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ABSTRACT

Launched in 2014, the Shanghai-Hong Kong Stock Connect (SHSC) is the first mutual access channel between the Chinese and Hong Kong equity markets. The scheme allows Hong Kong and international investors to purchase eligible Shanghai-listed shares, while at the same time permitting eligible Chinese investors to purchase eligible Hong Kong-listed shares. This paper aims to examine the impact of the scheme on the effectiveness of the price limit rule, which is only imposed in China but not in Hong Kong. Results show that the scheme alleviates the delayed price discovery problem caused by price limits but has no significant effect on the problems of volatility spillover and trading interference.

1. Introduction

Since the economic revolution in 1979, the Chinese economy has gradually opened up to the world. There are two significant open-door policies specific to the stock market: the Qualified Foreign Institutional Investors (QFII) Scheme in 2013 and the Shanghai-Hong Kong Stock Connect (SHSC) in 2014. While the QFII regime allows qualified foreign investors to invest in Chinese stock markets, which were open only to domestic investors before, SHSC further opens up the market and allows all Hong Kong and international investors to invest in qualified Shanghai-listed shares.

Despite its rapid development in the past 40 years, the Chinese equity market remains relatively new and is often considered less mature compared to developed equity markets such as those in the U.S. and Hong Kong. To protect inexperienced investors and serve as a market stabilization mechanism, daily price limits of 10% on regular stocks and 5% on stocks under special treatment have been in effect in Chinese stock markets since 1990. On the other hand, price limit regulations have never been implemented in Hong Kong. Given this intriguing fact, it would be interesting to see how the launch of SHSC, which ties the two equity markets much more closely, would impact on the effectiveness of China's price limit policy.

Intuitively, SHSC is expected to increase the effectiveness of China's price limit policy. Given the involvement of the more transparent Hong Kong market, information in the Chinese market should be transmitted more quickly, therefore helping the price limit to cut down excessive and panic trading arising from information asymmetry. On the other hand, the new bilateral investment channel may dampen the price limit's ability to reduce market volatility during turmoil by allowing non-domestic investors to inject capital during market booms and withdraw funds during market crashes. Besides, given the relatively small turnover of SHSC compared to the whole market, it is questionable whether the policy could have a significant impact on the effectiveness of the price limit.

This paper focuses on the impact of SHSC on price limit regulations in the Chinese stock market only. Despite the fact that Shenzhen-Hong Kong Stock Connect (SZSC), which is the first mutual access scheme between Shenzhen and Hong Kong stock markets, was subsequently launched in November 2016, the impact of SZSC is not studied because the available daily trading data on SZSC remain insufficient for proper analysis.

We divide the panel data into different groups and begin our research by first investigating the distribution of price limit hit events. Then, we perform a regression analysis to check and compare the security betas of stock groups, which measure the tendency for their returns to respond to swings in the market. Next, we calculate the abnormal return, volatility and trading activity of the groups. With these data, we examine the possible impact of SHSC on the effectiveness of price limits by testing three hypotheses: the volatility spillover hypothesis, the delayed price discovery hypothesis and the trading interference hypothesis.

The rest of the paper is organized as follows. Section 2 provides the background; Section 3 is the literature review; Section 4 describes the sample data; Section 5 states the methodology; Section 6 shows and discusses the empirical results; Section 7 concludes the paper.

2. Background

2.1 Shanghai-Hong Kong Stock Connect

A major change in the structure of the Chinese stock markets has been underway since the launch of SHSC. On April 10, 2014, the China Securities Regulatory Commission and the Securities and Futures Commission made a joint announcement to approve, in principle, the development of the pilot program to establish mutual access between the mainland Chinese and Hong Kong stock markets. Seven months later, the program was officially launched on November 17, 2014. SHSC provides a cross-boundary investment channel between the Shanghai and Hong Kong stock markets so that investors of each stock market can trade stocks listed on the other market through local clearing houses and brokers. This is a landmark event in the reform of the Chinese stock markets, as it relaxes restrictions and reshapes the financial structures of both Chinese and Hong Kong stock markets. For the first time, SHSC is able to provide a broad range of investors with a feasible, controllable and expandable channel for mutual market access between mainland China and Hong Kong, paving the way to the further opening up of the Chinese financial markets and RMB internationalization. This pilot program significantly increases the capital flow between Shanghai and Hong Kong stock markets in both directions, given that mainland Chinese investors have the opportunity to invest in the major companies listed in Hong Kong, while Hong Kong and international investors can access the Shanghai A-share market in a less restrictive manner than ever. This arrangement leads to both outward and inward financial market liberalization and enables intensive interactions between the Shanghai and Hong Kong stock markets.

With Northbound Trading, all Hong Kong and international investors are able to purchase eligible shares listed on the Shanghai Stock Exchange (SSE) through their local brokers; only certain stocks in the Shanghai A-share market are included in Northbound Trading. Other products like exchange-traded funds, B-shares and other securities are not included. This trading arrangement also includes all constituent stocks (which are reviewed from time to time) of the SSE 180 Index and the SSE 380 Index, as well as the SSE A-listed shares that are not included as constituent stocks of the above-mentioned indices but have corresponding H-shares listed on the Hong Kong Stock Exchange (SEHK) except those which are not traded in RMB and are under risk alert. The number of total eligible Northbound Trading securities was 570 as at October 31, 2017 (568 as at November 17, 2014).

On the other hand, for Southbound Trading, eligible Chinese mainland investors, institutional investors and individual investors who have RMB 0.5 million in their investment and cash accounts, can purchase eligible shares listed on SEHK via their own local brokers. Southbound Trading only includes the constituent stocks of the Hang Seng Composite Large Cap Index, constituent stocks of the Hang Seng Composite Mid Cap Index, together with all H-shares that are not included as constituent stocks of the aforementioned indices but have corresponding A-shares listed in Shanghai, except for Hong Kong shares not traded in Hong Kong dollars and H-shares which have shares listed and traded not in Shanghai. The number of total eligible Southbound Trading securities was 310 as at October 31, 2017 (268 as at November 17, 2014).

In the initial stage, trading under SHSC is subject to an annual aggregate quota, together with a daily quota. The Northbound Aggregate Quota and Daily Quota were set at RMB 300 billion and RMB 13 billion respectively, while the Southbound Aggregate Quota and

Daily Quota were set at RMB 250 billion and RMB 10.5 billion respectively. From August 16, 2016 onwards, both the Northbound Aggregate Quota and the Southbound Aggregate Quota were abolished. From May 1, 2018 onwards, the Northbound Daily Quota is increased to RMB 52 billion, and the Southbound Daily Quota is increased to RMB 42 billion. Since its launch in 2014, the average daily turnover of Northbound Trading has stayed relatively stable at around RMB 2–3 billion, constituting around 1% to 4% of the average daily turnover of SSE. In contrast, the average daily turnover of Southbound Trading has increased rapidly in the past few years from around HKD 0.465 billion in 2014, which is around 1% of the 2014 average daily turnover of SEHK, to around HKD 4.465 billion in 2017, which is around 7% of the 2017 average daily turnover of SEHK.

Obviously, the implementation of SHSC has provided a new channel for both international and Chinese investors to access both the Shanghai and Hong Kong stock markets. It provides new opportunities for Chinese investors to diversify their investment portfolios with Hong Kong-listed stocks. On the other hand, it also provides new opportunities for international investors to invest in RMB, as they do not need to own an account in China. These gradual steps towards comprehensive financial liberalization will continue to accelerate the integration of Chinese financial markets into the rest of the world.

2.2 Price Limit Rule

Price limits are literal boundaries set by authorities as a maximum range of upward and downward daily price movements. Therefore, setting price limits in the stock market is essentially a policy to restrict extreme daily security price movements and provide a cooling-off period for investors during panic trading. Today, such a mechanism has been widely adopted in countries such as Japan, Korea, Thailand and Malaysia. For instance, stocks listed on the Korea Composite Stock Price Index (KOSPI) are only allowed to rise or fall daily by up to 30% of their previous closing prices.

In 1990, the Chinese government first enacted the price limit policy for both upward and downward price movements to prevent the financial market from potentially causing social instability. The policy was once abolished in 1992 but resumed in December 1996. The policy allows the price of a stock to only move by ±10% of the closing price of the previous trading day. An exception is for newly listed stocks on their first public trading day or their first trading day after resumption, where ±20% price changes are allowed. Additionally, poor-performing firms will be assigned special treatment status, and a tighter price limit of ±5% daily will be imposed. In contrast to other countries where trading ceases after stocks hit the limits, SSE and SZSE allow trading to continue but only at prices within a specified range. If a stock hits its price limits for three consecutive days, it will be suspended for half a trading day until an explanation is provided.

As for the case of Hong Kong, price limit regulations have never been imposed in the stock market.

3. Literature Review

There is limited existing literature studying SHSC. Zhang and Jaffry (2015) explored the influence of SHSC on the one-minute intraday high frequency volatility spillover between the two markets using asymmetric BEKK-GARCH models. The results indicated that while there was no volatility spillover in the pre-connection period, strong bidirectional volatility spillover existed in the connected period. Huo and Ahmed (2017) used dynamic forecasting techniques to show that the implementation of SHSC increases the conditional volatility of both stock markets. Ruan et al. (2018) examined the effects of financial liberalization on stock market co-movement using both multifractal detrended fluctuation analysis (MF-DFA) and multifractal detrended cross-correlation analysis (MF-DCCA). The results confirmed that there was an increase in the efficiency of the Shanghai stock market after the implementation of SHSC and verified the existence of persistent cross-correlation between the Shanghai and Hong Kong stock markets, which became stronger after the launch of the program.

Rather than concentrating on the increased capital linkage between the two markets, Fan and Wang (2017) showed that SHSC can significantly reduce the A-H share premium for dual-listed companies in Shanghai and Hong Kong markets. Burdekin and Siklos (2018) suggested that, notwithstanding the relatively small scale of SHSC, the Northbound and Southbound cash flows have meaningfully affected the A-H share premium post November 2014. Wang and Chong (2018) performed confirmed that a substantial number of A-share and H-share stocks began to co-integrate after the launch of the Shanghai–Hong Kong Stock Connection Scheme1 and the Shenzhen–Hong Kong Stock Connection Scheme, which demonstrates the effects of the two schemes in promoting financial integration and cross-border capital flows.

In contrast, while there is a large amount of existing literature studying the price limit, the mechanism remains controversial. Proponents believe that price limits provide sufficient time for the identification of market information and the re-evaluation of the intrinsic value of stocks. Ma et al. (1989) argued that price limits provide a cooling-off period for the market and allow traders time to digest the causes of any substantial price revisions that culminate in the activation of the limits. The conclusion of Huang et al. (2001) is consistent with the overreaction hypothesis, which suggests that an overreaction is delayed and corrected by price limits; thus, the results support the validity of price limits.

Tian and Cao (2003) confirmed that price limits reduced the volatility of the Chinese stock market. Furthermore, Chen et al. (2005) found that the effect of price limits is asymmetric for bullish and bearish sample periods. During a bullish period, price limits effectively reduce the stock volatility of downward price movements and not upward price movements, whereas during a bearish period, price limits effectively reduce the stock volatility of upward price movements but not downward price movements.

On the other hand, opponents believe that price limits hinder market information transmission, increase information asymmetry, delay price discovery and reduce market efficiency. They mainly focus on three hypotheses: the volatility spillover hypothesis and the delayed price discovery hypothesis by Fama (1989), as well as the trading interference hypothesis by Lauterbach and Ben-Zion (1993). Kim and Rhee (1997) empirically tested these hypotheses by investigating the impacts of price limits on the Tokyo Stock Exchange, and they compared stock volatility, trading volume and returns among all groups of stocks. Their findings support the three hypotheses and suggest that price limits may be ineffective. Qu (2007) researched the effects of price limits on the Chinese stock market. He substantiated the three hypotheses based on the existence of short selling restrictions and concluded that widening price limits would have a greater impact on market efficiency. Chang and Hsieh (2008) found no evidence supporting the volatility spillover hypothesis or the trading interference hypothesis. However, they determined that delayed price discovery exists. Investors are more likely to purchase stocks that hit upper limits than to sell stocks that hit lower limits.Yeh and Yang (2013) found evidence of delayed price discovery and trading interference, and that the significance of these phenomena depends on the level of the price limits. Chong et al. (2016) explores the effects of price limits on the stock market of China during global market turmoils. It is found that the price limit system increases volatility significantly during the downward price movement. Moreover, price limit delays the efficient price discovery for upward and downward price movements.

There is no existing literature that studies the relationship between mutual market access schemes and price limit regulations. This paper is the first to study this topic using SHSC data.

4. Data

This research investigates the impact of SHSC on the effectiveness of China's stock market price limit regulations and therefore uses SSE data only. Despite the launch of SZSC, which is the first mutual access scheme between the Shenzhen and Hong Kong stock markets, in November 2016, the impact of SZSC is not the focus of this paper because the available data on SZSC remain highly insufficient. The number of trading days up to October 31, 2017 is 674 for SHSC but only 207 for SZSC.

Information on SSE-listed shares, including daily closing price, daily trading volume and daily total shares outstanding, are obtained from the WIND database. The sample period spans 951 trading days, starting from November 17, 2012 and ending on November 16, 2016. While there are 481 trading days in the 2-year period before the launch of SHSC (Before), there are 470 trading days in the 2-year period after the launch (After). Only the companies which remain listed throughout the sample period are included in the panel data. Excluding stocks under special treatment, the sample data include 930 stocks in total, among which 556 are eligible for trading under SHSC (Covered) and 374 are not (Non-Covered). Other information, such as the daily return of the SSE Composite Index (r_{SSECI}) and the 10-year China government bond yield (r_{CN10Y}), is also captured to calculate the abnormal returns of securities. The panel data are divided into four groups, namely Covered Before, Non-Covered Before, Covered After and Non-Covered After, for comparison. Table 1 summarizes the sample panel data.

We employ a traditional event study approach in this paper and identify all price limit hits as events. They are then divided into two types, upper price limits hits and lower price limit hits, to determine if there is any asymmetric effect. Due to the difficulty in analyzing the effect of consecutive day price limit hits, this paper only reports the results of single day limit hits.

5. Methodology

We start our research by first analyzing the distribution of price limit hit events. Then, we perform a regression analysis to check and compare the security betas of the four groups, which measure the tendency for their returns to respond to swings in the market.

The effectiveness of different types of price limits for different groups is examined by testing three hypotheses: the delayed price discovery hypothesis, volatility spillover hypothesis and trading interference hypothesis.

The delayed price discovery hypothesis states that although price limits stop stock prices from rising or falling beyond a certain threshold on the hit day, stock prices are likely to move in the same direction in subsequent trading days until reaching its equilibrium. If price limits are ineffective and delay price discovery, we should observe price continuation in the market (i.e., positive abnormal return after upper limit hits and negative abnormal return after lower limit hits). If price limits are not ineffective and do not delay price discovery, then we may observe price reversal in the market (i.e., negative abnormal return after upper limit hits and positive abnormal return after lower limit hits).

We examine the hypothesis by first comparing the abnormal returns of different stock groups within the same time period (i.e., Covered Before versus Non-Covered Before and Covered After versus Non-Covered After). Then, we compare the returns of the same stock group across different time periods (i.e., Covered Before versus Covered After and Non-Covered Before versus Non-Covered After). Finally, we check if there are significant inter-stock-group temporal differences among groups, which represent the impact of SHSC on the effectiveness of price limits. Comparisons between returns after upper limits hits and lower limits hits are also performed to examine if there is similar impact brought by different types of hits. It is expected that SHSC would help prevent price continuation in the Chinese equity market, since the involvement of the more transparent Hong Kong market should accelerate information transmission, therefore helping price limits to reduce price continuation behavior, such as herding and panic trading, due to information asymmetry.

The volatility spillover hypothesis claims that price limits cannot reduce overall stock price volatility. Although they can somewhat restrict the volatility of stock prices on the hit day, stock price volatility tends to increase over a long period of time afterwards. If price limits are ineffective and lead to volatility spillover, we should observe higher volatility in the days after the limit hits. If price limits are not ineffective and do not lead to volatility spillover, then we may only observe a one-day price volatility jump on the hit day but not an increase in price volatility in the following days. We examine the hypothesis by first comparing the price volatility of different stock groups during the same time period. Then, we compare the price volatility of the same stock group across different time periods. Finally, we check if there are significant inter-stock-group temporal differences among the price volatility of groups, which represent the impact of SHSC on the effectiveness of price limits. Comparisons between price volatility after upper limits hits and lower limits hits are also performed to verify if there is similar impact brought by different types of hits. It is expected that SHSC would magnify stock price volatility in the Chinese equity market because the new bilateral investment channel allows non-domestic investors to inject capital during market booms and withdraw funds during market crashes, therefore dampening the price limit's ability to reduce market volatility during turmoil.

The trading interference hypothesis argues that although price limits drain the liquidity of stocks on the hit day, an increased number of trading activities would be observed in subsequent days. If price limits are ineffective and interfere with trading activity, we should observe increased trading activity after price limit hits. If price limits are not ineffective and do not interfere with trading activity, we may observe similar trading activity before and after price limit hits. We examine the hypothesis by first comparing the trading activity of different stock groups during the same time period. Then, we compare the trading activity of the same stock group across different time periods. Finally, we check if there are significant inter-stock-group temporal differences among groups, which represent the impacts of SHSC on the effectiveness of price limits. Comparison between trading activity before and after upper limits hits and lower limits hits are also performed to ascertain if there is similar impact brought by different types of hits. It is expected that SHSC would bring more trading activity to the Chinese equity market because the program allows Hong Kong and international investors to invest in the market much more conveniently than before. We also expect there to be a more significant trading interference effect brought by upper price limit hits than lower price limit hits due to the magnet effect caused by investor behavior: inexperienced investors tend to be overly optimistic and buy stocks even after upper price limit hits in bullish markets but are hesitant to sell stocks that incur losses and instead await government intervention to raise stock prices even after lower price limit hits in bearish markets.

6. Empirical Results and Discussion

6.1 Analysis of Price Limit Hits and Security Betas

Table 2 presents the distribution of price limit hits. In the 2-year period before the launch of SHSC, there were 1,258 upper price limit hits and 168 lower price limit hits for the Covered stock group. A similar trend can be observed in the Non-Covered stock group, which had 1,139 upper price limit hits and 126 lower price limit hits. It is very obvious that there were far more upper price limit hits than lower price limit hits for both stock groups in the pre-SHSC period. As for the 2-year period after the launch of SHSC, 3,816 upper price limit hits and 3,324 lower price limit hits were recorded for the Covered stock group, whereas there were 3,209 upper price limit hits and 2,830 lower price limit hits for the Non-Covered stock group. While the number of upper price limit hits tripled for both groups, the number of lower price limit hits increased even more significantly by almost 20 times in the post-SHSC period.

Such uneven distribution could probably be explained by the general trend of the Chinese stock market. Chart 1 illustrates the performance of the SSECI. We can observe that the SSECI has been generally stable, fluctuating around the level of 2,000 since mid-2012. After underperforming in 2013, the market gradually rebounded in 2014 and skyrocketed from mid-2014. The SSECI surged for more than 23% within just half a year from a level of 2,005 on May 19, 2014 to a level of 2,478 on November 16, 2014. In light of the positive market sentiment, it is not surprising that there are far more upper than lower price limit hits in the pre-SHSC period.

The bullish market atmosphere continues in early 2015, and the SSECI reaches its peak at the level of 5,178 on June 12, 2015, which was historically the second highest level since the index's establishment in 1990. However, market sentiment suddenly reversed upon the burst of the stock market bubble and the beginning of the 2015 Chinese stock market turbulence, mainly attributed to the tightened market regulation from the China Securities Regulatory Commission (CSRC) and broadly decelerating growth of the Chinese economy. One third of the value of SSE-listed A-shares was lost within one month from mid-June 2015. By July 2015, the SSECI had plunged over 30 percent, and more than half of the listed companies had filed for a trading halt to prevent further losses. With the great effort of the Chinese government to stop the fall, the market experienced a small rebound in late 2015. However, a new round of market meltdown was set off again entering 2016. Trading was even halted on January 7, 2016 after the market fell for more than 7% within just 30 minutes of opening. Since then, the market has gradually recovered, and the SSECI slowly rose from its local minimum level of 2,655 on January 28, 2016 to 3,205 on November 16, 2016. In light of such huge market turbulence, it is reasonable that the total number of price limit hits saw a drastic rise in the post-SHSC period. While the number of lower price limit hits increased greatly due to the market crash, the number of upper price limit hits also increased as a result of the temporary market recovery in late 2015.

Given the noticeable difference in the number of price limit hits before and after the launch of SHSC, it is worthwhile to perform a regression analysis to check and compare the security betas among groups, which measure their tendency of return in response to swings in the market. We first define $r_{g,t;i,j}$ as the daily return of stock *i* in stock group *g* for time period *t* on trading day *j*, where *g* = *non-covered* when stock *i* is in the Non-Covered stock group; *g* = *covered* when stock *i* is in the Covered stock group; *t* = *before* when trading day *j* is in the Before time period; *t* = *after* when trading day *j* is in the After time period.

We can calculate $r_{g,t;i,j}$ according to

$$r_{g,t;i,j} = \ln\left(\frac{p_{g,t;i,j}}{p_{g,t;i,j-1}}\right) \qquad (1)$$

, in which $p_{g,t;i,j}$ and $p_{g,t;i,j-1}$ denote the daily closing price of stock *i* in stock group *g* in time period *t* on trading days *j* and *j-1* respectively.

Then, we can calculate the average daily return of stocks in stock group *g* in time period *t* on trading day *j*, denoted as $\bar{r}_{g,t;j}$ according to

$$\bar{r}_{g,t;j} = \frac{\sum_{i=1}^{ns_{g,t}} r_{g,t;i,j}}{ns_{g,t}} \qquad (2)$$

, in which $ns_{g,t}$ denotes the number of stocks in stock group *g* in time period *t.*

According to Xu and Zhang (2014), pitfalls may arise if we directly apply the

Fama-French three-factor model to the Chinese stock returns, as several special features in China may considerably affect the explanatory power of the model, which is the outcome of decades of research on U.S. stock returns. Instead, we apply the simple Capital Asset Pricing Model (CAPM) to find the betas of stock groups. Using the return of SSECI (r_{SSECI}) as the return of market portfolio (r_m), we can run the following regression:

$$\bar{r}_{g,t} = \beta_0 + \beta_1 r_{SSECI} + \varepsilon_{g,t} \qquad (3)$$

, in which $\bar{r}_{g,t}$ is the average daily return of stocks in stock group g in time period t;

r_{SSECI} is the daily return of SSECI;

$\varepsilon_{g,t}$ is the error term,

where the number of observations is the number of trading days in time period t.

Table 3 presents the results of the single variable regressions. In Case (1), the dependent variable is the average daily return of stocks in the Non-Covered stock group in time period Before ($\bar{r}_{non-covered,before}$); in Case (2), the dependent variable is the average daily return of stocks in the Covered stock group in time period Before ($\bar{r}_{covered,before}$); in Case (3), the dependent variable is the average daily return of stocks in the Non-Covered stock group in time period After ($\bar{r}_{non-covered,after}$); in Case (4), the dependent variable is the average daily return of stocks in the Covered stock group in time period After ($\bar{r}_{covered,after}$).

We can observe an increase in betas for both stock groups after the launch of SHSC, probably because the 2015 Chinese stock market turbulence made both groups more sensitive to market trends in light of the overreaction from investors. We can also notice that the Covered stock group has a lower beta than the Non-Covered stock group both before and after the launch of SHSC, probably because the Covered stock group is made up mainly of blue-chip stocks, which are less subject to speculative activities. Difference in inter-stock-group beta is found to be narrowed after the launch of SHSC, probably because the price of blue-chip stocks also fell considerably in tandem with penny stocks during the market crash.

To test whether the intertemporal, inter-stock-group and inter-stock-group temporal differences in beta are statistically significant, we perform the following regression:

$$\bar{r} = \beta_0 + \beta_1 time + \beta_2 group + \beta_3 r_{SSECI} + \beta_4 time\_group + \beta_5 time\_r_{SSECI} + \beta_6 group\_r_{SSECI} + \beta_7 time\_group\_r_{SSECI} + \varepsilon \qquad (4)$$

, in which $\bar{r}$ is the average daily return of stocks;

$time$ is a dummy variable

($time = 0$ when $t = before$; $time = 1$ when $t = after$);

$group$ is a dummy variable

($group = 0$ when $g = non\text{-}covered$; $group = 1$ when $g = covered$);

r_{SSECI} is the daily return of SSECI;

$time\_group$ is the product of variables $time$ and $group$;

$time\_r_{SSECI}$ is the product of variables $time$ and r_{SSECI};

$group\_r_{SSECI}$ is the product of variables $group$ and r_{SSECI};

$time\_group\_r_{SSECI}$ is the product of variables $time$, $group$ and r_{SSECI};

ε is the error term.

The number of observations is twice the total number of trading days.

If β_5 (the coefficient of $time\_r_{SSECI}$) in the regression is significant, then there is significant intertemporal beta difference in stock group g. If β_6 (the coefficient of $group\_r_{SSECI}$) in the regression is significant, then there is significant inter-stock-group beta difference in time period t. If β_7 (the coefficient of $time\_group\_r_{SSECI}$) in the regression is significant, then there is significant inter-stock-group temporal difference in beta among the groups.

Details of the above-mentioned regression results are not shown here. Instead, we present the significance test result (at levels of 1%, 5% and 10%) of each difference term in Table 4. Since the inter-stock-group temporal difference term is shown to be insignificant, we conclude that SHSC does not have any significant effect on the beta of SSE-listed stocks.

6.2 Tests on the Delayed Price Discovery Hypothesis

We employed a traditional event study approach to examine the effectiveness of price limits, and all price limit hits are identified as events. Given the distribution of price limit hits as shown in Table 2, there are 13,179 events in total. We regard "Day 0" as the day when the price limit is hit; "Day −2" is 2 days before the hit; "Day −1" is 1 day before the hit; "Day 1" is 1 day after the hit; "Day 2" is 2 days after the hit, and so forth.

We follow Li et al. (2014) and test the delayed price discovery hypothesis by examining the abnormal return of securities that hit the price limit. We first define $abnr_{g,t;u,v}$ as the abnormal daily return of the price limit hitting stock of event u in stock group g in time period t on Day v, where g = *non-covered* when the price limit hitting stock is in the Non-Covered stock group; g = *covered* when the price limit hitting stock is in the Covered stock group; t = *before* when event u occurs in the Before time period ; t = *after* when event u occurs in the After time period. We can calculate $abnr_{g,t;u,v}$ based on CAPM:

$$abnr_{g,t;u,v} = r_{g,t;u,v} - E(r_{g,t;u,v}) = r_{g,t;u,v} - [r_f + \beta_{g,t}(r_m - r_f)] \qquad (5)$$

, in which $r_{g,t;u,v}$ denotes the daily return of the price limit hitting stock of event u in stock group g in time period t on Day v;

$E(r_{g,t;u,v})$ denotes the expected daily return of the price limit hitting stock of event u in stock group g in time period t on Day v;

r_f denotes the daily return of risk-free investment;

$\beta_{g,t}$ denotes the beta of stock group g in time period t;

r_m denotes the daily return of market portfolio.

Using the return of SSECI (r_{SSECI}) as the return of market portfolio (r_m) and 10-year China government bond yield (r_{CN10Y}) as the return of risk-free investment (r_f), we then have

$$abnr_{g,t;u,v} = r_{g,t;u,v} - [r_{CN10Y} + \beta_{g,t}(r_{SSECI} - r_{CN10Y})] \qquad (6)$$

We can calculate the average abnormal daily return of the price limit hitting stocks of events in stock group g in time period t on Day v, expressed as $\overline{abnr}_{g,t;v}$, according to the following equation:

$$\overline{abnr}_{g,t;v} = \frac{\sum_{u=1}^{n_{g,t}} abnr_{g,t;u,v}}{n_{g,t}} \qquad (7)$$

, in which $n_{g,t}$ denotes the number of events in stock group g in time period t.

Tables 5 and 6 report the five average abnormal daily return of upper and lower price limit hitting stocks in the four groups (Non-Covered Before, Covered Before, Non-Covered After and Covered After) from Day -2 to Day 5. The figures demonstrate that upper price limit hits and lower price limit hits share similar results. Instead of price continuation (i.e., positive abnormal return after upper limit hits and negative abnormal return after lower limit hits), evidence of price reversal (i.e., negative abnormal return after upper limit hits and positive abnormal return after lower limit hits) is found in all groups. Therefore, delayed price discovery is not deemed to be a problem resulting from China's price limit regulations. Besides, a general increase (decrease) in the abnormal return of upper price limit hitting stocks (lower price limit hitting stocks) after the launch of SHSC is perceptible, probably because the 2015 Chinese stock market turbulence not only increased the systematic risk level of the whole market but also elevated the unsystematic risk of each individual stock. We can also observe that the Covered stock group generally has a lower (higher) abnormal return than the Non-Covered stock group for upper price limit hits (lower price limit hits), probably because the Covered stock group has lower unsystematic risk, as it is made up mainly of blue-chip stocks, which have lower but less volatile return.

To test whether the intertemporal, inter-stock-group and inter-stock-group temporal differences in abnormal daily return of the price limit hitting stocks of events on Day *v* are statistically significant, we perform the following regression:

$$abnr_v = \beta_0 + \beta_1 time + \beta_2 group + \beta_3 time\_group + \varepsilon_v \qquad (8)$$

, in which $abnr_v$ is the abnormal daily return of the price limit hitting stocks of all events on Day *v*;

$time$ is a dummy variable

(*time = 0* when *t = before*; *time = 1* when *t = after*);

$group$ is a dummy variable

(*group = 0* when *g = non-covered*; *group = 1* when *g = covered*);

$time\_group$ is the product of variables $time$ and $group$;

ε_v is the error term.

The number of observations is the total number of events.

If β_1 (the coefficient of $time$) in the regression is significant, then there is significant intertemporal abnormal daily return difference in stock group *g*. If β_2 (the coefficient of $group$) in the regression is significant, then there is significant inter-stock-group difference in abnormal daily return in time period *t*. If β_3 (the coefficient of

$time\_group$) in the regression is significant, then there is significant inter-stock-group temporal difference in abnormal daily return among the groups.

Detailed results of the regressions above are not presented here. Instead, we include the significance test results (at levels of 1%, 5% and 10%) of the inter-stock-group, intertemporal and inter-stock-group temporal difference terms in Tables 5 and 6. Despite the fact that both the intertemporal and inter-stock-group differences are shown to be significant on Day 0, the inter-stock-group temporal difference on Day 0 is found to be insignificant. This means that after the general trend of the market is controlled for, SHSC shows no significant impact on the hit day's abnormal return. Instead, we can observe significant inter-stock-group temporal difference on Day 2 with an earlier price reversal. It is thus believed that SHSC helps improve the delayed price discovery problem caused by China's price limits. By bringing in the more transparent Hong Kong market, information is transmitted at a greater speed in the Chinese stock market, therefore reducing the amount of price continuation activity, such as herding and panic trading, arising from information asymmetry.

6.3 Tests on the Volatility Spillover Hypothesis

We follow Kim and Rhee (1997) and test the volatility spillover hypothesis by examining the price volatility of securities that hit the price limits. We measure the daily price volatility of securities as follows:[1]

$$vol_{g,t;u,v} = (r_{g,t;u,v})^2 * 1{,}000 \qquad (9)$$

, in which $vol_{g,t;u,v}$ denotes the daily price volatility of the price limit hitting stock of event *u* in stock group *g* in time period *t* on Day *v*; $r_{g,t;u,v}$ denotes the daily return of the price limit hitting stock of event *u* in stock group *g* in time period *t* on Day *v.*

Then, we calculate the average daily price volatility of the price limit hitting stock of events in stock group *g* in time period *t* on Day *v*, expressed as $\overline{vol}_{g,t;v}$, according to the equation below:

$$\overline{vol}_{g,t;v} = \frac{\sum_{u=1}^{n_{g,t}} vol_{g,t;u,v}}{n_{g,t}} \qquad (10)$$

, in which $n_{g,t}$ denotes the number of events in stock group *g* in time period *t*.

Tables 7 and 8 report the average daily price volatility of upper and lower price limit hitting stocks in the four groups (Non-Covered Before, Covered Before, Non-Covered After and Covered After) from Day -2 to Day 5. The figures show that the price volatility

[1] Another common measure of stock price volatility following Grossman (1988) is the natural log of the ratio of the daily highest price to the daily lowest price, i.e., voli,j = ln (hpi,j / lpi,j-1). Literature has shown that results generated form the two measures are similar.

of lower price limit hits is, in general, higher than that of upper price limit hits, which is probably due to investors engaging in panic trading during market crashes. Despite that, upper price limit hits and lower price limit hits share similar results. We can observe higher price volatility in days after the price limit hit compared to the days before; therefore, volatility spillover is deemed to be a problem caused by China's price limit regulations. Besides, a general increase in price volatility after the launch of SHSC is visible, which is probably because of the onset of the 2015 Chinese stock market turbulence. However, we cannot observe any noticeable inter-stock-group difference in the price volatility between the Covered stock group and the Non-Covered stock group.

To test whether the intertemporal, inter-stock-group and inter-stock-group temporal differences in daily price volatility of the price limit hitting stocks of events on Day *v* are statistically significant, we perform the following regression:

$$vol_v = \beta_0 + \beta_1 time + \beta_2 group + \beta_3 time\_group + \varepsilon_v \qquad (11)$$

, in which vol_v is the daily price volatility of the price limit hitting stocks of all events on Day *v*;

$time$ is a dummy variable

(*time = 0* when *t = before*; *time = 1* when *t = after*);

$group$ is a dummy variable

($group = 0$ when $g = non\text{-}covered$; $group = 1$ when $g = covered$);

$time\_group$ is the product of variables $time$ and $group$;

ε_v is the error term.

The number of observations is the total number of events.

If β_1 (the coefficient of $time$) in the regression is significant, then there is significant intertemporal daily price volatility difference in stock group g. If β_2 (the coefficient of $group$) in the regression is significant, then there is significant inter-stock-group daily price volatility difference in time period t. If β_3 (the coefficient of $time\_group$) in the regression is significant, then there is significant inter-stock-group temporal daily difference in price volatility among the groups.

Detailed results of the aforementioned regressions are not presented here. Instead, we include the significance test results (at levels of 1%, 5% and 10%) of the inter-stock-group, intertemporal and inter-stock-group temporal difference terms in Tables 7 and 8. Despite this, we can still recognize a number of significant intertemporal differences in the results, and no inter-stock-group difference is found to be significant. In addition, none of the inter-stock-group temporal difference is found to be significant. That means after the general market trend is controlled for, SHSC shows no significant impact on price volatility. This result does not match our prediction that SHSC would magnify the stock price volatility in China's equity market, since the new bilateral investment channel allows non-domestic investors to inject capital during market booms and withdraw funds during market busts, inhibiting the ability of China's price limits to reduce market volatility during turmoil. One of the possible reasons for the insignificant impact of SHSC on price volatility may be the relatively small turnover size of SHSC when compared to the whole market.

6.4 Tests on the Trading Interference Hypothesis

We follow Kim and Rhee (1997) and test the trading interference hypothesis by examining the trading change (TC) of securities that hit the price limits. We first define trading activity (TA) as the ratio of daily trading volume to the daily total shares outstanding, calculated as follows:

$$TA_{g,t;u,v} = \frac{tv_{g,t;u,v}}{os_{g,t;u,v}} \qquad (12)$$

, in which $TA_{g,t;u,v}$ denotes the trading activity of the price limit hitting stock of event u in stock group g in time period t on Day v; $tv_{g,t;u,v}$ denotes the daily trading volume of the price limit hitting stock of event u in stock group g in time period t on Day v; $os_{g,t;u,v}$ denotes the daily total shares outstanding of the price limit hitting stock of event u in stock group g in time period t on Day v.

Trading change (TC) is then computed as the logarithmic percentage change in trading activity from the previous day, i.e.,

$$TC_{g,t;u,v} = \ln\left(\frac{TA_{g,t;u,v}}{TA_{g,t;u,v-1}}\right) * 100 \qquad (13)$$

, in which $TC_{g,t;u,v}$ denotes the trading change of the price limit hitting stock of event *u* in stock group *g* in time period *t* on Day *v.*

Then, we calculate the average trading change of the price limit hitting stock of events in group *g* in time period *t* on Day *v*, expressed as $\overline{TC}_{g,t;v}$, according to this equation:

$$\overline{TC}_{g,t;v} = \frac{\sum_{u=1}^{n_{g,t}} TC_{g,t;u,v}}{n_{g,t}} \qquad (14)$$

, in which $n_{g,t}$ denotes the number of events in stock group *g* in time period *t.*

Tables 9 and 10 report the average trading change of upper and lower price limit hitting stocks in the four groups (Non-Covered Before, Covered Before, Non-Covered After and Covered After) from Day -2 to Day 5. The figures indicate that the trading change of upper price limit hits is in general larger than that of lower price limit hits; one probable reason is that short selling is prohibited in the Chinese stock market. Another reason may be the magnet effect on investors' behavior, which claims that inexperienced investors tend to be overly optimistic and buy stocks even after upper price limit hits in the bullish market but are hesitant to sell stocks that incur losses and instead wait for government intervention to raise stock prices even after lower price limit hits in the bearish market. Despite the findings above, upper price limit hits and lower price limit hits share similar results. We note that the trading change in the days after the price limit hits is larger compared to the days before, therefore, trading interference is regarded as a problem of China's price limit regulations. In addition, there is a general increase in trading change after the launch of SHSC, which is probably because of the start of the 2015 Chinese stock market turbulence. However, we cannot observe any notable inter-stock-group differences in price volatility between the Covered stock group and the Non-Covered stock group.

To test whether the intertemporal, inter-stock-group and inter-stock-group temporal differences in trading change of the price limit hitting stocks of events on Day *v* are statistically significant, we perform the following regression:

$$TC_v = \beta_0 + \beta_1 time + \beta_2 group + \beta_3 time\_group + \varepsilon_v \qquad (15)$$

, in which TC_v is the trading change of the price limit hitting stocks of all events on Day *v*;

$time$ is a dummy variable

(*time = 0* when *t = before*; *time = 1* when *t = after*);

$group$ is a dummy variable

($group = 0$ when $g = non\text{-}covered$; $group = 1$ when $g = covered$);

$time\_group$ is the product of variables $time$ and $group$;

ε_v is the error term.

If β_1 (the coefficient of $time$) in the regression is significant, then there is significant intertemporal trading change difference in stock group g. If β_2 (the coefficient of $group$) in the regression is significant, then there is significant inter-stock-group trading change difference in time period t. If β_3 (the coefficient of $time\_group$) in the regression is significant, then there is significant inter-stock-group temporal difference in trading change among the groups.

Detailed results of the foregoing regressions are not presented here. We instead include the significance test results (at levels of 1%, 5% and 10%) of the inter-stock-group, intertemporal and inter-stock-group temporal difference terms in Tables 9 and 10. Despite the fact that a number of significant intertemporal differences are perceptible in the results, no inter-stock-group difference is found to be significant. In addition, none of the inter-stock-group temporal difference is significant. This means that upon controlling for the general trend of the market, SHSC shows no significant impact on trading change. This result does not match our prediction that SHSC would bring in more trading activity to China's equity market because the program allows both Hong Kong and international investors to invest in the market in a much more convenient way than before. One of the possible reasons for the insignificant impact of SHSC on trading change may be the relatively small turnover size of SHSC as compared to the whole market.

7. Conclusion

As a relatively safe instrument, the mutual market access scheme has been commonly used by China to gradually liberalize its financial market in recent years. Subsequent to the launch of SHSC and SZSC, the Chinese government introduced the Bond Connect (a mutual market access scheme between the Chinese and Hong Kong bond markets) in 2017 and is now putting forward the Shanghai-London Stock Connect (a mutual market access scheme between Shanghai and London stock markets) to further open up the market.

This paper studies the impact of such mutual market access schemes on China's price limit regulations in the equity market by using the data of SHSC. The effectiveness of price limits is tested with three hypotheses: the delayed price discovery hypothesis, the volatility spillover hypothesis and the trading interference hypothesis. The results show that while SHSC has a significantly positive effect on the delayed price discovery problem, its negative effects on the volatility spillover problem and the trading interference problem are found to be insignificant.

Given the massive market turmoil in 2015, our data on the Chinese stock market are severely distorted. Research can be conducted in the future to further study the impact of SHSC on price limits in China's equity market during tranquil periods.

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9. Appendix

Table 1: Summary of Sample Panel Data

Covered Before	**Non-Covered Before**
Period Covered: November 17, 2012– November 16, 2014 Number of Trading Days: 481 Number of Stocks Covered: 556 Number of Price Limit Hits: 1,426	Period Covered: November 17, 2012– November 16, 2014 Number of Trading Days: 481 Number of Stocks Covered: 374 Number of Price Limit Hits: 1,265
Covered After	**Non-Covered After**
Period Covered: November 17, 2014– November 16, 2016 Number of Trading Days: 470 Number of Stocks Covered: 556 Number of Price Limit Hits: 7,140	Period Covered: November 17, 2014– November 16, 2016 Number of Trading Days: 470 Number of Stocks Covered: 374 Number of Price Limit Hits: 6,039

Table 2: Distribution of Price Limit Hits

		Upward Price Limit Hits	%	Downward Price Limit Hits	%	Total	%
Before SHSC (November 17, 2012–November 16, 2014)	**Covered Before**	1,258	47	168	6	1,426	53
	Non-Covered Before	1,139	42	126	5	1,265	47
Total		2,397	89	294	11	2,691	100
After SHSC (November 17, 2014–November 16, 2016)	**Covered After**	3,816	29	3,324	25	7,140	54
	Non-Covered After	3,209	24	2,830	21	6,039	46
Total		7,025	53	6,154	47	13,179	100

Chart 1: The Shanghai Composite Index (SSECI) from Nov 17, 2012 to Nov 17, 2016

Table 3: Single Variable Regression Results

Variables	**(1)** $r_{non\text{-}covered,\ before}$	**(2)** $r_{covered,\ before}$	**(3)** $r_{non\text{-}covered,\ after}$	**(4)** $r_{covered,\ after}$
Constant	0.02063	0.009219	0.015071	0.009654
r_{SSECI}	1.168521***	1.088619***	1.202831***	1.144806***
Observations	470	470	481	481
R-Square	0.418	0.4969	0.3551	0.435

*This table shows the single variable regression results. Asterisks (***, **, *) denote that the coefficient is significant at the 1%, 5% and 10% levels, respectively.*

Table 4: Comparison of Securities Betas

(1) **Non-Covered Before**	**(2)** **Covered Before**	**(2 - 1)** **Inter-Stock-Group Difference**
1.168521	1.088619	-0.079902 *
(3) **Non-Covered After**	**(4)** **Covered After**	**(4 - 3)** **Inter-Stock-Group Difference**
1.202831	1.144806	-0.058025
(3 - 1) **Intertemporal Difference**	**(4 - 2)** **Intertemporal Difference**	**(4 -1)** **Inter-Stock-Group Temporal Difference**
0.034310	0.056187	-0.023715

*This table presents and compares the securities betas of the four groups. Asterisks (***, **, *) denote that the coefficient is significant at the 1%, 5% and 10% levels, respectively.*

Table 5: Comparison of Average Abnormal Daily Returns (Upper Price Limit Hits)

Day	(1) Non-Covered Before	(2) Covered Before	(2) – (1) Inter-stock-group Difference
-2	0.0043	0.0022	-0.0021
-1	0.0081	0.0046	-0.0035
0	0.0576	0.0448	-0.0128 ***
1	0.0174	0.0147	-0.0027
2	0.0084	0.0075	-0.0009
3	-0.0051	-0.0027	0.0024
4	-0.0039	-0.0025	0.0014
5	0.0047	0.0029	-0.0018
Day	**(3) Non-Covered After**	**(4) Covered After**	**(4) – (3) Inter-stock-group Difference**
-2	0.0072	0.0038	-0.0034
-1	0.0093	0.0064	-0.0029
0	0.0724	0.0623	-0.0101 **
1	0.0191	0.0153	-0.0038
2	0.0111	-0.0045	-0.0156 ***
3	-0.0067	-0.0013	0.0054 *
4	-0.0049	0.0047	0.0096 **
5	0.0052	0.0040	-0.0012
Day	**(3) – (1) Intertemporal Difference**	**(4) – (2) Intertemporal Difference**	**(4) – (1) Inter-stock-group Temporal Difference**
-2	0.0029	0.0016	-0.0005
-1	0.0012	0.0018	-0.0017
0	0.0148 ***	0.0175 ***	0.0047
1	0.0017	0.0006	-0.0021
2	0.0027	-0.0120 ***	-0.0129 ***
3	-0.0016	0.0014	0.0038
4	-0.0010	0.0072 **	0.0086 **
5	0.0005	0.0011	-0.0007

This table presents and compares the average abnormal daily returns of the four groups for upper price limit hits.

*Asterisks (***, **, *) denote that the coefficient is significant at the 1%, 5% and 10% levels, respectively.*

Table 6: Comparison of Average Abnormal Daily Returns (Lower Price Limit Hits)

Day	(1) Non-Covered Before	(2) Covered Before	(2) – (1) Inter-stock-group Difference
-2	-0.0054	-0.0039	0.0015
-1	-0.0087	-0.0077	0.0010
0	-0.0576	-0.0454	0.0122 ***
1	-0.0096	-0.0082	0.0014
2	-0.0083	-0.0061	0.0022
3	0.0061	0.0052	-0.0009
4	0.0043	0.0038	-0.0005
5	-0.0055	-0.0048	0.0007
Day	**(3) Non-Covered After**	**(4) Covered After**	**(4) – (3) Inter-stock-group Difference**
-2	-0.0082	-0.0077	0.0005
-1	-0.0097	-0.0086	0.0011
0	-0.0696	-0.0584	0.0112 **
1	-0.0127	-0.0110	0.0017
2	-0.0097	0.0055	0.0152 ***
3	0.0072	0.0034	-0.0038
4	0.0044	0.0009	-0.0035
5	-0.0076	-0.0049	0.0027
Day	**(3) – (1) Intertemporal Difference**	**(4) – (2) Intertemporal Difference**	**(4) – (1) Inter-stock-group Temporal Difference**
-2	-0.0028	-0.0038	-0.0023
-1	-0.0010	-0.0009	0.0001
0	-0.0120 **	-0.0130 ***	-0.0008
1	-0.0031	-0.0028	-0.0014
2	-0.0014	0.0116 **	0.0138 ***
3	0.0011	-0.0018	-0.0027
4	0.0001	-0.0029	-0.0034
5	-0.0021	-0.0001	0.0006

This table presents and compares the average abnormal daily returns of the four groups for lower price limit hits.

*Asterisks (***, **, *) denote that the coefficient is significant at the 1%, 5% and 10% levels, respectively.*

Table 7: Comparison of Average Daily Price Volatility (Upper Price Limit Hits)

Day	**(1) Non-Covered Before**	**(2) Covered Before**	**(2) – (1) Inter-stock-group Difference**
-2	2.0857	2.0281	-0.0576
-1	2.0484	2.0653	0.0169
0	9.5972	9.5430	-0.0542
1	2.2906	2.2400	-0.0506
2	2.2095	2.1867	-0.0228
3	2.1461	2.1431	-0.0030
4	2.1147	2.1559	0.0412
5	2.1391	2.1214	-0.0177
Day	**(3) Non-Covered After**	**(4) Covered After**	**(4) – (3) Inter-stock-group Difference**
-2	2.1007	2.1248	0.0241
-1	2.2157	2.1620	-0.0537
0	9.7282	9.6703	-0.0579
1	2.4813	2.4296	-0.0517
2	2.3485	2.2927	-0.0558
3	2.1832	2.2351	0.0519
4	2.2471	2.2023	-0.0448
5	2.2375	2.1841	-0.0534
Day	**(3) – (1) Intertemporal Difference**	**(4) – (2) Intertemporal Difference**	**(4) – (1) Inter-stock-group Temporal Difference**
-2	0.0150	0.0967 *	0.0391
-1	0.1673 *	0.0967 *	0.1136
0	0.1310 *	0.1273 *	0.0731
1	0.1907 **	0.1896 **	0.1390
2	0.1390 *	0.1060 *	0.0832
3	0.0371	0.0920 *	0.0890
4	0.1324 *	0.0464	0.0876
5	0.0984 *	0.0627	0.0450

This table presents and compares the average daily price volatility of the four groups for upper price limit hits.

*Asterisks (***, **, *) denote that the coefficient is significant at the 1%, 5% and 10% levels, respectively.*

Table 8: Comparison of Average Daily Price Volatility (Lower Price Limit Hits)

Day	(1) Non-Covered Before	(2) Covered Before	(2) – (1) Inter-stock-group Difference
-2	2.2574	2.2252	-0.0322
-1	2.2765	2.2250	-0.0515
0	9.6910	9.6373	-0.0537
1	2.5463	2.5097	-0.0366
2	2.3467	2.3226	-0.0241
3	2.3057	2.3654	0.0597
4	2.3497	2.2977	-0.0520
5	2.2354	2.2823	0.0469
Day	**(3) Non-Covered After**	**(4) Covered After**	**(4) – (3) Inter-stock-group Difference**
-2	2.3323	2.2836	-0.0487
-1	2.2864	2.3157	0.0293
0	9.8017	9.7573	-0.0444
1	2.6767	2.6303	-0.0464
2	2.4645	2.4236	-0.0409
3	2.3944	2.3757	-0.0187
4	2.4401	2.3504	-0.0897
5	2.2888	2.3176	0.0288
Day	**(3) – (1) Intertemporal Difference**	**(4) – (2) Intertemporal Difference**	**(4) – (1) Inter-stock-group Temporal Difference**
-2	0.0749	0.0584	0.0262
-1	0.0099	0.0907 *	0.0392
0	0.1107 *	0.1200 *	0.0663
1	0.1304 *	0.1206 *	0.0840
2	0.1178 *	0.1010 *	0.0769
3	0.0887 *	0.0103	0.0700
4	0.0904 *	0.0527	0.0007
5	0.0534	0.0353	0.0822

This table presents and compares the average daily price volatility of the four groups for lower price limit hits.

*Asterisks (***, **, *) denote that the coefficient is significant at the 1%, 5% and 10% levels, respectively.*

Table 9: Comparison of Average Trading Change (Upper Price Limit Hits)

Day	**(1) Non-Covered Before**	**(2) Covered Before**	**(2) – (1) Inter-stock-group Difference**
-2	1.2121	1.8005	0.5884
-1	2.8293	2.0935	-0.7358
0	64.9418	58.8284	-6.1134
1	-65.8883	-58.2081	7.6802
2	10.3442	13.0656	2.7214
3	-3.0768	5.7411	8.8179
4	2.8136	-2.5995	-5.4131
5	1.8822	2.6794	0.7972
Day	**(3) Non-Covered After**	**(4) Covered After**	**(4) – (3) Inter-stock-group Difference**
-2	1.6142	2.8205	1.2063
-1	1.8038	2.0662	0.2624
0	74.8522	66.6111	-8.2411
1	-65.6162	-59.5399	6.0763
2	3.4918	-2.9408	-6.4326
3	-1.989	2.7571	4.7461
4	2.7052	2.941	0.2358
5	2.3484	2.1808	-0.1676
Day	**(3) – (1) Intertemporal Difference**	**(4) – (2) Intertemporal Difference**	**(4) – (1) Inter-stock-group Temporal Difference**
-2	0.4021	1.0200	1.6084
-1	-1.0255	-0.0273	-0.7631
0	9.9104 *	7.7827	1.6693
1	0.2721	-1.3318	6.3484
2	-6.8524	-16.0064 **	-13.2850
3	1.0878	-2.9840	5.8339
4	-0.1084	5.5405	0.1274
5	0.4662	-0.4986	0.2986

This table presents and compares the average trading change of the four groups for upper price limit hits.

*Asterisks (***, **, *) denote that the coefficient is significant at the 1%, 5% and 10% levels, respectively.*

Table 10: Comparison of Average Trading Change (Lower Price Limit Hits)

Day	(1) **Non-Covered Before**	(2) **Covered Before**	(2) – (1) **Inter-stock-group Difference**
-2	2.1712	0.4382	-1.7330
-1	3.2175	-1.0284	-4.2459
0	54.1649	46.6863	-7.4786
1	-53.2093	-47.4181	5.7912
2	3.1411	1.3169	-1.8242
3	-2.1973	2.4807	4.6780
4	0.1711	-2.4675	-2.6386
5	1.2184	0.4035	-0.8149
Day	**(3) Non-Covered After**	**(4) Covered After**	**(4) – (3) Inter-stock-group Difference**
-2	1.3145	-0.3333	-1.6478
-1	4.4906	-1.4677	-5.9583
0	64.4183	60.6218	-3.7965
1	-67.4656	-59.7221	7.7435
2	-13.1853	-18.3132	-5.1279
3	2.1359	5.2653	3.1294
4	-1.0324	3.2009	4.2333
5	1.9431	-0.1128	-2.0559
Day	**(3) – (1) Intertemporal Difference**	**(4) – (2) Intertemporal Difference**	**(4) – (1) Inter-stock-group Temporal Difference**
-2	-0.8567	-0.7715	-2.5045
-1	1.2731	-0.4393	-4.6852
0	10.2534 *	13.9355 *	6.4569
1	-14.2563 *	-12.3040 *	-6.5128
2	-16.3264 **	-19.6301 **	-21.4543
3	4.3332	2.7846	7.4626
4	-1.2035	5.6684	3.0298
5	0.7247	-0.5163	-1.3312

This table presents and compares the average trading change of the four groups for lower price limit hits.

*Asterisks (***, **, *) denote that the coefficient is significant at the 1%, 5% and 10% levels, respectively.*