

Controlling Shareholders' Equity Pledge, Financing Constraints and Corporate R&D Investment

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Abstract. In recent years, equity pledge has gradually become an emerging financing method for enterprises to solve financing difficulties, which has attracted the attention of many shareholders and financial institutions. As an important driving force for enterprises to carry out economic transformation and upgrading, innovation can also effectively enhance their core competitiveness in the same industry. This paper selects the data of China's A-share ChiNext listed companies from 2013 to 2021 as the analysis object, and studies the impact of equity pledge and corporate R&D investment and the intermediary role played by financing constraints, and the results show that the equity pledge of controlling shareholders is significantly negatively correlated with corporate R&D investment, and the inhibition effect is more obvious with the increase of equity pledge ratio. In addition, this paper finds that financing constraints play a partial intermediary role in the relationship between controlling shareholders' equity pledge and enterprise innovation. In response to this situation, this paper puts forward corresponding countermeasures and suggestions.

1 Introduction

With the advent of the era of trade globalization, innovation, as the first driving force leading enterprises to carry out economic transformation, is particularly important in the development of enterprises. If enterprises want to invent new products and improve their innovation capabilities, they need to receive a lot of financial support, and their cash flow also has high requirements, and continuous and stable innovation investment plays a decisive role in effectively improving innovation efficiency. However, at present, China's overall economy is under great downward pressure, and the shortage of funds of listed companies has caused financing difficulties. In recent years, equity pledge with the characteristics of convenient review, flexible financing, strong liquidity and so on has gradually become one of the important financing channels in China's capital market, favoured by China's listed companies, can effectively meet the needs of enterprise funds, solve the problem of difficult financing for enterprises, controlling share-holders in the financing method of equity pledge to ease the financing constraints at the same time, can introduce more external factors to monitor the enterprise, and then promote the development of the enterprise, in addition, Enterprises also need to pay attention to the possible impact of financing constraints in the pro-cess of business development, in which financial support plays a very significant role, and it is also a prerequisite for their effective innovation activities.

In summary, this paper selects the 2013-2021 China A-share ChiNext listed companies as the research object, studies the impact of controlling shareholders' equity pledge and corporate innovation investment, and the intermediary role played by internal control, and puts forward targeted countermeasures and suggestions based on the research results.

2 Literature review

As an effective guarantee for enterprises to maintain long-term competitiveness, innovation also plays an important role in promoting economic growth. Due to the great uncertainty between the generation of R&D revenue and the cycle of innovation return on investment, enterprises need to make long-term and stable huge investments to see results. At present, most of the research on the characteristics of equity and enterprise innovation is related to the composition of equity and the nature of organization. Lin et al. (2017) believes that when the equity balance is maintained at a reasonable level, effective supervision by major shareholders can maintain the internal control of the enterprise from being undermined by other self-interested managers, and reduce the occurrence of various risks caused by R&D investment.^[1] Guoyu Zhao and Wei Yu (2018) have observed that equity checks and balances can mitigate the negative impact caused by some common agency cost problems, promote enterprises to effectively increase innovation investment and reduce unnecessary inefficient investment.^[2] Wang et al. (2020) have shown that the shorter the time it takes for enterprises with

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larger equity balances to form a consensus, which is conducive to improving the effect of innovation output.^[3]

Ronald and Michael (2015) have found that stock pledging by controlling shareholders who exert control or significant influence over the enterprise has a greater impact on the formulation and execution of their development plans, and becomes more significant as the size and number of pledges increase.^[4] Dan Chen et al. (2020) have found that the basis for controlling shareholders to have an impact on the investment decisions of enterprises when pledging shares is that they have not lost control due to equity pledges.^[5] Some scholars with positive views have proposed that if the expected results of technological innovation are achieved, it will be conducive to improving the core competitiveness of enterprises, and thus obtain greater economic benefits, and it is unwise for controlling shareholders to steal corporate wealth if they generate hollowing out motives for short-term private interests (Xiaowen Jiang, 2019).^[6] Changqing Li and Min Zeng (2021) have empirically proved that when the equity pledge ratio is small, if the stock price reaches the liquidation line and requires additional funds, the major shareholder can choose to pledge the remaining shares held by him to reduce the financial pressure and control risk, at this time the major shareholder will not interfere in the decision-making of the enterprise, and reducing the innovation investment of the enterprise will become a lose-lose choice.^[7] On the contrary, many scholars with negative views believe that after the equity pledge, the controlling shareholders will greatly increase their risk aversion to decision-making, only care about the immediate vested interests, and inhibit innovation investment related to the long-term value of the enterprise. Minetti R et al. (2015) have pointed out that the long time period of corporate innovation activities, the unstable expected returns, the high amount of capital occupied, and the large adjustment costs are very likely to cause panic in the market once they fail, which will have a great negative impact on their stock prices.^[8] Zhang et al. (2017) have found that companies with pyramid structures have made their agency problems worse, and that controlling shareholders are less willing to invest in innovation activities when other major shareholders also engage in mortgage financing.^[9] The results of Asija et al. (2015) have shown that the equity pledge behaviour of controlling shareholders is negatively correlated with the level of innovation investment, and further analysis proves that the negative relationship between the two has nothing to do with whether the shareholder is pledging equity for the first time.^[10] Lei Zhu and Cheng Sun (2019) have used ChiNext listed companies as a sample to empirically find that the equity pledge financing behaviour of major shareholders can have a negative impact on the innovation investment level of enterprises,^[11] and Changqing Li and Yukun Li et al. (2018) also found that the negative impact between the two is more significant when the two positions are combined.^[12] Caiji Pang and Ying Wang (2020) have found that the existence and size of the equity pledge behaviour of controlling shareholders who can control the enterprise both restrict

the future R&D output and quality of the enterprise, and the equity pledge behaviour will not lead to increased investment by listed companies for innovation activities.^[13]

Most domestic scholars believe that financing constraints will inhibit corporate innovation investment. Xuan Zhang (2017) and Kaiguo Zhou (2017) have proposed that when enterprises seek credit in the face of different financing constraints, there is a great possibility that the innovation income of enterprises will be constrained and their stable operation will be hindered.^{[14][15]} Xiufeng Zhou et al. (2015) have found that when enterprises receive more constraints and influences in the process of operation, their actual operation is closely related to the further definition of different signals and the self-sustainment of funds that enterprises may obtain, and once the financial support is insufficient, enterprises will give up on carrying out innovative activities.^[16] Therefore, for enterprises, if they face more financing constraints, the less willing they are to invest in innovation; Conversely, the more willingness to innovate. Haifeng Gu et al. (2021) have taken ChiNext listed companies as a sample for research, and have empirically analysed that financing constraints play an intermediary role between the controlling shareholder's equity pledge and the enterprise's innovation input, and the controlling shareholder's pledge financing behaviour will aggravate the degree of financing constraints of the enterprise.^[17]

3 Theoretical analysis and assumptions

3.1 The impact of the controlling shareholder's equity pledge on the innovation investment of enterprises

A large number of shareholders can have a huge impact on the enterprise, and the controlling shareholder can influence the decision-making of the enterprise through the board of directors or the representative of the company. As a common financing behaviour, equity pledge can help enterprises when they face financing constraints, while the use of equity pledge for financing will lead to a deepening inconsistency between shareholders' voting rights and cash value, resulting in shareholders wanting to protect or obtain corporate interests more obviously.

On the one hand, the separation of ownership and control of an enterprise will lead to the occurrence of agency problems seen by shareholders with different status and power, prompting the controlling shareholders to protect their own interests under internal and external pressure of the enterprise, resulting in an increase in the possibility of hollowing out and encroaching on motives. On the other hand, the short-term effect of the controlling shareholder's equity pledge will breed its behaviour of protecting private interests. During the period of stock pledge, the controlling shareholder will manage the market value of the enterprise to avoid the potential risk of equity pledge, maintain the stock price, and restrain the innovation input level which plays a key

role in the long-term value and competitiveness of the enterprise. In addition, during the period of equity pledge, shareholders still enjoy the same discourse and voting rights, so they can continue to intervene in the major business decisions of the enterprise, and even have the right to choose managers, so as to choose the enterprise behaviour that can achieve their own maximum economic benefits.

To sum up, due to the separation of the two rights and the hollowing out effect and short-sighted effect caused by the controlling shareholder's equity pledge financing, the possibility of hollowing out and encroaching on the motive increases, and it has not lost its right to speak due to equity pledge, and can still interfere in the decision-making of the enterprise management. In order to maintain their control and short-term interests, shareholders greatly inhibit the investment in innovation activities with long return on investment and uncertain expected returns. Therefore, the hypothesis is proposed:

H1: The pledge of the controlling shareholder's equity has a negative impact on the innovation investment of enterprises.

3.2 The intermediary effect of financing constraints on the innovation relationship of controlling shareholders pledging enterprises

Corporate innovation is usually financed and invested in by external financing. However, due to its high-risk nature and the impact of receiving asymmetric information, corporate innovation can lead to increased external financing costs. When the controlling shareholder solves the financing constraints of the enterprise by pledging the shares held by the controlling shares, it will convey a series of negative information to the capital market such as the shortage of funds and the existence of problems in the amount of funds, which in turn will aggravate the external financing constraints it faces and lead to the reduction of its innovation investment level. In addition, since during the share pledge period, the pledgee owns part of the cash flow value of its pledged shares, the controlling shareholder can only seize private interests by using the controlling position and ownership, which leads to the further deepening of the separation of the two rights, and due to the deepening of the inconsistency between voting rights and cash value, the will of the majority shareholder with the highest voting right is deviated or even contrary to the overall interests of the enterprise, and the motivation of the major shareholder to seek private interests will be stronger. Shareholders' risk aversion increases, and shareholders who can control the company will favour less risky projects and make more conservative investment decisions in order to protect their maximum voting rights. However, due to the long-time cycle required for innovation activities, the large amount of funds occupied, the unstable expected returns, and the large adjustment costs, all the investment in the early stage will be wasted once the investment fails, resulting in the willingness of the dominant shareholders to invest

in innovation activities becoming lower and hindering enterprises from investing in innovation. Therefore, financing constraints indirectly play an intermediary role in the relationship between the equity pledge of controlling shareholders and the innovation investment of enterprises. Based on the above analysis, this paper puts forward the following assumptions:

H2: Financing constraints can play an intermediary role in the negative impact of equity pledge and enterprise R&D investment.

4 Model design

4.1 Sample Selection and Data Source

In order to ensure the accuracy of the empirical results, this paper selects the data of China's A-share ChiNext listed companies from 2013 to 2021 as the analysis object, and processes the collected data as follows: (1) exclude the samples of ST, *ST, and PT listed companies; (2) Exclude the sample companies in the financial industry; (3) Exclude sample companies with missing data. In the end, 3652 sample observations were obtained. In addition, in order to avoid the influence of extreme values, the Winsor treatment of up and down 1% is continuously carried out. The explanatory variables involved in this paper are from the Wind database, and the explanatory variables R&D investment and intermediary variables financing constraints SA index and other control variables come from the CSMAR database. The software used is Stata 16.0 and Excel 2021.

4.2 Selection and Definition of Variables

4.2.1 The variable is interpreted:

R&D investment (RDS). This paper uses the ratio of R&D input to total year-end operating income to measure R&D investment.

4.2.2 Explaining the variables:

Equity pledge. This paper designs two variables to measure equity pledge: (1) whether there is equity pledge (PleD), if the enterprise has equity pledge, the value is 1, otherwise 0; (2) The equity pledge ratio (PleR) is measured by the ratio of the number of shares pledged by the controlling shareholder to the total number of shares.

4.2.3 Mediator variables:

Financing constraints (SA). This paper uses the SA index in the CSMAR database for quantification, and its specific calculation formula is: $SA = -0.737 * Size + 0.043 * Size^2 - 0.04 * Age$, where Size is the size of the company, take the logarithm of total assets, Age represents the listed years of the company, the greater

the SA value, the greater the external financing constraints.

4.2.4 Control variables:

By collecting and organizing the literature, this paper selects the following variables as control variables: (1) the level of liabilities (Lev), which is measured by the asset-liability ratio, that is, the ratio of total liabilities to total assets; (2) Operating efficiency (Laz), measured by the ratio of current assets to operating income; (3) the size of the enterprise, measured by the natural logarithm of total assets at the end of the year; (4) operating cash flow (Cfo), which is measured by the ratio of net cash flows generated by operating activities to total assets in the current period; (5) Total net asset profit margin (Roa), which is measured by the net profit margin on total assets as net profit and average total assets; (6) return on equity (Roe), which is calculated using the average balance of net profit and shareholders' equity; (7) Two positions and one (Dual), when there is a chairman and a general manager for one person, take 1, otherwise take 0; (8) Total asset turnover ratio (ATO), measured by the ratio of operating in-come to average total assets; (9) Growth capacity (TobinQ), calculated by the ratio of the sum of the total market value of stocks and total liabilities to the total assets of the enterprise; (10) Equity concentration (Top1), measured by the shareholding ratio of the largest shareholder; (11) Enterprise age (Age), calculated by subtracting the natural logarithm of the year of establishment plus 1 from the year of observation. In addition, in order to control the impact of industry and year, industry dummy variable (Ind) and annual dummy variable (Year) are introduced.

4.3 Model Establishment

Based on previous research, the following three models are created to analyse whether the hypothesis proposed in this paper is true.

$$RDS = \beta_0 + \beta_1 PleR + \beta_2 Lev + \beta_3 Laz + \beta_4 Size + \beta_5 Cfo + \beta_6 Roa + \beta_7 Roe + \beta_8 Dual + \beta_9 Dual + \beta_{10} ATO + \beta_{11} TobinQ + \beta_{12} Top1 + \beta_{13} Age + \Sigma Ind + \Sigma Year + \varepsilon \quad (1)$$

The relationship between the controlling shareholder's equity pledge and the innovation input of the enterprise is empirically tested by Model (1), and if the β_{-1} is significantly negative, hypothesis 1 is true.

$$SA = \beta_0 + \beta_1 PleR + \beta_2 Lev + \beta_3 Laz + \beta_4 Size + \beta_5 Cfo + \beta_6 Roa + \beta_7 Roe + \beta_8 Dual + \beta_9 Dual + \beta_{10} ATO + \beta_{11} TobinQ + \beta_{12} Top1 + \beta_{13} Age + \Sigma Ind + \Sigma Year + \varepsilon \quad (2)$$

$$RDS = \beta_0 + \beta_1 PleR + \beta_2 SA + \beta_3 Lev + \beta_4 Laz + \beta_5 Size + \beta_6 Cfo + \beta_7 Roa + \beta_8 Roe + \beta_9 Dual + \beta_{10} Dual + \beta_{11} ATO + \beta_{12} TobinQ + \beta_{13} Top1 + \beta_{14} Age + \Sigma Ind + \Sigma Year + \varepsilon \quad (3)$$

Model (2) and Model (3) introduce the SA index on the basis of Model (1) to study the intermediary effect of financing constraints between equity pledge and

enterprise innovation input, and then verify whether hypothesis 2 is true.

5 Descriptive statistics and empirical results

5.1 Descriptive Statistics

It can be seen from "Table 1" that the minimum value of the R&D Investment Index RDS is 0.004, the maximum value is 0.322, and the average value is 0.072, indicating that the R&D level of ChiNext companies is generally not high, and in addition, some enterprises consciously include R&D expenditure as their major expenses. The average pledge ratio of controlling shareholders' equity pledge is 0.152, and the maximum value is 1, indicating that most enterprises are reluctant to adopt equity pledge as a financing method, but due to the monopoly problem of controlling shareholders, the pledge ratio is as high as 100%. The descriptive statistics of other variables are similar to those in the existing literature, so they will not be repeated here.

Table 1. Descriptive statistics for the samples

Variable	Obs	Mean	SD	Min	Max
PDS	3652	0.072	0.057	0.004	0.322
PleD	3652	0.696	0.460	0.000	1.000
PleR	3652	0.152	0.228	0.000	1.000
SA	3652	-3.744	0.203	-4.276	-3.301
Lev	3652	0.353	0.175	0.050	0.811
Laz	3652	1.492	0.814	0.377	4.811
Size	3652	21.530	0.854	19.954	23.967
Cfo	3652	0.040	0.063	-0.142	0.219
Roa	3652	0.038	0.088	-0.362	0.241
Roe	3652	0.050	0.157	-0.778	0.336
Dual	3652	0.434	0.496	0.000	1.000
ATO	3652	0.535	0.284	0.116	1.755
TobinQ	3652	2.489	1.411	1.017	9.024
Top1	3652	0.283	0.117	0.077	0.595
Age	3652	2.810	0.279	2.079	3.367

5.2 Correlation Analysis

According to the data of "Table 2", the R&D investment of enterprises is significantly negatively correlated with the equity pledge ratio of the controlling shareholder, while the financing constraint and the equity pledge ratio are significantly positively correlated, that is, the equity pledge behaviours of the controlling shareholder will inhibit the enterprise from investing in innovation and enhance the external financing constraint problem faced by the enterprise, which is consistent with the assumption in this paper. In addition, the correlation coefficients in this paper are basically significantly correlated, which can basically exclude the possibility of serious multicollinearity, so formal fundamental regression can be performed.

Table 2. Correlation Analysis

	PDS	PleR	SA	Lev	Laz	Size	Cfo
PDS	1						
PleR	-0.069***	1					
SA	0.027	0.092***	1				
Lev	-0.246***	-0.050***	-0.192***	1			
Laz	0.375***	0.028*	0.085***	-0.165***	1		
Size	-0.126***	-0.158***	-0.336***	0.411***	-0.064***	1	
Cfo	-0.003	-0.061***	-0.039**	-0.223***	-0.237***	0.019	1
Roa	-0.073***	-0.012	0.092***	-0.347***	-0.145***	-0.021	0.314***
Roe	-0.089***	-0.018	0.083***	-0.273***	-0.156***	0.019	0.259***
Dual	0.079***	-0.009	0.054***	-0.022	0.018	-0.118***	-0.001
ATO	-0.332***	0.008	-0.004	0.134***	-0.647***	-0.026	0.140***
TobinQ	0.202***	-0.026	0.137***	-0.248***	-0.011	-0.219***	0.193***
Top1	-0.105***	-0.062***	0.090***	-0.058***	-0.001	-0.149***	0.043***
Age	-0.002	-0.057***	-0.935***	0.100***	-0.064***	0.122***	0.046***

	Roa	Roe	Dual	ATO	TobinQ	Top1	Age
Roa	1						
Roe	0.947***	1					
Dual	0.017	0.023	1				
ATO	0.257***	0.264***	0.015	1			
TobinQ	0.235***	0.177***	0.032*	0.036**	1		
Top1	0.176***	0.173***	0.107***	0.058***	0.025	1	
Age	-0.091***	-0.090***	-0.036**	0.011	-0.065***	-0.067***	1

*p<0.1, **p<0.05, ***p<0.001

5.3 Multiple Regression

The regression results are shown in "Table 3", and the following conclusions can be drawn:

The correlation coefficient of -0.0139 between the equity pledge ratio of the controlling shareholder and the innovation investment of the enterprise is significantly negatively correlated at the level of 1%, that is, the higher the pledge ratio, the less the innovation investment of the enterprise, so the H1 can be verified. In addition, all variables in Model 1's quantitative regression are significant, so it can be effectively tested according to the mediating effect of stepwise regression. After Model 2 introduced the SA index, it was found that the correlation coefficient of 0.0071 between the equity pledge of the controlling shareholder and the financing constraint SA was significantly positive, indicating that the higher the pledge ratio, the greater the degree of financing constraint faced by the enterprise. Combined with the regression analysis of Model 1, Model 2 and Model 3, it is determined whether the financing constraint plays an intermediary role in the relationship between the equity pledge of the controlling shareholder and the innovation investment of the enterprise. In Model 1, the controlling share-holder's equity pledge has a significant negative correlation with the company's investment. The correlation coefficients of controlling shareholders' equity pledge and financing constraint SA index in Model 3 were -0.220 and -0.0466, respectively,

and both were negatively correlated at the level of 1%, indicating that financing constraints played a partial intermediary role between controlling shareholders' equity pledge and enterprise innovation input, and the intermediary effect accounted for 23.80% of the total effect. Thus, H2 was established.

Table 3. Multiple Regression

	Model 1 PDS	Model 2 SA	Model 3 PDS
PleR	-0.0139*** (-4.06)	0.0071* (1.74)	-0.0220*** (-5.97)
SA			-0.0466*** (-3.14)
Lev	-0.0534*** (-9.41)	-0.0085 (-1.25)	-0.0556*** (-9.31)
Laz	0.0189*** (14.55)	0.0053*** (3.41)	0.0193*** (14.05)
Size	-0.0006 (-0.57)	-0.0519*** (-39.93)	-0.0047*** (-3.44)
Cfo	0.0309** (2.24)	0.0202 (1.23)	0.0350** (2.39)
Roa	-0.1250*** (-4.34)	-0.0918*** (-2.67)	-0.1160*** (-3.72)
Roe	0.0393** (2.57)	0.0434** (2.35)	0.0312* (1.85)
Dual	0.0069*** (4.49)	-0.0019 (-1.02)	0.0087*** (5.16)
ATO	-0.0239*** (-5.92)	0.0146*** (3.02)	-0.0234*** (-5.86)
TobinQ	0.0081***	0.0067***	0.0075***

	Model 1	Model 2	Model 3
	PDS	SA	PDS
	(12.67)	(8.80)	(11.91)
Top1	-0.0267*** (-3.87)	-0.0126 (-1.53)	-0.0567*** (-7.73)
Age	-0.0092*** (-3.05)	-0.6560*** (-182.46)	-0.0245** (-2.40)
Constant	0.0702*** (2.64)	-0.7733*** (-24.33)	0.0698** (2.43)
Ind/Year	Yes	Yes	Yes
N	3652	3652	3652
R2-a	0.3794	0.9289	0.2517

*p<0.1, **p<0.05, ***p<0.001

5.4 Robustness Test

Considering that there may be a lag in the R&D investment of enterprises, the regression analysis of the original R&D investment variables lagging for one period is still significant, that is, the negative impact of the controlling shareholder's equity pledge on the innovation investment of the enterprise and the intermediary effect played by the financing constraint are significant, and the robustness of the aforementioned regression model has been further verified.

6 Conclusions

This paper selects the relevant data of China's A-share ChiNext listed companies from 2013 to 2021 for analysis, and concludes that the equity pledge of the controlling shareholder is significantly negatively correlated with the corporate R&D investment. Financing constraints play a partial intermediary role between equity pledge and enterprise innovation input. This paper mainly draws the following conclusions: (1) the equity pledge behaviour of the controlling shareholder hinders the corporate R&D investment; (2) Financing constraints play a partial intermediary effect between the equity pledge of controlling shareholders and the R&D investment of enterprises.

In addition, the research in this article can give me some inspiration. On the one hand, the information disclosure of the financing used by the controlling shareholder's equity pledge financing should be strengthened, if the shareholder uses the funds obtained from the pledge financing for non-main business activities, or even speculative arbitrage for private interests, it is very likely to reduce the capital operation efficiency of the enterprise, and if the controlling shareholder uses the pledged financing funds for the innovative investment of the main business, the difficulty of its financing should be reduced, otherwise its financing difficulty should be increased. On the other hand, we should adhere to the innovation-driven strategy and improve the level of innovation investment of enterprises, and the government can formulate more inclusive policies to encourage enterprises to invest in innovation, that is, tilt the policy towards enterprise innovation; Regulatory departments should improve relevant regulatory policies while fully considering enterprise innovation factors, and relevant departments

should strengthen supervision over factors that are not conducive to enterprise innovation, on the contrary, appropriate relaxation should be given to factors conducive to enterprise innovation.

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