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# Market Competition, Ownership Structure and Enterprise Innovation Performance

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## Abstract

**Currently, a new round of scientific and technological revolution is developing by leaps and bounds, and innovation has become the critical factor in determining the overall high-quality development of China . Enterprise innovation is affected by its internal and external environment, this paper focuses on the A-share listed companies from 2015 to 2019 to explore the relationship between market competition, corporate equity structure and enterprise innovation performance through empirical analysis. The results show that market competition has an obvious positive promotion effect on enterprise innovation; when other conditions remain unchanged, equity concentration weakens the positive relationship between market competition and enterprise innovation performance, and equity balance strengthens the positive relationship between market competition and enterprise innovation performance; further analysis finds that management shareholding is conducive to the improvement of enterprise innovation performance, and can also positively adjust the relationship between market competition and enterprise innovation.**

## Keywords

**Innovation Performance; Market Competition; Shareholding Structure.**

## 1. Introduction

At present, a new round of scientific and technological revolution is developing by leaps and bounds. The country insists on taking scientific and technological self-reliance and self-improvement as the supporting point of development. Innovation has become a factor that cannot be ignored in China's development process. Data shows that China’s research and experimental development expenditures reached 2,442.6 billion yuan, and the transaction value of technology contracts reached 2,825.2 billion yuan in 2020. The important position of innovation in China’s overall development has been highlighted. Innovation is related to the overall situation of China’s high-quality economic development. At present, China’s innovation investment has reached the forefront of the world. However, innovation investment must be transformed into results to promote high-quality economic development. How to convert innovation input into output and improve enterprise innovation efficiency has become the focus of academic circle under the current background.

An important subject of technological innovation is the enterprise, among which listed companies are the main force of innovation input and output, and enterprise innovation can drive national development [1]. Enterprise innovation is different from other business activities of enterprises, it has greater uncertainty and faces greater risks. Therefore, it is of great significance to study how companies can improve innovation performance. Rosenberg [2] believes that innovation, as a high-quality means of competition, can not only help enterprises create core competitiveness, but also help enterprises obtain long-term benefits. The research on the influencing factors of innovation performance mainly starts from the external and internal aspects of the enterprise: the external influencing factors mainly include macro-level

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industrial policy [3], financial environment [4], legal environment [5], government industrial policy [6], etc. The influencing factors mainly include management heterogeneity [7-8], ownership structure and corporate governance [9], and internal personnel training [10-11]. It can be seen that the innovation of enterprises is affected by various internal and external factors. To study the innovation performance of enterprises should not only start from the external links, but also pay attention to the internal governance of the enterprise.

As an important external environment for enterprises, the market is directly related to all aspects of production and operation of enterprises. Competition is the core of the market mechanism, which will inevitably affect the innovation performance of enterprises. The ownership structure determines the governance structure of different enterprises, which is also inseparable from the innovation behavior of enterprises. Therefore, this paper starts with the external market competition environment and the company's internal ownership structure to study how companies can better improve their innovation performance. The research of this paper finds that market competition can promote the improvement of corporate innovation performance from the external perspective, equity concentration plays a negative regulatory role, and equity balance plays a positive regulatory role from the perspective of corporate ownership structure. The contributions of this paper are as follows: First, this paper analyzes the effect of market competition and ownership structure on enterprise innovation, and provides a theoretical basis for enterprises to improve corporate governance and promote innovation. Second, this paper studies the influencing factors of enterprise innovation performance from the perspective of the combination of internal and external enterprises, which enriches and expands the research in related fields. Third, the research in this paper provides some reference to relevant departments for formulating active market and innovation policies.

## 2. Theoretical Analysis and Research Assumptions

### 2.1. The Relationship between Market Competition and Enterprise Innovation

Enterprises develop as a result of competition, and the operation of enterprises is inseparable from the market. Innovation, which is the core driving force of enterprise development, is also affected by market competition [12]. China is an emerging market country, and there are many investment opportunities for enterprises. Innovation investment is an inevitable requirement for enterprises to gain advantages in product market competition, and it is also an inexhaustible driving force for enterprises to maintain their survival and development. The information asymmetry and the principal-agent problem will inhibit the willingness and ability of R&D innovation of enterprises, thereby reducing the innovation performance of enterprises [13]. The market is the external environment for the survival and development of enterprises, and product market competition to a certain extent can alleviate the agency conflict within the enterprise, improve the inefficiency and lack of enthusiasm of the enterprise management, improve the transparency of enterprise information, and then promote the improvement of enterprise innovation performance [14]. Both the intensity of market competition and the dynamics of the market have an important impact on the innovation effect of an enterprise. The more intense the market competition is, the newer and higher requirements for enterprise innovation would be put forward by buyer' s market forces, which will promote the company' s R&D innovation. The higher the market dynamics of the industry in which the enterprise is located, the more active the market power will be, the more obvious the "promoting and stimulating effect" on innovation will be, and the stronger the enterprise' s ability to innovate [15].

From the perspective of information asymmetry, the more fully the product market competition is, the more and higher-quality information management will tend to provide to

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the outside world, thereby strengthening information exchange to alleviate financing constraints, low investment efficiency and other problems. At the same time, the market can transmit information about consumers' demand for commodities to enterprises, prompting enterprises to innovate according to the independent demands of consumers, so as to seize market share [16]. In a fully competitive environment, the market is easy to enter. The disclosure of good news by enterprises can convey good information to the market, and disclosure of bad news can also hinder the entry of potential investors, which makes enterprises also willing to share information, thus making information easy to obtain. The asymmetry is somewhat alleviated, which improves the efficiency of enterprise resource allocation. More enterprise resources are used in the field of innovation, which improves the level of enterprise innovation [14].

From the perspective of principal-agent, the uncertainty of the enterprise environment will exacerbate the principal-agent problem, and the conflict between shareholders and management would make the enterprise resources unable to be reasonably allocated, and then the enterprise's innovation investment may become the management's way of earning management and other means. It is a way to grab benefits and resources, thereby increasing the principal-agent cost of enterprises. The market has the function of signal transmission. The more intense the competition of market products, the higher the information content transmitted by the stock price, so that the information asymmetry can be improved to a certain extent, resulting in the "relief of agency cost effect" [17], which makes the management's work more difficult. Subject to supervision and constraints, to a certain extent, the agency efficiency of the management is improved, the effective allocation of resources is promoted, and the innovation efficiency is improved.

From the perspective of incentives, both product market competition and managerial incentives can increase the enthusiasm of managers. There is a complementary relationship between the two, which together positively affect the company's innovation performance. Incentives would generate more benefits than costs, and shareholders tend to improve managers' incentives [18]. Managers who lack incentives are unwilling to take risks to support corporate innovation activities, which is not conducive to corporate innovation. Market competition will make shareholders tend to motivate managers. Equity incentives have a convergence effect of interests, making managers support the innovation activities of enterprises for their own long-term interests and the company's long-term core competitiveness, and equity incentives moderate the management's evasive attitude towards R&D [19] , compared with companies whose management has not received equity incentives, listed companies whose management has equity incentives are more inclined to increase their energy in research and development, and their innovation behavior is also more efficient [20] .

Based on the above analysis, this paper proposes Hypothesis 1:

H1: Market competition can promote enterprise innovation.

## 2.2. Shareholding Structure and its Regulating Effect

The ownership structure corresponds to the internal governance structure of the company, which will affect the company's governance capability and efficiency, as well as the company's innovation. The degree of equity concentration mainly refers to the control power of different shareholders over the company, which reflects the characteristics of the company's equity distribution and the ability to check and balance, and has an important impact on the company's innovation decision-making, innovation investment and efficiency, which can avoid the "tunneling behavior" caused by information asymmetry, which has an important impact on enterprise innovation.

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## 2.3. The Moderating Effect of Ownership Concentration

Many scholars believe that equity concentration has a negative effect on innovation. Zhang Yujuan and Tang Xiangxi [21], Yang Feng and Li Qingyun [22] believe that the power of major shareholders is too concentrated, which will cause principal-agent problems, inhibit corporate innovation investment and negatively affect corporate technological innovation. Yang Jianjun et al. [23] believe that from the perspective of risk, investors tend to use low risk to obtain personal interests when making decisions, and this is also true for major shareholders. Due to risk aversion, major shareholders will hate investments with higher risks relating innovation. From the controlling position of major shareholders, major shareholders have control over the company and have sufficient control over the resources of the enterprise. In addition, innovation activities have certain risks and there are results spillovers and other enterprises' "the free-rider" effect, where major shareholders often use information to their advantage, inhibits innovation investment and output. The output of innovation results is inseparable from the exertion of the role of corporate governance, the production resources of enterprises are reasonably allocated under corporate governance. When the market competition is fierce, if the company has a shortage of funds and a high degree of equity concentration, the controlling shareholder will invest more resources in the daily production links of the company to maintain the normal production and operation of the company, and invest less in high-risk innovation fields. Companies may experience short-term performance declines immediately amid fierce competition. Based on the above analysis, this paper proposes the following assumptions:

H2a: Ownership concentration plays a negative moderating role between market competition and corporate innovation.

### 2.3.1. The Moderating Effect of the Degree of Equity Checks and Balances

To a large extent, equity checks and balances can alleviate the plundering and encroachment of corporate resources by major shareholders, strengthen internal supervision of enterprises, and optimize corporate governance, thereby improving the innovation performance of enterprises [24]. Under the equity check and balance, the probability and number of related transactions between shareholders will be reduced, which inhibits the behavior of major shareholders to use their position to seize resources and company interests, thereby alleviating the crowding-out effect of corporate innovation caused by the encroachment of major shareholders' resources. In addition, the collective efforts and collective decision-making among multiple major shareholders avoid the willful actions and decision-making mistakes of major shareholders under the information asymmetry, which is more conducive to relevant decision-making involving innovation. At the same time, facing the strict supervision of multiple major shareholders, the management reduces opportunistic behavior, actively seeks innovative investment opportunities, takes the initiative to take risks, and seeks the growth of long-term interests for the enterprise [9]. Based on the above analysis, this paper proposes the following assumptions:

H2b: Equity checks and balances play a negative moderating role between market competition and corporate innovation.

# 3. Research Design

## 3.1. Data Source and Sample Selection

This paper selects all non-financial A-share listed companies as the research object, takes 2015-2019 as the sample interval, and performs the following data processing on the sample: (1) ST listed companies and samples with severely incomplete data were excluded. (2) In order to eliminate the influence of extreme values, the Winsorize treatment of the upper and lower 1 % quantiles were performed on the continuous variables. (3) Classify and calculate the Herfindahl

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index according to the "Guidelines for Industry Classification of Listed Companies" issued by the China Securities Regulatory Commission in 2012. The patent data in this paper comes from the CNSDR database, and the rest of the data are from the CSAMAR database of financial reports of listed companies. After data processing using Stata 17.0, a total of 12,809 samples were obtained.

## 3.2. Variable Selection

### 3.2.1. Explained Variable - Enterprise Innovation Performance ( Patent )

Regarding the measurement method of enterprise innovation performance, the academic circle has not yet formed a unified opinion. Relevant research mainly uses two types of indicators: The first is R&D intensity, such as the ratio of enterprise R&D expenditure to operating income, the proportion of new product sales to sales revenue, and the number of R&D personnel; the second is R&D effect, which mainly includes the number of enterprise patent applications or the number of patents obtained by the enterprise number, etc. Both types of indicators have their own advantages and disadvantages. Comparatively speaking, R&D expenditure is a financial statement item, which is more likely to be interfered by other factors such as the company's potential tax avoidance motive, so the R&D effect can better reflect the effectiveness of the company's innovation. This paper draws on the practice of Jiang Xuanyu et al. [13], and uses the number of enterprise patent applications (Patent) to measure the innovation performance of enterprises.

### 3.2.2. Explanatory Variable - Market Competition Intensity (HHI)

For the measurement of the degree of market competition, there are many opinions in the academic circle. Most scholars use indicators such as market share (CR4 or CR8), Herfindahl index (HHI) and Lerner index to measure it. In the literature on market competition, the Herfindahl index is the most widely used. The lower the Herfindahl index, the greater the market competition the enterprise faces, the lower the market control ability of the enterprise, and vice versa, the less market competition the enterprise faces. The market competition degree described in this paper is opposite to that described by the Herfindahl index, so this paper multiplies the Herfindahl index by minus 1 as a proxy variable for the degree of market competition.

### 3.2.3. Adjustment Variables - Equity Concentration (CR ) , Equity Balance (Balance)

Referring to the research of Guan Bilin and Ge Zhisu [25] (p1-12), this paper selects the sum of the squares of the shareholding ratios of the top 10 major shareholders of the company to measure the shareholding concentration, the degree of equity checks and balances is measured by dividing the sum of the shareholding ratios of the second to fifth largest shareholders by the shareholding ratio of the largest shareholder.

### 3.2.4. Control Variables

Referring to the research of Guo Xiaoling et al. [15] and Wang Jingyu et al. [14], the company size (Size), asset-liability ratio (Lev), total asset turnover ratio (A TO), return on equity (ROE), number of board of directors (Bord), listing years (ListAge), whether two jobs are combined (Dual), and cash flow ratio (Cashflow) are used as control variables. The detailed definitions of all variables are shown in Table 1.

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**Table 1**. Variable Definition

| Type | Name | Variable | Definition |
|---|---|---|---|
| Explained variable | Innovation performance | Patent | The number of patents applied for by the company in the current year + 1 is the logarithm |
| Explanatory variables | Market competition | HHI | Herfindahl exponent multiplied by -1 |
| Moderator | Ownership concentration | CR | The sum of the squares of the shareholding ratios of the top ten shareholders |
| | Equity balance | Balance | The sum of the shareholding ratios of the second to fifth largest shareholders divided by Shareholding ratio of the largest shareholder |
| Control variable | Company Size | Size | Take the natural logarithm of total annual assets |
| | Assets and liabilities | LEV | Year-end total liabilities divided by year-end total assets |
| | Total asset turnover | ATO | Operating income divided by total average assets |
| | Roe | ROE | Net profit divided by total shareholders' equity |
| | Board of Directors | Bord | The natural logarithm of the number of directors |
| | Listing period | ListAge | The year of the current year minus the year of listing plus one, then take the natural logarithm |
| | Two jobs in one | Dual | 1 if the chairman and general manager are the same person, otherwise 0 |
| | Cash flow ratio | Cashflow | Net cash flow from operating activities divided by total assets |

## 3.3. Model Design

$$\text{Patent}_{it} = \beta_0 + \beta_1 \text{HHI}_{it} + \sum_{j=2}^{9} \beta_j \, \text{controls}_{it} + \text{Year}_t + \text{Ind}_i + \varepsilon_{it} \quad (1)$$

$$\text{Patent}_{it} = \beta_0 + \beta_1 \text{HHI}_{it} + \beta_3 \text{CR}_{it} + \beta_4 \text{HHI} * \text{CR}_{it} + \sum_{j=4}^{11} \beta_j \, \text{controls}_{it} + \text{Year}_t + \text{Ind}_i + \varepsilon_{it} \quad (2)$$

$$\text{Patent}_{it} = \beta_0 + \beta_1 \text{HHI}_{it} + \beta_3 \text{Balance}_{it} + \beta_4 \text{HHI} * \text{Balance}_{it} + \sum_{j=4}^{11} \beta_j \, \text{controls}_{it} + \text{Year}_t + \text{Ind}_i + \varepsilon_{it} \quad (3)$$

Model (1) is used to test the relationship between enterprise innovation performance and market competition, where $\text{Patent}_{it}$ is the explained variable, representing the innovation ability of the enterprise; $\text{HHI}_{it}$ is the main explanatory variable, which represents the intensity

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of market competition, and the remaining variables are control variables, and to mitigate endogeneity, time ($Year_t$) and industry fixed effects ($Ind_i$) were controlled in the model.

Model (2) and model (3) were used to test the moderating effect of ownership structure. Among them, model (2) adds equity concentration ($CR_{it}$) and the multiplication term ($HHI * CR_{it}$) of market competition and equity concentration on the basis of model (1) to test the moderating effect of equity concentration. Model (3) adds the degree of equity checks and balances ($Balance_{it}$) and the multiplication term of market competition and equity checks and balances ($HHI * Balance_{it}$) based on the model (1), which are added to test the moderating effect of the equity balance degree.

## 4. Empirical Results and Analysis

### 4.1. Descriptive Statistics

Table 2 presents the main results of descriptive statistics. The maximum value of innovation performance ( Patent ) is 9.25 , the minimum value is 0.00 , and the standard deviation is 1.65, which indicates that there is a large gap in the level of innovation among Chinese enterprises. The explanatory variable market competition degree (HHI) has a maximum value of -0.01, a minimum value of -1.00, and a mean value of -0.09, showing a left-skewed distribution, which is consistent with the actual situation in China, indicating that except for a few industries and key industries controlled by the state in addition to less competition in some areas, companies in most other industries have market competition. The maximum value of the adjustment variable ownership concentration ratio (CR ) is 0.79, and the average value is 0.16, showing a left-skewed distribution, indicating that under the current environment, the ownership of most Chinese enterprises is relatively concentrated, and the major shareholders have a very important position in the corporate governance system. The maximum value of the equity balance (Balance) is 4.00, the minimum value is 0.01, and the average is 0.80, showing a right-skewed distribution, indicating that most Chinese companies have a relatively weak equity balance.

**Table 2**. Descriptive statistics of main variables

| Variable | N | Mean | p50 | SD | Min | Max |
|---|---|---|---|---|---|---|
| Patent | 12 809 | 2.73 | 2.83 | 1.65 | 0.00 | 9.25 |
| HHI | 12 809 | -0.09 | -0.06 | 0.10 | -1.00 | -0.01 |
| CR | 12 809 | 0.16 | 0.13 | 0.11 | 0.00 | 0.79 |
| Balance | 12 809 | 0.80 | 0.63 | 0.64 | 0.01 | 4.00 |
| Size | 12 809 | 22.20 | 22.02 | 1.31 | 17.81 | 28.64 |
| LEV | 12 809 | 0.40 | 0.39 | 0.20 | 0.01 | 3.92 |
| ATO | 12 809 | 0.65 | 0.56 | 0.49 | 0.01 | 12.37 |
| ROE | 12 809 | 0.07 | 0.08 | 0.18 | -7.22 | 1.61 |
| Bord | 12 809 | 2.11 | 2.20 | 0.20 | 1.10 | 3.00 |
| ListAge | 12 809 | 1.97 | 2.08 | 0.93 | 0.00 | 3.40 |
| Dual | 12 809 | 0.31 | 0.00 | 0.46 | 0.00 | 1.00 |
| Cashflow | 12 809 | 0.05 | 0.05 | 0.07 | -0.47 | 0.66 |

### 4.2. Correlation Coefficient Analysis

Table 3 shows the results of the correlation coefficient analysis. It can be seen from Table 3 that the absolute values of the correlation coefficients between variables are all less than 0.5. In addition, the maximum VIF value in this model is 3.10, which is much smaller than 10 , which can exclude the interference of severe multicollinearity on the results. There is a significant positive correlation between enterprise innovation performance (Patent) and market

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competition degree (H HI ) at the level of 1%, which can preliminarily verify hypothesis 1 of this paper, enterprise innovation performance (Patent) equity concentration (CR ) and equity balance ( Balance ) is significantly correlated negatively and positively at the level of 1% , which is consistent with the previous analysis. There is a certain correlation between corporate innovation performance (Patent) and other control variables, which proves that the selection of control variables is necessary.

**Table 3.** Correlation coefficients

| Variable | Patent _ | HHI | CR | Balance | Size | Lev |
|---|---|---|---|---|---|---|
| Patent | 1.000 | | | | | |
| HHI | 0.048*** | 1.000 | | | | |
| CR | - 0.039*** | -0.085*** | 1.000 | | | |
| Balance | 0.032*** | 0.033*** | -0.506*** | 1.000 | | |
| Size | 0.385*** | -0.138*** | 0.201*** | -0.130*** | 1.000 | |
| Lev | 0.200*** | -0.092*** | 0.039*** | -0.121*** | 0.535*** | 1.000 |
| ATO | 0.025*** | -0.028*** | 0.070*** | -0.039*** | 0.054*** | 0.130*** |
| ROE | 0.057*** | 0.024*** | 0.103*** | -0.003 | 0.037*** | -0.206*** |
| Board | 0.097*** | -0.074*** | 0.016* | 0.004 | 0.272*** | 0.158*** |
| ListAge | 0.131*** | -0.050*** | -0.138*** | -0.170*** | 0.482*** | 0.338*** |
| Dual | -0.066*** | 0.061*** | -0.013 | 0.045*** | -0.207*** | -0.144*** |
| Cashflow | -0.008 | -0.021** | 0.136*** | -0.029*** | 0.054*** | -0.160*** |
| variable | ATO | ROE | Board | ListAge | Dual | Cashflow |
| ATO | 1.000 | | | | | |
| ROE | 0.111*** | 1.000 | | | | |
| Board | 0.017** | 0.010 | 1.000 | | | |
| ListAge | -0.008 | -0.156*** | 0.162*** | 1.000 | | |
| Dual | -0.023*** | 0.045*** | -0.173*** | -0.247*** | 1.000 | |
| Cashflow | 0.101*** | 0.224*** | 0.031*** | -0.031*** | 0.010 | 1.000 |

Note: * p<0.1, ** p<0.05, *** p<0.01, the same below

## 4.3. Regression Analysis and Adjustment Effect Test

In order to eliminate the endogeneity caused by omitted variables, this paper controls the industry and time in the regression. At the same time, in order to alleviate the influence of heteroscedasticity, the robust standard error of heteroscedasticity is used in the regression. In addition, the multiplication between variables may lead to multicollinearity, so this paper centers the moderator and main explanatory variables in model (2) and model (3). The results of regression analysis are shown in Table 4, where columns (1), (2), and (3) correspond to the regression results of model (1), model (2), and model (3), respectively.

The regression coefficient of the explained variable market competition (HHI) is 0.657, and it is significant at the 1 % level, indicating that market competition, as an external governance mechanism, will positively promote the improvement of enterprise innovation performance. The H1 of this paper is verified again.

In model (2), the regression coefficient of market competition (HHI) is positive and significant, and the regression coefficient of equity concentration (CR) is -0.06 , and it is significant at the level of 1 %, indicating that equity is too concentrated, which will inhibit enterprises the performance of innovation efficiency, and the regression coefficient of the intersection of market competition and equity concentration (HII*CR) is -0.06, and it is significant at the 1% level, which shows that equity concentration weakens the relationship between market competition and corporate innovation performance. The positive relationship between the two,

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that is, the ownership concentration plays a negative regulatory role, which verifies the H2a in this paper. As mentioned above, when an enterprise faces fierce competition in the external market, if the shareholding is highly concentrated, the controlling shareholder will devote more resources to the daily production and operation of the enterprise, rather than focusing on high-risk investment such as enterprise innovation, thereby reducing the risk of Enterprise innovation performance.

In model (3), the regression coefficient of market competition (HHI) is positive and significant, and the regression coefficient of equity balance ( Balance ) is 0.059, and it is significant at the level of 5%, indicating that there are checks and balances among major shareholders. It will promote the improvement of the innovation output and efficiency of enterprises, and the regression coefficient of the multiplication term of market competition and equity balance (HII* Balalnce ) is 0. 498, and it is significant at the 10 % level, which indicates that the equity balance is strengthened. It is found that there is a positive relationship between market competition and corporate innovation performance, that is, the degree of equity checks and balances plays a positive moderating role, which verifies the H2b of this paper. As mentioned above, under the external pressure of market competition, the mutual supervision between multiple major shareholders can avoid the encroachment of enterprise resources by a single major shareholder, and collective efforts can make better decisions related to innovation, and improve the efficiency and level of enterprise innovation.

**Table 4.** Analysis of regression results

| | (1) | (2) | (3) |
|---|---|---|---|
| | Patent | Patent | Patent |
| HHI | 0.657*** | 0.064*** | 0.377* |
| | (4.35) | (4.33) | (1.65) |
| CR | | -0.060*** | |
| | | (-4.10) | |
| Balance | | | 0.059** |
| | | | (2.06) |
| HII*CR | | -0.060*** | |
| | | (-2.87) | |
| HHI*Balance | | | 0.498* |
| | | | (1.71) |
| Controls | control | control | control |
| _cons | -12.235*** | -12.499*** | -12.267*** |
| | (-40.78) | (-41.10) | (-40.90) |
| I nd /Y ear | control | control | control |
| N | 12809 | 12809 | 12809 |
| r2_a | 0.370 | 0.371 | 0.370 |
| F | 226.862 | 217.474 | 214.742 |

## 4.4. Robustness Test

### 4.4.1. Endogenous Problem Handling

The residuals of the model $\varepsilon_{it}$ may include other factors that have not been included in the model that affect the innovation performance of enterprises, resulting in the problem of missing variables in the model. At the same time, considering that there may be mutual causality between market competition and enterprise innovation performance, the basic regression has used panel data at this part, and based on the control of industry and year differences in the model, instrumental variable regression is further used to alleviate possible endogeneity. Drawing on the researches of Li Chuntao and Song Min [26], Li Huiyun et al. [27] , the mean value of the market competition degree in the same industry excluding the enterprise itself is selected as an instrumental variable. The reasons are as follows: the degree of market

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competition faced by other enterprises in the same industry will have an impact on the degree of market competition, but it cannot directly affect the innovation performance of the enterprise. Table 5 shows the results of regression using instrumental variables in this paper. It can be seen from Table 5 that the value of the regression coefficient of market competition intensity (HHI) in all models is significantly positive. In model (2), The regression coefficient of the multiplication term of market competition intensity and ownership concentration (HHI*CR) is significantly negative, and the regression coefficient of the multiplication item (HHI*Balance) of the market competition intensity and the degree of equity checks and balances in model (3) is significantly positive. The conclusions obtained above are consistent, which proves that the conclusions of this paper are robust.

**Table 5.** Regression of Instrumental Variables

| | (1) | (2) | (3) |
|---|---|---|---|
| | Patent | Patent | Patent |
| HHI | 0.989*** | 0.975*** | 0.993*** |
| | (6.20) | (6.12) | (6.18) |
| CR | | -0.059*** | |
| | | (-4.05) | |
| Balance | | | -0.011 |
| | | | (-0.49) |
| HHI*CR | | -0.060*** | |
| | | (-2.91) | |
| | | | |
| HHI*Balance | | | 0.395** |
| | | | (2.56) |
| Controls _ | control | control | control |
| _cons | -12.198*** | -12.402*** | -12.231*** |
| | (-40.54) | (-40.66) | (-40.62) |
| Ind /Y ear | control | control | control |
| N | 12809 | 12809 | 12809 |
| r2 | 0.371 | 0.373 | 0.372 |
| r2_a | 0.370 | 0.371 | 0.370 |

### 4.4.2. Tobit Regression

Because of the high risk of enterprise innovation and R&D and the heterogeneity of the industry and its own characteristics, not every enterprise applies for patents every year, and the number of patent applications of many enterprises is 0, so the number of patents applied by enterprises (Patent) is affected by limited variables. Therefore, this paper considers taking Tobit regression while controlling for year and industry. The regression results are shown in Table 6, where column (1), column (2) and column (3) show the results of the Tobit regression of the three models. It can be seen from Table 6 that in all models,the regression coefficients of market competition intensity (HHI) are all significantly positive, that is, market competition has a positive effect on corporate innovation performance. The regression coefficient of the cross product (H HI*CR) in model (2) is significantly negative, that is, ownership concentration can negatively regulate market competition and the relationship between enterprise innovation performance. The regression coefficient of the cross product (H HI* Balance) in model (3) is significantly positive, that is, the degree of equity balance can positively regulate the relationship between market competition and enterprise innovation performance, both of which are consistent with the conclusions obtained in this paper, which proves that the conclusions of this paper have good robustness.

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### 4.4.3. Replacement Variable Regression

This section replaces the indicator of innovation performance with the number of patents granted by the firm. The regression results are shown in Table 6, where model column (4), column (5) and column (6) respectively show the results of the regression of the three models of substitution variables, and the regression coefficients of all models' market competition intensity (HHI ) are significantly positive, the regression coefficients of the intersection terms (H HI*CR , H HI* Balance) in model (2) and model (3) are -0.036 and 0.053 respectively, and both are significant, which is consistent with the conclusion obtained above, and proves that the results in this paper are robust.

**Table 6.** Tobit regression and substitution variable regression

| variable | Tobit regression | | | Replacement Variable Regression | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| HHI | 0.696*** | 0.068*** | 0.377* | 0.638*** | 0.063*** | 0.340* |
| | (4.59) | (4.53) | (1.83) | (4.80) | (4.80) | (1.69) |
| C R | | -0.074*** | | | -0.036*** | |
| | | (-4.69) | | | (-2.62) | |
| H HI *CR | | -0.055** | | | -0.064*** | |
| | | (-2.44) | | | (-3.29) | |
| Balance | | | 0.059** | | | 0.053** |
| | | | (2.08) | | | (2.07) |
| HHI* | | | 0.498* | | | 0.545** |
| Balance | | | (1.78) | | | (2.07) |
| Controls | control | control | control | control | control | control |
| _cons | -13.585*** | -13.924*** | -12.267*** | -11.941*** | -12.094*** | -11.582*** |
| | (-41.20) | (-41.17) | (-42.43) | (-41.73) | (-41.73) | (-42.19) |
| I nd /Y ear | control | control | control | control | control | control |
| N | 12809 | 12809 | 12809 | 12809 | 12809 | 12809 |
| r2 | | | | 0.384 | 0.385 | 0.380 |
| r2_a | | | | 0.382 | 0.383 | 0.378 |
| F | | | | 216.030 | 206.045 | 217.223 |

## 4.5. Further Analysis

### 4.5.1. Management's Shareholding Adjustment

Management's shareholding can reduce the agency cost of enterprises, produce an incentive compatibility effect, and promote increased innovation investment to cultivate new competitive advantages [9] . Secondly, management's shareholding can reduce sub-optimal innovation projects and curb executives' short-sighted behavior [28]. Finally, equity incentives for management can indeed produce a benefit convergence effect, which encourages management to make decisions for the company's long-term interests and create its own core competitiveness and brand [29]. Management's shareholding not only directly plays an important incentive role, but also has a profound impact on corporate governance. According to the previous analysis, the balance of multiple major shareholders' equity can play a positive regulating role between market competition and corporate innovation, then further, does management's shareholding also have a similar positive moderating effect? Therefore, this paper further explores whether management's shareholding can promote the improvement of corporate innovation performance, and whether it plays a moderating role in the process of market competition affecting corporate innovation performance. The regression results are shown in Table 7 .

Table 7 examines the effect of management shareholding on corporate innovation performance. The regression coefficient of management shareholding ( Mshare ) is 0.293 and is significant at

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the 1% level, indicating that management tier-holding is conducive to corporate innovation. The regression analysis in column (2) in Table 7 tests whether management's shareholding has a positive moderating effect between market competition and corporate innovation performance. The regression coefficient of the multiplication term (HHI * M share) is 1.695 , and it is significant at the 10% level, which proves that management's shareholding positively regulates the relationship between market competition and enterprise innovation.

**Table 7.** Management shareholding adjustment analysis

| variable | (1) | (2) |
|---|---|---|
| HHI | | 0.451*** |
| | | (2.63) |
| Mshare | 0.293*** | 0.397*** |
| | (4.38) | (4.30) |
| HHI*M share | | 1.695* |
| | | (1.76) |
| Controls _ | control | control |
| _cons | -12.556*** | -12.462*** |
| | (-40.45) | (-40.05) |
| Ind /Y ear | control | control |
| N | 12 809 | 12 809 |
| r2 | 0.368 | 0.369 |
| r2_a | 0.366 | 0.367 |
| F | 222.332 | 208.138 |

## 5. Research Conclusion and Implications

This paper takes all listed companies in China's A-share market from 2015 to 2019 as a research sample to empirically study the relationship between market competition and corporate innovation, and to test the moderating effect of ownership structure in it, and further analyze the incentive effect of management shareholding on innovation performance improvement. The main research conclusions are as follows:

There is a positive correlation between market competition and corporate innovation, that is, market competition is conducive to the improvement of corporate innovation performance of listed companies; equity structure plays an important role in regulating. Specifically, equity concentration weakens the impact of market competition on corporate innovation performance. In other words, equity concentration plays a negative regulatory role. Equity checks and balances can strengthen the positive role of market competition, that is, equity checks and balances play a positive regulatory role.

Management shareholding can play an incentive role, produce a benefit convergence effect, and promote the improvement of enterprise innovation performance. At the same time, when an enterprise faces market competition, management shareholding has played a positive regulating role, strengthening the market's influence on enterprise innovation incentive.

The inspirations drawn from the conclusions of this study are as follows:

This paper further supports the effective role of China in establishing a more fair, open and transparent market from experience. An orderly competitive market makes the flow of capital and technology more efficient, information transmission is more convenient and timely, and the industrial structure is more optimized and reasonable, thus promoting the technological progress and innovation of enterprises, which is conducive to promoting the high-quality development of China's economy. In the context of the huge impact of the new crown epidemic and the construction of a new development pattern dominated by the domestic cycle, it is

particularly important for the domestic market to play a more effective role in resource allocation to promote innovation.

The external market is the environment for enterprises to survive, and it is also an important factor affecting the innovation of enterprises, so anti-monopoly is very necessary. Monopoly makes the market lose its vitality, which is not conducive to enterprise innovation. At present, with the rapid development of science and technology and the digital economy, the scope of use of digital platforms is constantly expanding. Many digital platforms are in a dominant position in their markets, and abusing their positions to refuse transaction data, technical tying, and price discrimination not only endangers the rights and interests of consumers, but also disrupts the order of market competition. Market monopoly is not conducive to the improvement of enterprise innovation performance and the further development of technology. Therefore, the government should strengthen anti-monopoly regulations, ensure a fair market environment for competition, provide external guarantees for enterprises, and give play to the decisive role of the market in resource allocation. Limit the use of resources.

Equity checks and balances and management's shareholding supervision are conducive to the improvement of corporate innovation performance, which has reference significance for Chinese companies. State-owned enterprises should deepen the reform of mixed ownership, allow more external supervisors to enter the enterprise, and give full play to managers' equity incentives to improve the principal-agent problem, thereby promoting the improvement of enterprise innovation performance. Private enterprises can also absorb more professional institutions, making innovative decisions and making better use of resources to innovate, and at the same time, it can also play the incentive role of management shareholding to promote innovation output.

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