WEP Warwick Evans Publishing

International Journal of Global Economics and Management

ISSN: 3005-9690 (Print), ISSN: 3005-8090 (Online) | Volume 3, Number 3, Year 2024
DOI: https://doi.org/10.62051/ijgem.v3n3.06
Journal homepage: https://wepub.org/index.php/IJGEM/index

Research Impact of Shorting Mechanism on Firms' Innovation Quality - Based on Listed Companies' Perspective

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ABSTRACT

The application of a shorting mechanism can make investors pay more attention to the negative information of firms and thus have an impact on managers' innovation decisions. This paper uses the implementation of China's securities financing policy as a quasi-natural experiment to explore the impact of the policy on the quality of corporate innovation. According to the data of A-share listed companies from 2007 to 2022, a double-difference model is used to assess the impact of the implementation of the short-selling mechanism on the quality of corporate innovation. The study shows that the policy significantly promotes the improvement of corporate innovation quality. Meanwhile, the incentivizing effect of the shorting mechanism on enterprise innovation quality is more significant in non-state-owned companies. The findings of the study provide important policy insights for the implementation of the innovation-driven development station strategy in China.

KEYWORDS

Shorting selling; Innovation quality; Listed companies; Patents

1. INTRODUCTION

Corporate innovation is the key to whether an enterprise can stand out in a fiercely competitive market, and it is also an important reflection of the level of corporate governance. However, because of the high investment and long payback period of innovation activities, they can bring great risks and challenges. Therefore, when enterprises face strong financing constraints, they often choose to reduce high-risk, high-cost innovation expenditures, and instead invest funds in "short and quick" projects, the incentives for R&D are suppressed, resulting in a low level of R&D [1].

The short-selling mechanism allows investors to borrow stocks and sell them in order to profit from falling stock prices. It is believed to increase the information transparency and efficiency of the market. And by exposing excessive valuations and questioning the decisions of corporate management, it motivates firms to focus more on long-term R&D investments and innovation activities. Under short-selling pressure, firms often seek groundbreaking innovations to preserve their market position and share price. Therefore, understanding the relationship between the short-selling and corporate innovation is vital for the formulation of relevant financial policies and corporate strategies.

Since the launch of China’s financing and securities trading system in 2010, it has rapidly expanded, innovating capital market investment methods. The gradual unfolding of China's two-financing policy motivated investors to dig up corporate information, and also influenced corporate investment decisions.

In the context of this system, the existing literature has found that as a trading mechanism, the shorting mechanism can profoundly affect the capital market in terms of volatility, liquidity, crash risk, etc. [2][3][4] However, the impact of the shorting mechanism on corporate behavior, especially on innovation activities, is still subject to many controversies. It is necessary to explore the impact of the shorting system on the quality of corporate innovation, which will be conducive to further improving the capital market system and realizing the mutual promotion between the financial market and the real economy.

This research empirically investigates the impact of short selling on corporate innovation quality using financial data from China's A-share listed companies from 2007 to 2022.It aims to verify the effect of short-selling mechanism on the quality of enterprise innovation, provide reference and basis for policy makers, explore the impact on different ownership systems, and contribute to the future innovation promotion from the perspectives of further implementing short-selling mechanism through enhancing the regulatory framework and encouraging the market's healthy development.

2. LITERATURE REVIEW

2.1. Impact of Short-Selling Mechanism On The Capital Market

Based on the "stock price overvaluation theory", the short-selling mechanism is an important trading mechanism that accelerates the reflection of negative information in stock prices [5], thus improving the pricing efficiency of the market and the effectiveness of the capital market [6]. The volatility of stock returns in markets that allow short-selling transactions is significantly lower than that in markets without a short-selling mechanism, i.e., securities financing can reduce the volatility of the securities market, benefit market stability [7] and improve the liquidity of the securities market [8].

2.2. Impact of the Short-Selling Regime on Corporate Governance

In addition, as an external governance mechanism, financing and securities financing can improve the level of corporate governance, constrain the behavior of managers and make them more prudent in making investment decisions. If traders find that corporate management is slack in innovation, then they may attack the listed company through short-selling transactions [9] The introduction of the short-selling mechanism reduces the underlying company's tendency to violate the law, prevents corporate violations [10], and inhibits the role of management manipulation of earnings [3]. Thanks to short-selling transactions, companies have further improvements in disclosure, innovative investments, and financial surplus management. However, there is a concern that facing the pressure of short selling on securities financing, the management may take short-sighted behaviors and give up R&D investment which is beneficial for long-term development [11].

2.3. Study of Factors Influencing Corporate Innovation

Innovation is an important long-term investment of the company, which is characterized by long time, long stage, high risk and uncertain output [12]. From the viewpoint of external environmental factors, firms need a favorable external environment for innovation, including the enactment of relevant laws such as the patent law [13] and differences in the nature of the industry of the firm [14]. From the viewpoint of internal corporate factors, agency-generated internal corporate governance issues have an impact on innovation activities [12], and the allocation and integration of resources for innovation projects are determined by corporate governance mechanisms [15]. In addition, relevant literature also discusses the factors affecting corporate innovation from the perspectives of institutional shareholding [16] and equity concentration [17].

2.4. Short-selling and Corporate Innovation

From the perspective of financing, enterprises innovation activities are severely constrained by due to their long-term nature and uncertainty, and they mainly rely on internal funds [18]. And SMEs mainly finance their R&D through developed stock markets [19]. After the introduction of the two-financing policy, the short-selling trading prompts investors to actively search for corporate information in order to make profits from short-selling, and thus the management of the company increases the importance of corporate innovation level [21]. Massa's empirical research found that the level of corporate innovation increases significantly after the inclusion of financing and bonding targets due to the strengthening of external regulation and the management's emphasis on medium- to long-term large investment opportunities such as improving corporate innovation level, and the reduction of short-term investment projects, significantly [20]. By studying the domestic financing and securities financing system, Quan Xiao Feng and Yin Hong Ying find no clear evidence that it can increase firms' R&D expenditures, but confirm that the financing and securities financing trading model can significantly increase firms' innovative output level [23].

Existing studies are mostly from the perspective of quantity such as corporate R&D inputs, patent outputs (number of patent applications), and less from the quality of innovation, to study the impact of short sale and short sale on corporate innovation, the improvement of R&D inputs and patent outputs does not necessarily represent the improvement of the quality of innovation, and only high-quality level of innovation can improve the value of the enterprise, and to solve China's current innovation dilemma problem. In practice, management is likely to increase low-value but fast-acting projects for the sake of short-term revenue goals, so it is extremely important to find out the impact of the short-selling mechanism on the quality of innovation.

3. RESEARCH HYPOTHESES

Short-selling mechanisms can provide effective oversight in the marketplace, as short sellers typically conduct in-depth research into a company's poor performance. Such scrutiny can force companies to focus more on projects that are truly competitive and have long-term growth potential, thereby improving the quality of innovation. Since the short-selling mechanism may incentivize company executives to take a more prudent approach and make responsible decisions. The management of companies entering the subject list will choose their projects more carefully in order to enhance their share price and prevent malicious short-selling of their businesses, ensuring that they invest in those areas of innovation that are truly promising. The short-selling mechanism forces firms to seek innovation more aggressively through enhanced external oversight and internal governance in order to remain competitive and obtain better financing terms. In summary, the short-selling mechanism positively contributes to the improvement of firms' quality of innovation. Therefore the hypothesis is proposed:

H1:The shorting mechanism promotes the improvement of firms' innovation quality

4. RESEARCH DESIGN AND EMPIRICAL FINDINGS

4.1. Research Design

4.1.1. Data source and sample selection

This paper takes A-share listed companies during the period of 2007-2022 as the research object, and the companies subject to financing and securities financing as the sample of the experimental group, and the companies not subject to financing and securities financing as the sample of the control group. First of all, this paper preprocesses the sample: (1) delete financial companies; (2) delete ST and ST* companies; (3) delete observations with missing data or obvious abnormalities in key financial

variables. In addition, in order to circumvent the interference of outliers on the results of empirical analysis, this paper carries out the shrinking tail (Winsor) treatment at 1% and 99% levels for all continuous variables. In this paper, the financing and securities data are from RESSET database, the company financial data are from CSMAR, and the enterprise innovation data are from CNRDS.

4.1.2. Modeling

Drawing on Li Chun Tao (2020) and other existing literature, based on the characteristics of the bulk expansion of the target stocks in margin trading and securities lending, this paper constructs the following multi-period double-difference (DID) model to test the impact of short selling mechanism on the quality of enterprise innovation:

$$Quality_{i,t} = \alpha_0 + \beta_1 PostList_{i,t} + \sum Controls_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (1)$$

Quality is the variable of the quality of corporate innovation, List is the dummy variable of short sale. Post is the dummy variable of the time of short sale, Controls is the control variables. Meanwhile, industry fixed effects and year fixed effects are controlled in order to minimize omitted variable bias. If the regression coefficient β_1 of PostList is positive, it indicates that the shorting regime significantly enhances the quality of corporate innovation.

4.1.3. Selection and measurement of key variables

(1) Explained Variables

Enterprise patents can be categorized into invention patents, design and utility model patents. Compared with design patents, invention patents and utility model patents are more difficult to authorize, more complex technology, and more valuable, which better reflect the innovation level of enterprises. This paper adopts the ratio of the sum of utility model and invention patents to the total number of patents to measure the level of enterprise innovation quality.

(2) Explanatory variable

The explanatory variables in this paper are PostList, List is a dummy variable for financing and financing securities, which takes the value of 0 for firms that are not included in the list of financing and financing securities underlying, and 1 for those that are. Post is a time dummy variable that has a value of 0 otherwise and 1 for the year it is added to the list and any following years. PostList is the cross-multiplier of List and Post, i.e., it takes the value of 1 if the sample listed firms are included in the list of financing and financing targets in that year, and 0 otherwise.

(3) Control variables

Referring to Chunyan Wang (2018), Xiaofeng Quan (2017), etc., Lnsize, ROA, LEV, TOBIN_Q, First, CEO_share and Age are used as control variables. Table 1 shows the variable definitions.

Table 1. Variable Definitions

Quality	Ratio of the sum of the number of utility model and invention patents to the total number of patents
List	Take the value of 1 for the subject of financing and financing securities, otherwise take the value of 0
Post	Value 1 for the year after the inclusion of the financing and financing bid, 0 otherwise
PostList	List*Post sample period firms' stocks included in the short-sale bid takes the value 1, otherwise 0
Lnsize	Firm size, expressed as the natural logarithm of the firm's total asset amount.
ROA	Return on Total Assets, obtained by dividing the firm's net profit for the current period by its total assets at the beginning of the period.
LEV	Gearing ratio company's total liabilities for the current year divided by total assets expressed.
TOBIN_Q	Company Growth Measurement Indicators
FIRST	Shareholding ratio of the first largest shareholder
CEO_share	Management shareholding ratio, expressed as the number of shares held by management divided by the total number of shares.
Age	Difference between the year of observation and the year the company went public
Industry	Industry dummy variable
Year	Year dummy variable

4.2. Descriptive Statistics

Table 2 shows the descriptive statistics of the main variables, where it can be seen that Quality has a mean value of 0.517, with a minimum value of 0 and a maximum value of 1, indicating that there is a large variation in the quality of innovation among different enterprise. 30.6% of the sample companies in the sample are included in the underlying stocks of financing and financing during the sample period. There is a significant difference in the average business size of 22.18, with minimum values of 19.83 and maximum values of 26.84. The distribution of other control variables is more reasonable and consistent with economic theory and common sense.

Table 2. Descriptive statistics

VARIABLES	N	mean	sd	min	max
id	36,034	297,380	274,145	2	689,009
Year	36,034	2,016	4.366	2,007	2,022
Quality	36,034	0.517	0.475	0	1
ln_patent	36,034	1.028	1.317	0	8.714
AGE	36,034	16.02	8.045	1	32
TOBIN_Q	36,034	2.053	1.308	0.851	8.545
FIRST	36,034	35.95	14.96	7.9	74.89
CEO_share	36,034	12.34	18.87	0	67.5
Lnsize	36,034	22.18	1.275	19.84	26.15
LEV	36,034	3.297	2.757	1.119	17.43
ROA	36,034	0.0357	0.0634	-0.258	0.198
PostList	36,034	0.306	0.461	0	1
Post	36,034	0.642	0.479	0	1
List	36,034	0.306	0.461	0	1

4.3. Regression Analysis

The benchmark model used for the empirical regressions in this paper is a two-way fixed effects model. In order to eliminate the effect of heteroskedasticity and other factors, the clustered robust standard errors are corrected for the standard errors of the regressions, and the corrected z-values of the two-sided tests are output in parentheses. Column (2) of Table 3 reports the basic regression results of the impact of the shorting mechanism on the quality of firms' innovations after adding control variables and fixed effects. The PostList regression coefficient is 0.033, which is statistically positive at the 1% level, according to the regression, indicates that the intervention of short selling extremely improves the innovation quality of subject firms relative to non-subject firms. Hypothesis H1 is verified.

Table 3. Results of the main regression test

	(1)	(2)
	Quality	Quality
PostList	0.0240*	0.0330***
	-2.27	-3.35
Lnsize		0.0165**
		-3.2
LEV		-0.00224
		(-1.54)
ROA		0.348***
		-6.54
TOBIN_Q		-0.0140***
		(-4.29)
FIRST		-0.000345
		(-1.10)
CEO_share		0.000343
		-1.31
AGE		-0.0131***
		(-15.41)
Industry	YES	YES
Year	YES	YES
_cons	0.510***	0.111
	-69.59	-0.92
N	36034	36034
R^2	0.001	0.308
adj. R^2	0.001	0.306
t statistics in parentheses		
* p < 0.05, ** p < 0.01, *** p < 0.001		

4.4. Heterogeneity Analysis

The nature of property rights has a profound influence on how business behave. In this research, the heterogeneity of corporate property rights in the benchmark regression is further analyzed, the results are displayed in Table 4. Column (1) reports the regression results for non-state-owned firms, and controlling for other factors being unchanged, the List*Post coefficient of the non-state-owned firms is 0.264, and it is significant at the 1% level, which suggests that the shorting mechanism's promotion of firms' innovation quality is significant in the case of the non-state-owned firms. Column (2) reports the regression results of state-owned enterprises, the List*Post coefficient of SOEs is not significant,

and the promotion effect of shorting mechanism on firms' innovation quality is not significant in state-owned enterprises. This is consistent with the analysis of Wang Chunyan (2018) on the heterogeneity of enterprise property rights, the reason for this conclusion may be that most of the SOEs are in key areas related to the national economy and people's life, and are not prone to the phenomenon of low R&D investment, and at the same time, the SOEs may also have a lack of endogenous motivation to innovate, which leads to a small impact of the policy of securities financing.

Table 4. Subgroup regression results

	(1)	(2)
	Quality	Quality
PostList	0.0384***	-0.00654
	-3.7	(-0.26)
Lnsize	0.0143**	0.0309**
	-2.68	-3.04
LEV	-0.00253	-0.0000794
	(-1.66)	(-0.02)
ROA	0.371***	0.0905
	-6.67	-0.61
TOBIN_Q	-0.0139***	-0.0141
	(-4.16)	(-1.26)
FIRST	-0.00026	-0.000933
	(-0.79)	(-1.45)
CEO_share	0.000287	0.000299
	-1.07	-0.1
AGE	-0.0136***	-0.0118***
	(-15.17)	(-7.48)
_cons	0.113	-0.127
	-0.89	(-0.51)
Industry	YES	YES
Year	YES	YES
N	30955	5079
R^2	0.3	0.33
adj. R^2	0.298	0.318
t statistics in parentheses		
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$		

4.5. Robustness Tests

4.5.1. Replacement of explanatory variables

The benchmark regression uses the sum of invention patents and utility model patents as a share of all patents to measure the quality of innovation, and the explanatory variable measures are replaced to make the results more robust. For robustness considerations, invention patents are more expensive and more strictly audited for authorization, with higher innovation content. Therefore, referring to the literature of Yuan et al. (2015), the natural logarithm of the number of invention patents applied by the company plus one is selected as a proxy variable for innovation quality to further test the effect of the shorting mechanism on the firm's innovation quality. Table 5 presents the regression results. The results illustrate that, controlling for other factors being unchanged, the coefficient of PostList is 0.183, which is significant at the 1% level, and the conclusion of the benchmark regression is verified and the regression results are robust.

Table 5. Regression Results of Shorting Mechanism and Firm Innovation Quality after Replacing Explained Variables

	(1)
	ln_patent
PostList	0.183***
	-5.58
Lnsize	0.250***
	-10.82
LEV	-0.0115**
	(-2.71)
ROA	1.174***
	-7.11
TOBIN_Q	0.0368***
	-3.54
FIRST	-0.000488
	(-0.46)
CEO_share	0.00231**
	-2.61
AGE	-0.0223***
	(-8.53)
_cons	-5.014***
	(-9.91)
Industry	YES
Year	YES
N	36034
R^2	0.279
adj. R^2	0.277
t statistics in parentheses	
* p < 0.05, ** p < 0.01, *** p < 0.001	

4.6. Endogeneity Test

4.6.1. Lagged explanatory variables

As the policy impact may exist lag, the decision-making process of enterprise R&D investment needs to be considered comprehensively, when making investment decisions, the management needs a certain amount of time to react and adjust the direction of decision-making in a timely manner, in order to constantly revise the judgment of enterprise R&D investment, so this paper lags all control variables by one period, and the results of regression are shown in Table 6. The table 6 demonstrates the coefficient of L. PostList is 0.0427, which is significant at the 1% level, proving the robustness of the conclusions.

Table 6. Regression results of shorting mechanism and firms' innovation quality after lagging one period control variables

	(1)
	Quality
L.PostList	0.0427***
	-3.85
Lnsize	0.0127*
	-2.31
LEV	-0.00413*
	(-2.40)
ROA	0.353***
	-6.22
TOBIN_Q	-0.0133***
	(-3.77)
FIRST	-0.000191
	(-0.56)
CEO_share	0.000356
	-1.2
AGE	-0.0129***
	(-13.95)
_cons	0.249
	-1.9
Industry	YES
Year	YES
N	30454
R^2	0.306
adj. R^2	0.304
t statistics in parentheses	
* p < 0.05, ** p < 0.01, *** p < 0.001	

5. CONCLUSIONS AND RECOMMENDATIONS

Based on the research background of financing and securities financing system, this paper discusses and tests the impact of shorting mechanism on firms' innovation quality with a sample of Chinese A-share listed firms. The results of the study find that the short-selling mechanism plays a significant positive role on the quality of corporate innovation. The possible reason is that the short-selling mechanism creates a constraining and monitoring effect, which helps to improve the internal and external governance environment of firms, and ultimately favors the improvement of innovation quality.

Further examination of the heterogeneity of the impact of the shorting mechanism on firms' innovation quality reveals that the shorting mechanism contributes more significantly to the innovation quality of non-state-owned firms compared to state-owned firms. Finally, the findings of this paper were tested for robustness by replacing the measure of the innovation quality variable. The test results remain robust.

The findings of this paper prove the incentive effect of the shorting system on the innovation quality of enterprises, which provides theoretical reference and practical guidance for solving the problems such as insufficient innovation of enterprises. Therefore, it is recommended that China continue to expand the financing and securities financing market, reduce the threshold and cost of securities financing transactions, and broaden the development space of financing and securities financing

business, and it is also recommended that enterprises increase the importance of innovation projects and focus on the sustainable development of enterprises.

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