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Article

Market Effects of Price Limits in the Chinese Stock Market: Evidence from the Shanghai, Shenzhen, and Beijing Stock Exchanges

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Abstract

Price limits represent an important trading mechanism in China's capital market and have undergone continuous adjustments while playing a crucial role in market operations. However, the effectiveness of the price limit system has long been subject to theoretical debate and empirical controversy in the literature.Using A-share main-board stocks listed on the Shanghai,Shenzhen, and Beijing Stock Exchanges from October 2020 to May 2025 as the research sample,this paper systematically examines three major hypotheses associated with price limit regulations:the volatility spillover effect,the trading interference effect, and the delayed price discovery effect. The empirical results show that when stocks hit the lower price limit,significant volatility spillover effects are observed in both the Shanghai and Shenzhen Stock Exchanges,whereas this effect is not statistically significant when stocks reach the upper price limit, indicating a clear asymmetry in volatility spillovers.The trading interference effect is strongly supported across all three exchanges. In addition, the delayed price discovery effect is significantly present in the Shanghai and Shenzhen markets but cannot be verified in the Beijing Stock Exchange.These findings contribute to a deeper understanding of the functioning of price limit mechanisms in different market environments and provide empirical evidence and theoretical insights for policy evaluation and potential institutional reforms of the price limit system.

Keywords: Price limits; Volatility spillover effect; Trading interference effect; Delayed price discovery

1. Introduction

The price limit system is one of the most important price control mechanisms in financial markets. By pre-specifying a daily trading band for asset prices, the mechanism restricts quotations or suspends trading once prices reach or exceed the predetermined limits,thereby aiming to curb excessive market volatility (Gu et al., 2022). Since the establishment of China's stock market in the early 1990s, the price limit system has been introduced simultaneously and has served as an important institutional arrangement for maintaining price stability in the market.

With the continuous development of the securities market,the price limit system has undergone several policy adjustments.It has gradually evolved from a strictly unified restriction standard in the early stages to a differentiated arrangement tailored to the characteristics of different market segments.For example,the main boards of the Shanghai and Shenzhen Stock Exchanges implement a ±10% daily price limit, the ChiNext board applies a ±20% limit, and the Beijing Stock Exchange adopts a ±30% limit.This institutional evolution reflects the regulatory authorities' effort to strike a prudent balance between maintaining market stability and preventing systemic risks,while simultaneously improving market efficiency and enhancing market vitality.

Although the price limit system was originally established to stabilize the market by curbing excessive stock price volatility, academic circles have long debated the necessity and effectiveness of such measures.On one hand, proponents argue that in emerging markets characterized by inadequate information disclosure, high levels of corruption, and inefficient rule-of-law regulation, price limits can function as a price stabilizer, reducing the risk of market disorder caused by panic selling or irrational chasing of rising prices (Deb et al., 2010). This view is supported by empirical studies on China's early stock market, which found that introducing price limits helped curb abnormal stock price volatility and promote market stability to some extent (Kim et al.,2013). From a trading mechanism perspective, price limit systems are considered to mitigate transaction initiation risk—the time lag between order placement and execution during stock trading. When asset prices fluctuate continuously, implementing price limits effectively provides investors with a predictable maximum loss boundary, thereby achieving a Pareto improvement in risk sharing (Kodres&O'Brien,1994). Furthermore, behavioral studies have supplemented these explanations, suggesting that when prices hit limits, the forced slowdown in trading allows market participants time to regain rationality and digest information, thereby reducing excessive reactions to information shocks (Wu et al.,2003).Conversely, as research on market microstructure deepens, increasing numbers of scholars have questioned the efficacy of price limit systems. Existing literature indicates that price limits may distort the price formation process, impede the normal functioning of market mechanisms, and lead to market inefficiency. A seminal study using the Tokyo Stock Exchange as a sample systematically validated three major effects of price limit systems: volatility spillover, trading disruption, and delayed price discovery (Kim&Rhee,1997). Additionally, scholars analyzing high-frequency trading data from the Taiwan Stock Exchange observed that price limits induce a magnetic effect:stock prices accelerate toward the limit when approaching the upper or lower bounds, paradoxically amplifying volatility(Cho et al.,2003). Furthermore,studies examining the temporal dimension suggest that price limit systems intensify price volatility in the short term but exhibit negligible effects over the long term (Tang, 2023).

Amidst the numerous controversies surrounding price limit systems, this paper focuses on three classic market effects potentially triggered by daily price fluctuation limits—volatility spillover, trading disruption, and delayed price discovery—and conducts an in-depth analysis of them. These three effects demonstrate how daily price limits, as a market stabilization intervention, may actually become factors that reduce efficiency in practice. As a typical emerging market, China's stock market features a high proportion of retail investors, strong policy sensitivity, and volatile market sentiment. These characteristics may amplify or alter the manifestation of the three effects. Therefore, this paper will thoroughly examine the practical effects of China's price limit system, providing scientific grounds for regulatory authorities to optimize the system.

2. Research Design

2.1 Data Sources and Sample Selection

This study aims to examine the implementation characteristics and market effects of the price limit system in China's stock market. Considering that the ChiNext market adjusted its price limit rules in August 2020 and that special treatment (ST) stocks on the main boards were subject to regulatory adjustments in June 2025, institutional changes across different market segments and time periods may generate spillover effects on market behavior, thereby interfering with the accurate identification of the market effects of price limits. To mitigate this potential interference, the sample period is set from October 2020 to May 2025.

The study focuses on main-board stocks listed on the Shanghai Stock Exchange (SSE), Shenzhen Stock Exchange (SZSE), and Beijing Stock Exchange (BSE).These three exchanges differ in terms of listing mechanisms, liquidity conditions, and investor composition. Incorporating them within a unified analytical framework allows for a comparative assessment of how the price limit system operates under different market environments.In addition, since the Beijing Stock Exchange was officially established in November 2021,the market experienced an initial adjustment period after its launch. To avoid potential distortions associated with the early stage of market operation, the sample period for the BSE is set from January 2022 to May 2025.

Following the sample screening procedure adopted by Luo(2017)9, several filters are applied. First, to eliminate the potential low-price stock effect, stocks with prices below RMB 1 are excluded from the sample. Second, to maintain consistency in the analysis of price limits across the three exchanges, observations involving stocks under abnormal trading conditions—such as special treatment (ST) stocks and suspended stocks—are removed. Furthermore, observations from the first trading day after listing and the first five trading days following the IPO, during which special price limit rules apply, are also excluded.

After applying these screening criteria, the final sample consists of 1,107 stocks listed on the Shenzhen Stock Exchange, yielding 1,196,827 daily observations; 1,370 stocks listed on the Shanghai Stock Exchange, yielding 1,467,918 daily observations; and 266 stocks listed on the Beijing Stock Exchange, yielding 159,710 daily observations. All data are obtained from the CSMAR database, including key variables such as the opening price, closing price, daily price change, and turnover rate.

2.2 Research Methodology

This paper adopts the classical research framework proposed by Kim and Rhee (1997), while incorporating the specific characteristics of the price fluctuation limit system implemented across China's three major stock exchanges. It systematically examines the volatility spillover effect, trading interference effect, and price discovery delay effect under the price fluctuation limit system. Following the approach of Xiao(2024), we use the closing price of a stock as the event-based criterion for determining whether it reached the daily limit. To construct a reasonable counterfactual comparison and mitigate sample selection bias, this study introduces stocks that "approached but did not reach the daily limit" as a control group, defined as follows:

$$Treatment\ group = \begin{cases} \frac{P_{i,t}-P_{i,t-1}}{P_{i,t-1}}/limitratio \geq 100\%,\ upward\ price\ movement \\ \frac{P_{i,t}-P_{i,t-1}}{P_{i,t-1}}/limitratio \leq -100\%,\ downward\ price\ movement \end{cases} \tag{1}$$

$$control\ group = \begin{cases} 90\%(80\%) \leq \frac{P_{i,t}-P_{i,t-1}}{P_{i,t-1}}/limitratio < 100\%(90\%),\ upward\ price\ movement \\ 100\%(-90\%) < \frac{P_{i,t}-P_{i,t-1}}{P_{i,t-1}}/limitratio \leq -90\%(-80\%),\ downward\ price\ movemen \end{cases} \tag{2}$$

$$limitration = \begin{cases} 10\%,\ if\ Stock_i\ is\ listed\ on\ the\ SSE\ or\ SZSE\ main\ board(non-ST) \\ 30\%,\ if\ Stock_i\ is\ listed\ on\ the\ BSE\ main\ board \end{cases} \tag{3}$$

In the above expression, $P_{i,t}$ denotes the closing price of stock i on day t, while$P_{i,t-1}$ refers to the closing price of stock i on day t−1, by measuring the ratio of the day's price change to the daily fluctuation limit, this metric quantifies the relative position of a stock's price movement against its price fluctuation cap. This paper categorizes the control group based on the proximity of closing prices to the limit into two categories: 90%-100% (Control Group1) and 80%-90% (Control Group2).This design aims to distinguish whether market effects stem from the limit system itself rather than the magnitude of price movements. Stocks in both control groups exhibit high similarity to limit-hit stocks in terms of information shock intensity,market sentiment, and trading environment,yet remain unconstrained by direct price restrictions.This allows for the identification of market effects attributable solely to the price limit system itself.

In the construction of the event window, the day on which a stock hits the price limit is defined as the event day (Day 0). The analysis then examines the changes in stock price behavior over several trading days surrounding the event day.

In the empirical analysis, the control group consists of stocks whose price changes on the same trading day approach the price limit but do not actually reach it. These observations are used as benchmark samples for the final empirical tests.

Regarding sample treatment, this study follows the differential processing approach proposed by Kim and Rhee (1997). When analyzing the volatility spillover effect and the trading interference effect, observations involving consecutive price limit events over multiple trading days are excluded. This procedure avoids repeatedly counting the same information shock within the event window, which could otherwise lead to systematic bias in the estimation results.

In contrast, when examining the delayed price discovery effect, consecutive price limit events are retained in the sample. This approach allows the analysis to more comprehensively capture the dynamic process through which stock prices adjust toward their equilibrium level under persistent price constraints.

2.2.1 Testing Method for Volatility Spillover Effect

The volatility spillover hypothesis emphasizes that price limit systems suppress price adjustments to information shocks on event days, causing some unrealized price fluctuations to be deferred and released in concentrated bursts on subsequent trading days, leading to abnormal post-event volatility spikes. Therefore, if price limits generate a volatility spillover effect, stocks hitting limit-up or limit-down levels should exhibit higher price volatility in subsequent trading sessions. Regarding the testing methodology, the event window is defined as the ten trading days preceding the event day (Day −10 to Day −1) and the ten trading days following the event day (Day +1 to Day +10). Together with the event day itself (Day 0), the event window spans a total of 21 trading days. This specification allows for a clearer observation of the dynamic changes in price volatility surrounding the event.The core focus of this study's volatility spillover effect test is: following a limit-up/limit-down event (Day1, Day2, ...), whether stocks that hit the limit (treatment group) exhibit sustained volatility increases, and whether this volatility level is significantly higher than that of stocks without price restrictions but facing comparable information shocks (control group). Accordingly, the core methodology for testing this effect involves comparing whether systematic differences exist in volatility between the event control group and the treatment group. Stock price volatility is measured using the squared daily return. $\mathrm{Close}_{\mathrm{i,t}}$ and $\mathrm{Close}_{\mathrm{i,t-1}}$ denote the closing prices of stock i on day t and day t−1, respectively. The volatility of stock i on day t ($V_{i,t}$) is defined as scaled squared returns,which facilitates clearer presentation and comparison across observations. The calculation is as follows:

$$V_{i,t} = (\frac{Close_{i,t}}{Close_{i,t-1}} - 1)^2 \times 1000 \tag{4}$$

In the above calculation, volatility measures for stocks in both the treatment and control groups are cross-sectionally averaged within the event window. The differences in average volatility between the two groups are then compared for each trading day after the event. If the treatment group exhibits significantly higher volatility than the control group for several days following the event, this suggests that the price limit delays the adjustment of volatility over time, indicating the presence of a volatility spillover effect.

To further test this effect, a nonparametric Mann–Whitney U test (Wilcoxon rank-sum test) is conducted to examine whether the volatility distributions of the treatment and control groups differ significantly during the event window. Since this method does not rely on the assumption of normality, it provides a robust comparison of the two samples in terms of their medians and overall distributions, and is therefore well suited for detecting short-term changes in volatility or trading activity induced by the event.

2.2.2 Testing Method for Trading Interference Effect

Trading interference effects essentially constitute an intervention in market liquidity. Price fluctuation limits may interfere with normal trading order, preventing investors from completing transactions on the day an information shock occurs. Consequently, some investors' trading demands are deferred until the trading day following the removal of restrictions, where they are released in a concentrated manner. To test this characteristic, the event window period is defined as the five trading days preceding and following the event date (Day 0), totaling 11 trading days (Day -5 to Day 5). A shorter event window facilitates capturing the short-term suppression and delayed release of investor trading behavior triggered by the event. An excessively long window may introduce extraneous market volatility or trading behavior noise unrelated to the event. In empirical calculations, the transaction interference indicators for both the treatment group and control group are similarly cross-sectionally averaged. The differences in average trading activity between the two groups across each trading day following the event are then compared. The test for transaction interference effects focuses on performance on the day following the event (Day 1). If the treatment group exhibits significantly higher trading activity than the control group on Day1, it indicates that trading delayed by the price limit was released the following day. In contrast, the control group completed its trading activity on the event day since it did not hit the price limit. In summary, the sustained trend of changing trading activity in the treatment group after the event day (Day0) directly reflects the trading disruption effect. The measurement of trading interference employs the relative change rate of turnover, defined as follows:

$$dTA_{i,t} = (ln(TA_{i,t}) - ln(TA_{i,t-1})) \times 100 \tag{5}$$

Here, $\mathrm{TA}_{\mathrm{i,t}}$ denotes the turnover rate of stock i on day t, while $\mathrm{dTA}_{\mathrm{i,t}}$ represents the daily change in the turnover rate, capturing the variation in trading activity relative to the previous trading day. To examine the trading interference effect,the same nonparametric Mann–Whitney U test (Wilcoxon rank-sum test) used in the volatility spillover analysis is applied to test whether the distributions of trading activity differ significantly between the treatment group and the control group during the event window.

2.2.3 Testing Method for Delayed Price Discovery Effect

The delayed price discovery effect suggests that the process of price discovery may be temporarily interrupted by the presence of price limits. When a stock reaches the price limit, the adjustment of prices toward their equilibrium level is suspended and resumes only on the trading day following the event. In other words, price limits hinder the immediate incorporation of new information into prices, causing the price movement observed on the event day to continue into subsequent trading periods.

Unlike the testing approaches used for the volatility spillover effect and the trading interference effect, the delayed price discovery effect is examined by analyzing the sign combinations of intraday returns on the event day (Day 0) and overnight returns following the event day. This approach provides a concise way to capture how prices respond to event-related information.

The returns are calculated as follows. The intraday return (from the opening price to the closing price on the event day) is defined as:$\mathrm{R}_{\mathrm{oc,t}} = \mathrm{Close}_{\mathrm{t}}/\mathrm{Open}_{\mathrm{t}} - 1$;and the overnight return (from the closing price on the event day to the opening price on the next trading day) is defined as:$\mathrm{R}_{\mathrm{co,t}} = \mathrm{Open}_{\mathrm{t+1}}/\mathrm{Close}_{\mathrm{t}} - 1$.The calculated returns may take positive, negative, or zero values, which are represented by the symbols“+”、“-”、“0”respectively. Based on the sign combinations of [$\mathrm{R}_{\mathrm{oc,t}}$， $\mathrm{R}_{\mathrm{co,t}}$], stock price behavior is classified into three categories: continuation, reversal, or no change.

When prices rise on the event day, the combinations [+，+]、[0，+] indicate price continuation,[+，-]、[0，-]indicate price reversal, and[+，0]、[0，0] indicate no price change.Conversely, when prices decline on the event day, the combinations [-，-]、[0，-]

represent price continuation,[-，+]、[0，+]represent price reversal, and[-，0]、[0，0]represent no price change. These sign combinations are used to determine whether delayed price discovery occurs.

The empirical test focuses on comparing the probability of delayed price adjustment between the treatment group and the control group following the event day. If the probability of delayed price discovery in the treatment group is significantly higher than that in the control group, the hypothesis that price limits lead to delayed price discovery is supported.

In addition, the two-sample binomial test is employed to statistically examine the delayed price discovery effect. Specifically, the proportions of different price behavior patterns(continuation, reversal, and no change)are compared between the treatment and control groups to assess whether the differences are statistically significant.

3. Empirical Analysis

3.1 Descriptive Statistics

Based on main board stock data from various exchange markets between October 2020 and May 2025, this study categorizes stocks that hit price limits (treatment group) and two groups of stocks approaching price limits (control group) into rising and falling scenarios based on price movement direction. It then calculates the frequency of price fluctuation events across different exchanges. Table 1 report the distribution of various events for the Shenzhen Stock Exchange (SZSE), Shanghai Stock Exchange (SSE), and Beijing Stock Exchange (BSE), respectively. Results indicate that the SZSE and SSE recorded 16,716 and 16,704 limit-up/down events respectively, with limit-up occurrences at 13,253 and 13,269—significantly higher than limit-down events. Both exchanges exhibited highly similar distributions of limit-up/down occurrences. The Beijing Stock Exchange, implementing a relatively broad 30% price fluctuation limit, recorded only 157 limit-up/limit-down events, far fewer than the Shanghai and Shenzhen exchanges. Despite institutional differences among exchanges, they all exhibit a common characteristic: the frequency of price increases exceeds that of price decreases. This phenomenon aligns with findings in existing literature (Hu, 2007). This phenomenon further reflects that in China's stock market, dominated by retail investors, trading behavior exhibits characteristics of “believing rumors and chasing rallies while selling on dips” (Wu Chonglin et al., 2021).

Table 1. Frequency of Price Limit Hits and Near-Limit Events on the Shenzhen,Shanghai and Beijing Stock Exchanges

	SZSE			SSE			BSE		
	upward	downward	sum	upward	downward	sum	upward	downward	sum
Treat	13253	3463	16716	13269	3435	16704	155	2	157
Control1	9391	5574	14965	9336	5728	15064	780	17	797
Control2	2735	3004	5739	3266	3149	6415	168	72	240

3.2 Volatility Spillover Effect

The empirical results for the volatility spillover effect across different exchanges within the event window [−10, +10] are reported in Table 2.

Table 2. Volatility Comparison on the Shenzhen Stock Exchange

	Upward Price Movement			Downward Price Movement		
Day	Treat	Control1	Control2	Treat	Control1	Control2

-10	1.62	>	1.53	>>	1.24	1.92		1.86		1.87
-9	1.64		1.62		1.34	3.64		3.63	>>	3.03
-8	1.73		1.73		1.65	2.87	>>	2.54	>>	2.06
-7	1.71		1.65	>>	1.21	2.52	>	2.40	>>	2.03
-6	1.86		1.78		1.47	2.47		2.47	>>	2.06
-5	1.87	>	1.80	>>	1.17	2.76		2.66	>>	2.13
-4	2.07		2.05		1.52	2.57		2.62		2.17
-3	2.21	<<	2.71	<<	2.18	3.54	>	3.34	>>	2.61
-2	2.26		2.39		2.01	4.42	>	4.13	>>	3.06
-1	2.25	<<	2.93		2.33	4.01		3.84	>>	3.14
0	10.05	>>	9.78	>>	7.14	10.04	>>	9.54	>>	7.19
1	3.38		3.46	>>	1.79	3.50	>>	2.98	>>	2.11
2	2.82		2.87	>>	1.53	2.32	>	2.11	>>	1.71
3	3.10		3.06	>>	1.74	2.77	>>	2.42	>>	1.82
4	2.80		2.83	>>	1.71	1.90	<<	1.95		1.77
5	2.81		2.81	>>	1.42	2.12	>>	1.86	>>	1.71
6	2.54		2.46	>>	1.36	1.74		1.66	>>	1.46
7	2.29		2.30	>>	1.46	1.68	>	1.52	>>	1.38
8	2.15		2.23	>>	1.48	1.32	<	1.43		1.36
9	2.07	<<	2.34		2.43	1.26		1.29	>	1.28
10	2.01		1.90	>>	1.30	1.14	<<	1.33	<<	1.30

* The Mann–Whitney U test (Wilcoxon rank-sum test) is employed to compare the distributions of the variables between the treatment group (treat) and the two control groups (control1 and control2). This non-parametric test does not rely on the normality assumption and evaluates whether the median ranks of the two independent samples differ significantly. Symbols ">>" and ">" denote that the median value of the treatment group is significantly higher than that of the corresponding control group at the 1% and 5% levels, respectively; "<<" and "<" denote significantly lower medians at the 1% and 5% levels. A blank cell indicates that the difference is statistically insignificant. The same applies to the tables below.

Table 3. Volatility Comparison on the Shanghai Stock Exchange

	Upward Price Movement					Downward Price Movement				
Day	Treat		Control1		Control2	Treat		Control1		Control2
-10	1.52		1.46	>>	1.22	1.58	<<	1.77	<<	1.74
-9	1.57		1.56		1.36	3.50		3.38		3.07
-8	1.61		1.66		1.60	2.81	>>	2.49	>>	1.95
-7	1.59	>	1.56	>>	1.17	2.49		2.31	>>	2.02
-6	1.73	<	1.77		1.40	2.39		2.29	>>	1.99
-5	1.74		1.74	>>	1.11	2.67		2.51	>>	2.03
-4	2.01	<	2.11		1.62	2.75	>>	2.45	>>	2.15
-3	2.18	<<	2.57		1.93	3.61	>>	3.18	>>	2.41

-2	2.19	<	2.35		1.94	4.47	>>	3.83	>>	3.09
-1	2.17	<<	2.77		2.15	3.87		3.64	>>	2.98
0	10.05	>>	9.76	>>	7.13	10.03	>>	9.56	>>	7.17
1	3.30		3.34	>>	1.80	3.21	>>	2.80	>>	1.94
2	2.85		2.86	>>	1.44	2.12		1.95	>>	1.58
3	2.94		2.91	>>	1.69	2.63	>>	2.34	>>	1.60
4	2.80		2.86	>>	1.62	1.88		1.77		1.73
5	2.72		2.68	>>	1.52	2.03	>>	1.77	>>	1.70
6	2.39		2.38	>>	1.42	1.80		1.58	>>	1.45
7	2.14		2.17	>>	1.42	1.58	>>	1.43	>>	1.26
8	2.08		2.05	>>	1.49	1.38		1.22		1.26
9	1.98	<<	2.26		2.35	1.19		1.20	>>	1.11
10	1.89	>>	1.83	>>	1.26	1.25		1.23		1.14

Table 4. Volatility Comparison for Price Increases on the Beijing Stock Exchange

Day	Treat		Control1		Control2
-10	4.75		8.70	>	3.88
-9	10.02		8.62		3.27
-8	10.06		11.81		15.18
-7	7.90		5.47		5.58
-6	5.61		7.20		7.37
-5	7.17		8.36		8.84
-4	6.41		7.77		7.51
-3	10.01		11.36	<	9.29
-2	16.81		11.80		14.85
-1	14.65		9.02		11.70
0	202.52	>>	88.40	>>	63.80
1	24.45		21.33		15.56
2	13.50		12.87		9.76
3	15.24		16.70		7.58
4	13.83		12.94	>>	7.10
5	10.31		11.41		12.12
6	8.07		8.94	>	6.58
7	7.90		6.44	>	4.54
8	12.05		11.14		14.32
9	7.36		7.27		7.25
10	6.56		7.69		5.44

* Lower price-limit events on the Beijing Stock Exchange are extremely rare during the sample period (January 2022-May 2025). Consequently, the limited number of observations does not allow reliable identification of the three market effects examined in this study. Therefore, only the market effects associated with upper price-limit events are reported.

The empirical results reported in Tables 2–4 show that the volatility of all groups reaches its peak on the event day (Day 0) when the upper or lower price limit is hit. Notably, the volatility level of the treatment group is substantially higher than that of the two control groups. This finding suggests that the price limit mechanism artificially interrupts the continuous process of price discovery on the event day, forcing price adjustments that would otherwise have been completed within the same trading day to spill over into subsequent trading days, thereby amplifying volatility. In addition, the volatility patterns observed on the Shenzhen Stock Exchange and the Shanghai Stock Exchange exhibit a high degree of consistency, which may stem from the institutional similarity between the two markets in terms of price limit rules and trading mechanisms.This finding is consistent with the argument that price limits may delay the incorporation of information into prices and generate subsequent volatility spillovers.

Further examination of the trading days following the price-limit events reveals that, under upward price movements, the volatility of the treatment group on the Shanghai and Shenzhen Stock Exchanges does not differ significantly from that of Control Group 1 during Day 1–Day 10. In contrast, under downward price movements, the volatility of the treatment group remains significantly higher than that of both control groups in the days following the event. This pattern indicates a persistent volatility spillover effect. Therefore, the volatility spillover effect in the Shanghai and Shenzhen markets exhibits clear asymmetry across different price directions.

Table 4 reports the volatility comparisons for the Beijing Stock Exchange (BSE) following price limit events. Overall, in the trading days after the event, the volatility differences between the treatment and control groups are not statistically significant, providing no sufficient evidence of a pronounced volatility spillover effect in the BSE. Compared with the 10% price limits in the Shanghai and Shenzhen Stock Exchanges, the wider 30% limit in the BSE allows greater room for price adjustment, making it more likely that information shocks are absorbed within the event day and thereby reducing the likelihood that price adjustments spill over into subsequent trading days.

It should be noted that downward limit events on the BSE are extremely rare during the sample period. As a result, the statistical inference for negative price movements is limited, and the conclusions regarding the BSE price limit system are primarily based on the overall sample and positive price shocks. Therefore, interpretations concerning downward shocks should be treated with caution. Overall, while persistent volatility spillover effects are observed in the Shanghai and Shenzhen Stock Exchanges under downward price movements, no statistically significant evidence of such an effect is found in the BSE sample.

3.3 Trading Interference Effect

The event window for the trading disturbance effect spans 11 trading days, encompassing the five days preceding and following the event date. Empirical tests reveal the trading activity patterns across the three major exchanges during both price increases and decreases, as shown in the tables below:

Table 5. Trading Activities on the Shenzhen Stock Exchange

	Upward Price Movement					Downward Price Movement				
Day	Treat		Control1		Control2	Treat		Control1		Control2
-5	-42.97		-40.94	>>	-48.32	-15.26		-14.26		-13.20
-4	-13.28	<	-11.83		-11.62	12.70		11.51		8.07
-3	-11.87	<<	-8.04	<<	-2.71	16.78	<<	9.25	<<	4.21
-2	1.71	<	2.67	<<	5.44	10.13		10.93		9.18

-1	3.11		3.52		2.70	20.71		22.62	<<	15.23
0	41.74		43.46	<<	54.37	2.69	<<	12.92	<<	20.93
1	36.83	>>	26.82	>>	-20.77	5.23	>>	-10.12	>>	-29.71
2	-20.22	<<	-19.36	<<	-20.09	-9.90		-10.21	>	-8.21
3	-0.04		-0.95	>>	-10.60	-11.05	>>	-13.51	>>	-16.26
4	-13.70		-15.52	<<	-12.97	-13.06	<<	-9.81	<<	-3.93
5	-13.14	<	-11.13	<<	-8.99	-6.74		-8.27		-7.41

Table 6. Trading Activities on the Shanghai Stock Exchange

	Upward Price Movement					Downward Price Movement				
Day	Treat		Control1		Control2	Treat		Control1		Control2
-5	-44.02		-41.67	>	-46.04	-20.41	<	-14.63		-16.12
-4	-12.92		-11.04		-9.64	11.80	<	8.41	<<	4.96
-3	-11.62		-12.45		-11.36	13.80		9.51	<<	5.84
-2	2.32		2.91	<<	6.22	9.76		12.33		8.44
-1	3.92		3.37		3.12	25.34		21.57	>>	17.22
0	46.32	<	48.44	<<	61.93	3.06	<<	14.24	<<	23.02
1	33.28	>>	21.98	>>	-21.20	6.72	>>	-9.72	>>	-30.21
2	-20.89	<<	-19.94	<<	-19.36	-10.90		-10.06		-10.77
3	-0.32		-1.22	>>	-10.47	-11.55	>	-13.92	>>	-15.26
4	-15.68	<<	-15.12	<<	-13.33	-12.34		-11.28	<<	-7.68
5	-13.09	<	-11.93	<<	-11.22	-7.50		-7.80	<	-5.00

Table 7. Trading Activity of Stocks Rising on the Beijing Stock Exchange

Day	Treat		Control1		Control2
-5	-31.51		-47.30	>>	-84.43
-4	-8.09		-10.71		-0.30
-3	9.22		7.48		28.02
-2	7.21		3.51		26.18
-1	13.17		18.51		16.60
0	60.16	<<	79.74		66.38
1	17.24	>>	10.19	>>	-20.81
2	-22.68		-25.45		-23.48
3	-4.68		-10.84	>	-17.78
4	-17.74		-17.30		-15.54
5	-18.13		-16.96		-11.51

The results reported in Tables 5–7 show that on the event day (Day 0), trading activity increases sharply when prices rise. This pattern indicates that positive information shocks trigger strong momentum-chasing behavior and herding among investors in the Chinese stock market, which is dominated by retail investors, leading to substantial trading demand from both buyers and sellers. In contrast, when prices decline, the Shanghai and Shenzhen Stock Exchanges exhibit extremely low trading activity. This phenomenon can be explained by the sharp increase in queued sell orders when stock prices approach the lower price limit, while buyers remain relatively inactive. As a result, the buy-side demand is insufficient to absorb the accumulated sell orders, leading to very limited actual trading volume.Furthermore, the treatment group(stocks that hit the price limits)generally exhibits significantly lower trading activity on the event day (Day 0) than the two control groups. This finding provides direct evidence that the price limit mechanism suppresses investors' willingness to trade and interferes with normal trading activity.

Further examination of the post-event dynamics reveals that on the day following the event (Day 1), the treatment group consistently shows significantly higher trading activity than both control groups across all three exchanges, regardless of the direction of price movement. The key to identifying the trading interference effect lies in the trading behavior on the day after the event. If trading activity in the treatment group is significantly higher than that in the control groups on Day 1, it suggests that trading demand suppressed on the event day is released once the price constraint is relaxed. This concentrated release of pent-up trading demand results in persistently elevated trading activity on Day 1, thereby supporting the trading interference hypothesis.

Overall, the empirical results presented in the tables indicate that the trading interference effect exists across all three Chinese stock exchanges—the Shanghai, Shenzhen, and Beijing Stock Exchanges. The price limit mechanism prevents investors from updating prices through actual transactions, leading to a simultaneous freeze in both price movement and trading activity, which ultimately hinders the price discovery process.

3.4 Delayed Price Discovery Effect

Unlike volatility spillover and transaction disruption effects, the price discovery delay effect emphasizes that institutional constraints prevent prices from fully adjusting to equilibrium levels on the event day, forcing the price discovery process to continue in subsequent trading sessions. Identifying this effect relies more heavily on the transaction termination status implied by the closing price and subsequent overnight return performance.

Table 8. Percentage Distribution of Price Change Directions on the Shenzhen and Shanghai Stock Exchanges

	SZSE				SSE			
	Treat	Control1	Control2	Z-statistic	Treat	Control1	Control2	Z-statistic
Upward Price Movement								
Continuation	34.19%	31.35%	27.12%	4.45***	37.38%	32.02%	26.90%	8.29***
Reversal	52.69%	56.66%	68.65%	-5.91***	49.63%	55.40%	68.06%	-8.54***
No Change	13.12%	11.99%	4.23%	2.52**	12.99%	12.59%	5.04%	0.86
Downward Price Movement								
Continuation	40.80%	34.80%	29.41%	5.74***	40.93%	35.94%	29.62%	4.76***
Reversal	49.52%	57.38%	64.38%	-7.27***	47.77%	55.33%	65.16%	-7.01***
No Change	9.67%	7.82%	6.21%	3.05***	11.30%	8.72%	5.22%	4.03***

* This table reports the Z-statistic for the treatment group versus control group 1 based on a binomial distribution test comparing two populations. "***", "**", and "*" indicate significance at the 1%, 5%, and 10% levels, respectively, for the treatment group versus control group 1. The same applies to the tables below.

Table 9. Percentage Distribution of Price Change Directions on the Beijing Stock Exchange

	BSE			
	Treat	Control1	Control2	Z-statistic
		Upward Price Movement		
Continuation	39.61%	34.11%	18.30%	1.31
Reversal	53.25%	59.04%	81.05%	-1.33
No Change	7.14%	6.85%	0.65%	0.13
		Downward Price Movement		
Continuation	50.00%	26.67%	4.23%	0.68
Reversal	50.00%	66.67%	95.77%	-0.46
No Change	0.00%	6.67%	0.00%	-0.38

Tables 8 and 9 present the probabilities of price continuation, price reversal, and no price change for both the treatment and control groups across the three major exchanges under upward and downward price movements, along with the Z-statistics from two-sample binomial tests comparing the treatment group with Control Group 1 for stocks hitting the daily price limit. The test results indicate that there is no significant difference between the treatment and Control Group 1 on the Beijing Stock Exchange, suggesting the absence of a price discovery delay effect in this market. In contrast, for the Shanghai and Shenzhen Stock Exchanges, regardless of whether stock prices increased or decreased, the probability that stocks hitting the price limit (treatment group) continue to move in the same direction on the next trading day is significantly higher than that of stocks approaching but not fully reaching the limit (Control Group 1), while the probability of price reversal is significantly lower. Further examination reveals that as the distance between the closing price and the daily limit widens (Control Group 2), the probability of price continuation gradually decreases, whereas the probability of reversal increases noticeably. These findings provide direct evidence that the price limit mechanisms on the Shanghai and Shenzhen exchanges delay the price discovery process, causing information-driven price adjustments to be postponed to the following trading day. Notably, although price reversals occupy a relatively high proportion in absolute terms, this does not negate the existence of a price discovery delay effect. The essence of the delay lies in the constraint imposed by price limits, which prevents asset prices from fully adjusting to their equilibrium within a single trading day, thereby deferring part of the price discovery process to subsequent sessions.

In summary, the price discovery delay effect is supported on the Shanghai and Shenzhen Stock Exchanges, while no evidence of such an effect is observed on the Beijing Stock Exchange.

4. Conclusions

Based on empirical tests across China's three major stock exchanges, this study systematically evaluates the market effects of price fluctuation limits in actual operation. By comparing two sample groups,stocks that hit the daily limit versus those that approached but did not hit the limit,across volatility, trading activity, and price direction metrics, the research draws the following conclusions:

First, the volatility spillover effect exhibits a certain degree of asymmetry with respect to the direction of stock price movements. Specifically, this effect appears to be more pronounced during price declines in the Shanghai and Shenzhen Stock Exchanges, while no statistically significant evidence is observed under price increase scenarios.

Second, the trading disruption effect is verifiable across all three major Chinese exchanges. Regardless of price direction, stocks hitting the limit on the day of the event exhibit significantly higher trading activity the following day compared to the control group of stocks that approached but did not hit the limit. This indicates that the price limit system disrupts normal market trading behavior in China.

Third, the 10% limit implemented on the SSE and SZSE produces a significant price discovery delay effect, whereas this effect is not observed on the BSE, which has a 30% limit. Thus, stricter price limits hinder information absorption and price discovery processes, leading to delayed price discovery.

5. Policy Recommendations

Based on the empirical findings above, the following two recommendations are proposed to enhance the operational efficiency of China's stock market:

First, implement asymmetric price fluctuation limits. This study finds that volatility spillover effects on the Shanghai and Shenzhen exchanges primarily manifest during price declines. Strict limits during downturns may exacerbate investor panic, perpetuating negative information transmission. Therefore, appropriately relaxing downward limits could provide greater price discovery space during declines, enhancing efficiency.

Second, Moderately relax but do not abolish price fluctuation limits. China's stock market currently features a retail-investor-dominated structure and remains relatively immature. To stabilize the market, maintaining the price fluctuation limit system remains necessary. However, empirical results from the three major exchanges indicate that the 30% limit at the Beijing Stock Exchange only exhibits a trading interference effect. In contrast, the Shanghai and Shenzhen exchanges, which enforce a 10% limit, not only show trading interference but also volatility spillover and delayed price discovery effects. This suggests that appropriately relaxing the limits at the Shanghai and Shenzhen exchanges could enhance the market's ability to respond promptly to information, thereby improving overall information efficiency.

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