of technological innovation of enterprises and is a nonlinear

Table 12: Regression results for the technology innovation influence mechanism.

	(1)	(2) ($\tau^o \le \widehat{\gamma}_2$)	(3) ($\tau^o > \widehat{\gamma}_2$)
Variables		*ItN*	
Cen	3.9e + 03 (2537.112)	86.542 (339.816)	2.9e + 04* 1.7e + 04
Size	17.846 (20.395)	25.227*** (4.907)	427.367** (179.495)
c.Cen#c.Size	193.140* (121.221)	-3.085 (16.389)	1258.727* (722.148)
_cons	-521.656 (395.370)	-534.799*** (99.771)	−1.0e + 04* ** (3936.328)
Control variable	Yes	Yes	Yes
Firm	Yes	Yes	Yes
Year	Yes	Yes	Yes
N	15176	9891	5285
R^2	0.058	0.297	0.114
R^2_a	0.057	0.296	0.112

Standard errors in parentheses. $^*P < 0.10$, $^{**}P < 0.05$, and $^{***}P < 0.01$.

relationship. The difference in group regression results may be due to the inherent influence of technology innovation on enterprises of different scales. For small- and medium-sized enterprises, it is not obvious that profit and development brought by technology innovation improvement reflect firm performance compared with enterprise expansion of scale and market share. In contrast, for large-scale enterprises that are in the stage of stable market ownership and relatively stable corporate development, technology innovation has become a breakthrough factor in firm performance. The regression results further confirmed these relevant conclusions and proved that centralized management indeed improved firm performance by affecting the technology innovation level of the enterprise.

5.3.3. Perspective of Investment Efficiency. In the research literature on centralization and firm performance, corporate investment efficiency is an important factor linking the correlation between the two. The measurement method of investment efficiency refers to the research of Richardson (2006) and Chen et al. (2011) to estimate the optimal investment level of enterprises and takes the absolute value of the residual of the regression model as a measure of investment efficiency. The specific regression model is as follows:

$$\begin{aligned}\mathrm{Inv}_{i,t} = {} & b_0 + b_1 Tb_{i,t-1} + b_3 \mathrm{Size}_{i,t-1} + + b_4 \mathrm{Roe}_{i,t-1} + b_5 \mathrm{Lev}_{i,t-1} \\ & + b_6 \mathrm{Age}_{i,t-1} + b_8 \mathrm{Cash}_{i,t-1} + b_7 \mathrm{Inv}_{i,t-1} + \theta_i + \gamma_t + \varepsilon_{i,t}.\end{aligned} \tag{11}$$

The dependent variable $\mathrm{Inv}_{i,t}$ is the capital investment volume of enterprise i in year t, that is, the investment scale. Tb is a variable related to the growth of the company, obtained by dividing the sum of the market value of floating stocks, the book value of nontradable stocks, and liabilities by the total assets (this is a relatively standard definition in literature, Tobin's Q, the ratio of the market value of the enterprise to the replacement cost of capital). . The definition of other variables is shown in Table 1. All independent variables in Model 1 lag one-period variables, and we controlled for firm fixed effects and year fixed effects. Referring to existing research, we regressed Model 11 by year and by enterprise and used the absolute value of the residual items as a measure of investment efficiency (InvEff). This means that the investment efficiency of the enterprise is lower if InvEff is greater. Similarly, we constructed a relevant model for mechanism analysis. The specific equation is as follows:

$$\mathrm{InvEff}_{i,t} = \beta_0 + + \beta_1 \mathrm{Cen} + \beta_2 \mathrm{Size} + \beta_3 \mathrm{Cen} \times \mathrm{Size} + \varphi X_{i,t} + u_i + \nu_t + \varepsilon_{i,t}. \tag{12}$$

Table 13 reports the regression results with investment efficiency (InvEff) as the dependent variable; that is, the test results of the impact of centralization on enterprise investment efficiency. In Column (2), the regression coefficient of the degree of centralization (Cen) is -8.807, and the significance level is 5%, indicating that compared with decentralized management, the investment efficiency of the enterprise is reduced under the centralized management mode; that is, a lack of effective investment and an increase in ineffective investment may exist at the same time, thereby reducing the efficiency of enterprise to grasp growth opportunities through investment. However, in the full sample and the sample of small- and medium-sized enterprises, the crossover terms of the degree of centralization and the scale of the enterprise are both significantly positive, and the significance levels are 1% and 5%, further indicating that the degree of enterprise centralization has a nonlinear relationship with the investment efficiency of the enterprise affected by the scale of the enterprise. The above empirical evidence shows that centralized management is helpful to cost

Table 13: Regression results for the investment efficiency influence mechanism.

	(1)	(2) ($\tau^o \le \widehat{\gamma}_2$)	(3) ($\tau^o > \widehat{\gamma}_2$)
Variables		InvEff	
Cen	-3.430	-8.807**	-0.752
	(2.263)	(4.195)	(3.680)
Size	0.993***	0.963***	1.095***
	(0.051)	(0.073)	(0.070)
c.Cen#c.Size	0.161*	0.418**	0.031
	(0.101)	(0.196)	(0.160)
_cons	-21.140*** (1.097)	-19.357*** (1.489)	-21.849*** (1.595)
Control variable	Yes	Yes	Yes
Firm	Yes	Yes	Yes
Year	Yes	Yes	Yes
N	10,503	7473	4580
R^2	0.179	0.119	0.173
R^2_a	0.179	0.117	0.170

Standard errors in parentheses. $^*P < 0.10$, $^{**}P < 0.05$, and $^{***}P < 0.01$.

allocation management and technology innovation, but the efficiency of centralized management is relatively low in activities with high uncertainty, such as investment.

6. Conclusion

Based on the relevant data from China's nonfinancial and nonreal estate listed corporate groups from 2009 to 2018, we constructed a threshold model for the relationship between corporate size in centralization and firm performance, revealing the complex relationship of size-threshold effect on the centralization and firm performance nexus, and analyzed the influence mechanism of the degree of centralization on firm performance from the three aspects of cost allocation management, technology innovation, and investment efficiency.

These results show that (1) the impact of the degree of centralized management of an enterprise on performance will change with the size of the centralized enterprise. There is a size-threshold effect on the centralization and firm performance nexus. Taking the data of return on total assets (ROA_1), for instance, when size ≤ 19,460; that is, with relatively small-scale corporations, if the degree of centralization of the corporation is higher, the level of firm performance can be better. When 19.460 < size ≤ 22.082, although the degree of centralization shows a positive relationship with corporate performance, the promotion effect continues to weaken. When the scale of corporations crosses the second threshold (22.082), the impact is not significant. The related endogeneity and robustness tests yielded significance. (2) The level of the size-threshold effect has differences in property right heterogeneity, industry heterogeneity, and family enterprises. The positive effects of samples of private corporations, family business samples, and manufacturing industries are more significant than other samples in the same category. (3) Centralized management changes firm performance under the threshold of scale by affecting cost allocation management, technology innovation, and investment efficiency. Centralized management reduces the investment efficiency of enterprises to varying degrees and thus reduces firm performance in small- and medium-sized enterprises but significantly improves the performance of enterprises by improving the level of cost allocation management and technology innovation.

Many of our findings provide guidance for companies to establish a decision-making power allocation that meets their own scale development needs. First, centralized management has a greater positive impact on firm performance among small- and medium-sized firms and is more suitable for enterprises with larger development space and less uncertain activities. Therefore, effectively enhancing the degree of centralization of enterprises while paying attention to the investment risks of enterprises seems to be the optimal strategy for small- and medium-sized corporations but not necessarily the optimal strategy for large-scale corporations. Second, through influence mechanism analysis, centralized management improves firm performance by improving the level of cost allocation management and technology innovation, meanwhile leading to performance decline by reducing investment efficiency. Combined with the heterogeneity analysis, we find that centralized management is more suitable for enterprises with larger development space and less uncertain dominant activities, while in mature and balanced enterprises centralized management has no obvious effect on performance improvement.

We believe that our model is reasonable and has a solid foundation in theory [31] (Kanamori and Motohashi, 2006). We have tested it with reliable survey tools and data. The

existing literature has seldom studied the role of firm size in the relationship between centralized management and firm performance [17]. Therefore, our evidence on the size-threshold effect on the centralization and firm performance nexus is emphasized in this article.

Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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