

# Short Selling and Financing Constraints: Evidence from Chinese Listed Firms

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## Abstract

Since the pilot program of margin trading and securities lending system was launched in China in 2010, a standardized short selling mechanism has been formed through gradual expansion. It has become an important institutional arrangement for improving the information environment and strengthening external governance of the capital market. Faced with widespread financing constraints among domestic firms, A-share listed companies in China over the period 2015–2024 are selected as research samples. As a quasi-natural experiment is constructed based on the phased expansion of margin trading and securities lending, a staggered DID estimation approach is adopted. Systematically investigated herein are how short selling rules affect corporate financing constraints, along with its underlying transmission paths. Estimated outcomes demonstrate several key findings. To start with, the adoption of short selling policies greatly eases financing difficulties faced by listed corporations. The above outcome is still reliable after we take corporate attributes, firm and year fixed effects into consideration. Next, tests on transmission paths prove that short selling lowers information gaps and agency problems. By enhancing corporate information openness and tightening external supervision, it effectively reduces firms' financing difficulties. The two paths both deliver significant partial mediation. Third, heterogeneous regression results present that short selling plays a stronger mitigating role in private firms, yet its effect is not statistically meaningful within state-owned enterprises. It implies that the external monitoring capacity of short selling functions more effectively in environments featuring serious financing prejudice and insufficient regulatory constraints. Fourth, the core findings remain valid after a series of robustness tests, including placebo test, PSM-DID, replacement of explained variables and adjustment of sample intervals. This paper expands the research scope of the economic consequences of short selling rules, while supplementing prior studies on drivers of financing constraints. It also provides empirical evidence for regulators to optimize the securities credit trading framework, improve corporate financing environment and boost resource distribution performance within the capital market.

## Keywords

Short Selling Mechanism; Margin Trading and Short Selling; Financing Constraints; Information Transparency; External Governance.

## 1. Study Overview

### 1.1. Background of the Study

Following the rollout of the credit trading securities lending pilot across China's capital market in 2010, the long-standing one-sided market pattern has been gradually broken. The framework of short selling was officially put in place and progressively refined. The rules for

securities lending were further optimized in 2015. In 2019, the registration-based IPO system piloted on the Sci-Tech Innovation Board worked in tandem with the short selling mechanism. The full implementation of the registration-based system in 2023 has further advanced the information disclosure-oriented regulatory philosophy, making short selling an increasingly prominent external governance tool.

The core institutional value of short selling lies in its external supervision and information governance effects. By granting investors the right to conduct reverse transactions, it pushes listed firms to improve information disclosure quality and reduce information asymmetry between enterprises and investors. At present, firms operating in China, notably private businesses and SMEs, are generally plagued by difficulties and high costs in financing, and information asymmetry is a key factor exacerbating financing constraints. Against this backdrop, whether the short selling mechanism established under the margin trading and securities lending system can effectively alleviate listed firms' financing constraints by optimizing the information environment and strengthening external supervision has become an important research topic with both theoretical and practical implications.

## 1.2. Research Significance

This study possesses remarkable academic value. It constructs a complete transmission chain: short selling mechanism → improved information transparency → strengthened external governance and supervision → reduced information asymmetry → alleviated financing constraints. This research organically integrates the dual-path theory and the studies on financing constraints, effectively addressing the deficiencies in existing literature, such as ambiguous decomposition of influencing paths and unsystematic mechanism tests.

Meanwhile, this paper integrates the information disclosure perspective together with the corporate governance view. By combining capital market microstructure theory and corporate finance theory, the research broadens the scope of elements that shape financing constraints from two layers: information effect and external governance effect. On this basis, the paper constructs an innovative theoretical framework to explain the alleviation of corporate financing constraints. Taking the staggered launch of China's margin trading and securities lending program as a quasi-natural experiment, this work corrects the bias when theories developed in mature capital markets are directly used for emerging economies. It also delivers distinctive Chinese empirical evidence to reveal how short selling mechanisms support the real economy, while supplementing fresh perspectives about the economic influences of short selling to existing academic works.

Valuable practical guidance can also be offered by the present study. Market supervisors are provided with robust empirical backing to enlarge the scope of stocks qualified for margin and short selling transactions, as well as perfect the transfer system for securities lending. Such measures can give full play to short selling's role in information-based governance, thereby fundamentally alleviating the persistent issues that firms face when accessing expensive and insufficient financing.

For listed firms, the conclusions offer clear practical guidance. By acknowledging the supervisory role of short selling, enterprises can take initiatives to enhance information disclosure quality and optimize internal governance structures. They can convert external market pressure into internal momentum to relieve financing constraints and gain greater recognition from investors.

For financial institutions such as banks, this study serves as a useful reference for credit decision-making and risk assessment. Incorporating short selling pressure, a market-oriented signal, into the risk identification system enables more accurate evaluation of corporate inherent risks, thereby improving capital allocation efficiency and reducing resource waste caused by credit misallocation.

### 1.3. Research Innovations

This paper has the following major innovations:

First, innovation in research perspective. This study establishes a complete logical transmission chain and incorporates both information and governance paths into a unified framework, which remedies the fragmentation in existing literature that only examines the information effect or governance effect separately.

Second, innovation in research methodology. We utilize the staggered launch of China's short selling and margin buying policy as an exogenous research shock. To precisely isolate causal impacts within the sample, the multi-period DID estimation framework is chosen for regression analysis. This study also integrates Wen Zhonglin's three-step procedure alongside Bootstrap approaches to conduct joint examinations of mediating pathways, which strengthens the trustworthiness of all empirical outcomes.

Third, contributions in research content. Heterogeneity tests are carried out across two dimensions: corporate ownership attributes and corporate information surroundings, which defines the scope where short selling can ease corporate financing restrictions. The derived analytical results match the actual operating conditions within China's capital market much better.

Fourth, original discoveries derived from this research. The present study confirms that short selling can relieve corporate financing frictions within China's unique institutional context, and supplies extra empirical support to demonstrate how short selling mechanisms boost the real economy across emerging economies.

## 2. Literature Review

### 2.1. Domestic Research Status

Although domestic research on the short selling mechanism started relatively late, relevant achievements have grown rapidly alongside the continuous expansion of the margin trading and securities lending system in recent years. Early literature mainly focused on macro issues such as market volatility, while recent studies have gradually shifted to analyzing the governance effects and financial behaviors of micro enterprises.

Scholars have reached a consensus on the role of short selling in improving information transparency. In a classic study using the difference-in-differences model, Li and Xu (2014) [1] found that the staggered rollout of short selling and margin buying policies significantly raised the information content of stock prices, providing pioneering evidence for the information effect of short selling. Following this line of research, Quan and Yin (2017) [2] studied corporate innovation and pointed out that China's short selling mechanism can break information barriers between enterprises and external investors by improving information disclosure quality. Li et al. (2017) [3] further demonstrated that as a market-oriented external supervision tool, short selling can deter management behavior, enhance information disclosure and markedly lower the likelihood of stock price collapse. When analyzing institutional optimization, Xu and Chen (2012) [4] also argued that short selling and margin buying constitute a vital institutional design to lift the whole pricing efficiency of capital markets.

Existing literature has gradually explored the correlation between short selling mechanism and financing constraints. Some scholars focused on the impact of short selling pressure on corporate financing costs. Based on panel data of China's listed companies, Gu and Zhou (2017) [5] proved that short selling pressure cuts debt financing costs by optimizing information disclosure and lowering credit risk premium, which directly verifies that short selling can alleviate financing constraints. Other researchers integrated investment and financing into a unified analytical framework. Jin et al. (2015) [6] discovered that the restraining effect of short

selling pressure on irrational investment is more pronounced among firms with severe financing constraints. Using data from 2009 to 2014, Li et al. (2017) [7] confirmed that margin trading and securities lending exert both internal and external information governance effects. They also directly examined its causal relationship with financing constraints for the first time, and concluded that short selling eases financing constraints via information governance and external governance. The above studies have provided empirical evidence for this relationship, yet a complete logical transmission chain has not been established.

## 2.2. Foreign Research Status

In recent years, foreign scholars have built a comprehensive analytical framework for short selling mechanisms, ranging from information efficiency to governance outcomes. The landmark study by Boehmer and Wu (2013) [8] laid a solid foundation. Using data of stocks listed on the NYSE, they verified across intraday, monthly and earnings announcement horizons that higher short selling activity corresponds to greater stock price information efficiency and speedier absorption of public news into share valuations.

Following the information channel, Chen, Da and Huang (2022) [9] constructed the Short Selling Efficiency (SSE) index. Their findings suggest that when short selling capital is efficiently allocated to overvalued stocks, mispricing is corrected, and this effect becomes more salient during periods of information scarcity. From the perspective of corporate information disclosure, Bao et al. (2019) [10] provided supplementary evidence. Residual short interest is selected as a measure of executives' private adverse information, and the results demonstrate that short selling transactions are capable of disclosing negative news masked by company insiders.

From the supply side, Beneish, Lee and Nichols (2015) [11] documented a negative correlation between securities lending supply and accounting-based mispricing. Specifically, stocks favored most by short sellers tend to have the lowest lending availability, indicating that securities lending constraints impede the functioning of short selling. From a macro perspective, Chen, Kelly and Wu (2020) [12] found that hedge funds will proactively enhance information acquisition when analyst coverage declines, thereby mitigating the deterioration of market efficiency.

To sum up, foreign studies have systematically validated the information discovery and external supervision functions of short selling in terms of market efficiency, corporate disclosure and supply constraints. These findings establish a theoretical basis for how short selling reduces information asymmetry and influences corporate financing.

## 2.3. Literature Review and Comments

To sum up, existing domestic and foreign studies have made important progress in three aspects. First, scholars generally agree that the short selling mechanism has two core functions: information discovery and external supervision. Second, existing literature has preliminarily confirmed the alleviating effect of short selling on corporate financing constraints. Third, abundant empirical evidence has been accumulated against the institutional context of the capital market of China.

Nevertheless, there are still obvious research gaps and room for further expansion in current studies. On the one hand, most existing researches only verify the information effect or governance effect of short selling separately, and rarely integrate both mechanisms within one consistent research paradigm for comprehensive analysis of their interactive influences. On the other hand, the complete transmission chain from short selling mechanism to the alleviation of financing constraints has not been fully decomposed. Specifically, how short selling improves information transparency and strengthens external governance supervision, reduces

information asymmetry between financial institutions and enterprises, and ultimately eases corporate financing constraints has not been thoroughly analyzed in prior studies.

Against the aforementioned deficiencies in prior literature, the present work sorts out the full logical transmission chain as follows: short selling mechanism → improved information transparency → strengthened external governance supervision → reduced information asymmetry → alleviated financing constraints. The information channel and governance channel are merged organically to unpack the inner pathways through which short selling shapes enterprises' financing constraints. It aims to make up for the deficiencies of existing research in theory and provide practical references for institutional optimization and the improvement of corporate financing environments.

### 3. Theoretical Analysis and Research Hypotheses

Information asymmetry is the core cause of corporate financing constraints. When an information gap exists between internal managers and external investors, investors cannot accurately assess firms' true value. They will therefore demand a higher risk premium or even refuse to provide financing. As a market-oriented external governance tool, the short selling mechanism has distinct characteristics. Short sellers' profit motives naturally drive them to dig out negative information concealed by firms (Boehmer & Wu, 2013). If a firm has flawed information disclosure or operational problems, short sellers will reflect such information in stock prices through trading activities, exposing hidden risks to market supervision. This information discovery function helps mitigate information asymmetry between investors and firms, strengthens investor confidence in corporate disclosure, broadens financing channels and cuts financing costs. Accordingly, the present work proposes the first hypothesis:

H1: The introduction of the short selling mechanism can significantly alleviate financing constraints of listed companies.

The short selling mechanism eases financing constraints partly by lifting firms' information disclosure quality. Bao et al. (2019) prove that short sellers' trading activities can uncover bad news concealed by managers and push firms to improve information disclosure quality. Chen, Da and Huang (2022) further find that market information efficiency rises markedly when short selling capital is effectively allocated to overvalued stocks. Faced with short selling pressure, managers will take the initiative to make information disclosure more timely, accurate and complete to avoid risks. Higher information transparency enables external investors to evaluate firm value more precisely and reduces the uncertainty premium in risk assessment, thereby relieving financing constraints. Hence, the second hypothesis is proposed:

H2: Information transparency plays a mediating role in the relationship between short selling and financing constraints. That is, short selling alleviates financing constraints by improving information disclosure quality.

The alleviating effect of short selling on financing constraints is also realized through strengthened external governance and supervision. Existing studies show that short selling can effectively restrain the tunneling behavior of controlling shareholders and deliver institutional value as an external supervision mechanism. The presence of short sellers acts as a deterrent to managers and major shareholders. If managers make value-damaging decisions or major shareholders conduct interest expropriation, short sellers will quickly capture relevant signals and initiate short positions, leading to stock price declines. The transmission mechanism of falling share prices and resulting wealth losses forces firms to optimize internal governance and curb opportunistic behaviors. Enhanced external governance reduces agency costs and builds greater investor trust, which in turn eases financing constraints. On this basis, the third hypothesis is presented:

H3: External governance plays a mediating role in the relationship between short selling and financing constraints. That is, short selling alleviates financing constraints by strengthening external governance.

## 4. Research Design

### 4.1. Sample Selection and Data Sources

This paper selects Chinese A-share listed companies from 2015 to 2024 as research samples to examine the impact of the short selling mechanism on corporate financing constraints. Data on margin trading and securities lending targets, corporate finance, corporate governance and information disclosure ratings are all retrieved from the CSMAR database.

The samples are screened in accordance with standard practices. Financial and insurance listed companies are excluded due to their distinct accounting standards and regulatory requirements. Samples labeled ST, \*ST and PT with abnormal financial status are removed to avoid the interference of outliers. Observations with missing key financial variables are also eliminated. To mitigate the impact of extreme values, all continuous variables are winsorized at the 1% and 99% quantiles. After screening, an unbalanced panel dataset is finally obtained, consisting of 4,956 firms and 33,465 firm-year observations.

### 4.2. Variable Definitions

**Table 1.** Variable Definitions

| Variable Type        | Variable Name            | Symbol     | Definition and Measurement                                                                                                                            |
|----------------------|--------------------------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dependent Variable   | Financing Constraints    | KZ         | Measured by the Kaplan and Zingales (1997) index. A larger value represents more severe financing constraints<br>Ownership Concentration              |
| Independent Variable | Short Selling Mechanism  | Treat×Post | Interaction term of short selling eligibility and entry time.<br>Takes the value of 1 after being included in the short selling list, and 0 otherwise |
| Mediating Variable   | Information Transparency | Info       | Exchange information disclosure rating<br>Assigned values from 1 to 4 corresponding to grades D through A                                             |
|                      | Corporate Governance     | Gov        | Negative ratio of administrative expenses, calculated as: $-(\text{Administrative Expenses} / \text{Operating Revenue})$                              |
| Control Variable     | Firm Size                | Size       | Natural logarithm of total assets at year-end                                                                                                         |
|                      | Leverage                 | Lev        | Total liabilities at year-end / Total assets at year-end                                                                                              |
|                      | Profitability            | ROA        | Net profit / Average total assets                                                                                                                     |
|                      | Firm Age                 | FirmAge    | Natural logarithm of listing years                                                                                                                    |
|                      | Firm Growth              | Growth     | Operating revenue growth rate                                                                                                                         |
|                      | Board Size               | Board      | Natural logarithm of total board members                                                                                                              |
|                      | Independent Directors    | Indep      | Proportion of independent directors                                                                                                                   |

### 4.3. Model Specification

**Baseline Regression Model:** To examine the impact of the short selling mechanism on corporate financing constraints, this paper constructs the following two-way fixed effects model:

$$KZ_{i,t} = \alpha_0 + \alpha_1 Treat \times Post_{i,t} + \sum \beta_k Controls_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t}$$

Variable Definitions:  $KZ_{i,t}$ : denotes the financing constraints of firm  $i$  in year  $t$ ;  $Treat \times Post_{i,t}$ : core independent variable, represents the short selling mechanism; equals 1 if the firm is included in the securities lending list in year  $t$ , otherwise 0;  $Controls_{i,t}$ : a set of control variables, including firm size (Size), asset-liability ratio (Lev), profitability (ROA), etc;  $\mu_i$ : firm fixed effects; used to control time-invariant firm characteristics;  $\lambda_t$ : time fixed effects; used to control time-varying characteristics such as macroeconomic fluctuations;  $\varepsilon_{i,t}$ : Random error term. Expected result: If the short selling mechanism alleviates financing constraints, the coefficient  $\alpha_1$  is expected to be significantly negative.

Mediation effect model: This paper adopts the three-step approach to examine whether information transparency (Info) and corporate governance (Gov) play mediating roles in the process where short selling mechanism alleviates financing constraints; the first step is the baseline model.

Step 2: Examine the influence exerted by short selling mechanisms on mediating variables

$$M_{i,t} = \theta_0 + \theta_1 Treat \times Post_{i,t} + \sum \beta_k Controls_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t}$$

Step 3: Incorporate both the independent variable and mediating variables into the model

$$KZ_{i,t} = \gamma_0 + \gamma_1 Treat \times Post_{i,t} + \gamma_2 M_{i,t} + \sum \beta_k Controls_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t}$$

Variable descriptions:  $M_{i,t}$ : mediating variables, represent information disclosure rating (Info) and corporate governance level (Gov) respectively; other variables are defined as above.

## 5. Empirical Results and Analysis

### 5.1. Descriptive Statistics of Main Variables

**Table 2.** Summary Statistics for Core Variables

| VarName    | Obs   | Mean   | SD    | Min    | Median | Max    |
|------------|-------|--------|-------|--------|--------|--------|
| KZ         | 33465 | 1.183  | 2.334 | -6.424 | 1.362  | 6.782  |
| Treat×Post | 33465 | 0.484  | 0.500 | 0.000  | 0.000  | 1.000  |
| Gov        | 33465 | -0.327 | 1.234 | -9.419 | -0.069 | -0.008 |
| Info       | 33465 | 3.019  | 0.658 | 1.000  | 3.000  | 4.000  |
| Size       | 33465 | 22.288 | 1.279 | 20.050 | 22.079 | 26.250 |
| Lev        | 33465 | 0.409  | 0.202 | 0.060  | 0.399  | 0.891  |
| ROA        | 33465 | 0.036  | 0.067 | -0.219 | 0.037  | 0.207  |
| FirmAge    | 33465 | 3.025  | 0.298 | 2.197  | 3.045  | 3.584  |
| Growth     | 33465 | 0.125  | 0.331 | -0.535 | 0.082  | 1.693  |
| Board      | 33465 | 2.093  | 0.194 | 1.609  | 2.197  | 2.565  |
| Indep      | 33465 | 37.981 | 5.382 | 33.330 | 36.360 | 57.140 |
| Top1       | 33465 | 0.327  | 0.145 | 0.085  | 0.303  | 0.721  |

This paper first conducts descriptive statistics on the main variables. As shown in Table 2, the full sample contains 33,465 observations. The mean value of the explained variable financing

constraint is 1.183 with a standard deviation of 2.334, and there is a large difference between extreme values, indicating substantial disparities in financing constraints across enterprises during the research time span. The mean of the core independent variable is 0.484, implying that nearly half of the observations belong to the treatment period following the rollout of short selling trading rules. The distribution characteristics of all control variables are basically consistent with those in classic corporate finance studies, and no obvious data anomalies are observed. It proves that the selected sample is representative and reliable.

## 5.2. Correlation Analysis

Table 3 presents the Pearson correlation coefficient matrix of major variables. Evidence can be obtained from the regression outputs that financing constraint, the explained variable, bears a notable correlation with control variables such as enterprise scale, asset-liability ratio and corporate profitability. This finding preliminarily proves the validity of variable screening. Furthermore, correlation coefficients between all control variables mostly stay under 0.6, which suggests that serious multicollinearity will not interfere with the following multivariate regression tests. A preliminary correlation between the core independent variable and the explained variable is observed, while the actual causal effect needs further rigorous tests after controlling for other factors.

**Table 3. Correlation Analysis**

|                | KZ                | Treat×P<br>ost    | Gov               | Info              | Size              | Lev               | ROA               | FirmA<br>ge       | Growth            | Board             | Indep        | Top<br>1 |
|----------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|--------------|----------|
| KZ             | 1                 |                   |                   |                   |                   |                   |                   |                   |                   |                   |              |          |
| Treat×P<br>ost | 0.007             | 1                 |                   |                   |                   |                   |                   |                   |                   |                   |              |          |
| Gov            | -<br>0.080*<br>** | 0.029**<br>*      | 1                 |                   |                   |                   |                   |                   |                   |                   |              |          |
| Info           | -<br>0.283*<br>** | 0.159**<br>*      | 0.084*<br>**      | 1                 |                   |                   |                   |                   |                   |                   |              |          |
| Size           | 0.186*<br>**      | 0.465**<br>*      | -<br>0.014*<br>** | 0.257*<br>**      | 1                 |                   |                   |                   |                   |                   |              |          |
| Lev            | 0.678*<br>**      | 0.081**<br>*      | -<br>0.056*<br>** | -<br>0.145*<br>** | 0.479*<br>**      | 1                 |                   |                   |                   |                   |              |          |
| ROA            | -<br>0.607*<br>** | 0.015**<br>*      | 0.063*<br>**      | 0.393*<br>**      | 0.025*<br>**      | -<br>0.366*<br>** | 1                 |                   |                   |                   |              |          |
| FirmAge        | 0.206*<br>**      | 0.147**<br>*      | -<br>0.060*<br>** | -<br>0.055*<br>** | 0.204*<br>**      | 0.182*<br>**      | -<br>0.119*<br>** | 1                 |                   |                   |              |          |
| Growth         | -<br>0.092*<br>** | -<br>0.061**<br>* | 0.007             | 0.107*<br>**      | 0.038*<br>**      | 0.028*<br>**      | 0.302*<br>**      | -<br>0.113*<br>** | 1                 |                   |              |          |
| Board          | 0.038*<br>**      | 0.104**<br>*      | -<br>0.017*<br>** | 0.097*<br>**      | 0.262*<br>**      | 0.127*<br>**      | 0.026*<br>**      | 0.105*<br>**      | 0.008             | 1                 |              |          |
| Indep          | 0.014*<br>**      | 0.006             | 0.009             | -<br>0.018*<br>** | -<br>0.023*<br>** | -<br>0.010*       | -<br>0.022*<br>** | -<br>0.012*<br>*  | -<br>0.014*<br>** | -<br>0.593*<br>** | 1            |          |
| Top1           | -<br>0.150*<br>** | 0.023**<br>*      | 0.011*<br>*       | 0.176*<br>**      | 0.162*<br>**      | 0.001             | 0.181*<br>**      | -<br>0.036*<br>** | 0.014*<br>*       | 0.004             | 0.037*<br>** | 1        |

### 5.3. Baseline Regression

**Table 4.** Baseline Regression

|                    | (1)                   | (2)                    |
|--------------------|-----------------------|------------------------|
|                    | KZ                    | KZ                     |
| Treat×Post         | -0.174***<br>(-3.683) | -0.150***<br>(-4.288)  |
| Size               |                       | -0.252***<br>(-7.407)  |
| Lev                |                       | 5.684***<br>(46.941)   |
| ROA                |                       | -9.194***<br>(-37.580) |
| FirmAge            |                       | 2.033***<br>(7.268)    |
| Growth             |                       | -0.085***<br>(-2.883)  |
| Board              |                       | -0.117<br>(-1.122)     |
| Indep              |                       | 0.006*<br>(1.846)      |
| Top1               |                       | -0.517**<br>(-2.566)   |
| _cons              | 1.267***<br>(55.248)  | -1.063<br>(-0.948)     |
| Firm fixed effects | yes                   | yes                    |
| year fixed effects | yes                   | yes                    |
| N                  | 33465                 | 33465                  |
| Adj.R <sup>2</sup> | 0.634                 | 0.748                  |

Notes: \*\*\*, \*\*, and \* denote significance levels at 1%, 5% and 10%, respectively. Figures in parentheses are t-values. Standard errors are clustered at the firm level. The same applies hereinafter.

Baseline regression outcomes examining how short-selling policies shape listed enterprises' financing constraints are presented in Table 4. Firm-level and annual fixed effects are incorporated within both Column (1) and Column (2). When all control indicators are added to Column (2), the core explanatory variable obtains a coefficient value of -0.150, passing the significance test at the 1% statistical level. Such statistical evidence reveals that the launch of short selling systems greatly eases financing restraints for public companies, matching the primary theoretical prediction put forward in this research. Among control variables, firms with higher asset-liability ratios tend to suffer from more severe financing constraints, while those with stronger profitability and longer listing years face relatively fewer constraints. The results are in line with economic intuition.

### 5.4. Mediation Effect Test

#### 5.4.1. Information Transparency Mechanism

To examine the role of information transparency in the mitigation of corporate financing constraints by short selling, this study adopts the traditional stepwise regression method. As shown in Column (1) of Table 5, the coefficient of the core independent variable is 0.046 and

significant at the 1% level. This suggests that short selling acts as a market supervisor and pushes firms to improve information disclosure quality.

Column (2) includes both short selling and information transparency in the regression model. A negative coefficient of -0.044 is observed for information transparency, which reaches statistical significance at the 5% threshold. Meanwhile, short selling still yields a significantly negative coefficient of -0.148, whose absolute magnitude declines relative to the benchmark regression outcome.

Strong statistical evidence validates the notable partial mediation channel operating through information transparency. To elaborate, improved disclosure transparency brought by short-selling policies lessens information gaps between internal managers and external investors, thereby easing financing frictions faced by listed enterprises.

#### 5.4.2. Corporate Governance Mechanism

This study further investigates the latent governance mechanism underlying corporate operational regulation. In Column (3) of Table 5, the coefficient of the core independent variable is 0.127 and significant at the 1% level. It indicates that firms under short selling pressure experience lower agency costs and improved overall corporate governance.

**Table 5. Mediation Effect Test**

|                    | (1)                                | (2)                    | (3)                            | (4)                    |
|--------------------|------------------------------------|------------------------|--------------------------------|------------------------|
|                    | Information transparency mediation |                        | Corporate governance mediation |                        |
|                    | Info                               | KZ (Info path)         | Gov                            | KZ (Gov path)          |
| Treat×Post         | 0.046***<br>(2.954)                | -0.148***<br>(-4.240)  | 0.127***<br>(3.728)            | -0.147***<br>(-4.223)  |
| Info               |                                    | -0.044**<br>(-2.514)   |                                |                        |
| Gov                |                                    |                        |                                | -0.019***<br>(-2.831)  |
| Size               | 0.211***<br>(14.977)               | -0.243***<br>(-7.108)  | 0.081***<br>(2.791)            | -0.250***<br>(-7.368)  |
| Lev                | -0.648***<br>(-12.799)             | 5.656***<br>(46.506)   | -0.696***<br>(-5.874)          | 5.671***<br>(46.843)   |
| ROA                | 1.738***<br>(19.972)               | -9.119***<br>(-36.721) | 0.445**<br>(2.497)             | -9.186***<br>(-37.554) |
| FirmAge            | 0.095<br>(0.833)                   | 2.037***<br>(7.281)    | -1.662***<br>(-6.019)          | 2.002***<br>(7.152)    |
| Growth             | 0.040***<br>(3.739)                | -0.083***<br>(-2.824)  | 0.080***<br>(2.980)            | -0.084***<br>(-2.833)  |
| Board              | 0.046<br>(0.999)                   | -0.115<br>(-1.103)     | -0.064<br>(-0.503)             | -0.118<br>(-1.132)     |
| Indep              | -0.001<br>(-0.787)                 | 0.006*<br>(1.832)      | 0.001<br>(0.170)               | 0.006*<br>(1.849)      |
| Top1               | 0.511***<br>(5.510)                | -0.494**<br>(-2.459)   | -0.006<br>(-0.032)             | -0.517**<br>(-2.568)   |
| _cons              | -2.011***<br>(-4.421)              | -1.151<br>(-1.026)     | 3.207***<br>(2.823)            | -1.004<br>(-0.894)     |
| N                  | 33465                              | 33465                  | 33465                          | 33465                  |
| Adj.R <sup>2</sup> | 0.491                              | 0.748                  | 0.262                          | 0.748                  |

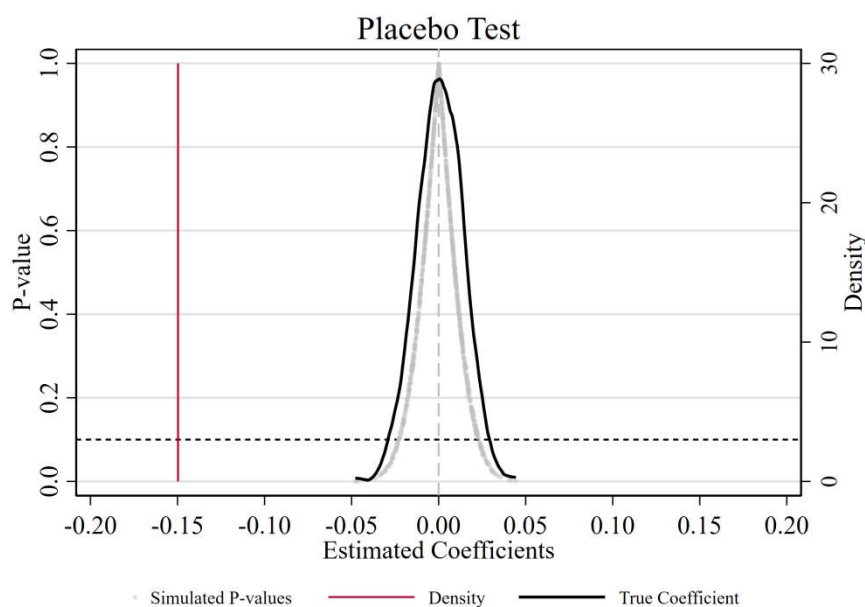
In Column (4), both short selling and corporate governance variables are incorporated into the regression. The coefficient of corporate governance is significantly negative at the 1% level (-0.019), and the coefficient of short selling remains significantly negative at the 1% level (-0.147). The results strongly support the partial mediating effect of corporate governance. Short selling effectively restrains opportunistic behaviors of corporate insiders. By strengthening external governance and mitigating Type I and Type II agency costs, it ultimately expands firms' external financing capacity.

**Table 6. Bootstrap Test for Mediation Effect**

| Mediator                        | Effect path                | Estimated coefficient | Standard error | Z-statistic | P-value | 95% confidence interval |
|---------------------------------|----------------------------|-----------------------|----------------|-------------|---------|-------------------------|
| Information transparency (Info) | Indirect impact (Indirect) | -0.002                | 0.001          | -2.04       | 0.041   | [-0.004, -0.000]        |
|                                 | Direct impact (Direct)     | -0.148                | 0.032          | -4.61       | 0       | [-0.210, -0.085]        |
| Corporate governance (Gov)      | Indirect impact (Indirect) | -0.002                | 0.001          | -2.36       | 0.018   | [-0.004, -0.000]        |
|                                 | Direct impact (Direct)     | -0.147                | 0.03           | -4.92       | 0       | [-0.206, -0.089]        |

## 5.5. Robustness Test

### 5.5.1. Placebo Test



**Figure 1. Placebo Test**

Referring to common practices in existing literature, this study conducts a placebo test via 1,000 random sampling simulations by randomly reassigning the timing of policy shocks and treatment groups. As shown in Figure 1, the simulated regression coefficients follow a normal distribution centered at zero, and p-values corresponding to these test results mostly exceed the threshold of 0.1. The benchmark regression's estimated parameter sits far within the left

extreme tail generated by simulated parameter samples. Such statistical evidence rules out the possibility that unmeasured omitted variables or stochastic noise distort the regression outcomes, which reinforces the reliability of core benchmark outputs.

### 5.5.2. Propensity Score Matching (PSM-DID)

To alleviate endogeneity caused by sample self-selection, this study adopts the 1:1 nearest neighbor matching to select control group samples with the most similar characteristics to the treatment group. The balance test shows that the standardized bias of all control variables drops substantially after matching, and the characteristic differences between the two groups are no longer statistically significant, indicating a good matching effect.

Re-estimation based on the matched samples is presented in Column (1) of Table 5.5. The coefficient of the core independent variable is -0.122 and significantly negative at the 1% level. The results demonstrate that after controlling for systematic bias in observable characteristics, short selling still significantly eases corporate financing constraints, and the baseline conclusion remains robust.

### 5.5.3. Replacement of Explained Variable

This study further uses the SA index and WW index to replace the original KZ index to measure corporate financing constraints. Columns (2) and (3) in Table 5.5 deliver consistent statistical outcomes: significant negative estimates appear at the 1% significance level when the SA index and WW index are separately set as dependent variables.

### 5.5.4. Change of Sample Interval

**Table 7. Robustness Test**

|                          | (1)                           | (2)                            | (3)                    | (4)                        |
|--------------------------|-------------------------------|--------------------------------|------------------------|----------------------------|
|                          | 1:1 nearest neighbor matching | replace the explained variable |                        | change the sample interval |
|                          | KZ                            | SA                             | WW                     | KZ                         |
| Treat×Post               | -0.122***<br>(-3.391)         | -0.011***<br>(-3.680)          | -0.003***<br>(-3.556)  | -0.088**<br>(-2.061)       |
| Size                     | -0.184***<br>(-4.489)         | 0.001<br>(0.229)               | -0.053***<br>(-79.706) | -0.286***<br>(-7.528)      |
| Lev                      | 5.581***<br>(40.433)          | 0.028***<br>(2.661)            | 0.029***<br>(10.622)   | 5.703***<br>(40.803)       |
| ROA                      | -9.502***<br>(-34.414)        | -0.002<br>(-0.144)             | -0.143***<br>(-28.984) | -9.301***<br>(-30.826)     |
| FirmAge                  | 1.954***<br>(6.201)           | 0.036*<br>(1.670)              | 0.019***<br>(3.365)    | 1.344***<br>(4.539)        |
| Growth                   | -0.104***<br>(-3.085)         | 0.006***<br>(3.115)            | -0.044***<br>(-47.838) | -0.043<br>(-1.173)         |
| Board                    | -0.157<br>(-1.286)            | -0.018*<br>(-1.657)            | 0.002<br>(0.699)       | -0.203<br>(-1.589)         |
| Indep                    | 0.007*<br>(1.909)             | -0.000<br>(-0.728)             | 0.000**<br>(2.002)     | 0.004<br>(1.179)           |
| Top1                     | -0.644***<br>(-2.774)         | -0.067***<br>(-3.298)          | -0.020***<br>(-4.172)  | -0.933***<br>(-3.952)      |
| _cons                    | -2.237*<br>(-1.718)           | 3.841***<br>(34.263)           | 0.100***<br>(4.531)    | 2.022*<br>(1.646)          |
| individual fixed effects | yes                           | yes                            | yes                    | yes                        |
| year fixed effects       | yes                           | yes                            | yes                    | yes                        |
| N                        | 26022                         | 33465                          | 33465                  | 21281                      |
| Adj.R <sup>2</sup>       | 0.740                         | 0.887                          | 0.853                  | 0.739                      |

Considering that drastic macroeconomic fluctuations or external policy changes in certain years may interfere with the empirical results, this study narrows and adjusts the sample period. Column (4) of Table 7 reports the regression results with the revised sample period. The core explanatory variable yields an estimate of -0.088, which carries negative statistical significance at the 5% critical level. Such evidence demonstrates that short-selling policies remain effective in easing financing frictions of enterprises even after eliminating potential yearly confounding factors, which further confirms the reliability of the core hypothesis.

**Table 8.** Balance Test for Propensity Score Matching

| Variables | Matching Status | Treatment Group Mean | Control Group Mean | Standardized Bias (%) | t-statistic | p-value |
|-----------|-----------------|----------------------|--------------------|-----------------------|-------------|---------|
| Size      | unmatched (U)   | 22.694               | 21.547             | 105.5                 | 86.89       | 0       |
|           | matched (M)     | 22.441               | 22.509             | -6.3                  | -6.31       | 0       |
| Lev       | unmatched (U)   | 0.419                | 0.391              | 14.3                  | 12.54       | 0       |
|           | matched (M)     | 0.406                | 0.44               | -17.1                 | -16.44      | 0       |
| ROA       | unmatched (U)   | 0.04                 | 0.028              | 18.8                  | 16.61       | 0       |
|           | matched (M)     | 0.04                 | 0.033              | 9.8                   | 10.97       | 0       |
| FirmAge   | unmatched (U)   | 3.029                | 3.016              | 4.4                   | 3.85        | 0       |
|           | matched (M)     | 3.021                | 3.005              | 5.5                   | 5.2         | 0       |
| Growth    | unmatched (U)   | 0.136                | 0.107              | 8.8                   | 7.68        | 0       |
|           | matched (M)     | 0.134                | 0.135              | -0.4                  | -0.33       | 0.74    |
| Board     | unmatched (U)   | 2.109                | 2.062              | 24.6                  | 21.43       | 0       |
|           | matched (M)     | 2.101                | 2.103              | -1.4                  | -1.39       | 0.165   |
| Indep     | unmatched (U)   | 37.91                | 38.112             | -3.8                  | -3.3        | 0.001   |
|           | matched (M)     | 37.789               | 37.437             | 6.6                   | 6.7         | 0       |
| Top1      | unmatched (U)   | 0.329                | 0.323              | 4.3                   | 3.73        | 0       |
|           | matched (M)     | 0.324                | 0.332              | -5.6                  | -5.54       | 0       |

### 5.6. Heterogeneity Test

Considering that differences in resource endowments and external supervision environment may arise from corporate ownership attributes, this paper further conducts group tests based on ownership nature, and the results are presented in Table 9. In Column (1) for the sample of non-state-owned enterprises, the estimated value of the key explanatory variable equals -0.198, reaching statistical significance under the 1% critical threshold. In comparison, the estimate lacks statistical significance within Column (2) when the sample is limited to state-owned firms. Cross-group parameter comparison tests generate a p-value of 0.014, which confirms that the gap between two groups reaches a statistically meaningful level. This suggests that compared with state-owned enterprises endowed with inherent political connections and soft credit constraints, the external supervisory and governance effect of the short selling mechanism plays a more vital role as timely assistance for non-state-owned enterprises suffering from severe financing discrimination, and yields a more prominent marginal improvement in alleviating their financing constraints.

**Table 9.** Heterogeneity Test Based on Property Right Nature

|                          | (1)                         | (2)                     |
|--------------------------|-----------------------------|-------------------------|
|                          | Non-state-owned Enterprises | State-owned Enterprises |
|                          | KZ                          | KZ                      |
| Treat×Post               | -0.198***                   | -0.027                  |
|                          | (-4.508)                    | (-0.489)                |
| Size                     | -0.241***                   | -0.281***               |
|                          | (-5.652)                    | (-4.557)                |
| Lev                      | 5.643***                    | 5.827***                |
|                          | (38.641)                    | (24.122)                |
| ROA                      | -9.480***                   | -8.211***               |
|                          | (-33.634)                   | (-16.065)               |
| FirmAge                  | 2.367***                    | 1.054*                  |
|                          | (6.787)                     | (1.783)                 |
| Growth                   | -0.047                      | -0.193***               |
|                          | (-1.248)                    | (-4.287)                |
| Board                    | -0.130                      | -0.123                  |
|                          | (-0.976)                    | (-0.691)                |
| Indep                    | 0.010**                     | -0.001                  |
|                          | (2.326)                     | (-0.282)                |
| Top1                     | -0.494*                     | -0.262                  |
|                          | (-1.714)                    | (-0.804)                |
| _cons                    | -2.430*                     | 2.816                   |
|                          | (-1.752)                    | (1.238)                 |
| Individual Fixed Effects | yes                         | yes                     |
| Year Fixed Effects       | yes                         | yes                     |
| N                        | 24002                       | 9463                    |
| Adj.R <sup>2</sup>       | 0.732                       | 0.778                   |
| Coefficient Difference   | -0.171(P=0.014)             |                         |

## 6. Research Conclusion

This paper selects Chinese A-share listed companies from 2015 to 2024 as the research sample. Taking the phased expansion of margin trading and short selling as a quasi-natural experiment, this study adopts the multi-period difference-in-differences (DID) model to systematically examine the impact, transmission channels and heterogeneous influences exerted by short-selling policies on enterprises' financing frictions. Additional sensitivity checks are implemented to validate the credibility of this study's empirical findings.

The main findings are presented as follows:

First, the introduction of the short selling mechanism can significantly alleviate the financing constraints of listed companies. After controlling for firm characteristics, individual firm fixed effects and year fixed effects, the regression coefficient of the short selling indicator (Treat×Post) is significantly negative. This indicates that the short selling pressure brought by the margin purchase and short selling regulatory scheme effectively reduces the level of corporate financing constraints, which verifies the core research Hypothesis H1 of this paper.

Second, the mechanism test confirms the existence of a dual-path transmission effect. The short selling mechanism mitigates information asymmetry and agency costs by improving information transparency and strengthening external governance, thereby easing financing constraints. Both paths present significant partial mediating effects. On the one hand, short

selling pressure forces firms to improve the quality of information disclosure and reduce investors' valuation uncertainty. On the other hand, the deterrence effect of short selling restrains the opportunistic behaviors of managers and major shareholders and cuts down agency costs. Together, these two aspects improve firms' financing conditions.

Third, the heterogeneity analysis reveals prominent differences across ownership types. The alleviating effect of the short selling system on financing constraints is more pronounced for non-state-owned enterprises, while it is insignificant for state-owned enterprises. This suggests that the external governance function of short selling exerts a more prominent marginal effect for private enterprises that face severe financing discrimination and weak internal supervision. In contrast, state-owned enterprises are insensitive to short selling supervision due to their inherent credit endorsement and soft budget constraints.

Fourth, robustness tests confirm the validity of the core conclusions. This research implements various identification strategies: placebo examinations, propensity score matching combined with difference-in-differences (PSM-DID), and alternative dependent variable measurements (KZ, SA and WW indicators), and adjustment of sample intervals. The results show that the core conclusions remain unchanged, which rules out the interference of endogeneity problems such as omitted variables, sample self-selection and indicator selection bias.

Overall, this paper proves that as a vital market-oriented external governance tool, the short selling mechanism can effectively ease the financing constraints of China's listed companies through two channels: information governance and supervisory governance, with a stronger effect on private enterprises. The research conclusions provide solid empirical evidence for regulators to continuously optimize the margin purchase and short selling regulatory scheme, improve the securities lending mechanism, ameliorate the corporate financing environment and enhance the resource allocation efficiency of the capital market.

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