The Effect of News Media Dissemination Speed and Stockholder Sentiment Diffusion on Short-Term Stock Price Volatility

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Abstract. This study quantifies how news propagation velocity (NPV) and investor sentiment diffusion (ISD) jointly drive short-term stock volatility. Using high-frequency social media data and vector autoregression modeling, we find:Firstly, NPV increases volatility by 0.19% per σ (15-min lag, $p<0.01$). Besides,ISD amplifies NPV effects by 21% ($\beta=0.27$, $p<0.05$), revealing an emotion-information feedback loop. Finally, Bull markets exhibit stronger NPV-ISD interactions ($\beta=0.35$ vs. 0.19 in bear markets). These findings support circuit breaker reforms and investor education frameworks.

Keywords: News propagation velocity (NPV); Investor sentiment diffusion (ISD); High-frequency volatility; Emotion-information feedback

1 Introduction

The acceleration of information transmission has amplified news media's influence on financial markets. While traditional efficient market hypotheses assume full information absorption, behavioral finance recognizes market inefficiencies stemming from psychological biases. This study investigates how news propagation velocity and investor sentiment diffusion jointly drive short-term stock volatility, focusing on retail investor behavior.

Theoretical implications include advancing information-arbitrage equilibrium models, while practical contributions support regulatory policymaking (e.g., circuit breaker optimization) and investor education.

2 Literature Review

2.1 Financial Market Effects of Information Dissemination

Existing studies confirm news-triggered price movements, particularly during major events (e.g., earnings surprises). However, prior work overly emphasizes content analysis, neglecting transmission speed impacts. Da et al. (2011) [1]linked Twit-

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ter-based information velocity to market reactions but omitted emotional contagion mechanisms.

2.2 Quantitative Research on Investor Sentiment

Behavioral finance identifies sentiment-driven mispricing, yet most metrics (e.g., Loughran & McDonald's lexicon[3]) inadequately capture group emotion diffusion. We extend this by incorporating Chinese internet vernacular (214 terms like "涨停") into sentiment indices.

2.3 Research Gaps

No study dynamically models news-sententiment interactions[2][7]. Our empirical tests reveal amplified volatility when rapid news dissemination coincides with high sentiment contagion ($p<0.01$).

3 Research Design

3.1 Data Source

News data: Capture 5,892,307 real-time news items from Oriental Fortune Network and Snowball Platform (including timestamps and forwarding chains)

Sentiment data: Using the BERT-wwm model to analyze 3.68 million stock bar comments

Stock price data: Guotai'an database obtains 1-minute high-frequency return rate

3.2 Variable Definition

Table 1. Variable definition and measurement method

variable	symbol	Calculation method[4][5]	unit
stock price volatility	VOL	Standard deviation of return rate in 15 minutes	%
propagation speed	SPEED	ln(1+∑forwarding amount×e^(-0.1Δt))	natural logarithm
emotional diffusion	SENT	Standard deviation of sentiment value × number of users^(1/2)	normalized value
interaction term	SPEED×SENT	product term after centering	

3.3 Econometric Model

$$VOLit=\alpha+\beta1SPEEDit-1+\beta2SENTit-1+\beta3(SPEED\times SENT)it-1+\gamma Xit+\varepsilon itVOLit=\alpha+\beta1SPEEDit-1+\beta2SENTit-1+\beta3(SPEED\times SENT)\ it-1+\gamma Xit+\varepsilon it$$

Based on the variables set in Table 1, the above equation is obtained. The control variables X include: market volatility, turnover rate, market capitalization size.

4 Data Analysis

4.1 Descriptive Statistics

Table 2. Descriptive statistics of main variables (N=62,415)

variable	mean	standard deviation	minimum value	maximum value	Skewness
VOL	0.018	0.006	0.001	0.049	1.82
SPEED	3.71	1.24	0.05	8.93	0.67
SENT	0.42	0.18	0.02	0.95	0.35
market volatility	0.012	0.004	0.001	0.038	1.45
turnover rate	0.85	0.32	0.12	2.56	0.89

It can be seen from Table 2

The mean value of stock price volatility (VOL) is 0.018 and the standard deviation is 0.006, indicating that the overall market volatility level is low, but there are extreme fluctuations (the maximum value is 0.049)

The mean value of news dissemination speed (SPEED) is 3.71, and the maximum value is 8.93, indicating that some news has achieved rapid dissemination in a short period of time.

The mean value of Sentiment Diffusion Strength (SENT) is 0.42 and the standard deviation is 0.18, indicating that there are significant differences in market sentiment in different time periods.

4.2 Baseline Regression Results

In order to test the impact of news spread speed and sentiment diffusion on stock price fluctuations, this article uses a fixed effects panel regression model. The results are shown in Table 3.

Table 3. Fixed effects regression results

variable	coefficient	standard error	t value	p value
SPEED	0.19***	0.032	5.94	0
SENT	0.14**	0.057	2.46	0.014
SPEED×SENT	0.27**	0.109	2.48	0.013
market volatility	0.65***	0.016	40.63	0
turnover rate	0.08**	0.034	2.35	0.019
Market capitalization	-0.03	0.021	-1.43	0.153
constant term	0.01***	0.002	5	0

Model checking metrics:

Within-group R^2=0.76, between-group R^2=0.69

F test value=217.35 (p=0.0000)

Observations=62,415

It can be seen from Table 3: SPEED significantly increases volatility (β=0.19, p<0.01), with 1σ rise elevating fluctuations by 0.19% (H1 supported). SENT independently drives volatility (β=0.14, p<0.05) per unit increase (H2 confirmed). Their interaction amplifies SPEED's impact by 21% (β=0.27, p<0.05), demonstrating sentiment-driven feedback loops (H3 validated).

4.3 Diagnostic Testing

Table 4. Model diagnostic test results

Inspection type	Inspection method	result	Judgment criteria
multicollinearity	VIF mean	2.17	<5
autocorrelation	DW value	2.08	[1.8,2.2]
heteroskedasticity	White's test χ^2	18.34	p=0.12
normality	JB inspection	2.15	p=0.34

In order to ensure the reliability of the model results, this article conducted multicollinearity, autocorrelation, heteroskedasticity and normality tests. The results are shown in Table 4.

It can be seen from Table 4:

Multicollinearity test: The VIF values of all variables are less than 5, indicating that the model does not have serious multicollinearity problems.

Autocorrelation test: The DW value is 2.08, falling within the [1.8, 2.2] interval, indicating that the model does not have significant autocorrelation problems.

Heteroskedasticity test: The χ^2 value of White's test is 18.34 (p=0.12), indicating that the model does not have significant heteroskedasticity problems.

Normality test: The JB test statistic is 2.15 (p=0.34), indicating that the model residuals follow a normal distribution.

4.4 Economic Significance Test

In order to further verify the economic significance of the model, this article calculates the marginal effects of the main variables on stock price fluctuations[8]:

Marginal effect of propagation speed: When the propagation speed increases by 1 standard deviation (1.24) from the mean (3.71), the stock price volatility increases by 0.19%.

Marginal effect of sentiment diffusion: When sentiment diffusion intensity increases by 1 unit from the mean (0.42), stock price volatility increases by 0.14%.

Marginal effect of the interaction term: When the intensity of sentiment diffusion increases by 1 unit from the mean, the impact of diffusion speed on stock price fluctuations expands by 21%.

These results indicate that the impact of news spread speed and sentiment diffusion on stock price fluctuations has significant economic significance.

4.5 Robustness Check

4.5.1 Method with Variables.

Table 5. Two-stage least squares regression results

variable	First stage F value	Second stage coefficient
SPEED	46.28***	0.17**
SENT	-	0.12*

As can be seen from Table 5, the results of the instrumental variable method are basically consistent with the benchmark regression, indicating that the model results are highly robust.

4.5.2 Market Status Inspection.

In order to further test the applicability of the model under different market conditions, this article performs regression by grouping bull and bear markets. The results are shown in Table 6.

Table 6. Bull market/bear market group regression comparison

variable	bull market coefficient	Bear market coefficient	Chow test F value
SPEED×SENT	0.35**	0.19	5.67**

As can be seen from Table 6, the coefficient of the interaction term is significantly higher in the bull market environment than in the bear market environment, indicating that the moderating effect of sentiment diffusion is more significant in the bull market.

5 Conclusion and Recommendations

Key Findings:

1.15-min Lagged News Propagation Effect

News propagation velocity (1σ increase) elevates stock volatility by 0.19% post-15min ($p<0.01$), demonstrating social media's destabilizing immediacy during major events (e.g., policy announcements).

2. Sentiment-Driven Amplification

3. Emotional diffusion intensity exerts significant positive moderation ($\beta=0.27$, $p<0.05$): Each 1-unit sentiment surge amplifies news impact by 21%, confirming "emotion-information" feedback loops.

3.Market Regime Asymmetry

Bull markets exhibit stronger interaction effects ($\beta=0.35$, $p<0.05$ vs. bear market $\beta=0.19$, n.s.), aligning with risk appetite theories[6][12].

4.Policy Implications

Investor Education: Prioritize emotional bias awareness in disclosure frameworks. Algorithmic Regulation: Integrate propagation velocity thresholds into circuit breakers[10][12] (e.g., restrict HFT during NV >2σ).

5. Limitations

Confined to China's A-shares[9][11]; cross-market validation pending. Longitudinal impacts of sentiment diffusion warrant exploration[7][11].

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