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The Impact of Controlling Shareholders' Equity Pledges on Corporate Investment

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SUMMARY: *Drawing upon agency theory and the perspective of control rights, this study investigates the dynamics between controlling shareholders' equity pledges (CSEP) and corporate investments within China's A-share listed firms from 2009 to 2020, particularly focusing on the mediating role of the tunneling costs and the moderating influence of internal governance mechanism. The empirical findings reveal that CSEP exerts a negative impact on corporate investments. This conclusion remains robust regarding fixed asset investments and R&D expenditures, replacing independent variables and employing the propensity score matching method. Furthermore, the tunneling costs mediate the relationship between CSEP and corporate investments, while effective internal governance mechanism mitigated this adverse effect. Notably, the impact of CSEP on corporate investments was more pronounced in non-state-owned and manufacturing companies. This insight enhances our comprehension of the underlying motives behind CSEP and broadens the scope of research into agency costs and internal governance mechanism.*

KEYWORDS: *Controlling shareholders Equity pledge corporate investment Tunneling costs internal governance mechanism*

1 Introduction

The equity pledge is defined as a transaction in which insiders pledge their stocks or other securities to fund from financial institutions or non-financial institutions, return the funds and cancel the pledge after the expiration [1]. Hence, the equity pledge business is also called share pledge repurchase. Equity pledge is the insiders' behavior, and the process of equity pledge is simple, which can quickly obtain funds to ease financing constraints. Consequently, equity pledge practices and scholarly examination are notably prevalent across emerging capital markets, particularly pronouncing in locales with significant equity concentration, exemplified by China, the Indian market, and Taiwan Province, indicating the widespread acknowledgment and utilization of equity pledges in diverse financial landscapes.

Previous research on the content of equity pledges predominantly examined its motivations and impacts. The driving forces behind equity pledges have been identified as keeping control rights [2], financing constraints, the pursuit of wealth diversification, cash holding, and tax consideration. Influences of equity pledge, embracing stock price crash, margin call, firm risk, firm performance [3]. Moreover, the literature on equity pledges pays attention to insiders, directors, senior management, and CEOs. However, in the context of China, the controlling shareholder emerges as a pivotal insider within equity pledges. Defined

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by holding a majority of shares, substantial capital contributions, or significant voting rights, controlling shareholders wield considerable influence over shareholder meetings and resolutions. They leverage their control rights to impact corporate investment decisions via shareholder meetings or the board of directors). Therefore, exploring the effects of equity pledges on corporate investments from the perspective of controlling shareholders is both meaningful and critical.

Meanwhile, corporate investments represent a vital avenue for corporate survival and development related to the company's long-term value and sustainable development). Investments not only create income and profit but also optimize and economize the utilization of investment funds. A wise company investment strategy is crucial for ensuring a firm's future expansion in the fiercely competitive business landscape. Existing studies have predominantly focused on the connection between corporate investment decisions and various factors, including firm-specific characteristics, political factors An, economic aspects, as well as the role of administrator [4]. However, there is a notable lack of research examining the impact of corporate investments from the perspective of controlling shareholders' behaviors. Thus, this paper aims to investigate the effects of controlling shareholders' equity pledging behaviors on corporate investments.

Drawing on insights from existing literature on the impact of equity pledges on innovation investments, this paper seeks to extrapolate these findings to understand the broader relationship between equity pledges and corporate investments. A segment of the academic community posits that equity pledges reduce insiders' risk-taking preference, curtailing innovation investments. However, empirical evidence presented by other scholars suggests an inverse relationship. Su & Alexiou (2022) [5] asserted that controlling shareholders put more pledged funds into the listed company, promoting capital investments and R&D expenditure when they pledge their equity. Similarly, Gan & Liu (2022) [6] observed that firms with equity pledges from controlling shareholders show a greater inclination to augment the capitalization rate of R&D expenditures. There is no definite and unified answer to the relationship between equity pledges and corporate investments. Therefore, a sound answer about the influence of CSEP on corporate investments is an urgent research gap. This research aims to ascertain whether equity pledges alleviate financing constraints, foster the growth of the real economy, and fulfill the primary objective of China's capital market in encouraging the development of equity pledge transactions.

Agency theory forms the foundational framework of our investigation, though our analysis diverges from the conventional scrutiny of the agency dilemma between managers and owners. Instead, our examination centers on the agency conflict between controlling and minority shareholders, commonly called the second type of agency problem. This particular agency issue has garnered extensive discussion in scholarly circles [7]. Notably, much of the discourse on the second agency problem has been situated within the realm of family-owned businesses, where family management agents exacerbate the conflict to the benefit of the family [8]. The impact and performance of the second agency problem in the context of publicly listed companies, as opposed to family businesses, remains underexplored. It is this gap that our paper seeks to address by examining the effects of the second agency problem on corporate investments, particularly in scenarios where controlling shareholders have pledged their equity in listed companies. Through this focus, the study aims to provide empirical evidence of the indirect impacts of the second agency problem, contributing to a nuanced understanding of its consequences on internal governance mechanism and investment behaviors [9].

This paper has made contributions to the literature from three aspects. Firstly, our paper helps to pay attention to the economic outcomes of equity pledging, offering a comprehensive

analysis of its effects on investments and enriching the discourse on this topic. Given the prevalence of equity pledges in emerging capital markets and considering China's position as the world's second-largest economy with a notable concentration of ownership, our examination of the equity pledge phenomenon within the Chinese capital market serves as a valuable policy reference for countries with similar ownership structures [10]. Secondly, this paper extends the exploration of factors influencing corporate investments by incorporating the perspectives of controlling shareholders and equity pledges, which are seldom addressed in existing research. The widespread practice of share pledging and the centralized share structure characteristic of listed companies in China offer a distinctive context for investigating the determinants of corporate investments. Thirdly, this paper enriches the literature on the mediating and moderating role between CSEQ and corporate investments, which is not rich in previous literature. From the perspective of the tunneling cost and internal governance mechanism, this paper discusses the role of controlling shareholders' interest encroachment and internal and external internal governance mechanism in alleviating the conflict between controlling shareholders and minority shareholders under the scenario of equity pledge, verifies the mediating mechanism of the second agency theory and the moderating role of internal governance mechanism, and enriches the agency theory.

The rest of this article is arranged below. We analyze the theoretical support and develop hypotheses in the second section. The methodology is presented in the third section. The fourth section is the empirical results, and the fifth is the heterogeneity analysis. Conclusions in the sixth section.

2 Theoretical support and hypotheses development

2.1 CSEP and corporate investments

Equity pledge refers to shareholders pledging their shares to financial institutions in exchange for funds. It was initially intended to alleviate financing constraints for companies and stimulate the growth of the real economy. Despite being a personal action of the controlling shareholder, it significantly shapes the company's decision-making through the influence wielded in shareholders' meetings and the board of directors. Consequently, the individual equity pledge behavior of the controlling shareholder can impact the company's investment decisions [11].

The principal-principal agency theory believes that controlling shareholders may prioritize their own interests at the expense of minority shareholders, and some empirical studies have explored the direct consequences of CSEP. Controlling shareholders often utilize pledged funds for personal consumption or investment diversification, rather than alleviating the company's financing dilemma. These funds are often channeled into personal expenses, enhancing the shareholders' quality of life, purchasing luxury items such as cars, real estate, yachts, or airplanes, as well as investing in other assets or refinancing equities. Consequently, the equity pledges fail to augment the company's investment funds or scale. Furthermore, Singh (2018) [12] highlights that pledging shares for personal consumption detrimentally affects the company's value.

According to control rights theory, controlling shareholders derive private benefits through their control rights. Following the equity pledges, fluctuations in stock prices directly impact shareholders' control over the company. To safeguard their control and mitigate the risk of stock price collapse, shareholders often adopt a conservative investment decisions, markedly reducing the company's margin call risk to secure their controlling position. Chauhan et al. (2021) [13] confirmed that CSEP reduces high-risk investments, R&D

expenditure, capital expenditure, asset growth, and future cash flow. These conservative investments policy will even lead insiders to avoid high-risk projects with positive net present value. Consequently, under the pressure of control transfer, companies with CSEP tend to restrict their investment scale. Therefore, according to the principal-principal agency theory and control rights theory, we assume that

H1: CSEP negatively impacts corporate investments.

2.2 Mediating effects of the tunneling cost

The tunneling cost refers to the expense incurred when the controlling shareholder cannot be adequately monitored by the minority shareholders, harming the minority shareholders' interests. In China, ownership structures are typically highly concentrated, leading to significant disparities between controlling shareholders' control rights and cash flow rights. Consequently, this frequently gives rise to pronounced conflicts of interest between controlling and minority shareholders [14].

According to agency theory, controlling shareholders retain control over the corporation when equity is pledged. However, the cash flow rights associated with the equity are transferred to the pledgee. Consequently, controlling shareholders cannot reap the benefits stemming from the cash flow rights generated by the company's growth, making them more inclined toward asset occupying, resulting in property loss. This situation incentivizes controlling shareholders to prioritize personal gains, potentially at the expense of the public interest, thus exacerbating conflicts between controlling and minority shareholders and increasing the tunneling costs. The occupation of the company's capital by controlling shareholders implies a reduction in available resources for the company [15].

However, corporate innovation investments, asset growth, and capital growth require a large amount of capital to be continuously invested. As a result, CSEP will intensify the conflict between controlling and minority shareholders and increase the tunneling costs, directly impeding corporate investments. Therefore, in line with the principal-principal agency theory, our second hypothesis is proposed.

H2: The tunneling cost mediates the link between CSEP and corporate investments.

2.3 Moderating effects of internal governance mechanism

According to agency theory, internal control mechanisms bolster supervision over controlling shareholders and the board of directors, enhancing internal governance mechanism effectiveness. Drawing upon the COSO framework, the moderating influence of internal control on the relationship between CSEP and corporate investments can be manifested through its five elements.

Regarding the control environment, internal control, serving as the institutional framework of a company, can improve the internal governance mechanism landscape, augment governance efficiency, and optimize the investment situation [16]. Risk assessment aids companies in identifying internal and external risks encountered in the investment process, averting "tunneling" behaviors such as appropriation of funds by controlling shareholders, improper fund transfers, and unfair related-party transactions. In terms of control activities, decisions regarding significant project investments and the utilization of substantial funds must be made through collective deliberation to enhance investment decisions' scientific rigor and reliability. Implementation of segregated duties in the investment process prevents the risk of fraudulent activities. Regarding information and communication, robust internal controls enhance the authenticity and reliability of accounting information disclosed by the company. Consequently, external investors gain insight into the

company's development potential and profitability, thus reducing the company's financing costs and risks associated with equity pledges, alleviating financing constraints, and expanding the company's pool of available funds for investment. Supervisory measures, including continuous daily monitoring and specialized oversight, deter controlling shareholders from appropriating the company's resources and engaging in unreasonable connected transactions. Therefore, we posit our third assumption as follows:

H3: Internal control moderates the negative link between CSEP and corporate investments.

From the viewpoint of agency theory, analysts' attention reduces agency costs. Compared to internal control, which establishes the corporate investment control and supervision system, analysts bridge the gap between the company and the market through their expertise and informational advantages, playing an external supervisory role in corporate investment behavior.

On the one hand, analysts leverage their financial and legal acumen, coupled with extensive industry experience, to provide insights into industry conditions and prospects. They interpret company investment status and financial information, promptly identify investment-related issues in listed companies, and facilitate effective supervision. On the other hand, analysts disclose corporate information through research reports, earnings forecasts, and other channels to reduce the internal and external information asymmetry of listed companies, which helps to improve the information transparency of listed companies and thus fosters effective oversight. Therefore, the analyst's supervisory would expose the unreasonable investment decisions of the company to avoid the controlling shareholders encroaching on the listed company's interests or making other short-sighted behaviors [17]. Analysts' attention mitigates the negative impact of CSEP on corporate investments. Therefore, the fourth hypothesis is put forward:

H4: Analysts' attention moderates the negative link between CSEP and corporate investments.

The theoretical framework diagram of the research model in this article is shown in Figure 1.

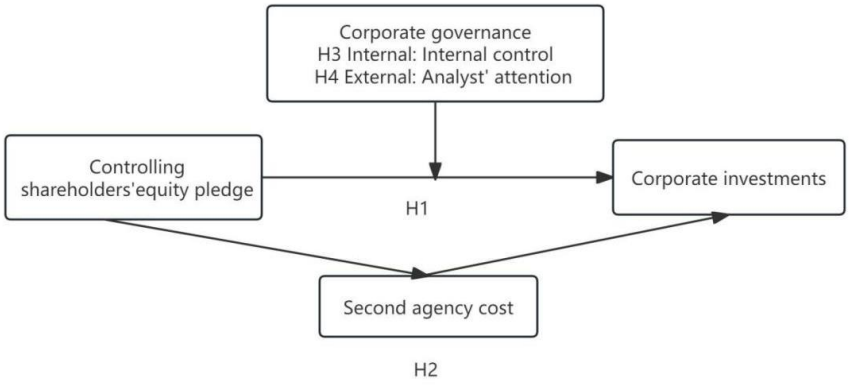

Figure 1: Theoretical framework

3 Methodology

3.1 Sample selection and data sources

This paper takes the data of China's A-share listed companies from 2009 to 2020 as the research sample. In addition, the data are filtered and processed as follows. ST and *ST

companies with abnormal financial data are excluded. Listed companies in the financial and insurance industries with different financial statement structures are deleted. Companies that have been listed for less than one year are deleted. Discontinuous data or other samples with missing data are ignored. This study minorize all of the data at the 1% and 99% levels. After these procedures, a total of 23,520 firm-year observations is obtained [18]. The data on CSEP, corporate investments, analysts' attention, and control variables in this paper were obtained from the Chinese CSMAR database. Internal control data are obtained from the Chinese DIB database.

3.2 Selection of variables

3.2.1 Dependent variable

Inv represents corporate investments. Accounting information from the balance sheet is heavily influenced by accounting policies and is highly manipulative, whereas the cash flow statement is relatively less susceptible to manipulation [19]. Therefore, we use the cash flow data, the ratio of cash paid for the construction of fixed assets, intangible assets, and other long-term assets to their total assets, to measure corporate investments. In addition, we disaggregate corporate investments into fixed assets investments and R&D investments for further analysis [20]. Pep denotes the ratio of net fixed assets to total assets, and R&D investments were measured by the ratio of R&D expenditure to operating income.

3.2.2 Independent variable

Ple represents controlling shareholders' equity pledges. Ple-dum is a dummy variable representing whether controlling shareholders have equity pledges and is assigned a value of 1 if it exists at the end of the year and 0 otherwise. Ple-amount represents the cumulative pledged shares of controlling shareholders to the company's total share capital.

3.2.3 Mediation variables

Cost2 represents the tunneling cost. In this study, drawing on, we use the ratio of other receivables to total assets to measure the second type of agency cost, acting as the mediating variable. Other receivables, in contrast to receivables resulting from sales by related parties, are less transparent and often serve as the primary means through which minority shareholders' interests are compromised by controlling shareholders. A higher proportion of other receivables indicates a more significant second type of agency cost, with this proxy lagging one stage behind.

3.2.4 Moderate variables

Ic represents internal controls, which are systems and procedures within a company to ensure its operations are conducted effectively, efficiently, and with integrity. We measure the quality of internal controls using the DIB internal control index, which we divide by 1000. A higher internal control index signifies better quality internal controls and a stronger internal control system within the company.

Att stands for analysts' attention. When more analysts follow a company, it tends to be beneficial as it helps reveal and spread information about the listed companies and reduces information gaps between market participants.

3.2.5 Control variables

We select the following control variables: company size (Size), taking the logarithm of total

assets [21]. Asset-liability ratio (Lev) is the ratio of total liabilities to total assets. Return on assets(Roa) is measured by net profit to total assets. Cash flow(Cash) is calculated by net cash flow from operating activities to total assets. Corporate nature(Soe), the value of state-owned enterprises is 1. Otherwise, it is 0. The age of listed companies(Age) is measured by the current year minus the company listing year. Moreover, The year and industry dummy variables are controlled to prevent missing variables that do not change with the year or industry from being captured.

3.3 Model construction

To test hypothesis 1, we construct Model (1), where Ple represents equity pledges as the independent variable, and Inv represents corporate investments as the dependent variable. Given that corporate investments in the current period may be influenced by equity pledge behavior in the previous period, we include lagged independent and control variables in these models [22].

$$Inv_{i,t} = \alpha_0 + \alpha_1 Ple_{i,t\text{-}1} + \alpha_2 \sum Controls_{i,t\text{-}1} + \sum Year + \sum Ind + \varepsilon_{i,t} \quad (1)$$

Following the recommendations regarding mediating effects, we proceed to construct equations (2) and (3). In equation (2), Ple is the independent variable, cost2 is the dependent variable, while cost2 and Ple are the independent variables in equation(3).

$$\mathrm{Cos}t2_{i,t\text{-}1} = \lambda_0 + \lambda_1 Ple_{i,t\text{-}1} + \lambda_2 \sum Controls_{i,t\text{-}1} + \sum Year + \sum Ind + \varepsilon_{i,t} \quad (2)$$

$$Inv_{i,t} = \alpha_0 + \alpha_1 Ple_{i,t\text{-}1} + \alpha_2 \mathrm{Cos}t2_{i,t\text{-}1} + \alpha_3 \sum Controls_{i,t\text{-}1} + \sum Year + \sum Ind + \varepsilon_{i,t} \quad (3)$$

Regarding Hypothesis 3 and Hypothesis 4, we followed Helm & Mark, (2012) and Dawson(2014)'s method to construct interactive items for testing the moderating effect. In Equation (4), $Ple_{i,t-1} * Ic_{i,t-1}$ is the interaction between equity pledges and internal control. In Equation (5), $Ple_{i,t-1} * Att_{i,t-1}$ is the interaction between equity pledges and analysts' attention. In addition, this study uses a one-year lag for the predictor variables since it is assumed that investments of the present year are the result of equity pledges and internal governance mechanism in the previous year.

$$\begin{aligned} Inv_{i,t} &= \alpha_0 + \alpha_1 Ple_{i,t-1} + \alpha_2 Ic_{i,t-1} + \alpha_3 Ple_{i,t-1} * Ic_{i,t-1} + \\ &\alpha_4 \sum Controls_{i,t-1} + \sum Year + \sum Ind + \varepsilon_{i,t} \end{aligned} \quad (4)$$

$$\begin{aligned} Inv_{i,t} &= \alpha_0 + \alpha_1 Ple_{i,t\text{-}1} + \alpha_2 Att_{i,t-1} + \alpha_3 Ple_{i,t-1} * Att_{i,t-1} + \\ &\alpha_4 \sum Controls_{i,t-1} + \sum Year + \sum Ind + \varepsilon_{i,t} \end{aligned} \quad (5)$$

4 Empirical results

4.1 Descriptive analysis

Table 1 presents the descriptive statistics of the sample data comprising 23,520 observations from the years 2009 to 2020. The average value of Ple-dum is 0.175, indicating that approximately 17.5% of controlling shareholders utilize equity pledge financing [23]. Notably, Cost2, representing the tunneling cost, exhibits a maximum value of 0.142 and an average

value of 0.017. This suggests instances where certain listed companies in China face significant challenges due to the infringement of interests by large shareholders. The standard deviation of R&D investment is 0.022, and there is little difference, while the standard deviation of fixed assets investment(Ppe)is 0.189, which is quite different among sample companies. Furthermore, Table 1 reveals the absence of significant outliers in the variables under consideration, reinforcing the validity and feasibility of conducting subsequent regression analyses.

Table 2 presents the pairwise Pearson correlation results. Across all specifications, correlations do not exceed 0.80, indicating the absence of multicollinearity issues.

Table 1: Descriptive analysis

Variables	N	Mean	SD	Min	Median	Max
Inv	23520	0.054	0.058	0	0.036	0.322
Ppe	23520	0.253	0.189	0.002	0.215	0.836
R & D	23520	0.018	0.022	0	0.012	0.114
Ple-dum	23520	0.175	0.38	0	0	1
Ple-amount	23520	0.012	0.034	0	0	0.2
Cost2	23520	0.017	0.024	0	0.008	0.142
Ic	23520	0.655	0.117	0	0.673	0.898
Att	23520	1.542	1.187	0	1.609	3.829
Size	23520	22.243	1.273	19.902	22.067	26.156
Lev	23520	0.447	0.201	0.059	0.446	0.873
Roa	23520	0.038	0.052	-0.178	0.034	0.192
Cash	23520	0.048	0.07	-0.159	0.046	0.248
Top1	23520	0.35	0.15	0.086	0.331	0.748
Soe	23520	0.448	0.497	0	0	1
Age	23520	10.927	6.516	2	10	25

Note: Inv represents corporate investments. Ppe stands for fixed assets investments. R&D represents innovation investments. Ple-dum stands for dummy variable of equity pledge. Ple-amount represents the proportion of equity pledge. Cost2 represents the tunneling cost. Ic represents internal control. Att represents analysts' attention. Size represents corporate size. Lev represents asset-liability ratio. Roa represents return on assets. Cash represents ratio of cash flow. Top1 represents the ratio of shareholding of the largest shareholder. Soe represents corporate nature. Age represents age of listing.

Table 2: Pearson correlation

Variables	Inv	Ppe	R & D	Ple-dum	Ple-amount	Cost2	Ic	Att	Size	Lev	Roa	Cash	Top1	Soe	Age
Inv	1.000														
Ppe	0.415***	1.000													
R & D	0.081***	-0.110***	1.000												
Ple-dum	-0.026***	-0.058***	0.032***	1.000											
Ple-amount	-0.014**	-0.018***	-0.070***	0.600***	1.000										
Cost2	-0.104***	-0.204***	-0.119***	0.042***	0.090***	1.000									
Ic	0.117***	0.014**	0.025***	-0.041***	-0.029***	-0.084***	1.000								
Att	0.225***	0.055***	0.154***	0.023***	-0.047***	-0.094***	0.277***	1.000							
Size	-0.031***	0.046***	-0.180***	-0.031***	-0.081***	0.032***	0.166***	0.394***	1.000						
Lev	-0.045***	0.038***	-0.270***	-0.015**	0.023***	0.195***	-0.006	-0.001	0.477***	1.000					
Roa	0.152***	-0.031***	0.170***	-0.023***	-0.046***	-0.142***	0.346***	0.397***	0.011*	-0.338***	1.000				
Cash	0.194***	0.242***	0.072***	-0.055***	-0.053***	-0.136***	0.123***	0.201***	0.027***	-0.167***	0.388***	1.000			
Top1	0.023***	0.092***	-0.127***	-0.043***	0.016**	-0.075***	0.124***	0.098***	0.226***	0.090***	0.114***	0.085***	1.000		
Soe	-0.022***	0.171***	-0.254***	-0.282***	-0.160***	-0.001	0.077***	-0.011*	0.300***	0.279***	-0.079***	0.008	0.232***	1.000	
Age	-0.151***	-0.014**	-0.278***	-0.108***	-0.047***	0.093***	-0.062***	-0.130***	0.344***	0.293***	-0.099***	-0.030***	-0.017***	0.420***	1.000

Note: Table 2 reports the pairwise Pearson correlation results. In any specification, the correlation does not exceed 0.80, which means there is no multilinear problem. * * *, * *, and * represent statistically significant levels of 1%, 5%, and 10%, respectively.

4.2 Benchmark regression

The benchmark regression uses whether equity is pledged and equity pledge ratio as an independent variable to verify Hypothesis 1. The regression analysis shows the coefficient of Ple-dum is -0.004 in Table 3 (1), which is significant at 1%, indicating that Ple-dum can significantly reduce the company's investments, indicating that the existence of equity pledges by controlling shareholders negatively affects corporate investments. Models (2) in Table 3, the Ple-amount has a coefficient of -0.032 and remains significant at the 1% level, indicating that corporate investments decrease with the increase in the proportion of equity pledges. The regression results support and verify hypothesis 1.

4.3 Robustness test

Firstly, this study divides corporate investments into fixed assets and R&D investments [24] to test the robustness. Through analyzing the benchmark regression results, this paper explores whether the equity pledge consistently impacts the above two investment types. As shown in Table 3, columns (3) and (4) respectively report the results of the influence of the equity pledge dummy variable on fixed assets investments and R&D investments. Specifically, the negative impact of the equity pledge dummy variable on fixed assets investments is statistically significant at 10%, and the negative impact on R&D investments is statistically significant at 5%. In addition, columns (5) and (6) of Table 3 further show the results of the impact of equity pledge ratio on fixed assets investments and R&D investments, showing that

the negative impact of equity pledge ratio on fixed assets investments is statistically significant at the level of 5%, and the negative impact on R&D investments is significant at the level of 1%. These findings indicate that even after disaggregating corporate investments into fixed assets and R&D, the robustness test results of the benchmark regression confirm the negative impact of equity pledges on both types of investments.

Secondly, we use the method of replacing independent variables to test the robustness. Specifically, we adopt the Ple-ratio, the proportion of the accumulated pledged shares of the controlling shareholder to their total holdings, as a substitute index and make a regression analysis again. As shown in Table 4, the regression results of Model (1) and Model (2) show that the coefficient of Ple-ratio is -0.011, which is significant at the 1% level. This shows that the regression results after replacing the independent variables are consistent with the benchmark regression results, thus confirming the robustness of the research hypothesis.

Finally, this study employs the method of Propensity Score Matching (PSM) to construct the control group. In this process, controlling shareholders with equity pledges are designated the treatment group, while companies without equity pledges form the control group [25]. Utilizing the one-to-one nearest neighbor matching technique, each observation in the treatment group is paired with the closest observation in the control group based on propensity scores derived from controlling variables' various dimensions. This method aims to ensure the effectiveness of the matching process. The analysis results of Model (3) and Model (4) in Table 4 indicate that the observed coefficients are negative and statistically significant at the 1% level, aligning with the findings from the benchmark regression analysis.

Table 3: Benchmark regression

	Inv	Inv	Ppe	Ppe	R&D	R&D
	(1)	(2)	(3)	(4)	(5)	(6)
Ple-dum	-0.004***		-0.004*		-0.001**	
	(-3.274)		(-1.839)		(-2.424)	
Ple-amount		-0.032***		-0.053**		-0.028***
		(-2.860)		(-2.086)		(-8.350)
Size	-0.013***	-0.013***	-0.043***	-0.043***	-0.003***	-0.004***
	(-9.362)	(-9.524)	(-10.815)	(-10.882)	(-9.014)	(-9.381)
Lev	-0.012**	-0.012**	0.022*	0.022*	-0.001	-0.001
	(-2.313)	(-2.284)	(1.690)	(1.706)	(-0.812)	(-0.725)
Roa	0.134***	0.134***	-0.081***	-0.082***	0.024***	0.024***
	(12.494)	(12.430)	(-3.733)	(-3.764)	(7.976)	(7.876)
Cash	0.018***	0.018***	0.072***	0.072***	0.003**	0.003**
	(2.898)	(2.879)	(5.465)	(5.439)	(2.223)	(2.031)
Top1	0.023**	0.023**	0.055**	0.056**	-0.002	-0.002
	(2.528)	(2.575)	(2.304)	(2.343)	(-1.163)	(-0.870)
Soe	-0.010**	-0.010**	-0.008	-0.007	0.001	0.001
	(-2.411)	(-2.357)	(-0.730)	(-0.729)	(1.039)	(0.799)
Age	-0.000	-0.000	0.011*	0.011*	0.000	0.000
	(-0.016)	(-0.007)	(1.727)	(1.724)	(0.125)	(0.062)
_Cons	0.359***	0.364***	1.243***	1.250***	0.083***	0.086***
	(9.938)	(10.061)	(12.363)	(12.416)	(8.952)	(9.264)
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
N	23520	23520	23520	23520	23520	23520
R^2	0.098	0.097	0.127	0.128	0.115	0.121

Note: Models (1)–(2) show the benchmark regression. Influences of equity pledge on investments and other factors controlled. Models (3)–(6) show the robustness analysis based on fixed assets investments and R&D investments. * * *, * *, and * represent statistically significant levels of 1%, 5%, and 10%, respectively.

Table 4: Robustness test

Dependent variable	Inv	Inv	Inv	Inv
Independent variable	(1)	(2)	(3)	(4)
Ple-dum			-0.005***	
			(-2.875)	
Ple-amount				-0.034**
				(-2.242)
Ple-ratio	-0.011***	-0.011***		
	(-3.368)	(-3.687)		
Size		-0.013***	-0.015***	-0.016***
		(-9.514)	(-5.750)	(-5.844)
Lev		-0.012**	-0.014	-0.014
		(-2.292)	(-1.526)	(-1.481)
Roa		0.134***	0.123***	0.121***
		(12.423)	(6.910)	(6.801)
Cash		0.018***	0.028**	0.028**
		(2.885)	(2.376)	(2.306)
Top1		0.022**	0.026	0.026
		(2.473)	(1.625)	(1.623)
Soe		-0.010**	0.005	0.005
		(-2.378)	(0.711)	(0.691)
Age		-0.000	0.006	0.006
		(-0.014)	(1.294)	(1.299)
_Cons	0.084***	0.363***	0.387***	0.395***
	(5.006)	(10.074)	(6.536)	(6.616)
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
N	23520	23520	7368	7368
R2	0.063	0.098	0.096	0.096

Note: Model (1) and Model (2) replace the Ple-ratio with Ple-amount and verify the reliability of independent variable data. Model (3) and Model (4) use the PSM model to re-match the samples. Other factors, annual effects, and industry effects were also considered in the model. * * *, * *, and * represent statistically significant levels of 1%, 5%, and 10%, respectively.

4.4 Mediating effect of the tunneling cost

Mode (1) in Table 5, the coefficient of equity pledge on tunneling cost is 0.001, which is significant at 5%, indicating that equity pledge can significantly increase agency costs between controlling and minority shareholders. Mode (2) In Table 5, the secondary agency cost factor of the corporate investments is -0.051, which is significant at the level of 5%; and Mode (1) in Table 3, the coefficient of equity pledge on investments is -0.004, significant at 1%, indicating that the secondary agency cost as a partial mediating role and reduces corporate investments. In addition, the confidence interval does not include 0 in the Bootstrap method, implying that the mediating effect of the tunneling cost is robust. This empirical evidence supports Hypothesis 2, suggesting that equity pledges indirectly influence corporate investments by tunneling cost.

We then test the mediating effect using the Ple-amount instead of the Ple-dum. In Mode (3) in Table 5, the coefficient of the Ple-amount on the tunneling costs is 0.044, which is

significant at 1%. Mode(4) in Table 5, the tunneling cost remains significantly negative on firm investment at the 1% level, indicating that the second agent costs partially mediate the negative effect of the equity pledge ratio on firm investments. Moreover, employing the Bootstrap method, the confidence interval does not include 0, reinforcing the robustness of the mediating effect of the tunneling cost on the relationship between Ple-amount and corporate investments.

Table 5: Mediating effect

Dependent variable	Cost2	Inv	cost2	Inv
Independent variable	(1)	(2)	(3)	(4)
Ple-dum	0.001**	-0.004***		
	(2.169)	(-3.230)		
Ple-amount			0.044***	-0.030***
			(7.338)	(-2.651)
Cost2		-0.051**		-0.048**
		(-2.199)		(-2.074)
Size	-0.002***	-0.013***	-0.002***	-0.013***
	(-3.114)	(-9.435)	(-2.821)	(-9.588)
Lev	0.017***	-0.011**	0.017***	-0.011**
	(7.208)	(-2.144)	(7.106)	(-2.126)
Roa	-0.014***	0.134***	-0.014***	0.133***
	(-2.912)	(12.458)	(-2.807)	(12.399)
Cash	-0.002	0.018***	-0.001	0.018***
	(-0.613)	(2.885)	(-0.462)	(2.871)
Top1	-0.009**	0.022**	-0.010***	0.022**
	(-2.413)	(2.485)	(-2.695)	(2.529)
Soe	-0.001	-0.010**	-0.000	-0.010**
	(-0.450)	(-2.425)	(-0.246)	(-2.366)
Age	0.001	0.000	0.001	0.000
	(0.594)	(0.012)	(0.630)	(0.021)
_Cons	0.054***	0.362***	0.049***	0.366***
	(2.962)	(10.005)	(2.703)	(10.121)
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
N	23520	23520	23520	23520
R^2	0.026	0.098	0.031	0.098
Bootstrap confidence interval	-.0004739	-.0001595	-.0110311	-.0063476

Note: Models (1) to (4) show the mediating effects of tunneling cost. ***,**, * * represent statistical significance level of 1%, 5%, and 10%, respectively. Bootstrap is used for the robust test of the mediation effect (sampling 1000 times).

4.5 Moderating effect of internal governance mechanism

We introduce the interaction term of internal control with CSEP [26]. We construct Model 4, which intermultiplies internal control with the presence of equity pledges and the percentage of equity pledges as Model(1) and Model(2). In Table 6, Ic_Ple-dum and Ic_Ple-amount coefficients are 0.024 and 0.248, significant at 1% and 5%, respectively, opposite the significant inhibitive relationship between equity pledges on corporate investments. This result verifies Hypothesis 3.

The construction of a securities market monitoring mechanism can be initiated not only by listed companies to improve their internal governance and strengthen their internal control management but also by the external monitoring role of the securities market, such as analysts' attention to listed companies, which can reduce the second kind of agency costs. Therefore, we investigate the analysts' attention moderating effect, construct model 5, and introduce the interaction term of analysts' attention with the presence of equity pledges and the proportion of equity pledges, as Model(3) and Model(4) in Table 6, Att_Ple-dum and Att_Ple-amount are 0.002 and 0.023, significant at 5%, which are opposite to the significant negative relationship between equity pledges on corporate investments, supporting the hypothesis 4.

Table 6: Moderating effect of internal control and analysts' attention

Dependent variable	Inv	Inv	Inv	Inv
Independent variable	(1)	(2)	(3)	(4)
Ple-dum	-0.004***		-0.005***	
	(-3.131)		(-4.231)	
Ple-amount		-0.030***		-0.031***
		(-2.624)		(-2.594)
Ic_Ple-dum	0.024***			
	(2.966)			
Ic_Ple-amount		0.248**		
		(2.430)		
Att_Ple-dum			0.002**	
			(1.998)	
Att_Ple-amount				0.023**
				(2.060)
Ic	0.028***	0.032***		
	(7.206)	(8.494)		
Att			0.010***	0.010***
			(13.967)	(14.303)
Size	-0.014***	-0.014***	-0.018***	-0.018***
	(-9.879)	(-10.054)	(-13.163)	(-13.295)
Lev	-0.012**	-0.012**	-0.007	-0.007
	(-2.317)	(-2.295)	(-1.367)	(-1.329)
Roa	0.112***	0.112***	0.090***	0.089***
	(10.238)	(10.185)	(8.392)	(8.346)
Cash	0.018***	0.018***	0.018***	0.017***
	(3.000)	(2.996)	(2.909)	(2.880)
Top1	0.022**	0.022**	0.023***	0.023***
	(2.456)	(2.513)	(2.644)	(2.681)
Soe	-0.010**	-0.010**	-0.009**	-0.008**
	(-2.493)	(-2.437)	(-2.110)	(-2.031)
Age	0.000	-0.000	0.001	0.001
	(0.020)	(-0.003)	(0.467)	(0.492)
_Cons	0.352***	0.355***	0.437***	0.441***
	(9.837)	(9.904)	(12.188)	(12.260)
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
N	23520	23520	23520	23520
R^2	0.103	0.102	0.119	0.118

Note: Models (1)–(4) show the moderating effect of internal control and analysts' attention. ***,**, * * represent statistical significance level of 1%, 5%, and 10%, respectively.

5 Heterogeneity test

This paper also discusses how the company's nature and industry classification affects the relationship between CSEP and corporate investments [27]. Columns (1) to (4) in Table 7 illustrate that compared to state-owned enterprises, CSEP has a more pronounced effect on the investment behaviors of non-state-owned corporations. This difference may be due to the extensive government intervention and significant political responsibilities of state-owned entities, which elevate their role in driving real economic development. In addition, compared with state-owned corporate, the transfer of control rights of controlling shareholders in non-state-owned corporate is less regulated by the government, which increases the risk of controlling shareholders losing control rights, which is more harmful to their personal influence. Therefore, the controlling shareholders of non-state-owned corporate may take a more cautious attitude towards the corporate investments after pledging their shares, which leads to its more significant influence in non-state-owned corporate.

The analysis results of columns (5) to (8) reveal that in manufacturing companies, the impact of CSEP on corporate investments is more significant than that of non-manufacturing companies. This discrepancy may arise from the greater need for fixed capital investments in manufacturing industries, including machinery and equipment purchases, facility construction, and technology upgrades. However, long-term and continuous investment amplifies the uncertainty and investment risk and increases the risk that the controlling shareholder may lose control.

Table 7: Heterogeneity test

	Non-state owned	State-owned	Non-state owned	State-owned	Non-manufacturing industry	Manufacturing industry	Non-manufacturing industry	Manufacturing industry
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ple-dum	-0.006***	0.003			0.003	-0.007***		
	(-4.736)	(1.023)			(1.446)	(-4.961)		
Ple-amount			-0.052***	0.007			-0.009	-0.043***
			(-4.002)	(0.309)			(-0.516)	(-3.060)
Size	-0.014***	-0.016***	-0.014***	-0.016***	-0.015***	-0.016***	-0.015***	-0.016***
	(-6.857)	(-7.817)	(-7.080)	(-7.781)	(-6.383)	(-7.896)	(-6.372)	(-8.063)
Lev	-0.011	-0.010	-0.010	-0.010	-0.004	-0.016**	-0.004	-0.016**
	(-1.480)	(-1.234)	(-1.420)	(-1.238)	(-0.418)	(-2.373)	(-0.416)	(-2.336)
Roa	0.112***	0.163***	0.111***	0.164***	0.132***	0.137***	0.133***	0.137***
	(9.116)	(7.852)	(9.015)	(7.866)	(7.135)	(10.231)	(7.171)	(10.160)
Cash	0.021**	0.012	0.021**	0.012	0.027***	0.009	0.026***	0.009
	(2.312)	(1.433)	(2.300)	(1.442)	(3.252)	(0.995)	(3.206)	(1.006)
Top1	0.040***	0.005	0.040***	0.005	0.015	0.016	0.016	0.016
	(3.144)	(0.391)	(3.184)	(0.389)	(0.981)	(1.527)	(1.002)	(1.536)
Soe					-0.001	-0.010*	-0.002	-0.009*
					(-0.225)	(-1.816)	(-0.294)	(-1.701)
Age	0.007*	-0.003	0.007*	-0.003	-0.002	0.001	-0.002	0.001
	(1.712)	(-1.161)	(1.781)	(-1.166)	(-0.734)	(0.215)	(-0.762)	(0.224)
_cons	0.351***	0.462***	0.361***	0.461***	0.425***	0.391***	0.425***	0.398***
	(7.168)	(8.323)	(7.379)	(8.298)	(7.749)	(8.592)	(7.752)	(8.729)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fisher's test	0.000***		0.000***		0.000***		0.030**	
N	12988	10532	12988	10532	8867	14653	8867	14653
R^2	0.094	0.121	0.093	0.121	0.100	0.110	0.099	0.109

Note: Models (1)–(4) show the heterogeneity of the company's nature, while Models (5)–(8) show the heterogeneity of industry classification. Controlling factors, annual effects, and industry effects were also considered in the model. * * *, * *, and * represent statistically significant levels of 1%, 5%, and 10%, respectively. The Fisher method tests the significance of the difference between groups, and the P-values are obtained using the Fisher test (sampling 100 times)

6 Discussion and conclusions

This paper examines the connection and transmission mechanism between CSEP and corporate investments in China using a sample dataset of 23,520 observations. The findings reveal several key insights. Firstly, CSEP significantly and negatively impacts corporate investments, indicating a decrease in investments following equity pledges by controlling shareholders. This conclusion remains robust regarding fixed asset investments and R&D expenditures, employing different equity pledge proxies and the propensity score matching method. Secondly, tunneling costs act as a mediator between CSEP and investments, highlighting the effectiveness of the "equity pledge-tunneling cost-corporate investments" transmission channel. Furthermore, the moderating effects of internal control and analysts' attention are notable and effective in mitigating the negative impact of this relationship. Notably, the impact of CSEP on corporate investments was more pronounced in non-state-owned and manufacturing companies.

6.1 Theoretical implications

Our research has contributed to the existing literature in many aspects. Firstly, by uncovering the negative impact of equity pledges on corporate investments, we suggest that controlling shareholders may divert pledged funds towards personal consumption rather than company development. These finding sheds light on the potential misuse of pledged equity capital.

Secondly, we identify tunneling costs as the underlying mechanism through which CSEP hampers corporate investments. This insight exposes controlling shareholders' motivations to mitigate risks associated with control rights transfer and margin calls and their tendency to prioritize their interests over those of minority shareholders in investment decision-making processes.

Thirdly, our study broadens the application scope of agency theory, shifting the research focus from the traditional examination of agency problems between shareholders and managers to the conflict between controlling and minority shareholders. This expansion enriches the understanding of traditional agency theory and provides insights into the performance and implications of the second agency problem within the context of equity pledges.

6.2 Practical implications

This study suggests strengthening the internal and external governance of the company because it helps to alleviate the agency problem of controlling shareholders to minority shareholders and reduce the negative impact of controlling shareholders' behavior on corporate investments. This proposal has practical significance for investors and policymakers.

For policymakers, this study verifies that CSEP does not necessarily increase corporate investments. Therefore, policymakers should take effective measures to guide the shareholders who implement the equity pledge to invest their funds in the development and construction of the company. For those shareholders who use the pledged funds for the company's development, policymakers can lower the warning line and warning line of the corresponding equity pledge to reduce the risk of shareholders' equity transfer and make shareholders use the funds for corporate investments with confidence, thus promoting real economic development.

For investors, understanding the true intentions behind shareholders' equity pledges is crucial. If shareholders divert pledged funds for personal use rather than company

development, it not only hampers the company's growth but also undermines its long-term value. Therefore, investors should carefully evaluate these factors to mitigate investment risks and safeguard their interests.

6.3 Limitation and future studies

Firstly, we suggest considering more diversified indicators to measure equity pledges. For example, examining the continuity of equity pledges and analyzing the flow of pledged funds can provide deeper insights into equity pledge behavior. Moreover, considering equity pledges made by other entities can offer additional perspectives on this complex phenomenon.

Secondly, we advocate for a comprehensive approach to measuring corporate investments. In addition to traditional metrics such as investments in fixed and intangible assets, it's essential to include various investment forms like financial, green, and ESG (Environmental, Social, and Governance) investments, which have garnered significant attention. By broadening the scope of investment assessment, we can better understand corporate investment behaviors and their implications for businesses.

Lastly, our research underscores the need for broader testing across different countries and economic systems to explore the influence of unique cultural, institutional, and political factors on the relationship examined in our study. Such exploration can offer deeper insights and enhance our understanding of the link between equity pledges and corporate investments.

Conflicts of interest

None

During the preparation of this work, the authors used ChatGPT in order to polish it. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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