Share Pledging and Corporate Risk-Taking: Insights from the Chinese Stock Market

Qingbin Meng, Xiaoran Ni, and Jinfan Zhang

Abstract

This paper documents that share pledging can discourage corporate risk-taking. We find that during the years 2005 through 2015, the level of share pledging is associated with less volatile earnings and tightened R&D expenditures. The effect is more pronounced for firms with more severe ex-ante risk-shifting problems (i.e. higher financial distress risk and longer debt maturity). In addition, we find that share pledging is associated with enhanced innovation efficiency. Overall, our results highlight that share pledging constrains excessive risk-taking and improves the investment efficiency of risky projects through facilitating creditor monitoring.

Keywords: Share pledging; Risk-Taking; Monitor; Creditor; Emerging Market

Meng, Business School, Renmin University, Beijing 100872, China; Ni, Department of Finance, School of Economics and Wang Yanan Institute for Studies in Economics (WISE), Xiamen University, Fujian 361005, China; and Zhang, Chinese University of Hong Kong, Shenzhen 518172, China, Shenzhen Advanced Institute of Finance, International Monetary Institute, Renmin University.

I. Introduction

The issue of share pledging (i.e., the practice whereby corporate insiders use their shares as collateral to secure loans from banks, trust firms, or security companies) is pervasive around the world.[1] In this paper, we ask the fundamental question of whether, and if so how, share pledging affects corporate risk-taking. This question is important because risk shifting sits at the heart of shareholder-creditor conflicts (Galai and Masulis (1976), Jensen and Meckling (1976), Myers (1977), Parrino et al. (2005), Chava et al. (2008), Eisdorfer (2008), Acharya et al. (2011)) and corporate risk-taking directly affects economic growth (Acemoglu and Zilibotti (1997)).

We conjecture that share pledging may impede corporate risk-taking. Due to asymmetric payoffs, creditors are more concerned about downside risk whereas shareholders are more concerned about upside potential. This risk-shifting (i.e., asset substitution) problem is especially noteworthy in emerging markets where controlling shareholders possess exclusive control rights and tend to undertake excessive risk, diverting the upside gains for private benefits while leaving the costs of failure to creditors (Shleifer and Vishny (1997), Lin et al. (2011)). Collaterals with high-liquidation value release additional information about borrowers, enabling creditors to discipline borrowers and protect themselves in the case of default (Picker (1992), Shleifer and Vishny (1992), Rajan and Winton (1995), Campello and

[1] In the United States, U.S. corporate executives and directors had, by the end of 2015, pledged at least US$15 billion of their own company stock holdings to secure personal loans.
(https://www.reuters.com/article/us-usa-executives-loans-idUSKCN0T61Y620151117).
In India, on April 30, 2016, the Minister of State for Finance Jayant Sinha informed the Lok Sabha that on the country's top two stock exchanges (i.e., the Bombay Stock Exchange (BSE) and the National Stock Exchange (NSE)) promoters of 798 of the total 4,268 firms listed on the BSE, and 570 of the 1,633 NSE-listed companies had pledged their shares
(https://economictimes.indiatimes.com/over-1368-promoters-of-listed-companies-pledge-shares/articleshow/52159656.cms).

Giambona (2013), Cerqueiro et al. (2016), Keil and Müller (2016)).[2] Serving as additional collaterals, pledged shares may help creditors learn about firms' performance and constrain corporate insiders' risk-shifting incentives. Also, as large price declines in a stock will trigger margin calls, forcing borrowers to sell other shares to raise funds and lose control of the company, or pledge additional shares as surety, risk-averse corporate insiders who value the control rights may forgo risky projects to prevent potential margin calls (Dou et al. (2017), Chan et al. (2018)).[3]

Alternatively, share pledging can also encourage risk-taking. As the practice of using stocks as collateral can limit insiders' liability to the shares pledged while retaining the upside potential of the cash flow rights, share pledging can create an option-like incentive for corporate insiders (Margrabe (1978), Ekström and Wanntorp (2008), Chen and Hu (2017)). Therefore, the option-like feature encourages shareholders to engage in more risk-taking activities.

Based on our above analysis, whether share pledging encourages or impedes corporate risk-taking is an empirical question. The Chinese stock market facilitates the ability to tackle this question for at least two reasons. First, China is the second largest economy in the world and the practice of share pledging is pervasive. In the data sample that we use for our

[2] Rajan and Winton (1995) theoretically analyze how collateral can improve lenders' incentives to monitor. In particular, they argue that in the presence of other claimants, monitoring is valuable because it allows a lender to demand additional collateral if the borrower is at an increased risk of distress. Consequently, other public investors and creditors can take increased collateralization as a sign that the borrower is in difficulty, the signal of which is stronger when the collateral either depreciates quickly or is quite risky in the short-run. Cerqueiro et al. (2016) provide empirical evidence on how collateral may complement monitoring.

[3] For example, Jerry Moyes, the chief executive of Swift Transportation Co., which is one of the largest trucking firms in the United States, has pledged more than US$600 million of his holdings in Swift as collateral for loans. The tremendous decline (i.e., 52%) of stock prices in 2015 triggered margin calls that Moyes dealt with by pledging more Swift shares. In addition, Michael Pearson, the CEO of Valeant Pharmaceuticals International VRX.TO, has pledged the stock as collateral to secure loans about US$100 million. Shares of this company fell 14% during a single trading session after 1.3 million shares of the company's stock was dumped on the market in a margin call.
(https://www.wsj.com/articles/a-board-struggles-with-its-ceos-borrowing-1454031068, https://www.reuters.com/article/us-usa-executives-loans-idUSKCN0T61Y620151117).

research, there are 1,581 companies involved in share pledging at the end of 2015, which accounts for 61.1% of the total number of firms listed on China's A-share stock market.[4] Second, the disclosure is compulsive under the supervision of the China Securities Regulatory Commission (henceforth CSRC), which is the counterpart of the Securities and Exchange Commission in the US, making shareholder-level and firm-level statistics available for researchers. In comparison, the reporting issues on pledged shares are still under heated debate in other large economies like the United States (Hwang et al. (2016), Chen and Hu (2017)). In Section II, we will discuss institutional details on share pledging in China.

We begin our research by conducting a regression analysis to examine the association between share pledging and corporate risk-taking. We find that a higher level of share pledging is associated with a lower tendency of risk-taking: on average, one standard deviation increase in share pledging lowers earnings volatility by 5.1% of the sample mean, and reduces research and development (R&D) expenditures by 35.8%, respectively.[5]

Although our primary findings imply that the amount of share pledging probably determines corporate risk-taking behavior, we take steps to validate this assumption. It is noteworthy that causality can run from corporate risk-taking to the decision of pledging shares, and omitted factors can determine both the level of share pledging and the degree of risk-taking. As such, we find that the negative relationship can be endogenous. To mitigate this concern, we resort to four identification strategies: the propensity-score matching method,

[4] According to the report of Sinolink (https://www.scmp.com/business/markets/article/2095530/sell-chinas-pledged-stocks-may-be-double-hong-kongs-gdp), in mid-2017 Chinese listed firms have had 14% of their shares pledged as collateral, accounting for about 11% of the total market capitalization of yuan-traded equities in Shanghai and Shenzhen, which outweighed Hong Kong's gross economic output of HK$2.5 trillion (US$320 billion) in 2016.

[5] The dependent variable is in logarithmic form when estimating the relation between share pledging and R&D expenditures, which enables us to use the current level of R&D expenditures as the benchmark when interpreting the economic significance.

the Heckman two-stage approach, differences-in-differences (DiD) analysis, and instrumental variable (IV) analysis.

We first use the propensity-score matching method to address the concern that as firms' decisions are not random, firms with and without pledged shares can be fundamentally different across several cross-sectional and time-series factors.[6] We select comparable counterparties (i.e., control firms) from firms with a zero amount of share pledging within the same year and the same industry for firms that engage in share pledging (i.e., treated firms). After successfully constructing the control group, our estimation results are quantitatively similar to the OLS results, providing further support for our premise that an increase in share pledging dampens corporate risk-taking incentives.

We also employ Heckman's (1979) two stage model to address the self-selection issue of pledging shares. The estimation results provide little support for the notion that the observed negative relationship is due to a self-selection problem, which provides additional support that share pledging discourages corporate risk-taking.

To further deal with potential endogeneity concerns, we employ two alternative identification strategies. First, we explore a regulatory change in 2013 that permits security companies to provide finance based on pledged shares from borrowers as a quasi-exogenous shock to share pledging.[7] As security companies require lower interest rates, have fewer restrictions on the usage of the loans, and approve transactions in a quicker manner, this regulatory change serves as a quasi-exogenous positive shock to share pledging. Our

[6] As indicated by Shipman et al. (2017), the propensity-score matching method can alleviate one sort of special endogeneity problem called "functional form misspecification", which is typically associated with the traditional solution to endogeneity problems using multiple-regression based methods.

[7] We discuss this regulatory change in detail in Section II.

empirical setting resembles that of Fang et al. (2014) and Brogaard et al. (2017) who use decimalization as an exogenous positive shock to stock market liquidity, i.e. the treatment group consists of firms whose amount of pledged shares increases the most (in the top three deciles of the sample) due to the regulatory change, and the control group consists of propensity-score matched firms whose amount of pledge shares increases less but with comparable firm characteristics. Using a differences-in-differences approach, we show that following the regulatory change, treatment firms, relative to control firms, experience a decrease in earnings volatilities corresponding to approximately 15.4% of the sample mean, and a 52.0% decrease in R&D expenditures, which further suggest a negative causal effect of share pledging on corporate risk-taking.

Second, we conduct IV analysis by using a two-stage least squares (2SLS) method. We identify two instrumental variables by using the average amount of pledged shares of other firms in the same industry (province) to capture the industry-level (province-level) factors to instrument for share pledging. Our results indicate that the 2SLS estimations still yield a negative and significant effect on share pledging, suggesting that share pledging deters corporate risk-taking.

In the following section, we seek to distinguish between two possible welfare implications of our main findings. On the one hand, the reduction on risk-taking indicates that the ex-ante level of risk-taking is excessive and share pledging curtails *over-investment* in risky investments. On the other hand, corporate insiders may *under-invest* in risky projects after pledging shares. Using both the baseline settling and the DiD framework above, we reveal that share pledging helps reduce redundant innovation inputs and improves the successful rate of patenting: Although share pledging is negatively associated with R&D expenditures, it contributes to an increased number of *eventually granted* invention patents. Also, consistent with Li et al. (2018), we document that firms with pledged shares have a higher market value. Therefore, it seems that share pledging alleviates shareholder-creditor conflicts and improves the efficiency of risky investments.

In the next section, we address the concern that earnings smoothing may drive our main findings. Since borrowers are concerned about sudden price declines, they may smooth their earnings by falsifying the firm's financial statements. Therefore, the observed decreases in earnings volatility may result from increased earnings smoothing. We find that share pledging is associated with higher earnings quality (i.e. reduced absolute discretionary accruals) and less bad news hoarding (reduced likelihood of stock price crashes), which are inconsistent with the earnings smoothing view but support the view that pledged shares provide additional information about the borrower, which facilitates creditor monitoring.

We also explore the cross-sectional effects of share pledging. We predict that the risk reduction effect of share pledging will be more pronounced for financially distressed firms whose risk-shifting problems are severer. We partition the sample based on the degree of ex-ante financial distress risk, and the estimation results confirm our conjectures. We further split the sample according to firms' ex-ante debt maturities and find that the effect of share pledging is weaker for those with a higher ratio of short-term debt, implying that short-term debt enables frequent negotiations and constrains risk-taking incentives ex-ante. In addition, we document that the decrease in risk-taking holds for both state-owned enterprises (henceforth SOEs) and non-state-owned enterprises (henceforth non-SOEs). These results further indicate that share pledging impedes corporate risk-taking through curtailing risk-shifting problems.

Last, we conduct a series of robustness checks. We include a series of additional control variables as well as province-times-year fixed effects in the baseline regressions to control for time-variant determinants of corporate risk-taking. We also use alternative measures of pledging and corporate risk-taking. These results buttress our main findings.

This paper mainly contributes to two strands of the literature. Our paper adds to a growing literature on the economic consequences of share pledging. Several previous studies build their settings on the Taiwan Stock Exchange, and document that share pledges destroy shareholder value (Chen and Hu (2007), Dou et al. (2017), Chan et al. (2018), Wang and Chou (2018)). Based on evidence from India, Singh (2017) finds that share pledges for personal loans destroy firm value, while share pledges for firm loans can increase firm value. They generally base their argument on that corporate insiders try to consolidate their control rights and prevent margin calls, which enhance their ability to extract private benefits of control. By focusing on the practice of share pledging in China, we demonstrate that in an environment where creditor protection is weak and investment is less efficient, in addition to the channel mentioned above, share pledging can facilitate creditor monitoring and help curtail excessive risk-taking. Therefore, our paper sheds some light on the recent policy debate regarding the costs and benefits of share pledging.[8]

[8] In March 2018, a new rule on pledged-stock loans came into effect in China, arguing that reckless borrowing by controlling shareholders destabilizes the market. According to the new rule, a single pledge can't exceed 50% of the stock's total traded volume on a public exchange. However, *the Paper*, a large state-backed news site, cites several brokers as saying that the risks of pledging are not that high. In August 2018, in a forum organized by Premier Keqiang Li, Xipei Jiang, the founder and Chairman of the Board of the Far East Holding Group Co., Ltd. (600869.SH), advised that the upper limit of the stock pledge rate would be abolished, stating that such requirements dampen the confidence of entrepreneurs and market participants.(https://www.caixinglobal.com/2018-01-15/regulators-limit-pledged-stock-loans-101197973.html, http://news.sina.com.cn/c/2018-08-13/doc-ihhqtawy2708224.shtml (in Chinese)).

Our paper also adds to the literature on the determinants of corporate risk-taking. More specifically, this paper is related to studies on how corporate insiders' characteristics (Faccio et al. (2011, 2016), Cassell et al. (2012), Cronqvist et al. (2012)) and the exposure to idiosyncratic risk (Gormley and Matsa (2011), Panousi and Papanikolaou (2012), Jagannathan et al. (2016)) affect corporate risk-taking. These studies largely examine the effects of managerial risk aversion while our paper focuses on shareholders' decisions on pledging shares. Our study also relates to Acharya et al. (2011) and Favara et al. (2017) by providing empirical evidence on the importance of creditors in shaping corporate insiders' risk-taking incentives.

The remainder of this paper is organized as follows: Section II provides general back ground information; Section III reports data and the empirical methodology used in this paper; Section IV reports the estimation results of our main empirical tests; and Section V concludes.

II. Background

In China, most listed firms have controlling shareholders, with highly concentrated ownership structures (Jiang and Kim, 2015). To cope with difficulties in obtaining external financing, controlling shareholders pervasively use their owned shares as collateral to borrow money from brokerages, banks, or trust firms. In this way, they can secure credit without altering their control rights (Singh, 2017). However, there are risks associated with pledged shares, as regulators and analysts often warn that share-pledging can amplify a market downturn. When a stock falls in the secondary market and reduces the value of the pledged shares, borrowers have to take out more shares as collateral. Otherwise, they will have to sell shares to pay back the principal.[9]

Both non-SOEs and SOEs can participate in share pledging. As the Chinse credit market is tight, many small and medium-sized non-SOEs have scarce recourse to banks or other sources of financing, and they commonly turn to pledge shares to finance companies as a way of raising cash.[10] For SOEs, they can pledge shares after getting approved by the State-owned Assets Supervision and Administration Commission (henceforth SASAC). Although possessing advantages in acquiring external financing, SOEs, especially those in capital-intensive industries (i.g. mining, real estate, steel, etc.), also pervasively pledge their shares. In June 2018, among the total 1,024 listed SOEs on the A-share market, 1,020 of them have pledged their shares, which accounts for 12% of the total value of shares under pledging for the whole market.[11]

The share-pledging loan business on the Chinese stock market has grown quickly. Before 2013, only banks and trust firms can participate in share-pledging activities. On May 24, 2013, the Shanghai Stock Exchange and the China Securities Depository and Clearing Co., Ltd. publish a rule ("The Guidance on Stock Pledge Repurchase Transactions, Registration, and Settlement") to guide the development of share pledging, permitting security companies to provide finance to borrowers based on pledge shares.[12] Compared with banks and trust firms, security companies require lower interest rates, have fewer restrictions

[9] https://www.scmp.com/business/markets/article/2095530/sell-chinas-pledged-stocks-may-be-double-hong-kongs-gdp.

[10] https://www.reuters.com/article/us-china-markets-stocks-pledged-analysis/slump-persists-china-fails-to-stimulate-markets-hobbled-by-pledged-shares-idUSKCN1MY0K8.

[11] http://finance.sina.com.cn/roll/2018-06-27/doc-iheqpwqx7418663.shtml (in Chinese).

[12] http://www.sse.com.cn/lawandrules/sserules/trading/stock/c/c_20150906_3976433.shtml (in Chinese).

on the usage of the loans, and approve transactions in a quicker manner.[13] This regulatory change has prominent real effects on share pledging activities. Since then, the share-pledging loan business has grown even faster. The value of shares pledged has expanded by more than Rmb200bn annually since 2014, according to S&P, taking the total to Rmb5tn ($720bn).[14] The volume of pledged-stock loans surpasses 1 trillion RMB (US$ 146 billion) in August 2016 and 1.28 trillion RMB (US$ 188 billion) at the end of 2016, an 81% increase from 2015.[15]

According to a CSRC requirement, firms should make announcements when their large shareholders (i.e., persons with more than 5% shareholdings) pledge their shareholdings for loans, making our setting well-suited for a study on the economic impacts of share pledging.[16] Accordingly, we construct the primary measure of share pledging, *Pledge*, as the amount of shares pledged by controlling shareholders as a percentage of total shares. We also construct an indicator variable, *Pledge_Dummy*, which measures whether the firm id involved in share pledging.

Table 1 shows our basic summary statistics on the share pledging of sample firms across years and industries, respectively. Panel A reports the chronological distribution of our sample firms. The ratio of firms involved in share pledging increased from 23.2% in 2010 to 61.1% in 2015, and the sample mean of *Pledge* doubled from 0.045 to 0.114 over this same time period. Conditional on firms involved in share pledging (*Pledge_Dummy*=1), an average firm pledges 19.7% of its total shares, and this ratio is rather stable over time. In Panel B, we

[13] http://www.infzm.com/content/137459 (in Chinese).
[14] https://www.ft.com/content/a342e01a-d758-11e8-a854-33d6f82e62f8.
[15] https://www.caixinglobal.com/2018-01-15/regulators-limit-pledged-stock-loans-101197973.html.
[16] http://www.csrc.gov.cn/pub/newsite/flb/flfg/bmgz/ssl/201012/t20101231_189729.html (in Chinese).

show that the majority of our sample firms are in the manufacturing sector, which is consistent with the industrial structure of the Chinese stock market (Li et al. (2017)). Some typical industries (e.g., Information technology, Real estate, Health, etc.) have an above average fraction of firms involved in share pledging. More specifically and consistent with some anecdotal evidence, among those involved in share pledging, real estate firms have the highest pledging ratio (0.270).[17]

[Insert Table 1 here]

III. Data and Methodology

3.1 Data Description

We adopt annual data of Chinese A-share listed firms spanning from 2005 to 2015. The financial variables and stock data are from the CSMAR Database, which discloses information on share pledging by the top 10 largest shareholders. Then, we select observations used in the empirical analysis according to the following procedures. First, we exclude observations from the financial industry according to the classification standard of the CSRC because these firms are fundamentally different from non-financial firms. In addition, all of the continuous main variables are winsorized at the 1% and 99% percentiles in order to alleviate the impact of outliers.

3.2 Construction of the Dependent Variable: Corporate Risk-Taking

Based on previous literature (e.g., Faccio et al. (2011), Boubakri et al. (2013)), our

[17] In mid-2014, among the firms listed on the Chinese stock market with a share pledging ratio larger than 50%, nearly one fourth of them belonged to the real estate industry. A fund manager indicates that this is because real estate firms are capital intensive and have a larger demand for external financing (http://money.163.com/14/0626/07/9VL8IO1900253B0H.html (in Chinese)).

primary measure of risk-taking is earnings volatility. Following Ljungqvist et al. (2017), we construct the main measure of earnings volatility in the main context, *Roa_Vol*, based on quarterly return on assets (ROA), which is calculated as the standard deviation of a firm's ROA over the following four quarters. For robustness, we further construct various alternative measures of earnings volatility based on quarter-level or year-level earnings as well as several measures of stock return volatility.

We also consider risky investments that can contribute to increases in earnings volatility. A large strand of the recent literature examines how various firm-level factors affect firms' innovative activities, which are idiosyncratic and risky. We consider different stages of innovative investments. Investment in R&D tends to be more discretionary with greater uncertain outcomes rather than regular capital investments (Kim and Lu (2011)). Therefore, we use R&D expenditures as a proxy for risky investment. More specifically, due to the right skewness of R&D expenditures and patent counts, and following previous literature on corporate innovation (e.g., He and Tian (2013)), we use the natural logarithm of R&D expenditures in year t+1 (*LogRd*) in our analysis.[18]

3.3 Model Specification

To examine the impact of share pledging on corporate risk-taking, we estimate the following equation:

$$Risk_{i,t} = \alpha + \beta Pledge_{i,t} + \gamma Control_{i,t} + \mu_i(\varphi_j) + \tau_t + \varepsilon_{i,t} \quad (1)$$

where i indexes the firm and t indexes the year. The coefficient on $Pledge$, β, captures the

[18] When calculating *LogRd*, we add one before taking the log transformation so that we can keep those observations with zero R&D expenditures and patent applications. Our results still hold if we only include observations with non-zero R&D expenditures or non-zero patent applications in the regressions.

sensitivity of corporate risk-taking to share pledging, which is the variable of our main interest. As a benchmark, we include both industry- (φ_j) and year- (τ_t) fixed effects in the regression to account for systematic variations in corporate risk-taking across each year and industry. In the majority of this paper, we further control for time-invariant firm-level factors by including firm-fixed effects (μ_i) in our model. To account for the within-firm correlation among different observations, we cluster the robust standard errors at the firm level.

Following previous studies, we include a vector of control variables as follows: firm size (*Size*), leverage (*Leverage*), age (*Age*), market-to-book ratio (*MB*), operating cash flows (*Opcf*), sales growth (*Gsale*), long-term investments (*Capex*), and ownership concentration (*Top1*). Table A.1 in the Appendix provides detailed definitions of all of the variables we use in this paper.

Table 2 reports the summary statistics of the main variables. Our final sample consists of a maximum of 20,708 firm-year observations covering the years 2005 to 2015. The distribution of *Pledge* is right-skewed. The mean of *Pledge_Dummy* is 0.388, indicating that share pledging occurs in one-third of the firm-year observations. The mean and median of *Roa_Vol* are 0.013 and 0.007, respectively. The distribution of *LogRd* has a wider range, with a mean and median of 8.900 and 13.999, respectively.

[Insert Table 2 here]

IV. Estimates of Share Pledging on Corporate Risk-Taking

4.1 Basic Approach

We begin by estimating the effect of share pledging on corporate risk-taking. Our estimation results are reported in Table 3. In Columns (1) and (2), we control for year- and industry-fixed effects. In Column (1), we examine whether increases in share pledging leads to more or less volatile earnings. The dependent variable *ROA_Vol* measures the degree of earnings volatility. The coefficient on *Pledge* is negative and significant at the 5% level, indicating that the pledging of stocks lowers firm risk measured by both earnings volatility and stock return volatility.

In Column (2), we consider another aspect of corporate risk-taking, specifically firm spending on innovative activities. The dependent variable is *LogRd*, the main measure of the scale of R&D expenditures.[19] The coefficient on *Pledge* is also negative and significant at the 1% level, which implies that share pledging hinders R&D investments. In Columns (3) and (4), to control for time-invariant determinants of corporate risk-taking, we control for both the year- and firm-fixed effects. The coefficients on *Pledge* are still negative and significant throughout the three columns, which further confirm a deterioration effect of share pledging on corporate risk-taking.

The negative effects of share pledging on the various measures of corporate risk-taking are not only statistically significant but also economically significant. Column (3) shows that on average, a one standard deviation increase in share pledging corresponds to a 5.1% (=0.005*0.132/0.013) decrease in the earnings volatility of the sample mean. In Column (4), as the dependent variable is in logarithmic form, we can calculate that compared with the current level, a one standard deviation increase in share pledging leads to around a 35.8% ($=1-e^{-2.321*0.132}$) decrease in R&D expenditures. The economic significance of these effects

[19] As the disclosure of R&D expenditures was not compulsory in China prior to 2007 when the new accounting standard came into effect, the sample period is 2006-2015 when *LogRd* in year t+1 is the dependent variable.

calls for further analysis on the causality issues of the negative relationship between share pledging and corporate risk-taking.

[Insert Table 3 here]

4.2 Addressing Endogeneity Concerns

Our primary tests indicate that share pledging is associated with less volatile earnings and decreased R&D expenditures. Although we argue that an increase in share pledging causes a decline in corporate risk-taking, we notice that the endogeneity concerns may exist because: (1) the causality can run from corporate risk-taking to the decision of pledging (e.g., shareholders of firms with a higher tendency of risk-taking may have a higher demand for pledging shares as collateral for external financing), or (2) omitted factors can determine both the level of share pledging and the degree of risk-taking (e.g., adverse shocks on the economy may restrain the ability of corporate insiders to pledge their shares thereby discouraging risk-taking).

In particular, the endogeneity bias could go in either direction, depending on how the perceived economic consequences of corporate risk-taking affect the decision of shareholders to pledge shares. On the one hand, if risk-taking is anticipated to increase the likelihood of adverse events, then shareholders may be better off reducing the number of pledged shares to reduce the risk of losing control. This line of reasoning implies that OLS estimates are biased toward more pronounced negative results. On the other hand, if shareholders with high risk preferences are eager to pledge shares in exchange for valuable external resources that are necessary to the continuation of risky projects and avoiding default, the OLS estimates will underestimate the causal decrease in corporate risk-taking that stems from share pledging.

In the previous section, the inclusion of firm-fixed effects in our regression models removes any purely cross-sectional correlation between share pledging and risk-taking, enabling us to compare periods with different levels of pledged shares within the same firm. However, such a practice may not be sufficient to address endogeneity concerns. Therefore, in the following sections, we employ propensity-score matching analysis, the Heckman two-stage approach, differences-in-differences analysis, and instrumental variable analysis to address the endogeneity concerns.[20]

4.2.1 Propensity-Score Matching Analysis

The choice of pledging shares is not random. Therefore, there could be systematic differences between firms with and without pledged shares. To mitigate the concern that the observed negative relationship between share pledging and corporate risk-taking are caused by cross-sectional or time-series factors that affect both the decision of pledging and the tendency of undertaking risk, we employ the propensity-score matching strategy (Rosenbaum and Rubin (1983)). The treatment group consists of firms with a non-zero number of pledged shares in a given year (*Pld_Dummy*=1). In an attempt to select "similar" firms to each firm that pledges shares in a given year, we construct a control sample of firms that are matched to the treated firms along a set of relevant firm characteristics where, to the extent possible, the members of the control group differ only in their involvement in share pledging. The pool of candidates to be chosen consists of firms with zero pledged shares (*Pld_Dummy*=0) that have valid matching variables.

[20] In the following sections, we will focus mainly on those regressions controlling for firm- and year-fixed effects in our model.

We construct the control sample through the following procedures. First, we estimate a logit model where the dependent variable equals one if a firm belongs to the treatment group in a given year, and zero otherwise, controlling for all of the control variables in the baseline regression as well as the year- and industry-fixed effects. Second, we use the estimated coefficients to predict the propensity score of entering into the treatment group. Third, we use the calculated propensity scores to perform a nearest-neighbor approach and select one or two control firms for each observation in the treatment group and retain all pairs in the case of multiple matching, with a propensity score match within 0.01.

In Table A.2 in the Appendix, we report the summary statistics for the examination of the post-match differences between the treatment group and the control group. The balance test shows that the treatment firms and the control firms are similar across all of the matching variables, ensuring that the change in corporate risk-taking is caused only by the increase in share pledging.

After we finish these procedures, in Table 4 we report our estimation results based on the propensity-score-matched sample. The coefficients on *Pledge* are quantitatively in line with the OLS results, further suggesting that compared to otherwise similar firms, firms with pledged shares will have fewer tendencies to undertake risk.

[Insert Table 4 here]

4.2.2 Heckman Two-Stage Approach

In Table 5, we further address the self-selection issue of share pledging by employing a Heckman (1979) two-stage approach. The first stage of this model is a Probit model with

Pledge_Dummy as the dependent variable, which estimates the choice of engaging in share pledging. In the second stage, we include the inverse Mills ratio derived from the first stage as an additional control variable. In Panel A, we observe that several firm characteristics are significantly correlated with the tendency of pledging shares. In Panel B, the inverse Mills ratio is statistically significant only in Column (2). More importantly, the coefficients on the *Pledge_Dummy* are negative and significant, indicating that our main results still hold after addressing potential self-selection issues.

[Insert Table 5 here]

4.2.3 Differences-in-Differences Approach

In the previous section, we show that there is a negative relation between share pledging and corporate risk-taking. In this section, we use the differences-in-differences (DiD) approach to determine the effect of a change in share pledging on corporate risk-taking. This methodology compares the level of risk-taking of a sample of treatment firms whose amount of pledge shares increases the most to that of control firms whose amount of pledge shares increases less but that are otherwise comparable, before and after the regulatory change that cause a quasi-exogenous shock to share pledging.

Specifically, we identify a regulatory change in 2013, namely the publication of a guidance rule of share pledging ("The Guidance on Stock Pledge Repurchase Transactions, Registration, and Settlement"), as a quasi-exogenous positive shock to share pledging. As indicated in Section II, prior to 2013, only banks and trust firms can participate in share-pledging activities. The rule permits security companies to provide finance based on pledged shares from borrowers. This regulatory change appears to be a good candidate to generate plausibly exogenous variation in share pledging for at least two reasons. First, it directly affects share pledging while unlikely to directly affect corporate risk-taking. As indicated by the general provision of the rule, the primary goal of the rule is "to regulate share pledging activities, maintain the market order, and protect the legitimate rights and interests of all parties involved in the transaction", which has no direct relation with listed firms' decisions. Second, changes in share pledging surrounding this regulatory change exhibit variation in the cross-section of firms. Hence, examining the change in risk-taking following the change in share pledging due to the publication of the rule provides a quasi-exogenous shock for our tests.

Our empirical setting resembles that of Fang et al. (2014) and Brogaard et al. (2017) who use decimalization as an exogenous positive shock to stock market liquidity. To begin with, we construct a treatment group and a control group of firms using propensity score matching. Specifically, we measure the change in *Pledge* from the pre-regulation year (2012) to the post-regulation year (2014), and construct a variable $\Delta Pledge_{-1\ to\ +1}$ for each firm. Based on $\Delta Pledge_{-1\ to\ +1}$, we then sort the sample firms into deciles and regard the top three deciles of the distribution representing the firms experiencing the largest increase in share pledging. Finally, we employ a propensity score matching algorithm to identify matches between firms in the top three deciles and other firms.

When applying propensity score matching, we estimate a Probit model based on firm characteristics by the end of 2012, the pre-regulation year, including all control variables from Equation (1) as well as industry-fixed effects. The dependent variable is equal to one if the firm-year belongs to the treatment deciles (top three deciles) and zero otherwise. We then use the estimated propensity scores to perform nearest-neighbor propensity score matching, with a propensity score match within 0.01. In particular, each firm in the top three deciles (treatment firms) is matched to a firm from the rest deciles with the closest propensity score (control firms).[21] We end up with 306 unique pairs of matched firms.

The validity of the DiD estimator critically depends on the parallel trend assumption, i.e. the underlying trends in the outcome variable should the same for both groups. Following Fang et al. (2014) and and Brogaard et al. (2017), we perform several diagnostic tests to verify that the assumption holds in our setting. We summarize the results of three-fold tests in Table A.3 in the Appendix.

In Panel A, we re-run the Probit model used to estimate propensity scores restricted to the matched sample, and report estimation results in Column (2). Compared to the estimation results on the baseline Probit model in Column (1), the coefficients on all the explanatory variables have smaller magnitude and are not statistically significant, suggesting that there are no observable different characteristics exist between the treatment and control groups before the regulatory change. Panel B reports the distribution of the propensity scores for both groups and their differences. We can see that the difference between the propensity scores of the treatment firms and those of the control firms is trivial, indicating that the two groups' propensity scores line up closely. In Panel C, we report the univariate comparisons between the treatment and control firms' pre-regulation characteristics. As shown, none of the observed differences between the treatment and control firms' characteristics is statistically

[21] If a firm from the pool of control firms is matched to more than one treatment firm, we retain the pair for which the distance between the two firms' propensity scores is the smallest.

significant, suggesting that the propensity score matching process removes meaningful observable differences. Therefore, it is more likely that the observed changes in corporate risk-taking (if any) are caused only by the exogenous change in share pledging due to the regulation.

We then define *Treat* as an indicator variable of the treatment group. The variable *Post13* is an indicator variable of the regulatory change, which equals to one if it is year 2013 or after, and zero otherwise. The coefficient on *Treat*Post13* is the one with main interest, which captures the change in dependent variables for firms with highest increases in share pledging relative to other firms subsequent to the regulatory change.[22]

We report estimation results in Table 6. In Columns (1)-(2), we observe negative and significant coefficients on *Treat*Post13*, indicating that the positive shock to share pledging discourages corporate risk-taking. On average, following the regulatory change, treatment firms, relative to control firms, experience a decrease in earnings volatilities corresponding to approximately 15.4% (=0.002/0.013) of the sample mean, and a 52.0% (=1-$e^{-0.734}$) decrease in R&D expenditures, which further suggest a negative causal effect of share pledging on corporate risk-taking.

To further confirm that the parallel trend assumption holds, we conduct a timing test in order to observe the dynamics of corporate risk-taking surrounding the regulatory change. Specifically, we estimate the following model:

$$Risk_{i,t} = \alpha + \beta_0 Treat_i * D12_t + \beta_1 Treat_i * D13_t + \beta_2 Treat_i * D14_t + \beta_3 Treat_i * D15_t + \gamma Control_{i,t} + \mu_i + \tau_t + \varepsilon_{i,t} \quad (2)$$

[22] One concern regarding our DiD setting is changes in economic conditions contemporaneous with the regulatory change may differently affect the treatment and control groups and are correlated with corporate risk-taking. Therefore, we include province-times-year fixed effects to control for time-variant macro-level omitted variables when estimating the model.

As the regulatory change occurs in 2013, we introduce four dummy variables, *D_12*, *D_13*, *D_14*, and *D_15*, which equal to one if it is year 2012/2013/2014/2015, respectively.[23] In Columns (3)-(4), we observe statistically insignificant coefficients on *Treat*D_12*, suggesting that the parallel trend assumption of the DiD approach is not violated. We generally observe significant coefficients only after the regulatory change, implying that consistent with our main findings, the plausibly exogenous increase in share pledging triggers the decrease in corporate risk-taking. Overall, these findings are consistent with previous sections.

[Insert Table 6 here]

4.2.4 Instrumental-Variable Approach

To further mitigate concerns on the potential endogeneity problem, we construct instruments for share pledging and use the 2SLS approach to correct for the potential bias due to endogeneity in the decision of pledging shares. Following Bernile et al. (2018), we construct two instrument variables, *Pledge_IV_Ind* (i.e., the average *Pledge* in the same CSRC 2-digit industry) and *Pledge_IV_Prov* (i.e., the average *Pledge* in the same province), excluding firm i's own level of *Pledge*. This sort of IV approach has also been adopted in other studies including Laeven and Levine (2009), Faccio et al. (2011), among others. The logic of the construction of these IVs rests on the idea that the average number of pledged shares of other firms in the same industry (i.e., province) captures the industry (i.e., province) -level factors explaining share pledging, while the decision of pledging shares of one firm does not influence the degree of share pledging of other firms. Therefore, *Pledge_IV_Ind* and

[23] As we control for year- and firm-fixed effects in the model, the effects of *Treat* and individual items of *D_12/D_13/D_14/D_15* are absorbed by the fixed effects.

Pledge_IV_Prov isolate the more enduring and more exogenous component of share pledging. However, as indicated by Bernile et al. (2018), while it seems reasonable that these IVs satisfy the relevance condition, it is less clear whether it is safe to assume that they satisfy the exclusion restriction, as the similarities in risk preferences of comparable firms may induce them to pledge a like proportion of shares. Therefore, we use the IV regressions only to further validate the broad inferences we draw from our baseline analysis and interpret the results with caution.

Table 7 shows our estimation results of the 2SLS analysis.[24] More specifically, Columns (1) and (3) show our estimation results for the first-stage regression. The coefficients on both *Pledge_IV_Ind* and *Pledge_IV_Prov* are positive and significant. The F-statistic is greater than 10, indicating that our instruments are empirically relevant with share pledging according to the criteria suggested by Stock and Yogo (2005). In addition, the Hansen J-tests in Columns (2) and (4) fail to reject the orthogonality condition at the 10% level.

After confirming the validity of the instrumental variables, the second-stage IV estimates the relationship between share pledging and corporate risk-taking by instrumenting the main explanatory variable with these two instruments. For the second-stage regressions, the coefficients on *Pledge* are significant at better than the 5% level, suggesting that share pledging has a negative causal effect on corporate risk-taking.

It is noteworthy that the negative impact of the instrumented share pledging is an order of magnitude larger than the OLS estimates, suggesting that the latter are positively biased. In turn, this suggests that some firms with higher risk preferences may have a stronger demand

[24] During 2015, the Chinese stock market experienced a tremendous crash, and many financial institutions voluntarily halted stock shorting activities in response to pressures from the CSRC. Therefore, we do not include observations in 2015 for this test.

for pledging shares as collateral to facilitate external financing, which potentially biases the estimated negative effect of share pledging on corporate risk-taking toward zero.

[Insert Table 7 here]

In summary, despite all of the tools employed (i.e., firm fixed effects, propensity-score matching, the Heckman two-stage model, the DiD estimation, and the IV approach), we find little evidence that the issue of endogeneity explains the negative relationship between share pledging and corporate risk-taking. While these tests do not perfectly eliminate endogeneity concerns, they strongly indicate that our results are unlikely driven by reverse causality and unobserved firm heterogeneity. We will further check for the robustness of our results in the following sections.

4.3 The Effects on Innovation Output

Although we document a strong negative relationship between share pledging and firm risk-taking, the economic implications of such findings are unclear. In this section, we seek to distinguish between two competing interpretations: (1) share pledging curtails ex-ante excessive risk-taking thereby increasing firm value; and (2) increased downside risk accompanied with share pledging induces firms to undertake suboptimal risk, thereby negatively affecting firm value. Specifically, we measure the output of firms' risk-taking by focusing on their patent applications. Compared with R&D expenditures, a patent is a superior measure because it captures the combined effect of all of the innovation inputs including R&D, human capital, and other intangibles (Agarwal et al. (2017)). We report estimation results in Table 9.

There are three types of patents in China: invention, utility model, and design patents. Among the three types of patents, the invention patent, which is granted for new technical solutions relating to a product, a process, or an improvement, is the patent type with the highest innovation value (He et al. (2018)). According to the requirement of amended Chinese Patent Law in 2008, invention patents need to "have prominent substantive features and represent notable progress".[25] Specifically, invention patent applications undergo substantive examination, which can last for two to four years before an invention patent is granted. By comparison, design and utility model patents, which are subject only to preliminary examinations, are more quickly granted (i.e., six months to one year grant lags) and are generally viewed as representing minor innovations (He et al. (2018)). The existing literature largely uses the number of citations a patent receives as a proxy for patent quality. However, there is no sufficient and reliable source on citations for Chinese patents. Therefore, we use the number of ultimately successful invention patent applications (i.e., those that are filed and *eventually granted*), *Patent1_Grant*, to measure innovation quality. We therefore construct *LogPatent1_Grant* as the dependent variable by taking the natural logarithm of one plus *Patent1_Grant*.

In Columns (1)-(2), Panel A, estimation results show that share pledging has a significant positive effect on patent quality in year t+1 and year t+2. In sum, we find that share pledging improves the successful rate of innovative projects, as firms obtain more granted invention patents with tightened R&D expenditures. That is, the *effectiveness* of

[25] Source: http://www.djrd.gov.cn/html/flfg/fl/18/03/4815.html (in Chinese).

risk-taking improves after firms pledge their shares.

Due to the lag between the application date and the grant date, some patents may not have been granted but only applied for, or filed. This truncation problem can be more severe for the last several years of our database coverage. We find that the applications for invention patents are usually granted in two years and in no more than five years. Therefore, we use a truncated sample from 1990 to 2010 to compute the application-grant time of invention patents. Then, we use the following formula to correct the truncation bias of patent counts from 2011 through 2016:

$$Patent1\_Grant_{adj} = {Patent1\_Grant} \Big/ {\sum_{s=0}^{2016-t} W_s} \mid 2011 \leq t \leq 2016 \tag{3}$$

where *Patent1_Grant*$_{adj}$ refers to the quantity of truncation-adjusted patents, and W_s is the percentage of patents applied for in a given year that are granted in s years according to our calculation. In Columns (3) and (4), Panel A, based on the truncation-adjusted patent count, we calculate the dependent variable *LogPatent1_Grant*$_{adj}$, which is the natural logarithm of one plus *Patent1_Grant*$_{adj}$. We obtain similar results as in Columns (1) and (2). In Panel B, we employ the PSM-DID approach used in Section 4.2.3 to address potential endogeneity concerns between share pledging and innovation output, and the above findings still hold.

In Panel C, to further assess whether the increase in innovation output is beneficial to shareholders, we directly examine the relationship between share pledging and firm value. In Columns (1)-(2), estimation results indicate that share pledging is positively associated with Tobin's Q in the current year and the next year. This result tends to be causal, as we obtain positive and significant coefficients on *Treat*Post13* based on a PSM-DID approach in Columns (3)-(4). These findings are consistent with Li et al. (2018) who document that share pledging is positively associated with firm value in China. Our evidence indicates that improved investment efficiency in risky projects can be a possible channel through which share pledging improves firm value, and we illustrate this point through more rigorous empirical tests.

In summary, our findings indicate that share pledging curtails corporate insiders' ex-ante tendencies of overinvestment in risky projects and improves firm value. Although prior literature has shown that shareholder pledges are associated with lower firm value in other institutional contexts such as the Taiwanese and Indian capital markets (Chen and Hu (2007), Dou et al. (2017), Singh (2017), Chan et al. (2018), Wang and Chou (2018)), we argue that opaque information environment and weak creditor protection in our setting may exaggerate risk-shifting problems, which can enhance the marginal benefits of pledged shares as collaterals with high-liquidation value to release updated information about borrowers and facilitate creditor monitoring.

[Insert Table 8 here]

4.4 Earnings Smoothing: An Alternative Explanation

In the main context of the paper, we employ earnings volatility as one of the main measures of risk-taking. An alternative explanation regarding less volatile earnings is that the increased downside risk associated with share pledging induces corporate insiders to smooth earnings (e.g., conceal negative information). Therefore, earnings manipulation motives may drive our results. To address this issue, we conduct additional tests and report our estimation results in Table 10.

In Columns (1) and (2), we examine whether share pledging is associated with worsened earnings quality. We employ two measures of earnings quality, *AbsDac_Jones* and *AbsDac_DD*, as the dependent variables, constructed based on the existing accounting literature of Jones (1991), Dechow and Diche (2002), and Cornett (2008). In contrast to the conjecture of this alternative explanation, we obtain negative and significant coefficients on *Pledge*, indicating that share pledging actually implies a lower degree of absolute discretionary accruals, i.e. improved earnings quality.

Previous research also shows that a lack of information transparency increases future crash risk by enabling corporate insiders to hide and accumulate bad news (Jin and Myers (2006), Hutton et al. (2009), Kim et al. (2011)). Therefore, to further assess whether share pledging induces corporate insiders to avoid downside risk through hiding bad news, we follow Chen et al. (2001) to construct two positive measures of stock price crash risk, *Ncskew* and *Duvol*, respectively.[26] In Columns (3) and (4), we obtain negative and significant coefficients on *Pledge*, suggesting that share pledging constrains corporate insiders to conceal adverse operating outcomes and reduces the likelihood of stock price crashes. These findings indicate that share pledging conveys additional information to creditors, which helps us pin

[26] In this paper, *Ncskew* indicates a negative coefficient of skewness, which is calculated by taking the negative of the third moment of daily returns, and dividing it by the standard deviation of daily returns raised to the third power. *Duvol* indicates down-to-up volatility. To calculate this measure, we separate all of the days with returns below the period mean (i.e., "down" days) from those with returns above the period mean (i.e., "up" days), and compute the standard deviation for each of these subsamples separately. We then take the log of the ratio of the standard deviation on the "down" days to the standard deviation on the "up" days. Following the crash risk literature on the Chinese stock market (e.g., Xu et al. (2014), Li et al. (2017)) we include several additional control variables in our model. Definitions of these variables are presented in Table A.1 in the Appendix.

down the alternative hypothesis and buttress our main findings.[27] These findings are also in line with the research of Asija et al. (2014) who find that as the ready availability of daily collateral values increases the intensity of monitoring by lenders, share pledging reduces the likelihood of accruals-based earnings management in Indian listed firms.

[Insert Table 9 here]

4.5 Cross-Sectional Analysis

In Table 10, we conduct cross-sectional tests to further identify the effect of share pledging on corporate risk-taking. To mitigate the concern that the variables used to split the sample themselves can be affected by increased share pledging, we use the values in the previous year. Our main argument assumes that share pledging impedes corporate risk-taking through informing creditors of information about borrowers and curtailing risk-shifting problems. Therefore, we expect that the baseline findings will be more pronounced for firms in which ex-ante risk-shifting problems are more severe.

Our tests are fourfold. In Panel A, we re-estimate our results by partitioning the whole sample into subsamples of low or high ex-ante financial distress risk measured by Altman's Z score in the previous year. We regard firms with below and above median Altman's Z scores as having higher or lower financial distress risk and hence more or less severe risk-shifting

[27] In an influential paper in Chinese, Xie et al. (2016) also find that share pledging in China is negatively associated with the likelihood of stock price crashes. We notice that a concurrent paper by DeJong et al. (2018) argue that Chinese firms with controlling shareholders pledging their shares engage in more positive discretionary accruals. We emphasize that our setting is different from theirs in several aspects. First, they focus on positive discretionary accruals, while we focus on the absolute value of discretionary accruals, since both positive and negative discretionary accruals can reduce earnings quality and increase stock price crash risk (Hutton et al., (2009); Zhu, (2016)). Second, we control for firm-level omitted variables through including firm- and year-fixed effects in the model, while they only control for industry- and year-fixed effects in the model. Third, our main measure of share pledging is a percentage of shares measure while they focus on a dummy variable indicating whether a firm has pledged shares in a given year. In un-tabulated tests, we confirm that the negative relation between share pledging and earnings quality also survives in the PSM-DID setting used in Section 4.2.3.

problems. Our estimation results indicate that the negative effects of share pledging are significant for firms with a below median Altman's Z score. We document no significant effect of shareholder pledging for firms with an above median Altman's Z score.

In Panel B, we use a firm's leverage ratio in the previous year as an indicator of ex-ante financial distress risk (Gormley and Matsa (2016)). Here, above and below median leverage ratio values indicate higher or lower financial distress risk. Our estimation results imply that the coefficient on *Pledge* loads negative and significant for firms with an above median leverage ratio, but are statistically insignificant for firms with a below median leverage ratio.

In Panel C, we examine whether share pledging has heterogeneous effects with respect to ex-ante debt maturities. Barnea et al. (1980) suggest that firms' risk-shifting can be minimized by issuing shorter maturity debt as short-term debt requires more frequent renegotiations and hence allows for more scrutiny from creditors. Therefore, we predict that the effect of share pledging will be less pronounced for firms with ex-ante shorter debt maturities (i.e., those firms with a higher ratio of short-term debt). We find that the decrease in corporate risk-taking concentrates in firms with a below median ratio of short-term debt. By comparison, the effect is statistically insignificant for firms with an above median ratio of short-term debt.

In Panel D, we split the sample into SOEs and non-SOEs according to the ultimate shareholder of firms. It shows that the coefficients on *Pledge* are negative and significant for both SOEs and non-SOEs. It is noteworthy that the effect is marginally more significant for SOEs, which tends to reflect the fact that Chinese SOEs have lower investment efficiency because of government intervention (Chen et al., 2011; Hao and Lu, 2018). Our results indicate that although SOEs receive political favors from the government that are helpful in mitigating the impact of negative events (Yu et al., 2015), under the monitoring from the SASAC, SOEs managers also undertake less risk to prevent potential margin calls in order to preserve their career prospects.

Combining the findings above, the evidence suggests that the decrease in corporate risk-taking induced by increased share pledging is more pronounced for firms with more severe ex-ante risk-shifting problems (lower Altman's Z score, higher debt ratio, and longer debt maturities), i.e. a higher likelihood of firm insiders to undertake excessive risk at the expense of creditors, and SOEs and non-SOEs behave similarly in risk-taking decisions after pledging shares.

[Insert Table 10 here]

4.6 Robustness Checks

4.6.1 Alternative Specifications

In this section, to check for the robustness of our main findings, we alter our baseline regression through changing the continuous main explanatory variable to a dummy variable, including additional control variables and controlling for high-degree fixed effects. We report our estimation results in Table 11.

(1) Using a dummy variable to measure the presence of share pledging. In Columns (1) and (2), we perform tests by changing the main explanatory variable to a dummy, *Pld_Dummy*, which equals to one if the number of stocks pledged by shareholders is larger than zero. The negative and significant coefficients on *Pld_Dummy* are consistent with our main findings.

(2) Including additional control variables. Corporate governance is an important determinant of corporate risk-taking (John et al. (2008)). Therefore, in Columns (3) and (4), we include a series of internal and external governance measures applied to Chinese firms in the baseline model, including board independence (*Indratio*), institutional ownership (*Inst*), analyst coverage (*Coverage*), control wedge (*Separation*), auditor quality (*Audit*), and industry concentration (*HHI*).[28] We obtain quantitatively similar results in these two columns.

(3) Including province*year-fixed effects. Although we use firm-fixed effects in most of our regressions to capture the effects of time-invariant and unobservable omitted variables, the time-varying effects may also cause our main findings to be spurious. For example, the fluctuation of the macro-economy may determine the decision of pledging shares and undertaking risk simultaneously. Also, several prior studies indicate that regional-level factors such as religion (Hilary and Hui (2009)), culture (Li et al. (2013)), and the strength of debt enforcement (Favara et al. (2017)) can affect firms' attitudes toward risk-taking. In addition, it is noticeable that in China, market development is largely segmented at the provincial level. Therefore, in Columns (5) and (6), we introduce province-times-year-fixed effects when estimating the baseline regressions to control for the time-variant regional omitted variables. Our baseline results are largely unchanged.

[Insert Table 11 here]

4.6.2 Additional Robustness Checks

Thus far, we have documented a negative relationship between share pledging and

[28] For detailed definitions on these variables, please refer to Table A.1 in the Appendix.

corporate risk-taking. We interpret our primary findings as shareholders prefer lower risk. In this section, we conduct a series of robustness checks to further buttress our main findings. We re-estimate the baseline regressions by using various alternative measures of earnings volatility, stock return volatility, and R&D expenditures to replace the ones investigated in the previous sections. Our estimation results are reported in Table 12.

(1) Other model specifications. In line with the above section, we estimate the baseline model using other specifications in Panel A. In Columns (1)-(2), we exclude the sample period corresponding to the global financial crisis (2008-2009). These macro shocks result in a large portion of individual firms have declining stock prices, and firms may adjust the decision of pledging shares and investment in risky projects simultaneously during that time. In Columns (3)-(4), we adopt the two-way cluster strategy. Our baseline findings still hold.

(2) Alternative quarter-level measures of earnings volatility. In Panel B, we construct several alternative measures of earnings' volatility based on quarter-level earnings. In Column (1), we first calculate industry-adjusted ROA (i.e., the difference between a firm's ROA and the average ROA across all firms in the same CSRC 2-digit industry) and then calculate *ROA_Vol_Adj* (i.e., the standard deviation of a firm's industry-adjusted ROA over the following four quarters). In this way, we can remove the industry-level economic cycle influence and obtain a cleaner measure of the level of risk resulting from corporate operating decisions (Faccio et al. (2011)). In Column (2), we alter the calculation process of *ROA_Vol* by using a longer time span, where the dependent variable *ROA_Vol_8q* is calculated as the standard deviation of a firm's ROA over the following eight quarters. In Columns (3) and (4), we use return on equity (ROE) as the measure of earnings and calculate *ROE_Vol*, the

standard deviation of the ROE over the following four quarters, and *ROE_Vol_8q*, the standard deviation of the ROE over the following eight quarters, respectively. The negative effect of share pledging is robust to these changes.

(3) Alternative year-level measures of earnings volatility. In Panel C, following the research of Faccio et al. (2011) and Boubakri et al. (2013), we construct a measure of earnings volatility based on yearly ROA, *ROA_Vol_3y*, which is calculated as the standard deviation of a firm's industry-adjusted ROA over the following three years. We also employ *ROA_Mm_3y* measured by the difference between the maximum and minimum of a firm's industry-adjusted ROA over a three-year interval as the dependent variable. The coefficients on *Pledge* are negative and significant in both of the columns. In Columns (3) and (4), we calculate the dependent variables corresponding to Columns (1) and (2), *ROA_Vol_4y* and *ROA_Mm_4y*, based on four-year intervals.

(4) Measures of stock return volatility. In Panel D, following several previous studies (e.g., Gormley and Matsa (2016), Shue and Townsend (2017)), we use measures of stock return volatility to proxy for the degree of risk-taking. For each firm in a given year, we calculate the standard deviation of weekly returns (*Ret_Vol*) and daily returns (*Ret_Vol_d*), and use them as dependent variables in Columns (1) and (2), respectively. In Columns (3) and (4), we calculate two measures of idiosyncratic volatility. The first one, *LogIdio_Vol_Indadj*, is calculated as follows:

$$LogIdio\_Vol\_Indadj = log \sum_{\tau \in t} \varepsilon_{i,\tau}^2 \quad (4)$$

where $\varepsilon_{i,\tau}$ is obtained by estimating $r_{i,\tau} = \alpha_0 + \beta_1 r_{M,\tau} + \beta_2 r_{M,\tau-1} + \gamma_1 r_{IND,\tau-1} + \gamma_2 r_{IND,\tau-1} + \varepsilon_{i,\tau}$ for firm i in year t. $r_{i,\tau}$ is firm i’s total return on week τ. $r_{M,\tau}$ and $r_{IND,\tau}$

are the market-value-weighted market returns and industry returns on week τ, respectively. In a similar way, we calculate the second measure *LogIdio_Vol_Madj* as follows:

$$LogIdio\_Vol\_Madj = log \sum_{\tau \in t} \varepsilon_{i,\tau}^2 \quad (5)$$

where $\varepsilon_{i,\tau}$ is obtained by estimating $r_{i,\tau} = \alpha_0 + \beta_1 r_{M,\tau-2} + \beta_2 r_{M,\tau-1} + \beta_3 r_{M,\tau} + \beta_4 r_{M,\tau+1} + \beta_5 r_{M,\tau+2} + \varepsilon_{i,\tau}$ for firm i in year t and $r_{i,\tau}$ is firm i's total return on week τ. When we examine the impact of share pledging on these two measures of idiosyncratic volatility, we still find negative and significant effects. These results indicate that in addition to the effect on earnings volatility, share pledging also leads to less volatile stock returns.

(5) Alternative measures of R&D expenditures. In Panel E, we employ a series of alternative measures of innovation inputs. In Column (1), we restrict the sample to observations with non-zero R&D expenditures to mitigate the concern that observations with zero R&D expenditures drive our results. Although the sample size shrinks, the baseline result still holds. To measure the relative scale of R&D expenditures, we employ *Rd_Asset*, the ratio of R&D expenditures to total assets as the dependent variable. In Column (3), we keep only those observations with non-zero *RD_Asset*. In Column (4), the dependent variable is *Rd_Sale*, the ratio of R&D expenditures to total sales. The negative effect of share pledging on innovation inputs continues to hold throughout the columns.

In summary, our baseline findings are robust to changes in measures of share pledging and corporate risk-taking, which further buttress our main arguments.

[Insert Table 12 here]

V. Conclusions

In this paper, we examine the effect of share pledging on corporate risk-taking. We employ a multivariable regression analysis and find that an increase in share pledging leads to less volatile earnings and tightened R&D expenditures. We use a propensity-score matched sample to address the systematic differences between firms that engage in pledging shares with firms that do not, and employ the Heckman two-stage approach to address self-selection issues. We then employ a regulatory change on share pledging in 2013 as a quasi-exogenous shock and conduct a differences-in-differences analysis. We also perform a 2SLS analysis to further address possible endogeneity concerns. Additional analysis indicates that firms with higher levels of share pledging obtain more granted invention patents with tightened R&D expenditures and have higher market values, indicating that share pledging improves the investment efficiency of risky projects. Overall, our evidence suggests that share pledging releases valuable information about borrowers, enabling creditors to constrain corporate insiders' incentives of excessive risk-taking by improving the efficiency of risky investments.

References

Acemoglu D, Zilibotti F. Was Prometheus unbound by chance? Risk, diversification, and growth[J]. Journal of Political Economy, 1997, 105(4): 709-751.

Acharya V V, Amihud Y, Litov L. Creditor rights and corporate risk-taking[J]. Journal of Financial Economics, 2011, 102(1): 150-166.

Agarwal V, Vashishtha R, Venkatachalam M. Mutual fund transparency and corporate myopia[J]. Review of Financial Studies, 2017.

Allen F, Qian J, Qian M. Law, finance, and economic growth in China[J]. Journal of Financial Economics, 2005, 77(1): 57-116.

Altman E I. Financial ratios, discriminant analysis and the prediction of corporate bankruptcy[J]. Journal of Finance, 1968, 23(4): 589-609.

Asija A, Marisetty V B, Rangan S. Do insiders who pledge their shares manipulate reported earnings?[J]. 2014, working paper.

Barnea A, Haugen R A, Senbet L W. A rationale for debt maturity structure and call provisions in the agency theoretic framework[J]. Journal of Finance, 1980, 35(5): 1223-1234.

Bernile G, Bhagwat V, Yonker S. Board diversity, firm risk, and corporate policies[J]. Journal of Financial Economics, 2018(127): 588-612.

Boubakri N, Cosset J C, Saffar W. The role of state and foreign owners in corporate risk-taking: Evidence from privatization[J]. Journal of Financial Economics, 2013, 108(3): 641-658.

Brogaard J, Li D, Xia Y. Stock liquidity and default risk[J]. Journal of Financial Economics, 2017, 124(3): 486-502.

Campello M, Giambona E. Real assets and capital structure[J]. Journal of Financial and Quantitative Analysis, 2013, 48(5): 1333-1370.

Cassell C A, Huang S X, Sanchez J M, et al. Seeking safety: The relation between CEO inside debt holdings and the riskiness of firm investment and financial policies[J]. Journal of Financial Economics, 2012, 103(3): 588-610.

Cerqueiro G, Ongena S, Roszbach K. Collateralization, bank loan rates, and monitoring[J]. Journal of Finance, 2016, 71(3): 1295-1322.

Chan K, Chen H K, Hu S Y, et al. Share pledges and margin call pressure[J]. Journal of Corporate Finance, 2018, 52: 96-117.

Chava S, Livdan D, Purnanandam A. Do shareholder rights affect the cost of bank loans?[J]. Review of Financial Studies, 2008, 22(8): 2973-3004.

Chen H K, Hu S. The information content of insider pledging[J]. 2017, working paper.

Chen J, Hong H, Stein J C. Forecasting crashes: Trading volume, past returns, and conditional skewness in stock prices[J]. Journal of financial Economics, 2001, 61(3): 345-381.

Chen Y, Hu S Y. The controlling shareholder's personal leverage and firm performance[J]. Applied Economics, 2007, 39(8): 1059-1075.

Chen S, Sun Z, Tang S, et al. Government intervention and investment efficiency: Evidence from China[J]. Journal of Corporate Finance, 2011, 17(2): 259-271.

Coles J L, Daniel N D, Naveen L. Managerial incentives and risk-taking[J]. Journal of Financial Economics, 2006, 79(2): 431-468.

Cornett M M, Marcus A J, Tehranian H. Corporate governance and pay-for-performance: The impact of

earnings management[J]. Journal of Financial Economics, 2008, 87(2): 357-373.
Cronqvist H, Makhija A K, Yonker S E. Behavioral consistency in corporate finance: CEO personal and corporate leverage[J]. Journal of Financial Economics, 2012, 103(1): 20-40.
Dechow P M, Dichev I D. The quality of accruals and earnings: The role of accrual estimation errors[J]. The Accounting Review, 2002, 77(s-1): 35-59.
Dou Y, Masulis R W, Zein J. Shareholder wealth consequence of insider pledging of company stock as collateral for personal loans[J]. 2017, working paper.
Eisdorfer A. Empirical evidence of risk shifting in financially distressed firms[J]. Journal of Finance, 2008, 63(2): 609-637.
Ekström E, Wanntorp H. Margin call stock loans[J]. 2008, working paper.
Faccio M, Marchica M T, Mura R. Large shareholder diversification and corporate risk-taking[J]. Review of Financial Studies, 2011, 24(11): 3601-3641.
Faccio M, Marchica M T, Mura R. CEO gender, corporate risk-taking, and the efficiency of capital allocation[J]. Journal of Corporate Finance, 2016, 39: 193-209.
Fang V W, Tian X, Tice S. Does stock liquidity enhance or impede firm innovation?[J]. Journal of Finance, 2014, 69(5): 2085-2125.
Favara G, Morellec E, Schroth E, et al. Debt enforcement, investment, and risk taking across countries[J]. Journal of Financial Economics, 2017, 123(1): 22-41.
Galai D, Masulis R W. The option pricing model and the risk factor of stock[J]. Journal of Financial Economics, 1976, 3(1-2): 53-81.
Gopalan R, Jayaraman S. Private control benefits and earnings management: evidence from insider controlled firms[J]. Journal of Accounting Research, 2012, 50(1): 117-157.
Gormley T A, Matsa D A. Growing out of trouble? Corporate responses to liability risk[J]. Review of Financial Studies, 2011, 24(8): 2781-2821.
Gormley T A, Matsa D A. Playing it safe? Managerial preferences, risk, and agency conflicts[J]. Journal of Financial Economics, 2016, 122(3): 431-455.
Hao Y, Lu J. The impact of government intervention on corporate investment allocations and efficiency: Evidence from China[J]. Financial Management, 2018, 47(2): 383-419.
Hayes R M, Lemmon M, Qiu M. Stock options and managerial incentives for risk taking: Evidence from FAS 123R[J]. Journal of Financial Economics, 2012, 105(1):174-190.
He J J, Tian X. The dark side of analyst coverage: The case of innovation[J]. Journal of Financial Economics, 2013, 109(3): 856-878.
He Z L, Tong T W, Zhang Y, et al. Constructing a Chinese patent database of listed firms in China: Descriptions, lessons, and insights[J]. Journal of Economics & Management Strategy, 2018, 27(3): 579-606.
Hilary G, Hui K W. Does religion matter in corporate decision making in America?[J]. Journal of Financial Economics, 2009, 93(3): 455-473.
Hutton A P, Marcus A J, Tehranian H. Opaque financial reports, R^2, and crash risk[J]. Journal of Financial Economics, 2009, 94(1):67-86.
Hwang A L J, Qiao Y, Ku C. Pledge or not pledge? Shares owned by insiders pledged for collateral[J]. 2016, working paper.
Imbens G W, Angrist J D. Identification and estimation of local average treatment effects[J]. Econometrica, 1994, 62(2):467-475.
Jagannathan R, Matsa D A, Meier I, et al. Why do firms use high discount rates?[J]. Journal of Financial

Economics, 2016, 120(3): 445-463.
Jensen M C, Meckling W H. Theory of the firm: Managerial behavior, agency costs and ownership structure[J]. Journal of Financial Economics, 1976, 3(4): 305-360.
Jiang F, Jiang Z, Kim K A, et al. Family-firm risk-taking: does religion matter?[J]. Journal of Corporate Finance, 2015, 33: 260-278.
Jiang F, Kim K A. Corporate governance in China: A modern perspective[J]. Journal of Corporate Finance, 2015 (32): 190-216.
Jiang W. Have instrumental variables brought us closer to the truth[J]. Review of Corporate Finance Studies, 2017, 6(2): 127-140.
Jin L, Myers S C. R^2 around the world: New theory and new tests[J]. Journal of Financial Economics, 2006, 79(2):257-292.
John K, Litov L, Yeung B. Corporate governance and risk-taking[J]. Journal of Finance, 2008, 63(4): 1679-1728.
Jones J J. Earnings management during import relief investigations[J]. Journal of Accounting Research, 1991: 193-228.
Keil J, Müller K. Do firms pledge their pledgeable assets?[J]. 2016, working paper.
Kim J B, Li Y, Zhang L. Corporate tax avoidance and stock price crash risk: Firm-level analysis[J]. Journal of Financial Economics, 2011, 100(3): 639-662.
Kim E H, Lu Y. CEO ownership, external governance, and risk-taking[J]. Journal of Financial Economics, 2011, 102(2): 272-292.
Laeven L, Levine R. Bank governance, regulation and risk taking[J]. Journal of Financial Economics, 2009, 93(2): 259-275.
Li K, Prabhala N. Self-selection models in corporate finance[J]. Handbook of corporate finance: Empirical corporate finance, 2007, 1: 37.
Li K, Griffin D, Yue H, et al. How does culture influence corporate risk-taking?[J]. Journal of Corporate Finance, 2013, 23: 1-22.
Li M, Liu C, Scott T. Share pledges and firm value. 2018, working paper.
Li X, Wang S S, Wang X. Trust and stock price crash risk: Evidence from China[J]. Journal of Banking & Finance, 2017, 76: 74-91.
Lin C, Ma Y, Malatesta P, et al. Ownership structure and the cost of corporate borrowing[J]. Journal of Financial Economics, 2011, 100(1): 1-23.
Ljungqvist A, Zhang L, Zuo L. Sharing risk with the government: How taxes affect corporate risk taking[J]. Journal of Accounting Research, 2017, 55(3): 669-707.
Margrabe W. The value of an option to exchange one asset for another[J]. Journal of Finance, 1978, 33(1): 177-186.
Myers S C. Determinants of corporate borrowing[J]. Journal of Financial Economics, 1977, 5(2): 147-175.
Panousi V, Papanikolaou D. Investment, idiosyncratic risk, and ownership[J]. Journal of Finance, 2012, 67(3): 1113-1148.
Parrino R, Poteshman A M, Weisbach M S. Measuring investment distortions when risk-averse managers decide whether to undertake risky projects[J]. Financial Management, 2005, 34(1): 21-60.
Picker R C. Security interests, misbehavior, and common pools[J]. University of Chicago Law Review, 1992, 59(2): 645-679.
Rajan R, Winton A. Covenants and collateral as incentives to monitor[J]. Journal of Finance, 1995, 50(4): 1113-1146.

Rosenbaum P R, Rubin D B. The central role of the propensity score in observational studies for causal effects[J]. Biometrika, 1983, 70(1): 41-55.

Shipman J E, Swanquist Q T, Whited R L. Propensity score matching in accounting research[J]. The Accounting Review, 2017, 92(1): 213-244.

Shleifer A, Vishny R W. Liquidation values and debt capacity: A market equilibrium approach[J]. Journal of Finance, 1992, 47(4): 1343-1366.

Shleifer A, Vishny R W. A survey of corporate governance[J]. Journal of Finance, 1997, 52(2): 737-783.

Shue K, Townsend R. How do quasi-random option grants affect CEO risk-taking?[J]. Journal of Finance, 2017.

Singh P P. Does pledging of shares by controlling shareholders always destroy firm value?[J]. 2017, working paper.

Stock J H, Yogo M. Testing for weak instruments in linear IV regression[J]. Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg, 2005: 80.

Wang Y C, Chou R K. The impact of share pledging regulations on stock trading and firm valuation[J]. Journal of Banking & Finance, 2018, 89: 1-13.

Xie D, Zheng D, Cui C. Is controlling shareholder’s share pledge a potential “mine’’[J]. Management World, 2016, 5: 128-140. (In Chinese)

Xu N, Li X, Yuan Q, et al. Excess perks and stock price crash risk: Evidence from China[J]. Journal of Corporate Finance, 2014, 25: 419-434.

Yu X, Zhang P, Zheng Y. Corporate governance, political connections, and intra-industry effects: Evidence from corporate scandals in China[J]. Financial Management, 2015, 44(1): 49-80.

Zhu W. Accruals and price crashes[J]. Review of Accounting Studies, 2016, 21(2): 349-399.

Appendix: Summary Statistics and Variable Definitions

Table A.1
Variable Definitions

Variable	Definition
Panel A: Main measures	
ROA_Vol	Earnings volatility, the standard deviation of a firm's return on assets (ROA) over the following four quarters.
LogRd	Research and development (R&D) expenditures, the natural logarithm of one plus R&D expenditures. The missing values of R&D expenditures are coded with zero.
Pledge	Share pledging ratio, the number of shares pledged by controlling shareholders as a percentage of total shares by the end of a given year.
Pledge_Dummy	Share pledging dummy, a dummy variable that equals to one if the fraction of share pledging is larger than zero by the end of a given year, and zero otherwise.
Size	Firm size, the natural logarithm of total assets.
Leverage	Firm leverage, the ratio of total debt to total assets.
Age	Firm age, the logarithm of one plus the current year, minus the listing year.
MB	Market-to-book ratio, the ratio of the market value of equity to the book value of equity.
Opcf	Operating cash flow, the ratio of net cash flows from operating activities to total assets.
Gsale	Cash holdings, the ratio of cash and cash equivalents to total assets.
Capex	Capital expenditures, the ratio of capital expenditures to total assets.
Top1	Ownership concentration, the fraction of shares held by the largest shareholder.
Panel B: Alternative measures of risk-taking	
ROA_Vol_Adj	The standard deviation of a firm's industry-adjusted ROA over the following four quarters.
ROA_Vol_8q	The standard deviation of a firm's ROA over the following eight quarters.
ROE_Vol	The standard deviation of a firm's return on equity (ROE) over the following four quarters.
ROE_Vol_8q	The standard deviation of a firm's ROE over the following eight quarters.
ROA_Vol_3y	The standard deviation of a firm's industry-adjusted ROA over the following three years.
ROA_Mm_3y	The difference between the maximum and minimum of a firm's industry-adjusted ROA over a three-year interval.
ROA_Vol_4y	The standard deviation of a firm's industry-adjusted ROA over the following four years.
ROA_Mm_4y	The difference between the maximum and minimum of a firm's industry-adjusted ROA over a four-year interval.
Ret_Vol	The standard deviation of a firm's weekly returns in a given year.
Ret_Vol_d	The standard deviation of a firm's daily returns in a given year.
LogIdio_Vol_Indadj	Idiosyncratic volatility, calculated as in Equation (X) in the context.
LogIdio_Vol_Madj	Idiosyncratic volatility, calculated as in Equation (X) in the context.
Rd_Asset	The ratio of R&D expenditures to total assets. The missing values of R&D expenditures are coded with zero.
Rd_Sale	The ratio of R&D expenditures to total sales. The missing values of R&D expenditures

	are coded with zero.
LogPatent1_Grant	The natural logarithm of one plus the sum of the number of invention patent applications filed and eventually granted to a firm in a given year. The missing values of invention patent applications are coded with zero.

Panel C: Other measures

Treat	An indicator variable of the treatment group that equals to one if a firm's amount of pledged shares increase the most (in the top three deciles of the sample) around the regulatory change in 2013, and zero otherwise.
Post13	An indicator variable of the regulatory change in 2013 that equals to one if it is year 2013 or after, and zero otherwise.
Pledge_IV_Ind	The average *Pledge* of all firms in the same CSRC 2-digit industry, excluding firm i's own level of *Pledge*.
Pledge_IV_Prov	The average *Pledge* of all firms in the same province, excluding firm i's own level of *Pledge*.
Az	The Altman-Z score, calculated following the research of Altman (1968).
Indratio	Board independence, the ratio of the number of independent directors over the total number of directors on the board.
Inst	Institutional ownership, the sum of the fractions of shares held by institutional investors.
Coverage	Analyst coverage, the logarithm of one plus the number of analysts who issued earnings forecasts for a firm in a given year.
Separation	Control wedge, the percentage point difference in the control rights and cash flow rights held by each controlling shareholder.
Audit	Auditor quality, a dummy variable that equals to one if the firm hires foreign auditors, and zero otherwise.
HHI	Industry concentration, the Herfindahl-Hirschman Index calculated based on total sales for 2-digit CSRC industries in a given year.
AbsDac_Jones	Earnings quality, measured by the absolute value of abnormal accruals and calculated following the process in Cornett (2008) using a modified model of Jones (1991) as follows: $\mathrm{TA}_{i,t} = NI_{i,t} - OCF_{i,t}$ $\frac{\mathrm{TA}_{i,t}}{A_{i,t-1}} = \alpha_0 \frac{1}{A_{i,t-1}} + \alpha_1 \frac{\Delta Sales_{i,t}}{A_{i,t-1}} + \alpha_2 \frac{PPE_{i,t}}{A_{i,t-1}} + \varepsilon_{i,t}$ $\mathrm{NDac\_Jones}_{i,t} = \hat{\alpha}_0 \frac{1}{A_{i,t-1}} + \hat{\alpha}_1 \frac{\Delta Sales_{i,t} - \Delta Receivables_{i,t}}{A_{i,t-1}} + \hat{\alpha}_2 \frac{PPE_{i,t}}{A_{i,t-1}}$ $\mathrm{Dac\_Jones}_{i,t} = \frac{\mathrm{TA}_{i,t}}{A_{i,j-1}} - \mathrm{NDac\_Jones}_{i,t}$ $\mathrm{AbsDac\_Jones}_{i,t} = \left\|\mathrm{Dac\_Jones}_{i,t}\right\|$ where TA denotes the total accruals calculated by net income (NI) minus operating cash flow (OCF), A denotes total assets, $\Delta Sales$ denotes the changes in total sales, denotes property, PPE denotes plant and equipment, and $\Delta Receivables$ denotes changes in account receivables.
AbsDac_DD	Earnings management, measured by the absolute value of abnormal accruals and calculated following the process in Dechow and Dichev (2002) using a modified model of

	Jones (1991) as follows: $$\frac{TA_{i,t}}{A_{i,t-1}} = \lambda_0 + \lambda_1 \frac{CFO_{t-1}}{A_{i,t-2}} + \lambda_2 \frac{CFO_t}{A_{i,t-1}} + \lambda_3 \frac{CFO_{t+1}}{A_{i,t}} + \lambda_4 \frac{\Delta Sales_{i,t}}{A_{i,t-1}} + \lambda_5 \frac{PPE_{i,t}}{A_{i,t-1}} + \varepsilon_{i,t}$$ $$\text{NDac\_DD}_{i,t} = \hat{\lambda}_1 \frac{CFO_{t-1}}{A_{i,t-2}} + \hat{\lambda}_2 \frac{CFO_t}{A_{i,t-1}} + \hat{\lambda}_3 \frac{CFO_{t+1}}{A_{i,t}} + \hat{\lambda}_4 \frac{\Delta Sales_{i,t}}{A_{i,t-1}} + \hat{\lambda}_5 \frac{PPE_{i,t}}{A_{i,t-1}}$$ $$\text{Dac\_DD}_{i,t} = \frac{TA_{i,t}}{A_{i,j-1}} - \text{NDac\_DD}_{i,t}$$ $$\text{AbsDac\_DD}_{i,t} = \left\|\text{Dac\_DD}_{i,t}\right\|$$ where CFO denotes net operating cash flows.
Ncskew	Stock price crash risk, measured as in Kim et al. (2011): $$r_{i,j} = \beta_0 + \beta_1 r_{m,j-2} + \beta_2 r_{m,j-1} + \beta_3 r_{m,j} + \beta_4 r_{m,j+1} + \beta_5 r_{m,j+2} + \varepsilon_{i,j}$$ $$W_{i,j} = Log(1 + \varepsilon_{i,j})$$ $$Ncskew_{i,t} = -[n(n-1)^{\frac{3}{2}} \sum W_{i,j}^3]/[(n-1)(n-2)(\sum W_{i,j}^2)^{3/2}]$$ where $r_{i,j}$ denotes the return on stock i in week j, $r_{m,j}$ denotes the value-weighted A-share market return in week j, and *n* denotes the number of trading weeks.
Duvol	Stock price crash risk, measured as in Kim et al. (2011): $$Duvol_{i,t} = \log\{[(n_u - 1) \sum_{Down} w_{i,j}^2]/[(n_d - 1) \sum_{Up} w_{i,j}^2]\}$$ where n_u and n_d denote the number of weeks with firm-specific weekly returns above or below the annual mean, respectively.
Turnover	Stock turnover rate, the average daily stock turnover rate in a given year.
Ret	Stock return, the average of firm-specific weekly returns in a given year.
Sigma	Stock return volatility, the standard deviation of firm-specific weekly returns in a given year.
Accm	The average of the absolute value of discretionary accruals in year t, t-1, and t-2.

Table A.2

Propensity Score Matching: Post-Match Differences

This table presents statistics of the post-match differences in propensity score matching. Column (1) presents the sample average of firm characteristics in the treated group. Column (2) presents the sample average of firm characteristics in the control group. Column (3) presents the t-test value of the differences between Columns (1) and (2). Column (4) presents the significant level of the sample-mean difference test between Columns (1) and (2). Definitions of all of these variables are provided in Table A.1 in this Appendix.

	Treated	**Control**	**t-value**	**p-value**
	(1)	**(2)**	**(3)**	**(4)**
Size	21.67	21.66	0.33	0.74
Lev	0.48	0.48	0.11	0.91
Age	2.01	2.01	-0.21	0.84
MB	2.01	2.00	0.23	0.82
Opcf	0.04	0.04	1.16	0.25
Gsale	0.12	0.12	-0.04	0.97
Capex	0.06	0.06	0.34	0.74
Top1	0.36	0.36	0.80	0.43

Table A.3

Propensity Score Matching Attached to the Differences-in-Differences Analysis

Panel A presents parameter estimates from the Probit model used to estimate propensity scores for firms in the treatment and control groups. Panel B reports the distribution of estimated propensity scores for the treatment firms, control firms, and the difference in estimated propensity scores post matching. Panel C presents statistics of the post-match differences in propensity score matching attached to the Differences-in-Differences analysis. Column (1) presents the sample average of firm characteristics in the treated group. Column (2) presents the sample average of firm characteristics in the control group. Column (3) presents the t-test value of the differences between Columns (1) and (2). Column (4) presents the significant level of the sample-mean difference test between Columns (1) and (2). Definitions of all of these variables are provided in Table A.1 in this Appendix.

Panel A: Pre-match regression and post-match diagnostic regression

	Pre-match	**Post-match**
	(1)	**(2)**
Size	-0.258***	0.003
	(0.056)	(0.105)
Lev	0.317	-0.516
	(0.280)	(0.522)
Age	-0.785***	0.077
	(0.080)	(0.149)
MB	-0.073**	-0.043
	(0.037)	(0.064)
Opcf	-0.312	-1.129
	(0.635)	(1.240)
Gsale	0.417***	-0.179
	(0.151)	(0.257)
Capex	0.716	0.225
	(0.993)	(1.940)
Top1	-1.445***	0.605
	(0.338)	(0.618)
Industry FE	Yes	Yes
N	2,404	599
Pseudo_R2	0.111	0.028

Table A.3 (Continued)

Panel B: Estimated propensity score distributions								
	Num	**Mean**	**Sd.**	**Min**	**P25**	**Median**	**P75**	**Max**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Treatment	306	0.335	0.147	0.031	0.215	0.320	0.451	0.671
Control	306	0.335	0.147	0.031	0.215	0.320	0.452	0.671
Difference	-	0.000	0.000	0.000	0.000	0.000	-0.001	0.000

Table A.3 (Continued)

Panel C: Post-match differences				
	Treated	**Control**	**t-value**	**p-value**
	(1)	**(2)**	**(3)**	**(4)**
Size	21.91	21.89	0.17	0.87
Lev	0.45	0.45	-0.50	0.62
Age	2.10	2.09	0.19	0.85
MB	1.78	1.91	-0.84	0.40
Opcf	0.03	0.04	-0.34	0.73
Gsale	0.12	0.14	-0.80	0.43
Capex	0.05	0.05	0.27	0.79
Top1	0.36	0.35	1.06	0.29

Table 1

Sample Description of Share Pledging

This table presents statistics of share pledging by year and industry.

Panel A: Distribution by year

Year	Number of observations (1)	Percentage of firms involved in share pledging (*Pledge_Dummy*=1) (2)	Average ratio of pledged shares/total shares (*Pledge*) (3)	Average ratio of pledged shares/total shares (conditional on *Pledge_Dummy*=1) (4)
2005	1217	0.326	0.073	0.223
2006	1281	0.301	0.065	0.216
2007	1397	0.258	0.051	0.197
2008	1474	0.270	0.052	0.194
2009	1567	0.262	0.054	0.205
2010	1897	0.232	0.045	0.192
2011	2183	0.244	0.047	0.193
2012	2336	0.429	0.085	0.198
2013	2349	0.503	0.100	0.199
2014	2420	0.552	0.109	0.198
2015	2587	0.611	0.114	0.186
Total	20708	0.388	0.077	0.197

Table 1 (Continued)

Panel B: Distribution by industry

Industry	Number of observations (1)	Percentage of firms involved in share pledging (*Pledge_Dummy*=1) (2)	Average ratio of pledged shares/total shares (*Pledge*) (3)	Average ratio of pledged shares/total shares (conditional on *Pledge_Dummy*=1) (4)
A-Agriculture	354	0.407	0.075	0.184
B-Mining	611	0.391	0.086	0.220
C-Manufacturing	12433	0.403	0.077	0.192
D-Electronic and energy supply	932	0.290	0.046	0.159
E-Construction	595	0.338	0.072	0.212
F-Retail and wholesale	1321	0.351	0.070	0.198
G-Transportation	793	0.155	0.036	0.234
H-Accommodation and catering	90	0.389	0.080	0.206
I-Information technology	1063	0.422	0.073	0.173
K-Real estate	1266	0.457	0.124	0.270
L-Leasing and business service	309	0.414	0.088	0.212
M-Scientific research	106	0.396	0.048	0.120
N-Public facility management	229	0.393	0.078	0.199
P-Education	11	0.182	0.003	0.016
Q-Health	57	0.544	0.129	0.238
R-Entertainment	294	0.401	0.081	0.201
S-Comprehensive	244	0.393	0.057	0.145
Total	20708	0.388	0.077	0.197

Table 2

Summary Statistics of the Main Variables

This table reports the summary statistics of the main variables used in our regressions estimated by the full sample that consists of firm-year observations. Columns (1) through (7) report the summary statistics of the variables in the full sample. Variable definitions are provided in Table A.1 in this Appendix.

	Num	**Mean**	**Sd.**	**P25**	**Median**	**P75**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
ROA_Vol	20,678	0.013	0.019	0.004	0.007	0.013
LogRd $_{t+1}$	19,491	9.619	8.798	0.000	15.728	17.689
Pledge	20,708	0.077	0.132	0.000	0.000	0.114
Pledge_Dummy	20,708	0.388	0.487	0.000	0.000	1.000
Size	20,708	21.736	1.250	20.867	21.598	22.441
Lev	20,708	0.465	0.244	0.286	0.461	0.624
Age	20,708	1.984	0.854	1.386	2.197	2.639
MB	20,708	2.160	2.068	0.823	1.530	2.718
Opcf	20,708	0.044	0.082	0.003	0.044	0.088
Gsale	20,708	0.124	0.346	-0.025	0.112	0.253
Capex	20,708	0.058	0.056	0.017	0.041	0.080
Top1	20,708	0.364	0.155	0.241	0.344	0.477

Table 3

Share Pledging and Corporate Risk-Taking

This table estimates the effect of share pledging on corporate risk-taking. All of the variables are as defined in Table A.1 in this Appendix. The sample period covers the years 2005 through 2015 in Columns (1) and (3), and the years 2006 to 2015 in Columns (2) and (4). All of our regressions control for year- and firm-fixed effects. The robust standard errors are clustered at the firm level. Robust standard errors are reported in parentheses. The coefficients marked with *, **, and *** are significant at 10%, 5%, and 1%, respectively.

	ROA_Vol (1)	$LogRd_{t+1}$ (2)	ROA_Vol (3)	$LogRd_{t+1}$ (4)
Pledge	-0.003**	-1.757***	-0.005**	-2.321***
	(0.001)	(0.520)	(0.002)	(0.699)
Size	-0.003***	0.795***	-0.006***	0.573***
	(0.000)	(0.082)	(0.001)	(0.192)
Lev	0.030***	-1.439***	0.037***	0.399
	(0.002)	(0.356)	(0.002)	(0.531)
Age	0.000	-2.129***	-0.002***	-2.164***
	(0.000)	(0.097)	(0.000)	(0.245)
MB	0.003***	0.057	0.001***	0.112**
	(0.000)	(0.041)	(0.000)	(0.049)
Opcf	0.001	2.098***	0.001	0.737
	(0.003)	(0.687)	(0.003)	(0.694)
Gsale	-0.003***	-0.132	-0.002***	-0.432***
	(0.001)	(0.130)	(0.001)	(0.134)
Capex	-0.021***	3.787***	-0.019***	-0.567
	(0.002)	(1.133)	(0.003)	(1.201)
Top1	-0.002	-0.523	-0.008**	-2.250*
	(0.001)	(0.497)	(0.003)	(1.197)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	No	No
Firm FE	No	No	Yes	Yes
N	20,678	19,491	20,678	19,491
Adj_R2	0.263	0.573	0.384	0.685

Table 4

Propensity-Score-Matched Sample

This table estimates the effect of share pledging on corporate risk-taking based on a propensity-score-matched sample. All of the variables are as defined in Table A.1 in this Appendix. The sample period covers the years 2005 through 2015 in Column (1), and the years 2006 to 2015 in Column (2). All of our regressions control for year- and firm-fixed effects. The robust standard errors are clustered at the firm level. Robust standard errors are reported in parentheses. The coefficients marked with *, **, and *** are significant at 10%, 5%, and 1%, respectively.

	ROA_Vol	$LogRd_{t+1}$
	(1)	(2)
Pledge	-0.007***	-1.484*
	(0.003)	(0.857)
Size	-0.007***	0.491**
	(0.001)	(0.225)
Lev	0.034***	0.637
	(0.003)	(0.597)
Age	-0.001	-2.059***
	(0.001)	(0.350)
MB	0.002***	0.046
	(0.000)	(0.068)
Opcf	-0.000	1.396
	(0.004)	(0.916)
Gsale	-0.002**	-0.439**
	(0.001)	(0.192)
Capex	-0.016***	0.046
	(0.005)	(1.620)
Top1	-0.005	-2.017
	(0.005)	(1.477)
Year FE	Yes	Yes
Firm FE	Yes	Yes
N	8,401	7,821
Adj_R2	0.362	0.698

Table 5

The Heckman Two-Stage Approach

This table estimates the treatment effect of share pledging on corporate risk-taking based on the Heckman two-stage approach. All of the variables are as defined in Table A.1 in this Appendix. The sample period covers the years 2005 through 2015 in Columns (1) and (2), and the years 2006 to 2015 in Columns (3) and (4). All of our regressions control for year- and firm-fixed effects. The robust standard errors are clustered at the firm level. Robust standard errors are reported in parentheses. The coefficients marked with *, **, and *** are significant at 10%, 5%, and 1%, respectively.

	1st stage	2nd stage	1st stage	2nd stage
	Pledge_Dummy	ROA_Vol	Pledge_Dummy	$LogRd_{t+1}$
	(1)	(2)	(3)	(4)
Pledge_Dummy		-0.001**		-0.360***
		(0.000)		(0.099)
Size	-0.284***	-0.003***	-0.505***	0.929***
	(0.058)	(0.000)	(0.013)	(0.106)
Lev	-0.938***	0.030***	0.541***	-1.498***
	(0.359)	(0.001)	(0.064)	(0.232)
Age	0.881***	0.000	-0.065***	-2.384***
	(0.103)	(0.000)	(0.017)	(0.065)
MB	-0.045	0.002***	-0.296***	0.256***
	(0.034)	(0.000)	(0.007)	(0.075)
Opcf	-1.025	0.001	0.625***	1.597***
	(0.936)	(0.002)	(0.161)	(0.590)
Gsale	0.773***	-0.003***	0.430***	-0.340**
	(0.271)	(0.001)	(0.038)	(0.153)
Capex	-0.710	-0.021***	3.189***	3.280***
	(1.144)	(0.003)	(0.280)	(0.976)
Top1	-0.089	-0.002	0.868***	-0.930***
	(0.448)	(0.001)	(0.086)	(0.351)
Inverse Mills ratio		0.024*		-0.948
		(0.013)		(0.621)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
N	20,727	20,727	19,510	19,510

Table 6

Differences-in-Differences Approach

This table estimates the effect of share pledging on corporate risk-taking based on the DiD approach. All of the variables are as defined in Table A.1 in this Appendix. The sample period covers the years 2010 through 2015. All of our regressions control for year- and firm-fixed effects. The robust standard errors are clustered at the firm level. Robust standard errors are reported in parentheses. The coefficients marked with *, **, and *** are significant at 10%, 5%, and 1%, respectively.

	ROA_Vol	$LogRd_{t+1}$	ROA_Vol	$LogRd_{t+1}$
	(2)	(3)	(3)	(4)
Treat*Post13	-0.002**	-0.734**		
	(0.001)	(0.315)		
Treat*D_12			-0.001	-0.720
			(0.002)	(0.469)
Treat*D_13			-0.002	-0.896*
			(0.002)	(0.469)
Treat*D_14			-0.003**	-0.983**
			(0.002)	(0.474)
Treat*D_15			-0.003*	-1.098**
			(0.002)	(0.474)
Size	-0.005***	0.668**	-0.005***	0.687**
	(0.001)	(0.267)	(0.001)	(0.268)
Lev	0.029***	0.457	0.029***	0.446
	(0.003)	(0.808)	(0.003)	(0.808)
Age	-0.003***	-3.544***	-0.003***	-3.553***
	(0.001)	(0.370)	(0.001)	(0.370)
MB	0.001***	0.123	0.001***	0.124*
	(0.000)	(0.075)	(0.000)	(0.075)
Opcf	-0.002	0.234	-0.002	0.287
	(0.004)	(1.310)	(0.004)	(1.311)
Gsale	0.001	-0.023	0.001	-0.027
	(0.001)	(0.275)	(0.001)	(0.275)
Capex	-0.023***	1.073	-0.023***	0.965
	(0.007)	(2.159)	(0.007)	(2.161)
Top1	-0.016***	1.605	-0.016***	1.563
	(0.005)	(1.700)	(0.005)	(1.700)
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
N	3,029	3,029	2,892	2,892
Adj_R2	0.089	0.264	0.090	0.264

Table 7

Instrumental Variable Analysis

This table presents estimates of the effect of share pledging on corporate risk-taking. All of the variables are as defined in Table A.1 in this Appendix. The sample period covers the years 2005 through 2015. All of the regressions control for year- and firm-fixed effects. The robust standard errors are clustered at the firm level. Robust standard errors are reported in parentheses. The coefficients marked with *, **, and *** are significant at 10%, 5%, and 1%, respectively.

	1st stage Pledge (1)	2nd stage ROA_Vol (2)	1st stage Pledge (3)	2nd stage LogRd (4)
Pledge		-0.060**		-48.331***
		(0.025)		(11.866)
Pledge_IV_Ind	0.330***		0.330***	
	(0.063)		(0.063)	
Pledge_IV_Prov	0.199**		0.197**	
	(0.098)		(0.098)	
Size	0.030***	-0.004***	0.030***	2.025***
	(0.003)	(0.001)	(0.003)	(0.436)
Lev	0.011	0.035***	0.011	0.961
	(0.010)	(0.002)	(0.011)	(0.664)
Age	0.064***	0.001	0.063***	0.766
	(0.004)	(0.002)	(0.004)	(0.818)
MB	0.003***	0.002***	0.003***	0.238***
	(0.001)	(0.000)	(0.001)	(0.071)
Opcf	0.017	0.003	0.018	1.641**
	(0.013)	(0.003)	(0.013)	(0.830)
Gsale	-0.005*	-0.001	-0.005*	-0.679***
	(0.003)	(0.001)	(0.003)	(0.194)
Capex	-0.006	-0.018***	-0.006	-0.931
	(0.020)	(0.003)	(0.020)	(1.435)
Top1	0.106***	-0.003	0.110***	2.942
	(0.025)	(0.004)	(0.026)	(2.141)
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
N	19,229	19,229	19,260	19,260
F-test (1st stage)	60.89		60.66	
Hansen J		0.356		0.314
(p-value)		(0.551)		(0.575)
Adj_R2	0.157	0.077	0.156	0.103

Table 8

Share Pledging and Innovation Output

This table estimates the effect of share pledging on innovation output. All of the variables are as defined in Table A.1 in this Appendix. The sample period in Panel A and Columns (1)-(2), Panel C covers the years 2005 through 2015. The sample period in Panel B and Columns (3)-(4), Panel C covers the years 2010 through 2015. All of our regressions control for year- and firm-fixed effects. The robust standard errors are clustered at the firm level. Robust standard errors are reported in parentheses. The coefficients marked with *, **, and *** are significant at 10%, 5%, and 1%, respectively.

Panel A: Full sample

	$LogPatent1\_Grant_{t+1}$	$LogPatent1\_Grant_{t+2}$	$LogPatent1\_Grant_{adj\ t+1}$	$LogPatent1\_Grant_{adj\ t+2}$
	(1)	(2)	(3)	(4)
Pledge	0.139***	0.155***	0.119**	0.131**
	(0.054)	(0.053)	(0.056)	(0.056)
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
N	17,630	15,399	17,630	15,399
Adj_R2	0.584	0.582	0.578	0.577

Panel B: PSM-DID sample

	$LogPatent1\_Grant_{t+1}$	$LogPatent1\_Grant_{t+2}$	$LogPatent1\_Grant_{adj\ t+1}$	$LogPatent1\_Grant_{adj\ t+2}$
	(1)	(2)	(3)	(4)
Treat*Post13	0.103**	0.129**	0.093*	0.143**
	(0.049)	(0.059)	(0.054)	(0.067)
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
N	2,516	2,006	2,516	2,006
Adj_R2	0.069	0.032	0.032	0.004

Panel C: The effects on firm value

	Full sample		PSM-DID sample	
	$TobinQ_t$	$TobinQ_{t+1}$	$TobinQ_t$	$TobinQ_{t+1}$
	(1)	(2)	(3)	(4)
Pledge	0.383**	0.635***		
	(0.154)	(0.154)		
Treat*Post13			0.229***	0.279***
			(0.088)	(0.088)
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
N	20,708	20,565	3,036	3,025
Adj_R2	0.686	0.656	0.238	0.159

Table 9

Share Pledging and Financial Reporting Quality

This table examines whether the effect of share pledging on corporate risk-taking is consistent with an alternative explanation that reflects changes in the quality of financial reporting. All of the variables are as defined in Table A.1 in this Appendix. The sample period covers the years 2005 through 2015. All of our regressions control for year- and firm-fixed effects. The robust standard errors are clustered at the firm level. Robust standard errors are reported in parentheses. The coefficients marked with *, **, and *** are significant at 10%, 5%, and 1%, respectively.

	AbsDac_Jones	AbsDac_DD	$Ncskew_{t+1}$	$Duvol_{t+1}$
	(1)	(2)	(3)	(4)
Pledge	-0.026***	-0.014**	-0.210**	-0.245***
	(0.009)	(0.007)	(0.090)	(0.074)
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
N	22,451	19,574	16,557	16,557
Adj_R2	0.206	0.138	0.113	0.137

Table 10

Cross-sectional Analysis

This table examines the cross-sectional differences of the effect of share pledging on corporate risk-taking. All of the variables are as defined in Table A.1 in this Appendix. The sample period covers the years 2005 through 2015 in Columns (1) and (2), and the years 2006 to 2015 in Columns (3) and (4). All of our regressions control for year- and firm-fixed effects. The robust standard errors are clustered at the firm level. Robust standard errors are reported in parentheses. The coefficients marked with *, **, and *** are significant at 10%, 5%, and 1%, respectively.

Panel A: Altman's Z score

	ROA_Vol		$LogRd_{t+1}$	
	Low	High	Low	High
	(1)	(2)	(3)	(4)
Pledge	-0.008***	-0.000	-2.747***	-1.392
	(0.003)	(0.002)	(0.968)	(0.865)
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Differences (Z=)	2.219**		1.044	
N	8,611	9,530	8,555	9,415
Adj_R2	0.502	0.261	0.700	0.739

Panel B: Leverage ratio

	ROA_Vol		$LogRd_{t+1}$	
	High	Low	High	Low
	(1)	(2)	(3)	(4)
Pledge	-0.009***	0.002	-2.361***	-0.450
	(0.003)	(0.002)	(0.889)	(0.737)
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Differences (Z=)	3.051***		1.658*	
N	9,033	10,886	9,863	11,625
Adj_R2	0.486	0.267	0.679	0.735

Panel C: Debt maturity

	ROA_Vol		$LogRd_{t+1}$	
	Long	Short	Long	Short
	(1)	(2)	(3)	(4)
Pledge	-0.007**	-0.001	-2.418***	-0.618
	(0.003)	(0.003)	(0.891)	(0.715)
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Differences (Z=)	1.414		1.676*	
N	8,898	11,070	9,577	11,920
Adj_R2	0.443	0.387	0.720	0.703

Table 10 (Continued)

Panel D: SOE versus non-SOE

	ROA_Vol		$LogRd_{t+1}$	
	SOE	Non-SOE	SOE	Non-SOE
	(1)	(2)	(3)	(4)
Pledge	-0.006***	-0.003**	-3.682***	-1.384***
	(0.002)	(0.002)	(1.042)	(0.476)
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Differences (Z=)	1.061		2.006**	
N	9,887	10,505	9,071	10,420
Adj_R2	0.404	0.399	0.643	0.702

Table 11

Alternative Specifications

This table estimates the effect of share pledging on corporate risk-taking using alternative specifications. All of the variables are as defined in Table A.1 in this Appendix. The sample period covers the years 2005 through 2015 in Columns (1), (3), and (5), and the years 2006 to 2015 in Columns (2), (4), and (6). All of our regressions control for year- and firm-fixed effects. The robust standard errors are clustered at the firm level. Robust standard errors are reported in parentheses. The coefficients marked with *, **, and *** are significant at 10%, 5%, and 1%, respectively.

	ROA_Vol	$LogRd_{t+1}$	ROA_Vol	$LogRd_{t+1}$	ROA_Vol	$LogRd_{t+1}$
	(1)	(2)	(3)	(4)	(5)	(6)
Pledge_Dummy	-0.001**	-0.366**				
	(0.000)	(0.160)				
Pledge			-0.005***	-3.180***	-0.005**	-1.676***
			(0.002)	(0.626)	(0.002)	(0.605)
Indratio			-0.001	-0.764	-0.001	-0.520
			(0.002)	(0.742)	(0.002)	(0.702)
Inst			-0.002**	-2.570***	-0.001	-0.031
			(0.001)	(0.370)	(0.001)	(0.361)
Coverage			0.000	0.163*	0.000	0.075
			(0.000)	(0.086)	(0.000)	(0.079)
Separation			0.000	0.001	0.000	-0.009
			(0.000)	(0.020)	(0.000)	(0.018)
Audit			0.002*	-0.896*	0.003**	-0.187
			(0.001)	(0.500)	(0.001)	(0.459)
HHI			0.010**	-8.998***	0.012**	-1.825
			(0.005)	(2.212)	(0.005)	(2.222)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Province*Year FE	No	No	No	No	Yes	Yes
N	20,475	22,130	19,611	20,865	19,611	20,865
Adj_R2	0.389	0.694	0.383	0.664	0.386	0.700

Table 12

Additional Robustness Checks

This table examines the robustness of the effect of share pledging on corporate risk-taking. All of the variables are as defined in Table A.1 in this Appendix. The sample period covers the years 2005 through 2015 in Panels A, B, and C, and the years 2006 to 2015 in Panel D. All of our regressions control for year- and firm-fixed effects. The robust standard errors are clustered at the firm level. Robust standard errors are reported in parentheses. The coefficients marked with *, **, and *** are significant at 10%, 5%, and 1%, respectively.

Panel A: Other model specifications

	Excluding 2008-2009		Two-way cluster	
	ROA_Vol	$LogRd_{t+1}$	ROA_Vol	$LogRd_{t+1}$
	(1)	(2)	(3)	(4)
Pledge	-0.005**	-2.382***	-0.005*	-2.321**
	(0.002)	(0.679)	(0.002)	(0.978)
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
N	17,641	16,450	20,678	19,491
Adj_R2	0.365	0.693	0.389	0.685

Panel B: Alternative quarter-level measures of earnings volatility

	ROA_Vol_Adj	ROA_Vol_8q	ROE_Vol	ROE_Vol_8q
	(1)	(2)	(3)	(4)
Pledge	-0.004*	-0.005**	-0.010*	-0.014*
	(0.002)	(0.002)	(0.006)	(0.007)
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
N	20,012	17,597	19,670	16,043
Adj_R2	0.339	0.506	0.350	0.433

Panel C: Alternative year-level measures of earnings volatility

	ROA_Vol_3y	ROA_Mm_3y	ROA_Vol_4y	ROA_Mm_4y
	(1)	(2)	(3)	(4)
Pledge	-0.007*	-0.013**	-0.006*	-0.014**
	(0.004)	(0.006)	(0.003)	(0.007)
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
N	17,630	20,042	15,399	20,042
Adj_R2	0.511	0.498	0.613	0.582

Table 12 (Continued)

Panel D: Measures of stock return volatility

	Ret_Vol	Ret_Vol_d	LogIdio_Vol_Indadj	LogIdio_Vol_Madj
	(1)	(2)	(3)	(4)
Pledge	-0.003*	-0.009*	-0.156*	-0.134**
	(0.002)	(0.005)	(0.086)	(0.061)
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
N	19,979	17,889	17,575	17,553
Adj_R2	0.605	0.120	0.377	0.402

Panel E: Alternative measures of R&D expenditures

	$LogRd_{t+1}$	Rd_Asset_{t+1}	Rd_Asset_{t+1}	Rd_Sale_{t+1}
	(1)	(2)	(3)	(4)
Pledge	-0.204**	-0.005***	-0.003**	-0.006***
	(0.089)	(0.001)	(0.001)	(0.002)
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
N	12,793	22,102	12,793	22,091
Adj_R2	0.844	0.709	0.800	0.769