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Online Voting of Small and Medium Shareholders, Stock Price Idiosyncratic Volatility, and Investment Returns

Langxuan Pan [1, #, *], Zixiang Ye [2, #], Jiadong Chen [1, #], Hanchuan Chen [3, #]

[1] Dornsife College of Letters, Arts and Sciences, University of Southern California, Los Angeles, America, CA 90089

[2] College of Art and Science, University of Miami, Coral Gables, America, FL 33124

[3] College of Art and Science, New York University, New York, America, NY 10013

* Corresponding author: Dylan1226plx@outlook.com

[#]These authors contributed equally.

Abstract. As informatization advances, online voting has become crucial in shareholder meetings, boosting participation from small and medium shareholders. This study examines Chinese companies listed in the A-share market from 2013 to 2022, showing a significant positive correlation between online voting by minority shareholders and idiosyncratic volatility in stock prices. Further analysis reveals that idiosyncratic volatility increases stock returns, and the interaction between online voting and idiosyncratic volatility strengthens the positive relationship between the two. The results remain valid after robustness tests, including core variables substitution, PSM testing, the instrumental variables method, exclusion of event-impacted samples, and handling missing data. Additionally, the findings from the heterogeneity analysis indicate that online voting participation will have a more significant increase in idiosyncratic volatility for firms with more advanced technology and higher levels of digital transformation. The significance of this study lies in enriching the research on the economic consequences of minority shareholders' online voting and providing a foundation for differentiated corporate governance and policymaking.

Keywords: Online voting; Idiosyncratic Volatility; Stock returns.

1. Introduction

As China's stock market evolves, online voting has become vital for small and medium shareholders in executive decision-making. These shareholders, primarily individual investors, play a key role but often face challenges from larger shareholders who may seek personal gain. To protect their rights, the government has introduced measures, including the promotion of online voting systems, which offer a convenient and cost-effective way for small and medium shareholders to participate in shareholder meetings.

Existing literature primarily examines the impact of online voting by small and medium shareholders on corporate governance and the effect of idiosyncratic volatility on stock returns. Many researchers have examined the role of online voting in corporate governance, finding that it significantly reduces first-type agency costs [1], enhances the oversight of large shareholders [2], improves transparency and internal control [3], and increases investment efficiency and cash holdings [4]. As a result of enhanced corporate governance, Ma et al. found online voting participation increases stock volatility [5]. Moreover, a substantial amount of research has analyzed the reason for a positive correlation between idiosyncratic volatility and stock returns, including liquidity [6] and higher risk-bearing [7]. However, few have connected these factors together. Therefore, this study aims to fill this research gap by exploring the impact of online voting and idiosyncratic volatility and the interaction between them on stock returns.

The main contributions of this study can be summarized in three key aspects. First, existing research on the economic consequences of online voting has mainly focused on its impact on agency costs, internal governance, and information transparency. This article links online voting with idiosyncratic

volatility, enriching the related research on the economic consequences of online voting and expanding the research perspective on the causes of idiosyncratic volatility. In addition, the article further explores the interaction between online voting and idiosyncratic volatility on stock returns, further enriching the content of the research. Finally, the heterogeneity analysis finds that the impact of online voting on idiosyncratic volatility is more significant in high-tech companies and in sample groups with a higher degree of digital transformation. To further enhance the effectiveness of online voting, this result provides evidence and a direction for thinking to better understand the current internal and external constraints.

2. Research Hypothesis

The ‘information perspective’ suggests that in an efficient market, information is the dominant factor driving stock price changes [8]. The widespread employment of online voting has increased information transparency, allowing minor shareholders to engage in corporate governance more easily, thereby encouraging management to prioritize information disclosure [4]. Enhanced transparency reduces information asymmetry, enabling investors to gain a more comprehensive understanding of the company's operations and intrinsic value. Moreover, online voting reduces agency problems, ensuring that all shareholders receive the same critical information simultaneously with improved accuracy during transmissions [2]. All these contributions eliminate the information advantage that large shareholders and management have over small and medium shareholders, encouraging shareholders to make rational decisions on an equal basis, thereby enhancing market fairness and efficiency.

In situations where corporate governance is strong and information is more symmetrical, the participation of small and medium shareholders in online voting contributes positively on idiosyncratic volatility [4]. First, increased transparency makes the market more sensitive to information, meaning even minor changes can cause fluctuations. Second, differences in how investors interpret information can intensify price volatility. Additionally, transparent information attracts short-term investors who engage in frequent trading, further increasing volatility. Ultimately, adjustments in the market's expectations for the company's future also lead to price fluctuations. Therefore, information transparency increases stock price idiosyncratic volatility through multiple ways.

Investors’ portfolios are not fully diversified, which means they demand higher returns for higher idiosyncratic volatility they bear [9]. Meanwhile, idiosyncratic volatility varies over time, and investors may adjust their investment strategies based on historical volatility, viewing it as a signal for potential high returns. Furthermore, stocks with high idiosyncratic volatility usually experience higher abnormal returns in the current month, but these returns tend to reverse in the following month [10]. This phenomenon explains the negative correlation between lagged idiosyncratic volatility and expected returns, but it does not affect the overall positive relationship between idiosyncratic volatility and expected returns. Thus, despite the short-term fluctuations and reversals in returns caused by idiosyncratic volatility, investors in high-idiosyncratic-volatility stocks can still achieve higher expected returns in the long run, supporting the theory that investors expect higher returns when facing high idiosyncratic volatility. In a digital environment, minority shareholders engage in corporate governance through online voting, increasing information transparency and integrating more firm-specific information into stock prices, thereby increasing stock price idiosyncratic volatility. Digital technologies also accelerate the speed of information transmission, further enhancing market responsiveness and stock price idiosyncratic volatility. In light of the previous discussions, this paper proposes:

Hypothesis H1: The participation of small and medium shareholders in online voting positively affects idiosyncratic volatility.

Hypothesis H2: Idiosyncratic volatility has a positive effect on stock returns, and participation in online voting by small and medium shareholders further amplifies this relationship

3. Research Design

3.1. Sample Selection

This study uses samples of Chinese firms in the A-share market with all data from the CSMAR database. The research period is set from 2013 to 2022. The starting point is chosen because of the higher availability and completeness of data. Moreover, this paper excludes ST samples and others with missing values due to potential anomalies. To mitigate the influence of outliers on the results, this study applies Winsorization to shrink the continuous variables at both ends by 1%, eventually obtaining 14,575 sample observations.

3.2. Variable Definition

3.2.1. Stock Return.

Referring to Jin's research, this paper selects the annual individual stock return, excluding the reinvestment of cash dividends, as a proxy variable for stock returns, denoted formally as *Yretnd* [11].

3.2.2. Online Voting.

Following the approach of Xu and Wu, small and medium shareholders are generally defined as those holding less than 5% of the shares [12]. Under the assumption that all large shareholders attend the shareholders' meeting, the numerator in Equation 1 can yield the total shares of small and medium shareholders. The specific indicator (*Onlinevoting*) is as follows:

$$Onlinevoting = \frac{\text{TS} - \text{TS more than 5\%}}{\text{TS}} \tag{1}$$

TS: Total number of shares from all shareholders participating in the meeting

TS more than 5%: Total number of shares from shareholders who hold more than 5%

3.2.3. Idiosyncratic Volatility.

This paper refers to the method of Zhang that uses the Fama-French three-factor model to calculate stock price idiosyncratic volatility [13]. According to the three factor model, the excess return of a portfolio is attributed to three factors: excess market return, size, and book-to-market ratio. The three factors—MKT, SMB, and HML—of the A-share market are calculated, and then the following model is used for regression:

$$R_{i,t} - R_t = \beta_{i,1} MKT_t + \beta_{i,2} SMB_t + \beta_{i,3} HML_t + \epsilon_{i,t} \tag{2}$$

In this regression model, $R_{i,t}$ represents the return of stock i during period t. R_t represents the risk-free rate. MKT_t represents the return of the market factor. $SMB_t$is the return of the size factor in period t. HML_t represents the return of the book-to-market ratio factor in period t. $\epsilon_{j,t}$ is the residual obtained from the regression. The standard deviation of the residuals for each month represents the idiosyncratic volatility of stock i in that month. Then, the monthly idiosyncratic volatility of stock prices is aggregated and averaged to derive the annual idiosyncratic volatility of stock prices. A formal symbol for idiosyncratic volatility is *IVOL*.

3.2.4. Control Variables.

With reference to Lee et al., this paper selects control variables that may affect idiosyncratic volatility and stock returns [5]. These include company size (*Size*), ratio of liabilities (*Lev*), return on equity (*ROE*), inventory ratio (*INV*), fixed assets proportion (*FIXED*), dual positions (*Dual*), Big4 options (*Big4*), and audit opinions (*Opinion*). Moreover, this paper controls year and industry dummy variables. A more formal definition of control variables is shown in Table 1.

Table 1. Definition of control variables

Name	Description	Definition
Size	Company Size	The natural log of total assets per year
Lev	Ratio of liabilities	Total liabilities divided by total assets
ROE	Return on equity	Net profit divided by total assets
INV	Inventory ratio	Ratio of net inventory to total assets
FIXED	Fixed assets proportion	Ratio of net fixed assets to total assets
Dual	Two positions in one	Chairman and general manager are the same person 1, otherwise 0
Big4	If Big 4	If the company is audited by the Big Four, it is 1, otherwise it is 0
Opinion	Audit opinion	The value of a standard audit opinion is 1, otherwise 0

3.3. Research Model

To investigate the relationship between the participation of minor shareholders in online voting and idiosyncratic volatility, the regression model is designed as follows:

$$IVOL_{i,t} = \beta_0 + \beta_1 Onlinevoting_{i,t} + \sum_k \varphi_k Control_{k,i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (3)$$

In equation 3, $IVOL_{i,t}$ represents the idiosyncratic volatility of the stock price for stock i in year t. $Onlinevoting_{i,t}$ is a proxy variable for online voting by small and medium shareholders. $Control_{k,i,t}$ denotes a set of control variables. $\sum Year$ and $\sum Industry$ denote the fixed effects controlling for year and industry, respectively. The coefficient β_1 of $Onlinevoting_{i,t}$ represents the impact of online voting on idiosyncratic volatility. A positive β_1 suggests that online voting increases the idiosyncratic volatility, while a negative β_1 suggests that online voting decreases the idiosyncratic volatility of stock prices.

Similarly, to investigate the interaction effect between online voting and idiosyncratic volatility in relation to stock returns, two regression models are designed as follows:

$$Yretnd_{i,t} = \beta_0 + \beta_1 IVOL_{i,t} + \sum_k \varphi_k Control_{k,i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (4)$$

$$Yretnd_{i,t} = \beta_0 + \beta_1 Onlinevoting\_IVOL_{i,t} + \beta_2 Onlinevoting_{i,t} + \beta_3 IVOL_{i,t} + \sum_k \varphi_k Control_{k,i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (5)$$

In equation 4, $Yretnd_{i,t}$ is the stock return of the company i in year t. A positive coefficient β_1 of $IVOL_{i,t}$ indicates the positive impact of stock price idiosyncratic volatility on stock returns. In equation 5, $Onlinevoting\_IVOL_{i,t}$ is an interaction term, defined by the product of $Onlinevoting$ and $IVOL$. A positive coefficient β_1 of this term indicates that the interaction effect between online voting and idiosyncratic volatility has a positive impact on stock returns.

4. Empirical Results

4.1. Descriptive statistics

Table 2 provides descriptive statistics for the core variables. The average stock return (*Yretnd*) is 0.122, with a wide range indicated by a standard deviation of 0.522, a minimum of -0.822, and a maximum of 9.393. Idiosyncratic volatility (*IVOL*) shows considerable variability with a mean of 0.371, a standard deviation of 0.271, and values ranging from 0.078 to 13.121. Online voting participation by small and medium shareholders (*Onlinevoting*) varies significantly, ranging from 0 to 0.565 with a standard deviation of 0.124. Control variables are within normal ranges.

Table 2. Descriptive statistics

Variable name	N	Mean	Standard deviation	Min	Max
Yretnd	14,146	0.122	0.522	-0.822	9.393
IVOL	14,575	0.371	0.271	0.078	13.12
Onlinevoting	14,575	0.122	0.124	0	0.565
Size	14,575	22.24	1.243	19.57	26.45
Lev	14,575	0.42	0.202	0.046	0.927
ROE	14,560	0.055	0.137	-0.962	0.415
INV	14,441	0.143	0.128	0	0.778
FIXED	14,575	0.205	0.154	0.002	0.719
Dual	14,575	0.283	0.450	0	1
Opinion	14,575	0.970	0.169	0	1
Big4	14,575	0.047	0.211	0	1

4.2. Correlation Test

To assess the presence of multicollinearity among variables, this paper conducts the Spearman and Pearson correlation coefficient analysis and variance inflation factor (VIF) test, and the results are shown in Table 3. The correlation coefficients between the control variables are all less than 0.6, excluding the possibility of multicollinearity between these variables. Meanwhile, the mean value of VIF is 1.21, and the VIF value of each variable is far less than 10. The possibility of multicollinearity between variables is further excluded.

Table 3. VIF test

	VIF	1/VIF
Lev	1.61	0.619
Size	1.61	0.622
ROE	1.23	0.813
INV	1.22	0.817
FIXED	1.14	0.877
Opinion	1.09	0.921
Big4	1.08	0.922
IVOL	1.05	0.951
Dual	1.04	0.958
Onlinevoting	1.02	0.979
VIF mean	1.21	

4.3. Baseline Results

4.3.1. Impact of Online Voting on Idiosyncratic Volatility.

To examine whether the participation of minority shareholders in online voting meetings affects idiosyncratic volatility, this paper conducts an analysis using the fixed effects model from equation 1. Table 4 shows two regression results. The values in parentheses in the table are the t-values of the variables. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level. The same applies hereafter.

The results in Column (1) indicate the outcome without control variables, where the coefficient for online voting is 0.0598 and is significant at the 1% level. Therefore, without control variables, participation in online voting can significantly increase idiosyncratic volatility. Column (2) shows the regression results with control variables. A coefficient of 0.0678 remains significant at 1%. This matches the results without control variables. These results further confirm that small and medium shareholders' online voting participation can positively affect the idiosyncratic volatility of stock prices. This supports Hypothesis H1, indicating the positive relationship between online voting and idiosyncratic volatility of stock prices.

Additionally, Column (2) explains the implications of control variables on idiosyncratic volatility. For instance, larger company size is associated with lower idiosyncratic volatility. Large companies typically have more diversified businesses and revenue streams, leading to more stable income and profitability, which reduces sensitivity to individual events or market fluctuations, resulting in lower idiosyncratic volatility. On the other hand, the debt ratio is positively correlated with idiosyncratic volatility. A high debt ratio may cause investors to have concerns about the company's profitability and debt repayment ability, increasing uncertainty and leading to greater stock price volatility.

Table 4. Impact of Online Voting on Idiosyncratic Volatility

	IVOL	
	(1)	(2)
Onlinevoting	0.0598***	0.0678***
	(2.76)	(3.17)
Size		-0.0353***
		(-6.32)
Lev		0.0566**
		(2.53)
ROE		0.0920***
		(5.25)
INV		-0.0417
		(-1.16)
FIXED		-0.0285
		(-0.95)
Dual		0.0144**
		(2.22)
Opinion		-0.0212
		(-1.62)
Big4		0.0001
		(0.01)
Constant	0.3350***	1.0880***
	(4.47)	(7.79)
Industry FE	Yes	Yes
Time FE	Yes	Yes
Observations	14575	14,426
R-squared	0.073	0.080

4.3.2. Interaction Effect of Online Voting and Idiosyncratic Volatility on Stock Returns.

In examining the interaction effect between online voting and volatility in relation to stock returns, this paper conducts analyses based on fixed effects models using equations 2 and 3 and presents the results in Table 5. Column (1) shows the regression results focusing on the direct impact of idiosyncratic volatility on stock returns. The results indicate that the coefficient of idiosyncratic volatility is 1.2820, with a level of significance at 1%, supporting the positive effect of idiosyncratic volatility on stock returns.

To further explore the interaction effect between online voting and idiosyncratic volatility, the article introduces an interaction term. The study then conducts a linear regression analysis of the interaction term. As shown in Column (2), the coefficient of the interaction term is 4.0420, and it is significant at the 1% level. This means that when the proportion of online voting participation is high, the impact of idiosyncratic volatility on stock returns becomes more significant. This result suggests that minority shareholders' online voting positively affects idiosyncratic volatility, thereby increasing stock returns. Therefore, Hypothesis 2 is supported.

Table 5. Interaction Impact on Stock Returns

	Yretnd	
	(1)	(2)
Onlinevoting_IVOL		4.0420***
		(14.91)
IVOL	1.2820***	0.9910***
	(48.22)	(30.30)
Onlinevoting		-1.4170***
		(-13.15)
Size	-0.1180***	-0.1110***
	(-10.30)	(-9.76)
Lev	0.2270***	0.1960***
	(4.49)	(4.31)
ROE	0.6620***	0.6500***
	(18.50)	(18.35)
INV	-0.0567	-0.0372
	(-0.77)	(-0.51)
FIXED	0.1290**	0.1170*
	(2.09)	(1.92)
Dual	-0.0202	-0.0198
	(-1.52)	(-1.51)
Opinion	0.0661**	0.0745***
	(2.50)	(2.85)
Big4	0.008	-0.0000
	(-0.02)	(-0.00)
Constant	2.1570***	2.1040***
	(7.52)	(7.41)
Time FE	Yes	Yes
Industry FE	Yes	Yes
Observations	14,010	14,010
R-squared	0.321	0.448

4.4. Robustness Tests

To ensure that the baseline regression results are robust, this study performs robustness tests, including core variables substitution, PSM testing, exclusion of event-impacted samples, the instrumental variables method, and handling of missing values.

4.4.1. Substitution of Core Variables.

This paper first defines small and medium shareholders' online voting and idiosyncratic volatility using different methods and then performs the fixed effect models of equation 3 and 5 with the new indicators. First, following the approach of Xu and Wu, this section constructs an alternative indicator, *Onlinevoting*$_2$, for small and medium shareholders' online voting [7]. The specific formula is as follows:

$$Onlinevoting_2 = \frac{Average\ online\ attendence - Average\ non-online\ attendence}{1000\ (1 + Average\ non\ online\ attendence)} \quad (6)$$

The results for substituting online voting are shown in Columns (1) and (2) of Table 6. Column (1) indicates the coefficient for online voting is 0.0321 and is significant at the 10% level, implying that small and medium shareholders' online voting continues to increase idiosyncratic volatility significantly. Column (2) displays the coefficient of interaction term is 0.2430, remaining significant at 5%. The result means the interaction effect between online voting and idiosyncratic volatility still has a significant positive impact on stock returns.

Moreover, Bozhkov et al. provide an alternative method to calculate stock price idiosyncratic volatility [9]. Instead of using the Fama-French three-factor model, a similar CAPM model is defined as follows:

$$R_{i,t} - R_f = \beta_{i,t}\left(R_m - R_f\right) + \epsilon_{i,t} \quad (7)$$

In equation 7, $R_{i,t}$ is the return of stock i in year t. R_f is the risk-free rate. $\beta_{i,t}$ is the sensitivity of the market factor to the return of stock i in year t. R_m is the expected return of the market portfolio. $\epsilon_{i,t}$ is the regression residuals, and the new idiosyncratic volatility is calculated as the standard deviation of the residuals and symbolized by *IVOL2*.

The results are shown in Columns (3) to (4) of Table 6. Column (3) indicates that when the new idiosyncratic volatility indicator is used as the dependent variable, the coefficient for small and medium shareholders' online participation is 0.0587, which is significant at the 1% level. Column (4) shows that when the idiosyncratic volatility indicator is replaced, the coefficient of the interaction term remains significantly positive at the 1% level. Both results indicate the baseline regression results hold robust when substituting the core variables.

Table 6. Substitution of Core Variables

	IVOL	Yretnd	$IVOL_2$	Yretnd
	(1)	(2)	(3)	(4)
$Onlinevoting_2$_IVOL		0.2430**		
		(2.17)		
Onlinevoting_$IVOL_2$				5.2340***
				(19.51)
Onlinevoting			0.0587***	
			(2.77)	
IVOL2				0.7870***
				(24.24)
IVOL		2.2240***		
		(47.76)		
$Onlinevoting_2$	0.0321*	-0.1660***		
	(1.94)	(-4.34)		
Controls	Yes	Yes	Yes	Yes
Constant	1.2450***	1.3420***	1.0230***	2.1960***
	(9.94)	(4.55)	(7.39)	(7.62)
Time FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Observations	13,646	13,237	14,426	14,010
R-squared	0.113	0.472	0.174	0.432

4.4.2. Propensity Score Matching (PSM).

To mitigate the interference of sample selection bias, the paper employs propensity score matching (PSM) for robustness testing. The specific steps are as follows: First, the online voting data of small and medium shareholders are ranked based on their values, classifying those above medians as the experimental group. Next, the remaining samples are matched to create a control group using the 1:2 nearest neighbor matching and kernel matching methods. The matching results are verified through a balance test. Columns (1) and (2) of Table 7 display the outcomes of 1:2 nearest neighbor matching, and Columns (3) and (4) show the results of kernel matching.

In Columns (1) and (3), the coefficients for online voting of small and medium shareholders are 0.0661 and 0.0678 and are significant at 5% and 1%, respectively. The result demonstrates that the positive impact of online voting on idiosyncratic volatility remains robust. Columns (2) and (4) present the results for the interaction term, with coefficients of 4.377 and 4.042, both significant at the 1% level, validating the positive impact of the interaction effect on stock returns.

Table 7. PSM Tests

	IVOL	Yretnd	IVOL	(Yretnd
	(1)	(2)	(3)	(4)
Onlinevoting_IVOL		4.3770***		4.0420***
		(14.03)		(14.91)
IVOL		0.8750***		0.9910***
		(25.24)		(30.30)
Onlinevoting	0.0661**	-1.5330***	0.0678***	-1.4170***
	(2.48)	(-12.34)	(3.17)	(-13.15)
Constant	1.0350***	2.0120***	1.0880***	2.1040***
	(6.14)	(6.08)	(7.80)	(7.41)
Controls	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Observations	11,357	11,033	14,426	14,010
R-squared	0.072	0.452	0.08	0.448

4.4.3. Excluding significant event samples.

The sample used in this paper spans from 2013 to 2022. However, the stock market crash in 2015 and the COVID-19 pandemic from 2020 to 2021 both have significant impacts on the financial markets, leading to sharp fluctuations in stock prices. To avoid the potential impact of these events, this section excludes data from these periods and re-perform the regression analysis. Columns (1) and (2) of Table 8 present the results after excluding the 2015 subsample; Columns (3) and (4) present the results after further excluding the 2020 and 2021 subsamples.

Columns (1) and (3) show that the coefficients for small and medium shareholders' online voting participation are 0.0632 and 0.0376 and are significant at the 1% and 10% levels. These results indicate that the positive relationship between small and medium shareholders' online voting participation and stock price idiosyncratic volatility remains robust. Columns (2) and (4) show that the coefficients for the interaction terms are 3.999 and 3.320, respectively, both significant at the 1% level. These results suggest that even after excluding the subsamples, the interaction effect between online voting and idiosyncratic volatility remains significantly positive on stock returns.

Table 8. Excluding Significant Event Samples

	IVOL	Yretnd	IVOL	Yretnd
	(1)	(2)	(3)	(4)
Onlinevoting_IVOL		3.9990***		3.3200***
		(14.62)		(10.31)
IVOL		0.9850***		0.8620***
		(30.58)		(26.57)
Onlinevoting	0.0632***	-1.3790***	0.0376*	-1.1260***
	(2.72)	(-12.87)	(1.74)	(-9.51)
Controls	Yes	Yes	Yes	Yes
Constant	1.0530***	2.0400***	0.9620***	2.0820***
	(6.88)	(7.11)	(7.06)	(7.12)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Observations	13,353	13,001	9,985	9,758
R-squared	0.054	0.433	0.034	0.494

4.4.4. Instrumental Variables Method.

This study may have endogeneity issues caused by reverse causality. According to the ‘information perspective', a higher idiosyncratic volatility indicates a greater amount of information contained in the stock price, and the information efficiency of the capital market is stronger. As a result, small and medium shareholders may have more motivation and willingness to participate in corporate governance. To further mitigate the issues of endogeneity, the article chose to use the instrumental variables method for robustness testing. This paper selects the industry mean of online voting, excluding the company's respective value, to construct the instrumental variable, *IV*. On one hand, companies within the same industry tend to adopt similar online voting mechanisms, making the instrumental variable strongly correlated with the endogenous variable. On the other hand, by excluding the company's own data, the instrumental variable avoids any direct correlation with the company's idiosyncratic volatility, thereby satisfying the requirement of exogeneity. Subsequently, the paper applies two-stage least squares to conduct an instrumental variable regression. The results in Table 9 show that, after controlling for endogeneity, the impact of online voting on idiosyncratic volatility remains significant, further validating the robust relationship between the two.

Table 9. Instrumental Variables

	Onlinevoting	IVOL
	(1)	(2)
IV	0.8931***	
	(17.42)	
Onlinevoting		0.2310*
		(0.122)
Controls	Yes	Yes
Constant	0.0154	1.3820***
	(0.63)	(0.05)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Observations	14,426	14,426
R-squared	0.035	0.099

4.4.5. Other Robustness Test.

In collecting samples, slight differences are noted in the scale of each variable. To avoid the impact of missing data on regression results, the total sample size in the baseline regression varies slightly. This section re-runs the baseline regression after excluding all missing values, and all results remain robust. Due to space limitations, the results are not displayed here.

5. Further Discussion

5.1. Heterogeneity Analysis

Online voting by small and medium shareholders significantly impacts idiosyncratic volatility in high-tech firms due to their better accessibility and transparency in decision-making, which in return increases the idiosyncratic volatility [14]. To further investigate the impact of technology, this paper refers to Peng and Mao’s classification of the high-technology industry, dividing the sample into two groups based on their industry code: high-tech and non-high-tech firms [15]. The same regressions are then performed separately for these two groups. Columns (1) and (2) of Table 10 present the heterogeneity test results on non-high-tech firms and high-tech firms respectively. The regression results show that the impact of online voting by small and medium shareholders on idiosyncratic volatility is more significant in the sample group of high-tech firms.

The impact of online voting on idiosyncratic volatility is also significant for firms with higher levels of digital transformation because these firms typically have more engaged, informed shareholders

who can more easily participate in online voting [16]. Additionally, digital transformation often correlates with more transparency and faster dissemination of information, amplifying the market's reaction to shareholder decisions, thereby increasing volatility. Referring to Wu et al.'s methodology, this paper constructs a new variable, *Digital Transformation*, and divides the sample into two groups: firms with values above the median are classified as having high digital transformation, while those with values below the median are classified as having low digital transformation [16]. Column (3) and (4) presents the results of the two group. The regression results indicate that the impact of the interaction between online voting and idiosyncratic volatility on stock returns is more significant for the groups with higher level of digital transformation.

Table 10. Heterogeneity Test Results

	IVOL	IVOL	IVOL	IVOL
	Non-High-Tech	High-Tech	Low Digital Transformation	High Digital Transformation
	(1)	(2)	(3)	(4)
Onlinevoting	0.0433	0.0879***	0.0272	0.0199**
	(1.05)	(3.89)	(0.622)	(2.47)
Controls	Yes	Yes	Yes	Yes
Constant	0.9000***	1.3990***	1.2100***	0.5000***
	(3.74)	(9.81)	(4.68)	(6.22)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Observations	6,694	7,732	7,185	7,241
R-squared	0.057	0.122	0.034	0.138

6. Conclusion

Through the main regression analysis, this study first finds a significant positive correlation between the online voting participation of minority shareholders and the idiosyncratic volatility. Moreover, interaction analysis shows that idiosyncratic volatility boosts stock returns, and online voting by small and medium shareholders strengthens this effect. A series of robustness tests, including core variable substitution, PSM testing, the instrumental variables method, exclusion of event-impacted samples, and handling of missing data, confirm that these two conclusions remain robust. Finally, the analysis of heterogeneity presents that the effect of minority shareholder’s online voting participation on idiosyncratic volatility is more significant for firms with more advanced technology or higher level of digital transformation.

This study proposes the policy recommendations as follows. Given the positive impact of online voting on idiosyncratic volatility, it is recommended that policymakers further enhance the online voting mechanism for small and medium shareholders to fully realize its potential benefits for information efficiency. Moreover, based on the results of the heterogeneity test, policymakers should adopt a differentiated management approach for companies. In firms with higher levels of technological development or advanced digital transformation, the impact of online voting on idiosyncratic volatility is more significant. Therefore, policymakers should avoid promoting online voting systems blindly across all companies. Instead, they should propose tailored policies based on each company's specific circumstances. In high-tech companies and those undergoing rapid digital transformation, refining and promoting online voting systems could yield better results. For other companies, policymakers should focus on addressing technological barriers and promoting digital transformation to create the necessary infrastructure for effective online voting.

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