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Research on the Impact of Short-Selling System on Tax Avoidance of Growth Enterprises

-- Based on the Research of ChiNext and STAR Market

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Abstract

With the continuous progress of China's capital market reforms, the short-selling system has been introduced in various markets to enhance price discovery and liquidity, strengthen external supervision, and is now gradually being applied to growth enterprises, such as ChiNext and the STAR Market, However, the effect of capital market governance on tax avoidance by high-growth companies has not been studied enough, Based on a sample of companies listed on ChiNext and the STAR Market from 2010 to 2023, this paper takes advantage of the quasi-natural experiment created by the staged introduction of the margin trading program to apply the difference-in-differences method and systematically studies the effect of short-selling on tax avoidance for growth companies. Therefore, the amount of tax evasion will be relatively small, After adding the firms to the margin trading list, their book-tax difference (BTD) has fallen substantially, and this result is consistent with PSM-DID and other indicators for the dependent variable, In different kinds of companies, the disciplinary function of short selling also varies. A company that invests more in research and development will be less eager to lower taxes by avoiding them, Based on the mechanism test, we found that the financing constraint transmits the effect of short-selling on corporate tax decisions, Increase financing pressure on the company and raise the tax-avoidance cost; thus, it is less attractive for short-selling. Based on the previous studies of the economic effects of short-selling and corporate tax avoidance, we present some empirical data and policy suggestions here to strengthen capital market regulation, build a joint regulatory mechanism with the tax authorities, and introduce differentiated regulatory policies.

Keywords

Short-Selling Mechanism; Corporate Tax Avoidance; Growth Enterprises; Difference-in-Differences.

1. Introduction

With the continuous deepening of capital market reform in China, the short-selling system aims to improve the market pricing mechanism, boost market liquidity, enhance regulatory efficiency, and is very beneficial for growth enterprises, so it is gradually being introduced in the market for growth enterprises, such as ChiNext and STAR Market, Although China's short-selling system has not been fully built, it can still be used as an external check on enterprises and is now necessary for building a strong and efficient capital market in China, Growing enterprises generally have the following characteristics: a large amount of R&D investment, a long profit cycle, rapid technological changes, high risk and high return. As the driving force for innovation, they are leading the industrial upgrading in China today and provide the foundation

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for high-quality development, Therefore, studying their tax planning and capital management are to be done to help realize the value of Chinese enterprises.

Most previous studies on the behaviour of corporate tax avoidance have focused on internal governance, tax policy, information disclosure, etc, However, the theoretical foundation for how external factors, such as the short-selling system, influence tax decisions has not been well established, and research on the impact of short selling on the behaviour of growth enterprises is also scarce, Given the two views of market pressure and regulatory constraints, this paper will extend the theoretical system of how institutional market mechanisms affect the actual behaviour of growth companies, put forward more effective coordinated policies for capital market and tax regulation, and guard against potential tax-avoidance incentives resulting from changes in the institutional system. For companies listed on the ChiNext and STAR Market, tax-avoidance activities will affect both the company's finances and tax obligations, and thus change how investors view it and price the stock, Determine the effect of external short-selling pressure on the tax avoidance decisions of growth companies, and based on the empirical evidence obtained, strengthen internal control and balance the interests of shareholders and the government.

The first aim of this paper is to examine in detail how the short-selling system affects the tax-avoidance behaviour of firms in the institutional environment of the ChiNext and STAR Market, given the typical characteristics of growth enterprises, First, considering the internal characteristics of the companies, all types of governance effects of the short-selling system at different levels of R&D intensity and risk tolerance are examined in this paper, and its monitoring function for growth enterprises is identified, Second, regarding the mode and channel, this paper will examine whether the pressure of short-selling increases the potential costs and risks of corporate tax avoidance by restricting financing options and enhancing external market supervision, thus curbing the behaviour of tax avoidance. Based on the above analysis, this paper will provide a general introduction and specific information on how the short-selling mechanism operates in the governance of emerging markets.

2. Literature Review

Foreign research on the short-selling system and the tax avoidance behaviour of enterprises began earlier, but it is generally classified as interdisciplinary research and covers problems such as market microstructure, corporate financial governance, tax planning, information asymmetry, etc, The short-selling trading system in the capital market can reveal information that enterprises have not released in time or have tried to hide, reduce the information asymmetry of enterprises, and thus increase the opportunity cost of corporate tax avoidance (Hasan et al., 2014), Given the complicated financial structure and tax collection and payment system, enhancing the transparency of information disclosure can prevent enterprises from hiding actual profits, reduce the difficulty of tax collection and management, increase the chances of external investor supervision, and thus reduce the risk of tax evasion by enterprises; consequently, it can help protect the reputation of the company and reduce career risks for managers (Armstrong et al., 2015)[1]. To avoid the problem of short selling, managers will reduce their own interest in earnings management, increase the disclosure of corporate financial information, and make tax avoidance more difficult (Massa et al., 2015)[2,3].

With the continuous development of the margin trading scheme in China, most research on related issues has focused on how short-selling affects corporate tax avoidance, and the results are not in agreement, Luo and others (2020) used the quasi-natural experiment of China's relaxation of the short-selling ban to find that easing the short-selling ban reduces the effective cash tax rate of enterprises and is thus expected to promote corporate tax evasion, Li Chuntao and others (2021) believe that short-selling is another form of tax administration regulation

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and can therefore curb corporate tax evasion[4]. Gu Naikang and others (2017) are of the view that, as an external governance tool, short-selling can provide prior deterrence against deficiencies in internal governance[5,6].

Many studies have shown that short-selling also has some governing functions in various ways, Yang Mingzeng and others (2020) have found that the intensity of tax avoidance decreases after a company is added to the margin-trading list, Tian Gaoliang and others (2020) have noted that this constraint is relatively stronger for managers-controlled companies, and Xiong Jiacai and others (2019) have found that short-selling-driven tax avoidance activities increase agency conflicts and harm the long-term interests of the firm. Zhou Zheyu and others (2026) have pointed out that in addition to short-selling, the "Stock Connect" program can also curb corporate tax evasion by improving information disclosure, Chen Zuohua and others (2018) have found that financing constraints are positively correlated with the extent of corporate tax evasion, and a good level of internal control can reduce this effect, Most of the existing research on the financial performance of growth enterprises has focused on reducing financing constraints, decreasing R&D expenses and improving operating efficiency (Zhang Yili, 2020), but studies of their tax-avoidance behaviour are relatively scarce[7-12]; thus, the research framework of this paper needs to be extended.

Although some Chinese scholars have carried out some studies on the operating mechanism, market governance influence and information disclosure function of short-selling, specific research on how short-selling affects the tax avoidance behaviour of growth companies in the ChiNext and STAR Markets is still lacking, Most of the previous studies have focused on listed companies in general and have not fully taken into account the typical features of high R&D expenses, high financing dependence and high business uncertainty in growth enterprises, Therefore, identifying different levels of governance for short-selling at various firms is difficult. A general selection of samples will not be specific enough to show the particular ways and economic consequences of short-selling in growth enterprises.

Most of the previous studies have focused on data before 2017 and have not covered the recent period of increased capital market reform, For example, in recent years, the full implementation of the registration-based IPO system on the ChiNext board of the Shenzhen Stock Exchange and the opening of the STAR Market on the Shanghai Stock Exchange have brought about substantial changes in market structure, investor composition and information disclosure requirements, Therefore, there will be new characteristics in the binding force and market reaction pattern of short-selling. Continuing to use the old data will not reflect the actual impact of short selling on corporate tax avoidance behaviour under the current institutional environment, and we will be unable to observe changes in the pattern of governance effects after institutional reform.

At the same time, there is relatively little research on heterogeneity, and most studies have only considered the general average effect; few have conducted group-level comparisons of different dimensions, such as R&D intensity, financing constraints, firm size, risk-taking ability, etc, The degree of impact of short-selling on a company's tax-avoidance efforts will vary according to various internal and external circumstances, Therefore, if we neglect this heterogeneity, it will not only reduce the explanatory power of the results to some extent but also make it difficult to offer differentiated policy recommendations for various parts of regulatory work.

Therefore, this paper will focus on growth companies listed on the ChiNext and STAR markets, and by adding recent market data and multi-dimensional heterogeneity analysis, we hope to correct the shortcomings in the sample structure, time period and research methods of existing studies, and obtain more detailed and practical empirical evidence on the impact of short-selling on corporate governance under the new institutional framework.

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3. Research Hypotheses

First, based on the principle of ex-ante deterrence, the new short-selling regulations will change the payoff structure for managers and thus modify their incentives, If there were no short-selling, the drop in stock price following the release of bad-news tax information would be smaller, and thus managers would be less inclined to engage in aggressive tax avoidance to inflate reported earnings, A company has been added to the short-selling target list, and now short-sellers will spread bad news in an organised manner (Chakrabarty and Shkilko, 2013). A credible threat of short-selling will cause a considerable decline in stock prices after the disclosure of tax evasion, and as a result, some of the former externalised tax-avoidance risk has now been borne by the management[13].

Second, short sellers can use the interim report to gather more data and learn how to find irregularities in book-tax differences, aggressive transfer pricing and tax havens, It is a market-oriented supplement to the old system of auditors, analysts and regulators, Given the high level of supervision mentioned above, the marginal cost of tax evasion is relatively high; thus, the marginal benefit of aggressive tax planning is small.

Finally, in the case of ex-post punishment, should tax fraud be discovered after the fact, authorities will regulate the company, impose all sorts of tax penalties and other sanctions, damage its reputation, increase the risk of litigation, and lead to career setbacks for high-level executives (Desai and Dharmapala, 2006), The short-selling regime will increase these ex-post costs by speeding up how quickly bad news is incorporated into stock prices and drawing more attention from the media and investors[14].

Together, the three reasons reduce the cost-benefit balance of tax avoidance behaviour; that is to say, the expected cost increases and the expected benefit decreases, so rational managers will reduce the extent of aggressive tax planning and adopt a more conservative tax policy, Therefore, this paper presents the following hypothesis:

H1: Enhance the negative effects of information disclosure and strengthen market supervision to curb the problem of tax evasion by listed companies.

The Degree to which Short-selling Limits Corporate Tax Avoidance May Vary Among Firms, Firms with a relatively high level of research and development are more likely to have a relatively large proportion of intangible assets and are also more susceptible to earnings fluctuations (Wu Zuguang and others, 2013); they are also subject to a higher degree of information asymmetry and have more discretion in using favourable tax policies (Hanlon, 2005), As a result, under the pressure of short-selling, these companies will voluntarily reduce their high-tax activities to maintain the confidence of the capital market[15,16]. Risk-averse companies have relatively unstable cash flows and are thus more likely to experience a drop in stock prices and harm to their reputation, The managers of these companies are likely to leave after the short-selling of stocks takes place, Therefore, Hypothesis H2 has been put forward.

H2a: Among the companies that have invested relatively more in research and development, the negative effect of short-selling on tax avoidance is more pronounced.

H2b: Among the more risk-averse enterprises, short selling has had an even more serious negative effect on corporate tax avoidance.

The arrival of short-selling will quickly increase the price drop of stocks due to reduced demand, A drop in stock prices will reduce the company's equity financing; therefore, creditors may be less willing to lend and thus reduce the amount of borrowing, Given the lack of funds, excessive tax avoidance will increase the risk of high financing costs and a downgrade in credit ratings; thus, the overall cost to the company will be significantly higher. Thus, considering the tax reduction effect and other risks, the company will not reduce taxes significantly, Therefore, Hypothesis H3 has been put forward.

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H3: Short-selling will reduce the amount of high-taxed tax avoidance by limiting the company's financing.

4. Data, Models, and Research Variables

4.1. Data Sources

A Difference-in-Differences method is used to study the effect of the margin trading system on corporate tax evasion, Firms that have been added to the margin-trading list on both the ChiNext Board of the Shenzhen Stock Exchange and the STAR Market of the Shanghai Stock Exchange (both listed in Shanghai and Shenzhen) are considered the treatment group, and non-listed firms are used as the control group, Since the margin-trading pilot was launched in 2010, 2010 is taken as the starting year and the sample window is from 2010 to 2023. T

he sample is further refined in the following steps:

(1) FinancialExcluding listed companies in the insurance industry.

(2) FirmsThose that do not appear normally, such as ST and ST*, are excluded.

(3) ObservationsThe missing key variables in the corresponding sample period are not added.

(4) AllWinsorise the continuous variables at the 1st and 99th percentiles to reduce the effect of outliers.

The data in this paper are mainly taken from the CSMAR and Wind databases, Firm-level tax avoidance, financial and governance data are obtained from CSMAR, and the list of margin-trading eligibility and trading records is obtained from Wind, Finally, there are a total of 7,590 firm-year observations.

4.2. Model Specification

4.2.1. Baseline Regression Model

Based on the above studies, the difference-in-differences model is employed to investigate the effect of the easing of short-selling restrictions on corporate tax avoidance behaviour.

$$\mathrm{BTD}_{i,t} = \alpha + \beta \cdot \mathrm{did}_{i,t} + Y \cdot \mathrm{Controls}_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t}$$

Among them, i represents the firm, t represents the year; $\mathrm{BTD}_{i,t}$ is the degree of corporate tax avoidance; $\mathrm{did}_{i,t}$ is the dummy variable of the short-selling institution; $\mathrm{Controls}_{i,t}$ is the set of control variables; μ_i is the firm fixed effect; λ_t is the year fixed effect; $\varepsilon_{i,t}$ is the random disturbance term. The core coefficient of interest is β . If β is significantly negative, it indicates that the short-selling institution inhibits corporate tax avoidance behavior, supporting Hypothesis H1.

4.2.2. Heterogeneity Analysis Model

To test Hypotheses H2a and H2b , this paper conducts grouped regressions on the samples according to R&D intensity and risk tolerance, and compares the magnitudes and significance differences of the did coefficients in different groups. The model form is the same as the baseline regression, but estimated separately in different subsamples.

4.2.3. Mechanism Test Model

To test Hypothesis , thisH3 paper uses the mediation effect test method put forward by Wen Zhonglin and others in 2004 to construct the following model:[17]

Step 1: $BTD_{i,t} = \alpha_1 + \beta_1 \cdot \mathrm{did}_{i,t} + \gamma_1 \cdot \mathrm{Controls}_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t}$

Step 2: $FC_{i,t} = \alpha_2 + \beta_2 \cdot \mathrm{did}_{i,t} + \gamma_2 \cdot \mathrm{Controls}_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t}$

Step 3: $BTD_{i,t} = \alpha_3 + \beta_3 \cdot \mathrm{did}_{i,t} + \theta \cdot FC_{i,t} + 3 \cdot \mathrm{Controls}_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t}$

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Here, $FC_{i,t}$ captures the extent of corporate financing constraints. Following the approach of Kaplan and Zingales (1997), this paper constructs and computes the KZ index. A larger KZ value signals stronger financing constraints confronting the firm[18]. Specifically, Model (1) serves as the baseline regression that gauges the overall influence of short-selling on corporate tax avoidance; Model (2) examines how short-selling affects financing constraints, corresponding to the first stage of the mediating effect; Model (3) assesses short-selling's direct impact on corporate tax avoidance once financing constraints are accounted for. Hypothesis H3 receives support when β_1,β_2 , β_3 are all statistically significant and β_3 falls in magnitude relative to β_1.

4.3. Variable Measurement

4.3.1. Explained Variable: Corporate Tax Avoidance (BTD)

Based on the studies conducted by Desai and Dharmapala (2006) and Li Chuntao et al. (2021), the book-tax difference (BTD) will be used in this paper to measure the degree of corporate tax avoidance, BTD is a type of indicator for corporate tax avoidance; the higher the BTD, the more severe the tax avoidance, This way, we do not need to consider differences in tax rates when calculating avoidance. The corresponding special formulas are as follows:

$$\mathrm{BTD} = \frac{\mathrm{Y^S} - \mathrm{Y^T}}{\mathrm{L.\,Asset}}$$

$$\mathrm{Y^T} = \frac{\mathrm{CFTE}}{\tau}$$

x is th$\mathrm{Y^S}$e firm's pre-tax profit in period t, y is the tax$\mathrm{Y^T}$able income, calculated as the actual income tax expense (CFTE) multiplied by the statutory tax rate (τ), and CFTE can be obtained by deducting deferred income tax expense from total income tax expense, Asset is the total assets of the company at the end of the previous period.

As Desai and Dharmapala (2006) point out, although the BTD measure derived from book-tax income differences can effectively capture the degree of corporate tax avoidance, this indicator embeds not only a tax-avoidance element but also an earnings-management component. To strip out the portion of the book-tax difference attributable to earnings management, Desai and Dharmapala (2006) adopt the regression residual $\mathrm{DDBTD_{i,t}}$ obtained from regressing the book-tax difference (BTD) on accrual earnings (TACC) to measure corporate tax-avoidance practices. For robustness purposes, this paper additionally employs $\mathrm{DDBTD_{i,t}}$ as an alternative proxy.

4.3.2. Core Explained Variable: Short-Selling System (did)

Given that it is a quasi-natural experiment, staged introduction of the margin-trading regime will be used to build a difference-in-differences (DID) model, Specifically, it is 1 from year t onwards if a firm is added to the margin-trading target list, and 0 otherwise, Therefore, we know whether short-selling has led to a change in corporate tax avoidance.

4.3.3. Heterogeneity Grouping Variable

R&D intensity and corporate risk tolerance serve as the heterogeneity grouping variables in this study. Specifically, R&D intensity is proxied by the R&D ratio, while corporate risk tolerance is captured through the RTA indicator.

R&D denotes the share of a firm's R&D outlays relative to its overall business scale, mirroring the firm's commitment to technological innovation, and is broadly applied to samples drawn from the ChiNext and the STAR Market. The formula is as follows:

$$\mathrm{R\&D} = \frac{\text{Research and Development Expenditures}}{\text{Total Assets at the End of the Period}}$$

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RTA is the extent of uncertainty and fluctuation in a company's operations that it can tolerate[19]; generally, it is used to gauge strategic risk-taking and financial health, Xiao Han and others in 2018 used RTA to assess the risk appetite of the company.

Based on the median R&D value, the sample is divided into a high-R&D group and a low-R&D group, and similarly, observations are divided into high-risk-tolerance and low-risk-tolerance groups according to the median of RTA.

4.3.4. Mediating Variable: Financing Constraint (KZ)

Kaplan and Zingales (1997) have put forward a financing-constraint index (KZ index) to reflect the degree of financing pressure on a company. A large KZ value shows that a company is in a severe financing situation.

4.3.5. Control Variables

Based on the above studies, the following control variables that can affect corporate tax-avoidance behaviour have been added in this paper: asset-liability ratio (Lev), return on assets (ROA), ownership concentration (OWNCON1), fixed-asset intensity (Fixed), intangible-asset intensity (Intangible) and market-to-book ratio (MTB), Firm fixed effects and year fixed effects are used to address the time-invariant characteristics of firms and fluctuations in the overall economy.

Table 1. Variable Definition Table

Variable type	Variable symbol	Variable name	Variable definition
Explained variable (measurement of the degree of corporate tax avoidance)	BTD	Difference between accounting book profit and actual tax burden	$\frac{\text{Profit Before Tax} - \text{Taxable Profit}}{\text{Total assets in the previous period}}$
	DDBTD	Accounting-tax difference calculated by the fixed effect residual method	$BTD_{i,t} = \beta_1 TACC_{i,t} + \mu_i + \epsilon_{i,t}$ $\text{DDBTD}_{i,t} = \mu_i + \varepsilon_{i,t}$
Core explanatory variable (measurement of short selling)	did	Margin trading and short selling eligible securities	If the enterprise is on the list of margin trading and short-selling eligible securities, then it is 1; otherwise, it is 0.
Heterogeneity grouping variable	R&D	R&D investment intensity	$\frac{\text{Research and Development Expenditures}}{\text{Total Assets at the End of the Period}}$
	RTA	Risk tolerance	Weighted average of gross operating margin, market share (the ratio of a company's operating revenue to the total operating revenue of the industry), and cash flow (the ratio of cash on hand to total assets of the company).
Mediating variable	KZ	Enterprise financing constraints	Assess the extent of financial difficulty for a company. Generally, the higher the amount, the more severe the financial pressure on the company.
	Lev	Asset - liability ratio	Ratio of total liabilities to total assets
Control variable	ROA	Return on total assets	Ratio of net profit to total assets
	OWNCON1	Equity concentration	Proportion of Equity Held by the Largest Shareholder
	Fixed	Fixed asset intensity	Ratio of fixed assets at the end of the year to total assets
	Intangible	Intangible capital intensity	The proportion of the net value of intangible assets at the end of the year to total assets.
	MTB	Price-to-book ratio	Ratio of a company's market value to its book value at the end of the year
	INDUSTRY	Control industry	
	YEAR	Control year	

4.4. Descriptive Statistics

The descriptive statistics of the main variables are shown in Table 2, The mean of the dependent variable BTD is 0.003, the standard deviation is 0.024, the minimum value is -0.08 and the maximum value is 0.129, Therefore, the book pre-tax profits of the sample firms are generally slightly higher than their taxable income after deducting actual tax payments, and there is a considerable difference in the degree of tax avoidance among these firms. The mean of the core

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independent variable is 0.361, and thus 36.1% of the sample firms qualify for margin trading, The means, standard deviations and extreme values of firms' capital structure, profitability, equity concentration, asset composition and market valuation in the control variables are quite different; thus, strong foundations have been laid for the following subgroup analysis and mechanism tests.

Table 2. Descriptive Statistics of Main Variables

Variable	Obs	Mean	Standard, Development.	Min	Max
BTD	7590	0.003	0.024	-0.08	0.129
did	7590	0.361	0.48	0	1
Lev	7590	0.295	0.171	0.027	0.962
ROA	7590	0.06	0.038	0	0.225
OWNCON1	7590	0.304	0.128	0.072	0.742
Fixed	7590	0.151	0.11	0.001	0.65
Intangible	7590	0.037	0.037	0	0.346
MTB	7590	4.437	3.47	0.055	58.107

5. Empirical Results Analysis

Table 3. Short-Selling System and Corporate Tax Avoidance

	(1)	(2)	(3)
VARIABLES	BTD	BTD	BTD
did	-0.004***	-0.004***	-0.004***
	(-3.17)	(-3.34)	(-3.31)
Lev		-0.010***	-0.009***
		(-3.09)	(-3.02)
ROA		0.228***	0.232***
		(17.71)	(17.43)
OWNCON1		0.011*	0.010*
		(1.96)	(1.72)
Fixed			0.016***
			(4.04)
Intangible			-0.036***
			(-3.46)
MTB			-0.000
			(-0.41)
Constant	0.004***	-0.010***	-0.011***
	(7.88)	(-4.99)	(-5.21)
Observations	7,590	7,590	7,590
R-squared	0.450	0.507	0.510
Company FE	YES	YES	YES
Year FE	YES	YES	YES

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

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Table 3 shows the results of the DID regression for the effect of short-selling on corporate tax avoidance, and firm-level clustering is used to adjust the standard errors, Model (1) only includes firm fixed effects and year fixed effects, and Models (2) and (3) add all sorts of control variables, such as financial conditions, governance structure, asset composition and market valuations, The coefficient of did is significantly negative at the 1% level in all three models, and it is consistently -0.004 (the corresponding t-statistics are -3.17, -3.34 and -3.31). With the addition of more control variables, the goodness of fit (R^2) of the model rises from 0.450 to 0.510; thus, the results are considered reliable.

Given that the mean BTD of the sample is 0.003, and it is negative, short-selling mechanisms can be used to reduce corporate tax avoidance behaviour, thus supporting the "tax-collection effect" of short-selling, This is in line with Massa and others' (2015) "constraint hypothesis" and the results of Li Chuntao and others (2021), The reasons may be as follows: (1) Due to the pressure of short-selling, the market has become more price-efficient; if the company's tax-avoidance activities are exposed, the stock price will fall and financing costs will increase. (2) Short-sellers have taken the initiative to discover and disclose financial and tax irregularities early on in order to reduce information asymmetry. The signs and magnitudes of the control-variable coefficients are in line with expectations; thus, Hypothesis H1 is supported.

6. Robustness Tests

6.1. PSM-DID Analysis

Although the DID estimates of the previous baseline regression have dealt with some extent the endogeneity problem of linking the short-selling regime with corporate tax avoidance behaviour, the treatment and control samples are not very similar in terms of sample size and firm-level characteristics, The listed companies in the margin-trading and short-selling lists are generally different from those not on the list in terms of scale, liquidity and financial conditions, There may be selection bias in the regression results. To address the above problem, following Chen et al. (2015), propensity score matching (PSM) is employed here to find control group firms that are similar to those in the treatment group, and then Difference-in-Differences (DID) estimation is carried out on the matched pooled sample[20].

The process is as follows: First, build the matched sample, Firm data from the previous year is added to the list of margin-trading and short-selling firms, and firm-year observations of firms that were never listed in the sample window are pooled to form the matching sample, Second, a Logit model is employed to obtain the propensity score of a company being designated as a margin-trading and short-selling firm. At this stage, the dependent variable is a binary indicator that shows whether a company has been added to the margin-trading and short-selling list; it is 1 if the company is designated as a short-selling target in year t, and 0 otherwise, Control variables are firm size (Size), leverage (Lev), return on assets (ROA), ownership concentration (OWNCON1), fixed-asset intensity (Fixed), intangible-asset intensity (Intangible), market-to-book ratio (MTB), fixed effects for industry and year, Third, one-to-one nearest-neighbour matching with replacement is employed for treatment companies, and the quality of the match is verified by the common support test and the balance test. As shown in the post-matching balance test results (refer to the appended figure for details), the standardised biases of all covariates in the treatment and control groups drop significantly after matching; they are all within the 10% threshold, which indicates that there are no more observable differences between the two subsamples and that the matching has been successful.

Based on the PSM method, the final set of firm-year observations is 5,081, Using the matched pooled sample, re-run the DID estimation and present the results in Table 3, Model (1) includes only firm- and year-fixed effects, and all the control variables have been added in Model (2).

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Table 4. Regression Results of PSM-DID

	(1)	(2)
VARIABLES	BTD	BTD
did	-0.004***	-0.004***
	(-2.93)	(-3.06)
Lev		-0.006
		(-1.57)
ROA		0.237***
		(13.16)
OWNCON1		0.005
		(0.76)
Fixed		0.017***
		(3.22)
Intangible		-0.038***
		(-2.75)
MTB		-0.000
		(-1.05)
Constant	0.003***	-0.010***
	(6.48)	(-3.81)
Observations	5,081	5,081
R-squared	0.495	0.547
Company FE	YES	YES
Year FE	YES	YES

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As shown in Table 4, under both specifications, the DID coefficient is negative at the 1% level; that is, it is -0.004 (t = -2.93) and -0.004 (t = -3.06), respectively, and thus the short-selling regime has effectively restricted tax-avoidance activities by the target companies, In magnitude, the PSM-DID coefficient is close to that of the Short*Post coefficient in Table 2 of the baseline regression, and the significance level remains unchanged; thus, the main results of this paper are not due to observable differences in treated and control firms, and the conclusions are robust.

Based on the estimation results of the control variables in the matched sample, the coefficient of ROA is still positive and at the 1% significance level; that is to say, more profitable enterprises are still more prone to tax avoidance, The fixed coefficient is also significantly positive, indicating that enterprises with large fixed-asset investments are more likely to use depreciation policies for tax planning, and the intangible coefficient is negative and significant; that is to say, enterprises with a relatively large proportion of intangible assets have a smaller scope for tax avoidance, Most of the signs of the remaining control-variable coefficients are the same as those in the baseline regression; therefore, the empirical results can be considered reliable.

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6.2. Replacement of the Explained Variable

To increase the confidence in the empirical results, we have also employed the discretionary book-tax difference (DBTD) as a proxy for the extent of corporate tax avoidance and re-run the regressions, Although BTD can show the gap between a company's book income and taxable income, there are other reasons apart from tax avoidance that may also cause this difference, such as earnings management and differences in accounting standards, Desai and Dharmapala (2006) propose that to rule out the effect of the above confounding factors, one should regress BTD on total accruals and use the residual as the discretionary book-tax difference (DDBTD); this will better reflect the extent to which a company avoids taxes.

Table 5 presents the regression results using DDBTD as the dependent variable. Model (1) controls solely for firm- and year-fixed effects, while Model (2) further adds the full set of control variables. According to the results, under both specifications, the did coefficient is significantly negative, valued at -0.003 ($t = -2.51, p < 0.05$) and -0.003 ($t = -2.64, p < 0.01$)respectively, demonstrating that the short-selling regime meaningfully diminishes firms' discretionary book-tax differences, that is, it curbs their active tax-avoidance behavior.

Table 5. Regression Results with DDBTB as the Explained Variable

	(1)	(2)
VARIABLES	DDBTD	DDBTD
did	-0.003**	-0.003***
	(-2.51)	(-2.64)
Lev		-0.009***
		(-3.12)
ROA		0.172***
		(15.17)
OWNCON1		0.006
		(1.09)
Fixed		0.010**
		(2.50)
Intangible		-0.036***
		(-3.56)
MTB		-0.000
		(-0.82)
Constant	0.003***	-0.006***
	(7.13)	(-3.03)
Observations	7,590	7,590
R-squared	0.578	0.608
Company FE	YES	YES
Year FE	YES	YES

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

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Compared with the baseline regression in Table 2 using BTD as the explained variable, after substituting the dependent variable, the sign, significance and economic interpretation of the DID coefficient remain the same, with only minor numerical differences, A reasonable explanation is that DDBTD removes the noise of non-tax-avoidance in BTD to improve the accuracy of the estimate, At the same time, the model's goodness of fit (R^2) increases from 0.510 to 0.608; therefore, it can explain more of the variability in DDBTD.

For the control-variable estimates, the coefficients of Lev, ROA, Fixed, and Intangible are all statistically significant, and Lev and Intangible are negative, while ROA and Fixed are positive, The results are in line with the signs and levels of significance of the corresponding control-variable coefficients in the baseline regression; therefore, they remain unchanged, The coefficient of OWNCON1 is no longer statistically significant in this model, and it is likely that, after controlling for earnings management, the effect of ownership concentration on pure tax avoidance behaviour is relatively small.

The regression results after substituting the dependent variable are close to those in the baseline case; thus, we believe that the curbing effect of short-selling on the tax-avoidance behaviour of growth companies is not sensitive to the choice of tax-avoidance indicator, and these conclusions should be considered reliable.

7. Heterogeneity Analysis

Although the previous empirical studies have shown that the short-selling regime is generally harmful to the tax-avoidance behaviour of growth companies, this governance effect may be different for different types of companies, There are many growth companies, and they have different levels of R&D investment and various risk profiles; thus, they may react differently to short-selling pressure, Therefore, this part will investigate the problem from the perspective of internal factors of the firm and conduct a heterogeneity test based on the two dimensions of R&D intensity and risk aversion to determine when short-selling has a governing effect.

Heterogeneity Analysis of R&D Intensity

Research and Development companies generally have a higher level of information asymmetry, As important links for the dissemination of information, short sellers are paying more attention to these companies and are therefore more likely to disclose any hidden risks; thus, stronger market discipline will be imposed on the management of high-R&D enterprises, The added tax risk will make the market more sceptical about the quality of the company's business. Therefore, compared to low-R&D enterprises, high-R&D companies are more likely to voluntarily reduce excessive tax avoidance after the introduction of the short-selling system in order to maintain the confidence of the capital market.

High-tech enterprises in general tend to have a higher proportion of intangible assets, are more sensitive to changes in earnings, face more serious problems of information asymmetry (Wu Zuguang and others, 2013), but can also enjoy favourable tax policies such as increased deductions for R&D expenses and reduced tax rates for high-tech enterprises (Hanlon, 2005), Due to the short-selling mechanism, the listed companies will be more susceptible to the attention of short-sellers and may therefore reduce some of their aggressive tax-avoidance activities voluntarily.

The ratio of a company's R&D expenses to total assets at the end of the year is taken as a proxy for R&D intensity, and the sample is divided into high-R&D and low-R&D groups based on the median for regression analysis, As shown in columns (1) and (2) of Table 6, the did coefficient for the high-R&D subgroup is -0.007 and is statistically significant at the 1% level, while for the low-R&D subgroup, the coefficient is -0.002 and does not have statistical significance, The absolute magnitude of the former is about 3.5 times that of the latter. Based on the above results,

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the short-selling regime has increased the control over corporate tax avoidance by high-R&D enterprises and thus supports Hypothesis H2a.

Table 6. The Impact of Corporate R&D Intensity and Risk Tolerance

	(1)	(2)	(3)	(4)
VARIABLES	BTD of High-R&D Group	BTD of Low-R&D Group	BTD of High-Risk Group	BTD of Low-Risk Group
did	-0.007***	-0.002	-0.002	-0.005***
	(-3.84)	(-1.40)	(-1.39)	(-2.90)
Lev	0.002	-0.014***	-0.012**	0.000
	(0.38)	(-3.40)	(-2.32)	(0.07)
ROA	0.266***	0.204***	0.224***	0.275***
	(12.10)	(11.68)	(12.35)	(11.79)
OWNCON1	-0.002	0.021***	-0.004	0.019**
	(-0.23)	(2.84)	(-0.45)	(2.38)
Fixed	0.016**	0.013**	0.013**	0.021***
	(2.30)	(2.23)	(2.10)	(3.04)
Intangible	-0.035*	-0.028*	-0.002	-0.054***
	(-1.66)	(-1.93)	(-0.10)	(-3.50)
MTB	-0.000	-0.000	0.000	-0.001**
	(-0.99)	(-0.43)	(0.74)	(-2.14)
Constant	-0.009**	-0.014***	-0.007*	-0.018***
	(-2.27)	(-4.59)	(-1.92)	(-5.31)
Observations	4,053	3,537	3,778	3,812
R-squared	0.579	0.534	0.574	0.615
Company FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Robust t-statistics in parentheses

A company that is less risk-averse will have more stable cash flows and be less volatile, If, through market information, it is revealed that these companies have been avoiding taxes, their stock prices may fall, credit ratings will be downgraded, and fundraising will be difficult, Therefore, they are more likely to be short-sold. Companies with a high-risk appetite have relatively more cash and are therefore more free in their choices; thus, the incentive to reduce taxes is relatively small.

According to the framework put forward by Xiao Han and others in 2018, the three weighted items that will be used to build a risk-tolerance index (RTA) are gross operating margin, market share and cash flow, The median is used to divide the sample, and then two groups are formed: a low-risk group (high-risk tolerance) and a high-risk group (low-risk tolerance), As shown in columns (3) and (4) of Table 6, the did coefficient is -0.005 for the high-risk subgroup, significant at the 1% level, and for the low-risk subgroup, the coefficient is -0.002 and does not reach statistical significance. The absolute magnitude of the former is about 2.5 times that of the latter, Based on the above evidence, the restraining effect of short-selling on corporate tax

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avoidance is relatively weak for companies with a lower risk appetite, so Hypothesis H2b is not supported.

Based on the analysis above, the curb effect of the short-selling regime on the tax avoidance behavior of growth companies is not uniform but heterogeneous; that is to say, among firms with high R&D intensity and low risk aversion, the governance effect of short-selling is relatively strong, while among firms with low R&D intensity and high risk aversion, the constraining force of the short-selling regime is relatively weak, This result can offer new knowledge for the study of boundary conditions of the regulatory effect of short-selling and serve as a reference for formulating all kinds of regulations, Short selling can be used as an external market-based governance tool for high information asymmetry and low-risk-averse growth companies, and at the same time, for companies with very transparent information and good financial health, all kinds of regulatory instruments should be used together to build a comprehensive governance system.

8. Analysis of the Influence Mechanism

Table 7. Results of the analysis of the impact mechanism of financing constraints

	(1)	(2)
VARIABLES	Financing Constraints	Financing Constraints
did	0.018***	0.019***
	(6.97)	(7.36)
Lev		-0.088***
		(-10.77)
ROA		-0.039*
		(-1.70)
OWNCON1		0.112***
		(7.57)
Fixed		0.052***
		(5.40)
Intangible		0.056
		(1.56)
MTB		0.003***
		(7.86)
Constant	-3.764***	-3.794***
	(-3,595.03)	(-652.29)
Observations	7,590	7,590
R-squared	0.978	0.980
Company FE	YES	YES
Year FE	YES	YES

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The estimation results of the model in Step 1 have already been listed in the baseline regression above, The coefficient of DID is negative (-0.004) and the t-value is -3.31; thus, the short-selling

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regime reduces corporate tax avoidance, and since β_1 is statistically significant, the first stage of the mediation test has been confirmed, Table 7 presents the regression results of the model in Step 2 for the effect of short-selling on financing constraints. Model (1) only includes firm- and year-fixed effects, and Model (2) adds all the control variables in Model (1), According to the regression results, both specifications show that the DID coefficient is positive and statistically significant at the 1% level; thus, the short-selling regime has increased the degree of corporate financing constraints, Economically speaking, after being added to the margin-trading target list, the KZ index of the firms rose by about 0.019 on average; thus, it can be concluded that short-selling has increased financing pressure on high-growth enterprises. The model's goodness of fit (R^2) is as high as 0.978 and 0.980, and it can explain the data very well, Therefore, the second stage of the mediation test has been established; that is, β_2 is significantly positive.

Table 8. The Mediating Role of Financing Constraints

	(3)	(4)
VARIABLES	BTD	BTD
did	-0.003***	-0.003***
	(-2,79)	(-2.91)
KZ	-0.019**	-0.021**
	(-2.03)	(-2.16)
Lev		-0.009***
		(-3.01)
ROA		0.231***
		(17.38)
OWNCON1		0.010*
		(1.73)
Fixed		0.016***
		(3.89)
Intangible		-0.035***
		(-3.41)
MTB		-0.001
		(-0.44)
Constant	-0.071***	-0.088***
	(-4.26)	(-4.74)
Observations	7,590	7,590
R-squared	0.452	0.512
Company FE	YES	YES
Year FE	YES	YES

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8 further reports the estimation results of the model of Step 3, in which the short-selling regime variable did and the financing-constraint variable KZ are simultaneously included in the

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regression of corporate tax avoidance. Model (3) controls only for firm- and year-fixed effects, while Model (4) additionally incorporates the full set of control variables. The empirical results show that, after the KZ index is introduced, the coefficient β_3 on did remains significantly negative at the 1% level, with $\beta_3 = -0.003$, $t = -2.91$ under the fully controlled specification. Compared with the baseline regression in the model of Step 1, where $\beta_1 = -0.004$, $t = -3.31$, the absolute magnitude of β_3 declines relative to β_1, satisfying the key condition of the mediation effect test. Meanwhile, the coefficient on the mediating variable KZ, denoted as θ, is significantly negative at the 5% level, with $\theta = -0.021$, $t = -2.16$, indicating that tighter financing constraints are associated with a lower level of corporate tax-avoidance behavior.

Recalling the results of the previous two stages, in Step 1, $\beta_1 = -0.004$ is significantly negative at the 1% level, confirming that the short-selling regime exerts a significant inhibitory effect on corporate tax avoidance; in Step 2, $\beta_2 = 0.019$ is significantly positive at the 1% level, indicating that the short-selling regime significantly intensifies corporate financing constraints. Combined with the Step 3 results that β_3 is significantly negative, $|\beta_3| < |\beta_1|$, and θ is significantly negative, all four conditions required for the mediation test of Wen Zhonglin et al. (2004) are jointly satisfied[17]. This implies that financing constraints play a partial mediating role in the transmission from the short-selling regime to corporate tax avoidance. Specifically, the indirect effect transmitted through financing constraints can be approximated by$\beta_2 \times \theta \approx 0.019 \times -0.021 \approx -0.0004$, accounting for roughly 11.8% of the total effect $\beta_1 = -0.004$, while the remaining direct effect $\beta_3 = -0.003$ reflects the channels of short-selling pressure that operate independently of financing constraints, such as enhanced information disclosure, market scrutiny, and litigation risk.

Based on the above results, the front end of the transmission chain is in a "short-selling regime → tightening of financing constraints → escalation of tax-avoidance costs → reduction in tax-avoidance behaviour", which is in line with the theoretical predictions of Hypothesis H3, On the one hand, short-sellers will reveal the financial and tax fraud at the company, draw the attention of regulators and media, increase the implicit costs of tax evasion, and at the same time, the resulting drop in stock prices will reduce the firm's equity financing ability and strengthen pressure from creditors, Due to financing problems and reduced supervision of short-selling, the expected net profit from aggressive tax avoidance has fallen, and thus the company will use a less favourable tax plan.

9. Conclusion and Policy Recommendations

9.1. Research Conclusion and Contributions

Listed companies on the ChiNext and STAR Markets from 2010 to 2023 are taken as the research subjects, and based on the quasi-natural experiment of the staged expansion of the margin-trading scheme, the difference-in-differences method is applied to investigate the impact of the short-selling regime on the tax-avoidance behaviour of growth companies, and the following results were obtained:

First, the short-selling system has reduced the tax avoidance of the growth industry, The baseline regression results are still valid after adding some relevant control variables and a set of robustness tests, so Hypothesis H1 is supported; it is proposed that the short-selling regime has an external discipline effect on firms by increasing the efficiency of negative information disclosure and strengthening market supervision, thus motivating management to reduce excessive tax avoidance and improve the compliance and legality of tax planning.

Second, the curb effect of the short-selling regime on corporate tax avoidance is not uniform, Subgroup regressions show that among firms with a high level of R&D intensity, the restricting effect of short-selling is relatively strong; thus, Hypothesis H2a is supported, and similarly, among firms with a low risk appetite, the disciplinary effect of short-selling is stronger and

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Hypothesis H2b is supported, High-tech enterprises are therefore more susceptible to the pressure of short-selling due to high information asymmetry, and firms with a low-risk appetite are also more sensitive to the pressure of short-selling because they have a small financial cushion; thus, they are more likely to carry out compliant and prudent tax planning.

Financing constraints are also one of the reasons why the company reduced its tax payments by short-selling, According to the mechanism test, short selling increases the financing constraints of enterprises and thus supports Hypothesis H3, A decline in stock prices due to short selling has reduced the company's equity financing, so it has gained the attention of creditors. As a result, due to financing difficulties and the relatively weak regulation of short selling, the expected net funds from the excessive tax-avoidance arrangement have fallen, and thus management has been compelled to adopt a more conservative tax policy.

First, by linking the short-selling regime to corporate tax avoidance behaviour, this paper has found that the disciplinary effect of short-selling as an external governance tool on the tax decisions of growth companies can be studied from both the perspective of market pressure and regulatory restraint; thus, the research scope of the external governance effect of the short-selling regime has been expanded, Second, given the institutional environment of the ChiNext and Sci-Tech Innovation Boards, as well as the particular attributes of growth enterprises-namely, high research and development investment, a large amount of financing, increased business risks, etc.-this paper investigates the influence of external market mechanisms on corporate tax avoidance behaviour and provides empirical evidence supporting the application of principal-agent theory and the constraint hypothesis in emerging economies, Third, based on the analysis of multidimensional heterogeneity, this paper examines the structural differences in the governance effect of short selling among firms with different attributes and provides empirical evidence to determine the boundary conditions for institutional effectiveness. Fourth, a mediation effect model will be used to trace the path of "short-selling regime → tightened financing constraints → rising tax-avoidance costs → reduced tax-avoidance behaviour" and obtain micro-level evidence of how external market pressure is manifested in internal corporate decisions through the financing channel.

9.2. Practical Implications

First, continue to strengthen the construction of the short-selling system and fully realise the outer-governance function of the system, Under the condition of controllable risks, regulatory authorities should gradually increase the scale of margin trading, optimise the rules for short-selling, reduce short-selling costs and improve market liquidity, so that the short-selling mechanism can better serve the functions of price discovery and external supervision, Given that there are many high-growth enterprises in markets such as ChiNext and Sci-Tech Innovation, extra support measures need to be taken; therefore, information disclosure supervision should be strengthened, the investor protection system improved, and a short-selling report disclosure mechanism established to strengthen the governance effect of short-selling.

Second, a joint supervision system for the capital market and tax authorities should be established, The tax authorities should pay more attention to enterprises that are short-sold or under considerable short-selling pressure, regard them as significant supervision objects, and improve the efficiency of tax collection and administration, At the same time, the sharing of information and coordination among the securities regulatory authorities and the tax authorities should be strengthened, a tax risk warning mechanism for margin-trading target enterprises needs to be established to pay more attention to enterprises with abnormally expanded short-selling activities, and a dual-constraint mechanism of "market supervision + administrative supervision" will be introduced to improve overall governance efficiency.

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Third, different regulatory policies will be applied to the various categories of enterprises, Growth enterprises have a relatively high degree of information asymmetry and are more risk-averse; therefore, to some extent, the governance function of the market mechanism should be employed, and external oversight can be strengthened by expanding the scope of margin trading securities and promoting research in short-selling, For enterprises with low R&D intensity and a high-risk appetite, since they are less under pressure from short-selling, direct supervision should be strengthened; that is, increase the frequency of tax audits, improve the requirements for information disclosure, enhance internal control audits, etc., to prevent them from taking advantage of information for excessive tax avoidance.

Fourth, growth enterprises should face the pressure of short-selling and strengthen their internal governance, Due to the pressure of short-selling, companies need to improve the quality of information disclosure, increase financial transparency, regularise tax-saving plans and curb the risks of tax evasion and non-compliance, Growth companies that have invested heavily in R&D, are risk-averse, need to pay attention to tax regulations, and otherwise, aggressive tax planning will cause market doubt and harm fundraising and development. At the same time, the company should build and strengthen its internal control system, improve tax risk management, integrate tax considerations into the corporate governance system, maintain the confidence of the capital market and the reputation of the company.

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