Restricted Equity Incentive and Stock Price Crash Risk: Evidence from China A-share Listed Companies

Yuzhu Zhang

College of Business & Public Management, Wenzhou-Kean University, Wenzhou 325000, China

1367203@wku.edu.cn

Abstract. This study takes China A-share listed companies in 2012-2022 as samples to test the impact of restricted equity incentives on the risk of stock price crash. Using the two-way fixed effect and DID method, we find that the implementation of restricted equity incentive significantly increases the risk of stock price collapse, which can be measured by negative skewness coefficient (NCSKEW) and bottom-up volatility (DUVOL). After parallel trend test, tendency score matching (PSM-DID) and including lagging dependent variables, the baseline results are still robust, and the effects are dynamically accumulated after implementation. Heterogeneity analysis shows that this effect is more obvious in state-owned enterprises, large enterprises, high-growth enterprises, enterprises with concentrated ownership and enterprises with higher profits. These findings show that restrictive equity incentives may aggravate the short-term behavior of management and the hoarding of bad news, thus increasing the possibility of collapse. This study contributes to the literature of equity incentives and provides enlightenment for corporate governance and regulatory policies in emerging markets.

Keywords: restricted equity incentive, Risk of stock price collapse, Differences in differences, Corporate governance, China A-share market.

1. Introduction

In recent decades, the risk of stock price collapse has attracted great attention from scholars, practitioners and regulators, especially after the global financial crisis in 2008 and the subsequent market turmoil. The stock price crash refers to the extremely negative abnormal value in the return distribution of a specific company, which may destroy a large number of investors' wealth overnight and undermine the broader market stability. Because crashes are difficult to diversify and often gather in times of stress, it is very important to understand the determinants at the company level for portfolio management, risk assessment and regulatory policy design.

Among all the factors that affect the risk of collapse, management equity incentive occupies a core position in corporate governance literature. Equity-based compensation is widely regarded as an effective mechanism to coordinate the interests of managers and shareholders, because it links managers' wealth with long-term stock price performance. However, more and more studies show that equity incentives can also lead to abnormal behaviors-earnings management, selective disclosure, information hoarding and excessive risk-all of which may increase the possibility of collapse. Restricted stock incentive is one of the most important forms of compensation in China. The difference between it and stock option is that restricted stock is subject to authorization conditions, and it is forbidden to be sold during the lock-up period. Even if the stock price falls, restricted stock can still maintain its value. Although these features are designed to promote long-term orientation, they may motivate managers to suppress negative news and smooth performance during the awarding period to meet the unlocking conditions; The accumulated bad news will eventually surface suddenly, causing a crash.

Although restricted equity incentives are becoming more and more important in China, the existing literature mainly focuses on stock options and general equity incentives, and the empirical evidence is still mixed. Some studies record the consistent effect of reducing risks, while others record the short-term effect of increasing risks. This study fills this gap by investigating the causal impact of restricted equity incentives on the risk of China A-share market crash. Using the comprehensive data

set of 556 listed companies from 2012 to 2022, we use the staggered adoption of restricted equity incentive plans within the framework of DID to compare the changes of collapse risk of companies that implemented such plans (treatment group) and those that did not (control group) before and after implementation. The staggered adoption time from 2014 to 2022 provides a variety of treatment queues and strengthens identification.

We find strong evidence that restricted equity incentives will significantly increase the risk of collapse. For NCSKEW and DUVOL (our two main collision risk indicators), the DID coefficient is positive, which is statistically significant at the traditional level, corresponding to about 7.4% and 5.7% of their respective standard deviations, which is an economic value equivalent to the established collision risk determinants. Results The parallel trend test, tendency score matching (PSM-DID) and lagging dependent variables of the event study passed, and the event study revealed the dynamic accumulation of the effect after implementation. Heterogeneity analysis shows that this effect is systematically stronger in state-owned enterprises, large enterprises, high-growth enterprises, enterprises with concentrated ownership and enterprises with higher profits-it is in these environments that information asymmetry and agency problems are more serious and bad news hoarding is easier, which supports the information hoarding mechanism.

China's environment is particularly suitable for this kind of analysis. Since China Securities Regulatory Commission issued the equity incentive management measures in 2006 and then relaxed it, the restricted equity incentive plan has become the main form of equity compensation for the management of A-share companies, which usually links the stock unlocking with the multi-year accounting performance targets, such as the cumulative net profit growth or the return on equity threshold. These performance awarding conditions create clear and powerful incentives for managers to achieve short-term goals. At the same time, China market is characterized by centralized ownership, huge state-owned sector, mainly retail investors, and external supervision is still weaker than the information environment in developed markets. This combination of strong authorization pressure and limited external review provides a rich environment, in which short-term channels of restrictive equity incentives can be identified and examined.

This research has three contributions. First of all, it provides causal evidence specific to restricted equity incentives, making up the blank left by previous work, which mainly focused on stock options and reported the correlation to a great extent. Second, staggered DID design, combined with event research, matching and dynamic analysis, establishes causality and tracks the evolution of treatment effect with time. Thirdly, by paying attention to China, a market characterized by centralized ownership, strong government influence and relatively weak investor protection, this study tests the universality of the collapse risk theory in an emerging market with a unique system, and provides governance and supervision experience related to similar environment. The rest of this paper is organized as follows: Section 2 reviews the literature and development assumptions; Section 3 describes data, variables and methods; Section 4 presents the baseline results; Section 5 reports heterogeneity analysis; Section 6 discusses the robustness check; Section 7 finally puts forward the policy implications.

2. Literature review and hypothesis development

2.1. The risk of stock price crash: theoretical basis

The theoretical basis of collapse risk comes from the agency theory of Zhan Sen and meckling [1]. The core view is that the manager, as the agent of shareholders, may conceal negative information about the company's performance for a long time, thus allowing negative news to accumulate within the company. When the accumulated bad news reaches a critical point and can no longer be concealed, they will be released to the market at once, resulting in a sudden and substantial negative price adjustment-collapse. Jin and Myers [2] formalize this intuition in a theoretical model, which shows that opaque information and management agency are the key determinants of collapse risk: managers get part of the company's cash flow and hide bad news to protect their jobs and privileges until the

deteriorating performance makes it unsustainable to continue to hide. Their model predicts that the more opaque the information environment and the greater the agency conflict, the more likely the company will collapse. Hutton et al. [3] provided empirical support, showing that companies with more opaque financial reports are more likely to experience collapse as measured by discretionary accruals, thus establishing a direct link between the quality of reports and the risk of collapse.

Subsequent work has expanded the determinants of collapse risk along several dimensions. Kim et al. [4] found that aggressive corporate tax avoidance is conducive to hoarding bad news and increasing the risk of collapse, while stable long-term institutional ownership reduces this risk through monitoring [5]. DeFond et al. [6] show that mandatory adoption of IFRS reduces the risk of collapse by improving transparency, especially in countries with strong law enforcement. In the context of China, Xu et al. [7] found that the excess allowance of executives is positively related to the risk of collapse, which is consistent with the agency view; Li et al. [8] recorded that the attention of retail investors represented by Internet search volume is negatively correlated with the risk of collapse, because strengthening censorship will curb information hoarding; Cao et al. [9] pointed out that religious tradition, as an informal cultural constraint, reduces the risk of collapse by suppressing management opportunism. In these studies, the unified mechanism is information hoarding under asymmetric information, which inspires our hypothesis and heterogeneous design.

2.2. Equity Incentive and Hypothetical Development

The relationship between equity incentive and collapse risk is vague in theory, and two competing views provide different predictions. The "Alliance Hypothesis" holds that equity compensation links managers' wealth with long-term stock performance, thus encouraging managers to disclose information more transparently, avoid excessive risks, and invest in value enhancement projects, all of which reduce the possibility of information hoarding and collapse. Burns and Kedia [10] found that equity-based compensation is related to the low possibility of financial restatement, and Feng et al. [11] proved that option-based compensation reduces the possibility of accounting fraud; In China, some studies also found that the equity incentive plan improved the quality of corporate governance and information disclosure.

The competing "short-term hypothesis" holds that equity incentives induce managers to raise short-term prices through earnings management, selective disclosure and suppression of negative news; The hidden bad news accumulated more and more, and finally surfaced, leading to collapse. Benmelech et al. [12] developed a model in which stock-based compensation encourages managers to conceal bad news and manipulate short-term performance, which increases the probability of collapse. Kim et al. [13] found that CEO option incentive is positively related to the risk of collapse, especially when the exercise period is short and the CEO has great power, because managers hoard bad news to support the price during the exercise period. As the focus of this study, restricted stocks have their own unique characteristics: they are usually granted at a discounted price, cannot be sold during the lock-up period, and-unlike options, options may lose their value-they can retain their value even when the price falls. These characteristics may give managers a particularly strong incentive to prevent the price from falling through information manipulation when the stock is limited. Based on the short-term hypothesis and the unique structure of restricted equity incentive, we put forward our main assumptions:

H1: The implementation of restricted equity incentive is positively related to the risk of stock price crash.

We further assume that this effect should be more obvious where the agency problem and information asymmetry are more serious, because this situation expands the space for managers to hoard bad news. Specifically, we expect that it will have a stronger influence in state-owned enterprises, large enterprises, high-growth enterprises, enterprises with concentrated ownership and enterprises with higher profits; These cross-section predictions provide the basis for the heterogeneity test in Section 5.

3. Research and design

3.1. Data and samples

Our sample includes China A-share listed companies from 2012 to 2022. The data of finance and stock market come from China Stock Market and Accounting Research (CSMAR) database, which is the most widely used source in China's capital market research. The information of restricted equity incentive plan comes from CSMAR corporate governance database and is verified manually according to the company announcement. We apply the following filters: (1) We exclude financial service companies, whose accounting and supervision are quite different; (2) We excluded the special treatment (ST) and special transfer (PT) companies in financial difficulties; (3) We discard the company's annual observation values with missing values of key variables; (4) We need the data of each company for at least two consecutive years for panel analysis. The final sample contains the annual observation results of 5,908 companies from 556 unique companies: 153 processing companies adopted the restricted equity incentive plan (27.6%) during the sample period, while 403 controlling companies did not. There are 716 annual observations of companies with a limit of 1 (12.1%). Because the implementation year is staggered between 2014 and 2022, these data form a multi-queue staggered treatment structure which is very suitable for DID identification. Staggered scheduling is beneficial for two reasons: it avoids relying on a single policy year that may be consistent with the shock within the market, and it uses companies that are adopted late and never adopted as control over early groups, which intensifies the counterfactual. We combine the incentive plan data with the financial and return data according to the company and year, and verify the processing time according to the initial announcement of the board of directors and shareholders' meeting to minimize the measurement error of the adoption year.

3.2. Definition of variables

Following Chen et al. [14] and Jin et al. [4, 5], we constructed two risk measures of collapse from the specific returns of the company every week. First of all, for each company year, we estimate an extended market model, the weekly return of the company that returns to the value-weighted market return, and two leads and two lags, so as to correct the asynchronous transactions that are common in the A-share market. The weekly rate of return of a specific company is defined as $W = \ln(1+\varepsilon)$, where ε is the regression residual, so W isolates the company-level information from the changes in market scope and industry scope.

Our first metric, NCSKEW (negative skewness coefficient), is the negative value of the third normalized moment of W scaled by the sample resizing factor; It captures the thickness of the left tail, and the higher the value, the more negative the return distribution, the greater the risk of collapse. Our second indicator, DUVOL (falling-rising volatility), divides the week into rising week and falling week, and takes the logarithmic ratio of the standard deviation of falling week and rising week; DUVOL is not sensitive to extreme observation because it does not depend on the third moment. These two indicators are highly correlated (0.9501), but they capture the complementary aspects of collision risk and are used to guard against measurement-specific conclusions.

The key independent variables are Restrict = Treat × Post, DID interactive items. Treating companies that have used restricted equity incentive plans is equal to 1, otherwise it is equal to 0; Starting from the implementation year, the Post of the processing company is equal to 1, otherwise it is equal to 0 (the post of the control company is always 0). According to the previous crash risk research, we control 13 company characteristics that may affect the crash risk: profitability (ROA, ROE), leverage (LR, ALR), growth opportunity (TQ), listing age, operating efficiency (TAT), equity concentration (Top1), state-owned equity (SOE) and management age (AGE). Winsorized all continuous variables at the 1st and 99th percentiles to reduce the influence of outliers.

3.3. Empirical model

We estimate a two-way fixed effect DID model: $CrashRisk(i, t) = \alpha+\beta$ restraint $(I, t)+\gamma$ Controls$(i, t)+\mu(i)+\lambda(t)+\varepsilon(i, t)$, where CrashRisk is NCSKEW or DUVOL of Company I in the t year, $\mu(i)$

represents the fixed effect of the company that absorbs all the characteristics of time-invariant companies (so Treat is absorbed without separate input), λ(t) represents the fixed effect of the company that absorbs common macro shocks (such as market turmoil in 2015 and 2015). The coefficient β on Restrict is the DID estimator: it measures the change of the collapse risk of the treatment company relative to the control company after implementation. A positive and significant β supports H1.

Because the residuals of the same company are sequence-related, estimating the traditional standard error under the assumption of independent and identical distribution will exaggerate the significance [15]; Therefore, we aggregate the standard error at the company level, which is the standard method in the collapse risk literature, and it produces conservative inferences. The causal explanation is based on the assumption of parallel trends-that is, if there is no treatment, the treatment and control companies will follow a similar collapse risk trajectory. We test this hypothesis and the dynamic path of influence through the event study in section 6, and solve the selection bias and reverse causality through PSM-DID and lagging dependent variable specification.

4. Empirical results

4.1. Descriptive statistics

Table 1 reports the descriptive statistics of the main variables. The average value of NCSKEW is 11.1256 (SD = 0.9479), and the average value of DUVOL is 14.2573 (SD = 1.0824), which are consistent with the previous research on China data, indicating that cross-company changes of downside risks are meaningful. The average value of Restrict is 0.1212, and the average value of Treat is 0.2764, which matches the processing structure described in Section 3.1. The average company's ROA is 3.42%, ROE is 6.46%, the leverage ratio is 0.5321, Tobin Q is 1.7089, the listing time is about 16.7 years, and the shareholding ratio of the largest shareholder is 39.49%, which reflects the characteristics of centralized ownership in China market. The average turnover rate of assets is 0.6493, the growth rate of total assets is 8.78%, and about 98% of the observed data are state-owned, which reflects the composition of companies with available incentive plan data. After winsor, the range of all continuous variables is economically reasonable.

Table 1. Descriptive statistics

changeable	ordinary	average	standard	Fujian dialect	P25	median	P75	maximum
NCSKEW	5908	11.1256	0.9479	7.6368	10.4400	11.0850	11.7631	14.4804
Divor	5908	14.2573	1.0824	12.0573	13.4721	14.1996	14.9848	16.5605
limit	5908	0.1212	0.3264	0.0000	0.0000	0.0000	0.0000	1.0000
treat cordially	5908	0.2764	0.4473	0.0000	0.0000	0.0000	1.0000	1.0000
return on assets	5908	0.0342	0.0411	-0.0738	0.0114	0.0283	0.0525	0.1553
fish roe/berry/egg	5908	0.0646	0.0806	-0.2206	0.0263	0.0633	0.1053	0.2515
Laboratory reactor	5908	0.5321	0.2280	0.1013	0.3502	0.5466	0.7135	0.9329
Circuit switching off time	5908	1.7089	1.0152	0.8297	1.0571	1.3408	1.9414	5.6424
List lattice	5908	16.7207	6.0563	2.0000	13.0000	17.0000	21.0000	32.0000
Gaudy clothes	5908	0.6493	0.4388	0.1000	0.3454	0.5521	0.8209	2.1374
ALR	5908	0.4975	0.1933	0.1132	0.3471	0.5067	0.6512	0.8587
Top1	5908	39.4947	14.2147	13.3063	28.4525	38.2018	50.5062	71.9277
Overlapping extension splicing method	5908	0.9816	0.1346	0.0000	1.0000	1.0000	1.0000	1.0000
basic wage	5908	15.1660	0.7531	13.3585	14.6813	15.1190	15.6224	17.3361
(constituting a verb) means "to put in a state of ..."	5908	18.4403	3.7403	8.0000	16.0000	18.0000	20.0000	35.0000
Inasset	5908	0.0878	0.1319	-0.1522	0.0043	0.0664	0.1488	0.5097

Note: Descriptive statistics of main variables in 2012-2022. Continuous variables are winsorized at the 1st and 99th percentiles.

4.2. Correlation analysis

Table 2 shows the Pearson correlation matrix. NCSKEW and DUVOL are highly correlated (0.9501), which proves that they capture the same potential risk structure through different distribution characteristics. Restrict is positively correlated with NCSKEW (0.1040) and DUVOL (0.1017), which provides initial univariate support for H1 before introducing any control or fixed effects. ROA and ROE are closely related (0.8902), because they both measure profitability, while Tobin's q is negatively correlated with the two collapse risk measures (-0.3204 and -0.3304), indicating that high-growth companies face greater market scrutiny and show lower realized collapse risk on average. Asset turnover rate and asset-liability ratio are positively correlated with these two collapse indicators. In order to ensure that these associations do not reflect collinearity, we calculate the variance expansion factors of all independent variables; All of them are below 5, indicating that multicollinearity is not a serious problem, and multiple regression is well recognized.

Table 2. Correlation matrix

	NCSKEW	Divor	limit	return on assets	fish roe/berry/ egg	Laboratory reactor	Circuit switching off time	Gaudy clothes	ALR	Top1	Overlapping extension splicing method
NCSKEW	1.0000										
Divor	0.9501	1.0000									
limit	0.1040	0.1017	1.0000								
return on assets	0.1038	0.1060	-0.0282	1.0000							
fish roe/berry/egg	0.2556	0.2577	-0.0440	0.8902	1.0000						
Laboratory reactor	0.2443	0.2202	-0.0473	0.0494	0.1099	1.0000					
Circuit switching off time	-0.3204	-0.3304	-0.0606	0.3054	0.1450	0.1776	1.0000				
Gaudy clothes	0.4438	0.4543	-0.0232	0.1042	0.1204	0.1363	0.0220	1.0000			
ALR	0.4466	0.4547	-0.0010	-0.4008	-0.1160	0.0833	-0.4181	0.0300	1.0000		
Top1	0.1933	0.2160	0.0493	0.0962	0.1240	-0.0400	-0.1155	0.0140	0.0408	1.0000	
Overlapping extension splicing method	0.0087	0.0177	-0.0223	-0.0554	-0.0421	-0.0432	-0.0766	-0.0184	0.0248	0.0798	1.0000

Note: Pearson correlation coefficient between key variables. All variance expansion factors are below 5.

4.3. Baseline Regression Results

Table 3 reports the baseline DID results of two dependent variables with and without control; All specifications include company and annual fixed effect and cluster standard error at company level. In the absence of control, Restrict is positive for NCSKEW (0.0602, $p = 0.081$) and DUVOL (0.0523, $p = 0.078$), and has marginal significance. Once included in the whole set of control, the coefficient of NCSKEW rose to 0.0700 ($p = 0.030$), with a significance of 5%, and that of DUVOL rose to 0.0618 ($p = 0.064$), with a significance of 10%. After adding control factors, the increase of quantity and accuracy shows that if not controlled, the mixed factors at the company level will slightly weaken the policy effect. The consistent positive coefficient and significant coefficient of the two collision risk indicators provide strong support for H1.

The economic scale is significant: the NCSKEW coefficient is 7.4%(0.9479) of its standard deviation, and the DUVOL coefficient is 5.7%(1.0824) of its standard deviation, which is equivalent to the influence of the determined collision risk determinants. Among these control factors, ROA, leverage ratio (LR), asset turnover ratio (TAT), asset-liability ratio (ALR) and management salary (lnsumsalary) are positive, while Tobin's Q is negative, which is consistent with the previous literature: companies with higher profits and higher turnover rate have more room for earnings management, while high-growth companies face stronger market scrutiny. The positive compensation coefficient is particularly telling-when the wealth of managers with higher incomes is linked to restricted shareholding, they have stronger motivation to maintain inflated stock prices. Generally speaking, the baseline evidence is inconsistent with the consistency hypothesis, but supports the short-term hypothesis: once the constant corporate characteristics and common year shocks are absorbed by the two-way fixed effect, restricted equity incentives will not improve transparency and reduce downside risks, but will lead to a significant increase in the risk of collapse.

Table 3. Baseline Regression Results: Restricted Equity Incentive and Collapse Risk

variable	(1) NCSKEW	(2) NCSKEW	(3) Duval	(4) Duval
limit	0.0602**	0.0700**	0.0523**	0.0618**
	(0.0345)	(0.0322)	(0.0296)	(0.0334)
control	no	be	no	be
Fixed FE	be	be	be	be
FE year	be	be	be	be
ordinary	5,908	5,908	5,908	5,908
R square	0.8883	0.9426	0.9091	0.9563

Note: Restrict is a DID interactive term (Treat × Post). In parentheses is the fixed clustering robust standard error. *, * * and * * * indicate the significance of 10%, 5% and 1% levels.

5. Heterogeneity analysis

Although the baseline results establish an average positive impact, exploring heterogeneity clarifies the underlying mechanism and helps to rule out alternative explanations. We divide the sample into six dimensions-ownership type, company size, growth opportunity, ownership concentration, profitability and leverage-and re-estimate the fully controlled DID model in each sub-sample. Table 4 reports the limiting factor and p value. This effect is positive, at least in every sub-group, but it is stronger in places where information asymmetry and agency conflict are more serious, which is consistent with the channel of bad news hoarding.

Table 4. Heterogeneity Analysis (Restriction Coefficient)

subsample	NCSKEW coefficient.	P value	Divor Cove.	P value
state	0.0722**	0.034	0.0596*	0.084
Non-state owned	0.0415*	0.082	0.0382*	0.088
Large company	0.0472*	0.087	0.0415*	0.079
small company	0.0356*	0.084	0.0287*	0.091
High growth	0.1012**	0.021	0.0751*	0.090
Low growth	0.0385*	0.076	0.0312*	0.087
high concentration	0.0623*	0.072	0.0499*	0.083
light concentration	0.0583*	0.074	0.0414*	0.086
High profitability	0.0755*	0.051	0.0965**	0.030
Low profitability	0.0328*	0.081	0.0274*	0.089
High lever	0.0412*	0.079	0.0358*	0.085
Low lever	0.0690*	0.072	0.0641*	0.078

Note: each row is a separate sub-sample DID regression, which has a fixed/annual effect and a complete control set; Standard error of enterprise cluster. *, * * and * * * indicate 10%, 5% and 1% significance.

5.1. Ownership, Scale and Growth

Type of ownership. This effect is stronger in state-owned enterprises (NCSKEW 0.0722, p = 0.034DUVOL 0.0596, p = 0.084) than in non-state-owned enterprises (0.0415, p = 0.0820.0382, p = 0.088), although the two groups are significant on the edge. State-owned enterprises in China are facing the problem of "absence of owners", that is, the ultimate owners (countries) lack strong incentives from supervisors, and managers of state-owned enterprises often encourage and suppress negative information for political career reasons; The resulting low transparency leaves more room for hoarding bad news. The small but still significant coefficient of non-state-owned enterprises shows that incentive-induced short-termism is not unique to state-owned enterprises. Company size. The coefficient of large companies is slightly larger than that of small companies, and the two groups are not significant, which is consistent with the greater organizational complexity, diversified management, scattered information flow and stronger analyst pressure of large companies, which are beneficial to information management; The significant small business coefficient further shows that the limited organization size has not eliminated the motivation of hoarding bad news.

Growth opportunities provide the most striking contrast and the most powerful mechanism evidence. The high Tobin q coefficient (0.1012, p = 0.021) is about 2.6 times that of the low q coefficient (0.0385, p = 0.076). High-growth companies hold more intangible assets, have greater investment decision-making power, and the valuation depends heavily on market expectations. All these increase information asymmetry, make bad news hoarding easier to hide, and are more rewarding for managers seeking to maintain valuation during the authorization period. Because heavy intangible assets are difficult to be evaluated and verified by outsiders, managers have greater discretion in the time and content of disclosure, which expands the feasible scope of concealment strategy. The obvious gap between high growth and low growth, as well as the fact that both groups remain significant, shows that short-term effects are widespread, but with the intensification of opacity, it directly supports the information asymmetry channel that supports our framework.

5.2. Ownership concentration, profitability and leverage

Centralized ownership. These two subgroups are not significant, and the high concentration group is slightly larger (NCSKEW is 0.0623 compared with 0.0583). When the controlling shareholders hold a large number of shares, and their wealth is linked to the stock price through the incentive plan, they have both power and motivation to influence information disclosure and suppress unfavorable news; The still significant low concentration results show that management incentives can play a role even in the case of decentralized ownership. Profitability. High ROA companies show a significantly stronger effect, especially for DUVOL (0.0965, p = 0.030), because financial slack gives profitable companies the discretion to smooth earnings and hide negative information, and any profit decline will be punished more severely by the market; Although companies with low ROA have less room for manoeuvre, they still have certain importance.

Leverage. These two groups are not very important, and low-leverage companies are slightly larger (0.0690 vs. 0.0412 NCSKEW). In low-leverage companies, weak creditor supervision leaves more hoarding space for managers, while in high-leverage companies, the distressed motivation of hiding bad news offsets the strong creditor supervision, leaving a small but still positive net effect. Taken together, the heterogeneous results show a consistent pattern: the therapeutic effect is never limited to a single subgroup, but it will expand systematically as the information environment becomes more opaque and external monitoring becomes weaker. This cross-sectional ranking is difficult to be consistent with the alternative explanation based on the general time trend or mechanical specification selection, so it provides supplementary evidence for the bad news hoarding mechanism.

6. Robustness check

In order to protect the causal interpretation of our research results, we conducted three robustness checks: an event study to verify the parallel trend hypothesis and track the dynamic impact, PSM-DID to solve the selection bias, and lagging dependent variables to solve the reverse causal relationship and persistence.

6.1. Event research and parallel trends

DID's design requires that if there is no treatment, the treatment and control company will follow a parallel collapse risk trajectory. We define the event time relative to the implementation year (0 year), construct a virtual model from t-3 to t+3, take t-1 as the reference period, and estimate an event research regression, including complete control set and fixed effect of company and year, and cluster the standard error at the company level. The coefficient of the virtual model of event time reflects the collision risk difference between the processing company and the control company in each lead and lag time relative to the base year. Table 5 shows that all the preprocessing coefficients are not statistically significant: for DUVOL, t-3 (-0.006) and t-2 (-0.016) are close to zero, while for NCSKEW, the negative preprocessing coefficients (-0.052 and -0.029) are also not significant, indicating that there is no systematic pre-trend, and the parallel trend hypothesis is completely applicable to both measurements. The lack of monotonous pretreatment also ruled out the expected effect of possible pollution comparison.

After implementation, the coefficient becomes positive and rises monotonically. For NCSKEW, they increased from 0.1098 (5%) at t=0 to 0.1538 (5%) at t+1, 0.2357 (5%) at t+2 and 0.2879 (5%) at t+3. For DUVOL, they increased from 0.0474 (10%) to 0.1196 (10%) at the same level. This dynamic and cumulative model is consistent with the fact that managers begin to suppress negative information after implementation and the stock of hidden bad news increases year by year until it is released centrally; By t+3, the increase of NCSKEW is about 30% of its standard deviation, which is a great cumulative effect in economy.

Table 5. Event Research Results: Dynamic Effects

Event time	NCSKEW	Divor
t-3	-0.0521 (0.1416)	-0.0060 (0.2536)
t-2	-0.0286 (0.1146)	-0.0155 (0.1277)
T-1 (base)	0	0
t=0	0.1098** (0.0442)	0.0474*(0.0258)
t+1	0.1538** (0.0652)	0.0633** (0.0343)
t+2	0.2357** (0.0962)	0.0963* (0.0520)
t+3	0.2879** (0.1252)	0.1196* (0.0624)

Note: The base period is t-1. The standard error of company aggregation is in brackets. *, * * and * * * indicate 10%, 5% and 1% significance. All regression includes company/year fixed influence and control.

6.2. propensity score matching (PSM-DID)

One worry is that companies that choose to adopt restricted equity incentive plans may have systematic differences with companies that don't adopt them in ways related to the risk of collapse, resulting in self-selection bias. We solve this problem in three steps. Firstly, we estimate a logit model, in which the dependent variable is the processing state and the regression variable is the company characteristics before processing, including ROA, ROE, leverage ratio, Tobin Q, listing age, ownership concentration and national ownership, so as to obtain the adoption tendency of each company. Second, we use 1:1 nearest neighbor matching, without substitution, to pair each processed company with the control company with the closest tendency score. Thirdly, we re-run the fully controlled DID model for 258 matched samples (153 received treatment and 105 matched control groups) and 2,762 observations. Although the sample has been reduced by more than half, Restrict is

still positive, and it is of little significance for NCSKEW (0.0585, p = 0.072) and DUVOL (0.0482, p = 0.085), and its amplitude is close to the baseline. Under the reduced statistical power, the survival of the effect confirmed that the discovery was not driven by observable self-selection, and the covariate balance test showed that there was no significant pre-treatment difference in matching variables between matched groups.

6.3. Lag dependent variable

In order to rule out reverse causality-the possibility that high-risk companies adopt incentive plans as governance countermeasures-and considering the strong persistence of collapse risk, we add a one-year lag dependent variable as additional control. Because the risk of collision is known to be persistent, norms that ignore lagging results may attribute pre-existing risk trajectories to treatment. Including lag is also helpful to absorb the residual sequence dependence left by enterprise clustering. For NCSKEW (0.0644, p = 0.025) and DUVOL (0.0535, p = 0.032), Restrict is still positive, and the significance is 5%; The lag dependent variable itself is significantly positive, which confirms the intertemporal persistence. Controlling persistence keeps the therapeutic effect unchanged in quantity and importance, effectively eliminates the risk enterprises from self-selecting into the incentive plan, and provides some strongest identification evidence in our inspection. Table 6 summarizes the robustness results, which unanimously confirm the baseline conclusions of all three methods.

Table 6. Summary of Robustness Check

Robustness check	NCSKEW coefficient.	P value	Divor Cove.	P value
Baseline (full sample)	0.0700**	0.034	0.0618*	0.064
Matching sample	0.0585*	0.072	0.0482*	0.085
Lag dependent variable	0.0644**	0.025	0.0535**	0.032

Note: All regression includes fixed effect of company/year, complete control set and standard error of company clustering. *, * * and * * * indicate 10%, 5% and 1% significance.

7. Conclusions and implications

Using the staggered DID design of 556 China A-share companies from 2012 to 2022, this study provides causal evidence that restricted equity incentives significantly increase the risk of stock price collapse. The baseline coefficients of NCSKEW and DUVOL are positive and significant, which are about 7.4% and 5.7% of their standard deviation. The effect survived in parallel trend test of event research, PSM-DID and lag dependent variable control, and accumulated dynamically after implementation, reaching about 30% of the standard deviation in NCSKEW in the third year. Heterogeneity analysis shows that this effect is the strongest among state-owned enterprises, large enterprises, high-growth enterprises, enterprises with centralized ownership and profit-making enterprises. These enterprises have greater information asymmetry and agency conflict, and always support the bad news hoarding channel rather than the alliance view.

This study provides causal evidence unique to restricted shares, complements previous work focusing on stock options, and extends the collapse risk theory to emerging markets with unique institutions. In terms of methods, the combination of staggered DID design, parallel trend test of clean incident research, observable feature matching and result persistence control solved the main identification threats-ignored time-invariant features, common macro-shocks, self-selection and reverse causality-and always had a consistent positive impact. Its discovery has practical significance. For the board of directors and the remuneration committee, the restricted stock plan should be combined with supplementary governance mechanisms (strengthening disclosure, independent supervision and recovery clauses), and the design of authorization period and performance conditions should avoid causing excessive short-term behavior; In particular, a longer and more gradual authorization schedule may reduce the motivation to concentrate bad messages in one unlocking window. For regulators, stronger authorization terms, mandatory disclosure of performance

indicators and potential conflicts, and risk management guidance of equity compensation will help curb the risk of systemic collapse. For investors, the adoption of restricted equity incentive plan should be regarded as a potential risk signal, especially in opaque and weak governance companies, and should be included in the downside risk assessment.

Some limitations still exist, and future research approaches are suggested. First of all, the sample is mainly state-owned enterprises, which may limit the promotion of non-state-owned enterprises and different institutional markets; Future work can check more different samples. Second, the hoarding behavior of management information is inferred, not directly observed; Text analysis of earnings conference calls, management forecasts and other disclosures can provide more direct mechanism evidence. Thirdly, this study estimates the average effect, and future research can examine how specific design features-authorization period, performance conditions and share-based compensation-adjust this effect, and compare restricted stocks with stock options and employee stock ownership plans. Generally speaking, these evidences highlight an important dark side of equity compensation and provide information for corporate governance and regulatory design in emerging markets.

References

[1] Zhan Sen, M.C., & meckling, W. H. Management behavior, agency cost and ownership structure. Journal of Financial Economics, 1976, 3(4): 305-360.

[2] Kim, Lee, Myers, S. C. R2 around the world: new theories and new tests. Journal of Financial Economics, 2006, 79(2): 257-292.

[3] Hutton, A.P., Marcus, A.J., & Tehran, H. Opaque financial report, R2 and the risk of collapse. Journal of Financial Economics, 2009, 94(1): 67-86.

[4] Jin Jianbo, Li, Yang, Zhang and Li. Corporate tax avoidance and the risk of stock price collapse: an analysis at the company level. Journal of Financial Economics, 2011, 100(3): 639-662.

[5] Jin Jianbo, Li, Yang and Zhang. Chief Financial Officer to CEO: Equity Incentive and Collapse. Journal of Financial Economics, 2011, 101(3): 713-730.

[6] Dai Fengde, Hong, Li and Li. Will mandatory adoption of IFRS affect the risk of collapse? Accounting Review, 2015, 90(1): 265-299.

[7] Xu, Li, Xu, Yuan, Chen and Chen. Excess Allowance and the Risk of Stock Price Crash: Evidence from China. Journal of Corporate Finance, 2013, 25: 419-434.

[8] Li Shusheng, Wang Shusheng, Wang Xiaoxia, Tong, Yu. Does the attention of retail investors increase the risk of stock price crash? Evidence from China. Journal of International Financial Markets, Institutions and Money, 2017, 51: 106-124.

[9] Cao, Xia, Chen and Qian Guochang. Religious Tradition and the Risk of Stock Price Crash: Evidence from China. Journal of Corporate Finance, 2019, 58: 61-81.

[10] Burns and Katia. The influence of performance-based compensation on false positives. Journal of Financial Economics, 2006, 79(1): 35-67.

[11] Feng, Mi, Ge, Wei, Luo, S, & Shevlim, T. Why does the CFO participate in major accounting manipulation? Journal of Accounting and Economics, 2011, 51(1-2): 21-36.

[12] Ben Miller, kandel and Veronesi. Stock-based compensation and CEO (dis) incentive. Quarterly Journal of Economics, 2010, 125(4): 1769-1820.

[13] Jin Jianbo, Li, Yang and Zhang. CEO and CFO: Who is more important to the risk of collapse? Journal of Banking and Finance, 2016, 69: 88-106.

[14] Chen, Hong and Chen Jianzhong. Predicting crash: conditional skewness of trading volume, past returns and stock price. Journal of Financial Economics, 2001, 61(3): 345-381.

[15] Bertrand, e. du flo and s. Mullainathan. To what extent should we trust the estimation of differences among differences? Quarterly Journal of Economics, 2004, 119(1): 249-275.