CONTROLLING SHAREHOLDERS' SHARE PLEDGING, INVESTMENT EFFICIENCY, AND FINANCIAL DISTRESS RISK IN THE CHINA A-SHARE MARKET

By

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Controlling shareholders' share pledging (CSSP) is a popular and particular financing way. Accompanied by CSSP, numerous firms completed fast expansions through internal investments, external set-ups, and mergers. Quite a few of these firms with CSSP ended with enforcement by financial institutions and then being delisted, making millions of atomistic shareholders hugely suffer. To explore what these listed companies have gone through, from CSSP to financial failures, this thesis aims to examine the effects of CSSP on Chinese firms' development.

The first objective of this research is to explore the relationship between CSSP and firm-level investment efficiency. The empirical results indicate that firms with CSSP are more prone to over-investment than under-investment and the degree of over-investment increases as the CSSP percentage increases. Firms with CSSP invest more in additional investment but less in maintenance

investment for particular purposes. The impact of CSSP on under-investment is insignificant. The second objective is to explore the relationship between investment efficiency and corporate financial distress risk. While over-investment has a positive linear relationship with financial distress risk, under-investment has a U-shaped relationship with financial distress risk, indicating a threshold in the under-investment degree. Below that threshold, under-investment alleviates corporate financial distress risk but exacerbates it above that threshold. The third objective is to investigate the impacts of CSSP on corporate financial distress risk. The empirical results suggest that CSSP exacerbates corporate financial distress risk, but the effect decreases as corporate financial distress risk increases.

This thesis reminds the regulators to consider if further restrictions on the CSSP are necessary, creditors and investors should be more concerned about firms' cash flows with CSSP while making lending and investing decisions, and minority shareholders should pay attention to the rationality of firms' operation, investment, and financing decisions made by controlling shareholders after they pledged their shares.

Keyword: Controlling Shareholders' Share Pledging, Over-investment; Under-investment, Financial Distress Risk.

SDG: GOAL 8: Decent Work and Economic Growth

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

MENGAWAL PEMEGANG SAHAM CAGARAN SAHAM KECEKAPAN PELABURAN DAN RISIKO KEMEROSOTAN KEWANGAN DALAM PASARAN SAHAM CHINA

Oleh

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Penggadaian saham oleh pemegang saham pengawal (CSSP) merupakan satu kaedah pembiayaan yang popular dan khusus. Dengan adanya CSSP, banyak firma telah melaksanakan pengembangan pesat melalui pelaburan dalaman, penubuhan luaran, dan penggabungan. Walau bagaimanapun, sebilangan firma yang terlibat dalam CSSP akhirnya menghadapi tindakan penguatkuasaan oleh institusi kewangan dan seterusnya dinyahsenaraikan, menyebabkan berjuta-juta pemegang saham kecil mengalami kerugian yang besar. Bagi memahami pengalaman yang dilalui oleh firma-firma ini, dari CSSP hingga kegagalan kewangan, tesis ini bertujuan untuk mengkaji kesan CSSP terhadap pembangunan firma di China.

Objektif pertama kajian ini adalah untuk meneroka hubungan antara CSSP dan kecekapan pelaburan di peringkat firma. Hasil empirikal menunjukkan bahawa firma dengan CSSP lebih cenderung mengalami leburan pelaburan (over-investment) berbanding kekurangan pelaburan (under-investment), dan

tahap leburan pelaburan meningkat seiring dengan peningkatan peratusan CSSP. Firma dengan CSSP melabur lebih banyak dalam pelaburan tambahan tetapi kurang dalam pelaburan penyelenggaraan untuk tujuan tertentu. Kesan CSSP terhadap kekurangan pelaburan adalah tidak signifikan. Objektif kedua adalah untuk mengkaji hubungan antara kecekapan pelaburan dan risiko kesusahan kewangan korporat. Dapatan menunjukkan bahawa leburan pelaburan mempunyai hubungan linear positif dengan risiko kesusahan kewangan, manakala kekurangan pelaburan menunjukkan hubungan berbentuk U dengan risiko kesusahan kewangan, yang menunjukkan kewujudan satu ambang dalam tahap kekurangan pelaburan. Di bawah ambang tersebut, kekurangan pelaburan dapat mengurangkan risiko kesusahan kewangan korporat, tetapi di atas ambang tersebut, ia meningkatkan risiko tersebut. Objektif ketiga adalah untuk menyelidiki kesan CSSP terhadap risiko kesusahan kewangan korporat. Hasil kajian menunjukkan bahawa CSSP memburukkan lagi risiko kesusahan kewangan korporat, namun kesan ini berkurang apabila risiko kesusahan kewangan meningkat.

Tesis ini mengingatkan pihak pengawal selia agar mempertimbangkan sama ada sekatan lanjut terhadap CSSP perlu dilaksanakan. Selain itu, pemiutang dan pelabur disarankan agar lebih prihatin terhadap aliran tunai firma dengan CSSP ketika membuat keputusan pembiayaan dan pelaburan. Pemegang saham minoriti pula harus memberi perhatian kepada rasionaliti operasi, pelaburan, dan keputusan pembiayaan firma yang dibuat oleh pemegang saham pengawal setelah mereka menggadaikan saham mereka.

Kata kunci: Pencagaran Saham Pemegang Saham Pengawal, Pelaburan Berlebihan, Pelaburan Kurang, Risiko Kemerosotan Kewangan.

SDG: MATLAMAT 8: Pekerjaan Yang Baik dan Kemajuan Ekonomi

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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Date: 13 March 2025

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LIST OF ABBREVIATIONS

2LSL	Two Stage Least Square Regression
CSMAR	China Stock Market and Accounting Research
CSRC	China Securities Regulatory Commission
CSSP	controlling shareholders' share pledging
DID	Difference-in-difference
GMM	Generalized Method of Moments
KDX	Kangdexin Co. Ltd.
NPV	Net present value
OLS	Ordinary Least Square
PP	Principal-principal
PSM	Propensity Score Matching
RDD	Regression Discontinuity Design
RO	Research objective
VIF	Variance Inflation Factor

CHAPTER 1

INTRODUCTION

1.1 Research Background

China's past 20 years have experienced rapid economic growth, providing various investment opportunities for firms (Ding et al., 2018). Controlling shareholders' share pledging (CSSP) arose during this process, becoming a popular and particular way for financing. Accompanied by CSSP, numerous firms completed fast expansions through internal investments, external set-ups, and mergers. Quite a few of these firms with CSSP ended with enforcement by financial institutions and then being delisted, making millions of atomistic shareholders hugely suffer.

What have these listed companies gone through from controlling shareholders' share pledges to enforcing pledged shares? These companies thoroughly have a commonality in that they massively invest in emerging industries and end in failure, e.g., Le TV (SZ.300104) invested in a new energy vehicles project, and KDX (SZ.002450) invested in optical and carbon fibre projects using the pledged funds by their controlling shareholders Jia Yueting and Zhong Yu, respectively. Massively investment expenditure and negative returns made KDX fail to repay the overdue bonds in 2019, and it was reorganized by sale and deregistered in 2023. Le TV was de-listed in 2020, and its controlling shareholder, Jia, filed for personal bankruptcy in the US in

2019. More cases with the same process include Huishan Milk (Stock code: 06863), Hainan Airlines (Stock code: 600221), and ST* Zhongnan (Stock code: 002445), but are not limited to these.

These cases exemplify that controlling shareholders can finance firms' investments with pledged funds. Meanwhile, they are forced to continue investing in projects that provide favorable information to the market to maintain the share price due to margin call pressure, some even negative NPVs. Massively investment expenditure and low returns put pressure on the company's cash flows and debt repayments, even causing financial distress.

In Chinese economics, CSSP and investment have intertwined to affect the enterprise's development for decades. Sorting out the relationship between them, as well as their respective impacts on corporate financial distress risk, is very important both for the enterprise itself and the investors, and it is also a reference for regulators to formulate policies. Therefore, this study is motivated to explore the interconnections between CSSP, investment efficiency, and financial distress risk. The reality context and research background of this thesis are specific as follows.

1.1.1 High Ratio of CSSP

According to Chinese Corporate Law, an equity pledge is a form of pledge security in which the pledgee pledges the equity held by the pledgee to the financial institution as the subject matter of the pledge. Controlling

shareholders are those whose capital contribution accounts for more than 50% of the total capital or whose capital contribution or shareholding is less than 50%, but their voting rights are sufficient to influence the resolutions of the shareholders' meeting. Moreover, CSSP means controlling shareholders pledge their shares to attach financing.

According to statistics, more than 50% of listed companies from 2007-2020 have been with the condition that net cash flow out of investment expenditure outweighs net cash flow in operational activity, which implies that these firms need external financing to support their investments. E.g. For KDX, over the last six years, from 2013 to 2018, its operating cash flows totaled a net inflow of $1.053 billion, and investment cash flows totaled a net outflow of $1.65 billion. To secure external financing, 96% of the shares held by KDX's controlling shareholder, Zhong Yu, had been pledged to the bank from 2010 to 2019. In China, it is common for controlling shareholders to pledge their owned shares to secure loans from brokerages, banks, or trust firms. According to the statistics, by the end of 2020, more than 80% of Chinese listed companies were involved in successive and multiple pledges made by the controlling shareholders, the main actors in equity pledges (Liao et al., 2018a).

In 2018, the China Securities Regulatory Commission (CSRC) imposed new restrictions on the ratio of single-share equity pledges. We can see a downward trend in the proportion of companies with equity pledges from 2017 in Figure 1. These policies state that a firm's maximum stock pledge ratio

should not exceed 60%, and the overall pledge ratio for a single A-share stock market should not exceed 50%.

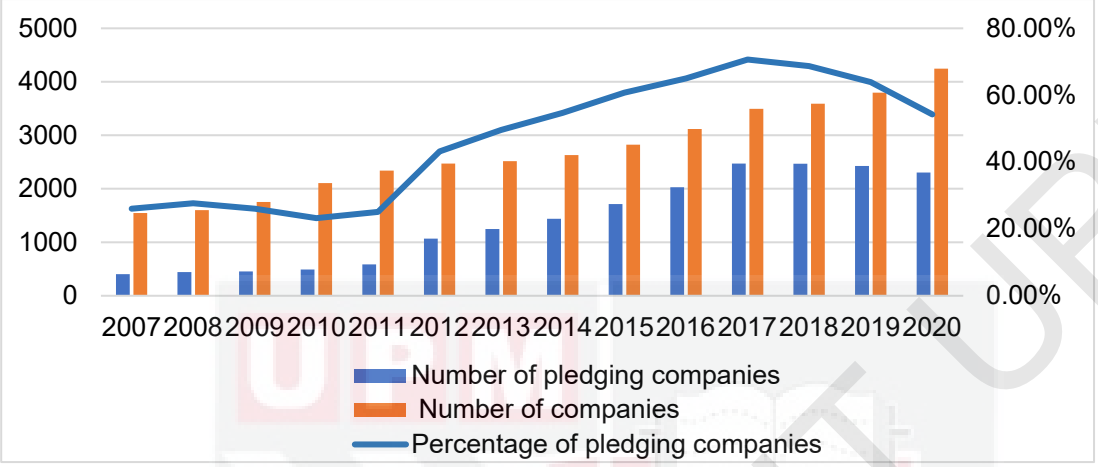

Figure 1.1: Development of CSSP 2007 to 2020

The diagram displays the proportions of listed companies engaging in share pledging within the subset of non-financial listed companies in the Chinese A-share stock market.
(Data source: CSMAR database, collated by Microsoft Excel)

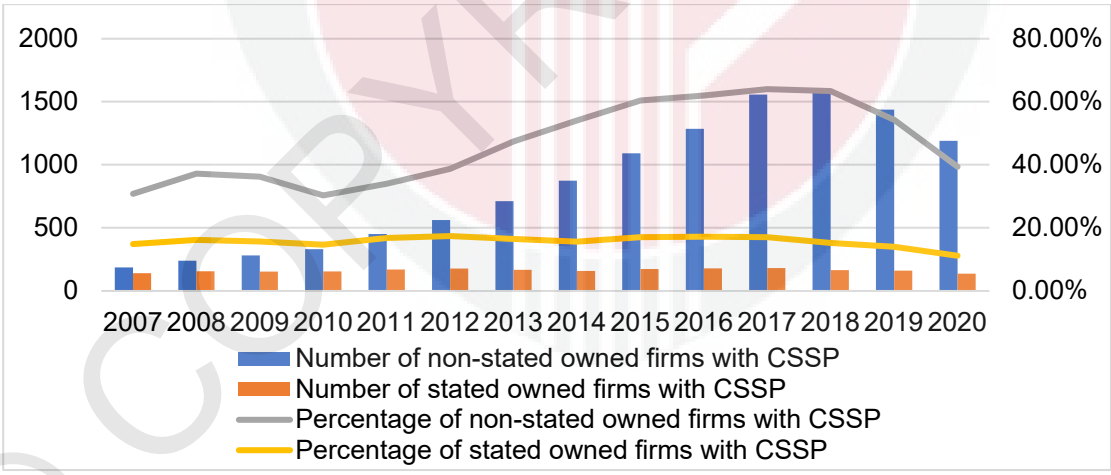

Figure 1.2: Development of CSSP Conditional on Firms' Nature 2007 to 2020

The diagram displays the proportions of listed companies engaging in share pledging conditional on the firms' nature within the subset of non-financial listed companies in the Chinese A-share stock market.
(Data source: CSMAR database, collated by Microsoft Excel)

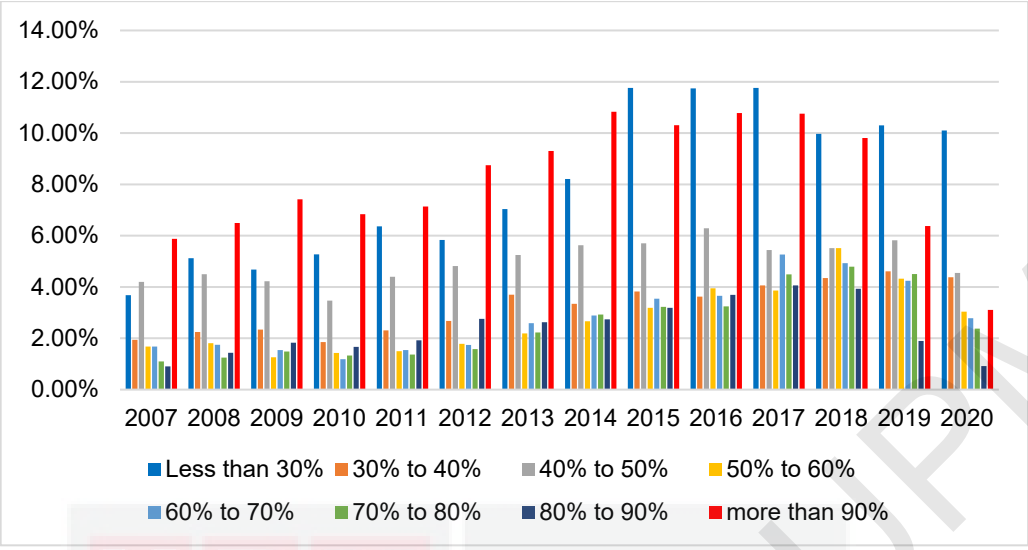

Figure 1.3: Development of CSSP Conditional on Pledging Percentages 2007 to 2020

The diagram displays the proportions of listed companies engaging in share pledging conditional on pledging percentages within the subset of non-financial listed companies in the Chinese A-share stock market.
(Data source: CSMAR database, collated by Microsoft Excel)

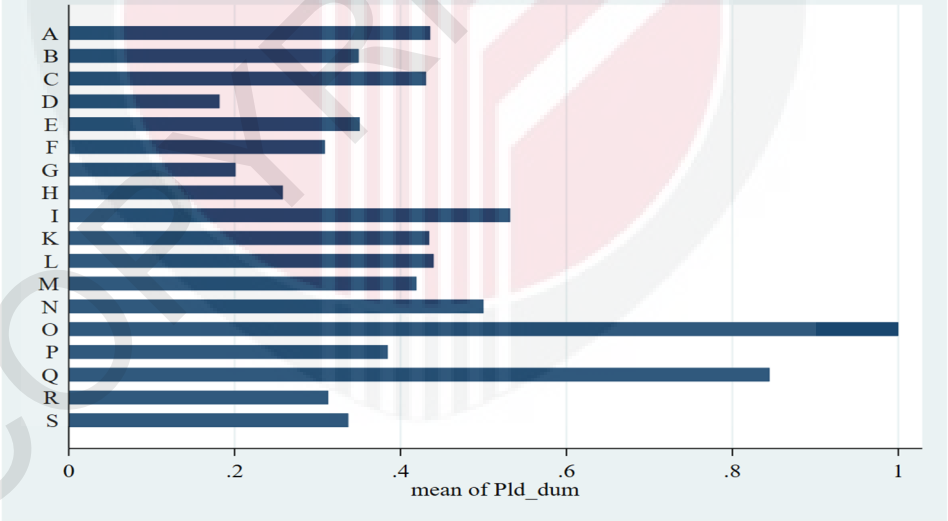

Figure 1.4: Development of CSSP Conditional on Firms' Industry 2007 to 2020

The diagram displays the proportions of listed companies engaging in share pledging conditional on the firms' industry within the subset of non-financial listed companies in the Chinese A-share stock market. Firms are classified according to Guidelines for the Classification of Listed Companies in China (2012 Revision) by CSRC, specifically as listed in Table A of the appendix.
(Data source: CSMAR database, collated by Stata 17.0)

Figure 1.2 presents the development of CSSP conditional on the firms' nature that the percentage of non-state-owned firms participating in CSSP is much higher than that of state-owned firms. Figure 1.3 presents the development of CSSP conditional on the firms' nature and the percentage of firms participating in CSSP at each magnitude, indicating that the top two magnitudes of firms are distributed in less than 30% and more than 90%. Figure 1.4 presents the development of CSSP conditional on firms' industry, indicating that the top two percentages of firms participating in CSSP are residential services, repairs and other services, and health and social work, respectively.

The research about share pledging in other countries focuses on insider equity pledges (Anderson & Puleo, 2020; Dou et al., 2019) . According to a recent survey, 982 directors or officers in the United States reported pledging stock in 2006–2009 proxy statements; the average pledge amounted to 44% of total holdings (Larcker & Tayan, 2010). In India, insiders in more than 20% of listed companies pledged part of their holdings; in 2013, the pledges had a market value of US $25.8 billion (Press Trust of India, 2013). Approximately 50% of listed companies in India had pledged equity between 2009 and 2014 (Singh, 2018). Given these nontrivial collateral amounts, stock pledges have attracted the attention of regulators and participants worldwide. Yet, personal shares are pledged by insiders, mainly by controlling shareholders who control the firm and make critical corporate decisions (Chan et al., 2018; Porta et al., 1999).

The vast differences in country shareholding structures have led to different research focuses on equity pledge agency issues. Equity is relatively

fragmented in Western countries, and management mainly studies equity pledges. At the same time, China has a high concentration of shareholdings, with controlling shareholders becoming the main actors in equity pledges (Liao et al., 2018a).

1.1.2 Status Quo of Inefficient Investment

Referring to how Richardson (2006) defined over-investment, this study conceptually defines investing efficiently as that investment expenditure equals that required to maintain assets in place and finance expected new investments in positive NPV projects, which can be called the optimal investment level for a firm. The inefficient investment component is the difference between a firm's actual and its optimal investment level. Thus, over-investment is defined as a firm's investing expenditure exceeding its optimal investment level, while under-investment is not up to the level.

To measure the investment efficiency of a firm, Richardson (2006) built the model to expect the optimal investment expenditure based on firms' profitability, leverage, investment opportunity, cash holding, and stock revenue. The absolute value of the estimated residual is the degree of inefficient investment in the company. A positive residual is considered over-investment, and a negative residual is considered under-investment.

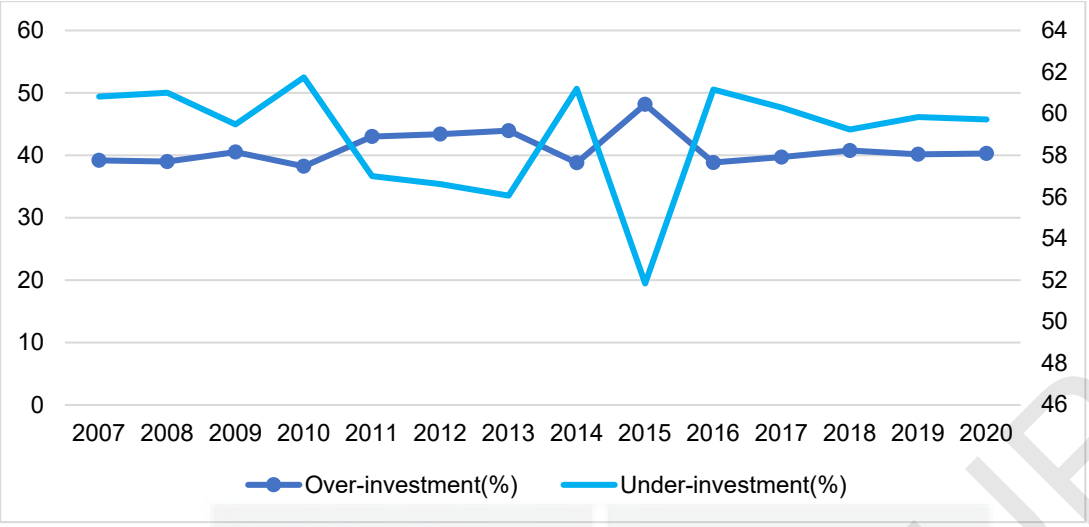

Figure 1.5: Average inefficient investment degree of Chinese Listed Companies from 2007 to 2020
(Data source: CSMAR database, collated by Stata15.0 & Microsoft Excel)

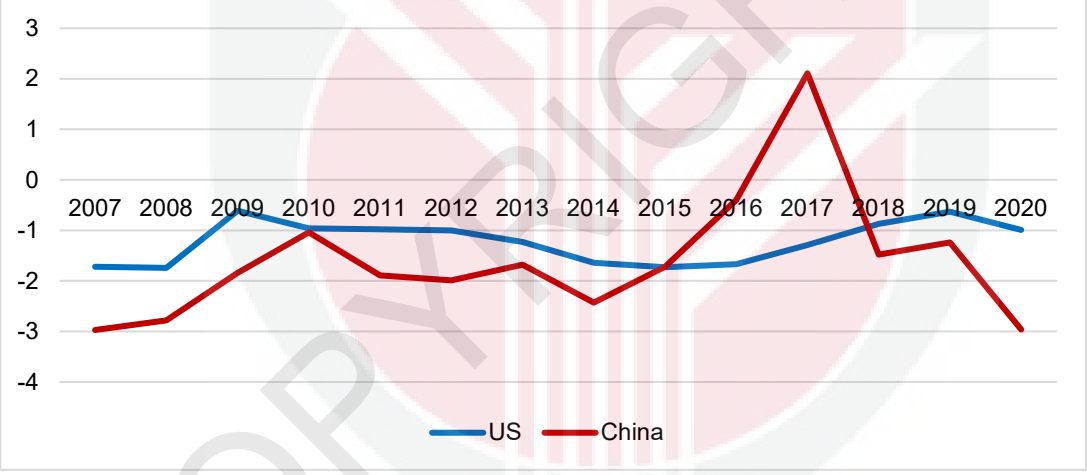

Figure 1.6: Comparison of the Ratio of Net Investment Cash Flow to Net Operating Cash Flow Between US and Chinese Listed Firms from 2007-2020
(Data source: Compustat & CSMAR databases, collated by Stata15.0, Microsoft Excel)

As shown in Figure 1.5, almost 40% of Chinese listed companies are over-invested annually, while the proportion of under-investment is around 60% from 2007 to 2020, indicating that under-investment is a more common problem for listed companies than over-investment. Figure 1.6 compares the

net investment cash flow ratio to the net operating cash flow between US and Chinese listed firms from 2007 to 2020. Chinese firms' net investment cash flow out is much greater than net operating cash flow compared to US firms.

1.1.3 How Close to Financial Distress?

Although financial distress has been researched by scholars for more than eighty years, it has not yet been defined with definitive standards. Financial distress is initially named financial failure by Beaver (1966), defined as the inability to pay its financial obligations as they mature. Gordon (1971) is the first to use financial distress to describe the status of a firm that cannot pay off the interest and principal on its debt.

The common criterion to distinguish whether a firm is in financial distress or not is that a firm cannot afford its maturing (Beaver, 1966; Deakin, 1972; John, 1993a). Other standards include, e.g., Morris (1997) lists 12 signs in decreasingly ranked severity, including being stopped trading in the stock market and audit opinion. Ross et al (1999) Financial distress is defined as four types of bankruptcies: financial failure, legal bankruptcy, technical bankruptcy, and accounting bankruptcy.

The definition of financial distress is less precise than the legal actions that define proceedings such as bankruptcy (Platt, 2006). Regardless of the solvent and the insolvent states, financial distress means an intermediate state a firm is confronted with (Purnanandam, 2008), which is an uncertain transition phase, possibly leading to survival or failure.

In this study, financial distress is defined as when firms have insufficient cash flows to settle debts. The triggers of financial distress include operation (Wang & Cao, 2021; Jiang & Liu, 2011; Zhuang & Mao, 2006), investment (Bassetto & Kalatzis, 2011; Froot et al., 1992; Majd, 1985; Männasoo et al., 2018; Wang, 2020), and financing (Hoshi et al., 1990; Zhao & Huchzermeier, 2019) strategies, and macroeconomic factors (ElBannan, 2021a; Pham Vo Ninh et al., 2018; Pindado et al., 2008). Previous research places emphasis on the impacts of managerial behaviors on financial distress risk (Lee & Yeh, 2004; Shahwan, 2015; Wang & Cao, 2021), while neglecting the controlling shareholders' role.

As Figure 1.7 shows, most Chinese listed companies have a current ratio between 1 and 2, while most US firms have a current ratio above 5. The average current ratio of Chinese listed corporates is 1.98 while the one of US firms is 4.91 between 2007 and 2020. Through data analysis (shown in Figure 1.7), we can attribute this to the fact that long-term borrowing is less accessible to Chinese companies since Chinese commercial banks generally provide short-term loans to companies in order to reduce credit risk. On the one hand, short-term debts are less costly, which enhances corporate profitability. On the other hand, the debt structure dominated by short-term obligations obviously increases the risk of falling into financial distress.

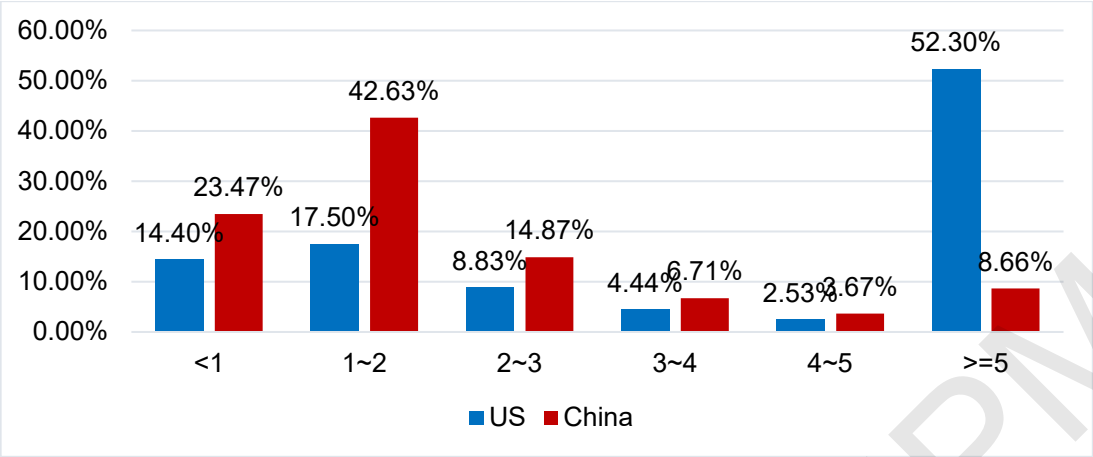

Figure 1.7: Comparison of Current Ratio Distribution Between US & Chinese Non-financial Listed Firms from 2007-2020
(Data source: Compustat & CSMAR databases, collated by Stata15.0, Microsoft Excel)

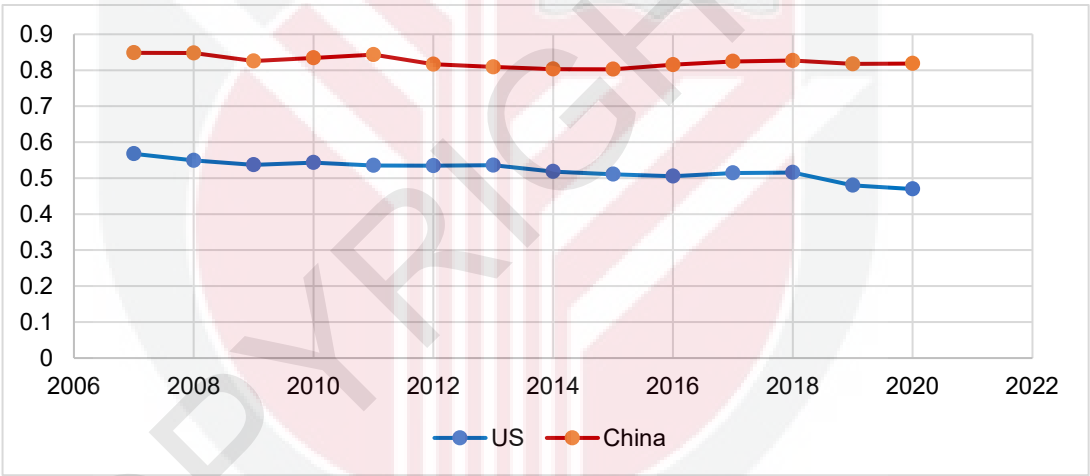

Figure 1.8: Comparison of Percentage of Current Liabilities to Total Liabilities Between US & Chinese Non-financial Listed Firms from 2007-2020
(Data source: Compustat & CSMAR databases, collated by Stata15.0 & Microsoft Excel)

1.1.4 Institutional Background

Compared to the well-founded market institutions in developed markets, the institutional protection of minority shareholders is usually lacking in emerging

economies (Young et al., 2008). As known, a lack of law leads to more opportunistic behavior (Williamson, 1979). Consequently, the interest encroachment of minority shareholders by controlling or majority shareholders in listed companies in developing countries and regions with inadequate laws manifests itself more seriously (Johnson et al., 2000).

While legal protection from regulators can affect the extent of conflicts between majority and minority shareholders (Dyck & Zingales, 2004), which we can call external constraints, another determinant is ownership concentration, which can be called internal constraints the more concentrated the ownership is, the easier for majority shareholders to make self-interested financial decisions (Franks & Mayer, 2001), including investment decision-making.

China has the typical characteristics of an emerging market: (1) lacking institutional protection for minority shareholders; (2) highly concentrated ownership structure of firms (Jiang & Kim, 2015), thereby making the agency conflict between controlling and minority shareholders the dominant agency problem in the Chinese economy (Jiang & Kim, 2020; Morck et al., 2005). Overall, China, now the largest emerging market in the world, lacks institutional protection for minority shareholders; most firms have highly concentrated ownership structures, and a large amount of controlling shareholders pledge their shares, making itself a natural lab for my empirical analyses for this study.

1.2 Problem Statement

The characteristics of an emerging market discussed above including highly concentrated ownership structures and a lack of institutional protection for minority shareholders, make the agency conflict between controlling and minority shareholders the dominant agency problem in China. Sorting out the relationship between CSSP, investment efficiency, and financial distress risk is very important both for the enterprise itself and the investors, and it is also a reference for regulators to formulate policies. China's past 20 years have experienced rapid economic growth, providing various investment opportunities for firms (Ding et al., 2018). CSSP arose during this process, becoming a popular and particular way for financing. Accompanied by CSSP, numerous firms completed fast expansions through internal investments, external set-ups, and mergers. Quite a few of these firms with CSSP ended with enforcement by financial institutions and then being delisted, making millions of atomistic shareholders hugely suffer.

What have these listed companies gone through from controlling shareholders' share pledges to enforcing pledged shares? These companies thoroughly have a commonality in that they massively invest in emerging industries and end in failure, e.g., Le TV (SZ.300104) invested in a new energy vehicles project, and KDX (SZ.002450) invested in optical and carbon fibre projects using the pledged funds by their controlling shareholders Jia Yueting and Zhong Yu, respectively. Massively investment expenditure and negative returns made KDX fail to repay the overdue bonds in 2019, and it was

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The investigation on relationships between CSSP and investment efficiency, investment efficiency, and financial distress risk, and CSSP and financial distress would uncover the role of controlling shareholders on firms' investment efficiency, contributing to the literature regarding investment efficiency, financial distress risk, and consequences of controlling shareholder governance. Also, it can deepen the theoretical revelations about the consequences of controlling shareholders' share pledges and provide empirical evidence for the theories, including agency theory, signaling theory, firm life circle theory, and stakeholder theory.

This research uses a deductive approach by quantitative method to realize the research objectives. Firstly, it proposes the hypotheses based on the theoretical framework and literature review. Secondly, it constructs the variables and sets up the models. Thirdly, it examines the models with statistical methods. Fourthly, it analyses the results. Finally, it draws the conclusions.

1.3 Research Questions

Quite a few listed companies with CSSP end up being enforced by financial institutions and being delisted or rearranged. These frequent failures of the listed firms with CSSP attract my concern and motivate me to research how these failures formed step by step. Specifically, the research questions of this thesis are as follows:

i. How does CSSP impact the firms' investment efficiency?
ii. How does investment efficiency impact financial distress risk?
iii. How does CSSP impact firms' financial distress risk?

1.4 Research Objectives

The overall research objective of this study is to reveal better the impacts of CSSP on investment efficiency, investment efficiency on financial distress risk, as well as CSSP on financial distress risk by incorporating the mechanisms of how the former impacts the latter and test whether the relations are significant in a large sample. Also, this study tries to better construct how the ties between

each two intertwine to impact the development of firms with CSSP. Specifically, this study aims to:

i. To examine the impacts of CSSP on firms' investment efficiency.

ii. To examine the impacts of firms' investment expenditure and efficiency on financial distress risk.

iii. To examine the impacts of CSSP on financial distress risk.

1.5 Significance of the Study

1.5.1 Theoretical Significance

This study takes cash flow as a thread of the internal correlations between CSSP, investment efficiency, and financial distress risk.

i. The two-step methodology enhances prior investigatory techniques concerning the factors influencing over-investment. Unlike previous approaches that solely regressed overinvestment expenditures on these factors (Chen et al., 2016; Dou et al., 2016; Li, 2020a), the approach takes into account their impact on the likelihood of over-investment.

ii. The research provides another perspective to analyse the causes of over-investment. Scholars used to attribute the over-investment to principle-agency (PA) conflicts (DeMarzo, 2002; Jensen, 1986; Kim, 2020; Xu et al., 2009) and free cash flow (Vogt, 1994; Klock & Thies, 1995; Alti, 2003; Richardson, 2006; Chen et al., 2016; Kwon et al., 2021). There is rare concern about the impacts of controlling shareholders' behavithes on over-investment. We reveal the changes in controlling shareholders' investing decisions after they pledge their shares, which directly facilitates over-investment.

iii. This study is first to assess the U-shaped relationship between the extent of under-investment and FDR. While the consequences of over-investment have been widely discussed (Dogru, 2017; Li, 2020b), under-investment has been largely overlooked. This study addresses this gap by enriching the literature on the relationship between under-investment and FDR.

iv. Previous research attributes over-investment to excess free cash flow (Alti, 2003; Chen et al., 2016; Klock & Thies, 1995; Kwon et al., 2021; Richardson, 2006; Vogt, 1994) and adverse selection by managers (Myers & Majluf, 1984; Li, 2021; Wang, 2020). The existing research related to under-investment is mainly about invest-cash-flow sensitivity (Fazzari et al., 1988; Hoshi et al., 1991; Schaller, 1993; Lu & Tang, 2005) and adverse selection by managers (Zhu & Xiong, 2020). Previous research regarding governance and financial distress risk has been concerned more with managerial characteristics and behaviors (Lee & Yeh, 2004; Shahwan, 2015; Wang & Cao, 2021). In sum, this literature regarding investment efficiency and financial distress emphasizes firms' managerial characteristics and behaviors while neglecting controlling shareholders' roles.

v. This study fleshes out the significance of principal-principal (PP) conflicts between dominant shareholders and minority shareholders, a crucial yet often neglected problem in corporate governance (Young et al., 2008). The impacting mechanism of CSSP on firms' investment is a new reflection of PP conflicts. As recognized, addressing PP conflicts in emerging economies could potentially enhance the quality of life for millions of investors (Morck et al., 2005).

vi. The findings of this study provide a comprehensive analysis of the impact of controlling shareholder's equity pledges on listed companies. While existing research findings are almost "lopsided" in exposing the negative impact of controlling shareholder's pledges on listed companies, this study explores the positive effects of controlling shareholder's equity pledges on listed companies and provides literature for subsequent studies on controlling shareholder's equity pledges.

vii. This study deepens the theoretical revelations about the consequences of CSSP and provides empirical evidence for the relationship between agency theory and signalling theory, supplementing Morris (1987). Also, this study utilizes life cycle theory to explain the impact of investment efficiency, agency theory, and stakeholder theory to analyze the role of CSSP on financial distress risk, respectively, which are applications in a new area for these theories.

1.5.2 Practical Significance

Controlling shareholders own most of the firms' shares, they have dominant decision-making rights for firms' operating, investing, and financing strategies. Therefore, their behaviors and decisions impact firms' investment efficiency,

and ultimately impact firms' financial situation. Especially in concentrated ownership firms gifting controlling shareholders stronger control, controlling shareholders' role on financial distress risk is more nonnegligible. However, rarely have scholars studied the role of controlling shareholders on investment efficiency and financial distress, or the effects of investment efficiency on financial distress. This study tries to fill these gaps to investigate the relationships between CSSP and investment efficiency, investment efficiency and financial distress risk, and CSSP and financial distress.

Research on the relationship between controlling shareholders' share pledges, investment efficiency, and financial distress in emerging markets has the managerial meanings as follows:

i. For regulators. The findings of this study may alert regulators to strengthen their policy formulation on controlling shareholder equity pledged loans, such as restricting the terms of pledges, in an effort to leverage the positive effects and discourage the negative effects of CSSP.

ii. For pledgee (financial institutes). The findings of this study may alert banks to be more cautious in reviewing loans to companies with CSSP to avoid creating greater credit risk for themselves to help controlling shareholders realise their private interests.

iii. For listed companies. The findings of this study can alert listed companies of cash flow problems, prudent investment and financing decisions, and constant vigilance against the occurrence of financial distress.

iv. For minority shareholders. The findings of this study can enlighten minority shareholders to pay attention to capital appropriation by controlling shareholders, assess the investment decisions of listed companies, address the financial distress of listed companies, and actively seek measures to protect their interests.

1.6 Chapter Summary

This chapter provided an overview of the overall research as a blueprint for the following few chapters by explaining the study's introduction, research background, problem statement, research objectives, questions, and significance.

The remainder of the contents is organized as follows. Chapter 2 attempts to review the studies, provide the underpinned theories, and develop the hypotheses for each research objective. Chapters 3 to 5 focus on the empirical designs of every objective, including methodology, data, and result discussions. Chapter 6 provides conclusions, implications, and recommendations of the thesis.

CHAPTER 2

LITERATURE REVIEW, THEORY, AND HYPOTHESES DESIGNS

2.1 Overview of CSSP

2.1.1 Motivations of CSSP

As the accounting information of controlling shareholders of the listed companies is not required to be publicly disclosed, scholars' studies can just use listed company data to infer the motivations why their controlling shareholders pledged shares. Jiang (2017) addresses that financing constraints, asset backing capacity, and credit ratings are important factors influencing the controlling shareholders' decision to pledge their equity. Motivations of controlling shareholders' shareholding pledges include: firstly, to alleviate the financial constraints of controlling shareholders (Huang & Han, 2014) & listed companies (Singh, 2018); secondly, to finance the investment for controlling shareholders (Ai & Wang, 2012; He et al., 2023); lastly, to obtain cash for particular purposes (Jiang, 2017). Wang (2020) & Wu (2019) analyze the motivations of CSSP of Great Town & ST Yinyi and Zhouji by analyzing the flow direction of pledging funds. Since current regulations do not require the disclosure of insiders' use of borrowed funds from non-listed firms according to Chinese economic law, no studies are based on the confirmed use of the pledged funds in detail.

2.1.2 Consequences of CSSP

There are two main branches of research on the economic consequences of CSSP: One is that CSSP exacerbates the separation of control and cash flow rights of listed companies (Ai & Wang, 2012; Hao & Liang, 2009), and further studies relative to which include: CSSP strengthens "hollowing out" effect (Wu & Wu, 2011 ; Zhang, 2020; Dang, 2022), decreases executive performance (Li & Xing, 2017), damages firm value (Dou et al., 2019; Hao & Liang, 2009; Zheng et al., 2014), and lessens dividend payout (Liao et al., 2018b; Xu & Huang, 2021).

The other branch is the risk of transfer of control to the company arising from the CSSP (Chan et al., 2018), relative researches include: CSSP decreases information disclosure quantity (Chen & Liu, 2013; Li et al., 2019; Li et al., 2024; Li & Xing, 2017), causing more irregularities of information disclosure; CSSP exacerbates the financial constraints of listed companies (Tang et al., 2019), reducing the lending willing of banks for listed companies (Zhai et al., 2020); CSSP exacerbates financial risk (Hao & Liang, 2009; Tian,2018; Wang, 2020); CSSP decreases R&D expenditure (Zhang et al., 2017); and CSSP might cause stock price collapse (Xie et al., 2016; Zhang, 2018).

For instance, Evergrande (3333. HK) was forced into liquidation this year, with only 3% of its US$331.94 billion debt being repaid to banks, resulting in more than 594 thousand investors losing their investment funds. Once the firms fall into liquidation or bankruptcy in courts, it implies the banks and other lenders

probably suffer losses. Hence, investigating the relationship between CSSP and corporate financial distress risk is crucial for both creditors and investors, and it also serves as a reference for regulators when formulating policies. Understanding the favorable and unfavorable effects of CSSP on firms' development matters to the development of developing economies due to the crucial position of CSSP.

Those companies thoroughly have a commonality in that they massively invest in emerging industries and end in failure, e.g., Le TV (SZ.300104) invested new energy vehicles project, and KDX (SZ.002450) invested in optical and carbon fiber projects using the pledged funds by their controlling shareholders Jia Yueting and Zhong Yu, respectively. Another commonality for these companies is that their collapse or being delisted brought huge losses to atomistic shareholders, e.g., following the collapse of KDX's share price (from $4.03 in 2017 to $0.03 in 2021) and then being delisted, more than 155 thousand investors suffered.

While most scholars concluded that CSSP are detrimental to many aspects of the listed companies, some researchers have contrary viewpoints. Wu (2016) reveals that when a controlling shareholder invests pledged funds in a listed company, the excess remuneration to the listed company is significantly higher than when the pledged funds are invested in the group of controlling shareholders. Li & Zheng (2015) documents that the market value management motive mitigates the encroachment of controlling shareholders on listed companies after share pledging. Using a sub-sample of major

shareholders pledging private equity and then lending to listed companies, Li et al. (2021) finds that major shareholders have strong incentives to support their facilitated companies in financial distress.

2.2 CSSP and Investment Efficiency

As discussed in 2.1, financing investment is one of the motivations for controlling shareholders to pledge their shares, which means that controlling shareholders' share pledges has come to be associated with investment from the beginning.

Investment efficiency includes over-investment and under-investment, which have different causes and processes. Previous research attributes over-investment to excess free cash flow (Alti, 2003; Chen et al., 2016; Klock & Thies, 1995; Kwon et al., 2021; Richardson, 2006; Vogt, 1994) and adverse selection by managers (Li et al., 2021; Myers & Majluf, 1984; Wang, 2020). However, rarely have scholars studied the impact of controlling shareholders on investment decisions that affect over-investment. In the Chinese context, the general meeting of shareholders is the highest authority of the enterprise. The controlling shareholder can decide on an investment plan, including when, where and how much to invest through their voting rights. So, the role of controlling shareholders on investment efficiency, especially over-investment, is significant. Compared to over-investment, previous research related to under-investment is mainly about invest-cash-flow sensitivity (Fazzari et al., 1988; Hoshi et al., 1991; Schaller, 1993; Lu & Tang, 2005) and adverse

selection by managers (Zhu & Xiong, 2020). However, no research on the impact of controlling shareholders' share pledges on under-investment through low-levelled operating cash flow due to controlling shareholders' encroachment (Hao & Liang, 2009; Wu & Wu, 2011; Zhang,2020; Dang, 2022).

This study analyzes the impact of controlling shareholder pledges on over-investment through investment decision-making and under-investment through invest-cash-flow sensitivity, respectively.

H1: Over-investment is more likely to occur when the firms' controlling shareholders participate in share pledging.

2.2.1 CSSP and Over-investment

There is no consistent conclusion about controlling shareholders and over-investment. Utilizing Chinese stock market data from 2006 to 2015, Xie & Wang (2017) find that CSSP raises over-investment in listed companies. Li (2020) documents that the controlling shareholder's equity pledge boosts firms' over-investment with pledged funds within the case study of ST Zhongnan (SZ.000717). On the contrary, Zhu and Xiong (2020) investigate the fact that equity pledges have an insignificant relationship with overinvestment. Zhang (2017) and Chang (2022) suggest that controlling shareholders' share pledges negatively correlated with R&D expenditure. These studies only examine the relationship between controlling shareholder's share pledging and over-investments, while these aim further to detect the mechanism in specific detail of how controlling shareholder's share pledging impacts firm over-investment.

Firstly, Chinese economic law stipulates that the dividends of the pledged shares are owned by the financial institution during the pledging period, making the controlling shareholders lose the cash flow rights of the pledged shares. This would force controlling shareholders to set up more subsidiaries by structuring pyramids and cross-shareholdings (Claessens et al., 2000; Jensen, 1986) to obtain substitute cash flow rights and more control. Also, setting subsidiaries through listed companies can save investment expenditure for controlling shareholders since the pyramid structure can get the ultimate controller the same control by investing less (Claessens et al., 2000).

Furthermore, investment in listed companies' names can send favorable messages to the market, leading to the investors' perception. After share pledging, controlling shareholders prefer the decision that can help maintain listed companies' share price to avoid the market downturn (Xie et al., 2016) and more collateral or paying back the principal (Chang et al., 2022). Investment pronounce can influence listed companies' stock price[1,2]. Hence, the investment projects determined by controlling shareholders would be in high-growth industries and industries with emerging technologies (Kumar et al., 2012), driven by the margin call pressure after they pledged their shares.

[1] KDX announced the establishment of Jiangsu KDX Carbon Fiber Composite Material Co. on 6th November 2014 and its stock price rose 9.44% in the following 3 weeks (from $1.67 to $1.81) and continuously rose in the following two years. Another announcement on the acquisition of Dimenco for naked-eye 3D projects and the investment of $0.37 billion made its stock price continuously rise in the following year, reaching $3.67 at the peak. (https://finance.sina.com.cn/realstock/company/sz002450/nc.shtml)

[2] Tesla (TSLA: NASDAQ GS) made announcement to confirm the $3.6 billion investment for Nevada expansion to make Semi truck, battery cells on 25th January 2023. Its stock price rose 48.33% in the following three weeks (from $ 144.43 on 25th January to $214.24 on 15th February) and continuously rose in the following months. (https://www.nasdaq.com/market-activity/stocks/tsla).

From the signaling point of view, the information disclosures about the selected investment projects are the signals used by controlling shareholders to convince potential investors of their stocks' values. To avoid the bad influence on the stock price, sometimes firms have to continuously invest in the projects even when they appear to return less. Gaining these distinguished signals is the signaling cost (Spence, 1973). People would choose to signal when the signaling cost is less than the loss if they do not do it. In this situation, the returns of the investment projects are co-borne by all the shareholders, while the margin call result is only borne by the controlling shareholders. Controlling shareholders would vote for the investment projects for their own benefit (Porta et al., 1999; Shleifer & Vishy, 1997).

Moreover, the influences of controlling shareholder's share pledging on firms' financing are competitive. On the one hand, CSSP reduces firms' cash-holding (Xing, 2018) and restricts external funding by reducing the lending will of banks (Zhai et al., 2020), thereby exacerbating the financial constraints (Tang et al., 2019) of the firms. Financing constraints can restrict firms' investment expenditure (Fazzari et al., 1988; Myers & Majluf, 1984). On the other hand, these effects can be counteracted if controlling shareholders finance the firms' investment with pledged funds (Jiang, 2017; Li et al., 2021).

Previous research attributes over-investment to excess free cash flow (Alti, 2003; Chen et al., 2016; Klock & Thies, 1995; Kwon et al., 2021; Richardson, 2006; Vogt, 1994) and agency conflicts (DeMarzo, 2002; Jensen, 1986; Kim, 2020; Xu et al., 2009), especially adverse selection by managers (Li & Li, 2021;

Myers & Majluf, 1984; Wang, 2020). Rare scholars have yet to study the impact of dominating shareholders' behavior on firms' investment. Although the correlation between CSSP and free cash flow has yet to be explored, it is clear that CSSP can affect over-investment explicitly by influencing shareholders' investment decision-making.

Collectively, this study set hypotheses as follows.

H2: CSSP has positive impacts on firms' over-investment.

There is also some research on ownership structure and investment. A firm's capital structure is irrelevant to investment (Cho, 1998) because external funds serve as an ideal alternative to internal capital (Fazzari et al., 1988). Wang (2021) concludes that equity concentration significantly improves energy companies' investment efficiency, especially when the decision-making power is decentralized. Ramírez (2022) shows that greater ownership concentration amplifies the responsiveness of expansion investments to shifts in a company's cash flow. This suggests that increased ownership concentration magnifies excessive investment tendencies, whereas a higher proportion of tradable shares, a larger board size of supervisors, or greater leverage help alleviate this effect. According to Chen's (2016) findings, an increase in ownership concentration leads to a rise in over-investment.

According to Chinese Corporate Law, controlling shareholders are those who possess voting rights significant enough to dominate the resolutions during shareholders' meetings (Dharwadkar et al., 2000). The controlling

shareholders can decide on investment plans, including when, where, and how much to invest through their voting rights. Naturally, the more concentrated the ownership of the firm is, the more minor the restriction to controlling shareholders from minority shareholders. Especially when these controlling shareholders pledge their shares, the wedge between control and cash flow rights will be more significant (Ai & Wang, 2012; Hao & Liang, 2009). In turn, as the gap widens, the conflicts arising from agency problems and information asymmetry between controlling shareholders and minority shareholders become increasingly severe, it creates a moral hazard situation because the financial gains resulting from expropriation surpass the financial costs for the controlling shareholder (Young et al., 2008).

H3: The impact of CSSP on firms' over-investment would be more pronounced among the firms characterized by concentrated ownership.

2.2.2 CSSP and Under-investment

Gao (2019), Li (2020a), Zhang (2018), and Zhu & Xiong (2020) employ the negative residual of Richardson (2006) as a proxy for an under-investment degree and consistently conclude that CSSP exacerbates under-investment. These researches consider the impact of CSSP on under-investment degrees while neglecting the impact of CSSP on investment expenditure. Referring to the definition of under-(over-)investment by Richardson (2006) As shortfall (excess) to optimal investment expenditure, the under-(over-) investment degree can more correctly proxy for under-(over-) investment together with investment expenditure.

Li (2020a) & Zhang (2018) attribute the impacts of CSSP on under-investment to the financial constraints caused by CSSP, while Zhu & Xiong (2020) attribute it to agency conflicts caused by loose internal control. Alternatively, Gao (2019) utilizes the absolute value of residuals as the proxy variable for inefficient investment degree to empirically examine the relationship between controlling shareholders' share pledges and investment efficiency, concluding a positive relationship between CSSP and investment efficiency through the reduction of free cash flow of the listed company through the direct appropriation of controlling shareholders, which verified the free cash flow hypothesis. However, there is a conflict in his research that the reduction of free cash flow cannot make both under-investment and over-investment at the same point according to the free cash flow hypothesis.

As discussed above, firms with CSSP are deemed to be more prone to over-investment and invest more in distinguishable projects to convey good messages to the market through controlling shareholders' dominant decision-making rights. On the other hand, an under-investment problem may arise when firms find that external financing is sufficiently expensive. They must reduce investment spending when internally generated cash flows are insufficient to finance growth opportunities (Gay & Nam, 1998).

From the signaling viewpoint, CSSP increases firms' investment expenditure, but on the other side, firms with CSSP may have less cash to invest due to severer financial constraints. Hence, this research constructs the fourth hypothesis as follows:

H4: CSSP has a negative impact on firms' under-investment.

2.3 Review of Financial Distress Risk

2.3.1 Formation of Financial Distress

Beaver (1966) and Gordon (1971) yield that financial distress originates from a fall in a corporation's earning power and then, at some point, creates a non-trivial probability that it would not be able to pay the interest and principal on its debt. Since debts due within one year are reflected in current liabilities in accounting, the inability to settle debts as they fall due begins with the inability to settle current liabilities. A firm is in financial distress at a given point in time when the firm's liquid assets are not sufficient to meet the current liquidity requirements of its hard contracts. (John, 1993a). A hard contract is a coupon debt contract that specifies periodic payments by the firm to the creditors.

Scholars refer to insolvency as the "insolvency" problem. Sometimes, cash flow shortfalls can be temporary, which can be mitigated by financing. But it also can make the operating and financial cycles unsustainable or even such situations can be classified as "illiquidity". If the problem cannot be solved in the short term, it may become financial distress in the long term (Zhuang & Mao, 2006).

The essence of liquidity is the distribution of cash flows in a firm's normal operating activities and the rearrangement of cash flows through financial management activities. According to Zhuang & Mao (2006), short-term liquidity

affects the firm's ability to make immediate payments, and the ability to repay debt is a sign of the firm's ability to pay. Long-term liquidity is expressed in the optimal composition of assets and capital, which affects the ability of the enterprise to obtain cash, with the speed and cost of converting assets into cash marking the ability of the enterprise to obtain cash.

The sustainable development of an enterprise is supported by sustainable financial res, the basic premise of which is the organic coordination between the asset structure and the capital structure. Short-term liquidity or long-term liquidity difficulties can affect the ability of an enterprise to obtain cash and to pay cash and ultimately become the trigger for financial distress (Mao, 2003).

2.3.2 Determinants of Financial Distress Risk

As mentioned in 1.3, financial distress risk is defined as the probability that firms' cash flow is insufficient to settle debts in this study.

The triggers that lead the company into financial distress include both internal and external factors. The internal factors include: strategy choice (Wang & Cao, 2021; Jiang & Liu, 2011; Zhuang & Mao, 2006), financial res (Hoshi et al., 1990; Zhao & Huchzermeier, 2019), and managerial ability (Jiang & Liu, 2011; Lee & Yeh, 2004; Shahwan, 2015; Wang & Cao, 2021). The external factors include the competitive environment and macroeconomic factors (ElBannan, 2021a; Pham Vo Ninh et al., 2018; Pindado et al., 2008). Wang (2005) found that the weakness of corporate governance, such as investor

protection, corporate governance, and external guarantees, was the most important reason why companies were in financial distress. Deng (2014) addresses that the growth of price level, interest rate level, growth, and stock price index are closely related to the probability of financial distress of a company. Using data from 11 emerging countries, ElBannan (2021) provides evidence that matured, profitable, liquid, small firms with high market-to-book ratios and low asset growth are less prone to financial distress.

However, previous research places emphasis on the impacts of managerial behaviors on financial distress risk (Lee & Yeh, 2004; Shahwan, 2015; Wang & Cao, 2021), while neglecting the controlling shareholders' role. This study tries to fill this gap by investigating the role of controlling shareholders on firms' financial distress risk through their decision-making right for firms' operating, investing, and financing activities.

2.3.3 Manifestations of Financial Distress Risk

Financial distress can manifest itself in a number of ways, including debt default, an overdrawn bank account, inequation of cash flow, nonpayment of a preferred stock dividend, or share price collapse. Possible outcomes of financial distress include recovery, bankruptcy, liquidation, and rearrangement.

Common measures of financial distress used by academics include profitability criteria, cash flow-related criteria, and comprehensive indicators taking both profitability and cash flow factors into account. Profitability criteria include

negative net earnings (Dai & Song, 2022), negative earnings before interest and tax (e.g. John, 1993b), negative net income before extraordinary items (e.g. Dai et al., 2020; Hofer et al., 2005), negative earnings before interest, taxes, depreciation, and amortization interest coverage (Asquith et al., 1994), and meeting the conditions of the three above (Platt, 2006); liquidity-related ratio, including debt ratio to equity, long-term debt to equity (Murphy et al., 1996), total debt scaled by the total asset (e.g. Ohlson, 1980); liquidity-related ratio, including current ratio (Casey & Bartczak, 1985; Chen & Liu, 2015; John et al., 2013) and cash ratio (Gentry et al., 1985); Leverage (Dichev & Skinner, 2002; Modigliani; & Miller, 1958). Z-score (Altman, 1968a) is a comprehensive index calculated by profitability indicators.

Cash flow-related criteria include cash flow scaled by total debt (Beaver, 1966; Deakin, 1972), cash flow less than current maturities of long-term debt (Whitaker, 1999), cash scaled by interest cover (e.g. Asquith, Gertner and Scharfstein, 1994; DeAngelo et al., 2002), cash flow patterns (e.g. Shamsudin, 2015); and other criteria including industry-relative ratios (Platt & Platt, 2002), and layoffs, restructurings, or missed dividend payments (e.g. Lau, 1987).

Cash flow criteria are more convinced to reflect firms' financial distress risk than profitability criteria. Previous research documents that profitability measures mean-revert over time (Brooks & Buckmaster, 1976; Fairfield et al., 1996; Fama, 2002; Freeman et al., 1982; Nissim & Penman, 1999). While profitable information is accrual, the cash flow category is largely independent of accounting policy choices and is consistent with the financial valuation

principle that the value of a corporate is the net present value of expected cash flows. Cash flow-type variables have both relative and incremental information content compared to accrual-based accounting variables (Chen, 1999).

The mixed indicator coverage ratio can select firms experiencing an immediate cash-flow crisis (Hoshi et al., 1990). Specifically, he identified all firms whose operating income was greater than their interest payments in one year (greater than one), but less in the next two (Hoshi et al., 1990). The comprehensive indicator O-score (Ohlson, 1980), which takes both profitability and cash flow factors into account, is extensively used (e.g., Boubaker et al., 2020; Dechow et al., 1998; Hou et al., 2020).

In China, scholars have tended to use being specially treated (ST) by SEC as a proxy variable for financial distress (Li, 2020b; Li et al., 2019; Sun et al., 2014; Wang, 2020), the criteria for ST for listed companies in China are (i) two consecutive years of losses or net assets per share below the par value of the stock; (ii) recent shareholders' equity below the registered capital; and (iii) audit reports and other that are unable to express an opinion or negative opinion for the year. It can be seen that the criteria for ST emphasize the profitability of the company, while there are no specific criteria for cash flow.

However, listed companies in financial distress in recent years such as KDX, Evergrande and Le TV went bankrupt without going through the ST process, but were directly unable to pay their debts as they fell due. Therefore, ST as a

measure of financial distress of listed companies has a lagging nature and the risk of not really reflecting the financial position of the company.

2.4 Investment Efficiency and Financial Distress Risk

Debt repayments on investments funded with external financing put a pressure on the company's cash flows. Still, there might be a considerable time-lag before productivity gains from the investments emerge, and in the worst case the investments may have a negative return. Furthermore, investments tend to increase the operational costs of installing, operating and maintaining new technology or production equipment (Männasoo et al., 2018).

2.4.1 Over-investment and Financial Distress Risk

Previous studies examining overinvestment and financial distress are rare. Diversification beyond firms' financial capacity can pose a financial risk to the business (Zhuang & Mao, 2006). Li (2017) argues that company's overdriving growth speed significantly increases the probability of financial distress, through examining the relationship between the growth rate of and the financial distress probability. Hao & Liang (2009) decompose the value of the company into two parts: the value of assets and the value of growth. The empirical results suggest that a reasonable growth rate of the enterprise will bring more value growth to the enterprise, while excessive growth of the enterprise will increase the possibility of the enterprise's financial distress.

Over-investment affects financial distress through cash flow in two ways. One is that excessive investment expenses reduce firms' cash holding and lower investment returns, enhancing the subsequent cash flow. Referring to (Keynes, 1936), prevention is one of the motivations for companies to hold cash. Excessive investment expenses exceed the level firms can afford will reduce the firms' solvency. The other one is that lower investment returns will enhance the subsequent cash flow. According to the life cycle theory, the project yields no cash return until it is actually completed (Majd, 1985) because it takes time to build. The subsequent reduction in cash flow will further reduce the solvency of the business and increase the likelihood of the business falling into financial distress. If a firm invests in projects with NPV < 0, the risk of over-investment worsening the firm's financial distress will be more intensive.

H5: Over-investment exacerbates the financial distress risk.

2.4.2 Under-investment and Financial Distress Risk

Previous studies related to under-investment focus on the effects of financial constraints on under-investment (Bond & Meghir, 1994; Fazzari et al., 1988; Hu & Schiantarelli, 1998; Kaplan & Zingales, 2000) and investment-cash flow sensitivity (Fazzari et al., 1988; Hoshi et al., 1991; Schaller, 1993; Lu & Tang, 2005). Research on the effects of under-investment on financial distress risk is rare, but under-investment can affect financial distress risk in the aspects as follows.

On the one hand, according to firm life circle theory, the investment expenditure can cause the subsequent reduction in cash flow in the following year, reducing the solvency of the business and increasing the likelihood of the business falling into financial distress. Hence, less investment expenditure will alleviate the shortfall of cash flows in the investing year and the short-term future, avoid the NPV<0 projects, and positively impact financial distress risk.

On the other hand, under-investment means firms forgo NPV>0 projects, which will have a detrimental effect on firms' long-term investing cash flows. As well as it will damage firms' normal operations if the under-investment is too severe regarding maintenance investment. Because maintenance investment is to keep firms' asset in place, including service the debt due (Richardson, 2006). The declining operating cash flow can also raise firms' financial distress risk since operating cash flow is the endogenous financing source for firms with both lowest cost and risk according to pecking order theory and static trade-off theory.

Taking together, this study conjectures that there may be a threshold under which, under-investment can alleviate firms' financial distress risk, while exceeding it will have the opposite impact, which results in the hypothesis as follows:

H6: Under-investment has a U-shaped relationship with financial distress risk.

2.5 CSSP and Financial Distress Risk

Previous research has addressed that CSSP increases the encroachment of controlling shareholders on listed companies (Hao & Liang, 2009; Wu & Wu, 2011; Zhang, 2020; Dang, 2022), triggers the true surplus management of listed companies (Wang & Song,2002, Chen & Liu, 2013; Li & Xing, 2017; Li et al., 2019), making the company's information quality worse and more likely to be punished by the regulator. The counterproductive thing is that, low-quality information disclosure will affect listed companies' access to external financing (Chen et al., 2013), intensify the lending constraints faced by listed companies when it comes to bank loans (Zhai et al., 2020), and thereby cause financing constraints (Tang et al., 2019), increasing financial distress risk of listed firms.

Zhang (2020) examines the exacerbating role of controlling shareholders' behaviors, including encroachment and embezzling, in the financial distress of Huishan Milk caused by debt defaults. Dang (2022) uses the Z-score as a proxy variable for financial risk to empirically test the existence of a correlation between CSSP and financial risk. Wang & Cao (2021) use structural equations to examine the mediating role of CSSP on financial risk, and find that the role of surplus management and capital appropriation was significant. Lee & Yeh (2004) present that the results suggest that the greater the deviation in control rights from cash flow rights, the more directors and supervisors controlled by the largest shareholder, combined with the higher the stock pledge ratio, the greater the likelihood the firm would get into financial distress in the following year. However, they have not explained the channels through which controlling shareholders' share pledges influence financial distress risk.

Controlling shareholders' encroachment behaviors and decisions for their private benefits with their control rights are PP conflicts between controlling and minority shareholders, both of which can influence firms' cash flows, including operating, investing, and financing cash flows. Specifically, controlling shareholders' encroachment behaviors include receivables against payables or underpayments (Lu & Tang, 2005) and transferring assets at low prices using accounts payable both of which can reduce firms' operating cash flow. Now the embezzlement is becoming more subtle (Gong et al., 2021), setting up a subsidiary in the name of the listed company and then transferring the equity to the controlling shareholder at a low price now is a commonly used way, which will reduce the returns of investment of listed companies.

Furthermore, CSSP exacerbates firms' adding investment expenditure while reducing firms' maintenance and R&D investments, as discussed in Section 3. The former reduces firms' investing cash flows, while the latter damages firms' operating cash flows and long-term development. Operating cash flow is the internal financing for firms (Zhuang & Mao, 2006). Firms with CSSP need more external financing to supplement internal financing (Fazzari et al., 1988) to finance the increasing investment. However, CSSP also increases the cost and shortens the terms of the bank loans (Zhai et al., 2020), which is the most popular financing channel in China.

Static trade-off theory specifies that internal financing not only offers the lowest cost of financing but also the lowest financial risk to the company according to the, and the double advantage makes it the safest form of financing. Debt

financing, especially short-term debt financing, although it has the advantages of low cost and tax shield compared to equity financing, it puts the most financial pressure on the business.

Overall, listed companies may risk a break in their capital chain If the operating cash flow fails to keep up, along with more investing expenditure and external financing restrictions, trapped into financial distress. Thereby this research sets the hypothesis about CSSP and firms' financial distress risk as follows:

H7: CSSP exacerbates corporate financial distress risk.

While CSSP exacerbates corporate financial distress risk through detrimental impacts on cash flows, there may be the opposite impact if controlling shareholders put pledged funds into listed companies. Wang (2020) compares the effects of "hollowing out" and "support" intention of controlling shareholders while equity pledges, which lead to the opposite flowing direction of pledged funds, and has opposite effects on financial distress risk in the case of firms of Great Town & ST Yinyi, respectively. Using a sub-sample of listed firms that get pledged funds financing by large shareholders, Li et al. (2021) find that large shareholders have strong incentives to support their facilitated firms in financial distress.

Compared to the PP conflicts in the agency theory due to control benefit, controlling shareholders' stakeholder identity in the stakeholder theory makes them prop up the companies under certain conditions with their private s (Friedman & Miles, 2002; Li et al., 2021). Controlling shareholders have not

lost control of the listed company while their shares are being pledged, long-term future dividend rights, and the shell values (Dyck & Zingales, 2004) of listed companies will limit the controlling shareholders' encroachment. Because that "hollowing out" is akin to "killing the chicken to get the egg", is contrary to the assumption of a rational economic person and is not consistent with the sustainability of control gains. As a result, the controlling shareholders' share pledges will increase the solvency of listed companies when controlling shareholders invest pledged funds into listed companies (Wu, 2016). Due to margin call pressure, the market value management motive stimulates a better supervisory of the listed company's operations and management from controlling shareholders (Li & Zheng, 2015). Plus, controlling shareholders are the main bearers of the loss of the delisting or bankruptcy of a listed company, they will do what they can to help the listed company pass its financial distress, e.g. providing funding support to listed companies (Li et al., 2021).

As whether the controlling shareholders hollow out a business or support it depends on the external macroeconomic environment and the financial position of the business (Li et al., 2021; Peng et al., 2011), this thesis set the hypothesis as follows:

H8: The exacerbating effect of CSSP on financial distress risk decreases as firms' financial distress risk increases.

2.6 Theoretical & Conceptual Framework

2.6.1 Theoretical Framework

The research will focus on relationships between CSSP & investment efficiency, investment efficiency & financial distress risk, and CSSP & financial distress risk.

Firstly, this study begins with analysing two direct economic consequences of CSSP, namely the separation of control and cash flow rights and the risk of transfer of control. The former will cause a private gain of control, including encroachments and blind expansion of control according to principle-agency theory, while the latter will lead to market value management according to signaling theory. Both the motivation of market value management and blind expansion can cause over-investment, respectively, according to signaling theory and principle-agency theory, while encroachments can lead to under-investment, according to the pecking order theory.

Secondly, according to the previous study (Keynes, 1936), prevention is one of the motivations for companies to hold cash. Over-investment can cause excessive investment expenditures, reducing the firm's investing cash flow and thereby reducing the firm’s solvency. Furthermore, lower investment returns will further diminish the subsequent cash flow. According to the life cycle theory, the project yields no cash return until it is actually completed (Majd, 1985) because it takes time to build. The subsequent reduction in cash flow

will further reduce the solvency of the business and increase the likelihood of the business falling into financial distress. If a firm invests in projects with NPV < 0, the exacerbating effect of over-investment on the firm's financial distress risk will be more intensive.

Although financial constraints cause under-investment, under-investment has feeding-back effects on the process from financial constraints to financial distress, including both mitigating and exacerbating effects. Specifically, under-investment can mitigate financial constraints because it reduces the investment expenses and negative cash flow of investment in the short term if there is a shortfall in adding investment; however, if there is a shortfall in maintenance investment, it will reduce the operating cash flow of the business and increase the likelihood of the business falling into financial distress, because operating cash flow is the endogenous financing source for firms with lowest cost and risk according to static trade-off theory.

Eventually, CSSP has competitive effects on financial distress. On one hand, according to principle-agency theory, the controlling shareholders' share pledges increase the controlling shareholders' encroachment on listed companies (Dang, 2022; Dou et al., 2019; Hao & Liang, 2009; Lee, 2005; Wu & Wu, 2011). Being hollowed out itself will reduce the cash of listed companies, weaken their solvency and exacerbate the risk of financial distress; in addition, previous scholars based on CSSP to strengthen the hollowing out effect found that CSSP will reduce the quality of accounting information (Chen & Liu, 2013; Lee, 2005; Li & Xing, 2017), which in turn will increase the external financing

restrictions (Chen et al., 2013; Tang et al., 2019; Zhai et al., 2020) of listed companies according to signalling theory. Being hollowed out, over-investment and external financing restrictions gradually accumulate cash shortages, more probably leading companies into financial distress.

On the other hand, controlling shareholders do not lose control of the listed company when their shares are pledged. If shareholders' shares are pledged only to empty the motive, this will increase the risk of a decline in listed performance or even bankruptcy (Dang, 2022), and controlling shareholders remain the main bearers of this risk. So, the "hollowed out", akin to "killing the chicken to get the egg", is contrary to the assumption of a rational economic person. In addition, "hollowed out" is not consistent with the sustainability of control gains. Plus, CSSP also brings margin call pressure to the controlling shareholder (Chan et al., 2018); once the share price of a listed company falls, the controlling shareholder will be under pressure to increase the pledge or pay off the debt early; otherwise the control of the listed company will be transferred to the bank. Therefore, controlling shareholders whose equity is pledged have a greater incentive to monitor management to improve the listed company's performance, reduce operational risk and maintain the share price.

In summary of the discussion above, cash flow acts as the rope that controlling shareholders' share pledges, investment efficiency, and financial distress are strung on.

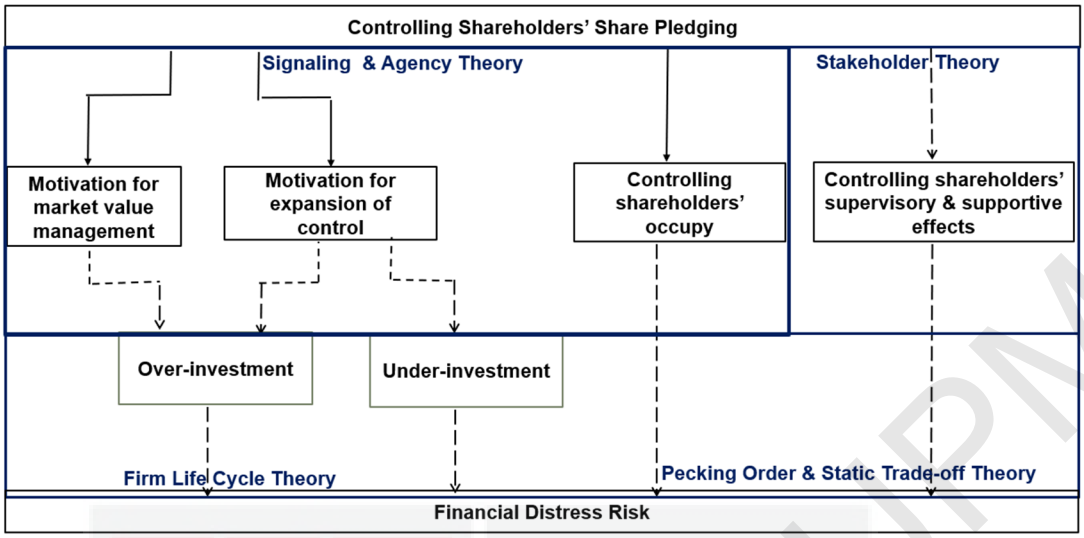


Figure 2.1: Theoretical Framework
(Source: Manually made by PowerPoint)

2.6.2 Conceptual Framework

This study will empirically test relationships between CSSP and investment efficiency, investment efficiency and financial distress risk, and CSSP and financial distress risk, respectively. Specifically, the explanation of the conceptual framework (shown in Figure 2.2) is as follows.

Firstly, this study will examine the relationship between CSSP and investment efficiency. This study will initially examine the relationship between CSSP and inefficient investment tendency to examine whether firms with CSSP are more prone to invest more or less (H1). Then, this study will examine the relationship between CSSP and over- (H2), and under-investment (H4). In the relationship between CSSP and over-investment, this study will also examine the moderating effect of firms' ownership concentration (H3).

Secondly, this study will separately examine the relationship between over-investment and financial distress risk (H5) and under-investment and financial distress risk (H6). Based on the different relationship types between over-investment and under-investment and financial distress risk, this study will examine them with different methods.

Lastly, this study will examine the relationship between CSSP and financial distress risk. Initially, this study will examine the general relationship between CSSP and financial distress risk (H7). Subsequently, this study will use hierarchical regression to examine the change of the role of controlling shareholders on firms' financial distress risk (H8).

This study will also use the data of Chinese A-share listed companies from 2007 to 2020 as an entire sample, build models, and conduct empirical analysis to draw conclusions.

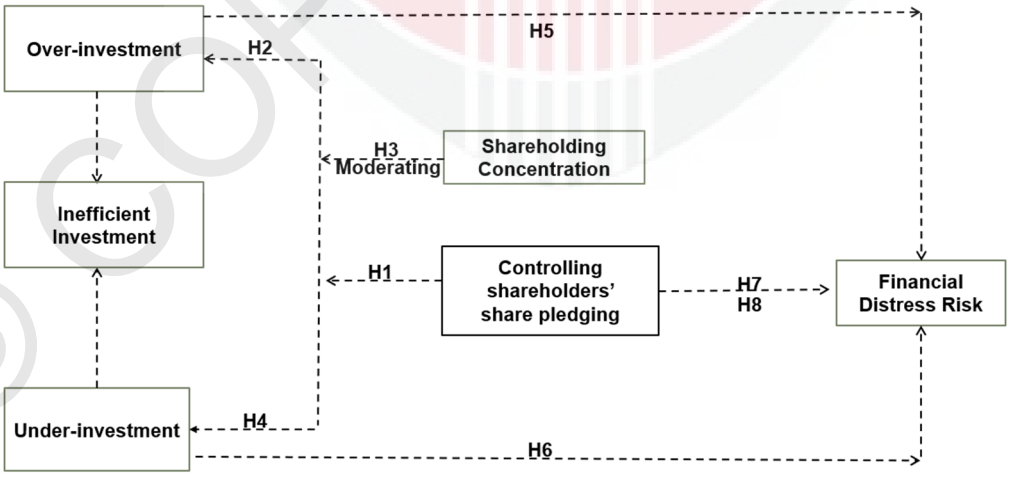


Figure 2.2: Conceptual Framework
(Source: Manually made by PowerPoint)

2.7 Research Gaps

2.7.1 Research Gap in the Consequences of CSSP

Until today, most research about CSSP boils down to agency problems between major and minority shareholders, regardless of the viewpoint of the separation of cash flow rights and control or the transfer of control. In the meantime, there is little research about the impact of CSSP on cash flows. Xing (2018) finds a U-shaped relationship between the pledges ratio of CSSP and firms' cash holding. Zhai et al. (2020) yield CSSP reduces the amount of bank loan financing available, and Tang et al. (2019) document that listed companies with CSSP have higher overall financing constraints. Research is necessary

Alternatively, Gao (2019) utilizes the absolute value of residuals as the proxy variable for inefficient investment degree to empirically examine the relationship between CSSP and investment efficiency, concluding a positive relationship between CSSP and investment efficiency through the reduction of free cash flow of the listed company through the direct appropriation of controlling shareholders, which verified the free cash flow hypothesis. However, there is a conflict in his research that the reduction of free cash flow cannot make both under-investment and over-investment at the same point according to the free cash flow hypothesis.

2.7.2 Research Gap in the Relationship Between CSSP and Investment Efficiency

Investment efficiency includes over-investment and under-investment, which have different causes and processes. Previous research attributes over-investment to excess free cash flow (Alti, 2003; Chen et al., 2016; Klock & Thies, 1995; Kwon et al., 2021; Richardson, 2006; Vogt, 1994) and adverse selection by managers (Myers & Majluf, 1984; Li, 2021; Wang, 2020). However, rarely have scholars studied the impact of controlling shareholders on investment decisions that affect over-investment. In the Chinese context, the general meeting of shareholders is the highest authority of the enterprise. The controlling shareholder can decide on an investment plan, including when, where, and how much to invest through their voting rights. So, the role of controlling shareholders on investment efficiency, especially over-investment, is significant. Compared to over-investment, previous research related to under-investment is mainly about invest-cash-flow sensitivity (Fazzari et al., 1988; Hoshi et al., 1991; Schaller, 1993; Lu & Tang, 2005) and adverse selection by managers (Zhu & Xiong, 2020). However, no research on the impact of controlling shareholders' share pledges on under-investment through low-leveled operating cash flow due to controlling shareholders' encroachment (Hao & Liang, 2009; Wu & Wu, 2011; Zhang,2020; Dang, 2022).

There is no consistent conclusion about controlling shareholders and over-investment. Utilizing Chinese stock market data from 2006 to 2015, Xie & Wang (2017) find that CSSP raises over-investment in listed companies. Li (2020) documents that the controlling shareholder's equity pledge boosts

firms' over-investment with pledged funds within the case study of ST Zhongnan (SZ.000717). On the contrary, Zhu and Xiong (2020) investigate that equity pledges have an insignificant relationship with overinvestment. Zhang (2017) and Chang (2022) suggest that controlling shareholders' share pledges negatively correlated with R&D expenditure. These studies only examine the relationship between controlling shareholder's share pledging and over-investments, while these aim further to detect the mechanism in specific detail of how controlling shareholder's share pledging impacts firm over-investment.

2.7.3 Research Gap in Financial Distress Risk

Previous research places emphasis on the impacts of managerial characteristics and behaviors on financial distress risk (Lee & Yeh, 2004; Shahwan, 2015; Wang & Cao, 2021) while neglecting the controlling shareholders' role. Controlling shareholders own most of the firms' shares, they have dominant decision-making rights for firms' operating, investing, and financing strategies. Therefore, their behaviors and decisions ultimately impact firms' financial situation. Especially in concentrated ownership firms gifting controlling shareholders stronger control, controlling shareholders' role on financial distress risk is more nonnegligible. This study tries to fill this gap by investigating the role of controlling shareholders in firms' financial distress risk in the context of share pledging.

Different from the literature generally examining the relationship between CSSP and FDR (Dang, 2022), this study explores the change of this relationship along with the intensification of FDR, and it also probes the diverse channels through which CSSP impacts FDR more accurately and holistically than Dang (2022) only uses other receivables proxying for controlling shareholders' occupancy. This study also analyzes the theoretical internal links between controlling shareholders' behaviors and FDR according to the double identities of controlling shareholders, as principals in agency theory and stakeholders in stakeholder theory.

This study uses Ohlson's (1980) *O-score* as the dependent variable in the baseline tests. *O-score* is a cash flow-type variable. Cash flow-type variables have both relative and incremental information content compared to accrual-based accounting variables (Chen, 1999). Cash flow criteria are more likely to reflect firms' FDR, profitability measures mean-revert over time (Fama, 2002; 1982; Nissim & Penman, 1999). While profitable information is accrual, the cash flow category is largely independent of accounting policy choices and is consistent with the financial valuation principle that the value of a corporation is the net present value of expected cash flows (Beaver, 1998).

2.7.4 Research Gap in the Relationship Between Investment Efficiency and Financial Distress Risk

Previous studies examining overinvestment and financial distress are rare. Diversification beyond firms' financial capacity can pose a financial risk to the business (Zhuang & Mao, 2006). Li (2017) argues that a company's

overdriving growth speed significantly increases the probability of financial distress by examining the relationship between the growth rate and the financial distress probability. Hao & Liang (2009) decompose the value of the company into two parts: the value of assets and the value of growth. The empirical results suggest that a reasonable growth rate of the enterprise will bring more value growth to the enterprise, while excessive growth of the enterprise will increase the possibility of the enterprise's financial distress.

Previous studies related to under-investment focus on the effects of financial constraints on under-investment (Bond & Meghir, 1994; Fazzari et al., 1988; Hu & Schiantarelli, 1998; Kaplan & Zingales, 2000) and investment-cash flow sensitivity (Fazzari et al., 1988; Hoshi et al., 1991; Schaller, 1993; Lu & Tang, 2005). Research on the effects of under-investment on financial distress risk is rare, but under-investment can affect financial distress risk in many aspects.

2.7.5 Research Gap in the Relationship Between CSSP and Financial Distress Risk

Previous research has addressed that CSSP increases the encroachment of controlling shareholders on listed companies (Hao & Liang, 2009; Wu & Wu, 2011; Zhang, 2020; Dang, 2022), triggers the true surplus management of listed companies (Wang & Song,2002; Chen & Liu, 2013; Li & Xing, 2017; Li et al., 2019), making the company's information quality worse and more likely to be punished by the regulator. The counterproductive thing is that, low-quality information disclosure will affect listed companies' access to external financing (Chen et al., 2013), intensify the lending constraints faced by listed companies

when it comes to bank loans (Zhai et al., 2020), and thereby cause financing constraints (Tang et al., 2019), increasing financial distress risk of listed firms.

Zhang (2020) examines the exacerbating role of controlling shareholders' behaviors, including encroachment and embezzling, in the financial distress of Huishan Milk caused by debt defaults. Dang (2022) uses the Z-score as a proxy variable for financial risk to empirically test the existence of a correlation between CSSP and financial risk. Wang & Cao (2021) use structural equations to examine the mediating role of CSSP on financial risk, and find that the role of surplus management and capital appropriation was significant. Lee & Yeh (2004) present that the results suggest that the greater the deviation in control rights from cash flow rights, the more directors and supervisors controlled by the largest shareholder, combined with the higher the stock pledge ratio, the greater the likelihood the firm would get into financial distress in the following year. However, they have not explained the channels through which controlling shareholders' share pledges influence financial distress risk.

Overall, Previous literature on the consequences of CSSP focuses on some aspects of firms' development, e.g. executive performance (Li & Xing, 2017), firm value (Dou et al., 2019; Hao & Liang, 2009; Zheng et al., 2014), and dividend payouts (Liao et al., 2018b; Xu & Huang, 2021)This study takes the next step in uncovering CSSP's ultimate influences on FDR, which matters to firms' sustainable development. This study tries to fill this gap by investigating the process that firms go through from CSSP to financial distress, and how investment efficiency is intertwined in this process. This study aims to reveal the process of how CSSP impacts a firm's comprehensive financial results.

2.8 Summary

This chapter reviews previous literature that focuses on CSSP, investment efficiency, and financial distress risk. The research framework and hypotheses were developed based on literature review. The underlying theories include principle-agency theory, signalling theory, firm's life cycle theory, pecking order theory, stakeholder theory, and static trade-off theory.

CHAPTER 3

IMPACT OF CSSP ON INVESTMENT EFFICIENCY

3.1 Models and Estimations Methods

3.1.1 Measurement of Inefficient Investment

The criteria this chapter employs to justify whether the firm over-invests and the measurement of over-investment degree are developed by Richardson (2006), as listed in Table 1.1. Drawing from the Hubbard (1998) model of examining firm-level investment decisions, he established the model to estimate the expected investment expenditure; thereby, the excess (shortfall) is over- (under-) investment. Many scholars conduct empirical research based on this model to explore factors regarding investment efficiency (Biddle et al., 2009b; Chen et al., 2011; Cheng et al., 2013; Wu et al., 2022).

$$Inv_t = \beta_0 + \beta_1 TobinQ_{t-1} + \beta_2 Lev_{t-1} + \beta_3 Cash_{t-1} + \beta_4 Age_{t-1} + \beta_5 Size_{t-1} + \beta_6 Ret_{t-1} + \beta_6 Inv_{t-1} + \sum Industry + \sum Year + \varphi_t \quad (3.1)$$

Whereas, Inv_t denotes actual new investment expenditure of the company in the specific year / Total assets at the beginning of the year; *TobinQ* denotes the growth opportunity of the firm; *Age* denotes the listing age of the firm; Lev denotes the financial leverage of the firm; *Cash* denotes the cash flow position of the firm, expressed as net cash flow from operations / Year beginning total assets; $Size$ denotes the firm's asset size, expressed as the natural logarithm of total assets; Ret denotes the firm's stock yield.

The positive residual value (φ_t) is considered the degree of over-investment, which is named Doi as a dependent variable in the models. The *Doi* is downloaded from the CSMAR database and calculated based on the regression results of the model (Richardson, 2006) using the 2000 to 2022 data of all non-financial listed companies. I repeat the test using the 2000 to 2022 data of all non-financial listed companies and get the same results as shown in column (1) in Appendix Table B. For robustness, this chapter repeats the test with the entire sample spanning from 2007 to 2020 in this study and gets similar results shown in column (2) in appendix table B.

3.1.2 CSSP and Inefficient Investment Propensity

3.1.2.1 Models

The following models are fitted to test hypothesis **H1**, which is whether the firms with CSSP are more prone to over- (under-) investment.

$$Poi_{i,t} = \beta_0 + \beta_1 Pld\_dum_{i,t} + \beta_i Controls_{i,t} + \sum Industry + \sum Year + \varphi_{i,t} \quad (3.2)$$

$$Ti_{i,t} = \beta_0 + \beta_1 Pld\_dum_{i,t} + \beta_i Controls_{i,t} + \sum Industry + \sum Year + \varphi_{i,t} \quad (3.3)$$

$$Dii_{i,t} = \beta_0 + \beta_1 Pld\_dum_{i,t} + \beta_i Controls_{i,t} + \sum Industry + \sum Year + \varphi_{i,t} \quad (3.4)$$

Poi is a dummy variable proxying whether the firm over- or under- invests, which is set to 1 if the firm over-invests in the specific year and 0 if the firm under-invests. I test Eq. (3.2) using binary logistic regression, within which *Poi* transforms into the proxy for the probability of over-investment. *Pld_dum* is a dummy independent variable that is set to 1 if any shares owned by the

controlling shareholders are pledged at the end of a specific year and 0 otherwise. *Ti* indicts firms' total investment expenditure in the specific year scaled by total assets at the beginning of the year. *Dii* indicts firms' inefficient investment degree (Richardson, 2006).

Supposing the statistical coefficient β_1 is simultaneously significant and positive (negative) in Eq. (3.2), (3.3), and (3.4), it will suggest that firms with share-pledged controlling shareholders increase the likelihood of the firm's over- (under-) investment, consistent with hypothesis H1, and this research will take the next step; otherwise, this research will be terminated.

3.1.2.2 Binary Logistic Regression

Binary Logistic Regression is established by Cox (1958), used for modelling the relationship between a binary dependent variable and one or more independent variables. The dependent variable, the outcome or response variable, takes on two possible outcomes, usually coded as 0 and 1. The independent variables, also called predictors or features, can be continuous or categorical.

$$(Y = 1) = \frac{1}{1 + e^{(b_0 + b_1 x_1 + b_2 b_2 + \cdots + b_k b_k)}}$$

Here, P(Y=1) is the probability of the dependent variable Y being 1. *e* is the base of the natural logarithm. $b_0, b_1, b_2, \ldots, b_k,$ are the coefficients that need to be estimated. x_k are the independent variables. The logistic regression equation is then transformed to the odds ratio:

$$Odds == \frac{\mathrm{P}(Y=1)}{1-\mathrm{P}(Y=1)} = e^{(b_0+b_1x_1+b_2b_2+\cdots+b_kb_k)}$$

In logistic regression, the coefficients are estimated using a maximum likelihood estimation method. The goal is to find the values of $b_0, b_1, b_2, \ldots, b_k$, that maximize the likelihood of observing the given data set.

3.1.2.3 OLS Regression with Time and Industry Fixed Effects

Tinbergen (1934) pioneered statistical analysis of time-series and cross-sectional data, laying the groundwork for fixed effects techniques in econometrics. The least squares method searches for the Sum of Squared Residuals (SSR) that minimizes $\sum_{i=1}^{n} e_i^2$ the smallest β. OLS regression with time and industry-fixed effects is a statistical technique to control for time- and industry-specific effects when estimating the relationship between variables. By including both time and industry-fixed effects in the regression model, this method can control for time-specific and industry-specific factors, thus reducing bias and obtaining more accurate estimates when analysing panel data, where observations are collected over time for multiple entities and when there are concerns about unobserved heterogeneity across both time periods and industries.

The general form of an OLS regression model with time and industry-fixed effects can be represented as follows:

$$y_{it} = \alpha + \beta X_{it} + \gamma_t + \lambda_i + \epsilon_{it}$$

Where: y_{it} is the dependent variable for entity i at time t. X_{it} is a vector of independent variables for entity i at time t. γ_t represents time-fixed effects. λ_i represents industry fixed effects; ϵ_{it} is the error term.

3.1.2.4 Probit Regression

Probit regression is proposed by Ittner (1934), used to model binary or categorical outcomes, using maximum likelihood estimation (MLE) to predict the probability of the binary outcome for given values of the independent variables. It is an alternative to logistic regression, and it is used to assess the robustness of the binary logistic regression in this chapter.

3.1.3 CSSP and Over-Investment

3.1.3.1 Models

To test **H2** and **H3,** this research examines the following equations (3.5) in the subsample of over-investing (*Poi* = 1) firms with year and Firm-fixed effect regressions.

$$Over\_invest_{i,t} = \beta'_0 + \beta'_1 Pledge_{i,t} + \beta'_i Controls_{i,t} + \sum Industry + \sum Year + \varphi_{i,t} \quad (3.5)$$

Specific as follows:

$$Doi_{i,t} = \beta'_0 + \beta'_1 Pld\_dum_{i,t} + \beta'_i Controls_{i,t} + \sum Industry + \sum Year + \varphi_{i,t} \quad (3.5.1)$$

$$Ti_{i,t} = \beta'_0 + \beta'_1 Pld\_dum_{i,t} + \beta'_i Controls_{i,t} + \sum Industry + \sum Year + \varphi_{i,t} \quad (3.5.2)$$

$$Doi_{i,t} = \beta'_0 + \beta'_1 Pld\_rate_{i,t} + \beta'_i Controls_{i,t} + \sum Industry + \sum Year + \varphi_{i,t} \quad (3.5.3)$$

$$Ti_{i,t} = \beta'_0 + \beta'_1 Pld\_rate_{i,t} + \beta'_i Controls_{i,t} + \sum Industry + \sum Year + \varphi_{i,t} \quad (3.5.4)$$

Whereas, *Doi* indicates the degree of over-investment calculated as the positive residual value of the regression result of the model (Richardson, 2006) to estimate the expected investment expenditure. *Ti* indicts firms' total investment expenditure in the specific year scaled by total assets at the beginning of the year. *Pld_dum* is set to 1 if CSSP exists in the firm at the end of the year; otherwise, 0. *Pld_rate* is calculated as the number of shares pledged by controlling shareholders scaled by the total number of shares held by controlling shareholders at the end of the year. If statistical coefficient β'_1 is simultaneously significant and positive (negative) in both Eq. (3.5.1) and (3.5.2), it will suggest firms with CSSP have a severe over-investment degree. If statistical coefficient β'_1 is simultaneously significant and positive (negative) in both Eq. (3.5.3) and (3.5.4), it will suggest that the more shares pledged by controlling shareholders, the more severe (milder) the over-investment is. Taken together, if the coefficients of *Pld_dum* and *Pld_rate* are kept in line, it would suggest that hypothesis H2 is accepted; otherwise, it is rejected.

To test hypothesis **H3**, this research categorizes the sample firms into two groups with a controlling shareholding (*First*) greater than or less than 30%, then retest Eq. (1) separately within each group. Suppose the statistical coefficient of *Pledge* is more significant or greater (smaller) at the same significance level in the group with the higher controlling shareholding; it will indicate the impact of controlling shareholders' share pledges on corporate

over-investment is stronger in the firms with more concentrated ownership, as hypothesis H3 proposes.

3.1.3.2 Moderating Effects

A moderating effect, also known as an interaction effect, refers to the influence of a third variable on the relationship between two other variables. In statistical terms, it refers to a situation where the relationship between the independent variable (X) and the dependent variable (Y) is dependent on the value of a third variable (M).

It helps researchers identify conditions under which certain relationships may hold or vary, leading to more accurate and nuanced conclusions about the phenomena under study. In statistical analysis, the moderating effect is often tested using interaction terms in regression models (McClelland & Judd, 1993) and subsample (Schmit & Ryan, 1992).

This study uses the subsampling method to analyze the moderating effect of ownership concentration on the relationship between CSSP and over-investment. Specifically, this study partitions the firms into two groups of higher and lower concentration ownership and redo the test for Eq. (2.2), (2.3), (2.4), and (2.5) in the same way within the two-group data, separately.

3.1.4 CSSP and Under-Investment

To test **H4,** this research examines the following equations (3.6) in the subsample of under-investing (*Poi* = 0) firms with year and Industry-fixed effect regressions, specifically as follows:

$$Under\_invest_{i,t} = \beta''_0 + \beta''_1 Pledge_{i,t} + \beta''_i Controls_{i,t} + \sum Industry + \sum Year + \varphi_{i,t} \quad (3.6)$$

$$Dui_{i,t} = \beta''_0 + \beta''_1 Pld\_dum_{i,t} + \beta''_i Controls_{i,t} + \sum Industry + \sum Year + \varphi_{i,t} \quad (3.6.1)$$

$$Ti_{i,t} = \beta''_0 + \beta''_1 Pld\_dum_{i,t} + \beta''_i Controls_{i,t} + \sum Industry + \sum Year + \varphi_{i,t} \quad (3.6.2)$$

$$Dui_{i,t} = \beta''_0 + \beta''_1 Pld\_rate_{i,t} + \beta''_i Controls_{i,t} + \sum Industry + \sum Year + \varphi_{i,t} \quad (3.6.3)$$

$$Ti_{i,t} = \beta''_0 + \beta''_1 Pld\_rate_{i,t} + \beta''_i Controls_{i,t} + \sum Industry + \sum Year + \varphi_{i,t} \quad (3.6.4)$$

Whereas: *Dui* indicates the degree of over-investment calculated as the negative residual value of the regression result of the model (Richardson, 2006) to estimate the expected investment expenditure. *Ti*, *Pld_dum*, and *Pld_rate* are defined as earlier. If statistical coefficient *β″₁* is simultaneously significant and positive (negative) in both Eq. (3.6.1) and (3.6.2), it will suggest that the more shares pledged by controlling shareholders, the severer (milder) the under-investment is. If statistical coefficient *β″₁* is simultaneously significant and positive (negative) in both Eq. (3.6.3) and (3.6.4), it will suggest that the more shares pledged by controlling shareholders, the severer (milder) the under-investment is. Taking together, if the coefficients of *Pld_dum* and *Pld_rate* are kept in line, it would suggest that hypothesis H4 is accepted; otherwise, it is rejected.

This research clarifies that the controlling shareholder owns most of the firm's shares explicitly and implicitly. As the primary hypothesis concerns the effect of CSSP, I incorporate additional variables to deal with firm-specific attributes in the analysis. In particular, I integrate size (*Size*) (Biddle et al., 2009b; Chen et al., 2011) and leverage (*Lev*) (Chen et al., 2011; Cheng et al., 2013) into the analysis to mitigate any potential size-related and financial leverage effects, respectively. I include growth (*Growth)* to control for investment demand (Sharpe, 1994) and opportunity (Guiso & Parigi, 1999; Love & Zucchini, 2006) because it is more significant than Tobin's Q on the firm-level investment decisions (Blundell et al., 1992). This research further adds asset return (*Roa*) (Wu et al., 2022) and free cash flow (*Fcf*) (Richardson, 2006) to handle profitability and financial reserves, respectively. Furthermore, the proportion of shares held by the management team (*Mhold*) (Wang et al., 2021) and controlling shareholders' occupancy (*Cso*) (Wu et al., 2022) are introduced into the model, accounting for corporate governance-related aspects. These inclusions help to control for their effects on the analysis and ensure a comprehensive understanding of the factors influencing the results.

Table 3.1 provides the definitions of all variables used in the research.

Table 3.1: Variable definitions in Chapter 3

Variables	Variable definitions
Dependent variables	
Poi	Firms over-invest in the specific year as 1, and 0 otherwise.
Dii[3]	The degree of over-investment. Calculated with $\mathrm{Inv}_t = \beta_0 + \beta_1 \mathrm{TobinQ}_{t-1} + \beta_2 \mathrm{Lev}_{t-1} + \beta_3 \mathrm{Cash}_{t-1} + \beta_4 \mathrm{Age}_{t-1} + \beta_5 \mathrm{Size}_{t-1} + \beta_6 \mathrm{Ret}_{t-1} + \beta_6 \mathrm{Inv}_{t-1} + \sum \mathrm{Industry} + \sum \mathrm{Year} + \varphi_t$; The value of the positive residual (φ_t) is considered as the degree of over-investment (Richardson, 2006).
Doi	The degree of over-investment. The value of the negative residual (φ_t) is considered as the degree of over-investment (Richardson, 2006).
Dui	The degree of under-investment. The value of the negative residual (φ_t) is considered as the degree of under-investment (Richardson, 2006).
Ti	Total capital investment expenditure / Year beginning total assets.
Mi	Maintenance investment expenditure / Year beginning total assets.
Ai	Additional investment expenditure / Year beginning total assets.
Ei	Investment for long term-assets / Year beginning total assets.
Si	Investment for subsidiaries / Year beginning total assets.
RD	Ln (R&D expenditures).
Independent variables	
Pld_dum	Firms with CSSP at the end of the year as 1; 0 otherwise.
Pld_rate	Shares pledged by controlling shareholders / Controlling shareholders' total shares.
Control variables	
Roa	Return on total assets.
Lev	Total liabilities / Year-end total assets.
Size	Natural log of year-end total assets.
Growth	Growth rate. (Operating income current year - operating income previous year) / Operating income the previous year.
Fcf	(Net profit + Interest & Non-cash expenses - Net capital expenses - Increased working capital)/ Year-end total assets.
Mhold	Shares held by the management team / Total shares of the firm.
Cso	Controlling shareholders' occupancy. (Other Receivables-Other payables) / Year-end total assets.
Other variables	
First	Shares owned by controlling shareholders / Total shares of the firm.
Post	1 for the years 2018 and beyond; 0, otherwise.
Soe	State-owned as 1, otherwise 0.
Pld_Iv_Indu	The average value of *Pld_dum* for all other observations in the same industry in a specific year, while omitting the value of *Pld_dum* for the firm being considered.
Pld_Iv_Prov	The average value of *Pld_dum* for all other observations in the same province in a specific year, while omitting the value of *Pld_dum* for the firm being considered.
Imr	Inversed Mills ratio.
Treat	A treatment group indicator variable, which is 1 if a firm's controlling shareholders have pledged shares and 0 otherwise.

[3] *Dii* is downloaded from CSMAR database, calculated based on the regression results of the model (Richardson, 2006) using the 2000 to 2022 all non-financial listed companies data. I repeat the test using the 2000 to 2022 all non-financial listed companies' data and get the same results as shown in column (1) in the appendix table A. For robust, I repeat the test with the entire sample using in this study spanning from 2007 to 2020, and get the similar results shown in column (2) in the appendix table A.

3.2 Sample and Data

This research adopts the Chinese A-share market annual data from 2007 to 2020 unbalanced. the entire sample consists of 29,959 firm-year observations, of which 12279 and 17680 firms that over-invest constitute the *Poi = 1* and *Poi = 0* subsample, respectively. This study started in 2007 because new accounting standards were implemented on 1 January 2007 in China, and using the same accounting standards provides better comparability of financial statement data. This research obtains the financial variables and stock data for the study from the China Stock Market and Accounting Research (CSMAR) Database, which provides detailed information regarding share pledging by the top 10 major shareholders. To ensure the reliability of the empirical analysis, this research follows a set of procedures to select the relevant observations. To begin with, this research omits observations from the financial industry as these firms have fundamental differences from non-financial corporates. Furthermore, this research winsorizes all continuous primary variables at the 1st and 99th percentiles, aiming to alleviate the impact of outliers on the dataset.

The statistical descriptions concerning the variables utilized in the analysis of the hypotheses are presented in Panel A of Table 3.2. The mean values of *Pld_dum* and *Pld_rate* stand at 0.403 and 0.235, respectively, in the entire sample during the sample period. This suggests that over 40% of firms are characterized by share pledging by their controlling shareholders, with an average pledging ratio surpassing 23%. The standard deviation of *Pld_rate* in

the entire sample is 0.343, implying that the pledging ratio is quite different in different firms as discussed in Section 1.1.1(The distribution of the firms with CSSP is shown in Figures 1.3 & 1.4). The mean value of *Poi*, *Doi*, and *Dui* is 0.410, 0.053, and 0.041, respectively, indicating that 41% (59%) of listed firms over- (under-) invest and the average extent of over- (under-) investment is 0.053 (0.041).

Further division of the sample based on *Pld_dum* allows us to contrast the mean and median values for each variable within these two subsamples, listed in panel B of Table 3.2. In the entire sample, the mean (median) values of *Poi* for the non-pledging and pledging group are 0.405 (0) and0.418 (0), respectively; the mean (median) values of *Dii* for the non-pledging and pledging group are -0.005 (-0.008) and -0.001 (-0.008), respectively; the mean (median) values of *Ti* for the non-pledging and pledging group are 0.053 (0.034) and 0.062 (0.039), respectively. The results from t-tests indicate significant differences at the 5% and 1% significance levels for *Poi*, *Dii*, and *Ti*, respectively, indicating firms within the pledging group are more likely to over-invest and associated with milder under-investment degree and more investment expenditure.

Similarly, within the subsample characterized by *Poi* = 1, the average (median) values of *Doi* in the non-pledging and pledging group are 0.046 (0.025) and 0.063 (0.032), respectively; the average (median) values of *Ti* in the non-pledging and pledging group are 0.092 (0.070) and 0.113 (0.076), respectively. The results from t-tests suggest that the firms with share-pledging controlling shareholders invest more than firms without, resulting in a severer over-

Table 3.2: Descriptive statistics

Panel A. Descriptive statistics								
Variable	**Mean**	**Med**	**Min**	**Max**	**p25**	**p75**	SD	N
Entire sample								
Poi	0.410	0.000	0.000	1.000	0.000	1.000	0.492	29959
Dii	-0.004	-0.008	-0.227	0.274	-0.034	0.020	0.066	29959
Ti	0.057	0.036	-0.109	0.432	0.011	0.079	0.078	25694
Pld_dum	0.403	0.000	0.000	1.000	0.000	1.000	0.491	29959
Pld_rate	0.235	0.000	0.000	1.000	0.000	0.469	0.343	29959
Roa	0.028	0.032	-0.414	0.205	0.011	0.061	0.077	29959
Lev	0.462	0.456	0.061	1.037	0.297	0.616	0.215	29959
Size	22.151	22.000	19.270	26.120	21.240	22.900	1.315	29959
Growth	0.170	0.097	-0.651	3.241	-0.041	0.260	0.483	29959
Mhold	0.233	0.001	0.000	1.738	0.000	0.259	0.426	29959
First	0.359	0.341	0.002	0.900	0.241	0.462	0.151	27032
Cso	-0.024	-0.009	-0.367	0.118	-0.032	0.001	0.061	29959
Fcf	0.001	0.015	-46.241	149.554	-0.032	0.055	0.943	29959
Poi = 1 subsample								
Doi	0.053	0.028	0.000	0.447	0.011	0.065	0.072	12279
Ti	0.101	0.076	-0.003	0.432	0.035	0.137	0.094	10429
Pld_dum	0.411	0.000	0.000	1.000	0.000	1.000	0.492	12279
Pld_rate	0.236	0.000	0.000	1.000	0.000	0.472	0.343	12279
Poi = 0 subsample								
Dui	0.041	0.028	0.001	0.282	0.013	0.051	0.046	17680
Ti	0.026	0.022	-0.109	0.161	0.006	0.045	0.041	15265
Pld_dum	0.398	0.000	0.000	1.000	0.000	1.000	0.489	17680
Pld_rate	0.233	0.000	0.000	1.000	0.000	0.468	0.344	17680

Panel B. Contrasts between share-pledging firms and non-pledging firms.					
	Pld_dum = 0		*Pld_dum* = 1		T-test
	Mean	Med	Mean	Med	T-stat
Entire sample					
Poi	0.405	0.000	0.418	0.000	-2.253**
Dii	-0.005	-0.008	-0.001	-0.008	-5.169***

Table 3.2: Continued

Ti	0.053	0.034	0.062	0.039	-10.084***
Roa	0.031	0.033	0.024	0.035	6.802***
Lev	0.463	0.460	0.459	0.450	1.510
Size	22.231	22.06	22.033	21.93	12.799***
Growth	0.148	0.862	0.202	0.117	-9.377***
Mhold	0.170	0.000	0.33	0.030	-32.907***
First	0.371	0.357	0.339	0.321	17.353***
Cso	-0.027	-0.01	-0.019	-0.010	-9.752***
Fcf	0.001	0.02	0.000	0.010	0.088
Poi=1 subsample					
Doi	0.046	0.025	0.063	0.032	-11.350***
Ti	0.092	0.070	0.113	0.076	-4.5403***
Poi=0 subsample					
Dui	0.039	0.027	0.045	0.029	-7.584***
Ti	0.259	0.021	0.267	0.023	-1.104

Panel C. Tabulation of *Pld_dum* & *Poi*

Pld_dum		*Poi*		
		0	1	Total
0	No.	10644	7233	17877
	Percentage	59.54	40.46	100.00
1	No.	7036	5046	12082
	Percentage	58.24	41.76	100.00
Total	No.	17680	12279	29959
	Percentage	59.01	40.99	100.00

Pearson Chi2 = 5.07 Prob = 0.0243

This table presents the statistical descriptions of variables observed for firm-year data spinning 2007-2020. The entire samples contain 29959 and 25694 observations for Eq. (2) & (3), respectively. The *Poi* = 1 subsamples contain 12279 and 10429 observations for Eq. (4) & (5), respectively. Each variable is clarified in Table 1.

investment degree, at the 1% significance level. Within *Poi* = 0 subsample, the differences in the under-investment degree between the non-pledging and pledging group are significant, while it is insignificant in the investment expenditure, indicating a negligible difference in under-investment between firms with and without CSSP.

We can also see the differences in Figure 3.1a, b, and c clearly. the preliminary assessments support that corporates with share-pledging controlling shareholders are more likely to over-invest, and the over-investing degree is severer in the firms with CSSP, as hypotheses H1 and H2 propose, respectively, but cannot provide significant evidence for H3. The results also indicate a significant difference between the two group enterprises regarding the control variables, i.e., pledging firms with greater growth ratio and management team shareholding alleviate systematic discrepancies. To enhance the credibility of the results and address any potential biases between firms without and with controlling shareholders who pledge their shares, this chapter utilizes the PSM approach to check robustness subsequently.

Panel C of Table 3.2 gives a tabulation of *Pledge_dum* & *Poi*. The Chi result (*P* = 0.002) indicates that the percentage of over-investment is significantly higher in the firms with CSSP (41.76%) than in firms without (40.16%).

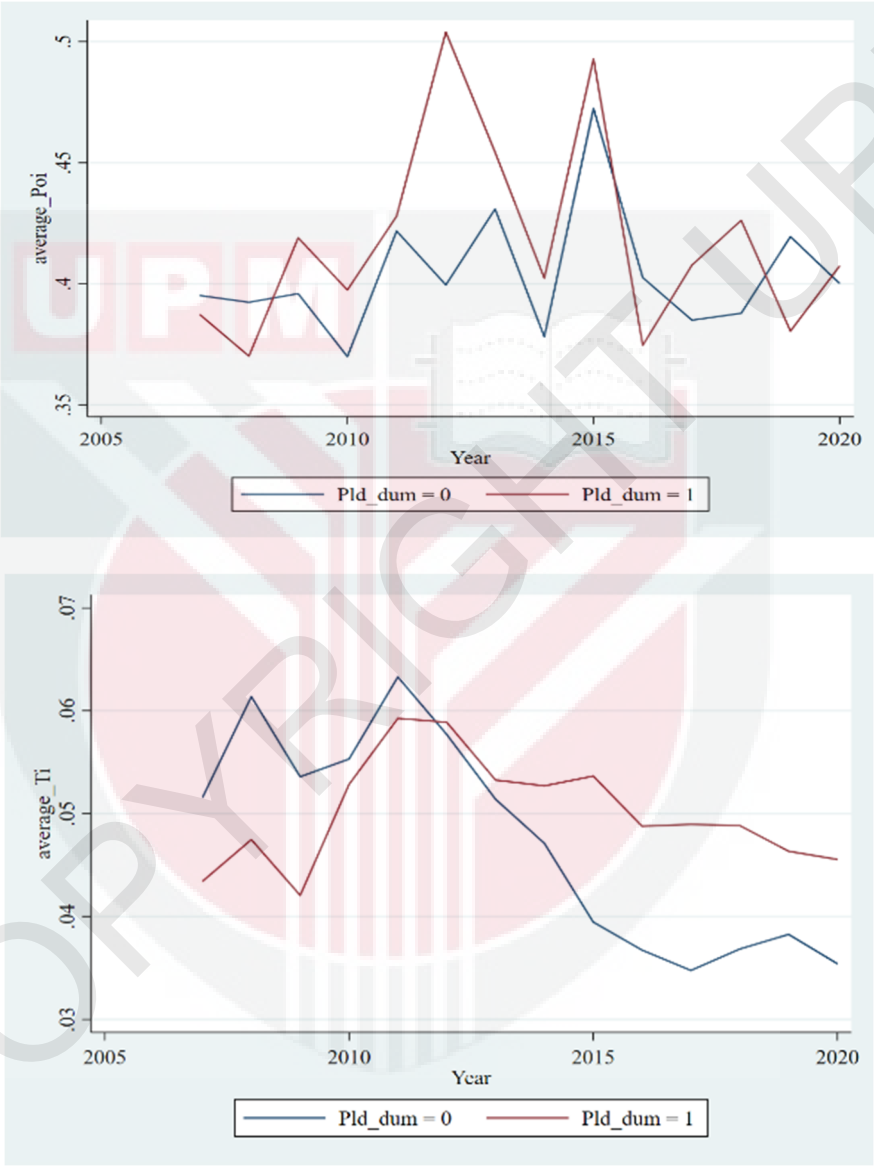
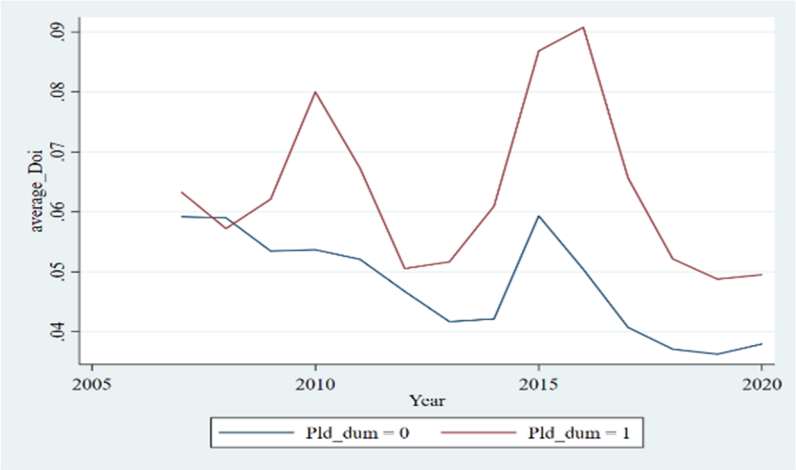


Figure 3.1a: Average Poi & Ti over Pld_dum within entire sample 2007-2020



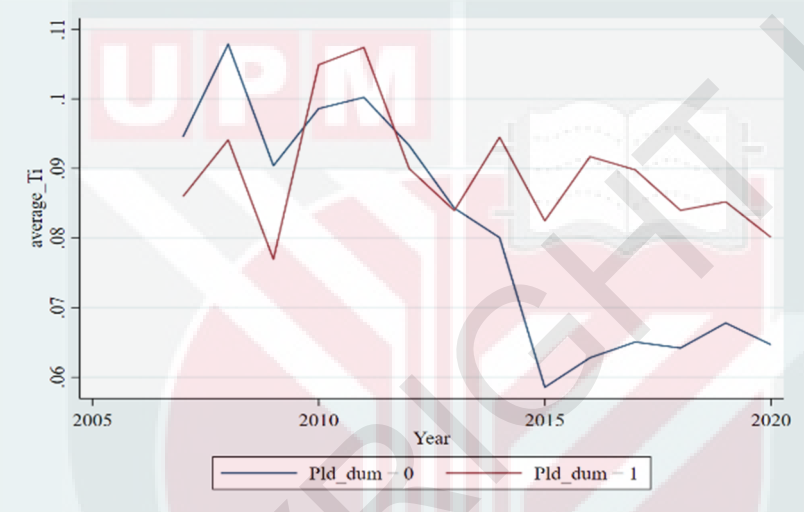


Figure 3.1b: Average Doi & Ti over Pld_dum within Poi = 1 subsample 2007-2020

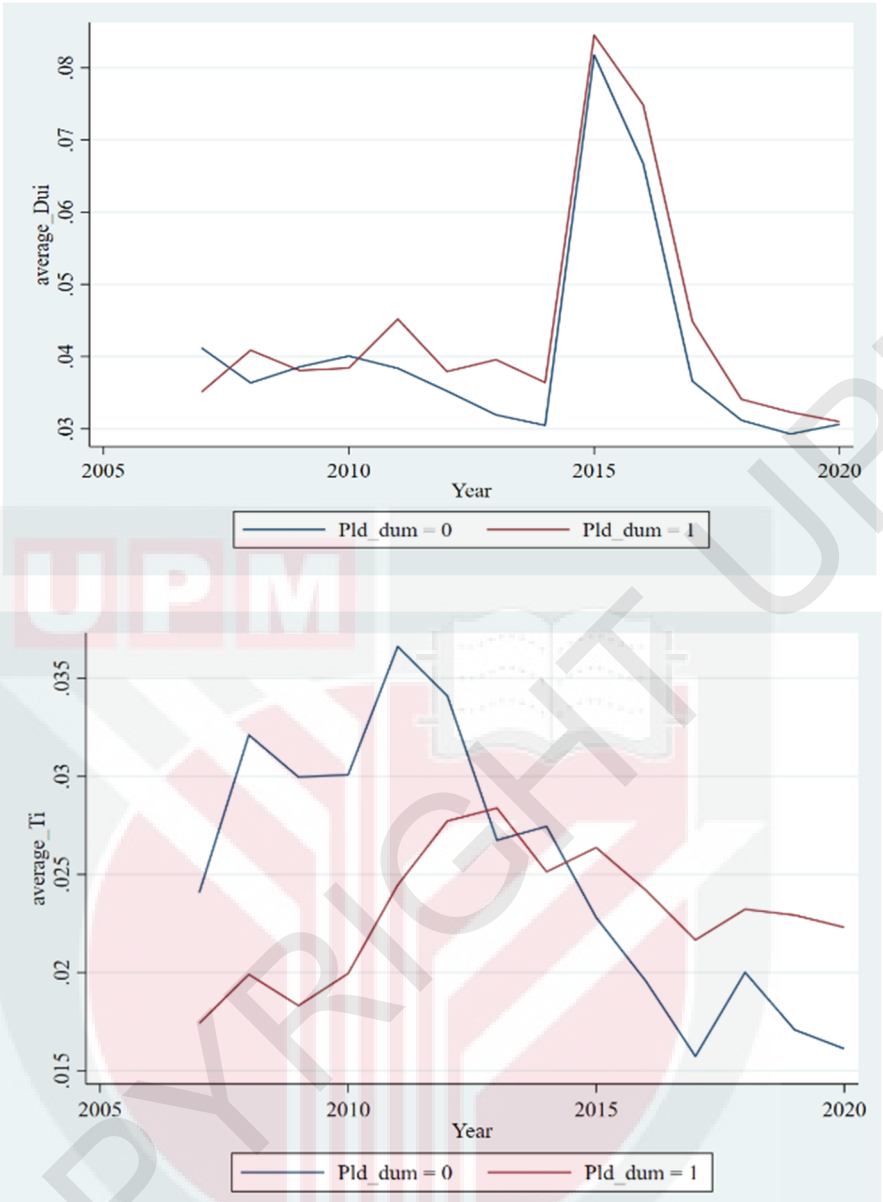


Figure 3.1c: Average Doi & Ti over Pld_dum within Poi = 0 subsample 2007-2020

Figure 3.1a displays the average probability of over-investment and the average total investment expenditure within the entire sample spanning from 2007 to 2020; Figure 3.1b displays the average degree of over-investment and the average total investment expenditure within the *Poi* = 1 subsample spanning from 2007 to 2020; Figure 3.1c displays the average degree of

under-investment and the average total investment expenditure within the *Poi* = 0 subsample spanning from 2007 to 2020;

Data source: CSMAR database, piloted by Stata 15.0

Table 3.3 illustrates the Pearson correlation matrix for all variables in the hypothesis tests. In the entire sample, the coefficients on *Poi*, *Dii*, *and Ti* are all significantly positive, indicating that CSSP has more significant effects on investment. Hence, I will place the emphasis on the relationship between CSSP and over-investment. Within the *Poi* = 1 subsample, *Doi* and *Ti* both positively correlated with their corresponding independent variables *Pld_dum* and *Pld_rate*, respectively, indicating that firms with share-pledging controlling shareholders are inclined to over-invest and associated with severer over-investment degree. Within *Poi* = 0 subsample, *Dui* positively correlated with their corresponding independent variables *Pld_dum* and *Pld_rate*, respectively, while *Ti* has an insignificant correlation with *Pld_dum and negative correlation with Pld_rate,* indicating a negligible relationship between CSSP and under-investment.

Also, the absolute value of Pearson correlation coefficient between each two variables in the same model are much lower than 0.2, indicating there is no multicollinearity issue in the models in this chapter. This study also uses the variance inflation factor (VIF) in the regression models (Eq. (3.1) to (3.13)) to test for the multicollinearity problem in the explanatory variables of the data. As the mean VIF ranges from 1.22 to 1.29 for all models, it indicates no multicollinearity concerns.

Table 3.3: Pearson correlation matrix

	Poi	*Dii*	*Ti*	*Mi*	*Ai*	*RD0*	*Pld dum*	*Roa*	*Lev*	*Size*	*Growth*	*Mhold*	*Cso*	*Fcf*
Poi	1													
Dii	0.668***	1												
Ti	0.477***	0.721***	1											
Mi	-0.021***	0.022***	0.338***	1										
Ai	0.509***	0.758***	0.965***	0.105***	1									
RD	0.060***	0.059***	0.067***	0.022***	0.063***	1								
Pld dum	0.013**	0.030***	0.062***	-0.040***	0.075***	-0.016**	1							
Roa	0.045***	0.047***	0.157***	0.031***	0.157***	0.120***	-0.040***	1						
Lev	0.085***	0.056***	-0.035***	-0.01	-0.035***	0.095***	-0.009	-0.350***	1					
Size	0.101***	0.113***	0.098***	0.018***	0.098***	0.519***	-0.074***	0.088***	0.345***	1				
Growth	0.084***	0.119***	0.268***	0.134***	0.239***	0.042***	0.056***	0.226***	0.017***	0.047***	1			
Mhold	-0.002	0.036***	0.107***	-0.079***	0.134***	-0.01	0.187***	0.105***	-0.280***	-0.210***	0.049***	1		
Cso	-0.035***	-0.006	0.021***	-0.026***	0.029***	0.095***	0.056***	0.145***	-0.281***	0.117***	-0.015***	0.120***	1	
Fcf	0.002	0	-0.011*	0.005	-0.014**	0.039***	-0.001	0.054***	0.007	0.003	-0.010*	0.002	-0.022***	1

	Doi	*Ti*	*Mi*	*Ai*	*RD0*	*Pld dum*	*Pld rate*	*Roa*	*Lev*	*Size*	*Growth*	*Mhold*	*Cso*	*Fcf*
Doi	1													
Ti	0.804***	1												
Mi	0.191***	0.464***	1											
Ai	0.828***	0.976***	0.288***	1										
RD	-0.077***	-0.021*	0.068***	-0.040***	1									
Pld dum	0.121***	0.110***	-0.027***	0.126***	-0.019*	1								
Pld rate	0.113***	0.069***	-0.068***	0.091***	-0.057***	0.826***	1							
Roa	0.073***	0.193***	0.120***	0.183***	0.133***	-0.01	-0.062***	1						
Lev	-0.064***	-0.105***	-0.064***	-0.101***	0.099***	-0.015*	0.035***	-0.369***	1					
Size	-0.056***	-0.011	0.022**	-0.017*	0.518***	-0.077***	-0.079***	0.050***	0.346***	1				
Growth	0.234***	0.315***	0.206***	0.290***	0.016	0.074***	0.073***	0.208***	0.012	0.009	1			
Mhold	0.092***	0.144***	-0.032***	0.165***	-0.031***	0.196***	0.092***	0.130***	-0.302***	-0.240***	0.057***	1		
Cso	-0.026***	0.033***	0.007	0.035***	0.099***	0.051***	0.022**	0.167***	-0.299***	0.143***	-0.035***	0.119***	1	
Fcf	-0.014	-0.074***	-0.013	-0.077***	0.043***	0.006	-0.004	0.044***	0.025***	-0.017*	-0.016*	-0.003	-0.057***	1

Table 3.3: Continued

	Dui	*Ti*	*Mi1*	*Ai1*	*RD0*	*Pld dum*	*Pld rate*	*Roa*	*Lev*	*Size*	*Growth*	*Mhold*	*Cso*	*Fcf*
Dui	1													
Ti	-0.292***	1												
Mi	0.077***	0.357***	1											
Ai	-0.354***	0.884***	-0.085***	1										
RD	-0.131***	0.148***	-0.01	0.158***	1									
Pld dum	0.057***	0.009	-0.050***	0.031***	-0.015*	1								
Pld rate	0.076***	-0.047***	-0.062***	-0.023***	-0.050***	0.836***	1							
Roa	0.020***	0.158***	-0.017**	0.173***	0.110***	-0.058***	-0.096***	1						
Lev	-0.064***	-0.081***	0.031***	-0.102***	0.086***	-0.006	0.036***	-0.352***	1					
Size	-0.187***	0.153***	0.020**	0.149***	0.516***	-0.074***	-0.085***	0.104***	0.335***	1				
Growth	0.061***	0.186***	0.073***	0.138***	0.056***	0.040***	0.027***	0.244***	0.009	0.065***	1			
Mhold	-0.008	0.132***	-0.113***	0.193***	0.006	0.181***	0.075***	0.092***	-0.266***	-0.191***	0.043***	1		
Cso	-0.070***	0.065***	-0.052***	0.093***	0.094***	0.061***	0.041***	0.139***	-0.266***	0.106***	0.008	0.121***	1	
Fcf	-0.036***	0.033***	0.011	0.027***	0.044***	-0.016**	-0.024***	0.107***	-0.029***	0.049***	0.003	0.012	0.048***	1

This table presents the Pearson correlations among the primary variables. Each variable is defined in Table 3.1. The sample contains 29959, 12279 and 17680 observations for Eq. (3.2) to (3.4), (3.5) and (3.6), respectively, spanning from 2007 to 2020. The notions ***, **, and * represent 1%, 5%, and 10% significance levels, respectively.

3.3 Results and Discussions

3.3.1 Hypotheses Tests

The first objective of this study is to examine the relationship between CSSP and inefficient investment. Specifically, hypothesis H1 predicts that firms with CSSP are more prone to over-invest, H2 predicts that CSSP exacerbates over-invest, H3 predicts that the exacerbating effect is more pronounced in the firms with more concentrated ownership, and H4 predicts that CSSP alleviates under-invest. Firstly, this chapter examines the overall relationship between CSSP and investment within the entire sample (Section 3.3.1.1). Then, this chapter examines the correlations between CSSP and over- (Section 3.3.1.2) and under-investment (Section 3.3.1.3). within the *Poi* = 1 and *Poi* = 0 subsample, respectively.

3.3.1.1 Relationship Between CSSP and Inefficient Investment Propensity

Table 3.4 presents the overall test using the entire sample for H1. Columns (1) and (2) illustrate the outcomes in the absence and presence of control

variables, respectively, with *Poi* proxying for the probability of over-investment. The statistical coefficients of *Pld_dum* are significant and positive (0.059, *t* = 2.38; 0.063, *t* = 2.46). This implies that firms with controlling shareholders taking part in share pledging are more likely to over-invest. Similarly, columns (3) and (4) represent the results in the absence and presence of control variables, respectively, with *Ti* proxying for investment expenditures; the statistical coefficients of *Pld_dum* are both significant and positive (0.012, *t* = 8.27; 0.010, *t* = 7.36), suggesting that firms with controlling shareholders participating in share pledging are linked to more investment expenditures, in line with the results of prior research (Li, 2020b). Columns (5) and (6) represent the results in the absence and presence of control variables, respectively, with *Dii* proxying for inefficient investment degree; the statistical coefficients of *Pld_dum* are both significant and positive (0.005, *t* = 5.80; 0.005, *t* = 5.74), suggesting that firms with controlling shareholders participating in share pledging are linked to greater inefficient investment degree. These results consistently support hypothesis H1.

3.3.1.2 Relationship Between CSSP and Over-investment

Table 3.5 presents the relationship between CSSP and over-investment using the *Poi* = 1 subsample for H2. Columns (1) to (4) display the outcomes with *Doi* as the proxy for the degree of over-investment and *Ti* as the proxy for investment expenditures of over-investing firms while *Pld_dum* as a proxy for whether the firms' controlling shareholders' participating share pledging. The statistical coefficients of *Pld_dum* are all significant and positive (0.017, *t* =

10.67; 0.014, *t* = 8.94; 0.025, *t* = 10.65; 0.019, *t* = 8.04), in the absence and presence of control variables, respectively, suggesting that firms with CSSP are positively related to severer over-investment. Similar results come out when *Pld_rate* as a proxy for the percentage of shares pledged, as listed in columns (5) to (8), suggesting that firms' over-investment severity increases as the CSSP ratio increases. Taken together, the results indicate that CSSP has a positive impact on over-investment, as H2 supposes.

The results are consistent with Xie & Wang (2017) and Li (2020) but inconsistent with Zhu & Xiong (2020). Compared to Zhu & Xiong (2020), who take *Soe* (stated-owned nature as 1; otherwise, 0.) as a control variable in their model, I take firms' nature as an instrumental variable because state-owned companies are both less probably to participate in share pledging (Xing, 2018) and over-investing (Chen et al., 2017) due to their unique nature. I will address the possible potential endogeneity problems in Section 5, including the "selection effect".

3.3.1.3 Impact of CSSP on over-investment Conditional on Ownership Concentration

To examine H3, this research partitions the firms into two groups of higher and lower concentration ownership and repeats the test for Eq. (3.5) in the same way within the two-group data, separately.

Table 3.6 presents the results of hypothesis tests for H3, which proposes that the impact of CSSP on over-investment is more pronounced in firms with

higher ownership concentration. Table 3.5 categorizes the sample into two groups: one with lower ownership concentration (columns (1), (3), (5), and (7)) and the other with higher ownership concentration (columns (2), (4), (6), and (8)), based on the shareholding of the controlling shareholders. The number of observations in higher ownership concentration is greater than in lower ownership concentration group, suggesting that most Chinese firms are characterized by highly concentrated ownership, consistent with Jiang & Kim (2015).

Columns (1) to (4) display the regression results for the entire sample. When *Poi* is the proxy for over-investment, the statistical coefficient on *Pld_dum* is insignificant in column (1) but significant in column (2), implying that the firms with CSSP on over-investment likelihood are insignificant in firms with unconcentrated ownership but significant in firms with concentrated ownership. When *Ti* is the proxy for over-investment, the statistical coefficients on *Pld_dum* are both significantly positive in columns (3) and (4) at 1% significance level, but the coefficient is larger in firms with higher concentrated ownership (0.013, t = 7.18) than firms with lower concentrated ownership (0.007, t = 3.15), revealing that CSSP has greater influence on investment expenditures in firms with higher concentrated ownership, consistent with Dou (2016).

Columns (5) to (8) display the regression results within the *Poi* = 1 subsample. When *Doi* is the proxy for an over-investment degree in columns (5) and (6) within the *Poi* = 1 subsample, the coefficients on *Pld_rate* are are both

significantly positive in column (5) and in column (6) at 1% significance level, and the coefficient is larger in firms with higher concentrated ownership (0.021, t = 6.63) than firms with lower concentrated ownership (0.016, t = 4.65). Similar results when *Ti* is the proxy for over-investment expenditures in columns (7) and (8), implying that CSSP ratio has a greater impact on over-investment severity in firms with higher concentrated ownership.

These results consistently suggest that concentrated ownership reinforces the effect of CSSP on over-investment. This finding confirms the deduction that the voting right controlled by controlling shareholders drives the positive impact of CSSP on over-investment, supporting hypothesis H3.

3.3.1.4 Relationship Between CSSP and Under-investment

Table 3.7 presents the results of the relationship between CSSP and under-investment using the *Poi* = 0 subsample for H4. Columns (1) to (4) display the outcomes with *Pld_dum* as an independent variable and Dui and Ti as the dependent variables, respectively. The coefficient of *Pld_dum* is significantly positive in columns (1) and (2), suggesting that firms with CSSP are positively related to severer under-investment. Nevertheless, the coefficient of *Pld_dum* is significantly positive in columns (3) and (4), suggesting that firms with CSSP are positively related to more investment expenditure for under-investment firms. Similarly, in columns (5) to (8), the coefficient of *Pld_rate* is positively significant while *Dui* is the dependent variable, but insignificant while Ti is the dependent variable. These inconsistent results make H4 unacceptable.

To explore the reason for these inconsistent results. This research observes the difference between the relationships between CSSP and under-investment degree, CSSP and average total investment expenditure in under-investing firms from 2007 to 2020, as Figure 2c displays. For listed firms, share-pledging transactions need to be registered at the securities registry institution to be effective. Initially, the lenders in the share pledging transactions mainly were consisted of banks and trust companies. In 2013, the Shanghai and Shenzhen stock exchanges allowed securities firms to take part in share-pledging transactions, which vastly increased the occurrence of share pledging. Hence, this research partitions the sample into two groups before and after year 2013. Still cannot find a consistent results in any group.

Taken together, the relationship between CSSP and under-investment is insignificant.

3.3.2 Robustness

Following earlier analyses that CSSP has significantly positive impacts on firms' over-investment rather than under-investment, this research now proceeds with a series of tests to validate the results of the relationship between CSSP and over-investment.

3.3.2.1 Sensitivity Tests

Firstly, I switch to the probit regression method and repeat Eq. (3.2). Further, this research switch to *Pld_rate* as the independent variable in Eq. (3.3) and

(3.4) and repeat. Columns (1) to (6) of Table 3.9 represent the results of the re-estimations; all the statistical coefficients remain significantly positive as before, suggesting that firms with CSSP are more inclined to over-investment and invest more as the CSSP ratio increases.

Table 3.4: The results of the general relationship between CSSP and investment efficiency (H1)

	(1) *Poi*	(2) *Poi*	(3) *Ti*	(4) *Ti*	(5) *Dii*	(6) *Dii*
Pld_dum	0.059**	0.063**	0.012***	0.010***	0.005***	0.005***
	(2.38)	(2.46)	(8.27)	(7.36)	(5.80)	(5.74)
Roa		1.537***		0.052***		0.013**
		(8.51)		(7.07)		(2.06)
Lev		0.742***		-0.021***		0.004*
		(9.92)		(-5.20)		(1.66)
Size		0.138***		0.011***		0.007***
		(12.14)		(15.13)		(15.75)
Growth		0.302***		0.040***		0.016***
		(11.18)		(20.71)		(12.14)
Mhold		0.140***		0.025***		0.010***
		(4.53)		(13.06)		(9.72)
Cso		-1.171***		-0.055***		-0.029***
		(-5.47)		(-4.74)		(-3.61)
Fcf		-0.002		-0.004		-0.000
		(-0.16)		(-1.46)		(-0.31)
_cons	0.054	-3.437***	0.074***	-0.158***	0.001	-0.162***
	(0.36)	(-12.02)	(3.62)	(-7.32)	(0.09)	(-12.03)
Indu FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	29958	29942	25694	25685	29959	29943
Adj_R2			0.045	0.153	0.007	0.040

Columns (1) to (6) display the regression results within the entire sample for H1 with *Pld_dum* as the explanatory variable. Columns (1) and (2) report the binary logistic regression result with *Poi* as the dependent variables, proxying for the probability of over- (under-) investment. Columns (3) and (4) report the OLS regression results with total investment expenditures (Ti) as the dependent variable, and columns (5) and (6) display the regression results with the inefficient investment degree (*Dii*) as the dependent variables. Each

variable is clarified in Table 3.1. In the regression analysis, this study accounts for year and industry fixed effects, and the corresponding t-statistics in the OLS regression are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10% respectively.

Table 3.5: The results of impacts of CSSP on firms' over-investment (H2)

	(1) *Doi*	(2) *Doi*	(3) *Ti*	(4) *Ti*	(5) *Doi*	(6) *Doi*	(7) *Ti*	(8) *Ti*
Pld_dum	0.017***	0.014***	0.025***	0.019***				
	(10.67)	(8.94)	(10.05)	(8.04)				
Pld_rate					0.022***	0.019***	0.024***	0.020***
					(9.28)	(8.25)	(6.54)	(6.10)
Roa		0.002		0.101***		0.005		0.106***
		(0.14)		(5.22)		(0.48)		(5.42)
Lev		-0.018***		-0.044***		-0.018***		-0.042***
		(-3.61)		(-5.76)		(-3.64)		(-5.59)
Size		0.000		0.009***		0.001		0.009***
		(0.63)		(7.40)		(0.82)		(7.34)
Growth		0.031***		0.049***		0.030***		0.049***
		(12.65)		(16.48)		(12.58)		(16.43)
Mhold		0.010***		0.032***		0.012***		0.034***
		(5.15)		(10.04)		(5.94)		(11.00)
Cso		-0.064***		-0.057***		-0.064***		-0.054**
		(-4.71)		(-2.60)		(-4.69)		(-2.47)
Fcf		-0.001		-0.033**		-0.001		-0.034**
		(-1.53)		(-2.37)		(-1.41)		(-2.37)
_cons	0.068***	0.055**	0.152***	-0.050	0.069***	0.053**	0.159***	-0.048
	(2.81)	(2.08)	(6.13)	(-1.49)	(2.91)	(1.99)	(6.24)	(-1.42)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	12279	12268	10429	10423	12279	12268	10429	10423
Adj_R^2	0.036	0.094	0.085	0.212	0.035	0.094	0.076	0.209

Columns (1) to (8) display the regression results within the *Poi* = 1 sample for H2. Columns (1) to (4) report the regression with *Pld_dum* as the explanatory variable, while columns (4) to (8) take *Pld_rate. Ti* and *Doi* as the dependent variables, proxying for the total investment expenditures inefficient investment degree. Each variable is clarified in Table 3.1. In the regression analysis, this research accounts for year and industry fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10% respectively.

Table 3.6: The results of impacts of CSSP on firms' over-investment conditional on ownership concentration (H3)

	(1) *Poi* *First*<30%	(2) *Poi* *First*>=30%	(3) *Ti* *First*<30%	(4) *Ti* *First*>=30%	(5) *Doi* *First*<30%	(6) *Doi* *First*>=30%	(7) *Ti* *First*<30%	(8) *Ti* *First*>=30%
Pld_dum	0.013	0.078**	0.007***	0.013***				
	(0.30)	(2.39)	(3.15)	(7.18)				
Pld_rate					0.016***	0.021***	0.015***	0.025***
					(4.65)	(6.63)	(3.28)	(5.30)
Roa	1.589***	1.958***	0.015	0.086***	-0.032*	0.053***	0.040	0.156***
	(6.08)	(5.38)	(1.53)	(7.54)	(-1.88)	(2.73)	(1.45)	(5.63)
Lev	0.721***	0.762***	-0.031***	-0.012**	-0.035***	-0.001	-0.064***	-0.020**
	(6.04)	(7.29)	(-4.87)	(-2.24)	(-4.43)	(-0.19)	(-5.52)	(-2.10)
Size	0.257***	0.096***	0.015***	0.008***	0.002	-0.000	0.012***	0.006***
	(12.40)	(6.70)	(12.02)	(9.35)	(1.63)	(-0.47)	(5.37)	(4.23)
Growth	0.225***	0.235***	0.034***	0.043***	0.037***	0.025***	0.044***	0.052***
	(5.41)	(6.40)	(11.80)	(16.09)	(9.52)	(8.24)	(9.41)	(13.53)
Mhold	0.115*	0.138***	0.034***	0.021***	0.016***	0.011***	0.045***	0.030***
	(1.71)	(3.87)	(8.54)	(9.90)	(3.60)	(4.99)	(6.52)	(8.96)
Cso	-1.341***	-1.319***	-0.050***	-0.084***	-0.063***	-0.083***	-0.038	-0.099***
	(-4.20)	(-4.39)	(-2.94)	(-5.35)	(-3.18)	(-4.13)	(-1.25)	(-3.46)
Fcf	0.009	-0.774*	-0.002	-0.013**	-0.000	-0.030**	-0.025	-0.048**
	(1.12)	(-1.83)	(-0.97)	(-2.25)	(-0.99)	(-2.13)	(-1.52)	(-2.12)
_cons	-6.152***	-2.384***	-0.237***	-0.083***	0.093	0.069**	-0.064	-0.020
	(-12.61)	(-6.02)	(-5.98)	(-3.22)	(1.38)	(2.50)	(-0.62)	(-0.62)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	10766	19176	9393	16292	4409	7859	3830	6593
Adj_R^2			0.149	0.166	0.118	0.088	0.191	0.229

Columns (1) to (4) display the regression results within the entire sample. Columns (1) and (2) report the logistic regression result with *Poi* as the dependent variables, proxying for the probability of over-investment and *Pld_dum* as the explanatory variable. Columns (3) and (4) report the OLS regression results with total investment expenditures (Ti) as the dependent variable and *Pld_rate* as the independent variable. Columns (5) to (8) display the regression results within the *Poi* = 1 subsample, with the degree of over-investment (*Doi*) and total investment expenditures (*Ti*) as the dependent variables, and *Pld_rate* as the explanatory variable. Each variable is clarified in Table 3.1. Firms are classified into higher (*First* >=30%) and lower (*First* <30%) ownership concentration sub-samples based on the controlling shareholders' explicit and implicit shareholdings. Columns (1), (3), (5), and (7) report the regression results of *First*<30% group, while columns (2), (4), (6), and (8) report the regression results of *First* >=30% group. In the regression analysis, this research accounts for year and industry fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10%, respectively.

Table 3.7: The results of impacts of CSSP on firms' under-investment (H4)

	(1) *Dui*	(2) *Dui*	(3) *Ti*	(4) *Ti*	(5) *Dui*	(6) *Dui*	(7) *Ti*	(8) *Ti*
Pld_dum	0.004***	0.003***	0.002**	0.002**				
	(4.30)	(3.50)	(2.50)	(2.43)				
Pld_rate					0.008***	0.006***	-0.004***	-0.001
					(6.07)	(4.94)	(-2.82)	(-0.90)
Roa		0.024***		0.012**		0.025***		0.011**
		(3.72)		(2.32)		(3.86)		(2.16)
Lev		0.001		-0.025***		0.001		-0.024***
		(0.47)		(-8.84)		(0.30)		(-8.58)
Size		-0.008***		0.008***		-0.007***		0.008***
		(-15.62)		(16.92)		(-15.35)		(16.63)
Growth		0.006***		0.016***		0.005***		0.016***
		(4.73)		(12.31)		(4.70)		(12.38)
Mhold		-0.005***		0.017***		-0.005***		0.018***
		(-6.13)		(15.13)		(-5.89)		(15.72)
Cso		-0.034***		-0.020**		-0.035***		-0.018**
		(-3.67)		(-2.38)		(-3.79)		(-2.12)
Fcf		-0.002		0.001		-0.002		0.001
		(-1.07)		(1.16)		(-1.05)		(1.13)
_cons	0.005***	0.151***	0.052**	-0.118***	0.005***	0.149***	0.055**	-0.114***
	(2.99)	(15.68)	(2.20)	(-4.69)	(2.98)	(15.57)	(2.35)	(-4.51)
Indu FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	17680	17675	15265	15262	17680	17675	15265	15262
Adj_R^2	0.122	0.164	0.060	0.169	0.124	0.165	0.061	0.168

Columns (1) to (8) display the regression results within the *Poi* = 0 sample for H4. Columns (1) to (4) report the regression with *Pld_dum* as the explanatory variable, while columns (4) to (8) employ *Pld_rate. Ti* and *Dui* are the dependent variables, proxying for the total investment expenditures under-investment degree, respectively. Each variable is clarified in Table 3.1. In the regression analysis, this research accounts for year and industry fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10% respectively.

Table 3.8: Results of the relationship between CSSP and under-investment before and after the year 2013

	Before the year 2013				After the year 2013			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dui	*Ti*	*Dui*	*Ti*	*Dui*	*Ti*	*Dui*	*Ti*
Pld_dum	0.003**	-0.001			0.004***	0.005***		
	(2.254)	(-0.606)			(4.175)	(6.195)		
Pld_rate			0.004**	-0.004**			0.008***	0.002
			(2.558)	(-2.290)			(5.458)	(1.500)
Roa	0.017	0.002	0.017	0.001	0.030***	0.017***	0.032***	0.016***
	(1.424)	(0.191)	(1.454)	(0.120)	(4.063)	(3.363)	(4.239)	(3.178)
Lev	-0.008**	-0.026***	-0.009**	-0.025***	0.010***	-0.022***	0.009**	-0.021***
	(-2.158)	(-6.862)	(-2.245)	(-6.644)	(2.704)	(-9.285)	(2.545)	(-9.063)
Size	-0.003***	0.012***	-0.003***	0.011***	-0.010***	0.006***	-0.010***	0.006***
	(-5.450)	(20.261)	(-5.354)	(19.833)	(-16.926)	(16.499)	(-16.715)	(16.338)
Growth	0.002	0.017***	0.002	0.017***	0.007***	0.015***	0.007***	0.015***
	(1.108)	(7.616)	(1.103)	(7.616)	(4.524)	(10.209)	(4.479)	(10.315)
Mhold	0.003**	0.023***	0.003**	0.023***	-0.008***	0.015***	-0.008***	0.016***
	(2.072)	(11.546)	(2.216)	(11.463)	(-7.880)	(16.575)	(-7.671)	(17.789)
Cso	-0.028**	0.013	-0.028**	0.015	-0.034***	-0.038***	-0.036***	-0.035***
	(-2.156)	(1.105)	(-2.200)	(1.283)	(-2.903)	(-4.974)	(-3.022)	(-4.629)
Fcf	-0.009*	0.006**	-0.009*	0.006**	-0.001	0.001	-0.001	0.001
	(-1.681)	(2.250)	(-1.684)	(2.255)	(-0.700)	(1.013)	(-0.674)	(0.981)
_cons	0.084***	-0.208***	0.082***	-0.094***	0.333***	-0.117***	0.331***	-0.115***
	(6.374)	(-19.283)	(6.279)	(-7.936)	(20.456)	(-7.182)	(20.191)	(-7.180)
Indu FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	6330.000	4936.000	6330.000	4936.000	11345	10326	11345	10326
Adj_R²	0.039	0.212	0.040	0.213	0.215	0.157	0.216	0.154

Columns (1) to (4) display the regression results within the *Poi* = 0 & year <= 2013 subsample. Columns (5) to (8) display the regression results within the *Poi* = 0 & year > 2013 subsample. Each variable is clarified in Table 3.1. In the regression analysis, this research accounts for year and industry fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10% respectively.

Table 3.9: Sensitivity tests for the robustness of H1

	(1) *Poi*	(2) *Poi*	(3) *Ti*	(4) *Ti*	(5) *Dii*	(6) *Dii*
Pld_dum	0.037**	0.040**				
	(2.38)	(2.55)				
Pld_rate			0.008***	0.009***	0.003**	0.005***
			(3.48)	(4.59)	(2.57)	(3.66)
Roa		1.001***		0.055***		0.013**
		(8.97)		(7.35)		(2.12)
Lev		0.462***		-0.020***		0.005*
		(10.03)		(-4.92)		(1.81)
Size		0.086***		0.011***		0.007***
		(12.24)		(14.93)		(15.57)
Growth		0.148***		0.040***		0.016***
		(9.12)		(20.08)		(12.18)
Mhold		0.089***		0.027***		0.011***
		(4.63)		(13.99)		(10.39)
Cso		-0.703***		-0.053***		-0.028***
		(-5.35)		(-4.50)		(-3.48)
Fcf		-0.002		-0.005		-0.000
		(-0.21)		(-1.48)		(-0.26)
_cons	0.034	-2.142***	0.077***	-0.140***	0.002	-0.162***
	(0.36)	(-12.09)	(3.72)	(-6.12)	(0.14)	(-11.97)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	29958	29942	25694	25685	29959	29943
Adj_R²			0.040	0.152	0.005	0.040

This table presents the results of sensitivity tests when I switch to the probit model for Eq. (3.2) and change the explanatory variable in Eq. (3.3) and Eq. (3.4). Each variable is clarified in Table 3.1. In the regression analysis, this research accounts for year and industry-fixed effects, and the corresponding

t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10% respectively.

3.3.2.2 Endogeneity

3.3.2.2.1 Endogeneity Concerns

The primary tests may suffer from potential endogeneity issues as there could be unobserved factors that influence both CSSP and corporate investment behaviors simultaneously. To mitigate these concerns, this research employs various methods such as regressions with firm-fixed effects, Heckman two-stage estimation combined with instrumental variables, PSM and DID approaches. These methods help to address the endogeneity issues in the analysis and enhance the reliability of the findings.

3.3.2.2.2 Firm-fixed Regression

To address the potential impact of time-independent factors at the firm level on the findings, I conduct a Firm-fixed effect regression to re-examine hypothesis H1. The results of this analysis are presented in Table 3.10. Columns (1) and (2) show the regression results when *Ti* is the independent variable and *Pld_dum* is the independent variable regressed with entire sample. The statistical coefficients of *Pld_dum* are significant and positive in column (1) (0.005, t = 2.81) without control variables. Columns (3) and (4) report regression results when *Doi* is used as the proxy for the over-investment

degree, and *Pld_rate* is the independent variable regressed with subsample (*Poi* = 1). The statistical coefficients of *Pld_dum* are significant and positive (0.014, *t* = 3.76; 0.011, *t* = 3.20) without and with all control variables. Columns (5) and (6) report regression results when *Ti* is used as the proxy for the investment expenditure level, and *Pld_rate* is the independent variable regressed with subsample (*Poi* = 1). The statistical coefficient of *Pld_rate* is significant and positive (0.012, *t* = 2.50; 0.007, *t* = 1.85) without and with all control variables. These results indicate that the results are not being driven by any unobserved time-independent factors at the firm level.

Chamberlain (1980) advanced the formalization and use of fixed effects models for analyzing panel data in econometrics, addressing issues such as endogeneity and unobserved heterogeneity. In firm-fixed effects regression, the focus is on controlling for unobserved time-invariant heterogeneity across firms. This is achieved by including fixed effects for each firm in the regression model. These fixed effects absorb all time-invariant characteristics of the firms. Firm-fixed effects regression is particularly useful in addressing concerns related to omitted variable bias and unobserved heterogeneity (Ullah et al., 2018), making it a valuable tool for analyzing panel data when unobserved differences across firms could affect the related relationships.

3.3.2.2.3 GMM Regression

This study uses the Generalized Method of Moments (GMM) regression to repeat Eq. (3.5) to see if the findings hold in the dynamic model. Table 3.11 presents the System GMM regression results.

GMM is introduced by Hensen (1982) as a framework for estimating parameters in economic models, particularly in situations where classical methods' assumptions are not met. GMM is widely used in panel data research regarding finance and economics (Ding et al., 2018; Law, 2023; Ullah et al., 2018), for It allows researchers to handle issues such as endogeneity, heteroscedasticity, and other violations of classical assumptions. GMM starts with a theoretical model describing the relationship between the dependent and independent variables. Moment conditions are functions of the data and parameters that capture certain features of the model. The objective function is constructed to measure the difference between the sample moments and the model moments. The objective function is a weighted sum of squared differences, where the weights are often determined by a positive definite weighting matrix.

Columns (1) and (2) report the results with *Pld_dum* as the proxy for CSSP, while columns (3) and (4) report *Pld_rate* as the proxy. The coefficients of *Pld_dum* and *Pld_rate* are all significantly positive regardless of whether *Doi or Ti is the* dependent variable, consistent with the main examinations. The coefficients on lagged *Doi* or *Ti* are not significant, suggesting that the dynamic effects of the baseline model Eq. (3.2) is not significant.

3.3.2.2.4 Heckman two-stage estimation with instrumental variables

To address the potential issue of endogeneity, like the factors driving controlling shareholders to pledge their shares may also influence firms' investment, this study employs the Heckman two-stage estimation. In the first

stage, this research regresses a probit model with *Pld_dum* as the dependent variable. Subsequently, I incorporate the Inverse Mills Ratio (*Imr*) derived from the first stage into Eq. (3.2) as the second stage model, with *Pld_dum* as the independent variable. The first stage model is expressed as follows:

$$Pld\_dum_{i,t} = \alpha_{i,t} + \beta_1 Post_{i,t} + \beta_2 Pld\_Iv\_Indu_{i,t} + \beta_3 Pld\_Iv\_Prov_{i,t} + \beta_4 Soe_{i,t} + \beta_5 Roa_{i,t} + \beta_6 Size_{i,t} + \beta_7 Lev_{i,t} + \beta_8 Age_{i,t} + \beta_9 Growth_{i,t} + \beta_{10} Mhold_{i,t} + \beta_{11} So_{i,t} + \beta_{12} Fcf_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (3.7)$$

The Heckman two-stage regression proposed by Heckman (1979) is widely used when dealing with situations where individuals self-select into the sample. It helps to correct for potential bias in estimating the impact of variables on the outcome due to the non-random selection of observations.

The Heckman two-stage regression involves a two-step estimation procedure. In the first stage, a probit or logit model is estimated to model the probability of selection into the sample (participation equation or selection equation). In the second stage, the outcome equation is estimated for the individuals who are in the sample. However, the inverse Mills ratio is included as an additional regressor in the outcome equation to correct for sample selection bias. The estimated coefficient on the inverse Mills ratio in the outcome equation provides information about the impact of sample selection on the outcome variable. The coefficient on the covariates in the outcome equation represents the effect of those covariates on the outcome variable after correcting for sample selection bias.

Eq. (3.7) contains four instrumental variables. First instrumental variable denoted as *Post*, takes a value of 1 for the years 2018 and beyond. As discussed in Section 2.1, CSRC has restricted the percentage of firms' share-pledging since 2018, thus leading to a reduced percentage of share-pledging. The alteration in regulations serves as an external shock that influences share pledging, yet it does not directly impact over-investment. The second one is *Soe*, which is set to 1 for the state-owned firms and 0 otherwise. Differently from the prior research, which takes *Soe* as a control variable (Chan et al., 2018; Xu & Huang, 2021; Zhu & Xiong, 2020), this research takes *Soe* as an instrumental variable because state-owned companies are both less probably to participate in share pledging (Xing, 2018) (also shown in Figure 3.2) and over-investment (Chen et al., 2017) due to their unique nature. Referring to Larcker & Rusticus (2010), introducing the variable that simultaneously influences dependent and independent variables into the model may cause endogeneity issues, and it should be introduced as an instrumental variable. Furthermore, this research introduces two additional instruments: *Pld_Iv_Indu*, defined as the average value of *Pld_dum* for all other observations from the same industry in a specific year, while omitting the value of *Pld_dum* for the firm being considered; and *Pld_Iv_prov*, clarified as the average value of *Pld_dum* for all other observations from the same province in a specific year, while omitting the value of *Pld_dum* for the firm being considered. In the first-stage regression, also incorporate the control variables from Eq. (3.2).

Table 8 presents the results of the Heckman two-stage estimation. In the first stage estimation, the negative statistical coefficients on *Soe* indicate that controlling shareholders of state-owned firms are less likely to pledge their shares, which aligns with Li & Xing (2017). In addition, the significant statistical

coefficient of *Imr* implies the presence of a selection effect. After this research considers the selection effect in the second stage, the statistical coefficients of *Pld_dum* remain significant and positive, suggesting CSSP has a causal effect on firms' overinvestment.

3.3.2.2.5 PSM approach

Propensity Score Matching (PSM) is used to reduce the resulting estimator's variance when it is estimated both parametrically and nonparametrically (Heckman et al., 1998). PSM is a statistical method used to estimate the causal effect of a treatment, intervention, or exposure when conducting observational studies. It is particularly useful when the treatment assignment is not random, and there is a need to balance the observed characteristics of treated and untreated groups.

The process of PSM is step-by-step as follows. Firstly, to identify the treatment group and the control group; secondly, to collect covariates, which are characteristics that need to be balanced between the treatment and control groups; Thirdly, to estimate propensity scores for each individual using a logistic regression, which is the predicted probability of receiving the treatment based on the observed covariates. Mathematically, if *e* is the propensity score and X represents the covariates: e=P(Treatment=1|X); Fourthly, to check balance, assessing the balance of covariates between the treatment and control groups by comparing the distributions of covariates before and after matching based on propensity scores, to ensure that the matched samples are

comparable; Fifthly, to match each treated individual with one or more untreated individuals who have similar or very close propensity scores. There are different matching algorithms, such as nearest neighbour matching, kernel matching, or Mahala Nobis distance matching; Sixthly, to estimate treatment effect. After matching, the outcome of interest between the treated and matched control groups was compared. The difference in outcomes provides an estimate of the causal effect of the treatment. Eventually, sensitivity analyses are conducted to evaluate the robustness of the results to different modelling choices, matching algorithms, and assumptions. (Chang et al., 2022; Xu & Huang, 2021).

Panel B of Table 3.2 exhibits substantial disparities in firm characteristics between firms with and without share pledging, which raises concerns that the results of the initial tests might be influenced by systematic dissimilarities in these groups. To address this concern, this study adopts the PSM approach. Explicitly, this study uses control variables in Eq. (1) and *First* to match firms with and without share-pledging controlling shareholders based on the closest matching score with maximum callipers of $2.5e^{-6}$ and $3.5e^{-5}$ without replacement in the full and subsample (*Poi* = 1), respectively. The matching process results in 1675 and 1206 matches in the full and subsample (*Poi* = 1), respectively. This research then regresses the primary tests using the matched sample. Table 3.13 presents the matching outcomes. Panels A and B illustrate no significant distinctions between the firms with and without share pledging controlling shareholders after matching. Table 3.14 presents the results regressed with the matching samples, where the statistical coefficients of

Pld_dum and *Pld_rate* remain significant and positive across all regressions, suggesting the systematic differences in the characteristics of firms with and without share-pledging controlling shareholders do not affect the core findings of this study.

Table 3.10: Firm-fixed effect regression results

	(1) *Ti*	(2) *Ti*	(3) *Doi*	(4) *Doi*	(5) *Ti*	(6) *Ti*
Pld_dum	0.005***	0.000				
	(2.81)	(0.27)				
Pld_rate			0.014***	0.011***	0.012**	0.007*
			(3.76)	(3.20)	(2.50)	(1.85)
Roa		0.029***		0.045***		0.080***
		(3.52)		(3.01)		(4.80)
Lev		-0.028***		-0.005		-0.030***
		(-4.19)		(-0.62)		(-3.73)
Size		0.027***		0.011***		0.030***
		(16.82)		(5.63)		(16.21)
Growth		0.035***		0.024***		0.043***
		(18.80)		(10.25)		(26.07)
Mhold		0.030***		0.008		0.023***
		(6.44)		(1.40)		(3.73)
Cso		-0.106***		-0.080***		-0.111***
		(-7.07)		(-4.33)		(-5.71)
Fcf		-0.002**		-0.001		-0.021***
		(-1.15)		(-1.28)		(-5.00)
_cons	0.054***	-0.544***	0.049***	-0.206***	0.097***	-0.568***
	(70.18)	(-15.65)	(54.69)	(-4.79)	(82.04)	(-14.17)
Number of observations	25239	25230	11648	11635	9738	9731
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Adj_R^2	0.247	0.335	0.156	0.203	0.345	0.447

The dependent variables of columns columns (1) & (2) is *Ti*, the explanatory variable is *Pld_dum*; The dependent variables of columns (3) & (4) and (5) & (6) are *Doi* and *Ti*, the explanatory variable is *Pld_rate*. Each variable is clarified in Table 3.1. In the regression analysis, this research accounts for firm and year fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10% respectively.

Table 3.11: GMM regression results

	(1) *Doi*	(2) *Ti*	(3) *Doi*	(4) *Ti*
Pld_dum	0.043** (2.168)	0.219*** (3.044)		
Pld_rate			0.071** (2.066)	0.249** (2.367)
L.Ti		0.196* (1.650)		0.122 (0.772)
L.Doi	0.090 (1.643)		0.094* (1.658)	
Roa	0.091** (2.021)	-1.844*** (-4.122)	0.065 (0.480)	-2.553*** (-4.220)
Lev	-0.040 (-1.606)	-1.610*** (-5.879)	-0.039 (-1.514)	-1.887*** (-4.941)
Size	-0.012* (-1.719)	0.488*** (4.406)	-0.008 (-1.402)	0.628*** (4.142)
Growth	0.023*** (4.343)	0.216* (1.711)	0.033 (0.590)	0.332* (1.883)
Mhold	-0.189* (-1.825)	-0.692** (-2.049)	-0.146 (-1.630)	-0.149 (-0.383)
Cso	0.003 (0.074)	-2.139*** (-4.282)	-0.018 (-0.387)	-2.684*** (-4.004)
Fcf	-0.009 (-0.937)	0.050 (0.945)	-0.009 (-0.779)	0.056 (0.841)
_cons	0.363* (1.884)	-10.219*** (-4.182)	0.263 (1.601)	-13.198*** (-4.007)
Indu FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Ar (1)	0.000	0.049	0.000	0.065
Ar (2)	0.581	0.235	0.303	0.240
Hansen Test	0.494	0.577	0.501	0.366
N	4801	8760	4801	8760

This table reports the effects of CSSP on over-investment by System GMM in the baseline model (3.2). This study uses the levels of explanatory variables lagged 4 times and more as instruments for the first-differenced equation. AR(n) is the test for the null of no n-th order autocorrelation of the differenced residuals, and the Hansen test is of over-identifying restrictions. Each variable is defined in Table 3.1. In the regression analysis, this research accounts for firm and year fixed effects, and values in parenthesis are the asymptotic standard errors and those in square brackets are the p-values of test statistics. *, ** and *** indicate the significance of coefficients at the 10%, 5% and 1% level respectively.

Table 3.12: Heckman two-stage estimation

	(1) First stage *Pld_dum*	(2) Second stage *Ti*	(3) First stage *Pld_dum*	(4) Second stage *Doi*	(5) Second stage *Ti*
Pld_dum		0.008***		0.011***	0.014***
		(7.43)		(7.41)	(7.19)
Pld_Iv_Indu	2.068***		1.949***		
	(26.98)		(16.01)		
Pld_Iv_Prov	2.122***		1.940***		
	(23.26)		(13.65)		
Post	-0.382***		-0.276***		
	(-6.81)		(-3.05)		
Soe	-1.139***		-1.198***		
	(-56.43)		(-38.21)		
Roa	-0.438***	0.058***	-0.059	0.006	0.108***
	(-3.48)	(8.97)	(-0.25)	(0.52)	(5.98)
Lev	0.927***	-0.025***	1.106***	-0.019***	-0.047***
	(18.33)	(-8.27)	(13.28)	(-4.13)	(-7.48)
Size	-0.010	0.011***	-0.036***	0.001	0.010***
	(-1.28)	(24.58)	(-2.79)	(1.19)	(10.58)
Growth	0.106***	0.039***	0.096***	0.030***	0.048***
	(6.11)	(19.86)	(3.79)	(12.16)	(15.79)
Mhold	-0.019	0.023***	-0.021	0.008***	0.028***
	(-0.90)	(16.17)	(-0.63)	(4.37)	(10.65)
Cso	1.634***	-0.061***	1.613***	-0.069***	-0.067***
	(10.73)	(-6.63)	(6.66)	(-5.21)	(-3.59)
Fcf	-0.000	-0.005	0.002	-0.001*	-0.033**
	(-0.06)	(-1.46)	(0.32)	(-1.66)	(-2.35)
imr		-0.008***		-0.007***	-0.012***
		(-6.51)		(-4.24)	(-5.43)
_cons	-1.350***	-0.159***	-0.825***	0.062**	-0.060**
	(-7.92)	(-8.08)	(-2.99)	(2.26)	(-2.02)
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	No	Yes	No	Yes	Yes
Number of observations	29457	25234	12083	12083	10251
Adj_R^2		0.156		0.095	0.215

In the first-stage estimation, I establish a probit model with *Pld_dum* as the independent variable., The *Imr* which derived from the first stage, are introduced into the second stage analysis. Each variable is clarified in Table 1. In the first stage regression, this study accounts for year fixed effect. In the second stage regression, this research accounts for year and industry fixed effects and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10% respectively.

Table 3.13: Post-match differences

Panel A: Post-match differences in the entire sample				
Variable	**Treated**	**Control**	***T* value**	***P* value**
Roa	0.029	0.028	0.220	0.829
Lev	0.472	0.481	-1.230	0.218
Size	22.133	22.123	0.210	0.832
Growth	0.139	0.153	-1.000	0.317
Mhold	0.121	0.110	1.150	0.252
So	-0.027	-0.025	-0.770	0.443
Fcf	-0.029	0.002	-1.110	0.269
First	0.349	0.346	0.760	0.448
Panel B: Post-match differences in *Poi* = 1 subsample				
Variable	**Treated**	**Control**	***T* value**	***P* value**
Roa	0.035	0.033	0.850	0.394
Lev	0.464	0.471	-0.940	0.346
Size	22.211	22.243	-0.650	0.513
Growth	0.214	0.231	-0.810	0.420
Mhold	0.222	0.229	-0.480	0.628
Cso	-0.022	-0.021	-0.650	0.516
Fcf	-0.014	0.016	-1.680	0.094
First	0.326	0.320	1.180	0.238

Panels A and B display the comparisons of firm characteristics between the treatment group and the control group after propensity score matching in both the entire sample and the subsample (*Poi* = 1), respectively.

Table 3.14: Regressions with the matched sample

	(1) *Ti*	(2) *Ti*	(3) *Doi*	(4) *Ti*
Pld_dum	0.008*** (3.42)			
Pld_rate		0.007** (1.96)	0.013*** (3.24)	0.026*** (5.61)
Roa	0.018 (0.86)	0.018 (0.90)	0.043 (1.32)	-0.001 (-0.02)
Lev	-0.028*** (-3.26)	-0.029*** (-3.30)	-0.049*** (-4.32)	-0.016 (-1.41)
Size	0.012*** (8.07)	0.012*** (8.07)	0.005*** (2.85)	0.001 (0.87)
Growth	0.020*** (3.38)	0.019*** (3.35)	0.007** (2.02)	0.016*** (3.79)
Mhold	0.021*** (6.15)	0.021*** (6.18)	0.016*** (4.37)	0.013*** (2.72)
Cso	-0.023 (-0.78)	-0.025 (-0.82)	-0.048 (-1.26)	-0.112*** (-2.77)
Fcf	0.000 (0.38)	0.000 (0.35)	-0.006** (-2.29)	-0.005 (-1.49)
First	0.025*** (3.03)	0.026*** (3.20)	0.023** (2.32)	0.008 (0.75)
_cons	-0.153*** (-4.43)	-0.153*** (-4.36)	0.063 (1.30)	0.106* (1.71)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Number of observations	3350	3350	2512	2512
Adj_R^2	0.103	0.101	0.123	0.071

This table presents the regression analysis results conducted using the matched sample. The dependent variables are *Ti* and *Doi*. The independent variables are *Pld_dum* and *Pld_rate*, respectively. Each variable is clarified in Table 1. In the regression analysis, this research accounts for year and industry effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notations ***, **, and * signify significance levels of 1%, 5%, and 10%, respectively, based on two-tailed tests.

Collectively, after employing regression with firm-fixed effects, Heckman two-stage combined with instrumental variables estimation, and the PSM approach to address possible endogeneity issues, the main findings still hold.

3.3.2.3 Policy Tests

As mentioned in section 2.1, new restrictions on the ratio of single-share equity pledges have been implemented since 2018. In this segment, this research employs the DID approach to examine the impact of the change in share pledging on over-investment. This research uses *Pld_dum* and *Post* (defined in section 5.2.2) as indicator variables of the treatment group and regulatory change in 2018, respectively. The coefficient on the interaction (*Pld_dum∗ Post)* captures the change in over-investment for firms with CSSP compared to other firms following the regulatory change.

The DID approach is proposed by Ashenfelter & Card (1986), used to estimate causal effects in observational studies, particularly when randomized controlled trials (RCTs) are not feasible or ethical. DID compares the changes in outcomes over time between a treatment group and a control group, allowing researchers to estimate the causal impact of an intervention, policy change, or treatment.

The basic idea behind DID is to exploit variations in treatment status and time to estimate the treatment effect. The key assumption is the parallel trends assumption, which posits that, in the absence of treatment, the trends in outcomes for the treatment and control groups would have followed the same trajectory over time. DID has several advantages, including its ability to control for time-invariant confounders, such as individual heterogeneity or omitted variables, through differencing. However, it also has limitations, such as the

reliance on the parallel trends' assumption and potential biases if this assumption is violated.

Table 11 reports the estimation results. Columns (1) ~ (3) present negative and significant statistical coefficients on *Pld_dum* $*$ *Post* with *Ti* as the dependent variable (-0.006, *t* = -3.11) within the entire sample; *Doi* as the dependent variable (-0.005, *t* = -1.89) within *Poi* = 1 subsample; and *Ti* as the dependent variable (-0.010, *t* = -2.87) within *Poi* = 1 subsample; suggesting that the negative shock to share pledging discourages firms' over-investment.

In order to verify that the assumption of parallel-trend is valid, this research conducts a timing test to analyze the changes in firms' investment behaviors before and after the regulatory change. This helps us ensure that pre-existing trends or other confounding factors do not drive the change in investment behaviors.

The model this chapter estimates is as follows:

$$Over\_invest_{i,t} = \beta_0 + \beta_1 Y_{17} * Pld\_dum_{i,t} + \beta_2 Y_{18} * Pld\_dum_{i,t} + \beta_3 Y_{19} * Pld\_dum_{i,t} + \beta_4 Y_{20} * Pld\_dum_{i,t} + \beta_i Controls_{i,t} + \mu_i + \tau_t + \varphi_{i,t} \quad (3.8)$$

As the change in regulation occurred in 2018, following Brogaard (2017) , this research introduces four dummy variables *Y17, Y18, Y19, Y20* proxying for the given year, which is set to 1 if it is year 2017, 2018, 2019, and 2020, respectively. Columns (6) ~ (8) of Table 12 present statistically insignificant coefficients on *Pld_dum*Y17*, indicating that the assumption of parallel trend

in the DID is not violated. Significant statistical coefficients can only be observed after the regulatory change, suggesting that the plausibly exogenous reduction in equity pledges leads to a reduction in firms' over-investment, in line with the main findings.

Collectively, the results indicate that the policy restricts the percentage of firms' shares pledged carried out in 2008 and also restricts firms' over-investment, which confirms the findings robustly.

Table 3.15: Differences-in-differences approach

	(1) *Ti*	(2) *Doi*	(3) *Ti*	(4) *Ti*	(5) *Doi*	(6) *Ti*
Pld_dum∗ Post	-0.006*** (-3.11)	-0.005* (-1.89)	-0.010*** (-2.87)			
*Pld_dum *Y17*				-0.001 (-0.35)	0.004 (0.83)	-0.002 (-0.44)
Pld_dum Y18*				-0.005** (-2.02)	-0.002 (-0.60)	-0.012*** (-2.63)
Pld_dum Y19*				-0.006** (-2.49)	-0.009** (-2.16)	-0.008* (-1.67)
Pld_dum Y20*				-0.006** (-2.20)	-0.005 (-1.22)	-0.005 (-0.96)
Roa	0.028*** (3.42)	0.045*** (3.03)	0.079*** (3.61)	0.027*** (3.32)	0.044*** (2.94)	0.078*** (3.55)
Lev	-0.028*** (-4.21)	-0.005 (-0.60)	-0.031** (-2.56)	-0.028*** (-4.16)	-0.005 (-0.57)	-0.030** (-2.52)
Size	0.027*** (16.94)	0.012*** (5.88)	0.030*** (10.44)	0.027*** (16.84)	0.012*** (5.84)	0.030*** (10.39)
Growth	0.035*** (18.76)	0.024*** (10.21)	0.043*** (15.24)	0.035*** (18.73)	0.024*** (10.21)	0.043*** (15.20)
Mhold	0.029*** (6.31)	0.007 (1.23)	0.022*** (2.72)	0.029*** (6.22)	0.007 (1.17)	0.022*** (2.67)
Cso	-0.105*** (-7.04)	-0.080*** (-4.30)	-0.111*** (-4.08)	-0.104*** (-6.99)	-0.079*** (-4.24)	-0.109*** (-4.02)
Fcf	-0.002 (-1.15)	-0.001 (-1.30)	-0.021** (-2.03)	-0.002 (-1.16)	-0.001 (-1.32)	-0.021** (-2.04)
_cons	-0.553*** (-15.76)	-0.218*** (-5.00)	-0.586*** (-9.20)	-0.551*** (-15.67)	-0.218*** (-5.00)	-0.585*** (-9.16)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	25685	11635	9731	25685	11635	9731
Adj_R^2	0.335	0.202	0.448	0.336	0.202	0.448

The table provides an estimation of the impacts of share pledging on firms' investment using the DID approach. Columns (1) to (3) present coefficients on *Pld_dum* ∗ *Post.* Columns (4) and (6) present the coefficients on *Pld_dum *Y17, Pld_dum *Y18*, *Pld_dum *Y19*, and *Pld_dum *Y20.* Each variable is clarified in Table 1. The sample period covers the years 2007 to 2020. The regressions have controlled year and firm-fixed effects. The robust standard errors are clustered at the firm level and reported in parentheses. The notation ***, **, and * signify significance levels of 1%, 5%, and 10%, respectively.

3.4 Mechanism Detecting

As discussed above, the empirical results suggest that CSSP exacerbates over-investment, and the exacerbating effect is more pronounced in firms with higher concentrated ownership. To detect the underlying mechanism of how CSSP impacts over-investment, this study detects the motivations of the controlling shareholders to make investment decisions after share pledging, as well as the channels through which CSSP exacerbates over-investment.

3.4.1 Additional and Maintenance Investments

Optimal investment is defined as the sum of maintenance investment and expected additional investment in positive NPV projects (Myers & Majluf, 1984; Richardson, 2006). Maintenance investment is investment expenditure to maintain assets in place, including existing servicing debt. Additional investment is composed of expected new investments in positive NPV projects

and abnormal investment (Richardson, 2006). The abnormal investment can be negative or positive, and over-investment is a positive condition, as stated before. Given that over-investment exists in additional investment, further analysis of the impacts of CSSP on maintenance investment and additional investment is necessary to reveal the process by which CSSP affects overinvestment in more detail.

To explore the impacts of CSSP on maintenance and additional investments, this research conducts the equations as follows:

$$Mi_{i,t} = \beta_0 + \beta_1 Pledge_{i,t} + \beta_i Controls_{i,t} + \sum Industry + \sum Year + \varphi_{i,t} \quad (3.9)$$

$$Ai_{i,t} = \beta_0 + \beta_1 Pledge_{i,t} + \beta_i Controls_{i,t} + \sum Industry + \sum Year + \varphi_{i,t} \quad (3.10)$$

Whereas *Mi* indicts the maintenance investment expenditure calculated as maintenance investment expenditure scaled by total assets, and *Ai* indicts the additional investment expenditure calculated as additional investment expenditure scaled by total assets. The independent variable is *Pledge*, including *Pld_dum* and *Pld_rate* as defined in Section 3.1

Table 3.16: Differences in specific capital and R&D investments between non-pledging and pledging firms

	***Pld_dum* = 0**		***Pld_dum* = 1**		**T test**
	Mean	**Med**	**Mean**	**Med**	**T-stat**
Mi (Entire sample)	0.029	0.026	0.027	0.025	6.468***
Ai (Entire sample)	0.024	0.007	0.035	0.013	-12.282***
Ei (Entire sample)	0.044	0.031	0.045	0.032	-1.705*
Si (Entire sample)	0.002	0.000	0.005	0.000	-7.301***
RD (Entire sample)	17.786	17.829	17.734	17.814	2.358**
Mi (*Poi* = 1 subsample)	0.028	0.025	0.027	0.024	2.729***
Ai (*Poi* = 1 subsample)	0.064	0.040	0.086	0.059	-9.503***
Ei (*Poi* = 1 subsample)	0.068	0.057	0.069	0.058	-1.100
Si (*Poi* = 1 subsample)	0.009	0.000	0.015	0.000	-9.443***
RD (*Poi* = 1 subsample)	17.905	17.940	17.842	17.911	1.787*

Table 3.16 presents the differences in the specific capital investments based on *Pld_dum* between firms with and without CSSP. Within the entire sample, the mean (median) values of *Mi* are 0.029 (0.026) and 0.027 (0.025) of the firms without and with share pledging, respectively. The mean (median) values of *Ai* are 0.024 (0.007) and 0.035 (0.013) of the firms without and with share pledging, respectively. Similar results come out when this research makes the comparisons within the *Poi* = 1 subsample. It suggests that compared to non-pledging firms, pledging firms significantly invest more in additional investment, including both long-term assets investment and subsidiary investment, while less in maintenance investments. Figures 4a and 4b also show the difference.

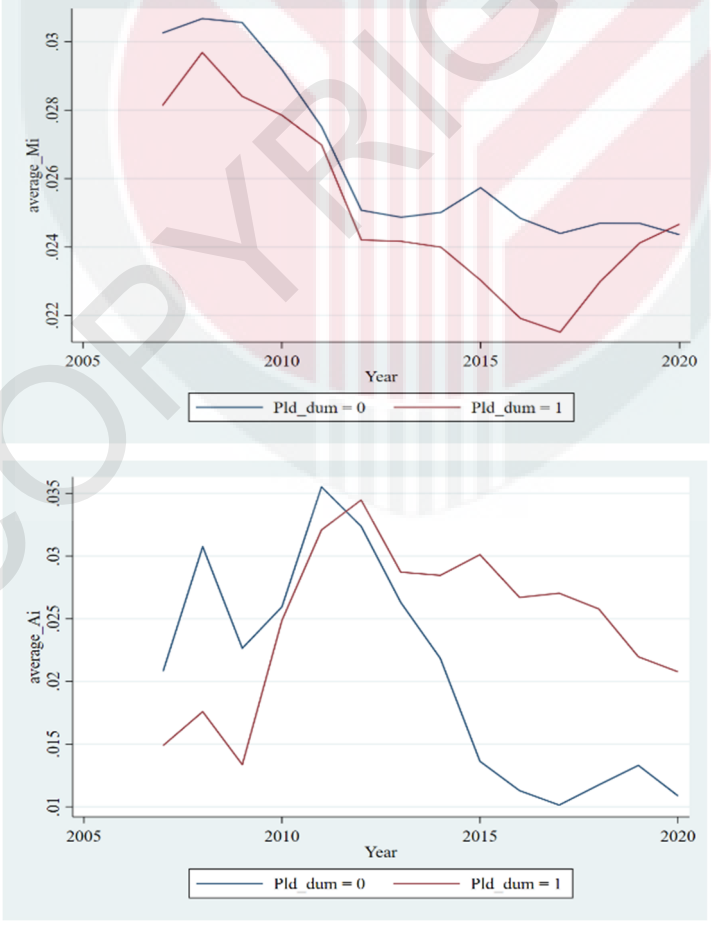


Figure 3.2a: Average Mi & Ai Over *Pld_dum* in Entire sample 2007-2020

Figure 3.2b: Average *Mi* & Ai Over *Pld_dum* in *Poi* = 1 Subsample 2007-2020

Figure 3.2a displays the average maintenance investment and additional investment within the entire sample spanning from 2007 to 2020; Figure 3.2b displays the average maintenance investment and additional investment within the *Poi* = 1 subsample spanning from 2007 to 2020;

Sources: manually made by Stata 17.0.

Table 3.17 presents the regression results of Eq. (8) and (9). Columns (1) and (5) illustrate the results within full and *Poi*=1 subsample, with *Mi* proxying for

maintenance capital expenditure. The statistical coefficients of *Pld_rate* are significant and negative (- 0.002, *t* = - 2.70), suggesting that the higher the share pledging ratio, the less the maintenance investment is. Columns (2) and (6) display the results within full and *Poi*=1 subsample, with *Ai* proxying for additional investment expenditure; the statistical coefficients of *Pld_dum* and *Pld_rate* are both significantly positive (0.011, *t* = 8.32; and 0.023, *t* = 7.40), suggesting that firms with controlling shareholders participating in share pledging are related to more additional investment expenditures. These outcomes imply that CSSP impacts additional investment positively, and maintenance investment negatively.

Then, this research further decomposes additional investment (*Ai*) as investment for plant and equipment, intangible assets and other long-term assets (*Ei*), and investment for subsidiaries and other operating units (*Si*) to examine the impacts of CSSP on over-investment in detail. This research repeats the tests of Eq. (8) and (9) with *Ei* and *Si* as independent variables. Columns (3) and (4), (7), and (8) report the results within full and *Poi*=1 subsample. The coefficients of *Pld_dum* and *Pld_rate* are both significant and positive (0.007, *t* = 5.66; 0.004, *t* = 5.15; and 0.008, *t* = 2.69; and 0.011, *t* = 5.28), suggesting CSSP intensify investments for both internal and external expansions.

Taken together, these results imply that controlling shareholders put emphasis on additional investments, in particular, internal expansions and external acquisitions, while damaging maintenance investments after they pledged

their shares. These findings are insistent with the fact that CSSP strengthens the "hollowing out" effect (Wu & Wu, 2011; Zhang, 2020; Dang, 2022), using a pyramid structure (Claessens et al., 2000; Jensen, 1986) to obtain substitute cash flow rights and more control for their self-benefit (Porta et al., 1999; Shleifer & Vishy, 1997). Also, they can send good messages to the market through announcements on expansions and acquisitions.

3.4.2 R&D Investments

Table 3.16 presents the differences in the R&D investment based on *Pld_dum* between firms with and without CSSP. Within the entire sample, the mean (median) values of *RD* are 17.786 (17.829) and 17.734 (17.814) of the firms without and with share pledging, respectively. Similar results come out when this research makes the comparisons within the *Poi* = 1 subsample. It suggests that compared to non-pledging firms, pledging firms significantly invest less in R&D investments.

To further discern the real intention of the controlling shareholders with share pledging on the firms' investments. This research conducts the equation as follows to examine the impacts of CSSP on firms' R&D investments.

$$RD_{i,t} = \beta_0 + \beta_1 Pledge_{i,t} + \beta_i Controls_{i,t} + \sum Industry + \sum Year + \varphi_{i,t} \quad (3.11)$$

Whereas *RD* indicates the R&D investment expenditure calculated as Ln (R&D investment expenditure) (Chang et al., 2022). The independent variable is *Pledge*, including *Pld_dum* and *Pld_rate* as defined in Section 3.1.

Table 3.18 presents the results of the impacts of CSSP on R&D investment expenditure. Columns (1) and (2), (3), and (4) present the results within full and sub-sample without and with control variables, respectively. coefficients of *Pld_dum* and *Pld_rate* are all significant and negative (-0.228, *t* = -5.21; -0.088, *t* = -2.73; and -0.463, *t* = -6.23; and -0.192, *t* = -3.36), suggesting CSSP has negative impacts on R&D investments.

This finding is consistent with Chang (2022) and Zhang (2017), also in line with Richardson (2006) that R&D investment can be captured by maintenance investment. Firms invest more after CSSP but less in both R&D investment and maintenance investment. It implies that firms' investments in the high-growth industry and high-technology projects are not for research and development but for sending good messages to the market to maintain their stock prices. To examine this intention of the investment decision-making of controlling shareholders, I will do further tests as follows.

3.4.3 Signalling Tests

Due to marginal call pressure after share pledging, controlling shareholders need the signals to lead the investors' perception when firms' stock prices appear to be in a downtrend, in particular, a sharp one. Hence, I conduct the following equations, Eq. (11) and (12), to examine the impacts of CSSP on over-investment conditional on stock price crash risks.

$$Ti_{i,t} = \beta_0 + \beta_1 Pld\_dum_{i,t} + \beta_i Controls_{i,t} + \sum Industry + \sum Year + \varphi_{i,t} \quad (3.12)$$

$$Doi_{i,t} = \beta_0 + \beta_1 Pld\_dum_{i,t} + \beta_i Controls_{i,t} + \sum Industry + \sum Year + \varphi_{i,t} \quad (3.13)$$

I partition the firms into two groups of higher (*Crash* = 1) and lower (*Crash* = 0) crash risk sub-samples based on weekly yield volatility. Then, I regress Eq. (11) and (12) within the two-group data, respectively.

Table 3.19 presents the results. Columns (1) and (2) display the regression results within the entire sample, while columns (3) to (6) display the regression results within the *Poi* = 1 subsample. The statistical coefficients on *Pld_dum* are all significant and positive in columns (1) to (6), and they are all larger in firms with higher stock price crash risk in columns (1), (3) and (5) (0.014, *t* = 4.12; 0.018, *t* = 3.70; and 0.025, *t* = 3.77) than firms with lower stock price crash risk in columns (2), (4) and (6) (0.010, *t* = 10.06; 0.012, *t* = 7.83; and 0.018, *t* = 7.33). These results suggest that CSSP has a stronger impact on over-investment among firms with high stock price crash risk.

The results also imply that the controlling shareholders' investment decision-making is intended to convey favorable signals to firms to the market after they pledge their shares. It is consistent with Xie et al. (2016), controlling shareholders prefer the decision that can help maintain listed companies' share price to avoid the market downturn, maintain stock price, and avoid more collateral or paying back the principal (Chang et al., 2022). It is in line with Li and Xing (2017) who document that controlling shareholders interfere in the information disclosure of listed companies only when the share price falls close to the close-out line, making the share price of listed companies fluctuate more frequently.

Table 3.17: The impact of CSSP on specific investments

	(1) *Mi*	(2) *Ai*	(3) *Ei*	(4) *Si*	(5) *Mi*	(6) *Ai*	(7) *Ei*	(8) *Si*
Pld_dum	-0.000	0.011***	0.007***	0.004***				
	(-0.24)	(8.32)	(5.66)	(5.15)				
Pld_rate					-0.002***	0.023***	0.008***	0.011***
					(-2.70)	(7.40)	(2.69)	(5.28)
Roa	-0.007***	0.065***	0.073***	-0.006	0.007*	0.100***	0.141***	-0.008
	(-3.01)	(9.04)	(11.10)	(-1.05)	(1.96)	(5.37)	(6.78)	(-0.63)
Lev	-0.003**	-0.018***	-0.009***	-0.012***	-0.006***	-0.037***	-0.019***	-0.021***
	(-2.25)	(-4.72)	(-2.62)	(-6.17)	(-3.19)	(-5.32)	(-2.79)	(-5.02)
Size	0.001***	0.010***	0.008***	0.002***	0.002***	0.007***	0.007***	0.000
	(3.88)	(15.20)	(12.51)	(6.96)	(5.28)	(6.74)	(6.66)	(0.52)
Growth	0.006***	0.031***	0.022***	0.012***	0.007***	0.041***	0.021***	0.018***
	(14.06)	(16.09)	(15.23)	(9.92)	(12.25)	(14.07)	(8.55)	(9.07)
Mhold	-0.003***	0.028***	0.016***	0.008***	-0.002**	0.036***	0.023***	0.010***
	(-4.98)	(16.25)	(9.62)	(6.94)	(-2.38)	(12.82)	(8.38)	(4.92)
Cso	-0.013***	-0.042***	-0.007	-0.049***	-0.012**	-0.040**	0.021	-0.058***
	(-3.44)	(-3.87)	(-0.72)	(-7.11)	(-2.56)	(-2.06)	(1.12)	(-4.85)
Fcf	0.000	-0.005	-0.008	0.002	-0.001	-0.033**	-0.051**	0.015**
	(0.94)	(-1.58)	(-1.55)	(1.58)	(-1.23)	(-2.32)	(-2.55)	(2.49)
_cons	0.023***	-0.166***	-0.121***	-0.019	0.002	-0.045	-0.041	0.015
	(2.72)	(-8.98)	(-6.91)	(-1.31)	(0.25)	(-1.47)	(-1.39)	(1.08)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	25685	25685	24824	13736	10423	10423	10103	5850
Adj_R^2	0.172	0.122	0.146	0.083	0.198	0.178	0.201	0.149

Columns (1) to (4) present the regression result within the entire sample, with *Pld_dum* as explanatory variable. Columns (5) to (8) present the regression result within the *Poi* = 1 subsample, with *Pld_rate* as the explanatory variable. Each variable is clarified in Table 3.1. In the regression analysis, this study accounts for year and industry fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10% respectively.

Table 3.18: The impacts of CSSP on R&D investments

	(1) *RD*	(2) *RD*	(3) *RD*	(4) *RD*
Pld_dum	-0.228*** (-5.21)	-0.088*** (-2.73)		
Pld_rate			-0.463*** (-6.23)	-0.192*** (-3.36)
Roa		1.170*** (6.31)		2.132*** (7.00)
Lev		-0.437*** (-4.02)		-0.396*** (-3.00)
Size		0.815*** (41.10)		0.820*** (34.55)
Growth		0.058** (2.53)		0.001 (0.04)
Mhold		0.287*** (8.94)		0.266*** (7.12)
Cso		1.366*** (4.01)		1.347*** (3.04)
Fcf		0.014 (0.72)		-0.024 (-0.21)
_cons	14.326*** (105.53)	-0.799* (-1.65)	16.234*** (27.60)	-0.904 (-1.52)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Number of observations	21213	21212	8690	8689
Adj_R^2	0.147	0.475	0.175	0.490

Columns (1) and (2) present the regression result with and without control variables within the entire sample, with *Pld_dum* as the explanatory variable. Columns (3) to (4) present the regression result within the *Poi* = 1 subsample, with *Pld_rate* as the explanatory variable. The dependent variable is Ln

(R&D investment expenditure). Each variable is clarified in Table 3.1. In the regression analysis, this research accounts for year and industry fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10% respectively.

Table 3.19: The impacts of CSSP on over-investments conditional on stock price crash risk

	(1) *Ti* *Crash* = 1	(2) *Ti* *Crash* = 0	(3) *Doi* *Crash* = 1	(4) *Doi* *Crash* = 0	(5) *Ti* *Crash* = 1	(6) *Ti* *Crash* = 0
Pld_dum	0.014***	0.010***	0.018***	0.012***	0.025***	0.018***
	(4.12)	(10.06)	(3.70)	(7.83)	(3.77)	(7.33)
Roa	0.067***	0.061***	-0.030	0.045***	0.062	0.157***
	(3.30)	(8.45)	(-0.71)	(3.27)	(1.19)	(8.19)
Lev	-0.024**	-0.020***	-0.044***	-0.010*	-0.067***	-0.033***
	(-2.45)	(-6.30)	(-2.63)	(-1.94)	(-3.26)	(-4.15)
Size	0.011***	0.011***	0.003	0.000	0.010***	0.008***
	(6.21)	(22.38)	(1.37)	(0.00)	(3.09)	(6.62)
Growth	0.026***	0.042***	0.043***	0.027***	0.048***	0.047***
	(4.30)	(19.97)	(4.30)	(10.80)	(4.36)	(15.27)
Mhold	0.019***	0.025***	0.004	0.011***	0.022**	0.031***
	(4.32)	(17.61)	(0.56)	(5.20)	(2.25)	(9.82)
Cso	-0.042	-0.062***	-0.125***	-0.064***	-0.108*	-0.067***
	(-1.44)	(-6.40)	(-2.71)	(-4.15)	(-1.90)	(-2.89)
Fcf	-0.010	-0.006	-0.000	-0.057***	-0.000	-0.096***
	(-0.94)	(-1.33)	(-0.02)	(-6.35)	(-0.01)	(-8.67)
_cons	-0.164***	-0.132***	-0.031	0.071***	-0.108	-0.040
	(-4.23)	(-7.46)	(-0.42)	(2.82)	(-1.16)	(-1.17)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	2322	22776	1051	10966	890	9325
Adj_R²	0.122	0.160	0.106	0.099	0.182	0.226

Columns (1) and (2) display the regression results within the entire sample, with *Ti* as the dependent variable, and *Pld_dum* as the explanatory variable. Columns (3) to (6) display the regression results within the *Poi* = 1 subsample, with the degree of over-investment (*Doi*) and total investment expenditures (*Ti*) as the dependent variables, and *Pld_dum* as the explanatory variable. Each

variable is clarified in Table 3.1. Firms are classified into higher (*Crash* = 1) and lower (*Crash* = 0) crash risk sub-samples based on weekly yield volatility. In the regression analysis, this study accounts for year and industry fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10%, respectively.

3.5 Summary

Firstly, this chapter examines the general relationship between CSSP and firms' investment efficiency with binary logistic regression, and the results indicate that firms with CSSP are more prone to over-invest. In addition, this chapter examines the relationships between CSSP and over-investment, as well as between CSSP and under-investment with the subsamples, respectively. The empirical results indicate that CSSP significantly exacerbates firms' over-investment while having an insignificant impact on under-investment. Specifically, the over-investment degree becomes severer as the pledging percentage increases, and this effect is more pronounced in firms characterized by more concentrated ownership structure. The findings hold up well after the sensitivity test with GMM regression and swapping independent variables, and endogeneity disposal with a firm-fixed effect regression, Heckman two-stage regression with instrumental variables, the PSM and DID approach. Furthermore, the empirical results of this chapter address that firms with CSSP tend to be concerned more with additional investments while neglecting maintenance investments and R&D investments.

Combined with the motivation of controlling shareholders to gain substitute cash flow rights and convey good signals to the market, as well as the feasibility of using their dominant voting rights and pledged funds, it properly illustrates the mechanism through which CSSP impacts over-investment, which meanwhile aggravates the principal-principal (PP) conflicts between controlling shareholders and minority shareholders. Consequently, the findings empirically demonstrate that signaling costs in signaling theory could explicitly conflict with the agency theory, adding new empirical evidence for the relationship between signaling theory and agency theory.

CHAPTER 4

IMPACT OF INVESTMENT EFFICIENCY ON FINANCIAL DISTRESS RISK

4.1 Models and Estimation Methods

4.1.1 Models

Based on the different hypotheses' development of H5 and H6 discussed in Section 2.3, this study sets up different models to examine the relationship between over-investment and financial distress risk, and under-investment and financial distress risk, respectively. Specific as follows:

To explore the relationships between over-investment and financial distress risk, this study establishes model Eq. (4.1), and examines it with *Poi* = 1 subsample:

$$Oscore_{i,t} = \beta_0 + \beta_1 Doi_{i,t} + \beta_i Control_{i,t} + \sum \text{Industry} + \sum \text{Year} + \delta_{i,t} \quad (4.1)$$

To explore the relationships between under-investment and financial distress risk, this study establishes model Eq. (4.2), and examines it with *Poi* = 0 subsample:

$$\text{Oscore}_{i,t} = \beta_0 + \beta_1 \text{Dui}_{i,t} + \beta_2 \text{Dui}_{i,t}^2 + \beta_i \text{Controls}_{i,t} + \sum \text{Industry} + \sum \text{Year} + \delta_{i,t} \quad (4.2)$$

Whereas, the *Oscore* indicates financial distress risk level (Ohlson, 1980). This thesis chooses the *Oscore* rather than the Z-score (Altman, 1968b) because *the Oscore places more weight on cash flows while the Z-score considers more* profitability. *Doi* and *Dui* indicate the degree of over- and under-investment calculated as the positive and negative residual value of the regression result of the model (Richardson, 2006), respectively.

As the primary hypothesis concerns the effect of inefficient investment degree, this study incorporates additional variables to deal with firm-specific attributes in the analysis regarding determinants of financial distress risk. In particular, this study integrates firms' size (*Size*) (Al-Hadi et al., 2019; ElBannan, 2021a) and leverage (*Lev*) (Dang, 2022; Wang & Cao, 2021) into the analysis to mitigate any potential size-related and financial leverage effects, respectively. This study includes growth (*Growth)* to control for financing demand (Sharpe, 1994) and investment opportunity (Guiso & Parigi, 1999; Love & Zucchini, 2006). This study further adds asset return (*Roa*) to handle profitability and firm circle stage, since firms with higher profitability are more mature and well established, while firms with lower profitability are younger firms that tend to be more vulnerable to financial distress (DeAngelo et al., 2006; Hasan et al., 2015; Mueller, 1972). Furthermore, the proportion of shares held by the management team (*Mhold*) (Dang, 2022; Wang & Cao, 2021) and controlling shareholders' occupancy (*Cso*) (Dang, 2022; Wang & Cao, 2021) are introduced into the model, accounting for corporate governance-related aspects. These inclusions help to control for their effects on the analysis and ensure a comprehensive understanding of the factors influencing the results.

For robustness, this study adds extra controls to repeat Eq. (4.1), including firms' age since foundation (Age), because maturity can affect firms' financial distress risk (Mueller, 1972). Market-to-book ratio (*BM*) is measured by the ratio of book value to the market value of equity, proxying for investment opportunities from the supplying side (Andreou et al., 2021). Cash holdings (*Cash*), as a proxy for firm liquidity, are included to control for firm solvency, ability to meet obligations, and recovery during periods of financial constraints (Al-Hadi et al., 2019). To account for the effects of managerial governance differences on financial distress, we introduce the ratio of independent directors to total directors in the board (*Independent*) (Dang, 2022; Li et al., 2021) and the duality of general manager and chairman of the board (*Dual*) (Wang & Cao, 2021) to the control variables. To control for macro environment effects, we take province-level gross domestic product (GDP) (ElBannan, 2021) and covid 19 into account.

This study reports results incorporating all controls in the baseline regression results, while reports results incorporating part of controls in other results to save space.

Table 4.1: Definitions of variables in Chapter 4

Variable	*Definition*
Dependent Variable	
Oscore[4]	Financial distress risk proxy calculated with Ohlson (1980) model.
Zscore[5]	Financial distress risk proxy calculated with Altman (1968) model.
Independent Variables	
Doi	Over-investing degree (Chen et al., 2011; Cheng et al., 2013; Richardson, 2006).
Ai	Additional investment expenditure/ Year beginning total assets
Dui	Under-investing degree (Chen et al., 2011; Cheng et al., 2013; Richardson, 2006).
Dui^2	Square of under-investment degree.
Dui^3	Cube of under-investment degree.
Control Variables	
Roa	Return on total assets.
Size	Natural log of year-end total assets.
Lev	Total liabilities / Year-end total assets.
Growth	Growth rate. (Operating income current year - operating income previous year) / Operating income the previous year.
Mhold	Shares held by the management team / Total shares of the firm.
Cso	Controlling shareholders' occupancy. (Other Receivables-Other payables) / Year-end total assets.
Bm	The book to market value of equity.
Age	*Number of years since foundation.*
Cash	Cash holding. Year-end cash and securities / Year-end total assets.
Independent	The ratio of independent directors to the total number of directors on the board.
Dual	Firms combining the positions of chairman and manager as 1; otherwise, 0.
Gdp	Natural log of the gross domestic product of the province where the listed company is located in.
Covid19	1 for the years 2020 and beyond; 0, otherwise.
Instrumental variables	
Soe	State-owned as 1, otherwise 0.
Pld_dum	Firms with CSSP at the end of the year as 1; 0 otherwise.
Doi_IV_Indu	The average value of *Doi* for all other observations in the same industry in a specific year, while omitting the value of *Doi* for the firm being considered.
Doi_IV_Prov	The average value of *Doi* for all other observations in the same province in a specific year, while omitting the value of *Doi* for the firm being considered.
Ai_IV_Indu	The average value of *Ai* for all other observations in the same province in a specific year, while omitting the value of *Ai* for the firm being considered.
Ai_IV_Prov	The average value of *Ai* for all other observations in the same province in a specific year, while omitting the value of *Ai* for the firm being considered.
Other variables	
Duilow	*Dui* is lower than the threshold.
Duihigh	*Dui* is higher than the threshold.
High	Dummy variable, if *Dui* is higher than the threshold,1; otherwise, 0.
Ntcf	Net total cash flow / Year-end total assets.
Nocf	Net operating cash flow / Year-end total assets.
Nicf	Net investment cash flow / Year-end total assets.
Nfcf	Net financing cash flow / Year-end total assets.

[4] I download the *Oscore* from CSMAR database calculated based on the equation by Ohlson (1980). I present the equation and the definition of indictors in the appendix table C.
[5] I download the *Zscore* from CSMAR database calculated based on the equation by Altman (1968a). I present the equation and the definition of indictors in the appendix table D.

4.1.2 Estimation Methods

This chapter examines the relationships between investment efficiency and financial distress risk. To examine the relationship between over-investment and financial distress risk, this study employs the OLS with time- and industry-fixed effects to get the main outcomes, followed by GMM regression for robustness. Then this study addresses the endogeneity issues with Firm-fixed effects regression, Two Stage Least Squares (2SLS) Regression with instrumental variables, and PSM to dispose of the endogeneity issues. To examine the relationship between under-investment and financial distress risk, this study uses goodness-of-fit to initially pilot the relationship between under-investment degree and financial distress risk, followed by the examination with OLS regression using panel data. Subsequently, this study re-examines the U-shaped relationship with Regression Discontinuity Design (RDD) and Poisson regression for robustness. Furthermore, this chapter uses Cubic regression to exclude the S-shaped relationship between under-investment and financial distress risk.

4.2 Sample and Data

This study adopts unbalanced Chinese A-share market annual data from 2007 to 2020. The entire sample consists of 29,956 firm-year observations, of which 12279 and 17677 firms that over-invest constitute the *Poi = 1* and *Poi = 0* subsample, respectively. The sample period starts in 2007 because new accounting standards have been implemented since 1 January 2007 in China,

and using the same accounting standards provides better comparability of financial statement data. The financial variables and stock data are from the China Stock Market and Accounting Research (CSMAR), which provides detailed information regarding Chinese. To ensure the reliability of the empirical analysis, this study omits observations from the financial industry as these firms have fundamental differences from non-financial corporates and winsorize all continuous primary variables at the 1st and 99th percentiles, aiming to alleviate the impact of outliers on the dataset.

The statistical descriptions concerning the variables utilized in the analysis of the hypotheses in this chapter are presented in Table 4.2. Within the *Poi*=1 Sample, the mean value of the *Oscore* is -8.193, while it is -8.361 in the *Poi*=0 Sample. The mean value of *Doi* is 0.052, indicating that the average extent of over-investment is 0.052. Similarly, the mean value of *Dui* is 0.041, indicating that the average extent of under-investment is 0.041.

Table 4.3 illustrates the Pearson correlation matrix for all variables in the hypothesis tests. Within the *Poi* = 1 subsample, *Oscore* is positively correlated with both independent variables *Doi* and *Ai*, respectively, indicating that over-investing firms are more likely to fall into financial distress. Within *Poi* = 0 subsample, *Oscore* is positively correlated with Dui^2, indicating there is U-shaped relationship between under-investment and financial distress risk.

Also, the absolute value of the Pearson correlation coefficient between each two variables in the same model is much lower than 0.2, indicating there is no

multicollinearity issue in the models in this Chapter. This study also uses the VIF in the regression models (Eq. (4.1) to (4.13)) to test for the multicollinearity problem in the explanatory variables of the data. As the mean VIF ranges from 1.27 to 2.79 for all models, it indicates no multicollinearity concerns.

Table 4.2: Descriptive Statistics

Variable	Mean	p50	Min	Max	p25	p75	SD	No.
***Poi*=1 Sample**								
Oscore	-8.193	-8.015	-15.262	-1.692	-9.36	-6.933	2.155	12279
Doi	0.052	0.028	0.000	0.447	0.011	0.065	0.070	12279
Ai	0.058	0.045	-0.032	0.224	0.014	0.088	0.058	12279
Roa	0.032	0.033	-0.334	0.195	0.013	0.061	0.065	12279
Lev	0.483	0.485	0.074	1.037	0.323	0.633	0.210	12279
Size	22.311	22.17	19.31	26.11	21.41	23.09	1.320	12279
Growth	0.212	0.119	-0.651	3.241	-0.015	0.296	0.523	12279
Mhold	0.232	0.001	0.000	1.730	0.000	0.244	0.428	12279
Cso	-0.026	-0.011	-0.367	0.102	-0.035	0.000	0.062	12279
Age	11.611	11.000	2.000	26.000	5.000	17.000	6.966	12279
BM	0.310	0.292	0.006	0.742	0.206	0.398	0.147	12279
Cash	0.142	0.115	0.006	0.566	0.068	0.188	0.103	12279
Independent	0.374	0.333	0.000	0.800	0.333	0.429	0.057	12279
Dual	35.367	33.490	0.164	155.190	23.720	45.670	15.060	12279
Gdp	10.329	10.395	5.835	11.615	9.862	10.952	0.818	12279
Covid19	0.112	0.000	0.000	1.000	0.000	0.000	0.315	12279
***Poi*=0 Sample**								
Oscore	-8.361	-8.199	-15.707	-1.692	-9.657	-6.930	2.395	17677
Dui	0.041	0.028	0.001	0.282	0.013	0.051	0.046	17677
Dui^2	0.004	0.001	0.000	0.080	0.000	0.003	0.010	17677
Roa	0.025	0.031	-0.414	0.205	0.009	0.062	0.085	17677
Lev	0.446	0.436	0.061	1.010	0.279	0.602	0.216	17677
Size	22.04	21.880	19.270	26.120	21.140	22.750	1.300	17677
Growth	0.134	0.081	-0.651	2.505	-0.057	0.236	0.410	17677
Mhold	0.234	0.001	0.000	1.738	0.000	0.269	0.425	17677
Cso	-0.022	-0.008	-0.355	0.118	-0.030	0.001	0.060	17677
Age	10.725	10.000	2.000	26.000	5.000	16.000	6.331	17677
BM	0.314	0.292	0.006	0.742	0.195	0.414	0.162	17677
Cash	0.151	0.119	0.006	0.566	0.065	0.202	0.119	17677
Independent	0.374	0.333	0.000	1.000	0.333	0.429	0.056	17677
Dual	35.617	33.750	0.004	89.990	23.920	45.900	15.202	17677
Gdp	10.324	10.383	5.835	11.615	9.841	10.952	0.829	17677
Covid19	0.115	0.000	0.000	1.000	0.000	0.000	0.319	17677

This table presents the statistical descriptions of variables observed for firm-year data spinning 2007-2020. The entire samples contain 29956, the *Poi* = 1 and *Poi* = 0 subsamples contain 17677 and 12279 observations, respectively. Each variable is clarified in Table 4.1.

Table 4.3: Pearson matrix

***Poi*=1 Sample**															
	OScore	*Doi*	*Ai*	*Roa*	*Lev*	*Size*	*Growth*	*Cso*	*Age*	*BM*	*Cash*	*Independent*	*Dual*	*Gdp*	*Covid19*
Oscore	1														
Doi	-0.053***	1													
Ai	-0.175***	0.741***	1												
Roa	-0.684***	0.074***	0.207***	1											
Lev	0.813***	-0.063***	-0.170***	-0.391***	1										
Size	0.008	-0.055***	-0.068***	0.043***	0.363***	1									
Growth	-0.092***	0.239***	0.169***	0.232***	0.01	0.012	1								
Cso	-0.299***	-0.026***	0.086***	0.166***	-0.279***	0.143***	-0.027***	1							
Age	0.220***	-0.137***	-0.369***	-0.185***	0.298***	0.335***	-0.087***	-0.157***	1						
BM	-0.453***	-0.023**	0.054***	0.138***	-0.536***	0.104***	-0.065***	0.254***	-0.071***	1					
Cash	-0.376***	-0.018**	-0.006	0.235***	-0.361***	-0.169***	0.011	0.057***	-0.108***	0.105***	1				
Independent	-0.002	0.005	-0.003	-0.021**	-0.005	0.023**	0	-0.011	-0.018*	-0.01	0.017*	1			
Dual	-0.120***	-0.016*	0.056***	0.156***	-0.011	0.156***	0.024***	0.024***	-0.131***	0.078***	0.053***	0.033***	1		
Gdp	-0.145***	-0.015*	-0.018*	0.052***	-0.130***	0.075***	-0.025***	0.068***	-0.044***	0.128***	-0.008	0.053***	-0.012	1	
Covid19	-0.064***	-0.053***	-0.063***	-0.013	-0.050***	0.085***	-0.061***	0.031***	0.069***	0.095***	0.018*	0.041***	-0.026***	0.227***	1

***Poi*=0 Sample**															
	OScore	*Dui*	*Dui2*	*Roa*	*Lev*	*Size*	*Growth*	*Cso*	*Age*	*BM*	*Cash*	*Independent*	*Dual*	*Gdp*	*Covid19*
Oscore	1														
Dui		1													
Dui2	0.013*	0.919***	1												
Roa	-0.710***	0.022***	0.017**	1											
Lev	0.787***	-0.067***	-0.034***	-0.387***	1										
Size	-0.011	-0.188***	-0.162***	0.098***	0.347***	1									
Growth	-0.109***	0.062***	0.053***	0.254***	0.011	0.066***	1								
Cso	-0.240***	-0.070***	-0.093***	0.139***	-0.255***	0.103***	0.007	1							
Age	0.177***	-0.006	0.055***	-0.101***	0.237***	0.230***	-0.058***	-0.161***	1						
BM	-0.416***	-0.169***	-0.172***	0.151***	-0.492***	0.158***	-0.044***	0.220***	-0.089***	1					
Cash	-0.415***	0.072***	0.079***	0.292***	-0.380***	-0.167***	0.048***	0.046***	-0.096***	0.064***	1				
Independent	0.004	0.031***	0.034***	-0.044***	-0.01	0.016**	-0.009	-0.003	-0.020***	-0.027***	0.01	1			
Dual	-0.151***	-0.064***	-0.073***	0.176***	-0.017**	0.237***	0.045***	0.039***	-0.129***	0.119***	0.050***	0.036***	1		
Gdp	-0.115***	-0.008	-0.005	0.024***	-0.110***	0.058***	-0.019**	0.080***	-0.093***	0.104***	-0.006	0.048***	-0.032***	1	
Covid19	-0.011	-0.083***	-0.059***	-0.043***	-0.003	0.053***	-0.098***	-0.005	0.066***	0.012	-0.013*	0.037***	-0.055***	0.199***	1

This table presents the Pearson correlations among the primary variables. Each variable is defined in Table 4.1. The sample contains12279 and 17677 observations for Eq. (4.1) and (4.2), respectively, spanning from 2007 to 2020. The notions ***, **, and * represent 1%, 5%, and 10% significance levels, respectively.

4.3 Results and Discussions

4.3.1 Hypotheses Tests

The second objective of this study is to examine the relationship between inefficient investment and financial distress risk. Specifically, Hypothesis H5 predicts that over-investment exacerbates financial distress risk, and H6 predicts that under-investment has a U-shaped impact on financial distress risk. Section 4.3.1.1 presents the empirical results of the relationship between over-investment and financial distress risk. Section 4.3.1.2 presents the empirical results of the relationship between under-investment and financial distress risk.

4.3.1.1 Relationship Between Over-investment and Financial Distress Risk

Table 4.4 presents the results of the relationship between over-investment and financial distress risk. Columns (1) and (2) display the results with *Doi* as explanatory variable with part of and all controls. Columns (3) and (4) display the results with A*i* as the explanatory variable with part of and all controls. The coefficients of the *Doi* and *Ai* in both columns (1) to (4) are significantly positive,

indicating that the over-investment severity positively affects financial distress risk.

The coefficients of control variables align with the findings from prior studies (i.e., ElBannan, 2021; John, 1993). Specifically, larger, more profitable, and faster-growing firms are less likely to experience financial distress, whereas firms with higher leverage are more prone to it. Compared the literature that documents financial constraints adhere over-investment (Hovakimian, 2009), this study finds that over-investment exacerbates financial distress risk, providing support for Hypothesis H5, realizing part of objective 2.

Table 4.4: Results of the relationship between over-investment and financial distress risk (H5)

	(1) *Oscore*	(2) *Oscore*	(3) *Oscore*	(4) *Oscore*
Doi	0.408*** (3.37)	0.275** (2.33)		
Ai			0.392*** (3.92)	-13.343*** (-39.54)
Roa	-11.853*** (-35.71)	-13.302*** (-39.42)	-12.156*** (-34.23)	8.176*** (66.53)
Lev	7.965*** (93.48)	8.148*** (66.41)	7.769*** (85.76)	-0.455*** (-45.51)
Size	-0.399*** (-43.14)	-0.451*** (-44.76)	-0.391*** (-41.63)	-0.053** (-2.57)
Growth	-0.068*** (-3.43)	-0.054** (-2.57)	-0.060*** (-2.85)	-0.066** (-2.49)
Mhold	-0.104*** (-3.98)	-0.063** (-2.36)	-0.128*** (-4.36)	0.339* (1.80)
Cso	0.979*** (4.67)	0.345* (1.83)	0.887*** (4.15)	0.006*** (3.42)
Age		0.004*** (2.63)		0.828*** (7.35)
Bm		0.809*** (7.19)		-1.286*** (-11.28)
Cash		-1.308*** (-11.56)		0.211 (1.54)
Independent		0.211 (1.54)		-0.001** (-2.08)
Dual		-0.001** (-2.10)		0.012 (0.87)
Gdp		0.011 (0.83)		-0.222*** (-4.47)
Covid19		-0.226*** (-4.56)		-0.977*** (-3.62)
_cons	-2.110*** (-8.72)	-0.992*** (-3.67)	-2.097*** (-8.52)	-13.343*** (-39.54)
Indu FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	12668	12268	10423	11813
Adj_R²	0.866	0.882	0.869	0.882

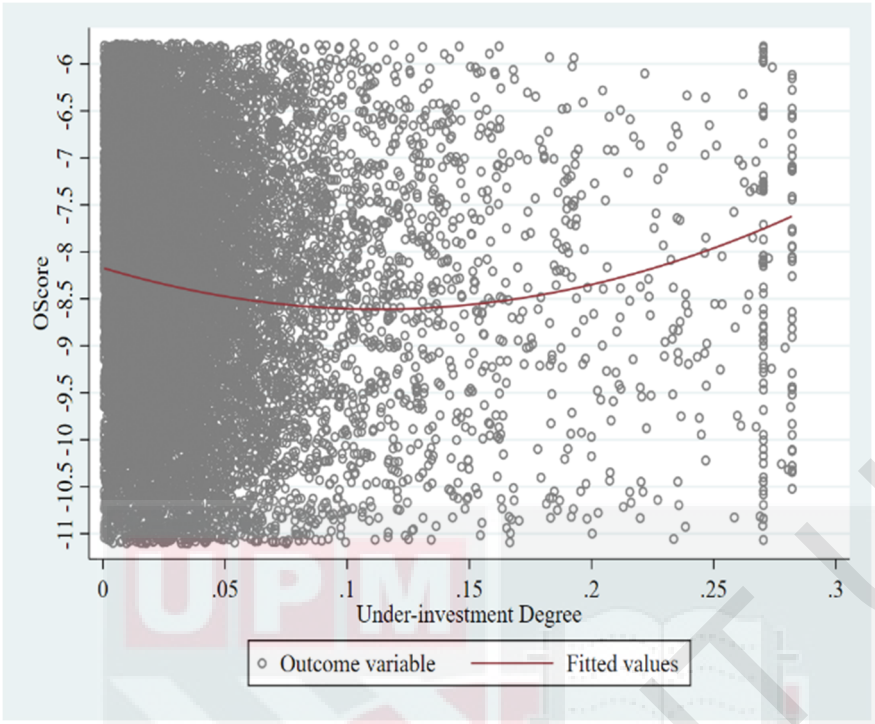
Columns (1) and (3), (2) and (4) display the results with part of and all controls, respectively. Columns (1) and (2) are with *Doi* as the independent variable, while columns (3) and (4) taking *Ai* as the explanatory variable. In the regression analysis, this study accounts for year and industry fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10%, respectively.

4.3.1.2 Relationship Between Under-investment and Financial Distress Risk

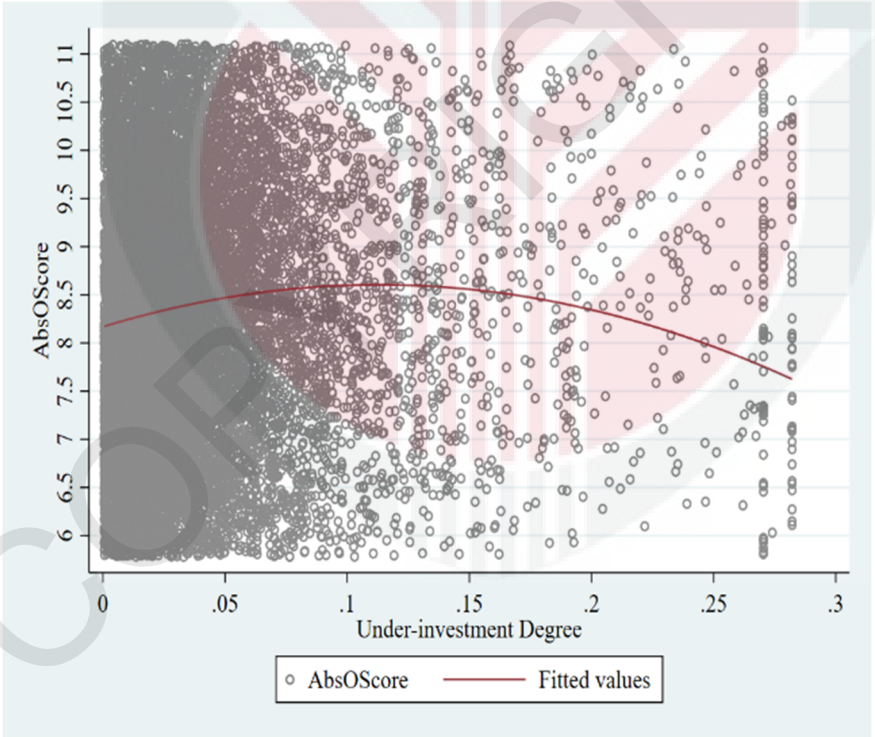
Following Lind & Mehlum (2010), this study takes three steps to confirm the U-shaped relationship between under-investment and financial distress risk. Step 1 is to pilot the relationship between under-investment and financial distress risk; step 2 is to confirm the U-shaped relationship between under-investment and financial distress risk using regressions; step 3 is to exclude the S-shaped relationship between under-investment and financial distress risk.

4.3.1.2.1 Preliminary Test

Figure 4.1 initially plots the relationship between under-investment degree and financial distress risk. Each point represents an observation. Figure 4.1a with *AbsOscore* proxying for financial distress risk, which is the absolute value of *Oscore.* The scatter shows all data points that lie in between the tenth and ninetieth deciles in the under-investment degree distribution as a u-shaped curve, initially proving H6.



a



b

Figure 4.1: Scatter Plot of Under-investment on Financial Distress Risk

Figure 4.1 initially plots the relationship between under-investment degree and financial distress risk. Figure 4.1a employs *Oscore* proxying for financial distress risk, while Figure 4.1b employs the absolute value of *Oscore*.

Source: Manually made by Stata 17.0.

4.3.1.2.2 Regression results

To confirm the u-shaped relationship between under-investment and financial distress degree, this study estimates Eq. (4.2) with OLS and Poisson regressions. Poisson (1837) introduced the Poisson distribution as a mathematical concept. Nelder & Wedderburn (1972) established Poisson regression as part of the generalized linear model framework, providing the methodology for modelling count data with the Poisson distribution. Poisson regression is used to model count data, where the response variable represents the number of occurrences of a particular event within a fixed time or space interval. It is especially useful when the response variable is a non-negative integer.

4.3.1.2.3 Regression Discontinuity Design

Table 4.5 presents the results. Columns (1) to (3) present the results of OLS regression, the statistical coefficients of Dui^2 are both significantly positive (35.091, t = 6.18; 7.980, t = 3.35;8.014, t = 3.39) without, with part of and all control variables, respectively. Columns (4) and (6) present the results of Poisson regression, the statistical coefficients of Dui^2 are both significantly

negative (-3.959, *t* = -5.81; 1.860, *t* = -3.27; -6.663, *t* = -2.55) without, with part of and all control variables control variables, respectively. These results consistently indicate a U-shaped relationship between under-investment and financial distress risk.

Following Aghion et al. (2005), this study employs RDD to confirm the u-shaped relationship between under-investment and financial distress risk. Tables 4.6 and 4.7 present the results of RDD with OLS and Poisson regressions, respectively. The coefficients of *Duilow* and *Duihigh* in column (1) of Table 4.6 are significantly opposite directions (-5.018, *t* = -6.24; 3.060, *t* = 2.14), and similar results in column (1) of 4.7, indicating that there is a threshold in the relationship between under-investment and financial distress risk.

Regression Discontinuity Design (RDD) is first formally introduced by Thistlethwaite and Campbell (1960). It is a quasi-experimental research design used to estimate causal relationships where a threshold or cutoff point determines treatment assignment along a continuous variable. The basic idea behind RDD is to compare units just above and below the threshold, assuming that units on either side of the threshold are similar in all aspects except for their treatment status.

From the results of columns (2) to (5) in Table 4.6, we can see that using 7.512/ (2*35.091) =0.1070 as the cutoff point for the segmented linear regression, the regression results show that the slope on the left side (-4.943) is close to the

slope on the left side of the U-curve (-5.018); the slope on the right side (4.811) is close to the slope on the left side of the U-curve (3.060). Using 0.0951 as the cutoff point for the model with control variables, the slopes of the two sides of the linear regression also have opposite defenses. Similar results come out in columns (2) to (5) in Table 4.7.

Table 4.5: Results of the U-shaped relationship between under-investment and financial distress risk (H6)

	OLS regression			Poisson regression		
	(1)	(2)	(3)	(4)	(5)	(6)
	Oscore	*Oscore*	*Oscore*	*AbsOscore*	*AbsOscore*	*AbsOscore*
Dui	-7.512***	-1.518***	-1.201***	0.857***	0.059	0.025
	(-6.37)	(-3.32)	(-2.67)	(6.15)	(1.25)	(0.53)
Dui²	35.091***	7.980***	8.014***	-3.959***	-0.860***	-0.663**
	(6.18)	(3.35)	(3.39)	(-5.81)	(-3.27)	(-2.55)
Roa		-11.455***	-13.478***		1.853***	2.039***
		(-46.41)	(-44.13)		(66.93)	(64.92)
Lev		7.990***	7.986***		-0.985***	-0.932***
		(84.18)	(61.10)		(-106.20)	(-80.96)
Size		-0.398***	-0.450***		0.051***	0.050***
		(-36.52)	(-36.88)		(42.78)	(35.77)
Growth		-0.033	0.003		0.005**	0.005**
		(-1.53)	(0.15)		(2.24)	(2.26)
Mhold		-0.141***	-0.093***		0.007***	-0.002
		(-4.70)	(-3.00)		(2.93)	(-0.89)
Cso		1.372***	0.873***		0.137***	0.177***
		(6.41)	(4.72)		(5.38)	(7.78)
Age			0.007***			-0.001***
			(3.84)			(-5.99)
BM			0.627***			0.046***
			(5.19)			(4.77)
Cash			-1.570***			0.112***
			(-13.95)			(11.14)
Independent			0.070			0.009
			(0.42)			(0.50)
Dual			-0.001**			0.000
			(-2.09)			(1.16)
Gdp			-0.017			0.002
			(-1.01)			(1.07)
Covid19			-0.215***			0.003
			(-4.08)			(1.04)
_cons	-2.131***	-1.395***	-1.116**	2.009***	1.349***	1.291***
	(-21.14)	(-6.40)	(-2.01)	(42.52)	(44.47)	(33.36)
Indu FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	17677	17672	17672	17677	17672	17672
Adj_R2	0.051	0.844	0.863			

Columns (1) to (3) display the OLS regression results without, with part of, and all controls, respectively. Columns (4) to (6) display the Poisson regression results without, with part of, and all controls, respectively. Each variable is clarified in Table 1. In the regression analysis, this study accounts for year and industry fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10%, respectively.

Table 4.6: RDD with OLS Regression

	(1) Oscore *Entire sample*	(2) Oscore Dui<0.1070	(3) Oscore Dui>0.1070	(4) Oscore Dui<0.0951	(5) Oscore Dui>0.0951
Duilow	-5.018*** (-6.24)				
Duihigh	3.060** (2.14)				
High	0.301** (2.34)				
Dui		-4.943*** (-5.70)	4.811*** (2.88)	-0.913** (-2.54)	1.222* (1.81)
Roa				-11.361*** (-44.12)	-12.022*** (-17.20)
Lev				8.030*** (81.38)	7.698*** (33.02)
Size				-0.398*** (-34.69)	-0.409*** (-11.82)
Growth				-0.042* (-1.86)	0.006 (0.11)
Mhold				-0.142*** (-4.62)	-0.124 (-1.53)
Cso				1.473*** (6.70)	0.817 (1.62)
_cons	-2.670*** (-20.33)	-2.165*** (-21.09)	-9.574*** (-9.39)	-2.485*** (-4.18)	-2.843*** (-3.61)
Indu FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	17677	16469	1208	16152	1520
Adj_R2	0.051	0.050	0.071	0.848	0.815

Column (1) is the result of OLS regression, with *Oscore* as the dependent variable, and *Duilow*, *Duihigh*, and *High* as the explanatory variable. Columns (2) and (3) display the OLS regression results within the *Duilow* and *Duihigh*

subsamples, respectively, without control variables. Columns (4) and (5) display the OLS regression results within the *Duilow* and *Duihigh* subsamples, respectively, with control variables. Each variable is clarified in Table 1. In the regression analysis, this study accounts for year and industry fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10%, respectively.

Table 4.7: RDD with Poisson Regression

	(1) *AbsOscore* *Entire sample*	(2) *AbsOscore* *Dui<=0.1082*	(3) *AbsOscore* *Dui>0.1082*	(4) *AbsOscore* *Dui<=0.0343*	(5) *AbsOscore* *Dui>0.0343*
Duilow	0.587*** (6.23)				
Duihigh	-0.367** (-2.10)				
High	-0.035** (-2.29)				
Dui		0.578*** (5.64)	-0.593*** (-2.93)	0.135 (1.51)	-0.188*** (-5.21)
Roa				1.782*** (52.79)	1.931*** (48.45)
Lev				-0.979*** (-95.33)	-0.994*** (-69.69)
Size				0.053*** (40.77)	0.047*** (26.00)
Growth				0.011*** (3.79)	0.001 (0.25)
Mhold				0.008*** (2.97)	0.005* (1.66)
Cso				0.165*** (5.51)	0.111*** (2.90)
_cons	2.074*** (67.17)	2.032*** (40.25)	1.910*** (14.95)	1.319*** (38.60)	1.401*** (33.20)
Indu FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
N	17677	16452	1225	10338	7334

Column (1) results from Poisson regression, with AbsOscore as the dependent variable and *Duilow*, *Duihigh*, and *High* as the explanatory variable. Columns (2) and (3) display the Poisson regression results within the *Duilow* and

Duihigh subsamples, respectively, without control variables. Columns (4) and (5) display the Poisson regression results within the t*Duilow* and *Duihigh* subsample, respectively, with control variables. Each variable is clarified in Table 1. In the regression analysis, this study accounts for year and industry fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10%, respectively.

With Poisson regression, confirming the u-shaped relationship between under-investment and financial distress risk. Overall, the U-shaped relationship between under-investment and financial distress risk is confirmed after the three steps above. This study is the first to propose the U-shaped relationship between under-investment and financial distress risk. Compared to the positive impact of financial constraints on investment efficiency (Hovakimian, 2009), this study captures the feedback impact of under-investment on financial distress risk, answering the second research question of this study by revealing how under-investment impacts financial distress risk

4.3.2 Robustness

4.3.2.1 Over-investment and financial distress

4.3.2.1.1 Sensitivity tests

In addition, this study switches to *Zsocre* proxying for corporate financial distress risk and repeat Eq. (4.1). Columns (2) and (3) of Table 4.8 represent

the results of the re-estimations, all the statistical coefficients remain significantly negative, suggesting that firms' over-investment has a positive impact on corporate financial distress risk, consistent with the result taking *Oscore* as the measure of financial distress risk.

Table 4.8: Alternative measure of financial distress risk

	(2) *Zscore*	(3) *Zscore*
Doi	-2.754*** (-5.74)	
Ai		-3.433*** (-4.91)
Roa	9.994*** (11.96)	10.241*** (12.21)
Lev	-11.400*** (-32.22)	-11.482*** (-32.37)
Size	-0.636*** (-15.11)	-0.624*** (-14.83)
Growth	0.097 (1.41)	0.057 (0.83)
Mhold	-0.611*** (-4.76)	-0.554*** (-4.24)
Cso	-2.616*** (-3.78)	-2.448*** (-3.55)
_cons	21.534*** (18.17)	21.443*** (18.17)
Indu FE	Yes	Yes
Year FE	Yes	Yes
N	12116	12116
Adj_R²	0.463	0.463

This table displays the regression results with *Zscore* as the dependent variable, *Doi* and *Ai* as the explanatory variable, respectively. Each variable is clarified in Table 4.1. In the regression analysis, this study accounts for year and industry fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10%, respectively.

4.3.2.1.2 GMM Test

This study uses GMM regression to repeat Eq. (4.1) to see if the findings hold in the dynamic model. Table 4.9 presents the System GMM regression results.

Columns (1) and (2) report the results with Doi and Ai as proxy for CSSP, respectively. The coefficients of Doi and Ai are both significantly positive, consistent with the main examinations. The coefficients on lagged Oscore are insignificant, suggesting no dynamic effect of the baseline model Eq. (4.1).

Table 4.9: Results of GMM tests

	(1) *Oscore*	(2) *Oscore*
Doi	5.203*** (2.643)	
Ai		0.870** (2.352)
L.Oscore	0.030 (0.676)	-0.019 (-0.805)
Roa	-9.007*** (-6.450)	-10.496*** (-12.992)
Lev	8.000*** (30.070)	8.593*** (13.216)
Size	-0.385*** (-15.087)	-0.624** (-2.549)
Growth	-1.323** (-2.005)	-0.103*** (-4.436)
Mhold	-0.062 (-0.807)	-0.274* (-1.747)
Cso	0.875*** (2.583)	1.665* (1.657)
_cons	-3.008*** (-9.626)	1.842 (0.350)
Indu FE	Yes	Yes
Year FE	Yes	Yes
Ar (1)	0.005	0.000
Ar (2)	0.750	0.124
Hansen Test	0.578	0.149
N	10423	10423

This table reports the effects of over-investment on financial distress risk by System GMM in the baseline model Eq. (4.1). This study uses the levels of explanatory variables lagged 2 times and more as instruments for the first-differenced equation. AR(n) is the test for the null of no n-th order autocorrelation of the differenced residuals, and Hansen test is of over-identifying restrictions. Each variable is clarified in Table 4.1. In the regression analysis, this study accounts for industry and year fixed effects, and values in parenthesis are the asymptotic standard errors and those in square brackets are the p-values of test statistics. *, ** and *** indicate the significance of coefficients at the 10%, 5% and 1% level respectively.

4.3.2.1.3 Firm-fixed effects

To address the potential impact of time-independent factors at the firm level on the findings, this study conducts a Firm-fixed effect regression to re-examine hypothesis H5. The results of this analysis are presented in Table 4.10. The statistical coefficients of *Doi* and *Ai* are significant and positive (0.285, t = 1.96; 313, t = 2.31) with all control variables, indicating that the results are not driven by any unobserved time-independent factors at the firm level.

Table 4.10: Results of firm-fixed effect regression

	(1) *Oscore*	(2) *Oscore*
Doi	0.285** (1.96)	
Ai		0.313** (2.31)
Roa	-10.640*** (-25.99)	-11.091*** (-24.40)
Lev	7.440*** (55.57)	7.148*** (49.25)
Size	-0.347*** (-13.16)	-0.312*** (-11.00)
Growth	-0.099*** (-4.31)	-0.092*** (-3.56)
Mhold	-0.127* (-1.75)	-0.128 (-1.48)
Cso	0.778*** (2.60)	0.780*** (2.74)
_cons	-3.635*** (-6.28)	-4.275*** (-6.88)
Firm FE	Yes	Yes
N	11635	9731
r2_a	0.896	0.901

This table presents the regression results with firm-fixed effect. Each variable is clarified in Table 4.1. In the regression analysis, this study accounts for firm and year fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10% respectively.

4.3.2.1.4 2SLS Regression

2SLS regression is proposed by Theil (1964) and used to address potential endogeneity issues. In the first stage, the endogenous variable is regressed to the model's instrumental and exogenous variables. In the second stage, the dependent variable is regressed on the predicted values obtained from the first stage, along with the exogenous variables.

This study accounts for instrumental variables by using the two-stage least squares (2SLS) approach to address the potential reverse causality. The instrumental variables this study uses include *Soe, Pld_dum, Doi_IV_Indu, Doi_IV_Prov* while *Doi* proxying for over-investment degree, and *Ai_IV_Indu, Ai_IV_Prov* while *Ai* proxying for over-investment. As discussed in Chapter 3, *Soe* and *Pld_dum* are both able to affect firm-level over-investment. *Doi_Iv_Indu* (*Ai_IV_Indu*), defined as the average value of *Doi* (*Ai*) for all other observations from the same industry in a specific year while omitting the value of *Doi* (*Ai*) for the firm being considered; And *Doi_Iv_Prov* (*Ai_IV_Prov*), clarified as the average value of *Doi* (*Ai*) for all other observations from the same province in a specific year, while omitting the value of *Doi* (*Ai*) for the firm being considered. In the first-stage regression, we incorporate the control variables from Eq. (4.1) as well. The first stage models are expressed as follows:

$$Doi_{i,t} = \alpha_{i,t} + \beta_1 Soe_{i,t} + \beta_2 Pld\_dum_{i,t} + \beta_3 Doi\_Iv\_Indu_{i,t} + \beta_4 Doi\_Iv\_Prov_{i,t} + \beta_5 Roa_{i,t} + \beta_6 Size_{i,t} + \beta_7 Lev_{i,t} + \beta_8 Growth_{i,t} + \beta_9 Mhold_{i,t} + \beta_{10} Cso_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (4.3)$$

$$Ai_{i,t} = \alpha_{i,t} + \beta_1 Soe_{i,t} + \beta_2 Pld\_dum_{i,t} + \beta_3 Doi\_Iv\_Indu_{i,t} + \beta_4 Doi\_Iv\_Prov_{i,t} + \beta_5 Roa_{i,t} + \beta_6 Size_{i,t} + \beta_7 Lev_{i,t} + \beta_8 Growth_{i,t} + \beta_9 Mhold_{i,t} + \beta_{10} Cso_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (4.4)$$

In the second-stage regression analysis, we regress the *Oscore* on the predicted *Doi* and *Ai* from the first-stage regression and the control variables from Eq. (4.1). Table 4.11 presents the results of the 2LSL estimations. In the first stage estimation, the significantly negative coefficients on *Soe* indicate that controlling shareholders of state-owned firms are less likely to over-invest, while the significantly positive coefficients on *Pld_dum* indicate that firms with

CSSP are more likely to over-invest, aligning with Geng et al. (2024). After considering selection effect in the second stage, the statistical coefficients remain significant and positive, suggesting over-investment severity has a causal impact on corporate financial distress risk.

Table 4.11: Results of 2SLS regressions

	(1) First Stage *Doi*	(2) Second Stage *Oscore*	(3) First Stage *Ai*	(4) Second Stage *Oscore*
Doi		1.282*** (4.22)		
Ai				1.317*** (6.39)
Soe	-0.006*** (-3.92)		-0.011*** (-5.87)	
Pld_dum	0.009*** (6.74)		0.011*** (6.39)	
Doi_IV_Indu	0.779*** (29.38)			
Doi_IV_Prov	0.590*** (16.02)			
Ai_IV_Indu			0.813*** (40.16)	
Ai_IV_Prov			0.628*** (19.53)	
Roa	-0.006 (-0.62)	-11.975*** (-95.12)	0.054*** (4.30)	-12.412*** (-91.26)
Lev	-0.008** (-2.20)	7.970*** (182.18)	-0.022*** (-5.02)	7.774*** (168.60)
Size	0.000 (0.58)	-0.412*** (-65.46)	0.007*** (10.31)	-0.407*** (-61.00)
Growth	0.025*** (21.85)	-0.085*** (-5.02)	0.034*** (23.52)	-0.090*** (-5.11)
Mhold	0.006*** (3.86)	-0.129*** (-7.12)	0.022*** (10.66)	-0.166*** (-7.80)
Cso	-0.047*** (-4.60)	1.141*** (8.82)	-0.030** (-2.29)	1.008*** (7.33)
Constant	-0.031*** (-2.81)	-2.455*** (-17.98)	-0.183*** (-12.77)	-2.487*** (-17.38)
Observations	12,083	12,083	10,251	10,251
R-squared	0.181	0.864	0.301	0.868

This table presents the results of 2SLS regressions. Columns (1) and (3) present the results with *Doi* proxying for over-investment severity; Columns (2) and (4) present the results with *Ai* proxying for over-investment severity. Each

variable is clarified in Table 4.1. The corresponding t-statistics are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

4.3.2.1.5 PSM Approach

To address the concern that the results of the initial tests might be influenced by systematic dissimilarities in the characteristics, such as profitability, leverage size, and et al., between these firms, this study adopts the PSM approach. Explicitly, this study uses control variables in Eq. (4.1) to match the firms based on the closest matching score with maximum calipers of 0.5e-5 without replacement in full. The matching process results in 1980 matches. This study then regresses the primary tests using the matched sample. Table 4.12 illustrates no significant distinctions at a 5% significance level between the firms after matching. Table 4.13 presents the results regressed with the matching samples, where both the statistical coefficients of *Doi* and *Ai* remain significant and positive, suggesting the systematic differences in other characteristics of firms do not affect the core findings of this Chapter.

Table 4.12: Post-match differences

Variable	Treated	Control	*T* value	*P* value
Roa	0.032	0.028	1.83	0.068
Lev	0.491	0.503	-1.37	0.172
Size	22.381	22.372	0.14	0.889
Growth	0.152	0.135	1.01	0.313
Mhold	0.096	0.077	1.86	0.064
Cso	-0.026	-0.023	-1.23	0.218

After matching propensity scores, this table compares firm characteristics between the treatment and control groups. Each variable is defined in Table 4.1.

Table 4.13: Regressions with the matched sample

	(1) *Oscore*	(2) *Oscore*
Doi	0.720**	
	(2.58)	
Ai		0.903***
		(2.62)
Roa	-12.307***	-12.350***
	(-17.61)	(-17.57)
Lev	7.923***	7.951***
	(43.15)	(43.49)
Size	-0.410***	-0.415***
	(-21.21)	(-21.57)
Growth	-0.088	-0.088
	(-1.64)	(-1.64)
Mhold	-0.182**	-0.205***
	(-2.46)	(-2.77)
Cso	2.011***	1.977***
	(3.80)	(3.73)
_cons	-1.646***	-1.561***
	(-4.10)	(-3.77)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Number of observations	1980.000	1980.000
Adj_R²	0.864	0.864

This table presents the results of the regression analysis conducted using the matched sample. The dependent variable is *Oscore* while the independent variables are *Doi* and *Ai*, respectively. Each variable is clarified in Table 4.1. In the regression analysis, this study accounts for year and industry effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notations ***, **, and * signify significance levels of 1%, 5%, and 10%, respectively, based on two-tailed tests.

Collectively, after employing regression with firm-fixed effects, 2SLS estimation, and the PSM approach to address possible endogeneity issues, the relationship between over-investment severity and financial distress risk holds up well.

4.3.2.2 Under-investment and financial distress

4.3.2.2.1 Sensitivity Tests

This study employs *Ai* as a proxy for under-investment and repeats Eq. (4.2). Table 4.14 presents the results. The coefficient of Ai^2 is significantly positive (5.254, *t* = 1.75). The coefficient of *Ai* is also significantly positive (0.434, t = 2.05. This result indicates that the U-shaped relationship holds well even when the under-investment proxy changes.

This study also repeats Eq. (4.2) with the u-test method; the results indicate the extreme point is 0.9070, and the slopes within the lower and upper bond are in opposite directions, consistent with the results of RDD with OLS regressions, confirming the u-shaped relationship between under-investment and financial distress risk validly.

Table 4.14: Results of alternative measure

	(1) ZScore	(2) ZScore
Ai	8.457***	3.548***
	(4.09)	(2.64)
Ai^2	95.660***	63.388***
	(4.73)	(4.28)
Roa		8.576***
		(10.42)
Lev		-15.054***
		(-29.20)
Size		-0.932***
		(-13.73)
Growth		-0.086
		(-0.77)
Mhold		-1.030***
		(-5.64)
Cso		-4.538***
		(-4.21)
_cons	0.065	30.897***
	(0.10)	(20.19)
Indu FE	Yes	Yes
Year FE	Yes	Yes
N	15072	15069
r2_a	0.077	0.479

Columns (1) and (2) display the regression results with *Ai* as the independent variable, and *Oscore* as the dependent variable with controls. Each variable is clarified in Table 4.1. In the regression analysis, this study accounts for year and industry fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10%, respectively.

4.3.2.2.2 Reverse Causality

To avoid reverse causality, this study lags the independent variable to repeat the main regression. Table 4.15 presents the results of regression with lagged *Dui* as the independent variable. The coefficients of *L. Dui*^{2} are both significantly positive (39.637, t = 7.02; 8.9832, t = 3.79) without and with

controls, respectively. The coefficients of *L.Dui* are both significantly negative (-7.124, t = -5.95; -0.917, t = -1.97) without and with controls, respectively. These results indicate that the u-shaped relationship holds up well between under-investment severity and financial distress risk without an inverted causality issue.

Table 4.15: Results of lagging the independent variable by one period

	(1) *Oscore*	(2) *Oscore*
L.Dui	-7.124*** (-5.95)	-0.917** (-1.97)
L.Dui^2	39.637*** (7.02)	8.982*** (3.79)
Roa		-11.690*** (-45.02)
Lev		7.924*** (81.84)
Size		-0.400*** (-34.98)
Growth		-0.020 (-0.98)
Mhold		-0.142*** (-4.52)
Cso		1.373*** (6.41)
_cons	-5.449*** (-8.02)	-2.719*** (-7.21)
Indu FE	Yes	Yes
Year FE	Yes	Yes
N	15125	15123
Adj_R^2	0.051	0.850

This table presents the results with lagged *Dui* as the explanatory variable. Each variable is clarified in Table 4.1. In the regression analysis, this study accounts for year and industry fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10%, respectively.

4.3.2.2.3 Cubic Regression

To check that the U-shaped curve is part of the S-shaped curve, this study adds the cube of *Dui* into Eq. (4.2) to repeat the regression. Cubic regression is used to quantify the S-shaped relationship between a predictor variable and a response variable.

Table 4.16 presents the results of the cubic regression. The coefficients of the cubic term of Dui^3 are both not significant (-87.404, t =-1.53; 25.366, t = 0.90) without and with controls, indicating that the relationship curve between under-investment degree and financial distress risk is not part of an S-curve but a complete U-curve.

Table 4.16: Regression results for the independent variable cubic

	(1) *Oscore*	(2) *Oscore*
Dui	-9.849***	-0.755
	(-5.03)	(-0.85)
Dui^2	66.026***	-1.560
	(3.08)	(-0.15)
Dui^3	-87.404	25.366
	(-1.53)	(0.90)
Roa		-11.456***
		(-46.43)
Lev		7.991***
		(84.17)
Size		-0.398***
		(-36.47)
Growth		-0.032
		(-1.50)
Mhold		-0.141***
		(-4.71)
Cso		1.377***
		(6.46)
_cons	-2.127***	-1.402***
	(-21.11)	(-6.42)
Indu FE	Yes	Yes
Year FE	Yes	Yes
N	17677	17672
Adj_R²	0.051	0.846

This table presents the results of cubic regression. Each variable is clarified in Table 1. In the regression analysis, this study accounts for year and industry fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10%, respectively.

4.4 Channels Detecting

As discussed above, the empirical results suggest that over-investment exacerbates financial distress risk while under-investment has a U-shaped relationship with financial distress risk. Since this study defines financial distress risk as insufficient cash flows to meet debt obligations, this study examines the impacts of investment efficiency on firms' cash flows, including operating, investing, and financing cash flows to detect the channels through which investment efficiency impacts financial distress risk.

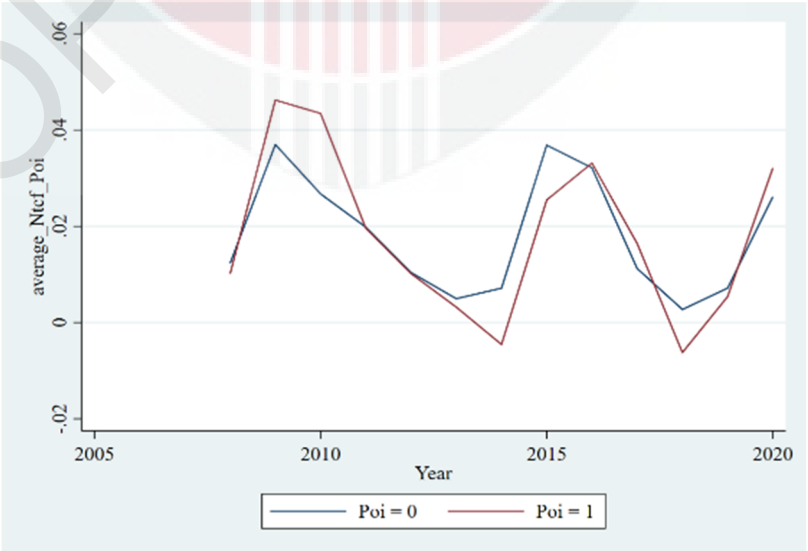


Figure 4.2a: Net Total Cash Flow Over Poi

Figure 4.2b: Net Operating Cash Flow Over Poi

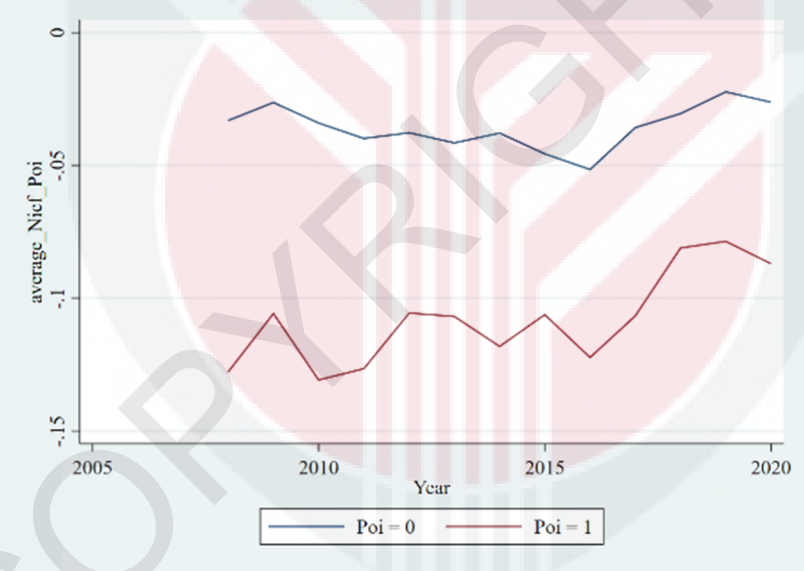


Figure 4.2c: Net Investing Cash Flow Over Poi

Figure 4.2d: Net Financing Cash Flow Over Poi

Fig4.2a, 2b, 2c, and 2d display the average net total cash flow, net operating cash flow, net investing cash flow, and net financing cash flow over *Poi* within the entire sample spanning 2007 to 2020, respectively. Each variable is clarified in Table 4.1.

Figures 4.2a, b, c, and d present the general impacts of investment efficiency on cash flows, including net total, operating, investing, and financing cash flows, respectively. Generally, the average net total cash flow levels of over- and under-investing firms are almost equal. Specifically, the average net operating cash flow level of over-investment firms is slightly higher than the under-investment group. The average net investing cash flow level of over-investment firms is much lower, while the average net financing cash flow level is much higher than that of the under-investment group. In comparison, over-investment firms rely more on external financing, causing higher financial distress risk according to static-trade theory.

As discussed earlier, under-investment has a U-shaped relationship with firms' financial distress risk, while over-investment exacerbates linearly. Hence, the effects of under-investment on firms' cash flows also should be non-linear, while the impact of over-investment should be linear.

4.4.1 The Impacts of Over-investment on Cash Flows

4.4.1.1 The Impacts of Over-investment on Operating Cash Flows

To examine the effects of over-investment on firms' operating cash flows, I establish the equations as follows:

$$Nocf_{i,t} = \beta_0 + \beta_1 Doi_{i,t} + \beta_i Control_{i,t} + \sum \text{Industry} + \sum \text{Year} + \delta_{i,t} \quad (4.5)$$

$$Nocf_{i,t} = \beta_0 + \beta_1 Ai_{i,t} + \beta_i Control_{i,t} + \sum \text{Industry} + \sum \text{Year} + \delta_{i,t} \quad (4.6)$$

Columns (1) and (4) of Table 4.16 display the results of the impacts of over-investment on net operating cash flow with *Doi* and *Ai* as proxy, respectively. The coefficient of *Ai* is positive and significant (0.037, *t* = 4.37), indicating that the impact of over-investment on firms' operating cash flow is positive, but unstable.

4.4.1.2 The Impacts of Over-investment on Investing Cash Flows

To examine the effects of over-investment on firms' investing cash flows, I establish the equations as follows:

$$Nicf_{i,t} = \beta_0 + \beta_1 Doi_{i,t} + \beta_i Control_{i,t} + \sum \text{Industry} + \sum \text{Year} + \delta_{i,t} \quad (4.7)$$

$$Nicf_{i,t} = \beta_0 + \beta_1 Ai_{i,t} + \beta_i Control_{i,t} + \sum \text{Industry} + \sum \text{Year} + \delta_{i,t} \quad (4.8)$$

Columns (2) and (5) of Table 4.16 display the results of the impacts of over-investment on net investing cash flow with *Doi* and *Ai* as proxy, respectively. The coefficients of *Doi* and *Ai* are both negative and significant (-0.604, *t* = -57.23; -0.617, *t* = -70.68). The results indicate that firms' investing cash flow declines as over-investment intensifies.

4.4.1.3 The Impacts of Over-investment on Financing Cash Flows

To examine the effects of over-investment on firms' financing cash flows, this study establishes the equations as follows:

$$Nfcf_{i,t} = \beta_0 + \beta_1 Doi_{i,t} + \beta_i Control_{i,t} + \sum \text{Industry} + \sum \text{Year} + \delta_{i,t} \quad (4.9)$$

$$Nfcf_{i,t} = \beta_0 + \beta_1 Ai_{i,t} + \beta_i Control_{i,t} + \sum \text{Industry} + \sum \text{Year} + \delta_{i,t} \quad (4.10)$$

Columns (3) and (6) of Table 4.17 display the results of the impacts of over-investment on net financing cash flow with *Doi* and *Ai* as proxy, respectively. The coefficients of *Doi* and *Ai* are both positive and significant (0.606, t = 46.52; 0.592, t = 50.80). The results indicate that over-investing firms need more external financing as over-investment intensifies.

Table 4.17: The results of the impacts of over-investment on cash flows

	(1) *Nocf*	(2) *Nicf*	(3) *Nfcf*	(4) *Nocf*	(5) *Nicf*	(6) *Nfcf*
Doi	0.012	-0.604***	0.606***			
	(1.37)	(-57.23)	(46.52)			
Ai				0.037***	-0.617***	0.592***
				(4.37)	(-70.68)	(50.80)
Roa	0.372***	-0.089***	-0.125***	0.379***	-0.041***	-0.180***
	(20.77)	(-7.64)	(-6.94)	(19.54)	(-3.59)	(-9.17)
Lev	-0.025***	0.030***	0.034***	-0.023***	0.011***	0.042***
	(-4.89)	(6.39)	(5.62)	(-4.01)	(2.59)	(6.63)
Size	0.003***	-0.005***	0.006***	0.003***	-0.001	0.002**
	(4.09)	(-7.44)	(7.46)	(3.49)	(-1.11)	(2.54)
Growth	-0.006***	0.005***	0.013***	-0.008***	0.014***	0.006***
	(-3.72)	(3.68)	(6.32)	(-4.81)	(8.60)	(2.61)
Mhold	-0.001	-0.022***	0.019***	-0.000	-0.007***	0.008***
	(-0.74)	(-11.98)	(8.54)	(-0.02)	(-3.64)	(3.26)
Cso	-0.052***	-0.050***	0.090***	-0.047***	-0.033***	0.064***
	(-3.43)	(-4.22)	(5.14)	(-2.88)	(-3.08)	(3.33)
_cons	0.015	0.008	-0.135***	0.025	-0.048***	-0.040*
	(0.58)	(0.47)	(-5.62)	(0.88)	(-2.65)	(-1.73)
Indu FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	12268	12268	12233	10423	10423	10392
Adj_R²	0.176	0.379	0.253	0.186	0.505	0.314

Each variable is clarified in Table 4.1. In the regression analysis, this study accounts for year and industry fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10%, respectively.

4.4.2 The Impacts of Under-investment on Cash Flows

4.4.2.1 The Impacts of Under-investment on Operating Cash Flows

To examine the effects of under-investment on firms' operating cash flows, this study establishes the equations as follows:

$$Nocf_{i,t} = \beta_0 + \beta_1 Dui_{i,t} + \beta_2 Dui_{i,t}^2 + \beta_{\mathrm{i}}\mathrm{Controls}_{\mathrm{i,t}} + \sum\mathrm{Industry} + \sum\mathrm{Year} + \delta_{\mathrm{i,t}} \quad (4.11)$$

Columns (1) and (2) of Table 4.18 display the results of the impacts of over-investment on net operating cash flow without and with controls, respectively. The coefficient of *Dui* is positive and significant (0.165, *t* = 4.83; 0.170, *t* = 5.36). Meanwhile, the coefficient of Dui^2 is negative and significant (-1.248, *t* = -8.02; -1.256, *t* = -8.39) without and with controls, respectively. These results imply that firms' under-investment and net operating cash flow have an inverted u-shaped relationship, indicating that below the threshold (0.067; 0.068 without and with controls, respectively), under-investment can advance firms' net operating cash flow, while exceeding the threshold decline it. These results can be explained by the fact that under-investment means less investment expenditure, thereby allowing firms to spend more on operations, while the under-investment degree is not so severe as to damage firms' normal operations. As the under-investment degree intensifies, becoming detrimental to firms' normal operations, firms' operating cash flows will decline.

4.4.2.2 The Impacts of Under-investment on Investing Cash Flows

As the under-investment is defined as the investment expenditure below the optimal investment expenditure level (Richardson, 2006), the investment cash flow should linearly increase as the under-investment intensifies in the given year. To examine the effects of under-investment on firms' investing cash flows, I establish the equations as follows:

$$Nicf_{i,t} = \beta_0 + \beta_1 Dui_{i,t} + \beta_i \text{Controls}_{i,t} + \sum \text{Industry} + \sum \text{Year} + \delta_{i,t} \qquad (4.12)$$

Columns (3) and (4) of Table 4.18 display the results of the impacts of under-investment on net investing cash flow without and with controls, respectively. The coefficient of *Dui* is positive and significant (0.292, *t* = 17.14; 0.279, *t* = 16.96), indicating that investment cash flow linearly increases as the under-investment intensifies in the given year.

4.4.2.3 The Impacts of Under-investment on Financing Cash Flows

To examine the effects of under-investment on firms' financing cash flows, this study establishes the equations as follows:

$$Nfcf_{i,t} = \beta_0 + \beta_1 Dui_{i,t} + \beta_2 Dui_{i,t}^2 + \beta_i \text{Controls}_{i,t} + \sum \text{Industry} + \sum \text{Year} + \delta_{i,t} \quad (4.13)$$

Columns (5) and (6) of Table 4.18 display the results of the impacts of over-investment on net financing cash flow without and with controls, respectively. The coefficient of *Dui* is positive and significant (-0.225, *t* = -5.54; -0.228, *t* = -5.66). Meanwhile, the coefficient of Dui^2 is negative and significant (0.639, *t* = 3.14; 0.681, *t* = 3.41) without and with controls, respectively. These results imply that firms' under-investment and net financing cash flow have a U-shaped relationship, indicating that below the threshold (0.18 and 0.17, without and with controls, respectively), under-investment can firms' decline net financing cash flow while exceeding the threshold advance it. Below the threshold of under-investment degree, less investment expenditure is combined with more operating cash flow; therefore, firms need less external financing. As the under-investment escalates, firms' operating cash flows decline, and firms demand more external financing to maintain assets in place.

Table 4.18: The results of the impacts of under-investment on cash flows

	(1) *Nocf*	(2) *Nocf*	(3) *Nicf*	(4) *Nicf*	(5) *Nfcf*	(6) *Nfcf*
Dui	0.165***	0.170***	0.292***	0.279***	-0.225***	-0.228***
	(4.83)	(5.36)	(17.14)	(16.96)	(-5.54)	(-5.66)
Dui^2	-1.248***	-1.256***			0.639***	0.681***
	(-8.02)	(-8.39)			(3.14)	(3.41)
Roa		0.265***		-0.031***		-0.076***
		(23.01)		(-3.69)		(-6.71)
Lev		-0.029***		0.040***		0.001
		(-6.92)		(10.40)		(0.29)
Size		0.004***		-0.005***		0.002***
		(6.75)		(-9.89)		(3.57)
Growth		-0.003		-0.013***		0.031***
		(-1.48)		(-8.30)		(14.49)
Cso		-0.070***		-0.004		0.029**
		(-4.94)		(-0.39)		(2.03)
_cons	-0.161***	-0.143***	-0.058***	0.024**	-0.030	-0.015
	(-50.40)	(-11.25)	(-22.61)	(2.21)	(-1.47)	(-1.15)
Indu FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	17680	17675	17680	17675	17592	17587
Adj_R^2	0.038	0.159	0.061	0.092	0.033	0.058

Columns (1) and (2), (3) and (4), (5) and (6) display the results of the impacts of under-investment on net operating cash flow, net investing cash flow, and net financing cash flow without and with controls, respectively. Each variable is clarified in Table 4.1. In the regression analysis, this study accounts for year and industry fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10%, respectively.

4.5 Summary

Firstly, this chapter examines the relationship between investment efficiency, including over-investment and under-investment, and corporate financial distress risk, respectively. Over-investment severity positively impacts firms' financial distress risk, while under-investment severity has a U-shaped

relationship with financial distress risk. The findings about relationship between over-investment and financial distress risk hold up well after the endogeneity disposal with GMM regressions, alternative dependent variables, and firm-fixed regression. Meanwhile, the findings about relationship between under-investment and financial distress risk hold up well using Poisson regression, RDD, and Cubic regression for the robustness. Furthermore, this chapter detects how investment efficiency, including over-investment and under-investment, impact financial distress risk, respectively. The empirical results show that both over-investment and under-investment affect firms' financial distress risk through cash flows, including operating, investing, and financing cash flows. Firm life cycle theory can explain the mechanisms that the project yields no cash return until it is completed (Majd, 1985), and the subsequent cash flow gradually increase in the consecutive years after it is finished. For the over-investing firms, the subsequent reduction in cash flow will further reduce the solvency of the business and increase the likelihood of the business falling into financial distress due to the NPV < 0 projects; For the under-investing firms, corporate financial distress risk is alleviated due to less investment expenditure under some extent, but the effect will be opposite if the under-investment so severe that it damages firms' normal operations.

CHAPTER 5

IMPACT OF CSSP ON FINANCIAL DISTRESS RISK

5.1 Models and Estimation Methods

5.1.1 Models

To test **H7** and **H8**, this study sets the equation as follows:

$$Oscore_{i,t} = \beta_0 + \beta_1 Pledge_{i,t} + \mu_i Controls_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} (5.1)$$

Whereas the *Oscore* indicates financial distress risk level (Ohlson, 1980). *Pledge* contains two specific proxies, *Pld_dum* and *Pld_rate. Pld_dum* is set to 1 if CSSP exists in the firm at the end of the year; otherwise, 0. *Pld_rate* is calculated as the number of shares pledged by controlling shareholders scaled by the total number of shares held by controlling shareholders at the end of the year.

As the primary hypothesis concerns the effect of inefficient investment degree, this study incorporates additional variables to deal with firm-specific attributes in the analysis regarding determinants of financial distress risk. In particular, this study integrates firms' size (*Size*) (Al-Hadi et al., 2019; ElBannan, 2021a) and leverage (*Lev*) (Dang, 2022; Wang & Cao, 2021) into the analysis to mitigate any potential size-related and financial leverage effects, respectively. This study includes growth (*Growth)* to control for financing demand (Sharpe,

1994) and investment opportunity (Guiso & Parigi, 1999; Love & Zucchini, 2006). This study further adds asset return (*Roa*) to handle profitability and firm circle stage, since firms with higher profitability are more mature and well established, while firms with lower profitability are younger firms that tend to be more vulnerable to financial distress (DeAngelo et al., 2006; Hasan et al., 2015; Mueller, 1972). Furthermore, the proportion of shares held by the management team (*Mhold*) (Dang, 2022; Wang & Cao, 2021) and controlling shareholders' occupancy (*Cso*) (Dang, 2022; Wang & Cao, 2021) are introduced into the model, accounting for corporate governance-related aspects. These inclusions help to control for their effects on the analysis and ensure a comprehensive understanding of the factors influencing the results.

For robustness, this study adds extra controls to repeat Eq. (5.1), including firms' age since foundation (Age), because maturity can affect firms' financial distress risk (Mueller, 1972). Market-to-book ratio (*BM*) is measured by the ratio of book value to the market value of equity, proxying for investment opportunities from the supplying side (Andreou et al., 2021). Cash holdings (*Cash*), as a proxy for firm liquidity, are included to control for firm solvency, ability to meet obligations, and recovery during periods of financial constraints (Al-Hadi et al., 2019). To account for the effects of managerial governance differences on financial distress, we introduce the ratio of independent directors to total directors in the board (*Independent*) (Dang, 2022; Li et al., 2021) and the duality of general manager and chairman of the board (*Dual*) (Wang & Cao, 2021) to the control variables. To control for macro environment effects, we take province-level gross domestic product (GDP) (ElBannan, 2021) and covid 19 into account. This study reports results incorporating all

controls in the baseline regression results, while reports results incorporating part of controls in other results to save space.

Each variable has been defined as listed in Table 5.1.

Table 5.1: Definitions of variables in Chapter 5

Variable	Definition
Dependent variable	
Oscore	Financial distress risk (Ohlson, 1980). The calculation is shown in Table C in appendix.
Zscore	Financial distress risk (Altman, 1968). The calculation is shown in Table D in appendix.
Independent variable	
Pld_dum	Firms with CSSP at the end of the year as 1; 0 otherwise.
Pld_rate	Shares pledged by controlling shareholders / Controlling shareholders' total shares.
Control variable	
Size	Natural log of year-end total assets.
Lev	Total liabilities / Year-end total assets.
Growth	Growth rate. (Operating income current year - operating income previous year) / Operating income previous year.
Roa	Return on total assets.
Mhold	Shares held by the management team / Total shares of the firm.
Cso	Controlling shareholders' occupancy. (Other Receivables-Other payables) / Year-end total assets.
BM	The book to market value of equity.
Age	*Number of years since foundation.*
Cash	Cash holding. Year-end cash and securities / Year-end total assets.
Independent	The ratio of independent directors to the total number of directors on the board.
Dual	Firms combining the positions of chairman and manager as 1; otherwise, 0.
Gdp	Natural log of the gross domestic product of the province where the listed company is located in.
Covid19	1 for the years 2020 and beyond; 0, otherwise.
Mediating variable	
Nocf	Net operating cash flow / Year-end total assets.
Nicf	Net investment cash flow / Year-end total assets.
Nfcf	Net financing cash flow / Year-end total assets.
Doi	Over-investment degree (See Table 3.1).
Instrumental variables	
Post	1 for the years 2018 and beyond; 0, otherwise.
Soe	State-owned as 1, otherwise 0.
Pld_Iv_Indu	The average value of *Pld_dum* for all other observations in the same industry in a specific year, while omitting the value of *Pld_dum* for the firm being considered.
Pld_Iv_Prov	The average value of *Pld_dum* for all other observations in the same province in a specific year, while omitting the value of *Pld_dum* for the firm being considered.
Other variables	
Imr	Inversed Mills ratio.
Treat	A treatment group indicator variable, which is to 1 if a firm's controlling shareholders have pledged shares and 0 otherwise.
Ar	Year ending accounts receivable / Year-end total assets
Ap	Year ending accounts payable / Year-end total assets
Loan	Cash inflows from loans / Year-end total assets.
Shortloan	Year-end (short-term loan + long-term loan due within a year) / Year-end total asset.
Bond	Cash inflows from bond / Year-end total assets.
Equity	Cash inflows from equity / Year-end total assets.
Other	Cash inflows from other financing channel / Year-end total assets.
Loanpercentage	Cash inflows from loans / Total financing cash inflows
Bondpercentage	Cash inflows from bond / Total financing cash inflows
Equitypercentage	Cash inflows from equity / Total financing cash inflows
Otherpercentage	Cash inflows from other financing channel / Total financing cash inflows

5.1.2 Estimation Methods

This chapter examines the impacts of CSSP on financial distress risk using the OLS with fixed time and industry effects and hierarchical regression to get the primary outcomes, followed by GMM regression for robustness. Subsequently, this chapter addresses the endogeneity issues with Firm-fixed effects regression, the Heckman two-stage regression with instrumental variables, and PSM. To detect the mechanism of how CSSP impacts financial distress risk, this study employs the sequential test and the Sobel test to examine the mediating effects of operating cash flows, financing cash flows, and over-investment extent. The methods used in this chapter are introduced specifically after the models.

5.2 Sample and Data

This chapter adopts unbalanced Chinese A-share market annual data from 2007 to 2020. This study chooses 2007 as the beginning year because new accounting standards have been implemente since 1 January 2007 in China, and using the same accounting standards provides better comparability of financial statement data. This study's financial variables and stock data are obtained from the China Stock Market and Accounting Research (CSMAR) Database. To ensure the reliability of the empirical analysis, this study follows a set of procedures to select the relevant observations. To begin with, this study omits observations from the financial industry as these firms have fundamental differences from non-financial corporates. Furthermore, this

study winsorizes all continuous primary variables at the 1st and 99th percentiles, aiming to alleviate the impact of outliers on the dataset. Finally, 29,959 firm-year observations are obtained.

The statistical descriptions concerning the variables utilized in the analysis of hypothesis 9 are presented in Panel A of Table 5.2. The mean values of *Pld_dum* and *Pld_rate* stand at 0.403 and 0.235, respectively, in the entire sample during the sample period. This suggests that over 40% of firms are characterized by share pledging by their controlling shareholders, with an average pledging ratio surpassing 23%. The mean value of *Oscore* in the entire sample is -8.292, while the values are -8.175 and -8.371 in the firms with and without CSSP groups, respectively, indicating that firms with CSSP are of higher financial distress risk, as shown in Panel B of Table 5.2.

Table 5.3 illustrates the Pearson correlation matrix for all variables in the hypothesis tests in this Chapter. The dependent variable *Oscore* is positively correlated with both independent variables *Pld_dum* and *Pld_rate*, indicating that firms with share-pledging controlling shareholders are related to higher financial distress risk. Moreover, in accordance with previous research, financial distress risk is negatively correlated with firm profitability, size, growth, and shareholdings of the management team while positively correlated with leverage.

Also, the absolute value of Pearson correlation coefficients between each of the two variables in one model is much lower than 0.2, indicating that there is

no multicollinearity issue in each model in this chapter. This study also uses the VIF in all regression models (Eq. (5.1) to (5.11)) to test for the multicollinearity problem in the explanatory variables of the data. As the mean VIF ranges from 1.25 to 1.46 for all models, it indicates no multicollinearity concerns.

Table 5.2: Univariate statistics

Panel A Descriptive Statistics								
Variable	**Mean**	**p50**	**Min**	**Max**	**p25**	**p75**	**SD**	**No.**
Oscore	-8.292	-8.117	-15.707	-1.692	-9.525	-6.932	2.301	29956
Pld_dum	0.403	0.000	0.000	1.000	0.000	1.000	0.491	29956
Pld_rate	0.235	0.000	0.000	1.000	0.000	0.469	0.343	29956
Lev	0.462	0.456	0.061	1.037	0.297	0.615	0.214	29956
Size	22.151	22.000	19.270	26.120	21.240	22.900	1.315	29956
Growth	0.166	0.097	-0.651	3.241	-0.041	0.260	0.461	29956
Mhold	0.233	0.001	0.0000	1.738	0.000	0.259	0.426	29956
Cso	-0.024	-0.009	-0.367	0.118	-0.032	0.001	0.061	29956
Age	11.088	10.000	2.000	26.000	5.000	16.000	6.613	29956
BM	0.313	0.292	0.006	0.742	0.199	0.407	0.156	29956
Cash	0.148	0.117	0.006	0.566	0.066	0.196	0.113	29956
Independent	0.374	0.333	0.000	1.000	0.333	0.429	0.057	29956
Dual	35.514	33.620	0.004	155.190	23.830	45.810	15.144	29956
Gdp	10.326	10.383	5.835	11.615	9.854	10.952	0.824	29956
Covid19	0.114	0.000	0.000	1.000	0.000	0.000	0.318	29956

Panel B Contrast of Oscore between firms with and without CSSP					
Variable	*Pld_dum* =1		*Pld_dum* =0		
	Mean	Media	Mean	Media	T-stat
Oscore	-8.175	-8.020	-8.371	-8.184	-7.25***

This table presents the statistical descriptions of variables observed for firm-year data spinning 2007-2020. The sample contains 29956 observations. Each variable is clarified in Table 5.1.

Table 5.3: Pearson correlations matrix

	Oscore	*Pld dum*	*Pld rate*	*Roa*	*Lev*	*Size*	*Growth*	*Cso*	*Age*	*BM*	*Cash*	*Independent*	*Dual*	*Gdp*	*Covid19*
Oscore	1														
Pld dum	0.042***	1													
Pld rate	0.095***	0.832***	1												
Roa	-0.698***	-0.040***	-0.086***	1											
Lev	0.796***	-0.008	0.036***	-0.382***	1										
Size	0	-0.071***	-0.079***	0.081***	0.359***	1									
Growth	-0.098***	0.058***	0.049***	0.244***	0.017***	0.050***	1								
Cso	-0.263***	0.056***	0.033***	0.147***	-0.266***	0.115***	-0.011*	1							
Age	0.195***	-0.135***	-0.042***	-0.130***	0.267***	0.281***	-0.066***	-0.161***	1						
BM	-0.429***	-0.061***	-0.072***	0.146***	-0.508***	0.134***	-0.053***	0.233***	-0.082***	1					
Cash	-0.402***	-0.093***	-0.098***	0.271***	-0.374***	-0.170***	0.029***	0.051***	-0.103***	0.079***	1				
Indep	0.002	0.045***	0.030***	-0.035***	-0.008	0.019***	-0.005	-0.006	-0.019***	-0.020***	0.012**	1			
Dual	-0.139***	-0.099***	-0.147***	0.168***	-0.015***	0.202***	0.036***	0.033***	-0.130***	0.103***	0.051***	0.035***	1		
Gdp	-0.126***	0.103***	0.059***	0.034***	-0.117***	0.065***	-0.021***	0.075***	-0.072***	0.113***	-0.007	0.050***	-0.024***	1	
Covid19	-0.032***	-0.023***	-0.064***	-0.032***	-0.022***	0.066***	-0.082***	0.010*	0.067***	0.044***	-0.002	0.039***	-0.044***	0.210***	1

This table presents the Pearson correlations among the primary variables in this Chapter. Each variable is defined in Table 5.1. The sample contains 29956 observations spanning from 2007 to 2020. The notions ***, **, and * represent 1%, 5%, and 10% significance levels, respectively.

5.3 Results and Discussions

5.3.1 Hypotheses Tests

The last objective of this study is to examine the relationship between CSSP and financial distress risk. Specifically, the Hypothesis H7 predicts that CSSP has a positive impact on financial distress risk and H8 predicts that the effect of CSSP on financial distress risk decreases as firms' financial distress risk increases. Section 5.3.1.1 presents the results of the impact of CSSP on financial distress risk, and Section 5.3.1.2 presents the results of the change of the relationship between CSSP and financial distress.

5.3.1.1 The Impact of CSSP on Financial Distress Risk

To examine the general relationship between CSSP and financial distress risk, this study regresses Eq. (5.1) with the entire sample. Table 5.4 presents the results of the impacts of CSSP on financial distress risk. The coefficients of *Pld_dum* are both significantly positive without and with controls (0.368, t = 7.04; 0.100, t = 6.35, respectively). Similarly, the coefficients of *Pld_rate* are also both significantly positive without and with controls (0.804, t = 10.72;

0.132, *t* = 5.65, respectively). These results indicate that CSSP has a positive impact on financial distress risk, thereby H7 is adopted.

The results are consistent with Dang (2022) and Wang & Cao (2021). Compared to Dang (2022), this study uses *Oscore* as independent variable to account for the financial distress risk. Wang & Cao (2021) use different measure of financial distress risk, and they exclude state-owned firms, which are an important part of listed firms in China. Dang (2022) takes Soe (stated-owned nature as 1; otherwise, 0.) as a control variable in their model, we take firms' nature as an instrumental variable because state-owned companies are both less probably to participate in share pledging (Xing, 2018), and easier to get bank financing (Brandt & Li, 2003; Hoshi et al., 1990) due to their unique nature. We will address the possible potential endogeneity problems in the Section 5.4, including reverse causality.

5.3.1.2 The Change of The Relationship Between CSSP and Financial Distress Risk

To examine H8, this study employs Hierarchical Regression to repeat Eq. 5.1. Hierarchical Regression was introduced by Carroll and Schneider (1985). In a scenario where the dependent variable moderates the relationship between a predictor variable and itself, the relationship between the predictor and the dependent variable may vary depending on the level or value of the dependent variable itself. This method is used to examine the effect of the predictor variable on the dependent variable changes as a function of the level of the dependent variable. Specifically, this study partitions the firms into two groups

of low, middle, and high financial distress risk groups based on the values of *Oscore* and repeats the test for Eq. 5.1 in the same way within the three-group data, separately.

Table 5.5 presents the results of hypothesis tests for H8, which proposes that the effect of CSSP on financial distress risk decreases as firms' financial distress risk increases. Columns (1) and (4) present the results of the relationship between CSSP and financial distress risk in the low financial distress risk group, while columns (2) and (5) present the results in the middle financial distress risk group and columns (3) and (6) present the high financial distress risk ones. The coefficients on *Pld_dum* decline in columns (1) to (3), shown as 0.060 (t = 2.52), 0.025 (t = 3.12), and 0.004 (t = 0.18), respectively. Similarly, the coefficients on *Pld_dum* decline in columns (4) to (6), shown as 0.073 (t = 2.06), 0.033 (t = 2.88), and 0.013 (t = 0.42), respectively. These results indicate that the effect of CSSP on financial distress risk decreases as firms' financial distress risk increases, supporting hypothesis H8.

Furthermore, both the coefficients on *Pld_dum* and *Pld_rate* in the high financial distress risk (columns (3) and (6)) are insignificant, indicating that for the firms of high financial distress risk, the exacerbating effect of CSSP on financial distress risk is unobservable. Compared to Dang (2022), who documents that CSSP exacerbates financial distress risk; these findings are the first to capture the change of the impact of controlling shareholders' role in firms' financial distress risk. This is consistent with the stakeholder theory that controlling shareholders will change to "supporters" from "embezzlers" when

their long-term interests are threatened, e.g., when firms are in close financial distress.

Table 5.4: Results of the relationship between CSSP and financial distress risk (H7)

	(1) *Oscore*	(2) *Oscore*	(3) *Oscore*	(4) *Oscore*
Pld_dum	0.100*** (6.35)	0.080*** (5.21)		
Pld_rate			0.132*** (5.65)	0.090*** (3.92)
Roa	-11.503*** (-52.45)	-13.352*** (-52.06)	-11.487*** (-52.39)	-13.343*** (-52.02)
Lev	7.973*** (105.88)	8.055*** (74.56)	7.973*** (105.49)	8.052*** (74.34)
Size	-0.393*** (-46.83)	-0.450*** (-48.60)	-0.392*** (-46.55)	-0.450*** (-48.30)
Growth	-0.046*** (-3.09)	-0.018 (-1.19)	-0.045*** (-3.07)	-0.017 (-1.14)
Mhold	-0.140*** (-5.83)	-0.088*** (-3.63)	-0.129*** (-5.41)	-0.081*** (-3.36)
Cso	1.100*** (7.01)	0.585*** (4.15)	1.104*** (7.03)	0.591*** (4.19)
Age		0.007*** (4.70)		0.007*** (4.41)
BM		0.710*** (7.16)		0.700*** (7.07)
Cash		-1.434*** (-15.33)		-1.446*** (-15.49)
Independent		0.137 (1.06)		0.141 (1.09)
Dual		-0.001** (-2.19)		-0.001** (-2.14)
Gdp		-0.005 (-0.35)		-0.005 (-0.37)
Covid19		-0.142*** (-3.76)		-0.136*** (-3.59)
_cons	-1.600*** (-9.13)	1.191*** (5.83)	-1.578*** (-9.04)	1.220*** (5.97)
Indu FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	29,940	28759	29,940	28759
Adj_R²	0.852	0.869	0.852	0.8670

This table presents the results of relationship between CSSP and financial distress risk. Columns (1) & (3), (2) & (4) are results with part of and all controls, respectively. The explanatory variable of columns (1) & (2), (3) & (4) is

Pld_dum, *Pld_rate,* respectively. Each variable is clarified in Table 5.1. In the regression analysis, this study accounts for firm and year fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10% respectively.

Table 5.5: Results of the relationship between CSSP and financial distress risk conditional on financial distress magnitude (H8)

	(1) Low *Oscore*	(2) Mid *Oscore*	(3) High *Oscore*	(4) Low *Oscore*	(5) Mid *Oscore*	(6) High *Oscore*
Pld_dum	0.060**	0.025***	0.004			
	(2.52)	(3.12)	(0.18)			
Pld_rate				0.073**	0.033***	0.013
				(2.06)	(2.88)	(0.42)
Roa	-20.132***	-8.038***	-7.075***	-20.119***	-8.030***	-7.074***
	(-56.92)	(-46.97)	(-45.62)	(-56.86)	(-46.94)	(-45.55)
Lev	11.112***	4.305***	3.752***	11.122***	4.304***	3.752***
	(44.80)	(59.42)	(28.29)	(44.92)	(59.45)	(28.28)
Size	-0.363***	-0.254***	-0.374***	-0.364***	-0.254***	-0.374***
	(-16.12)	(-44.51)	(-35.36)	(-16.19)	(-44.48)	(-35.32)
Growth	-0.028	-0.058***	-0.046**	-0.027	-0.058***	-0.046**
	(-1.01)	(-6.34)	(-2.12)	(-0.97)	(-6.33)	(-2.13)
Mhold	0.014	0.021**	-0.144***	0.020	0.025**	-0.145***
	(0.52)	(2.08)	(-4.19)	(0.75)	(2.41)	(-4.21)
Cso	0.529	-0.317***	-0.866***	0.530	-0.315***	-0.868***
	(0.88)	(-3.45)	(-6.57)	(0.87)	(-3.43)	(-6.58)
_cons	-2.209***	-3.964***	0.188	-2.202***	-3.966***	0.179
	(-4.95)	(-28.69)	(0.42)	(-4.95)	(-29.01)	(0.40)
Indu FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	10987	10990	7963	10987	10990	7963
Adj_R²	0.741	0.588	0.734	0.752	0.589	0.735

Firms are classified into low, middle, and high financial distress risk sub-samples. Columns (1) & (4) report the regression results of low financial distress risk group, columns (2) & (5) report the regression results of middle financial distress risk group, and columns (3) & (6) report the regression results of high financial distress risk group. Each variable is clarified in Table 5.1. In the regression analysis, this study accounts for year and industry fixed effects,

and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10%, respectively.

5.3.2 Robustness

5.3.2.1 Sensitivity Test

Firstly, this study employs *Zscore* proxying for financial distress risk to repeat Eq. (5.1). Columns (1) to (4) of Table 5.6 represent the results of the re-estimations, all the statistical coefficients remain significantly negative, suggesting that CSSP has a positive impact firms' financial distress risk.

Table 5.6: Sensitivity test

	(1) *Zscore*	(2) *Zscore*	(3) *Zscore*	(4) *Zscore*
Pld_dum	-0.338*** (-2.61)	-0.116** (-2.35)		
Pld_rate			-0.703*** (-3.90)	-0.228* (-1.85)
Roa		8.843*** (19.50)		8.806*** (12.04)
Lev		-13.322*** (-71.97)		-13.307*** (-33.92)
Size		-0.833*** (-34.58)		-0.837*** (-16.22)
Growth		-0.026 (-0.46)		-0.024 (-0.40)
Mhold		-1.009*** (-14.73)		-1.020*** (-7.60)
Cso		-3.335*** (-7.61)		-3.301*** (-4.35)
_cons	0.629 (1.16)	26.518*** (40.10)	0.653 (1.21)	26.595*** (20.62)
Indu FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	29,566	29,555	29,566	29,555
Adj_R2	0.070	0.457	0.071	0.457

This table presents the results of sensitivity tests when I switch to *Zscore* as the proxy for financial distress risk. Each variable is clarified in Table 5.1. In the regression analysis, this study accounts for year and industry fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10% respectively.

5.3.2.2 GMM Test

This study uses GMM regression to repeat Eq. (5.1) to see if the findings hold in the dynamic model. Table 5.7 presents the System GMM regression results.

Columns (1) and (2) report the results with Pld_dum and Pld_rate as proxy for CSSP, respectively. The coefficients of Pld_dum and Pld_rate are both significantly positive and consistent with the main examinations. The coefficients on lagged Oscore are significantly negative, suggesting negative dynamic effects of the baseline model Eq. (5.1).

Table 5.7: Results of GMM regressions for H7

	(1) *Oscore*	*(2)* *Oscore*
Pld_dum	0.265**	
	(2.312)	
Pld_rate		0.368**
		(2.393)
L.Oscore	-0.083**	-0.060***
	(-2.459)	(-2.615)
Roa	-14.967***	-12.488***
	(-6.317)	(-8.637)
Lev	7.539***	7.727***
	(21.793)	(8.442)
Size	-0.563***	-0.460***
	(-6.757)	(-2.785)

Table 5.7: Continued

Growth	2.843*	1.071
	(1.697)	(1.059)
Mhold	-1.612***	-0.966**
	(-2.924)	(-2.106)
Cso	1.741***	0.284
	(3.168)	(0.031)
_cons	0.091	-1.894
	(0.058)	(-0.561)
Indu FE	Yes	Yes
Year FE	Yes	Yes
Ar (1)p	0.034	0.009
Ar (2)p	0.118	0.134
Hansen Test	0.672	0.643
N	25683	25683

This table reports the effects of CSSP on financial distress risk by System GMM in the baseline model Eq. (5.1). This study uses the levels of explanatory variables lagged 2 times and more as instruments for the first-differenced equation. AR(n) is the test for the null of no n-th order autocorrelation of the differenced residuals, and Hansen test is of over-identifying restrictions. In the regression analysis, this study accounts for firm and year fixed effects, and values in parenthesis are the asymptotic standard errors and those in square brackets are the p-values of test statistics. *, ** and *** indicate the significance of coefficients at the 10%, 5% and 1% level respectively.

5.3.2.3 Firm-fixed Effect

To address the potential impact of time-independent factors at the firm level on the findings, I conduct a Firm-fixed effect regression to re-examine hypothesis H7. The results of this analysis are presented in Table 5.8. Columns (1) and (2) show the regression results when *Pld_dum* is the independent variable without and with control, respectively. The statistical

coefficients of *Pld_dum* are significant and positive in column (2) (0.066, *t* = 3.27) with control variables. Columns (3) and (4) report regression results when *Pld_rate* is the independent variable without and with controls. The statistical coefficient of *Pld_rate* is significant and positive in column (4) (0.094, *t* = 3.08) with control variables. These results indicate that the results are not driven by any unobserved time-independent factors at the firm level.

Table 5.8: Firm-fixed effect regression

	(1) *Oscore*	(2) *Oscore*	(3) *Oscore*	(4) *Oscore*
Pld_dum	0.024	0.066***		
	(0.51)	(3.27)		
Pld_rate			0.041	0.094***
			(0.59)	(3.08)
Roa		-10.658***		-10.657***
		(-44.89)		(-44.88)
Lev		7.200***		7.200***
		(72.61)		(72.63)
Size		-0.292***		-0.290***
		(-14.98)		(-14.93)
Growth		-0.099***		-0.099***
		(-6.49)		(-6.49)
Mhold		-0.052		-0.052
		(-1.06)		(-1.05)
Cso		0.676***		0.673***
		(3.71)		(3.70)
_cons	-8.299***	-4.828***	-8.299***	-4.858***
	(434.10)	(-11.58)	(509.78)	(-11.66)
N	29853	29837	29853	29837
Adj_R²	0.575	0.889	0.575	0.889

This table presents the results of firm-fixed regression. The explanatory variable of columns (1) & (2) is *Pld_dum*; the explanatory variable of columns (3) & (4), is *Pld_rate*. Each variable is clarified in Table 1. In the regression analysis, this study accounts for firm and year fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10% respectively.

5.3.2.4 Heckman two-stage estimation with instrumental variables

To address the potential issue of endogeneity, such as the factors driving controlling shareholders to pledge their shares, which may also influence firms' financial distress risk, this study employs the Heckman two-stage estimation. As discussed in Section 3.5.1, this study regresses a probit model with *Pld_dum* as the dependent variable in the first stage. Subsequently, this study incorporates the Inverse Mills Ratio (*Imr*) derived from the first stage into Eq. 5.1 as the second stage model, with *Pld_dum* as the independent variable.

Table 5.9 presents the results of the Heckman two-stage estimation. In the first stage estimation, the negative statistical coefficients on *Soe* indicate that controlling shareholders of state-owned firms are less likely to pledge their shares, which aligns with Li and Xing (2017). In addition, the significant statistical coefficient of *Imr* implies the presence of a selection effect. After this study considers the selection effect reverse causality in the second stage, the statistical coefficients of *Pld_dum* remain significant and positive, suggesting CSSP has a causal effect on firms' financial distress risk.

Table 5.9: Heckman two-stage estimation

	First stage *Pld_dum*	Second stage *Oscore*
Pld_dum		0.128*** (10.00)
Pld_Iv_Indu	2.068*** (26.98)	
Pld_Iv_Prov	2.122*** (23.26)	
Post	-0.382*** (-6.81)	
Soe	-1.139*** (-56.43)	
Roa	-0.438*** (-3.48)	-11.552*** (-66.86)
Lev	0.927*** (18.33)	8.018*** (153.14)
Size	-0.010 (-1.28)	-0.400*** (-65.71)
Growth	0.106*** (6.11)	-0.037** (-2.53)
Mhold	-0.019 (-0.90)	-0.122*** (-7.51)
Cso	1.634*** (10.73)	1.220*** (8.62)
Fcf	-0.000 (-0.06)	
imr		0.077*** (5.35)
_cons	-1.350*** (-7.92)	-1.573*** (-11.65)
Year FE	Yes	Yes
Industry FE	No	Yes
Number of observations	29457	29454
Adj_R^2		0.853

In the first-stage estimation, this study establishes a probit model with *Pld_dum* as the independent variable., The *Imr* which derived from the first stage, are introduced into the second stage analysis. Each variable is clarified in Table 5.1. In the first stage regression, this study accounts for year fixed effect. In the second stage regression, this study accounts for year and industry fixed effects and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10% respectively.

5.3.2.5 PSM approach

Table 5.10 exhibits substantial disparities in firm characteristics between firms with and without share pledging, which raises concerns that the results of the initial tests might be influenced by systematic dissimilarities in these groups. To address this concern, this study adopts the PSM approach. This study uses control variables in Eq. (5.1) to match firms with and without share-pledging controlling shareholders based on the closest matching score with maximum calipers of 1.5e-6 without replacement in full. The matching process results in 1772 matches. I then regress the primary tests using the matched sample. Table 10 presents the matching outcomes. Table 5.10 illustrates no significant distinctions between the firms with and without share pledging controlling shareholders after matching. Table 5.11 presents the results regressed with the matching samples, where both the statistical coefficients of *Pld_dum* and *Pld_rate* remain significant and positive, suggesting the systematic differences in the characteristics of firms with and without share-pledging controlling shareholders do not affect the core findings of this Chapter.

Table 5.10: Post-match differences

Variable	Treated	Control	*T* value	*P* value
Roa	0.030	0.031	-0.130	0.899
Lev	0.465	0.474	-1.320	0.188
Size	22.195	22.182	0.330	0.742
Growth	0.137	0.140	-0.250	0.805
Mhold	0.109	0.097	1.470	0.141
Cso	-0.024	-0.023	-0.840	0.403

This table compares firm characteristics between the treatment group and the control group after propensity score matching. Each variable is defined in Table 5.1.

Table 5.11: Regressions with the matched sample

	(1) Oscore	(2) Oscore
Pld_dum	0.078*** (2.63)	
Pld_rate		0.121*** (2.58)
Roa	-13.423*** (-21.58)	-13.408*** (-21.59)
Lev	7.842*** (48.71)	7.838*** (48.65)
Size	-0.416*** (-25.03)	-0.413*** (-24.50)
Growth	-0.006 (-0.11)	-0.004 (-0.08)
Mhold	-0.409*** (-5.31)	-0.405*** (-5.27)
Cso	1.611*** (3.59)	1.608*** (3.58)
_cons	-0.990 (-1.15)	-1.036 (-1.20)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Number of observations	3542	3542
Adj_R²	0.848	0.848

This table presents the results of the regression analysis conducted using the matched sample. The dependent variable is *Oscore,* while the independent variables are *Pld_dum* and *Pld_rate*, respectively. Each variable is clarified in Table 1. In the regression analysis, this study accounts for year and industry effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notations ***, **, and * signify significance levels of 1%, 5%, and 10%, respectively, based on two-tailed tests.

Collectively, after employing regression with firm-fixed effects, Heckman's two-stage method combined with instrumental variable estimation and the PSM approach to address possible endogeneity issues, the main findings in this chapter still hold.

5.4 Mechanism Detecting

As financial distress is defined as a firm's cash flow is not enough to pay off the debts due. This study also considers the impacts of CSSP on firms' profitability. Firms' profitability is based on accrual accounting, predicating firms' future cash flows (Beaver, 1998). Firms' financial distress risk depends more on firms' current cash flows rather than contingencies. Thereby, this study explores the channels through which CSSP impacts financial distress risk by impacting cash flows, including operating, financing, and investing cash flows.

Table 5.12 presents the differences in firms' net total cash flow, net operating cash flow, net financing cash flow, and net investing cash flow in firms without and with CSSP. The t-test results show that the net total cash flow in firms with CSSP is a little higher than the firms without; the net operating cash flow in firms with CSSP is obviously lower than the firms without; the net financing cash flow in firms with CSSP is much higher than the firms without; and the net investing cash flow in firms with CSSP is obviously lower than the firms without, all at 1% significance level. Differences can also be seen in Figure 5.1a & b.

Table 5.12: T-tests for net total, operating, financing, and investing cash flows between without and with CSSP

	***Pld_dum* = 0**		***Pld_dum* = 1**		**T test**
	Mean	**Med**	**Mean**	**Med**	**T-stat**
Ntcf	0.016	0.003	0.019	0.005	-2.64***
Nocf	0.056	0.053	0.044	0.044	6.699***
Nicf	-0.056	-0.040	-0.073	-0.054	13.42***
Nfcf	0.015	0.01	0.043	0.012	-17.85***

This table presents the results of t-tests for net total, operating, financing, and investing cash flows between non-pledging and pledging firms over *Pld_dum*. Each variable is clarified in Table 5.1.

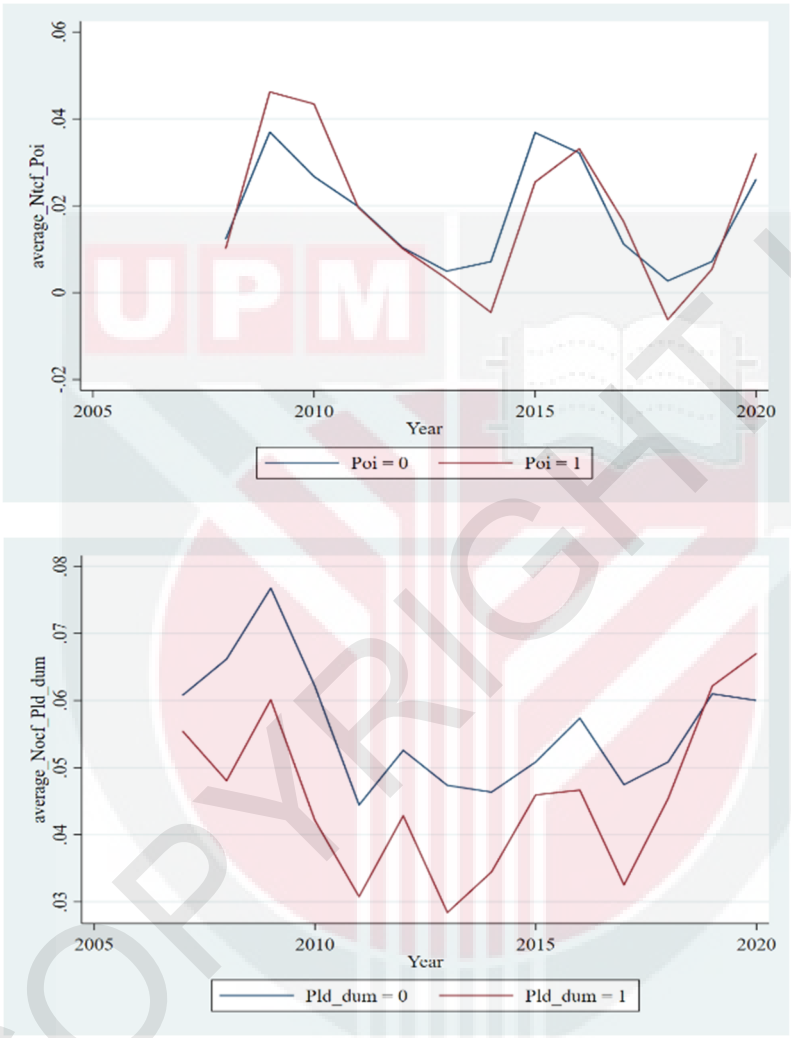


Figure 5.1a: Average Ntcf & Nocf Over Pld_dum in Entire sample Spanning 2007 to 2020

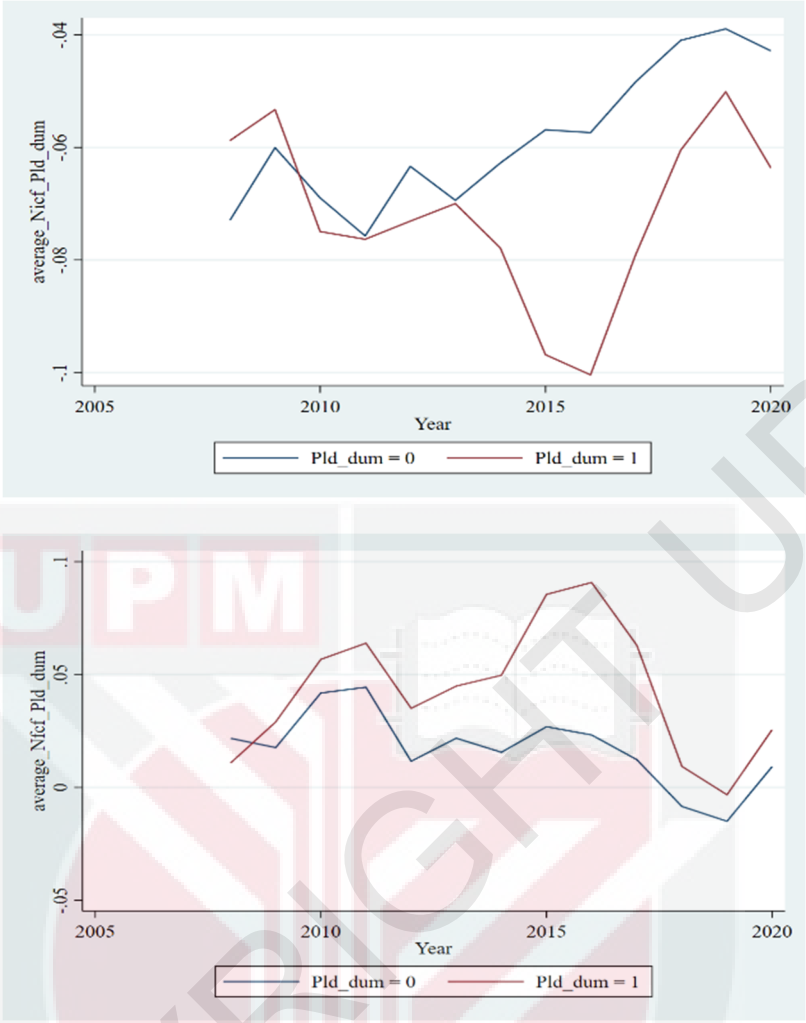


Figure 5.1b: Average Nicf & Nfcf Over Pld_dum in Entire sample Spanning 2007 to 2020

Figures 5.1a & b display the average net total cash flow, net operating cash flow, net investment cash flow, and net financing cash flow over *Pld_dum* within the entire sample spanning 2007 to 2020, respectively. Each variable is clarified in Table 1.

5.4.1 Impacts of CSSP on Operating Cash Flows

As discussed above, it initially illustrates that firms with CSSP have lower operating cash flow. To examine the channel role of operating cash flow on

the impacts of CSSP on firms' financial distress risk, this study establishes the equation as follows:

$$Nocf_{i,t} = \alpha_0 + \alpha_1 Pledge_{i,t} + \mu_i Controls_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (5.2)$$

Table 5.13 presents the results of the impacts of CSSP on firms' operating cash flow. The coefficients of *Pld_dum* are negative and significant (-0.007, *t* = -4.66; -0.003, *t* = -2.31) as displayed in columns (1) and (2), respectively, without and with controls. Similar results are obtained when *Pld_rate* as explanatory displayed in columns (3) and (4) without and with controls, respectively. These results indicate that CSSP detrimentally impacts firms' operating cash flow, consistent with the t-test discussed earlier.

Table 5.13: The effect of CSSP on net operating cash flow

	(1) *Nocf*	(2) *Nocf*	(3) *Nocf*	(4) *Nocf*
Pld_dum	-0.007*** (-4.66)	-0.003** (-2.31)		
Pld_rate			-0.018*** (-8.02)	-0.007*** (-3.89)
Roa		0.345*** (29.89)		0.344*** (29.81)
Lev		-0.039*** (-9.34)		-0.038*** (-9.16)
Size		0.006*** (9.50)		0.006*** (9.24)
Growth		0.001 (0.53)		0.001 (0.62)
Mhold		0.002 (1.10)		0.002 (0.96)
Cso		-0.079*** (-6.17)		-0.077*** (-6.05)
_cons	0.080*** (3.39)	-0.184*** (-13.85)	0.081*** (3.40)	-0.181*** (-13.65)
Indu FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	29959	29943	29959	29943
Adj_R²	0.018	0.095	0.020	0.095

The dependent variable of columns (1) to (4) is *Nocf*. The explanatory variables of columns (1) and (2) are Pld_dum, (3) and (4) are *Pld_rate,* respectively. Each variable is clarified in Table 5.1. In the regression analysis, this study accounts for firm and year fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10% respectively.

This study compares the main operating cash flow items to further detect how CSSP impacts firms' operating cash flow. Table 5.14 presents the differences in the main items of operating cash flows and accounts receivable and payable between firms without and with CSSP.

Both the operating cash inflows and outflows are lower in the firms with CSSP than those without. In particular, the cash inflows by sales and cash outflows for purchasing decrease in the firms with CSSP. The results of comparisons indicate that CSSP reduces firms' operation size. Combined with the discussion in Section 3.4.1 that CSSP lessens firms' maintenance and R&D investments, this study conjectures that inadequate maintenance investments cannot keep firms' assets in place, thereby detrimental to firms' normal operations.

The value of accounts receivable is larger in firms with CSSP than without, while accounts payable are the opposite. Since receivables against payables or underpayments are common methods of embezzling of controlling shareholders (Lu & Tang, 2005), using accounts payable hedging advances

and transferring assets at low prices becoming new forms of embezzlement (Tan, 2022), the larger accounts receivable value may imply the severer embezzlement from controlling shareholders in the firms with CSSP. Besides, the smaller balance of accounts payable in the firms with CSSP is consistent with Jiang et al. (2021) that CSSP makes it harder for firms to obtain trade credit from suppliers.

Table 5.14: T-tests for specific operating cash flows, accounts receivable and payable between firms without and with CSSP

	Pld_dum = 0		*Pld_dum* = 1		T-test
	Mean	Med	Mean	Med	T-stat
Operating cash inflows	0.789	0.622	0.718	0.572	9.39***
Cash inflows by sales	0.744	0.583	0.664	0.527	10.99***
Ending period accounts receivable	0.104	0.077	0.123	0.101	-15.96***
Operating cash outflows	0.733	0.563	0.673	0.524	8.02***
Cash outflows for purchasing	0.543	0.376	0.475	0.331	10.12***
Ending period accounts payable	0.097	0.078	0.089	0.075	9.40***

This table presents the results of specific operating cash flows, accounts receivable and payable between firms without and with CSSP over *Pld_dum*. Each variable is clarified in Table 1.

As examined above, CSSP positively impacts firms' financial distress risk and negatively impacts firms' net operating cash flow. To confirm the mediating role of operating cash flow on the impacts of CSSP on firms' financial distress risk, this study employs Sobel tests of Eq. (5.1) and (5.2) as presented earlier and (5.3) as follows.

$$OScore_{i,t} = \beta_0' + \beta_1' Pledge_{i,t} + \beta_2' Nocf_{i,t} + \mu_1' Controls_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t}' \quad (5.3)$$

The Sobel approach is introduced by Sobel (1982). The Sobel approach tests the mediation mechanism of the channel variables by examining whether the product of the parameter estimates of the independent variable and mediating variable is statistically significant and equal to 0. The mediation effect of investor sentiment is significant if the product of the two terms is statistically significant. If it is significant, the mediation effect is valid; otherwise, it is not.

Table 5.15 presents the results of the Sobel tests of the mediating role of *Nocf* on the impact of CSSP on financial distress risk. According to Baron & Kenny (1986), Wen et al (2004), and Wen et al (2022), if $\beta_1 = \beta_1' + \alpha_1 * \beta_2'$, and $|\beta_1'| < \beta_1$, it indicates that there are mediating effects of the mediators on the impacts of the independent variable on the dependent variable. While *Pld_dum* is the explanatory variable, β_1 = 0.100 (t = 6.35), α_1= -0.003 (t = - 2.31), β_1' = 0.091 (t = 5.98), β_2' = -2.458 (t = -7.68), the interaction of $\alpha_1 * \beta_2'$ is significantly greater than 0. Similar results are obtained when *Pld_rate* is the explanatory variable. The Z-value of the Sobel tests is significant (5.64) at a 1% level. These results indicate that net operating cash flow has a mediating effect on the impacts of CSSP on financial distress risk, and the proportion of mediated effect to total effect is 26.8%.

Table 5.15: Sobel tests for mediating effects of net operating cash flow on the impacts of CSSP on financial distress risk

	(1) *Oscore*	(2) *Oscore*
Pld_dum	0.085*** (8.51)	
Pld_rate		0.096*** (6.79)
Nocf	-4.776*** (-76.21)	-4.772*** (-76.09)
Roa	-9.856*** (-134.12)	-9.847*** (-133.87)
Lev	7.787*** (266.11)	7.791*** (266.00)
Size	-0.363*** (-80.82)	-0.363*** (-80.54)
Growth	-0.042*** (-3.93)	-0.041*** (-3.83)
Mhold	-0.132*** (-10.77)	-0.121*** (-10.01)
Cso	0.724*** (8.62)	0.735*** (8.75)
_cons	-2.509*** (-3.08)	-2.473*** (-3.04)
Indu FE	Yes	Yes
Year FE	Yes	Yes
N	29940	29940
Sobel Test (Z-value)	5.64***	5.64***
Proportion of Mediated effect	0.268	0.268
Adj_R^2	0.876	0.876
F-value	5573.880	5568.306

This table presents the Sobel tests for mediating the effects of net operating cash flow on the impacts of CSSP on financial distress risk. The dependent variable of columns (1) and (2) is Oscore, and the explanatory variables are Pld_dum and Pld_rate, respectively. Each variable is clarified in Table 1. In the regression analysis, this study accounts for firm and year-fixed effects. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10% respectively.

Collectively, the negative impacts of CSSP on firms' operating cash flow is one channel through which CSSP exacerbates firms' financial distress risk. This

finding is consistent with the fact that operating cash flow is the internal financing source for firms (Mao, 2003). Related to the findings in Section 3.4.1 that CSSP negatively impacts firms' maintenance and R&D investments, it implies that inadequate maintenance investments cannot keep firms' assets in place, thereby damaging firms' normal operations and debt-servicing capacity.

5.4.2 Impacts of CSSP on Investing Cash Flows

As discussed earlier, the findings in Chapter 3 address that firms with CSSP invest more, enhancing the investment expenditure level. Also, the t-tests in Table 5.12 initially illustrate that firms with CSSP have lower investing cash flow levels. To examine the channel role of investing cash flow on the impacts of CSSP on firms' financial distress risk, this study sets the equation as follows:

$$Nicf_{i,t} = \alpha_0' + \alpha_1' Pledge_{i,t} + \gamma_1' Controls_{i,t} + \sum Industry + \sum Year + \pi_{i,t}' \quad (5.4)$$

Table 5.16 presents the results of the impacts of CSSP on firms' investing cash flow. The coefficients of *Pld_dum* are negative and significant (-0.017, *t* = -10.10; -0.015, *t* = -11.86) without and with controls, as displayed in columns (1) and (2), respectively. Similar results are obtained when *Pld_rate* as explanatory displayed in columns (3) and (4) without and with controls, respectively. These results indicate that CSSP has a negative impact on firms' operating cash flow, consistent with the findings in Chapter 3.

Table 5.16: The results of effect of CSSP on net investing cash flow

	(1) *Nicf*	(2) *Nicf*	(3) *Nicf*	(4) *Nicf*
Pld_dum	-0.011*** (-8.41)	-0.010*** (-7.86)		
Pld_rate			-0.006*** (-3.04)	-0.009*** (-4.99)
Roa		-0.059*** (-7.45)		-0.060*** (-7.51)
Lev		0.029*** (7.51)		0.028*** (7.25)
Size		-0.009*** (-15.28)		-0.009*** (-15.00)
Growth		-0.015*** (-12.24)		-0.015*** (-12.36)
Mhold		-0.028*** (-18.14)		-0.029*** (-19.19)
Cso		0.013 (1.18)		0.010 (0.96)
_cons	-0.056*** (-3.93)	0.099*** (8.52)	-0.057*** (-4.02)	0.092*** (7.94)
Indu FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	29959	29943	29959	29943
Adj_R²	0.034	0.093	0.030	0.091

The dependent variable of columns (1) to (4) is *Nicf*. The explanatory variables of columns (1) and (2) are Pld_dum, (3) and (4) are *Pld_rate,* respectively. Each variable is clarified in Table 1. In the regression analysis, this study accounts for firm and year-fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10% respectively.

As discussed (shown in Table 3.16) in Chapter 3, CSSP has a negative impact on firms' investing cash flow and is mainly attributed to the positive impact of CSSP on firms' additional investments, including subsidiary investment and new long-term asset investment. Hence, increasing cash outflows decreases the net investing cash flow level.

As the empirical results suggest that CSSP has a positive impact on firms' financial distress risk and a negative impact on firms' net investing cash flow, this study employs Sobel tests of Eq. (5.1), (5.4), and (5.5) to confirm the mediating role of net investing cash flow on the impacts of CSSP on firms' financial distress risk, as follows.

$$Oscore_{i,t} = \beta_0'' + \beta_1'' Pledge_{i,t} + \beta_2'' Nicf_{i,t} + \mu_1' Controls_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t}'' \quad (5.5)$$

Table 5.17 presents the results of the Sobel tests of the mediating role of *Nocf* on the impact of CSSP on financial distress risk. According to Baron & Kenny (1986), Wen et al (2004), and Wen et al (2022), if $\beta_1 = \beta_1'' + \beta_1' * \beta_2''$, and $|\beta_1''| < \beta_1$, it indicates that there are mediating effects of the mediators on the impacts of the independent variable on the dependent variable. While *Pld_dum* is the explanatory variable, β_1 = 0.100 (t = 6.35), β_1' = -0.003 (t = - 2.31), β_1'' = 0.091 (t = 5.98), β_2'' = -2.458 (t = -7.68), the interaction of $\beta_1' * \beta_2''$ is significantly greater than 0. Similar results are obtained when *Pld_rate* is the explanatory variable. The Z-value of the Sobel tests is significant (5.64) at a 1% level. These results indicate that net operating cash flow has a mediating effect on the impacts of CSSP on financial distress risk, and the proportion of mediated effect to total effect is 26.8%.

Table 5.17: The mediating effects of net investing cash flow and over-investment degree the relationship between CSSP and financial distress risk

	(1) *Oscore*	(2) *Oscore*	(3) *Oscore*	(4) *Oscore*
Pld_dum	0.103***		0.059***	
	(9.37)		(3.83)	
Pld_rate		0.134***		0.085***
		(8.65)		(3.90)
Nicf	0.293***	0.276***		
	(4.20)	(3.96)		
Doi			0.367***	0.366***
			(3.43)	(3.42)
Roa	-11.485***	-11.470***	-11.857***	-11.840***
	(-149.46)	(-149.09)	(-93.50)	(-93.34)
Lev	7.964***	7.965***	7.944***	7.944***
	(249.48)	(249.34)	(169.79)	(169.80)
Size	-0.390***	-0.390***	-0.396***	-0.395***
	(-79.23)	(-78.86)	(-56.59)	(-56.34)
Growth	-0.041***	-0.041***	-0.070***	-0.070***
	(-3.54)	(-3.52)	(-4.81)	(-4.85)
Mhold	-0.132***	-0.121***	-0.113***	-0.107***
	(-9.80)	(-9.01)	(-6.02)	(-5.73)
Cso	1.096***	1.101***	0.936***	0.936***
	(11.97)	(12.01)	(7.28)	(7.28)
_cons	-1.629*	-1.604*	-2.109***	-2.120***
	(-1.83)	(-1.80)	(-8.48)	(-8.52)
Indu FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	29940	29940	12268	12268
Sobel test	-3.91***	-3.41***	3.28***	11.24***
Proportion of total effect that is mediated:	-0.028	-0.018	0.083	0.081
Adj_R2	0.852	0.852	0.866	0.866
F	4542.530	4540.225	2141.065	2141.174

This table presents the results of the mediating effects of over-investment on the relationship between CSSP and financial distress risk. The dependent variables of columns columns (1) & (2) is *Ti*, the explanatory variable is *Pld_dum*; The dependent variables of columns (3) & (4) and (5) & (6) are *Doi* and *Ti*, the explanatory variable is *Pld_rate*. Each variable is clarified in Table 1. In the regression analysis, this study accounts for firm and year fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10% respectively.

5.4.3 Impacts of CSSP on Financing Cash Flow

As discussed earlier in this Section, firms with CSSP have higher financing cash flow level. As the financial distress risk is defined as the probability of that firms' cash flow cannot meet firms' debts due. On the one hand, more net financing cash flows can alleviate firms' liquidity constraints; on the other hand, more net financing cash flows imply more debts and equity, meanwhile increasing firms' financial risk.

Firstly, this study sets the Eq. (5.4) to examine the impacts of CSSP on firms' financing cash flow:

$$Nfcf_{i,t} = \alpha_0'' + \alpha_1'' Pledge_{i,t} + \gamma_1'' Controls_{i,t} + \sum Industry + \sum Year + \pi_{i,t}'' \quad (5.6)$$

Table 5.18 presents the results of the impacts of CSSP on firms' financing cash flow. The coefficients of *Pld_dum* are positive and significant (0.019, t = 13.55; 0.016, t = 11.67) as displayed in columns (1) and (2), respectively, without and with controls. Similar results come out while *Pld_rate* as explanatory displayed in columns (3) and (4) without and with controls (0.022, t = 10.10; 0.019, t = 9.45), respectively. These results indicate that CSSP positively impacts firms' operating cash flow, consistent with the t-test discussed earlier.

Referring to Fazzari et al. (1988), external funds serve as perfect substitutions for internal financing; this finding implies that firms with CSSP need more external financing to encounter the reduction of operating cash flow and finance more investment expenditures. According to static trade-off theory,

external financing brings higher financial risk than internal financing (Myers, 1977).

Table 5.18: The effect of CSSP on net financing cash flow

	(2) *Nfcf*	(1) *Nfcf*	(3) *Nfcf*	(4) *Nfcf*
Pld_dum	0.019*** (13.55)	0.016*** (11.67)		
Pld_rate			0.022*** (10.10)	0.019*** (9.45)
Roa		-0.075*** (-7.13)		-0.072*** (-6.92)
Lev		0.019*** (4.52)		0.019*** (4.61)
Size		0.007*** (10.92)		0.007*** (10.89)
Growth		0.033*** (20.05)		0.033*** (20.14)
Mhold		0.022*** (13.39)		0.024*** (14.63)
Cso		0.011 (0.91)		0.013 (1.03)
_cons	0.055*** (16.46)	-0.115*** (-9.14)	0.062*** (19.35)	-0.109*** (-8.66)
Indu Dummy	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes
N	29820	29836	29836	29820
Adj_R²	0.038	0.081	0.034	0.080

The dependent variable of columns (1) to (4) is *Nfcf*. The explanatory variable of columns (1) and (2) is *Pld_dum,* (3) and (4) is *Pld_rate,* respectively. Each variable is clarified in Table 1. In the regression analysis, this study accounts for firm and year-fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10% respectively.

To detect the changes in firms' financing amounts and structures following CSSP, this study compares the amounts and percentages of external financing channels, including loans, bonds, equity, and others.

Panel A of Table 5.19 presents the results of T-tests of the amount of each financing channel between firms with CSSP and without. Firms with CSSP finance more from loans. This result is opposite to Zhai et al. (2020), who empirically conclude that firms with CSSP get fewer bank loans proxied by nature logarithm of average adding loan of the given year, while this thesis uses the proxy of cash inflow from the loan scaled by year-end total assets. This study repeated the T-test of nature logarithm of average adding loan of the given year and got the same result as Zhai et al. (2020). Following Altman (1968) and Lau (1987), the percentage of loans to assets can better measure firms' financial distress risk than pure values of loans because loans rely on assets to pay. Though the pure amount of loans may decline following firms' CSSP, the loan burdened level by asset increases. In particular, there are more short-term loans in firms with CSSP than those without, indicating that firms with CSSP rely more on short-term loans, consistent with Zhai et al. (2020). These results indicate that firms with CSSP have higher financial distress risk due to loans.

Panel B of Table 5.19 presents the differences in the external financing structure between pledging and non-pledging firms. Financing from loans is obviously lower in the pledging group, suggesting CSSP reduces the lending will of banks for listed companies, indicating that firms with CSSP find it more difficult to get loans from banks, consistent with Zhai (2020). As shown in both Panel A and B of Figure 5.19, financing from bond issues and other channels is higher in pledging firms, indicating that firms with CSSP rely more on bond and other financing channels. The different financing channels mainly refer to

non-equity financing from controlling shareholders and other related parties, e.g., cash donations. Therefore, more financing from another channel may imply the pledged funds from controlling shareholders, especially for firms with high financial distress risk.

To confirm the impacts of CSSP on specific financing channels, including loans, short-term loans, bonds, equity, and another financing channel, this study establishes the equations as follows:

$$Loan_{i,t} = \beta_0 + \beta_1 Pledge_{i,t} + \mu_i Controls_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (5.7)$$

$$Shortloan_{i,t} = \beta_0 + \beta_1 Pledge_{i,t} + \mu_i Controls_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (5.8)$$

$$Bond_{i,t} = \beta_0 + \beta_1 Pledge_{i,t} + \mu_i Controls_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (5.9)$$

$$Equity_{i,t} = \beta_0 + \beta_1 Pledge_{i,t} + \mu_i Controls_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (5.10)$$

$$Other_{i,t} = \beta_0 + \beta_1 Pledge_{i,t} + \mu_i Controls_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (5.11)$$

Table 5.20 reports the results of the impact of CSSP on the amount from loans, bonds, and equity. The coefficients are all positive and significant on *Pld_dum* and *Pld_rate* when *Loan*, *Shortloan*, *Bond*, and Equity are dependent variables, indicating that CSSP has positive impacts on firms' loan, short-term loan dependence, bond, and equity financing burdening by the asset. More financing cash flows bring higher financial distress risk to firms; the results confirm that CSSP exacerbates firms' financial distress risk.

To detect the founding support effect from controlling shareholders among firms with CSSP, this study examines Eq. (5.9) with the subsample of firms

with low, middle, and high financial distress risk, respectively. Since firms' founding support from controlling shareholders is recorded in the other financing sources in accounting. Table 5.21 reports the results of the impact of CSSP on the other financing channels conditional on different financial distress risks. The increasing coefficients on *Pld_dum* and *Pld_rate* demonstrate that as firms' financial distress risk increases, more financing from other channels increases.

Table 5.19: T-tests for financing structure between firms without and with CSSP

	***Pld_dum* = 0**		***Pld_dum* = 1**		**T test**
	Mean	**Med**	**Mean**	**Med**	**T-stat**
Panel A The difference in cash inflow of each financing channel between firms with CSSP and without					
Loan	0.205	0.148	0.221	0.182	-7.40***
Shortloan	0.123	0.092	0.143	0.124	-14.51***
Bond	0.036	0.000	0.046	0.000	-5.98***
Equity	0.042	0.001	0.057	0.003	-12.06***
Other	0.028	0.000	0.044	0.005	-15.08***
Panel B The difference in the percentage of cash inflow of each financing channel to total between firms with CSSP and without in a given year					
Loanpercentage	0.762	0.944	0.742	0.886	3.56***
Bondpercentage	0.026	0.000	0.029	0.000	-2.59***
Equitypercentage	0.133	0.001	0.140	0.004	-1.48
Otherpercentage	0.079	0.000	0.089	0.003	-2.84***

This table compares amounts and percentages of external financing channels, including loans, bonds, equity and others. *** p≤0.01, **p≤ 0.05, * p≤0.1.

Table 5.20: Results of the impact of CSSP on the amount from loan, bond and equity

	(1) *Loan*	(2) *Shortloan*	(3) *Bond*	(4) *Equity*	(5) *Loan*	(6) *Shortloan*	(7) *Bond*	(8) *Equity*
Pld_dum	0.024***	0.018***	0.002***	0.012***				
	(6.59)	(8.20)	(3.16)	(11.45)				
Pld_rate					0.029***	0.022***	0.002***	0.015***
					(5.63)	(7.28)	(2.81)	(9.95)
Roa	-0.049**	-0.126***	0.005	-0.063***	-0.045**	-0.124***	0.005	-0.061***
	(-2.36)	(-9.78)	(1.35)	(-8.71)	(-2.20)	(-9.57)	(1.40)	(-8.46)
Lev	0.478***	0.383***	0.006***	-0.054***	0.478***	0.383***	0.006***	-0.053***
	(36.87)	(51.23)	(3.77)	(-16.36)	(36.95)	(51.17)	(3.79)	(-16.26)
Size	0.001	-0.012***	0.004***	0.008***	0.002	-0.012***	0.004***	0.008***
	(0.66)	(-9.92)	(11.70)	(16.57)	(0.70)	(-9.76)	(11.59)	(16.55)
Growth	-0.006**	-0.007***	-0.002***	0.017***	-0.005**	-0.007***	-0.002***	0.017***
	(-2.47)	(-5.20)	(-3.72)	(13.31)	(-2.38)	(-5.12)	(-3.69)	(13.39)
Mhold	0.006	0.002	0.003***	0.003***	0.008**	0.004	0.003***	0.005***
	(1.44)	(0.77)	(3.36)	(2.69)	(2.17)	(1.62)	(3.59)	(3.75)
Cso	0.653***	0.407***	0.017***	-0.015**	0.654***	0.407***	0.017***	-0.015**
	(18.95)	(18.92)	(4.27)	(-2.03)	(18.95)	(18.96)	(4.27)	(-2.00)
_cons	-0.106**	0.245***	-0.042***	-0.121***	-0.098**	0.243***	-0.042***	-0.119***
	(-2.56)	(5.18)	(-4.58)	(-6.22)	(-2.38)	(5.14)	(-4.56)	(-6.14)
Indu FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	27828	28010	15181	23379	27828	28010	15181	23379
Adj_R2	0.321	0.455	0.214	0.089	0.320	0.454	0.214	0.088

This table presents the results of the impact of CSSP on the amount from loans, bonds and equity. The explanatory variable of columns (1) to (4) is *Pld_dum,* (5) and (8) is *Pld_rate,* respectively. Each variable is clarified in Table 1. In the regression analysis, this study accounts for firm and year fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10% respectively.

Table 5.21: Results of the impact of CSSP on the other financing channels conditional on different financial distress risk

	(1) Low *Other*	(2) Mid *Other*	(3) High *Other*	(4) Full *Other*	(5) Low *Other*	(6) Mid *Other*	(7) High *Other*	(8) Full *Other*
Pld_dum	0.004***	0.009***	0.016***	0.009***				
	(3.41)	(6.51)	(5.11)	(6.85)				
Pld_rate					0.007***	0.014***	0.021***	0.014***
					(3.86)	(6.47)	(4.52)	(6.65)
Roa	-0.017	-0.007	-0.018	-0.038***	-0.015	-0.005	-0.017	-0.036***
	(-1.58)	(-0.31)	(-1.35)	(-4.31)	(-1.46)	(-0.19)	(-1.27)	(-4.13)
Lev	0.034***	0.049***	0.076***	0.066***	0.034***	0.048***	0.075***	0.066***
	(7.00)	(5.18)	(6.81)	(13.38)	(6.96)	(5.10)	(6.73)	(13.30)
Size	-0.002***	-0.005***	-0.006***	-0.005***	-0.002***	-0.005***	-0.006***	-0.005***
	(-3.16)	(-5.44)	(-4.33)	(-8.67)	(-3.06)	(-5.24)	(-4.08)	(-8.37)
Growth	0.001	0.001	0.003	0.001	0.001	0.001	0.004	0.001
	(0.66)	(0.47)	(1.39)	(0.78)	(0.59)	(0.43)	(1.40)	(0.76)
Mhold	-0.000	-0.004**	-0.010**	-0.003***	-0.000	-0.003	-0.008**	-0.002**
	(-0.44)	(-2.12)	(-2.32)	(-2.62)	(-0.03)	(-1.61)	(-1.97)	(-1.96)
Cso	-0.012	-0.063***	-0.074***	-0.072***	-0.014	-0.063***	-0.074***	-0.073***
	(-0.56)	(-3.15)	(-3.91)	(-5.41)	(-0.66)	(-3.15)	(-3.90)	(-5.47)
_cons	0.027**	0.059***	0.151***	0.056***	0.025**	0.056***	0.146***	0.053***
	(2.31)	(3.56)	(3.39)	(4.67)	(2.13)	(3.47)	(3.29)	(4.39)
Indu FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	7461.000	8806	6961	23228	7461	8806	6961	23228
Adj_R2	0.070	0.082	0.130	0.139	0.071	0.083	0.129	0.140

This table presents the results of the impact of CSSP on the other financing channels conditional on different financial distress risks. Firms are classified into low, middle, and high-risk sub-samples. Columns (1) & (5) report the regression results of low financial distress risk group, columns (2) & (6) report the regression results of middle financial distress risk group, columns (3) & (7)

report the regression results of high financial distress risk group, and (4) & (8) report the regression results of the entire sample. Each variable is clarified in Table 5.1. In the regression analysis, this study accounts for year and industry fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. *** p<0.01, ** p<0.05, and * p<0.1.

Overall, controlling shareholders divest superior assets from listed firms and lessen firms' maintenance R&D investments after share pledging, decreasing operating cash flows. Simultaneously, controlling shareholders massively increases firms' additional investment, decreasing firms' investing cash flows and forcing firms to finance more from external channels. In addition, decreasing the lending will of banks and creditors' offering of supplies further increases firms' financial distress risk. As controlling shareholders, meanwhile, are the main bearers of firms' financial distress or failure, they pop up firms more with their private sources (Friedman, Johnson, & Milton, 2003) as firms' financial distress risk increases. The results are consistent with Peng et al. (2011), who document that transactions with controlling shareholders can be used for tunneling or propping depending on the different financial situations of the firms.

5.5 Summary

Firstly, this chapter examines the general relationship between CSSP and corporate financial distress risk. The results indicate that CSSP exacerbates corporate financial distress risk. In addition, this chapter examines the effect

of CSSP on financial distress risk conditional on different distress risk magnitudes, and finds the exacerbating effect of CSSP on financial distress risk decreases as firms' financial distress risk increases. The findings hold up well after the alternative measure of the dependent variable for robustness and endogeneity disposal with a firm-fixed effect regression, Heckman two-stage regression with instrumental variables, and the PSM approach. To detect the channels how CSSP impacts financial distress risk, this chapter also examines the mediating effects of operating, financing, and investment cash flows on the impacts of CSSP on financial distress risk with Sobel tests. The competitive effects of CSSP on corporate financial distress risk reveal the double identities of controlling shareholders as "embezzlers" and "supporters" simultaneously. Controlling shareholders' embezzling behaviors originate in the control benefit (Opler et al., 1999; Porta et al., 1999; Shleifer & Vishy, 1986), aggravating the principal-principal conflicts between controlling and minority shareholders in agency theory. The supports from the controlling shareholders are generated in the long-term interests of the controlling shareholders because they are the main bearer of the firms' failure, e.g., bankruptcy, which the stakeholder theory can explain. Hence, the findings provide empirical evidence for the relationship between agency theory and stakeholder theory.

CHAPTER 6

CONCLUSIONS

6.1 Summary and Discussion of The Research Findings

Table 6.1 summarizes the results of this thesis's three objectives, including hypotheses, methods, and findings. Specifically, as follows.

6.1.1 Results Summary and Discussion of Research Objective I

Research question 1: How does CSSP impact firms' investment efficiency?

The first research objective is to explore the relationship between CSSP and firm-level investment efficiency, including over- and under-investment. Using the entire sample and binary logistic regression, the results indicate that firms with CSSP are more prone to over-investment rather than under-investment. Further results indicate that the degree of over-investment increases as the CSSP percentage increases, and firms with CSSP invest more in additional investment but less in maintenance investment for particular purposes. The impact of CSSP on under-investment is insignificant. This section uses Probit and GMM regressions to repeat the tests for robustness to confirm the findings. The findings standstill after the endogeneity disposal with a firm-fixed effect regression, Heckman two-stage regression with instrumental variables, PSM, and DID approaches. The selected investment projects dominated by

controlling shareholders through their voting rights are the signaling costs for conveying good information to the stock market after they pledged their shares. Hence, the findings provide new empirical evidence for the relationship between signaling theory and agency theory, that signaling costs in signaling theory could be explicit conflicts in the agency theory.

6.1.2 Results Summary and Discussion of Research Objective II

Research question 2: How does investment efficiency impact firms' financial distress risk?

The second research objective is to explore the relationship between investment efficiency and corporate financial distress risk, including over- and under- investment, respectively. Using *Poi*=1subsample, this study examines the linear relationship between over-investment and financial distress risk using OLS with time and industry fixed effect regression and repeats the tests with

Table 6.1: Summary of the Results

	Research Objectives	Dependent / Independent Variables	Samples	Hypotheses Tests			Robustness				Mechanism		
				Hypothesis	Predicted Sign	Methods	Baseline Regression	Alternative Measurements	Endogeneity Testing methods	Endogeneity Concerns	Channels	Methods	Theoretical interpretation
		Poi, Dii, Ti / Pld_dum, Pld_rate	Entire	H_1	+	Binary Logistic, OLS	Supported	Supported	Probit Regression	-	-	-	-
1	**To investigate the impact of CSSP on investment efficiency**	*Doi, Ti / Pld_dum, Pld_rate*	*Poi=1*	H_2	+	OLS	Supported	Supported	GMM, Fixed-effect regression, PSM, DID, Heckman Two-stage regression with Instrumental variables	Supported	Signaling Cost	OLS	Signaling
		Doi, Ti / Pld_dum, Pld_rate	*Poi=1*	H_3	+	OLS	Supported	Supported	-	-	Investment decision	OLS	Agency
		Dui, Ti / Pld_dum, Pld_rate	*Poi=0*	H_4	-	OLS	Not supported	-	-	-	-	-	-
2	**To examine the impact of investment efficiency on financial distress risk**	*Oscore / Doi*	*Poi=1*	H_5	+	OLS	Supported	Supported	GMM, Fixed-effect regression, PSM, 2SLS Regression	Supported	Cash Flow Channels	OLS	Firm life circle/Trade-off
		Oscore / Dui	*Poi=0*	H_6	U-shaped	OLS	Supported	Supported	Poisson Regression, RDD, Cubic Regression	Supported	Cash Flow Channels	OLS	Firm life circle/Trade-off
3	**To examine the impact of CSSP on financial distress risk**	*Oscore / Pld_dum, Pld_rate*	Entire	H_7	+	OLS	Supported	Supported	GMM, Fixed-effect regression, PSM, Heckman Two-stage regression with Instrumental variables	Supported	Decision Making / Cash Flow Channels	OLS	Agency/Trade-off
			Low, Mid, High Financial Distress Risk Group	H_8	Declining+	OLS	Supported	Supported	-	-	Decision Making / Cash Flow Channels	OLS	Stakeholder

This table presents the summary of the results for the three objectives of this thesis, including hypotheses, methods, and findings. Ha = Alternative Hypothesis, Sig = Significant

GMM, firm-fixed effect, 2SLS regressions, and PSM approach for robustness. Using *Poi*=0 subsample, this study primarily pilots the relationship between under-investment and financial distress risk with a U-shaped curve, and examines the U-shaped relationship between under-investment and financial distress risk with OLS and Poisson regressions with acceptable outcomes, indicating that there is a threshold in under-investment degree. Subsequently, this study employs the RDD to examine the relationship between under-investment and financial distress risk above and below the threshold to confirm the U-shaped relationship between under-investment and corporate financial distress risk. This study also employs the U-test and cubic regression for robustness. Taking together, over-investment exacerbates firms' financial distress risk while under-investment has a U-shaped relationship with financial distress risk. Firm life cycle theory can explain the mechanisms of how over- and under-investments impact financial distress risk, respectively. Specifically, the investment project yields no cash return until it is completed (Majd, 1985), and the subsequent cash flow gradually increases in the consecutive years after it is completed. Thus, for the over-investing firms, the subsequent reduction in cash flow will further reduce the solvency of the business and increase the likelihood of the business falling into financial distress due to the NPV < 0 projects; for the under-investing firms, corporate financial distress risk is alleviated due to less investment expenditure under some extent, but the effect will be opposite if the under-investment severity damages firms' normal operations.

6.1.3 Results Summary and Discussion of Research Objective III

Research question 3: How does CSSP impact firms' financial distress risk?

The third research objective is to investigate the impacts of CSSP on corporate financial distress risk, including both explicit and implicit effects. Firstly, this study examines the general relationship between CSSP and corporate financial distress risk with time and industry fixed effect OLS regression, and the results indicate that CSSP positively impacts corporate financial distress risk. In addition, this study examines the effect of CSSP on corporate financial distress risk conditional on different financial distress magnitudes; the results suggest that the exacerbating effect of CSSP on financial distress risk decreases as corporate financial distress risk increases. The findings standstill after the GMM regressions and endogeneity disposal with a firm-fixed effect regression, Heckman two-stage regression with instrumental variables, and the PSM approach. As well as, this study examines the mediating effects of operating, financing and investment cash flows on the impacts of CSSP on financial distress risk with Sobel tests. The competitive effects of CSSP on corporate financial distress risk reveal the double identities of controlling shareholders as "embezzlers" and "supporters" at the same time. Controlling shareholders' embezzling behaviors originate in the control benefit (Opler et al., 1999; Porta et al., 1999; Shleifer & Vishy, 1986), aggravating the principal-principal conflicts between controlling and minority shareholders in agency theory. While the supports from the controlling shareholders are generated in the long-term interests of the controlling shareholders because they are the

main bearer of the firms' failure, e.g., bankruptcy, which can be explained by the stakeholder theory. Hence, the findings provide empirical evidence for the relationship between agency theory and stakeholder theory.

6.2 Theoretical Implications

6.2.1 Theoretical Implications of the Impact of CSSP on Investment Efficiency

This study deepens the theoretical revelations about the consequences of controlling shareholders' share pledges and provides empirical evidence for the relationship between agency theory and signaling theory. The selected investment projects dominated by controlling shareholders through their voting rights are the signaling costs for conveying good information to the stock market after they pledged their shares. Firms' over-investments damage the minority shareholders' interests, aggravating the PP conflicts. Hence, the findings take a further step in the relationship between agency theory and signaling theory from the point that Information asymmetry is the overlap between agency theory and signaling theory (Morris, 1987) and empirically demonstrate that signaling costs could be explicit conflicts in the agency theory.

Investment in listed companies' names can send favorable messages to the market, leading to the investors' perception. After share pledging, controlling shareholders prefer the decision that can help maintain listed companies' share price to avoid the market downturn (Xie et al., 2016) and more collateral

or paying back the principal (Chang et al., 2022). Investment pronounces can influence listed companies' stock prices. Hence, the investment projects determined by controlling shareholders would be in high-growth industries and industries with emerging technologies (Kumar et al., 2012), driven by the margin call pressure after they pledged their shares.

From the signaling point of view, the information disclosures about the selected investment projects are the signals used by controlling shareholders to convince potential investors of their stocks' values. To avoid the bad influence on the stock price, sometimes firms have to continuously invest in the projects even when they appear to return less. Gaining these distinguished signals is the signaling cost (Spence, 1973). People would choose to signal when the signaling cost is less than the loss if they do not do it. In this situation, the returns of the investment projects are co-borne by all the shareholders, while the margin call result is only borne by the controlling shareholders. Controlling shareholders would vote for the investment projects for their own benefit (Porta et al., 1999; Shleifer & Vishy, 1997).

6.2.2 Theoretical Implications of the Impact of Investment Efficiency on Financial Distress Risk

This study provides new implications of firm life circle theory and static trade-off theory in the process of investment efficiency influencing FDR.

As Keynes (1936) notes, one of the motivations for companies to hold cash is precautionary. Over-investment leads to excessive investment spending,

thereby depleting a firm's cash reserves and weakening its solvency. Secondly, lower investment returns further diminish subsequent cash flow. According to the life cycle theory, projects yield no cash return until they are completed (Majd, 1985) because it takes time to build. This delay in cash returns further reduces firms' solvency and increases the likelihood of financial distress. If a firm invests in negative-NPV projects, the adverse effect of over-investment on the firm's FDR becomes even more severe. Lastly, increased investment expenditures result in greater external financing demands. As discussed above, over-investment reduces a firm's cash flows. Cash flows are the internal financing for a firm, when a firm's internal financing cannot meet the financing demand, it turns to external financing.

The pecking order theory creates a hierarchy of costs in the use of external financing based on the argument of asymmetric information. New investments are financed first by retentions, then by low-risk debt, followed by hybrids like convertibles and equities only as a last resort (Myers, 1984; Myers & Majluf, 1984). Consequently, firms would first choose debt financing when internal financing is in short supply. Trade-off theory states that a value-maximizing firm chooses external financing by considering the marginal costs and benefits of each additional unit of financing and then choosing the form of financing that equates these marginal costs and benefits. Benefits of debt include its tax advantage and the reduced agency costs of free cash flow; costs include the increased risk of financial distress and increased monitoring and contracting costs associated with higher debt levels (Harris & Raviv, 1991). In sum, debt financing incurs higher costs and payment pressures, thereby elevating the firms' FDR, compared to internal financing.

According to firm life circle theory, the investment expenditure can cause the subsequent reduction in cash flow in the subsequent year, reducing firms' solvency and increasing the likelihood of financial distress. Hence, less investment expenditure may alleviate the shortfall of cash flows in the investing year and the following years. In addition, under-investment may result in firms shunning projects with negative NPV, which positively influences their FDR. Conversely, by forgoing projects with positive NPV, firms may experience a detrimental effect on their long-term investing cash flows. Furthermore, under-investment may damage firms' normal operations if it is too severe to involve maintenance investment. Maintenance investment is to keep firms' assets in place, including service of the debt due (Richardson, 2006), which causes firms to fail to meet their maturities, increasing FDR. Moreover, declining operating cash flow caused by insufficient maintenance investment also raises firms' FDR since operating cash flow is the endogenous financing s for firms with both the lowest cost and risk. As discussed earlier, debt financing incurs higher costs and payment pressures, thereby elevating the firms' FDR according to the pecking order theory and static trade-off theory.

6.2.3 Theoretical Implications of the Impact of CSSP on Financial Distress Risk

The findings provide evidence for the double identities of controlling shareholders as "principals" in agency theory and "stakeholders" in stakeholder theory.

In agency theory, controlling shareholders make decisions based more on self-benefits, which is detrimental to firms' operation, investment, and financing, resulting in detrimental impacts on operating and investing cash flows, making it more difficult to attach loans. In stakeholder theory, controlling shareholders have not lost control of the listed company while their shares are being pledged. Long-term future dividend rights and the shell values of listed companies would limit the controlling shareholders' tunneling (Li et al., 2021). Besides, controlling shareholders are the main bearers of the loss of the delisting or bankruptcy of a listed company, which will cut off the sustainability of their control gains. As a result, controlling shareholders will provide funds to the companies close to or already in financial distress to help them survive or recover for their own long-term interests. Share pledged funds make it easier for controlling shareholders to prop up the companies. The pledged funds have also been observed by scholars funneled back to firms in some case studies, e.g., Great Town (600094. SH) (Wang, 2020).

The key point is controlling shareholders' intention whether or when to prop up the firms. When firms appear in healthy financial situation, controlling shareholders have the propensity to make decisions satisfying their own benefits while damaging firms' benefits (Gong et al., 2021; Peng et al., 201), generating principal-principal conflicts in agency theory. But when firms are close to or already in financial distress, controlling shareholders may prop up the companies with their private s (Friedman et al., 2003; Peng et al., 2011) according to stakeholder theory (Friedman & Miles, 2002). Nonetheless, it can provide pledged funds when controlling shareholders intend to prop up the listed firms.

6.2.4 Contributions to the Literature

Firstly, the two-step methodology enhances prior investigatory techniques concerning the factors influencing over-investment. Unlike previous approaches that solely regressed overinvestment expenditures on these factors (Chen et al., 2016; Dou et al., 2016; Li, 2020a), the approach takes into account their impact on the likelihood of over-investment.

Secondly, the research provides another perspective to analyse the causes of over-investment. Scholars used to attribute the over-investment to principle-agency (PA) conflicts (DeMarzo, 2002; Jensen, 1986; Kim, 2020; Xu et al., 2009) and free cash flow (Vogt, 1994; Klock & Thies, 1995; Alti, 2003; Richardson, 2006; Chen et al., 2016; Kwon et al., 2021). There is rare concern about the impacts of controlling shareholders' behaviors on over-investment. We reveal the changes in controlling shareholders' investing decisions after they pledge their shares, which directly facilitates over-investment.

Thirdly, this study is first to assess the U-shaped relationship between the extent of under-investment and FDR. While the consequences of over-investment have been widely discussed (Dogru, 2017; Li, 2020b), under-investment has been largely overlooked. This study addresses this gap by enriching the literature on the relationship between under-investment and FDR.

Fourthly, previous research attributes over-investment to excess free cash flow (Alti, 2003; Chen et al., 2016; Klock & Thies, 1995; Kwon et al., 2021; Richardson, 2006; Vogt, 1994) and adverse selection by managers (Myers & Majluf, 1984; Li, 2021; Wang, 2020). The existing research related to under-investment is mainly about invest-cash-flow sensitivity (Fazzari et al., 1988; Hoshi et al., 1991; Schaller, 1993; Lu & Tang, 2005) and adverse selection by managers (Zhu & Xiong, 2020).

Fifthly, previous research regarding governance and financial distress risk has been concerned more with managerial characteristics and behaviors (Lee & Yeh, 2004; Shahwan, 2015; Wang & Cao, 2021). In sum, this literature regarding investment efficiency and financial distress emphasizes firms' managerial characteristics and behaviors while neglecting controlling shareholders' roles.

Lastly, the findings of this study provide a comprehensive analysis of the impact of controlling shareholder's equity pledges on listed companies. While existing research findings are almost "lopsided" in exposing the negative impact of controlling shareholder's pledges on listed companies, this study explores the positive effects of controlling shareholder's equity pledges on listed companies and provides literature for subsequent studies on controlling shareholder's equity pledges.

6.3 Practical Implications of the Study

Controlling shareholders own most of the firms' shares, they have dominant decision-making rights for firms' operating, investing, and financing strategies. Therefore, their behaviors and decisions impact firms' investment efficiency and ultimately impact firms' financial situation. Especially in concentrated ownership firms gifting controlling shareholders stronger control, controlling shareholders' role in financial distress risk is more nonnegligible. However, rarely have scholars studied the role of controlling shareholders on investment efficiency and financial distress or the effects of investment efficiency on financial distress. This study tries to fill these gaps to investigate the relationships between CSSP and investment efficiency, investment efficiency, and financial distress risk, and CSSP and financial distress.

6.3.1 For Regulators and Policymakers

Firstly, regulators should be concerned about whether further restrictions on the CSSP are necessary. Secondly, The findings flesh out the significance of principal-principal (PP) conflicts between dominant shareholders and minority shareholders, a crucial yet often neglected problem in corporate governance (Young et al., 2008). The impacting mechanism of controlling shareholders' share pledging on firms' investment is a new reflection of PP conflicts. As recognized, addressing PP conflicts in emerging economies could potentially enhance the quality of life for millions of investors (Morck et al., 2005). Therefore, the results highlight the importance of regulating the controlling

shareholders' behaviors, including their decision-making in firms' investments, operations, and financing. Lastly, the results highlight the importance of regulating investment expenditures in negative-NPV projects to limit over-investment, as over-investment is shown to exacerbate FDR linearly. Similarly, policymakers should establish minimum criteria for investment expenditures in positive-NPV projects, as under-investment beyond a certain threshold worsens FDR.

6.3.2 For Practitioners

Firstly, creditors and investors should be more concerned about firms' cash flows with CSSP while making lending and investing decisions, respectively. Lastly, minority shareholders should pay attention to the rationality of firms' operation, investment, and financing decisions made by controlling shareholders after they pledged their shares. Secondly, the findings offer valuable insights for firms aiming to better manage their FDR by improving investment efficiency. Specifically, the findings suggest that practitioners could consider reducing investment expenditure within the allowable limit, when necessary, as under-investment below this level alleviates FDR. Lastly, minority shareholders and creditors should actively seek measures to protect their interests.

6.4 Limitations and Recommendations

6.4.1 Limitations of This Study

This study is subject to several limitations that warrant acknowledgment. First, the data on the use of the pledged funds is unavailable since the controlling shareholders are not required to disclose their financial information if they are not listed companies. Therefore, the intention of the controlling shareholders to pledge their shares cannot be deducted directly.

In addition, the research primarily focuses on the economic consequences of CSSP, thereby excluding other potential dimensions such as social, environmental, or governance-related impacts. Furthermore, the examination of the relationship between investment efficiency and financial distress risk is limited to data from emerging markets. This geographic focus may restrict the generalizability of the findings to developed or other types of markets. Moreover, the analysis is confined to the immediate impact of investment expenditure on financial distress risk, specifically within the investing year. This temporal constraint may overlook the long-term implications of investment activities on financial stability. Last, the study employs comprehensive indicators to measure financial distress risk. While these indicators provide valuable insights, they may not capture all nuances or context-specific factors influencing financial distress.

6.4.2 Recommendation for Future Research

This study offers several recommendations for future research to address its limitations and expand upon its findings. First, while this research primarily focused on the economic consequences of CSSP, future studies should explore the social consequences of CSSP, including social, environmental, or governance-related impacts. This additional focus would provide a more holistic understanding of the multifaceted impacts of CSSP on organizational and societal outcomes.

Second, the current findings are derived from emerging market data, suggesting the need for further validation in the context of developed markets. Incorporating data from developed economies would enhance the robustness and generalizability of the conclusions, allowing for broader applicability across diverse economic contexts. Third, the analysis of investment expenditure on financial distress risk is limited to the investing year. Future research should investigate the long-term effects of investment expenditure on financial distress risk. Such an extension would provide a more comprehensive perspective on the enduring financial implications of investment decisions.

Last, while this study utilized comprehensive indicators to measure financial distress risk, future efforts should focus on constructing improved indicators. Specifically, developing a measure that attaches greater weight to cash flows would better capture the liquidity and operational aspects of financial distress. Finally, there is a pressing need to construct and integrate data on the uses of

pledged funds. Detailed insights into how pledged funds are utilized would significantly enhance the understanding of their impact on financial outcomes.

6.5 Conclusions

Utilizing Chinese A-share market data spanning 2007-2020, the results suggest that CSSP exacerbates firms' over-investment, while insignificant with under-investment. CSSP has a positive effect on financial distress risk, while investment efficiency has diverse effects on corporate financial distress risk. CSSP impacts firm level investment efficiency through controlling shareholders' control rights, in particular decision-making rights. CSSP impacts corporate financial distress risk through both decision-making and cash flow channels. Moreover, investment efficiency impacts financial distress through investment cash flows. These three objectives are achieved separately with different methods, while their overlaps make them intertwined as a whole. Not only does this thesis reveal how CSSP, investment efficiency, and financial distress risk are intertwined to impact firms' development, but it also investigates the theoretical insights into the processes.

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APPENDIX

Table A: Industry Classification Structure and Codes

Code	Industry
A	Agriculture, Forestry, Animal Husbandry and Fisheries
B	Mining
C	Manufacturing
D	Electricity, Heat, Gas and Water Production and Supply
E	Construction
F	Wholesale & Retail Trade
G	Transportation, Storage and Postal Services
H	Accommodation and Catering
I	Technology Information Transmission and Related Services, Software
K	Real Estate
L	Leasing and Business Services
M	Scientific Research and Technical Services
N	Water Resources, Environment and Public Facilities Management
O	Residential Services, Repairs and Other Services
P	Education
Q	Health and Social Work
R	Culture, Sports and Recreation
S	Comprehensive Industry

(Data sources: Guidelines on Industry Classification of Listed Companies (Revised 2012) by CSRC)

Table B: Regression results of expected investment model using Chinese A-share data

	(1) *Invt* $_t$	(2) *Invt* $_t$
TobinQ $_{t-1}$	0.003***	0.003***
	(7.96)	(5.59)
Size $_{t-1}$	0.003***	0.003***
	(9.34)	(7.36)
Lev $_{t-1}$	-0.027***	-0.026***
	(-15.44)	(-9.46)
Age $_{t-1}$	-0.001***	-0.001***
	(-16.27)	(-9.86)
Cash $_{t-1}$	0.055***	0.024***
	(12.74)	(4.21)
Ret $_{t-1}$	0.011***	0.012***
	(12.58)	(8.18)
Inv$_{t-1}$	0.392***	0.376***
	(58.17)	(40.05)
_cons	-0.038***	-0.051**
	(-2.62)	(-2.33)
Year FE	Yes	Yes
Industry FE	Yes	Yes
N	40875	21679
Adj_R^2	0.244	0.212

$Invt$: actual new investment expenditure of the company in the specific year / Year beginning total assets; *TobinQ* denotes the growth opportunity of the firm; Age denotes the listing age of the firm; Lev denotes the financial leverage of the firm; $Cash$ denotes the cash flow position of the firm, expressed as net cash flow from operations / Year beginning total assets; $Size$ denotes the firm's asset size, expressed as the natural logarithm of total assets; Ret denotes the firm's stock yield. I account for year and industry fixed effects, and the corresponding t-statistics are computed with robust standard errors clustered by firm. The notation ***, **, and * signify two-tailed significance levels of 1%, 5%, and 10%, respectively.

Table C: Calculation of *Oscore*

$$OScore = -1.32 - 0.407\ SIZE + 6.03TLTA - 1.43WCTA + 0.0757CLCA - 2.37NITA - 1.83FUTL + 0.285INTWO - 1.72OENEG - 0.521CHIN$$

Whereas：*SIZE* indicts Ln (Total assets)； *TLTA* indicts total debts scaled by total assets; WCTA indicts working capital scaled by total assets; *CLCA* indicts current debt scaled by current assets; NITA indicts net profit scaled by total assets; *FUTL* indicts net operating cash flow scaled by total debts; *INTWO* indicts negative net profit for past two years as 1; otherwise, 0. *OENEG* indicts total debt greater than total assets as 1; otherwise; 0. CHIN indicts (NI_t − NI_t−1)/(|NI_t | + |NI_{t-1}|);*NI* indicts net profit.

Table D: Calculation of *Zscore*

$$ZScore = 1.2X1 + 1.4X2 + 3.3X3 + 0.6X4 + 0.999X5$$

Whereas：X_1 = working capital/total assets, reflecting the liquidity and size characteristics of assets. X_2 = Retained Earnings/Total Assets, reflecting the firm's cumulative profitability. X_3 = EBIT/Total Assets, reflecting the profitability of assets. X_4 = Market value of equity/book value of total liabilities, measuring a company's financial structure and shows the relative relationship between owner's equity and creditor's equity, and reflects a company's solvency. X_5 = Operating Income/Total Assets, reflecting the turnover of a company's assets and is used to measure the efficiency with which a company utilizes its assets.

BIODATA OF STUDENT

Student Geng Huixia completed a Master of Accounting at the School of Economics and Management of Southwest University of China in 2012. Her Bachelor of Accounting was obtained from Southwest University of China in 2009. Her research interest is centered on firms' finance. Before pursuing this PhD program, she worked as a lecturer at Chongqing University of Sciences and Arts. She is both a CPA (Certified Public Accountant) and a CTA (Certified Tax Advisor).

LIST OF PUBLICATIONS

Huixia Geng (2024). Exacerbate or alleviate? The Impact of Controlling Shareholders' Share Pledging on Over-investment. Pacific-basin Finance Journal, volume 85. 102341, Elsevier Publishers

Huixia Geng (2025). How Does Investment Efficiency Affect Financial Distress Risk? Evidence from China. Accepted by the Journal of Behavioral and Experimental Finance

Huixia Geng. How Does CSSP Relate to Financial Distress Risk? Evidence from China. Submitted to Research in International Business and Finance