

A Study on the Impact of Short Selling Mechanisms on Corporate Innovation

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ABSTRACT

This study examines the impact of short-selling mechanisms on corporate innovation, focusing on listed companies in China's A-share market. It constructs a theoretical framework through two pathways: financing constraints and governance oversight. Empirical analysis is conducted against the backdrop of short-selling regulations implemented between 2007 and 2022. Results indicate that short-selling pressure significantly suppresses corporate R&D expenditure, reflecting a financing constraint effect. Concurrently, it drives increases in patent citation frequency and the proportion of invention patents, demonstrating that governance oversight can enhance innovation quality. The intensity of these effects varies with property rights characteristics and regional marketisation levels, with non-state-owned enterprises and highly marketised regions exhibiting more pronounced quality enhancement. Robustness tests further validate the findings. The research concludes that short-selling mechanisms exert dual functions in market oversight and corporate behaviour regulation, offering practical implications for capital market institutional design and corporate innovation strategies.

KEYWORDS

Short-selling Mechanism; Corporate innovation; Financing constraints; Governance oversight

1 Institutional evolution and market functions of short selling mechanisms

1.1 Developmental history of short selling regulations

The short-selling regime has undergone multiple stages of evolution, reflecting shifts in market regulation and institutional adaptation. The United States implemented the "up-and-away rule" in 1938, explicitly stipulating that short-selling could only occur when the latest transaction price exceeded the previous price. This rule remained in effect for approximately 70 years. In 2005, the US Securities and Exchange Commission (SEC) introduced Regulation SHO, requiring brokers to confirm stock availability before executing short sales and imposing corresponding delivery time constraints. The 1938 rule was subsequently repealed in 2007, replaced by Rule 201 within Regulation SHO, which triggers restrictions when share prices decline by more than 10%. During the 2008 global financial crisis sweeping across European and American markets, multiple nations imposed temporary short-selling bans on financial stocks. Italy, Spain, France, Greece, and Belgium suspended short-selling on certain securities for short periods.

These regulations fall into three broad categories: trading restrictions, securities lending oversight, and disclosure requirements. Another study constructed an "enforceability index" based on the ratio of borrowable shares to market capitalisation, combined with an "enforcement effectiveness index" incorporating violation rates, thereby revealing the systemic impact of varying enforcement levels across nations on short-selling activity.

In 2023, the SEC issued regulations requiring institutional investors to disclose monthly information when holding short positions in a stock reaching \$10 million or 2.5% of the float, thereby enhancing transparency of short selling activities for regulators and the public.

1.2 Analysis of the economic function of short selling

Short selling performs critical systemic functions within capital markets, influencing market efficiency, liquidity, and price discovery processes. Research indicates short selling helps curb asset overvaluation, promoting fairer pricing. Academic investigations emphasise that short selling provides a key driver for market efficiency, particularly in facilitating price discovery.

In early 2025, Ortex data revealed that short sellers in US companies with market capitalisations exceeding \$10 billion realised paper profits of \$127 billion between 2 and 7 April. Concurrently, the S&P 500 index shed \$5 trillion in market value. The depth of short selling activity during this period underscores its role in pricing and risk propagation.

Analysis indicates that following the implementation of Rule 201 restrictions in the US, short selling volume declined by approximately 8%, with active short selling by sellers decreasing by around 5%. This was accompanied by reduced price volatility, narrowing bid-ask spreads, and increased buying depth. These changes suggest that regulating short selling can enhance market stability and trading depth.

Cross-market historical research on short-selling regulations reveals that stringent domestic restrictions exert a "regulatory spillover effect" on domestic ADR (American Depositary Receipt) short-selling activity, thereby suppressing

related transactions. No evidence of arbitrage shifting overseas has been observed. These empirical observations confirm that short-selling can both incentivise information efficiency and function as a stabiliser to moderate financial volatility.

1.3 The constraining effect of short selling mechanisms on corporate behaviour

The short-selling mechanism provides capital markets with an effective oversight channel, subjecting firms to passive scrutiny pressure. When market participants perceive corporate valuations as inflated, they express this judgement through short-selling transactions. This constitutes a potent market constraint, compelling firms to devote greater attention to disclosure practices and risk management. Short-selling pressure may drive management to optimise investment decisions, strengthen corporate governance structures, and enhance the efficiency of innovation resource allocation. In responding to short-selling expectations, corporate governance mechanisms such as board independence play a pivotal role. These behavioural adjustments stem from interlinked mechanisms like market feedback, transforming short-selling into a catalyst for internal corporate governance and innovation.

2 Theoretical exploration of the relationship between short selling mechanisms and corporate innovation

2.1 Short selling pressure and financing constraint effects

Innovative activities typically require substantial long-term capital investment. Given the extended R&D expenditure cycles and elevated risks involved, firms exhibit significant dependence on external financing. During periods of active short-selling, negative market expectations regarding a company's prospects are rapidly reflected in its share price. This pressure on share prices leads to a contraction in corporate market capitalisation, subsequently diminishing the firm's refinancing capacity. Banks and other credit institutions raise financing thresholds based on risk assessments, ultimately constricting the supply of R&D funding.

Academic research indicates that companies subject to frequent short selling experience heightened stock price volatility in capital markets, directly impacting the success rates of their stock pledge financing and rights issues. Data from the US Nasdaq market between 2010 and 2020 revealed that firms with high short interest ratios incurred average capital costs 1.2 to 1.8 percentage points higher than those with low short interest ratios. The rise in financing costs compels companies to reduce their R&D budgets, with some projects being delayed or even cancelled. This entire process constitutes a significant pathway through which short-selling pressure impacts corporate innovation.

Within China's capital market history, following the introduction of margin trading mechanisms on the Shenzhen and Shanghai exchanges in 2010, short-selling ratios for certain technology enterprises rose sharply. Research data indicates that companies within the top 25% of the sample in terms of short-selling ratios experienced an average decline of 6.5% in their R&D expenditure as a proportion of operating revenue. This phenomenon further corroborates the role of financing constraints within the transmission chain.

2.2 Short selling pressure and management governance effects

Short selling serves not merely as a channel for capital constraints but also embodies an external oversight function over management. When market investors engage in short selling based on expectations of corporate financial fraud, inefficient R&D, or misaligned strategic positioning, management faces intense pressure. This pressure compels management to exercise greater caution in decision-making, enhance evaluations of R&D investment returns, and consequently reduce ineffective innovation or so-called "excessive innovation".

In firms with weaker governance structures, short selling assumes a market-driven oversight role, compensating for deficiencies in traditional internal governance. Academic research indicates that companies experiencing high short-selling activity tend to strengthen information disclosure practices and enhance transparency in R&D expenditure to counter negative perceptions. Data from China's A-share market between 2015 and 2022 reveals that firms experiencing rising short-selling ratios increased patent applications the following year and improved the quality of detailed disclosures regarding R&D expenditure.

Beyond these effects, short selling indirectly influences executive incentive mechanisms. Share price pressure reduces the market value of management holdings, prompting executives to proactively refine R&D strategies and project execution to stabilise share prices and market expectations. These dynamics demonstrate how short selling's oversight function within governance channels impacts both the quality and direction of corporate innovation.

2.3 Pathway model of short selling mechanisms influencing corporate innovation

The role of short-selling mechanisms in corporate innovation manifests through two primary pathways: financing constraints and governance oversight. The financing constraint pathway emphasises the transmission effect of falling share prices on external financing environments. When share prices experience significant volatility due to short-selling pressure, external investors and financial institutions reassess risks, thereby increasing financing costs or reducing credit lines. As innovation activities require long-term capital support, this constraint directly compresses R&D budgets, leading to a downward trend in innovation output.

The governance oversight pathway highlights the market's role in counterbalancing management. Short selling vividly signals investors' negative expectations, such negative signals compel management to enhance disclosure practices, optimise mechanisms for selecting R&D projects, and improve the efficiency of allocating and utilising corporate R&D resources. Short-selling pressure can partially compensate for deficiencies in traditional governance structures, fostering greater prudence in innovation direction selection and project execution. While this effect may lead to a decline in the quantity of innovation outputs, it tends to enhance their quality.

In practical scenarios, these dual pathways often coexist concurrently. The financing constraint effect and governance oversight effect may interact, creating a trade-off between innovation quantity and quality. In firms with relatively high financing dependency, the constraint effect may dominate, while in companies with weaker governance structures, the oversight effect becomes more pronounced. Companies operating in industries with differing property rights characteristics, levels of competition, and degrees of marketisation exhibit significant variations in their innovation responses when facing short-selling pressure. The resulting logical framework provides a theoretical foundation for subsequent empirical analysis.

3 Empirical analysis of short selling mechanisms on corporate innovation

3.1 Data sources and variable specification

This study employs Chinese A-share listed companies as its research sample, covering the period from 2007 to 2022. This period spans a critical phase of the gradual refinement of short-selling regulations. The study utilises the list of securities eligible for margin financing and securities lending published by the China Securities Regulatory Commission as the basis for institutional shocks. Firms included in this list are designated as the treatment group, while those excluded form the control group. Data is primarily sourced from the CSMAR database and WIND database, with innovation output indicators derived from the National Intellectual Property Administration's public patent database.

The dependent variable employed two distinct measurement approaches: innovation input, primarily represented by R&D expenditure as a proportion of total assets and as a proportion of operating revenue; and innovation output, measured through indicators such as patent application volume, patent grant volume, patent citation frequency, and the proportion of invention patents. The core explanatory variable was short-selling intensity, quantified as the ratio of securities lending balances to free float market capitalisation. Intermediate variables comprise financing constraint indicators such as the KZ Index and SA Index. Moderating variables include institutional investor ownership ratio and analyst coverage. Control variables encompass firm size, debt-to-equity ratio, profitability, cash flow, industry, and year effects.

3.2 Empirical model construction and testing methodology

The benchmark model employs a Difference-in-Differences (DID) approach, incorporating firm-level and year-level fixed effects to control for unobservable factors. The model specification is as follows:

$$\text{Innovation}_{i,t} = \alpha + \beta(\text{PostShort}_t \times \text{Treatment}_i) + \gamma X_{i,t-1} + \mu_i + \lambda_t + \epsilon_{i,t}$$

Where PostShort_t denotes the dummy variable for the period following the implementation of the short-selling regime, Treatment_i indicates whether the firm is a short-selling pilot enterprise, and the interaction coefficient β reflects the average treatment effect of the short-selling mechanism on innovation. The control variable $X_{i,t-1}$ incorporates lagged financial and governance indicators.

Beyond benchmark regression, this study employs propensity score matching combined with DID (PSM-DID) to mitigate sample selection bias. Furthermore, instrumental variables are introduced to address potential endogeneity issues. Robustness checks are conducted through variable substitution, sample range alterations, and the application of two-way clustered standard errors.

3.3 Descriptive statistics and regression analysis results

Prior to examining the relationship between short-selling mechanisms and corporate innovation, descriptive statistics were conducted on core sample variables, as presented in Table 3-1. Overall, significant variation in R&D intensity was observed across firms, with some firms exhibiting higher R&D ratios and others lower. The distribution of patent quantity and quality spans a broad range, characterised by relatively large standard deviations, indicating substantial variation in firms' innovation outputs. The maximum short-selling pressure far exceeds the mean, suggesting that some firms face more pronounced external constraints, while others experience relatively limited short-selling transaction pressures.

Table 1 Descriptive statistics

Variable	Mean	Median	Standard Deviation	Minimum	Maximum
Short Selling Pressure	0.135	0.092	0.118	0.001	0.625
Financing constraints (SA index)	-3.21	-3.45	1.12	-5.87	-1.02
Research and Development Intensity (RDI)	0.041	0.028	0.037	0.001	0.162
Number of Patent Applications (PatentNum)	32.6	20	45.3	1	216
Patent Quality (PatentQ)	6.5	4	8.3	0	42
Enterprise Size	22.7	22.5	1.12	20.1	25.4
Asset-liability ratio (Lev)	0.43	0.41	0.19	0.08	0.87

Data sources: CSMAR database, China National Intellectual Property Administration, compiled by the researchers.

Building upon existing foundations, regression analysis was conducted to examine the relationship between short-selling pressure, financing constraints, and innovation. The results are presented in Table 3-2. Model 1 primarily tests the relationship between short-selling pressure and financing constraints. The significant positive coefficient indicates that greater short-selling pressure correlates with stronger financing constraints for enterprises. Model 2 incorporates innovation investment into the regression analysis. The results demonstrate that financing constraints exert a significant inhibitory effect on R&D investment, confirming the existence of a mediating effect. Model 3 further examines innovation outputs, with the final conclusion aligning with previous findings: the negative impact of financing constraints remains consistently significant.

Table 2 Regression results for short selling pressure, financing constraints and corporate innovation

Variable	Model 1: Financing Constraints	Model 2: R&D Expenditure	Model 3: Innovation Output
Short Selling Pressure (Short)	0.215	-0.084	-0.067
Financing Constraints (SA Index)		-0.142	-0.105
Enterprise size (Size)	-0.187	0.062	0.058
Debt-to-Asset Ratio (Lev)	0.041	-0.017	-0.013
Profitability (RoA)	-0.026	0.053	0.049
Control Variables	Control	Control	Control
Sample size	3568	3568	3568
R ²	0.311	0.428	0.402

Data sources: CSMAR database, China National Intellectual Property Administration, compiled by the researchers.

The results indicate that short-selling pressure suppresses R&D investment and innovation output by intensifying financing constraints, thereby further validating the research hypothesis. This finding suggests that while short-selling mechanisms in capital markets serve a governance and oversight function, they also exacerbate long-term innovation resource constraints for enterprises to some extent and limit the sustainability of innovation activities.

3.4 Impact of short-selling mechanisms on innovation investment

Empirical results demonstrate that following the implementation of short-selling mechanisms, pilot enterprises exhibited a marked decline in R&D intensity. Across the full sample, the proportion of R&D expenditure relative to total assets decreased by approximately 0.4 percentage points, while the proportion relative to operating revenue fell by roughly 0.7 percentage points. Both differences were statistically significant at the 1% level. These findings indicate that short-selling pressure compels enterprises to reduce R&D expenditure in the short term by constricting financing capacity, thereby alleviating capital constraints.

Further sector-specific analysis reveals a more pronounced contraction effect in technology-intensive industries. Taking the information technology sector as an example, enterprises in the top 25% of the short-selling proportion experienced a 9.2% greater decline in R&D expenditure compared to the control group. This finding corroborates that the financing constraint pathway exerts a more pronounced effect in capital-intensive industries.

3.5 Impact of short selling mechanisms on innovation outcomes

Despite the contraction in R&D expenditure, innovation output quality showed an improving trend. Patent citation counts and the proportion of invention patents rose significantly following the implementation of short-selling mechanisms, with results remaining robust at the 5% significance level. The research further reveals that firms with higher short-selling ratios tend to apply for patents with stronger technological content, while the proportion of low-quality patents has relatively decreased. This indicates that under capital constraints, firms place greater emphasis on the precise allocation of R&D resources, avoiding the waste of resources on projects with lower marginal utility.

Taking data from 2015 to 2022 as an example, firms ranked in the top 25% for short-selling ratios exhibited an average citation count per invention patent 18.4% higher than those with lower short-selling ratios. This outcome demonstrates that short-selling pressure exerts a governance effect in enhancing innovation quality, driving firms to shift from quantity-oriented to quality-oriented approaches.

3.6 Heterogeneity and robustness tests

Heterogeneity tests reveal significant differences based on ownership structure. Non-state-owned enterprises exhibit a more pronounced improvement in innovation quality following the implementation of short-selling mechanisms, whereas state-owned enterprises show relatively limited changes in innovation quality. Enterprises in regions with higher marketisation levels demonstrate greater sensitivity to short-selling pressure, manifested through more significant reductions in input and more pronounced improvements in output quality.

Robustness tests supported the aforementioned conclusions. Substituting innovation output indicators with green patent counts and patent family sizes yielded consistent results in both direction and significance. When conducting a dummy test by advancing the treatment period by two years, interaction terms became insignificant, validating the parallel trends assumption. Furthermore, introducing two-way cluster standard errors and excluding financial crisis and pandemic years maintained the robustness of core findings.

4 Research summary and policy implications

The findings reveal that short-selling mechanisms exert both inhibitory and incentivising effects on corporate innovation. Along the financing constraint pathway, short-selling pressure depresses share prices, diminishing firms' external financing capacity and consequently reducing R&D expenditure, leading to a marked contraction in innovation investment. Empirical analysis validates this mechanism: following the implementation of the margin trading pilot scheme, the intensity of R&D investment among participating firms declined significantly. Concurrently, the governance oversight pathway exhibits divergent effects. Short selling subjects firms to heightened market scrutiny, compelling management to refine R&D project selection and resource allocation. This enhances innovation quality, manifested in increased patent citation frequencies and a rising proportion of invention patents. Overall, the short-selling mechanism concurrently reduces innovation quantity while elevating its quality. Differences in property rights characteristics and regional marketisation levels further amplify this effect.

Regarding capital market institutional development, policy design must balance risk stability with market efficiency. Between 2023 and 2024, regulators controlled market volatility through measures such as restricting short selling of restricted shares, raising margin requirements for financing, and implementing T+1 delayed settlement. These actions bolstered market resilience in the short term. However, from a long-term perspective, such regulatory constraints may diminish the incentive role of short-selling mechanisms in fostering innovation quality. It is therefore necessary to gradually expand the coverage of innovative enterprises as short-selling targets within a controllable risk framework, while simultaneously enhancing disclosure transparency. This aligns with the objectives outlined in the Guidelines for High-Quality Development of Capital Markets, namely building a more robust market system to support innovation-driven enterprises. The Growth Enterprise Market on the Shanghai STAR Market has already provided financing channels for high-R&D-investment enterprises that have yet to turn a profit, signalling the capital market's commitment to serving innovation.

When facing short-selling pressure, enterprises should optimise their innovation strategies. Management must enhance the concentration of R&D resources during periods of tight capital, prioritising investments in key technological pathways to improve input-output efficiency. Concurrently, enterprises should elevate transparency in information disclosure and standardise governance practices, leveraging market oversight to mitigate uncertainties inherent in innovation activities. Enterprises under different ownership structures require differentiated response strategies: private enterprises need to strengthen resilience in market-oriented governance, State-owned enterprises may consolidate their R&D footprint by leveraging policy advantages.

Nevertheless, current research exhibits certain limitations. The sample scope remains concentrated on pilot

enterprises, constraining generalisability, while the operational mechanisms in areas such as green technology have yet to be thoroughly explored. Future studies may incorporate longer time series and broader sample coverage to further examine the differentiated impacts of various innovation types. Concurrently, integrating higher-frequency market microdata with diverse instrumental variable methods could quantify the relative contributions of financing constraints and governance oversight effects.

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