EMPIRICAL STUDY ON THE IMPACT OF EQUITY STRUCTURE ON ENTERPRISE INNOVATION ABILITY：BASED ON COMPANIES LISTED ON CHINA'S GROWTH ENTERPRISE MARKET

Yi Su [1], Khunanan Sukpasjaroen [2], and Thitinan Chankoson [3*]

[1] Chakrabongse Bhuvanarth International Institute for Interdisciplinary Studies (CBIS), Rajamangala University of Technology Tawan-OK, Thailand.

[2] Chakrabongse Bhuvanarth International Institute for Interdisciplinary Studies (CBIS), Rajamangala University of Technology Tawan-OK, Thailand.

[3] Faculty of Business Administration for Society, Srinakharinwirot University, Thailand.

Abstract

This study investigates the relationship between ownership structure, market competition, and technological innovation ability for companies listed on China's Growth Enterprise Market (GEM). Panel data of 181 GEM-listed firms from 2010-2019 was analyzed using regression modeling. The results reveal an inverted U-shaped relationship between ownership concentration and innovation ability. Initially, concentrated ownership promotes innovation as the interests of large and small shareholders converge. However, beyond a threshold level, further concentration impedes innovation likely due to entrenched major shareholders pursuing private benefits. Moreover, intense market competition positively moderates this relationship by enhancing the benefits and deterring the downsides of concentrated ownership of corporate innovation activities. The findings provide vital insights into how equitable control balances alongside competitive forces can enable higher innovation efficiency, especially for rapidly growing Chinese enterprises. This study advances the understanding of antecedents of innovation capability for firms in emerging economies.

Keywords Listed companies on GEM, equity structure, innovation ability，market competition

1.INTRODUCTION

Innovation, as an important part of an enterprise's core competitiveness, enables enterprises to form core expertise in development and gain unique advantages in a fiercely competitive environment (Xu Zhengliang and Wang Lizheng, 2005). Especially today, as the trade tensions between China and the United States become increasingly tense, the United States and other Western countries have jointly imposed sanctions on Huawei and banned the supply of chips to Huawei. This has sounded the alarm for China. Only by continuous breakthroughs and innovations can we firmly hold the core technology in our own hands. Can it effectively deal with Sino-foreign trade frictions, reduce the vulnerability of China's technology supply chain amid intensifying

tensions between China and the United States, and achieve the strategic goal of "Made in China 2025"?

China has been making remarkable achievements in building an innovative country in an all-around way, and regarding R&D input, science and technology research and development funds, and personnel investment have increased significantly. From 2013 to 2022, China's R&D expenditure will increase from 11847 billion yuan to 30870 billion yuan, 260.57%. The intensity of R&D investment increased from 2.08% (GDP was 56.88 trillion yuan in the year) to 2.55% (GDP was 121.02 trillion yuan in the year) (Figure 1.1).
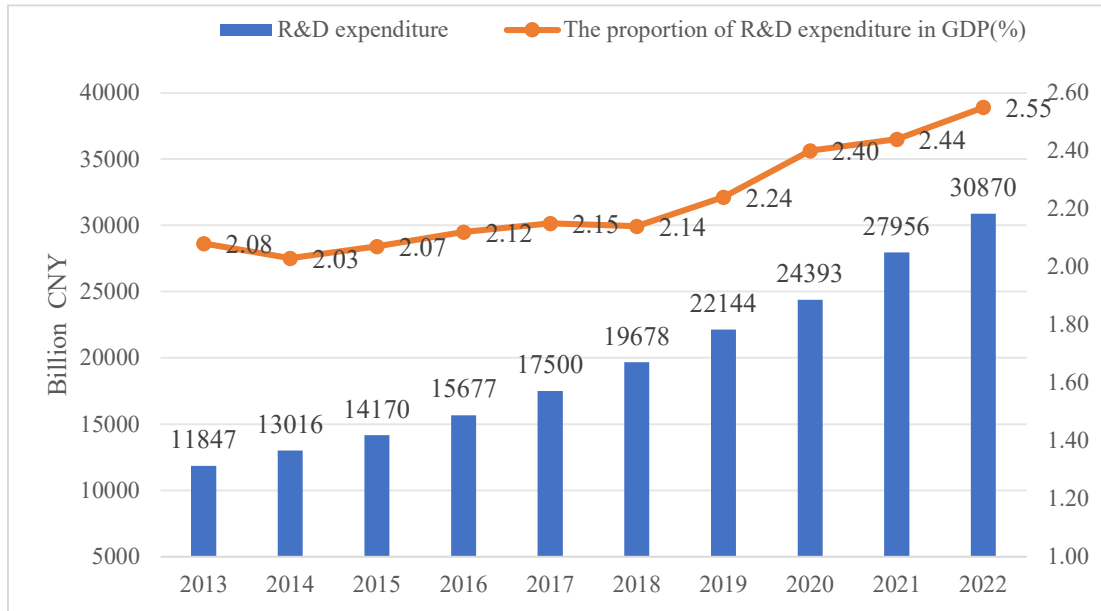
Figure1.1 China's R&D expenditure and its proportion in GDP from 2013 to 2022

Source： National Bureau of Statistics of China（2023）

From 2013 to 2022, the no. of patent applications in China increased from 2.377 million to 6.365 million, an increase of 2.68 times. The number of authorized patents increased from 1.313million to 4.323 million, 3.29 times more in 2022 than in 2013 (Figure 1.2)。
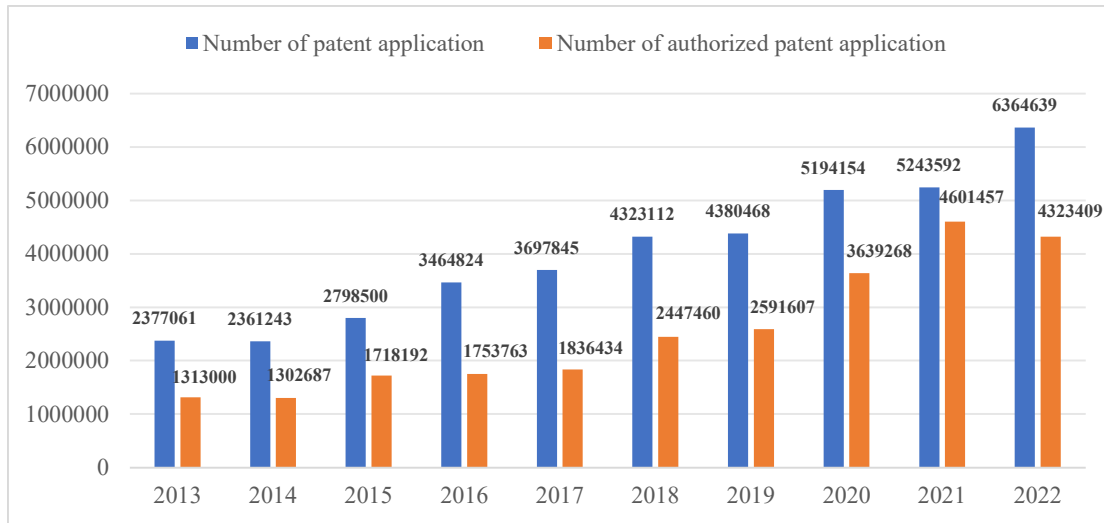
Figure1.2 China's number of patent applications and grants from 2013-2022

Source： National Bureau of Statistics of China（2023）

Technological innovation is crucial for China's growth and development. It drives economic growth, fosters sustainable development, and promotes industrial restructuring. Chinese enterprises must increase their investment and efficiency in innovation to gain a competitive advantage in global markets and implement sustainable development strategies. To enhance core competitiveness and promote sustainable development, enterprises must possess a sense of independent innovation and increase investment in innovation.

Listing on the Growth Enterprise Market (GEM) is essential to China's independent innovation strategy. It promotes innovation, fosters high-growth potential, and flexible management systems. Since its establishment in 2009, the GEM has cultivated high-quality enterprises with strong innovation abilities, core competitiveness, and industry influence. It serves as a driving force behind China's rapid economic and innovative development. The GEM's significance lies in nurturing more high-growth innovative enterprises, creating a solid engine for growth, and promoting new financial strategies. It provides a favorable environment for high-tech enterprises, diversifies funding sources, enhances share liquidity, and supports economic development and reform. However, GEM-listed companies must still strengthen technological innovation to improve their core competitiveness and achieve long-term and efficient results. Increasing investment in innovation and promoting independent innovation awareness are crucial for these companies.

In the current economic context, equity structure is increasingly important for corporate development, especially for GEM-listed companies with high stock liquidity. A reasonable equity structure will effectively alleviate the company's agency and equity problems. Allocation problems, financing constraints and market information asymmetry are crucial to increasing enterprise innovation investment. La Porta (1999) found that in the world's major stock markets, more than 60% of listed companies have a "one dominant stock" phenomenon, which is more

common in East and Southeast Asia. The control rights of major shareholders profoundly affect the company's decision-making path and interest distribution mechanism, and have become a key influencing factor in corporate R&D investment decisions.

Based on the above-mentioned background of innovation, reform and opening up, this article studies the following questions: Is more dispersed ownership more conducive to improving the technological innovation abilities of enterprises? Under different levels of market competition, will the impact of ownership concentration on corporate technological innovation abilities change?

2. LITERATURE REVIEW AND RESEAR HYPHESES

2.1 Literature review

Equity structure refers to the nature and number of shares held by each shareholder within the enterprise. The separation of ownership and control rights in modern enterprises forms a principal-agent relationship. The greater the degree of separation between the two rights and the more dispersed the ownership structure, the greater the agency cost for shareholders to supervise operators (Zhu Desheng and Zhou Xiaopei, 2016), and the existence of controlling shareholders will also follow. It can effectively reduce the adverse effects of dispersed ownership structure (Shleifera, 1986). A concentrated ownership structure can reduce information asymmetry and shorten shareholders' decision-making time. Research shows that ownership concentration is positively related to corporate R&D investment, and major shareholders can have a positive impact on enterprise innovation (Hill.W.L, 1989). Francis and Smith (2004) compared the R&D investment expenses of enterprises with different ownership structures and found that compared with enterprises with dispersed ownership, enterprises with concentrated ownership invested more in R&D expenses. However, an overly concentrated ownership structure may also harm corporate investment in innovation. As the rights of major shareholders gradually expand, it is easy for major shareholders to abuse their control rights for personal gain, and many small shareholders may also be deprived of their interests. At this time, the concentration of ownership structure may inhibit the innovative activities of enterprises. Ananzeh. H & Bugshan. A (2023) used sample data of 94 Jordanian listed companies to conclude that highly concentrated ownership structures and management shareholding levels will have a negative impact on the market environment. O'nell (2003) compared American and Japanese companies and found that ownership concentration inhibits enterprise innovation investment. Since investors are averse to investment risks, the higher the concentration of corporate ownership, the less investment in innovative activities (Vitojd. J. D, 2010).

Therefore, some studies have shown that within an appropriate range, there is a positive relationship between ownership concentration and R&D investment intensity. But when a "one controlling shareholder" situation occurs, the shareholding ratio of the largest shareholder will be directly related to the intensity of R&D investment. There is a significant negative correlation (Chen. V, 2014). Liu Shengqiang and Liu Xing (2010) combined the situation that the ownership

concentration of listed companies in my country is generally high. Through empirical analysis, they found that when the shareholding ratio of major shareholders is less than a certain critical value, there is a "U"-shaped relationship between R&D investment and R&D investment. When values are high, a firm's agency problems are primarily conflicts of interest between large and small shareholders. Despite this, major shareholders are still capable of leveraging R&D investments to generate more private income. As the shareholding ratio of the largest shareholder increases, R&D expenses decrease. ; When the shareholding ratio of the largest shareholder exceeds this critical value, the interests of large and small shareholders gradually converge, and R&D increases as the shareholding ratio of the largest shareholder increases. Su Hengye and Dai Liang (2022) used empirical evidence to prove that the effect of innovation investment is reflected in enterprise growth. Innovation investment is positively related to enterprise development, and ownership concentration will enhance the positive relationship between the two. That is, the higher the ownership, the higher the participation. The higher the degree, the higher the degree to which innovation input is transformed into corporate performance. Therefore, for the long-term development of the company, important shareholders are more willing to increase investment in R&D and innovation and rationally optimize resource allocation. Regarding the effect of innovation investment, Zhang Yujuan and Zhang Lu (2022) believe that innovation investment is ultimately reflected in corporate value. Through a lagged one-period regression analysis of innovation investment and corporate value, it is found that there is a positive promotion relationship between the two, while ownership concentration has a reverse moderating effect on this relationship.

Scholars have different opinions on whether market competition has a remarkable regulatory impact on the relationship between equity concentration and enterprise innovation ability and how to adjust the direction. Yang Jianjun et al. (2015) studied the relationship between equity concentration and enterprise-independent innovation from the perspective of behavioral motivation. They found that a nonlinear relationship exists between them, and the level of market competition has no significant moderator effect on them. Li Jian et al. (2016) took medium-sized enterprises in China as a sample and found that with the intensification of equity concentration, enterprises' continuous innovation investment showed a downward trend. After considering the scenario effect of market competition, they found that as product market competition intensified, the passive correlation between equity concentration and enterprise innovation investment became more pronounced. However, only some scholars are involved in the adjustment test of the relationship between foreign investors' shareholding and enterprise innovation in market competition. Zheng Chunmei and Zhu Lijun (2019) believe that compared with highly competitive industries, low-competitive industries are more likely to lack innovation due to monopoly, while the entry of foreign equity can provide them with new business ideas, cash flow, technology, and other resources, stimulate innovation vitality and motivation, so in low, competitive industries, foreign ownership can promote the enterprise technological innovation ability.

2.2 Research Hypotheses

2.2.1Ownership concentration and enterprise innovation

From the perspective of the agency relationship between large, medium and small shareholders, moderate concentration of ownership can improve the consistency of the interests of large shareholders and small and medium shareholders. Under the influence of interest convergence, large shareholders will reduce inefficient innovation investments that harm the interests of small and medium-sized shareholders, influential innovative behaviors will be more protected, and they will pay more attention to the long-term development and development of the enterprise. enterprise. Investment in innovation has been further increased. Adopting a "supportive behavior" attitude toward the company will produce a "supportive effect."

In addition, due to the existence of multiple large shareholders, the high risks brought by corporate innovative behavior can be effectively dispersed (Maury et al., 2005). On the other hand, the higher the ownership concentration, the weaker the checking and balancing effect of other shareholders on the controlling shareholder. Due to information asymmetry, controlling shareholders are subject to less supervision and are more likely to misappropriate company assets and make inefficient investments. This kind of self-interested behavior will damage the company's long-term interests, that is, adopt a "hollowing out behavior" attitude toward the company, and have a "destructive effect" on the company's comprehensive technological innovation capabilities. Therefore, when the company's ownership concentration is in a moderate area, the supporting role of ownership concentration can enhance the company's technological innovation capabilities. When the ownership concentration exceeds a certain limit, the destructive effect will dominate, and the increase in ownership concentration will reduce the company's technological innovation capabilities. This leads to hypothesis H1:

H1: There is an inverted U-shaped relationship between ownership concentration and corporate technological innovation capabilities. As equity concentration increases, the technological innovation capabilities of enterprises increase and decrease.

2.2.2 The moderating effect of market competition on ownership concentration and enterprise innovation

The external environment will affect the impact of ownership concentration on enterprise technological innovation. As a typical external environment, the degree of market competition will affect the relationship between ownership concentration and corporate technological innovation capabilities. On the one hand, fierce market competition can enhance the supporting role of ownership concentration in enterprise innovation. In the fierce market competition environment, companies face higher risks and the possibility of bankruptcy and liquidation increases, which will prompt companies to improve corporate governance. Strengthen manager supervision, reduce agency problems, improve the effective use of funds, and help enterprises increase effective investment in innovation. Fierce competition will also cause companies to have a competitive

escape effect. Enterprises gain advantages through strengthening innovation and avoid being completely eliminated by the same industry.

On the other hand, fierce market competition can inhibit the destructive effect of ownership concentration on enterprise innovation. The more companies competing in the market; the more practical information enterprises obtain, the smaller the degree of information asymmetry. Operators pursue personal interests. Incentives, moral hazard, and adverse selection will all be reduced, thereby promoting the improvement of corporate technological innovation capabilities. To sum up, market competition is crucial to affecting the two effects of ownership concentration and corporate technological innovation capabilities. Therefore, market competition has a moderating effect on the inverted U-shaped relationship between ownership concentration and corporate technological innovation capabilities. Compared with a weak market competition environment, a good market competition environment has a more significant supporting effect on ownership concentration and a weaker destructive effect. Therefore, in a fierce market competition environment, ownership concentration better affects the technological innovation capabilities of enterprises.

Therefore, this article proposes the following hypotheses:

H2: Market competition moderates the inverted U-shaped relationship between ownership concentration and corporate technological innovation capabilities.

H3: Fierce market competition can improve the overall inverted U-shaped curve between ownership concentration and corporate technological innovation capabilities.

3 RESEARCH DESIGN

3.1 Data selection and sources

This thesis's initial sample data for empirical research are from the Wande database (WIND) and the Guotai'an database (CSMAR). The initial data includes the data of China's GEM-listed companies from 2010 to 2019. On this basis, the original data are processed as follows: (1) the sample data of financial companies (according to the industry classification of the CSRC in 2012) is removed, (2) the ST sample company data is removed, and (3) the company data with missing and abnormal variables is removed. The unbalanced panel data of 181 public companies remained after the above principles were eliminated. STATA15.0 and EXCEL software are used for data processing and analysis. To eliminate the potential impact of extreme values on the regression results, this study employed winsorization to adjust all continuous variables at the 1% quantile.

3.2 Variable design

3.2.1 Independent variable

The Independent variable is the index which reflects the equity structure, including the index which reflects the ownership concentration degree. Equity concentration is used to indicate the distribution status of a company's equity, whether it is concentrated in the hands of a few large shareholders or dispersed among many small shareholders. In the past, scholars often used the shareholding ratio of the largest shareholder, the shareholding ratio of the top three shareholders, the shareholding ratio of the top five shareholders, and the shareholding ratio of the top ten shareholders as proxy variables for ownership concentration. This article chooses the shareholding ratio of the largest shareholder (share) to measure ownership concentration.

3.2.2 Dependent variable

Different scholars have different methods for measuring enterprise innovation abilities. Since the research in this article explores the choice and impact of ownership concentration on enterprise innovation behavior, R&D investment is chosen to measure enterprise innovation investment. For R&D investment, domestic and foreign scholars use different measurement standards, mainly R&D expenses, the proportion of R&D expenses to total assets, or the proportion of R&D expenses to operating income. Under normal circumstances, companies will invest their disposable cash flow into enterprise innovation activities to enhance sustainable development and market competitiveness, which will increase corporate R&D expenses. Taking into account the availability of data, the measure chosen in this article is the ratio of annual reported R&D expenses to operating income.

3.2.3 Moderator variable

The degree of market competition is the moderator variable. There are two methods to measure the degree of market competition: structural and non-structural. The structural method is based on the analysis paradigm of "structure-behavior-performance," which is usually measured by the concentration degree of the top four major manufacturers (CR4) and the Herfindahl index (HHI). The non-structural method directly estimates the degree of market competition by deducing the measurement model based on economic theory and combining it with manufacturers' data. this thesis uses the Herfindahl Index (HHI) as the proxy variable of market competition, and the calculation formula is as follows:

$$HHI = \sum_{i=1}^{n} \left(\frac{S_{i,h,t}}{S_{h,t}} \right)^2 \quad \text{(Formula 1)}$$

In formula 1, $S_{i,h,t}$ represents the operating revenue of Company I in industry h in year t, and $S_{h,t}$ represents the sum of the operating revenue of all companies in industry h in year t. The closer the HHI is to 1, the more the market environment tends to be a monopoly, and the closer the HHI is to 0, the more the market environment tends to be complete competition. Based on the median of the Herfindahl index, the samples are divided into a strong market competition group and a weak market competition group. Construct dummy variable Comp. When HHI is greater than the median

digit, the market competition is weak, and the value of Comp is 0; when HHI is less than the median digit, the market competition is strong, and Comp is 1.

3.2.4 Control variables

Control variables reflect the essential characteristics of the Company, combined with theoretical analysis and existing literature research, appropriately selected some control variables. It mainly includes company size (Size)、 asset-liability ratio (Ratio) 、Tobin's Q value (TbQd)、 enterprise growth ability (Grow) and return on assets (Roa). And controls the year and industry.

Table 1 Definitions of Variable

Variable	Variable name	Variable symbol	Variable operational definition and description
dependent variable	Innovation input	Input	R&D expenditure/Operating income
independent variable	Ownership concentration	Share	Share proportion of the largest share holder
moderator variable	Market competition	Comp	It is 0 if Herfindahl index is greater than the median, otherwise it is 1
Control variable	Enterprise size	Size	The natural log of total assets at the end of the year
	Asset-liability ratio	Ratio	Total liability/ Total assets
	Return on assets	Roa	Net profits/ Average balance of assets
	Tobin's Q value	TbQd	(Equity market value + net debt market value)/(Total assets - net value of intangible assets - net value of goodwill)
	Enterprise growth ability	Grow	The annual growth rate of the main business income of the enterprise

3.3 Research methodology and model construction

In order to examine the influence of ownership structure on enterprise innovation ability and the moderating effect of market competition, the OLS regression analysis model of interface data of control year and industry was adopted.

$$Input=\beta_0+\beta_1 Share+\beta_2 Size+\beta_3 Roa+\beta_4 Ratio+\beta_5 TbQd+\beta_6 Grow+\varepsilon \qquad (Mode1)$$

$$Input=\beta 0+\beta_1 Share+\beta_2 Share^2+\beta_3 Size+\beta_4 Roa+\beta_5 Ratio+\beta_6 TbQd+\beta_7 Grow+\varepsilon \quad \text{(Model 2)}$$

$$Input=\beta_0+\beta_1 Share+\beta_2 Share^2+\beta_3 Share*Comp+\beta_4 Share^2*Comp+\beta_5 Comp+\beta_6 Size$$

$$+\beta_7 Roa+\beta_8 Ratio+\beta_9 TbQd+\beta_{10} Grow+\varepsilon \qquad \text{(Model 3)}$$

4 EMPIRICAL ANALYSIS

4.1 Statistical descriptive analysis

After performing descriptive statistical analysis on the selected research sample data, the specific results are presented in Table 2.

Table 2 Descriptive statistics analysis of variables

Variable	N	Mean	Std. Dev.	Min	Max
Input	1810	0.039	0.036	0.000	0.413
Share	1810	0.301	0.124	0.030	0.752
Comp	1810	0.501	0.5	0	1
Size	1810	21.172	0.736	19.703	24.303
Roa	1810	0.034	0.092	-0.437	0.279
Ratio	1810	0.287	0.188	0.026	0.832
TbQd	1810	3.110	1.835	1.024	10.932
Grow	1810	0.162	0.523	-0.955	2.621

The level of innovation input measures the density of investment in innovation. The mean value is 0.039, with a standard deviation of 0.036. This indicates that, on average, the sample companies in the GEM market have an innovation input expenditure that accounts for 3.9% of their total assets. It can be observed that the overall level of innovation input by GEM-listed companies is not high. The innovation input levels among GEM-listed companies exhibit significant variation, with the maximum value reaching 0.413 and the minimum value being 0, indicating that some companies do not invest in innovation.

The average value of ownership concentration ratio (CR) is 0.301, with the maximum value reaching 0.752, and the standard deviation is 0.124. It can be seen that the ownership concentration of companies listed on China's GEM is relatively high, and some companies have highly concentrated ownership.

Comp is a dummy variable of the degree of market competition; 1 represents intense market competition, 0 represents weak market competition, and the mean value is 0.501, indicating that the sample companies' average degree of market competition is relatively middle.

4.2 Correlation analysis

In order to preliminarily detect whether there is collinearity among the variables, this paper conducts the Pearson test on the main variables in the model. The test results include specific significance levels and correlation coefficients, as shown in Table 3.

Table3 Correlation analysis

	Input	Share	Share^2	Comp	Size	Roa	Ratio	TbQd	Grow
Input	1								
Share	0.082***	1							
Share^2	0.097***	0.869***	1						
Comp	0.003	-0.084***	-0.085***	1					
Size	0.431***	0.202***	0.262***	-0.192***	1				
Roa	0.129***	0.116**	0.135**	-0.052***	0.045	1			
Ratio	-0.021**	0.116***	0.108**	0.080***	0.457***	-0.160***	1		
TbQd	0.099***	-0.121***	-0.154***	-0.105***	-0.325***	0.105***	-0.350***	1	

Grow	0.044	0.012	-0.004	0.004	0.044***	0.089**	0.153***	0.105*	1

In order to verify whether there is a collinearity problem among the variables, the Pearson correlation coefficient analysis was carried out, and the results are shown in Table 3, except that the correlation coefficient between Share and the square item Share^2 of the equity concentration is 0.869, the rest are all lower than 0.5, and there is no serious multicollinearity between the variables in the preliminary judgment.

4.3 Analysis of regression results

Table4 Regression results of the impact of ownership concentration and market competition on enterprise innovation ability

	Mode1	Mode2	Mode3
Share	0.003 （1.28）	0.100*** （3.01）	0.004*** （3.51）
Share^2		-0.337*** （-2.85）	-0.439*** （-3.40）
Share_Comp			-0.002* (-1.84)
Share^2_Comp			0.304* (1.88)
Comp			0.082** (2.11)
Constant	0.216*** (6.97)	0.197*** (7.84)	0.189*** (8.01)
Industry FE	YES	YES	YES
Year FE	YES	YES	YES
N	1810	1810	1810
Adj.R-squared	0.325	0.331	0.329

Columns (1) show Model 1 regression results. When the quadratic item of equity concentration is not included, the correlation coefficient between equity concentration Share and enterprise innovation input is insignificant, 0.003. After adding the square term of ownership concentration, the regression results of ownership concentration and enterprise innovation investment in column (2) show that the one-time and two-time items of ownership concentration are both significant at the 1% confidence level, and the coefficient of the first-order is 0.100, greater than 0. The coefficient of the second item is -0.337, less than 0. As the proportion of the first largest shareholder's shareholding increases, there is a corresponding increase in the innovation investment density of the enterprise. Once the shareholding ratio of the first largest shareholder reaches a certain threshold, the escalation of equity concentration tends to impede the innovation input of the enterprise. This finding aligns with our expectations and provides support for hypothesis H1. The ownership concentration and enterprise innovation ability are in an inverted U shape. Before the equity concentration reaches a certain level, the support effect dominates, and the enterprise innovation ability increases with the increase of the equity concentration. After the equity concentration reaches a certain level, the hollowing-out impact is more significant than the support effect, and the enterprise innovation ability decreases with the increase of the concentration of ownership. When the concentration of corporate equity is too high, it will lead to the lack of necessary small and medium shareholders to contain and supervise it. On the one hand, if the most significant shareholders or shareholders with absolute control have risk aversion, they will intervene in the company's decision-making and reduce the company's activities with a long payback period and uncertain returns; on the other hand, when the equity concentration is too high at times, it is easy for them to have dictatorial behavior or infringe on the rights and interests of other shareholders for personal gain, which will hurt the development of the company, thereby inhibiting the growth of enterprise innovation activities.

To examine the effectiveness of the moderating effect, Model 3 was simplified to model 4, and the curve shape of the inverted U shape could be represented by the vertex curvature K, which is the second derivative of Input. The expression formula is shown in Formula 2.

$$\text{Input} = \beta_0 + \beta_1 \text{Share} + \beta_2 \text{Share}^2 + \beta_3 \text{Share} * \text{Comp} + \beta_4 \text{Share}^2 * \text{Comp} + \beta_5 \text{Comp}$$

$$= \beta_0 + (\beta_1 + \beta_3 \text{Comp}) * \text{Share} + (\beta_2 + \beta_4 \text{Comp}) * \text{Share}^2 \qquad \text{(Model 4)}$$

$$K = \ddot{\text{Input}} = 2\,(\beta_2 + \beta_4 \text{Comp})\,\text{Share} \qquad \text{(Formula 2)}$$

Referring to Haans et al.'s (2016) test of an inverted U shape with a regulating effect, two conditions must be met if the regulating effect of market competition is practical. First, the coefficient β_1 shows a significant positive relationship, while the coefficient β_2 demonstrates a significant negative relationship, and β_3 and β_4 have at least one significant effect. Second, the maximum and minimum values of the moderator variable Comp must meet the requirement that K is less than 0. If K is greater than 0, the inverted U-shaped curve may be turned into a U-shaped curve due to the appearance of the moderator variable.

According to Zhu Dan's (2018) analysis of the influence of the moderator variable on the inverted U-shaped curve, when the moderator variable increases, the dependent variable corresponding to any value of the independent variable will increase, which can indicate that the addition of the moderator variable can raise the overall level of the inverted U-shaped curve. Take the two values of the moderator variables Z_2 and Z_1, where Z_2 is more significant than Z_1, and put them into Model 4, respectively. Subtract the two equations to get Formula 3:

$\text{Input}_{Z_2} - \text{Input}_{Z_1}$

$= (\beta_0 + \beta_1 \text{Share} + \beta_2 \text{Share}^2 + \beta_3 \text{Share} * Z_2 + \beta_4 \text{Share}^2 * Z_2 + \beta_5 Z_2)$

$- (\beta_0 + \beta_1 \text{Share} + \beta_2 \text{Share}^2 + \beta_3 \text{Share} * Z_1 + \beta_4 \text{Share}^2 * Z_1 + \beta_5 Z_1)$

$= (Z_2 - Z_1)(\beta_3 \text{Share} + \beta_4 \text{Share}^{2} + \beta_5)$ 　　　　　(Formula 3)

According to the table 4, the Share^2_Comp coefficient is 0.304, which is greater than 0, and the value of $\beta3^2 - 4\beta_4\beta_5$ is -0.10023, which is less than 0; that is, the function f(Share) has no real root, and the formula 3 is always greater than 0, which shows that the moderator variable of market competition has a significant influence on the concentration of ownership and The inverted U-shaped curve relationship of corporate technological innovation investment plays an overall role in raising the overall level. The enterprise's innovation ability can be promoted when the equity concentration is lower than a specific value. The robust market competition environment can expand this promotion effect. When the equity concentration degree is higher than a certain level, it has an inhibitory impact on the enterprise's innovation ability, and the robust market competition environment can alleviate this inhibitory effect to a certain extent, which verifies H3.

4.4 Robustness Check

There are multiple approaches available to measure the level of ownership concentration. In the above analysis, this study selects the shareholding ratio of the first largest shareholder (Share) as a substitute variable for the degree of ownership concentration. To ensure the robustness of the findings, the shareholding ratio of the top three shareholders (Share3) replaced Share and respectively substituted into Model 2 and Model 3 to regress the results. The Share3 coefficients in column (1) of Table 5 exhibit a significant positive correlation at the 1% confidence level. At the same time, the Share3^2 coefficients display a significantly negative correlation at the same confidence level, validating hypothesis H1. The Share3 coefficient in column (2) demonstrates a significant positive relationship at the 1% confidence level, the Share3^2 coefficient displays a significantly negative correlation at the 5% confidence level, the cross-product Share3_Comp and Share3^2_Comp coefficients are both significant, and the moderator variable is taken as extreme When the value is, the vertex curvature K is less than 0, verifying the hypothesis H2. The Share3^2_Comp coefficient is positive, and $\beta_3^2 - 4\beta_4\beta_5$ equals -0.123559 and less than 0, which verifies hypothesis H3.

Table 5 Regression results of shareholding concentration share3 affecting enterprise innovation ability

	(1)	(2)
Share3	0.089***	0.003***
	(2.62)	(3.72)
Share3^2	-0.239***	-0.408***
	(-2.35)	(-3.29)
Share3_Comp		-0.003*
		(-2.69)
Share3^2_Comp		0.331*
		(2.44)
Comp		0.111**
		(2.90)
Constant	0.195***	0.192***
	(7.67)	(6.89)
Industry FE	YES	YES
Year FE	YES	YES
N	1810	1810
Adj. R-squared	0.331	0.330

5 CONCLUSIONS

This research explored the triangular relationship between concentrated ownership, market competition intensity, and corporate innovation capability for Chinese GEM-listed enterprises. The empirical examination demonstrates an inverted U-shape linkage between ownership power and innovation propensity initially triggered by converging shareholder interests but impeded later by entrenched control. Meanwhile, intense competition positively reinforces concentrated ownership's spurring effect on innovation. These findings showcase how equitable and diffused control mechanisms interplaying with competitive market forces could stimulate innovation

vitality as a growth strategy for emerging economy firms. However, nuances must be considered regarding alternative governance structures across diverse contexts. Future studies can build on this investigation of ownership dynamics to advance understanding of innovation ecosystem enablers, especially for developing economies like China with an evolving regulatory environment

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