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Enterprise online sales and extreme changes in stock prices

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Abstract. With the continuous development of the Internet, online sales are increasingly becoming an important sales channel for enterprises, and its impact on the capital market is also increasing. This article uses the online sales data of A-share listed firms between 2015 and 2024 to study the effect of online sales of enterprises on the soar and crash of stock prices. The study found that online sales, on the one hand, suppresses the soar and crash of stock prices by improving the transparency of information, and on the other hand, the abnormal fluctuations of online sales data affect investors' judgement, thus promoting the soar and crash of stock prices. The regression results of sub-samples show that the impact of online sales data on the soar and crash of stock prices is more obvious in enterprises with duality and the rate of separation of company's shareholding and management. Mechanism analysis shows that online sales affect extreme changes in stock prices by increasing the number of Baidu searches, news and improving the quality of financial information. The above results are consistent with the logic that online sales can not only improve the information environment, but also amplify the irrational investment of investors. This conclusion is of certain significance for listed companies to improve information disclosure, strengthen corporate governance and prevent extreme fluctuations in stock prices.

Keywords: Online sales; stock prices soar and crash; information asymmetry; abnormal fluctuation of sales data.

1. Introduction

With the development and widespread adoption of the internet, China's digital economy has continued to grow rapidly, and online sales have evolved from an emerging consumption channel into one of the primary channels for consumer spending in the country. Online sales not only provide convenience for people's daily lives and have profoundly transformed their consumption patterns, but have also become a key driver of high-quality economic development and supply-side structural reform in China. The report of the 20th National Congress of the Communist Party of China explicitly calls for "accelerating the development of the digital economy and promoting the deep integration of the digital economy with the real economy." This statement not only charts the course for the future development of online sales but also sets practical requirements for the academic community to conduct in-depth research on the digital economy. It is worth noting that in 2023, the total sales volume of the national online retail market exceeded 15 trillion yuan, with consumer goods accounting for over 30% of this figure. This demonstrates that the economic impact of online sales has extended to the capital markets and is becoming increasingly profound. To guard against the risk of extreme stock price volatility, effectively leverage the capital markets' role in serving the real economy, and support high-quality economic development, we need to explore the economic consequences of online sales on the capital markets, thereby providing more theoretical guidance for market participants and stakeholders.

Numerous studies have examined the impact of online sales on corporate behavior and information intermediaries from various perspectives. Lendle et al. (2016)[1] found that online sales have, to some extent, overcome geographical barriers, thereby reducing spatial inequality in consumption. Han Huichao and Xu Kangning (2020)[2] found that firms with larger-scale online sales are more likely to achieve optimal resource allocation through the mechanism of survival of the fittest in market competition. This process drives the innovation process, ultimately leading to an increase in total factor productivity. Liu Yunguo et al. (2024)[3] found that after adopting online sales, firms'

operational transparency increases, providing more external stakeholders with the opportunity to monitor their business activities. Zhang Ran et al. (2012)[4] found that online sales, as a form of non-financial information, contains incremental information beyond traditional financial data and can be used to predict future revenue and earnings. Building on the preceding literature, this paper examines the impact of online sales on sharp fluctuations in stock prices.

In theory, online sales data can contribute to sharp fluctuations in stock prices. Once online sales data is released, normal variations in sales figures (such as seasonal fluctuations and promotional activities) may be misinterpreted as abnormal fluctuations. Yu Qingjin and Zhang Bing (2012)[5] found that investors pay limited attention to online sales information, which leads to temporary deviations in asset prices. Furthermore, Lee et al. (2019)[6] found that investors underreact to online sales information, which may make it difficult to observe earnings reversals. These factors can trigger irrational investor behavior, thereby contributing to sharp stock price fluctuations.

On the other hand, online sales data can also serve to mitigate sharp fluctuations in stock prices. Sun Puyang et al. (2017)[7] found that online sales channels feature transparent and publicly visible product pricing, which improves information asymmetry in supply and demand markets. Tian Gaoliang et al. (2019)[8] also demonstrated that online sales enhance stakeholders' ability to access information about the corporate environment. Liao Li et al. (2021)[9] found that e-commerce sales data is directly correlated with a company's operating revenue and is highly real-time, providing relevant information about the company's future performance and stock prices, and can serve as an effective source of information for capital markets. These factors can stabilize investor expectations, guide investors to make timely judgments and choices, and thereby mitigate the risk of sharp stock price declines.

In summary, online sales may either promote or suppress extreme stock price volatility, and their specific mechanisms require empirical testing. Using a sample of online sales data from A-share listed companies from 2015 to 2024, this study demonstrates that online sales exert both a promoting and a suppressing effect on extreme stock price volatility. This result remains robust after varying the dependent variable, changing the independent variables, and applying instrumental variable methods. This effect is more pronounced in firms with higher rates of separation of ownership and management and in those with a dual-role structure. Online sales data can indeed suppress the probability of stock price surges and crashes by enhancing information transparency, while simultaneously promoting such volatility by influencing investor decisions through abnormal stock price fluctuations. These conclusions are consistent with the logic that online sales can amplify irrational investor behavior and improve the information environment.

The contributions of this paper include: first, expanding research on the economic consequences of online sales. Existing literature primarily focuses on the impact of online sales on management's earnings forecasts (Peng and He, 2021)[10], consumer preferences (Chen Jian et al., 2020)[11], and the excess returns from forecasting a firm's future revenue and earnings announcements (Huang, 2018)[12]. Building on this foundation, this paper explores the impact of online sales on stock price volatility, thereby enriching the understanding of the relationship between online sales and capital markets. Second, it deepens our understanding of the impact of stock price volatility. Unlike previous studies that examined stock price volatility solely from the perspective of information transparency, this paper simultaneously examines the effects of both information transparency and abnormal fluctuations in sales data on stock price volatility, thereby broadening our understanding of the causes of extreme stock price volatility. Third, it holds significant practical implications. The findings of this study are relevant for preventing abnormal stock price fluctuations in capital markets, safeguarding investors' legitimate rights and interests, and improving information disclosure systems related to online sales.

The structure of this paper is as follows: Part Two covers the institutional background and theoretical analysis; Part Three introduces the research design; Part Four presents the main empirical tests and analysis; Part Five includes further analysis and mechanism testing; and Part Six presents the conclusions.

2. Literature review

2.1. Research related to online sales

Online sales refers to the process of displaying, selling and trading goods or services through the Internet platform. It covers various forms such as e-commerce, social media sales, mobile sales, etc., breaking through the time and space constraints of traditional offline sales forms and bringing convenience to enterprises and consumers. Lendle et al. (2016)[1] found that the transaction mode of e-commerce no longer requires offline fixed trading places, thus breaking through the space limitations of transactions. In addition, online sales also have an efficient data interaction. Clicking, purchasing and other behaviors of consumer terminals can cause merchants to arrange marketing strategies, inventory management and other activities. On the one hand, the popularization of online sales has greatly enriched consumers' choices and prompted enterprises to improve the level of products or services. On the other hand, it has also greatly impacted the traditional offline sales channels and hit some of the real economy to a certain extent. At the same time, the information asymmetry of online sales has also become a concern for some consumers.

Sun Puyang et al. (2017)[7] found that the adoption of online sales model helps to reduce the sales costs of enterprises. Liao Li et al. (2021)[9] based on the research of transaction data of China's e-commerce platform shows that the sales data of the e-commerce platform is not only directly related to the company's actual business activities, operating income, etc., but also provides relevant information about the company's future performance and stock price, so it can be used as a valuable source of information in the capital market. Huang (2018)[12] believes that the content of the evaluation from consumers contains information about the company's future cash flow. Han Huichao and Xu Kangning (2020)[2] found that the larger the scale of online sales, the easier it is for enterprises to obtain more high-quality resources under the influence of the market. Liu Yunguo et al. (2024)[3] found that with the development of online sales, the sales and operation of enterprise products have been made public, and more external stakeholders have the opportunity to influence enterprise decision-making and management behaviour by supervising enterprise operations.

Lendle et al. (2016)[1] found that online sales are less constrained by geographical distance, which is conducive to weakening the imbalance of consumption space. Yu Qingjin and Zhang Bing (2012)[5] found that investors usually price only based on the online sales information they pay attention to, which is prone to temporary pricing deviations. Lee et al. (2019)[6] found that if investors do not respond enough to online sales information, it is difficult to find the phenomenon of return reversal. Tian Gaoliang et al. (2019)[9] found that online sales relying on the Internet platform has broadened the communication channels and audience range of media reports, improved the knowledge of external stakeholders about enterprise environmental information, and also weakened the dominant position of enterprises in information asymmetry. Liao Li et al. (2021)[9] and Zhang Ran et al. (2012)[4] found that compared with traditional financial information, online sales as non-financial information have incremental information value, which can be used to predict future income and income levels. Liu Yunguo et al. (2024)[3] found that enterprises that carry out online sales are more likely to attract more attention from analysts, which also helps to improve the quality of analysts' surplus forecasts.

2.2. Research on the sharp rise and fall of stock prices

The surge and collapse is a special market performance in the financial market. The surge refers to the rapid growth of asset prices in a short period of time, usually accompanied by a large number of buying transactions, causing the price to rise rapidly. The plunge refers to the rapid decline in asset prices at the same time, accompanied by a large number of sell transactions, resulting in a sharp decline in prices. The surge and fall of stock prices is generally affected by investor sentiment (Liu Shengyao et al., 2016)[13], and the surge and fall of a single stock is likely to be affected by other stocks or affect other stocks, or even the entire market. In addition, leveraged instruments such as bonds in the financial market and procedural trading will amplify this extreme stock price fluctuation to a certain extent. The sharp rise and fall of stock prices will have more negative impact on the

market. For example, the soaring stock price will lead to the funds shift from the real to the virtual, causing asset bubbles; while the plummeting stock prices will lead to the rapid evaporation of the wealth of leveraged investors. The surge and fall of stock prices may also be transmitted to the financial market, affecting the development of the real economy, investors' investment behaviour and consumers' consumption behaviour.

Shi Yongdong and Wang Jinle (2014)[14] found that Chinese institutional investors will aggravate the increase in stock prices in the rising stage of the market; while in the falling stage of the market, although it can reduce the fluctuation of stocks to a certain extent, they cannot prevent the stock price from continuing to fall. Bian et al. (2018)[15] found that the collapse of the A-share market in 2015 was closely related to the existence of a large number of highly leveraged financing accounts. Hirshleifer (2001)[16] found that the risk of soaring is mainly caused by short-term price bubbles, which are caused by stock price manipulation and irrational investors' overreaction to information. Liu Shengyao et al. (2016)[13] found that high investor sentiment may cause stock price bubbles and trigger the risk of stock price plummeting.

Kothari et al. (2009)[17] found that the sharp decline in stock prices is due to the fact that managers selectively disclose information to the market out of their own career prospects and short-term incentives. Generally, they take the initiative to disclose good news to the outside world and deliberately hoard bad news. When the bad news accumulates to a certain extent, it is only pushed to the market at once, which causes investors to overreact, which eventually leads to a sharp decline in the company's stock price. Liu et al. (2017)[18] found that when enterprises face financing constraints, funds with scarce funds and non-trading stocks with poor liquidity are more likely to be sold. When the market begins to fall, institutions will be forced to sell assets, and the unique trading system in the Chinese market makes asset owners become It is particularly fragile. When financing liquidity further develops into a systemic liquidity crisis, the risk of stock market crashes may break out at any time. Jin and Myers (2006)[19] found that the more transparent the information in a country is, the greater the risk of its stock price plummet.

Online sales data will affect enterprises and other market entities such as consumers and investors. The soaring and plummeting of stock prices will be caused by both investors and selective information disclosure of enterprises and other factors. However, the impact of online sales data on the surge and collapse of stock prices has not been fully studied. By analyzing the impact of online sales on the surge and fall of stock prices, the research in this article reveals how the information transparency caused by online sales is transmitted to the capital market and suppresses the volatility of stock prices; on the other hand, it also provides new information for understanding how abnormal fluctuations in sales data accelerate the diffusion and trigger systemic risks in the digital age. The perspective, thus providing a theoretical supplement for cross-market supervision and risk prevention and control.

3. Research hypotheses and empirical design

Research hypothesis. Online sales data is generally more transparent and accessible than other types of data, making it easier for investors to obtain in a timely manner. However, sales data is prone to normal fluctuations caused by special circumstances, such as short-term promotional events like Double Eleven and seasonal product variations. These normal fluctuations are often mistaken by investors as abnormal fluctuations in sales data. Yu Qingjin and Zhang Bing (2012)[5] found that investors' focus on online sales data is one-sided, specifically manifesting in their tendency to analyze only the online sales information they deem relevant, which can lead to temporary deviations in asset prices. Lee et al. (2019)[6] found that the difficulty in observing earnings reversals may stem from investors' insufficient reaction to online sales information. These abnormal fluctuations do not accurately reflect a company's operational performance but rather represent normal changes caused by short-term external environmental factors.

If online sales data exhibits abnormal fluctuations, it will significantly influence investor expectations. Hirshleifer (2001)[16] found that the primary cause of crash risks lies in short-term price bubbles, which primarily stem from irrational investors' excessive reactions to information. Although institutional investors have professional teams to conduct analysis, they still face the risk of misinterpreting abnormal fluctuations as market signals; individual investors, with weaker information processing capabilities, are even more prone to misinterpreting such fluctuations in online sales data. Both types of investors may make irrational decisions due to misinterpretations of online sales data, thereby triggering sharp stock price surges and crashes. Liu Shengyao et al. (2016)[13] found that heightened investor sentiment can lead to stock price bubbles, and the bursting of these bubbles directly triggers subsequent crash risks.

Stock price surges and crashes are influenced by irrational investor decisions and are characterized by suddenness, blindness, and contagion. Wang Zhengwei et al. (2022)[20] found that the year-over-year growth rate of online sales can significantly predict stock returns for the following month. This largely reflects the lag in the information conveyed by online sales data. This lag, in turn, exacerbates investors' irrational decision-making behavior. Consequently, online sales data intensifies sharp fluctuations in stock prices by directly triggering irrational investor behavior.

Based on this, we propose Hypothesis H1: Online sales have a facilitating effect on sharp fluctuations in stock prices.

The public disclosure of online sales data inherently leads to greater transparency, which implies a reduction in information asymmetry. Sun Puyang et al. (2017)[7] found that information asymmetry in supply and demand markets was mitigated by the transparency of online sales data. Tian Gaoliang et al. (2019)[8] also demonstrated that online sales information, leveraging internet platforms, effectively expands the dissemination channels and audience reach of media reports, thereby undermining, to some extent, the dominant position that firms previously held within the information asymmetry framework. These disclosure practices send genuine operational signals to the capital market, thereby reducing information asymmetry.

A reduction in information asymmetry lowers the probability of sharp stock price fluctuations. Hutton et al. (2009)[21] argue that a company's level of information transparency has a certain impact on the risk of stock price crashes. Jin and Myers (2006)[19] also contend that the less transparent a company is, the higher its risk of experiencing sharp stock price fluctuations. On the one hand, a reduction in information asymmetry means that a company's operational status can be reflected in a timely manner, reducing the likelihood of management concealing information and thereby lowering the probability of sharp stock price fluctuations. On the other hand, a reduction in information asymmetry enhances market transparency, allowing external institutional and individual investors to access relevant data in a timely manner, which further reduces the probability of sharp stock price fluctuations.

Stock price volatility is often triggered by information asymmetry and is both widespread and actionable. Online sales can provide investors with more signals by constraining management's selective disclosure of information, thereby alleviating information asymmetry to some extent. Consequently, online sales data helps curb stock price volatility by enhancing information transparency.

Based on this, we propose Hypothesis H2: Online sales have a dampening effect on stock price volatility.

Empirical design. To examine whether online sales affect the sharp fluctuations of stock prices, this paper draws on the research designs of Zhang Jie et al. (2010)[22] and constructs the following econometric model:

$$Extreme_{i,t}=\alpha+\beta ONLINESP_{i,t}+\gamma' Control_{i,t}+\sum Year+\sum Industry+\varepsilon_{i,t} \quad (1)$$

Extreme refers to the number of instances of extreme price surges and plunges. Existing literature primarily measures extreme price movements from the perspective of stock price crash risk. Although some scholars use the risk of price surges (UP) and the risk of price plunges (NCSKNEWS, DUVOL) as proxy variables for extreme price movements, these measures fail to capture extreme volatility in both directions—price surges and plunges—simultaneously. Therefore, following the approach of Xiong Lihui et al. (2021)[23], this study uses the number of extreme price movements as a proxy for stock price volatility. Specifically, Extreme is defined as the logarithm of the number of extreme price movements.

Onlinesp represents the proportion of online sales. Following the approach of Xu Yue et al. (2024)[24], this study adopts the proportion of online sales—specifically, the ratio of annual revenue generated by the company's directly operated stores and flagship stores on e-commerce platforms such as Tmall and JD.com to the company's total operating revenue—as a proxy for online sales. This study primarily focuses on the estimated value of the regression coefficient β. If the estimated value is significantly positive, it indicates that online sales promote extreme stock price volatility, confirming Hypothesis H1; if the estimated value is significantly negative, it indicates that online sales suppress extreme stock price volatility, confirming Hypothesis H2.

Control represents a set of control variables, including firm size (Size), proportion of independent directors (IndRate), revenue growth rate (Growth), firm age (FirmAge), largest shareholder's ownership ratio (Top1), debt-to-equity ratio (Leverage), board size (Boardsize), cash holdings (Cash), and return on assets (ROA). Year and IndustryCode denote that this study controls for fixed effects of year and industry, respectively. To address potential cross-sectional correlation issues, this study performs cluster adjustment of standard errors at the firm level in all regressions. Detailed definitions are provided in Table 1.

Table 1. Variable Definition and Construction

Variable symbol	Variable name	Description of variable Construction
Extreme	The number of times the stock price has skyrocketed and plummeted	ln the number of sharp rises and falls
Onelinesp	Proportion of online sales	The total number of seats on the board of directors at the end of the year
Boardsize	Size of broad	The total number of seats on the board of directors at the end of the year
IndRate	Ratio of independent directors	The number of independent directors/the total number of board members
Size	Firm size	The natural logarithm of total assets at the end of the year ln (Total assets)
Top1	Share proportion of the largest shareholder	The number of shares held by the largest shareholder/the total number of shares
FirmAge	Enterprise age	ln (Current year - Listing year +1)
Cash	Cash holding level	(Monetary funds + trading financial assets)/Total assets
ROA	Return on total assets	Net profit/Total assets at the end of the year
Growth	Increase rate of business revenue	(Current period's revenue - previous period's revenue)/Previous period's revenue
Leverage	Asset-liability ratio	Year-end total liabilities/year-end total assets

Data sources. This study focuses on companies listed on the A-share market, utilizing online sales data, stock price transactions, and other relevant data from 2015 to 2024. All data in this paper are sourced from the Wind database. To ensure the validity of the sample, the following data processing steps were performed: ST and *ST stocks, as well as financial sector data, were excluded; companies

with missing values were removed, resulting in a total of 34,971 observations; to avoid outliers, the sample variables were trimmed at the top and bottom 1%.

3.1. Descriptive statistics

Table 2. Descriptive Statistics

	(1)	(2)	(3)	(4)	(5)
VARIABLES	N	mean	sd	min	max
Extreme	34,971	0.257	0.722	0	3.045
Onelinesp	34,971	0.005	0.027	0	0.216
Boardsize	34,971	2.098	0.197	1.609	2.639
IndRate	34,971	0.380	0.054	0.333	0.571
Size	34,971	22.37	1.295	20.04	26.41
Top1	34,971	0.327	0.146	0.080	0.729
FirmAge	34,971	3.049	0.290	2.197	3.664
Cash	34,971	0.154	0.115	0.009	0.569
ROA	34,971	0.028	0.070	-0.308	0.193
Growth	34,971	0.127	0.366	-0.595	2.079
Leverage	34,971	0.421	0.202	0.060	0.898

As shown in Table 2, the mean value for Extreme (stock price volatility) is 0.257, indicating that 25.7% of the companies experienced extreme stock price volatility; the mean value for Size is 22.37, indicating that the companies' year-end total assets amounted to 5.19 billion yuan; and the mean value for Leverage is 0.421, indicating that the companies' average debt-to-asset ratio was 42.1%. Among these, the standard deviations for Extreme price volatility and Online sales ratio (Onlinesp) are 0.723 and 0.027, respectively, both indicating significant fluctuations. This suggests that there are substantial differences among the companies in the sample regarding their online sales ratios and the frequency of extreme price volatility, providing strong data support for the study.

3.2. Empirical Results and analysis

Analysis of benchmark regression results.

Table 3. Benchmark regression analysis

	(1)	(2)	(3)	(4)
VARIABLES	Extreme	Extreme	Extreme	Extreme
Onelinesp	-0.931***	-0.588***	-0.751***	-0.334***
	(-13.890)	(-9.282)	(-9.428)	(-5.813)
Boardsize			-0.283***	-0.019*
			(-13.348)	(-1.930)
IndRate			-0.218***	0.016
			(-2.959)	(0.449)
Size			-0.029***	-0.051***
			(-10.355)	(-34.052)
Top1			-0.084***	-0.036***
			(-3.865)	(-3.296)
FirmAge			0.242***	-0.063***
			(20.488)	(-11.585)
Cash			0.054	0.017
			(1.612)	(1.196)
ROA			-1.085***	-0.388***
			(-15.405)	(-14.978)
Growth			-0.068***	0.035***
			(-7.315)	(10.342)
Leverage			-0.154***	0.063***
			(-6.532)	(6.112)
Constant	0.261***	-0.052*	0.977***	1.250***
	(89.945)	(-1.944)	(12.947)	(26.742)
Observations	34,971	34,971	34,971	34,971
R-squared	0.001	0.807	0.037	0.816
Industry FE	NO	YES	NO	YES
Year FE	NO	YES	NO	YES

Note: ***, **, and * respectively indicate significant statistical levels of 1%, 5%, and 10%. The same applies below

Table 3 examines the impact of the online sales share on stock price volatility. Model (1) is a simple regression with neither control variables nor fixed effects; Model (2) is a regression with fixed effects; Model (3) is a regression with control variables; and Model (4) is a regression with both fixed effects and control variables. The results show that the regression coefficient for the share of online sales (Onlinesp) is significantly negative in all models ($p < 0.01$), indicating that online sales have a significant dampening effect on extreme stock price volatility. This validates Hypothesis H2 of this study, namely, that although online sales have both a promoting and a dampening effect on extreme stock price volatility, the dampening effect plays a significantly dominant role.

3.3. Robustness test.

To prove that the regression results of this paper are not accidental phenomena, the following method is now adopted for robustness testing. Replace the interpreted variable

Table 4. Change the measurement method of the interpreted variable

	(1)	(2)	(3)
VARIABLES	Positive Extreme	Negative Extreme	Hutton Extreme
Onelinesp	-0.306***	-0.175***	-0.220***
	(-5.609)	(-3.749)	(-4.170)
Boardsize	-0.022**	-0.004	0.013
	(-2.409)	(-0.428)	(1.608)
IndRate	0.014	0.029	0.024
	(0.440)	(0.935)	(0.846)
Size	-0.037***	-0.049***	-0.006***
	(-27.044)	(-36.900)	(-4.386)
Top1	-0.040***	-0.013	-0.008
	(-3.951)	(-1.317)	(-0.905)
FirmAge	-0.054***	-0.053***	0.005
	(-10.611)	(-10.621)	(1.158)
Cash	0.021	0.004	-0.003
	(1.546)	(0.342)	(-0.215)
ROA	-0.353***	-0.294***	-0.082***
	(-14.876)	(-12.411)	(-3.640)
Growth	0.031***	0.025***	-0.005
	(9.670)	(7.887)	(-1.112)
Leverage	0.044***	0.055***	0.031***
	(4.501)	(5.879)	(3.460)
Constant	0.946***	1.167***	0.225***
	(21.328)	(29.264)	(6.038)
Observations	34,971	34,971	34,971
R-squared	0.790	0.652	0.227
Industry FE	YES	YES	YES
Year FE	YES	YES	YES

In the benchmark regression, we use the logarithm of the number of extreme price movements to measure extreme stock price volatility. To test for robustness, this paper now uses the logarithm of the number of price surges, the logarithm of the number of price crashes, and the Hutton accrual opacity index (based on the measurement method in Hutton et al., 2009[21]) to measure price extremes (Extreme). We employ the same four sets of models as in the baseline regression, and the resulting regression results are presented in Table 4. The results show that the regression coefficient for the online sales share (Onlinesp), after replacing the dependent variable, remains significantly negative in all models, indicating that the results of the baseline regression are robust.

Change the explanatory variable:

Table 5. Change the measurement method of the explanatory variable

	(1)	(2)
VARIABLES	Extreme	Extreme
lnSales	-0.002***	
	(-5.462)	
lnNum		-0.003***
		(-5.425)
Boardsize	-0.019*	-0.019*
	(-1.872)	(-1.859)
IndRate	0.017	0.018
	(0.481)	(0.496)
Size	-0.051***	-0.051***
	(-33.889)	(-33.877)
Top1	-0.037***	-0.037***
	(-3.350)	(-3.333)
FirmAge	-0.062***	-0.062***
	(-11.425)	(-11.415)
Cash	0.017	0.018
	(1.214)	(1.217)
ROA	-0.386***	-0.386***
	(-14.893)	(-14.906)
Growth	0.035***	0.035***
	(10.293)	(10.298)
Leverage	0.064***	0.064***
	(6.231)	(6.227)
Constant	1.242***	1.241***
	(26.524)	(26.495)
Observations	34,971	34,971
R-squared	0.816	0.816
Industry FE	YES	YES
Year FE	YES	YES

In the benchmark regression, we measure the online sales share (Onlinesp) as the proportion of annual sales revenue generated by the company's directly operated stores and flagship stores on e-commerce platforms relative to the company's total operating revenue. To test for robustness, this paper now uses lnSales and lnNum to measure the online sales ratio (Onelinesp), employing the same four sets of models as in the baseline regression. The regression results are presented in Table 5. The results show that the regression coefficient for stock price volatility (Extreme) remains significantly negative across all models after changing the dependent variable, indicating that the results of the benchmark regression are robust.

Change the regression sample:

Table 6. Change the regression sample Method

	(1)	(2)	(3)	(4)
VARIABLES	Extreme	Extreme	Extreme	Extreme
Onelinesp	-4.779***	-3.676***	-3.277***	-2.062***
	(-10.457)	(-7.622)	(-7.924)	(-4.770)
Boardsize			-0.205***	-0.130**
			(-3.722)	(-2.441)
IndRate			-0.060	0.032
			(-0.309)	(0.175)
Size			-0.283***	-0.293***
			(-32.683)	(-33.755)
Top1			-0.355***	-0.179***
			(-5.780)	(-2.870)
FirmAge			-0.366***	-0.299***
			(-11.924)	(-9.828)
Cash			0.051	-0.125
			(0.649)	(-1.627)
ROA			-1.960***	-1.673***
			(-13.720)	(-12.074)
Growth			0.157***	0.132***
			(4.869)	(4.371)
Leverage			0.257***	0.271***
			(5.058)	(5.287)
Constant	2.048***	1.660***	9.960***	9.236***
	(190.790)	(6.756)	(44.432)	(28.850)
Observations	4,425	4,425	4,425	4,425
R-squared	0.022	0.179	0.380	0.455
Industry FE	NO	YES	NO	YES
Year FE	NO	YES	NO	YES

To eliminate the existence of some biased samples that would make the regression results unreliable, this paper deleted the samples with a value of 0 for the sharp rise and fall of stock prices and conducted the same regression as the benchmark regression. The obtained regression results are shown in Table 6. The results show that the regression coefficient of the stock price fluctuation (Extreme) after changing the explained variable remains significantly negative in all models, indicating that the benchmark regression results are robust.

Propensity Score Matching (PSM):

Table 7. PSM

	(1)
VARIABLES	Extreme
Onelinesp	-0.232***
	(-2.937)
Boardsize	-0.042
	(-1.181)
IndRate	-0.024
	(-0.228)
Size	-0.043***
	(-7.432)
Top1	-0.065*
	(-1.701)
FirmAge	-0.064***
	(-2.801)
Cash	0.055
	(1.221)
ROA	-0.434***
	(-4.435)
Growth	0.000
	(0.014)
Leverage	0.091**
	(2.135)
Constant	0.578
	(1.317)
Observations	3,580
R-squared	0.686
Industry FE	YES
Year FE	YES

To address the issue of sample selection bias affecting the robustness of regression, this paper also employs PSM to test the robustness of benchmark regression. First, select Treat as the processing variable - if the proportion of online sales is greater than 0, the value of Treat is 1; If the proportion of online sales =0, then the value of Treat is 0. Then, match the grouped Treats and delete the samples without values. Finally, the benchmark regression was conducted again, and the obtained regression results are shown in Table 7. The results show that the regression coefficient of the stock price fluctuation (Extreme) after changing the explained variable remains significantly negative in all models, indicating that the benchmark regression results are robust.

Endogeneity test.

Table 8. Instrumental variable method

	(1)	(2)
VARIABLES	Onelinesp	Extreme
iv	0.716***	
	(5.488)	
Onelinesp		-2.160***
		(-3.138)
Boardsize	0.002	-0.017*
	(0.838)	(-1.671)
IndRate	0.010	0.033
	(1.191)	(0.903)
Size	0.001***	-0.048***
	(4.381)	(-27.705)
Top1	0.003	-0.032***
	(0.855)	(-2.819)
FirmAge	0.001	-0.060***
	(1.030)	(-10.934)
Cash	0.012***	0.039**
	(3.692)	(2.326)
ROA	0.016***	-0.356***
	(3.411)	(-12.548)
Growth	-0.002***	0.031***
	(-5.504)	(8.397)
Leverage	-0.001	0.062***
	(-0.317)	(6.009)
Constant	-0.049***	1.168***
	(-5.293)	(21.020)
Observations	34,971	34,971
R-squared	0.166	0.816
Industry FE	YES	YES
Year FE	YES	YES

To address the potential endogeneity issues, this paper employs the instrumental variable method for endogeneity testing. Specifically, this paper refers to the approach of Li Jianing and Zhong Tianli (2019)[25] to handle endogeneity. The mean of each province is used as the instrumental variable, and the two-stage instrumental variable IV method is adopted for endogeneity processing. The regression results are shown in Table 8. The results of the first-stage regression show that the regression coefficient of iv is significantly positive, indicating that the mean of each province is highly positively correlated with the online sales data. The results of the first stage of regression show that the regression coefficient for the Extreme situation of stock price fluctuations remains significantly negative, indicating that the results of the benchmark regression are robust.

4. Further analysis

4.1. Heterogeneity analysis

Duality: The dual role refers to a situation where the company's chairman and general manager are the same person. This arrangement leads to a high degree of centralization in the company's power and decision-making processes. The dual role allows the controlling shareholder to exert stronger control over the company. For example, when the chairman and the manager are the same person, the

individual may selectively disclose information to the market based on personal career interests and short-term incentives, triggering an overreaction from investors and causing the company's stock price to plummet (Kothari et al., 2009)[17]. Consequently, we expect that firms with dual roles will exhibit lower information transparency and more frequent information problems, and that online trading will play a more pronounced role in driving sharp fluctuations in stock prices.

Drawing on the research methodology of Wang Chengfang et al. (2020)[26], this study uses Dual as a proxy variable for the dual-role arrangement: if the general manager and chairman are the same person, Dual = 1; otherwise, Dual = 0. We employ cross-product regression to test for heterogeneity, adding a cross-term of online sales share and the dual-role arrangement to the baseline regression model and rerunning the analysis. The regression results are shown in Table 9(1). The results of the regression analysis indicate that the coefficient of the interaction term is significantly negative at the 5% significance level. This confirms that in firms where the general manager and chairman roles are combined, the role of online sales in driving sharp fluctuations in stock prices is more pronounced, consistent with our expectations.

4.2. The separation rate of the two rights

The separation of ownership and control refers to the degree to which a company's equity ownership and management authority are separated in corporate governance. A higher degree of separation indicates that the actual controller has obtained a greater degree of control with a smaller equity stake, which may lead to agency problems and conflicts of interest. When online sales data experiences abnormal fluctuations, controlling shareholders of firms with a high separation of ownership and management will exercise greater caution in disclosing information to protect their control rights, thereby reducing misjudgments by investors and ultimately mitigating extreme stock price volatility. Friedman et al. (2003)[27] found that when a firm faces negative shocks, providing support to the firm is the optimal solution for the actual controller to ensure the firm's continued survival in the market. Consequently, we expect agency problems to be more frequent in firms with high separation of ownership and control, and thus the moderating effect of online sales on sharp stock price fluctuations will be stronger.

This paper adopts the research methodology of Song Yu (2009)[28], defining the degree of separation of ownership and control as the ratio of ownership to control; the closer this ratio is to 1, the smaller the difference between ownership and control. This paper employs cross-product regression to test for heterogeneity. We added a cross-product term of the online sales ratio and the ownership-control separation ratio to the baseline regression model and performed the regression again; the results are shown in Table 9(2). The regression results indicate that the coefficient of the cross-product term is significantly negative at the 5% statistical level. This finding confirms that in firms with a high ownership-control separation ratio, online sales exert a stronger dampening effect on stock price volatility, consistent with our expectations.

Table 9. Heterogeneity analysis based on the rates of the integration of two positions and the separation of two powers

	(1)	(2)
VARIABLES	Extreme	Extreme
Onelinesp x Seperation	-1.604**	
	(-2.006)	
Seperation	0.005	
	(0.214)	
Onelinesp x Dual		-0.327**
		(-2.496)
Dual		0.015***
		(4.131)
Onelinesp	-0.265***	-0.196***
	(-3.633)	(-2.720)
Boardsize	-0.020*	-0.017*
	(-1.950)	(-1.647)
IndRate	0.014	0.021
	(0.377)	(0.562)
Size	-0.051***	-0.050***
	(-34.004)	(-32.755)
Top1	-0.036***	-0.037***
	(-3.277)	(-3.325)
FirmAge	-0.063***	-0.059***
	(-11.519)	(-10.592)
Cash	0.017	0.016
	(1.181)	(1.096)
ROA	-0.387***	-0.392***
	(-14.955)	(-14.897)
Growth	0.035***	0.034***
	(10.343)	(9.893)
Leverage	0.063***	0.062***
	(6.133)	(5.935)
Constant	1.251***	1.228***
	(26.751)	(25.214)
Observations	34,971	34,001
R-squared	0.816	0.819
Industry FE	YES	YES
Year FE	YES	YES

4.3. Mechanism analysis

Based on previous research, online sales have two distinct effects on stock price volatility. On the one hand, online sales curb stock price volatility by enhancing information transparency; on the other hand, online sales send misleading signals to investors through abnormal fluctuations in sales data, thereby increasing the probability of extreme stock price volatility.

This paper conducts a mechanism analysis from three dimensions: financial information quality, number of news media articles, and Baidu search volume. The measurement method for financial information quality follows Huang Shizhong and Ye Qinhua (2023)[29], using the financial reporting credibility index; a higher credibility index indicates higher quality of the company's financial information; The measurement of news media coverage follows the approach of Gan Qinyu and Luo

Ronghua (2025)[30], using the number of media reports as an indicator; a higher number of reports indicates greater corporate transparency; the measurement of Baidu search volume follows the approach of Yu Qingjin and Zhang Bing (2012)[5], using Baidu Index search volume as an indicator; a higher search volume implies greater investor attention. We replaced the number of price surges and plunges—the dependent variable in the baseline regression—with these three common variables and performed a regression; the results are presented in Table 10. The regression results indicate that financial information quality is significantly negative, demonstrating that online sales suppress stock price surges and plunges; the number of news media articles and Baidu search volume are significantly positive, demonstrating that online sales promote stock price surges and plunges.

Table 10. Mechanism Analysis Based on Financial Information Quality, Number of News Articles, and Baidu Search

	(1)	(2)	(3)
VARIABLES	FERR1	News	Baidu search
Onelinesp	-1.646***	3.416***	6.540***
	(-5.595)	(7.608)	(6.366)
Boardsize	-0.130	0.146**	0.091
	(-1.551)	(2.381)	(0.418)
IndRate	0.412	1.041***	0.442
	(1.579)	(5.115)	(0.590)
Size	-0.107***	0.366***	0.920***
	(-8.251)	(34.800)	(26.542)
Top1	-0.258***	-0.277***	-1.318***
	(-3.110)	(-3.850)	(-5.023)
FirmAge	-0.053	-0.241***	2.243***
	(-1.139)	(-6.828)	(14.743)
Cash	-0.327***	0.349***	-0.255
	(-3.071)	(4.331)	(-0.844)
ROA	-7.255***	0.243**	-4.170***
	(-27.050)	(2.258)	(-9.192)
Growth	-0.313***	0.072***	-0.253***
	(-8.808)	(5.453)	(-5.108)
Leverage	0.035	0.151***	-0.192
	(0.356)	(2.718)	(-0.885)
Constant	4.074***	-2.134***	-11.803***
	(10.397)	(-6.784)	(-12.133)
Observations	21,754	34,971	34,971
R-squared	0.123	0.399	0.256
Industry FE	YES	YES	YES
Year FE	YES	YES	YES

5. Conclusion

Over the past decade, China's e-commerce sector has experienced rapid growth, exerting an increasingly significant influence on the capital markets. This paper empirically examines the impact of online sales on stock price volatility by analyzing online sales data from A-share listed companies between 2015 and 2024. The findings indicate that online sales can both promote and suppress sharp stock price fluctuations, with the suppressing effect being more pronounced. Heterogeneity analysis reveals that the integration of executive and supervisory roles weakens the suppressing effect of online sales on sharp stock price fluctuations, while an increase in the separation rate of executive and supervisory roles weakens the promoting effect of online sales on such fluctuations. Mechanism

analysis reveals that online sales promote extreme stock price volatility by releasing false signals through increased media coverage and Baidu search volume, while simultaneously enhancing information transparency by improving the quality of corporate financial disclosures, thereby effectively mitigating such volatility. The logic of this study is that online sales can suppress extreme stock price volatility by enhancing information transparency, yet they can also promote such volatility by increasing abnormal fluctuations in sales data. The findings of this study have the following implications: First, they provide supplementary evidence for the positive role that online sales play in enhancing the efficiency of information allocation in capital markets. Second, for regulators, this study enriches understanding of the economic consequences of online sales activities, offering theoretical references and a basis for decision-making to further guide investors toward rational investment and establish reasonable disclosure standards. Third, for investors, this study helps them view short-term fluctuations in online sales data rationally and make more effective investment decisions.

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