The Effect of Suspensions on Liquidity of the Chinese Stock Market

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ABSTRACT

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In this paper, I study the effect of suspensions on liquidity of stocks in the same industry or province in the Shanghai Stock Exchange A-share market from 1997 to 2017. I find that each additional suspended stock has a significant and positive effect on the bid-ask spread of non-suspended stocks in the same industry or province. Besides, suspensions lasting for a longer period of time have weaker impact on the liquidity of informationally and regionally related stocks than suspensions lasting for a short period. What's more, suspensions caused by different reasons have different impact on liquidity of related stocks. For suspensions due to limit hit, they are significantly and negatively related to the spread of non-suspended stocks in the same industry or province. This is due to the fact that according to the regulation that stocks hitting price limits for several continuous days will be suspended what leads to higher predictability of this type of suspension. But suspensions caused by negative news and neutral news have a significant and positive impact on illiquidity of other non-suspended stocks in the same industry or province. Thereby suspensions caused by negative news have a larger impact on the liquidity of informationally and regionally related stocks than suspensions caused by neutral news.

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1. Introduction

Suspension of trading in a stock, which means that the stock market stops trading in this stock for a period of time, is used by market regulators to protect investors' profits from extreme price movements. Usually, it is applied when a stock has experienced abnormal price fluctuations or the listed firm needs to provide more information on important issues. It allows investors to gather and analyze more information on the stock value when an important event occurs and make rational trades when trading resumes after the end of the suspension period. Firms can provide more information regarding abnormal price fluctuations, unusual stock transactions or regarding other substantial facts during the suspension period. Suspensions are also used for market supervision, to prevent secret deals and market manipulation. There are many researchers studying the effect of suspensions on liquidity of suspended stocks in different markets. Lee et al. (1994) finds that the trading volume and volatility do not increase immediately when the suspension ends. But the trading volume and volatility of the suspended stock will increase on the next trading day of resumption. Moreover, Frino et al. (2011) study the Australian stock market, Yong et al. (2008) study the Spanish stock market and Crowin et al. (2002) study the New York stock market. They all find that during the suspension, since investors are prohibited from trading the stock and the information flow is decreased due to uncertainty of stock price, the liquidity of the suspended stock will be lower after the suspension. Moreover, Jiang et al. (2009) study the impact of trading halts on the liquidity of informationally related stocks on the NYSE and find that the liquidity of informationally related stocks will decrease. Guo et al. (2017) study in the Taiwan stock market and find out the same result as Jiang et al. (2009). However, there is only a few studies investigating the Chinese stock market. Xu et al. (2014) studied how the market react after suspension in a short period of time in the Shanghai Stock Exchange (SSE). SSE is a large stock market with 33067.950 billion RMB (about 4897.649 billion USD) market capitalization and are 1383 A-share stocks. According to Tian (2007) investigation on the relation among the Chinese stock market and other markets in Asia, such as Hong Kong market, Taiwanese market and Japanese market, the Chinese stock market has a large impact on the other Asian stock markets. Besides, suspension is quite active in the market, where there are 48685 suspensions happened from 1997 to 2017. Differing from other stock markets, since some firms use suspension to avoid risks during the fluctuation period, suspensions in SSE may last for a really long time. There are about 12% of suspensions last longer than one trading day, which accounts for 83% of suspension period during two decades. Hence, it is necessary to study the suspension in Chinese stock market. This article is the first one to study the impact of suspension on not only the liquidity of informationally related stocks like Jiang et al. (2009) and Guo et al. (2017) analysis, but also the liquidity of locally related stocks.

Shive (2012) uses power outages to study the market efficiency when all local investors cannot trade in the market. She assumes all the local investors are informed investors in the market. She finds that the quoted spreads of local stocks decrease when the power outage happens. Due to a power outage, the adverse selection in the market shrinks since local investors, presumably informed, are barred from trading. Similar to power outages, suspensions prevent investors from trading. But during the power outages, information regarding the stock price is prevented from flowing in the market. Thus, it is necessary to investigate how local investors react when a stock headquartered in their region is suspended, with regard to trading in other local stocks. Besides, according to Kyle (1985) model, when the suspension happens in one province, the public information flow is reduced due to unobservable price dynamics of the suspended stock. The market maker cannot have a precise guess on a stock price of another closely located company due to the increase of fundamental uncertainty. This would make the liquidity lower. Moreover, in the Chinese stock market, 90% of investors in the market are individual investors, and one characteristic of individual investors in China is that they prefer to trade in stocks whose headquarters are in the same region as them (Seasholes and Zhu, 2010). Thus, it is meaningful to study the action of local investors when the suspension occurs.

Suspension is accepted to lessen liquidity and increase volatility (Mcinish and Wood, 1992; Lee et al.,1994). Moreover, Jiang et al. (2009) finds that the liquidity of informationally related stocks decreases when a stock is suspended. I test all these findings with a more comprehensive panel data in Shanghai A-share stock market, which includes 1383 stocks from 1 January 1997 to 31 December 2017. Hence, my database covers stocks from all the industries and all the provinces in the market during the two decades when the market developed from a small market with only 85 stocks and worth 912 billion RMB to the fifth largest market with 1383 stocks and market capitalization of 33067 billion RMB. Besides, Frino et al. (2011) investigates how good and bad news of suspensions impact the liquidity and volatility of the Australian market. According to reasons of suspension, I separate them into three sections: limit hits (including abnormal fluctuations and intraday temporary trading halts), neutral news (including announcement of board of directors, change in investment and equity, clarification announcement etc.) and negative news (including failing to publish announcement on important issues). I examine the relation between suspension reasons and liquidity.

I use the mean group estimator of dynamic heterogeneous panels (Pesaran and Smith, 1995) to run the regressions on my panel data set, containing spreads, suspensions and control variables. My approach differs from Guo et al. (2017) and Jiang et al. (2009) in three aspects. First, I investigate the stocks in the Chinses stock market instead of in Taiwan or US market, which is larger than Taiwan market and has more individual investors than the US market does. Second, the economic methodology I used is quite different from them. I use the panel data and calculate the mean group estimator to analyze how the suspension affects the liquidity in the market while Guo et al. (2017) checks the changes of the liquidity measures of stocks informationally related to the suspended stocks and runs the OLS regression to find the determinants of the suspension liquidity impact. My approach separates all the stocks in the market to get rid of bias caused by heterogeneous slopes. However, Guo et al. (2017) methodology runs the regression with all the stocks together. Third, Guo et al. (2017) only considers the suspension effect on the informationally related stocks, but I also consider the effect on the stocks in the same location as the suspended stocks.

My results show that suspension can lower the liquidity of the same stock at the end of the trading day. Consistent to Jiang et al. (2009) and Guo et al. (2017) findings, when a stock is suspended, liquidity of the informationally related stocks will decrease. Besides, I find that suspensions have a negative effect on liquidity of regionally related stocks. Moreover, according to Christie et al. (2002) study, investors need time to process information so that the longer the suspension lasts, the less impact suspension will have on liquidity of other related stocks. Thus, I run the same regression on suspensions with different suspension periods. It turns out that for each additional suspended stock, which lasts within one hour has a negative effect on the liquidity of no suspended stock in the same industry, and for suspensions lasting longer, the effect is the same. In addition, the difference is statistically significant at conventional levels. Furthermore, the effect of suspension within one hour on the spread of regionally related stocks is stronger than the effect of suspension longer than 81 hours on the spread of regionally related stocks. What is more, if the stock is suspended by limit hits, the liquidity of both the informationally related stocks and the regionally related stocks will rise. However, if the stock is suspended by neutral news or negative news, the liquidity of related stocks will decrease. According to the result of Wald test, suspensions caused by negative news has a greater impact on the illiquidity of informationally and regionally related stocks than suspensions caused by neutral news. For stocks' volatility, I get the same results as liquidity.

Guo et al. (2017) differs limit hits from suspensions, since investors are able to trade during limit hits within the limit hit price but not allowed to trade during suspensions. Thus, they study how limit hits affect the informationally related non limit hit stocks. They do the analysis on data from 2004 to 2013 on the Taiwanese stock market, which has 849 common stocks. In their paper, it shows that the average number of limit hits per year is 679.4. Comparing with the recent data of suspensions in SSE, which there are 808 announcements of suspension and 13053 suspensions in 2016, suspension happens more frequently in SSE. It is uncertain whether the results from Guo et al. (2017) methodology would be different from my approach. Thus, I use Guo et al. (2017) methodology to analyze the liquidity impact of suspended stocks on informationally related stock from 2016-2017 in 76 industries. The reason why I only chose those two years to do the analysis is that almost every stock had a suspension in one trading year before 2016 so that it is impossible to have a reference group which covers all the industries. Besides, their methodology needs a more precise criteria of industry classification since the maximum number of stocks in volatility group is 54 and the average of stocks in the group is 13.33. What is more, I use the same criteria of industry classification as my approach, 2012 CSRC Industry Classification, which classifies 76 industries in the market, to practice Guo et al. (2017) methodology.

Conforming to Guo et al. (2017), I find that trade-based liquidity of informationally related stocks increases when suspension happens. Compared with results from my approach, the growth ratio of bid-ask spread from Guo et al. (2017) method is higher. Moreover, I also expand Guo et al. (2017) method into investigating how suspension reasons affect the liquidity impact of suspended stocks on related stocks. It turns out that results got from two methodologies are quite different. From my approach, the relation between spread and the sum of informationally related or regionally related stocks is insignificant between 2016 to 2017. But the relationship is significant from 1997 to 2017. I find that the bid-ask spread of informationally related stocks decreases when the suspension is due to limit hits, and suspensions caused by neutral news and negative news both increase the bid-ask spread of related stocks. Suspensions due to negative news have a greater impact on the spread of related stocks than suspensions due to neutral news. However, the results from Guo et al. (2017) method indicates that all of the three kinds of suspension reasons will increase the bid-ask spread of related stocks. The result from my approach indicates that the difference of results from two methodologies might be caused by different definition of reference group, including control variables and the methodology.

Both Guo et al. (2017) and Jiang et al. (2009) use the same methodology to define the determinants of limit hits liquidity impact in different reference groups. They estimate how those determinants would affect the liquidity of informationally related stocks when suspension happens in the industry. They include variables related to suspension, such as the market share of suspended stock, market share of reference stock and market capitalization of reference stock. Moreover, they also consider dummy variable that captures suspension in typical announcement months and firm specific control variables, such as volume, close price and market capitalization of reference stock. Additionally, I separate the reference group into two parts according to the suspension reasons of their related stocks: limit hits and other reasons. For reference stocks related to suspensions caused by other reasons, I add a dummy variable to investigate whether suspensions caused by neutral news would affect the liquidity of reference stocks. It turns out that suspensions caused by neutral news have a negative impact on the trade volume ratio of informationally related stocks. Consistent with Tookes (2008) findings, the market share of suspended stocks has a positive impact on the liquidity impact, and investors would rather choose small companies to trade than large companies. What is more, the longer the suspension lasts, the greater impact it will have on liquidity of informationally related stocks.

In this paper, it is notable that liquidity of not only informationally related stocks but also regionally related stocks can be affected by suspensions in the same industry or province. Except for the finding that suspension has a negative impact on the liquidity of the stock, which is confirmed by many studies, I also find that different suspension reasons would have different effects on the liquidity of both informationally related stocks and regionally related stocks. Suspensions caused by limit hits would have a positive and significant impact on the liquidity of related stocks. However, suspensions due to neutral news or negative news will decrease the liquidity of related stocks, and suspensions due to negative news have a greater effect on the liquidity of informationally and regionally related stocks. For price volatility, I get quite similar results as liquidity. By analyzing non-suspended stocks which are informationally related to the suspended stock, I find that trade-based liquidity increases when the suspension happens no matter what suspension reason is. Furthermore, for the determinants of liquidity impact, I find that liquidity impact is positively related to the market share of suspended stocks, and investors prefer trading small firms. The suspension period in one trading day also has a positive impact on liquidity impact.

My paper is organized as follows. I first explain the institutional background of Shanghai Stock Exchange (SSE) and the suspension policy in the market. In section 3, I describe the hypothesis in this paper. In section 4, I describe the data and the main approaches used. In section 5, I discuss the results, and I present the conclusions in the last section.

2. Institutional background

Shanghai Stock Exchange (SSE) was established in December 1990, with only 6 A-share stocks. The market capitalization was 2.0826 billion RMB (about 435.3443 million USD). In 1997, the number of stocks increased to 85, and the market capitalization was 912 billion RMB. However, at the end of 2017, there are 1383 A-share stocks in SSE, with 33067.9504 billion RMB (about 4897.6486 billion USD) market capitalization. SSE ranks the fifth largest stock exchange market in the world in 2017, and it is the second largest in the Asian stock exchange markets. There are two trading periods during every Monday to Friday, excluding national holidays. The morning period starts from 9:30 to 11:30, and the afternoon period is from 13:00 to 15:00. Orders can be submitted 15 minutes before the market opens. The trading currency in SSE A share market is RMB, and the scale size is one cent. Moreover, SSE is an order-driven market, without any market makers or specialists.

There are three main reasons causing suspensions in SSE. First reason is important announcement, such as annual report, general meeting of shareholders, mergers and acquisitions, assets restructuration, etc. Secondly, the stock will be suspended when the security regulatory authority thinks that firms need to report their major issues. At last, if the firm is investigated due to suspected violation, the stock is forced to be suspended. Furthermore, in 2006, the security regulatory authority released a policy that allows stocks to be suspended due to price fluctuation. This means that if the deviation of closing price in three continuous trading days is $\pm 20\%$, the stock will be suspended by the regulatory authority. It can be resumed if the firm posts the announcement about explanation of the price fluctuation before 10:30 on the trading day.

From 1997 to 2017, there have been 48685 suspensions in SSE A share market, which last 691535 hours in total. And about 88% suspensions last within one trading day (4 hours) and have the resumption in the next trading day. For the rest of suspensions longer than one trading day, the sum of suspension period is 575206 hours, which accounts for 83.178% of all the suspension periods of all the stocks during twenty years. Among these suspensions, about 3.8509% suspensions last more than 80 hours (about 20 trading days).

Besides, firms use suspension to avoid market risk when there exists huge market fluctuation. For example, in 2015, SSE experienced several huge index fluctuations, which the highest point of Shanghai Composite Index was 5166.35 in June, and it reached its lowest point 2927.29 in August. On July 8, 2015, Shanghai Composite Index dropped about 5.90% and about 355 firms in SSE were suspended on that day. For those suspended stocks, the suspension reason of more than 50% stocks was major issues not announced, about 40% stocks' suspension reason was temporary suspension, and only about 5% suspensions were due to abnormal fluctuation. Many firms use suspension as a method to evade temporary risk, since their stock price will still drop at the same level as the degree of price decrease of the other stocks in the same industry after resumption. Thus, this will cause new panic in the market, which may cause a round of price decreases. Besides, a large amount of suspended stocks in the market will cause other stocks being short. Too many suspended stocks will also lower the liquidity of the market, which is not good for the development of the market.

Above all, inappropriate usage of suspension is a problem in SSE market. That is why the security regulatory authority released a policy to prevent malicious suspensions in the market in November 2018, which requires each suspension last no more than 25 days. But the effect of the policy still needs time.

3. Hypothesis development

Suspension provides investors a period of cooling-off time to digest the news and make a more rational strategic decision. Thus, it is a way to maintain profits of the investors. During the suspension, the liquidity will have changes. Bid-ask spread is a measurement of liquidity, which is affected by four elements: activity, risk, information and competition (Schwartz, 1988). According to Mcinish and Wood (1992), the less the number of trades when suspension occurs, the wider the bid-ask spread at the end of the trading day will be. The cost of adverse selection will increase during suspension (Stoll, 1989), so that the differential risk of stocks and intervals of trading day which will cause the increase of bid-ask spread (Mcinish and Wood, 1992).

Hypothesis 1. The bid-ask spread of suspended stock is wider at the end of the trading day.

Suspension is highly related to information asymmetry (Spiegel and Subrahmanyam, 2000). Jiang et al. (2009) investigates the relation between the trading halts of stocks listed on the NYSE and the liquidity of informationally related stocks, which are in the same industry as the halted stocks. They find that trading halt is significantly related to the liquidity of the informationally related stocks, and when the trading halt occurs, spreads of the stocks in the same industry as the halted one will increase. What is more, Guo et al. (2017) studies the impact of limit hits on the informationally related stock on the TWSE. They get the same result as Jiang et al. (2009). Therefore, it turns out that no matter it is trading halt or limit hits, when the stock is temporarily stopped for trading, investors will see it as a signal of the situation of the other stocks in the same industry and trade in other industries. However, the major difference between suspensions in SSE and in the US market is that suspensions longer than one trading day constitute a large portion of all suspensions in SSE. Additionally, Christie et al. (2002)

finds that investors would process more information when the suspension lasts longer so that there will be less uncertainty of the stock after resumption. Hence, it is reasonable to suggest that the effect of suspension on the liquidity of stocks informationally related or regionally related differs from different suspension periods.

Hypothesis 2. When a stock is suspended for a short period, the liquidity of the informationally related stock will decrease. But for stocks suspended for a long period of time, the impact of suspension on the liquidity of informationally related stocks will become weaker.

Except for informationally related stocks, liquidity of stocks in the same registered location may be affected by suspension. For example, Shive (2012) uses power outages to examine the impact of local investors on the stock price and market efficiency. She finds out that due to the power outage, the average spread of the stocks headquartered in the power outage area decreased. For stocks that are more frequently traded by local investors, their bid-ask spreads are wider than stocks less traded by local traders. When local investors are banned from trading due to power outage, the liquidity of stocks often traded by local investors decreases. Likewise, Kyle (1985) model indicates that a suspension would cut down the information flow of stocks in the same location so that the fundamental uncertainty would increase due to unobservable price dynamics. This would lead to lower liquidity and make investors switch to trading related non-suspended stocks. Thus, it is reasonable to assume that there is a negative and significant relationship between suspensions and the liquidity of locally related stocks.

Hypothesis 3. When a stock is suspended, the liquidity of the locally related stock will decrease.

Suspension is usually caused by price fluctuations and news release. In SSE, if the deviation of closing price in three continuous trading days reaches $\pm 20\%$, the stock will be suspended. This means that one of the factors causing suspension is that the stock price hits the lower limit or upper limit for several trading days. It is different from the definition of limit hits in other articles, which refers to price hits that investors can still trade within the trading range (Guo et al., 2017). Suspensions due to limit hits may not have an inverse relationship with liquidity as Chordia et al. (2002) finding in the New York Stock Exchange since the price hits continues for several days and they can predict the suspension. Thus, suspensions caused by limit hits is supposed to be positively related to bid-ask spread. Besides, for neutral news, which include interim report, merger and acquisition, stock expansion etc. Lakhal (2008) studies the stock market in France and finds that investors only react negatively to bad news but do not react to neutral news since neutral news does not transmit material information. This indicates that the market only reacts to unexpected news.

Hypothesis 4. Suspensions caused by limit hits have a positive effect on liquidity of related stocks. Suspensions caused by negative news have a stronger impact on liquidity of related stocks than suspensions caused by neutral news.

Except for liquidity, volatility is another highly discussed variable. Lee et al. (1994) finds that the volatility increases immediately after suspensions, no matter in which suspension type or news category the suspension is. Corwin et al. (2000) extends Lee et al. (1994) study, and they find that the increased volatility after the suspension is caused by the reduced depth in limit order book. Besides the studies on New York stock exchange market, studies on other markets, such as A. Frino et al. (2011) study on the Australian market, Kryzanowski and Nemiroff (1998) study on Toronto market, Wu (2003) study on Hong Kong market, etc., they get the same result that volatility increases after the suspension.

Hypothesis 5. Volatility increases significantly after suspension.

I follow Guo et al (2017) and Jiang et al. (2009) to examine the influence of suspensions on market conditions of stocks in the same industry by estimating the factors that identify liquidity effects. For example, Tookes (2008) finds that the suspension of stock with higher market share has a greater influence on the other stocks' liquidity in the same industry. Thus, the liquidity impact of the suspended stock on the informationally related stocks has a positive relation with the market share of suspended stock, and it has a negative relation with the market share of informationally related stocks. Tookes (2008) also finds that the largest liquidity impact is related to smaller informationally related firms. Hence, it turns out that investors would rather trade in small firms in the reference group when suspension happens. Jiang et al. (2009) shows that suspension period in a trading day is positively related to the liquidity impact on connected stocks. Besides, I also examine the relation between suspension reasons and liquidity impact.

4. Data

In this section, I explain the panel data used to run my regression model in 4.1. Then, I describe the suspension data used for Guo et al. (2017) methodology in 4.2.

4.1. Panel Data

I analyze the trading data of 1383 A share stocks traded on the Shanghai Stock Exchange (SSE), which contain almost every market capitalization in SSE market and are all valued and traded in RMB (Chan and Kwok, 2017), between 1 January 1997 and 31 December 2017 from

Thomson Datastream database. Xu et al. (2014) and Frino et al. (2011) only select the top 203 and 200 stocks, respectively according to the market capitalization in their data set. In order to have a clear view of the impact of suspension on the liquidity in the market, my data sample contains all the A share stocks traded in the market during the 20 years and involves a complete range of industry and location sectors.

I use the CSMAR database to identify 191096 suspensions placed on 1383 A share stocks on Shanghai Stock Exchange (SSE) between 1 January 1997 and 31 December 2017. Since I only focus on suspensions of trading, I remove all the suspension types of delisting and suspension of listing. The database offers information of the announcement date, suspension date, suspension time, resumption date, resumption time, trade suspension period and suspension reason.

In addition, I also obtain the industry data and location data from the CSMAR database. For the industry data, I use the 2012 CSRC Industry Classification as the criterion to separate all the stocks, which classifies all the industries into 76 groups. And the location data provides information about the province of the firm's registered city, which includes 31 provinces.

4.2. Data for liquidity impact

4.2.1. Suspension determination for reference group

I identify the suspensions for all the A share stocks on the Shanghai Stock Exchange market from CSMAR for the period from January 2016 to December 2017. And I also classify all the suspensions into different industries by the 2012 CSRC Industry Code, which is more precisely identified for the Reference Group methodology. Besides, as Jiang et al. (2009) did, I dropped all the suspensions that happened on the same trading day in the same 2012 CSRC Industry Code due to my Reference Group methodology.

For each suspended stock, I determine the informationally related stocks in the same 2012 CSRC Industry Code. For each industry, I start with the top 15 stocks which have the largest market share in the industry and the rest of the suspended stocks in the same industry during the sample period.

4.2.2. Volatility reference group categorization

I intend to categorize a reference group of stocks in the same 2012 CSRC Industry which are informationally related to the suspended stocks. According to Caballe and Krishnan (1994) model of informationally related trading for different kinds of traders and assets, market-makers can notice all the order flows so that the informed traders would decide their demand for stocks together instead of separately. Therefore, returns can denote the market measurement of the informationally related stocks.

Using Jiang et al. (2009) method for the volatility reference group, I abstract the daily return data from CSMAR database for all the stocks that have the same CSRC Industry Code as the suspended stock. And the daily volatility of the stock is calculated as the square of the residual of the market model. I drop any stock if its squared residual has a Pearson correlation with the one of the suspended stock below 10% level. And if there is no stock having a significant correlation with the suspended stock, the suspended stock is dropped. I calculate the correlation and classify the reference group for each year during the sample period. Besides, the correlations of volatility represent the extent of co-movement between the suspended stock and reference stock of the informed trading.

4.2.3. Illustrative statistics for volatility reference group

In Table 1, Panel A, I collect the statistics for suspensions from 2016 to 2017. For brevity's sake, I only analyze the result of suspensions happened during the whole period. It turns out that there are 13053 suspensions in 2016 and 14011 suspensions in 2017 that can be used to define the volatility group. And I find that there are 63.705% of suspensions which are caused by neutral news while suspensions due to limit hits only constitute 0.754% of suspensions. The suspension duration is much longer than Jiang et al. (2009) results. The mean of suspension period is 3.9878 hours, indicating that most of suspensions would take almost a whole trading day. Besides, the market share of suspended stocks varies from 0.018 to 98.067.

Table 1, Panel B also presents the statistics for the stocks in the volatility reference group. The average number of stocks informationally related to the suspended stock for each industry is 11.346, and the maximum number is 38 stocks related to the suspended stock in the same industry. The mean of market shares of reference stocks is 7.496, which is higher than the one of suspended stocks.

Above all, the volatility reference group involves a large range of industries and stocks informationally related to suspended stocks.

5. Methodology

In this section, I first discuss my methodology for the panel data and the variables used in the regression model in 5.1. Next, I illustrate Guo et al. (2017) methodology for analyzing the impact of suspensions, which is treated as a Robustness test.

5.1. Panel data regression

5.1.1 Variables description

In order to avoid the heterogeneous slopes caused by fixed-effected model and get the chain reaction of independent variable to dependent variables, I use the mean group estimator of dynamic heterogeneous panels (Pesaran and Smith, 1995) to calculate the coefficient means of dependent variables in the following regression to get the relationship between suspension and the liquidity of the stock:

$$Y_{i,t} = \alpha_i + \beta_i S_{i,t} + \gamma_i C_{i,t-1} + \lambda_i Y_{i,t-1} + \varepsilon_{i,t}$$

where $Y_{i,t}$ represents dependent variables, including bid-ask spread and price range. $S_{i,t}$ denotes the set of suspension related explanatory variable. $C_{i,t-1}$ represents the set of control variables.

The mean group estimator is to estimate each regression of stock separately and calculate the mean of coefficients. To avoid serial dependence, I include lagged dependent variable in my model. However, the lagged dependent variable would cause the bias of dynamic regression. In this case, the regression can avoid biases caused by dynamic regression and heterogeneous slopes which might be caused by fixed-effect model. Besides, it is suitable for panel data with large cross-sections and a long period of time (Pesaran and Smith, 1995).

The variables used to run the regression model are described and outlined in Table 3. As my major dependent variable, the relative bid-ask spread (SPREAD) is calculated as $\frac{ask\ price - bid\ price}{(ask\ price + bid\ price) \times 0.5}$, adjusted by eliminating the negative ones and the ones during the suspension period to represent the liquidity of the stock. And I use price range (RANGE) as the dependent variable to check how suspension affects the volatility of the stock.

For the suspension variables, I first introduce the dummy variable of suspension (SUS) to represent the suspension happened in each trading day for each stock. What is more, I consider whether the duration of suspension would have effect on the liquidity. Thus, I introduce an independent variable to my model, the duration from suspension till the market closes (SUS_END). Both Guo et al. (2017) and Jiang et al. (2009) discuss how limit hits and trading halts influence the liquidity of the informationally related stocks respectively. Therefore, I investigate how the liquidity of the non-suspended stocks in the same industry as the suspended stock acts when the suspension occurs by adding the variable SAMEINDU_SUS_k, the total number of the other suspended stocks in the same industry as the suspended one, which is measured as following:

$$\text{SAMEINDU\_SUS}_k = \sum_{i=1}^{I} sus_i - sus_k$$

where sus_i represents the suspension happens in industry i and sus_k represents the dummy variable of suspension for stock k.

Besides, I also introduce the variable of the total number of the other stocks in the same province as the suspended one (SAMELOCA_SUS) to investigate how the traders will respond when there is stock in the same location as the stock that they already invested in or intend to invest. The variable SAMELOCA_SUS is calculated in the same way as SAMEINDU_SUS.

Since suspensions longer than one trading day constitute most part of the total hours of suspension period and Christie et al. (2002) finds that investors need time to process information, it is possible to study suspensions lasting for different time periods. I separate all the suspensions into the following periods: suspensions in one hour and longer than one month (longer than 81 hours). Moreover, I include variables indicating the sum of other stocks in the same industry as the suspended stock lasting for different periods and the sum of other stocks in the same province as the suspended stock lasting for different periods.

The suspension data from CSMAR database also contains reasons for suspension. So under the premise of the content of news from the press and returns around the suspension, whether the return of stock increases or decreases after the suspension, I distinguish them into three suspension reasons: limit hits (including abnormal fluctuations and intraday temporary trading halts), negative news (including failing to publish announcement on important issues) and neutral news (including announcement of board of directors, change in investment and equity, clarification announcement etc.). Thus, dummy variables SUS_LIMIT, SUS_NEUTRAL and SUS_NEGATIVE, which equal to 1 when the suspension is caused by limit hits, neutral news and negative news respectively, are involved to discuss the relation between suspension reason and liquidity of stock.

Then I consider to combine the above parts together to investigate whether the suspension caused by different reasons would influence the liquidity of stocks in the same industry. Variable SAMEINDU_SUS_LIMIT, the total number of the other stocks in the same industry as the suspended stock caused by limit hits, is measured as following:

$$\text{SAMEINDU\_SUS\_limit}_k = \sum_{i=1}^{I} sus\_limit_i - sus\_limit_k$$

where sus_limit_i represents the suspension due to limit hits happens in industry i and sus_limit_k represents the dummy variable of suspension due to limit hits for stock k. And variable SAMEINDU_SUS_NEUTRAL, which denotes the total number of the other suspended stocks in the same industry as the suspended stock caused by neutral news, and SAMEINDU_SUS_NEGATIVE, which indicates total number of the other suspended stocks in the same industry as the suspended stock caused by negative news, are calculated in the same way.

For the control variables, I mainly concern for the firm features and trading disclosure. For the firm features, since Guo et al. (2017) and Jiang et al. (2009) both discuss the relation between firm size and liquidity impact, I use market capitalization (SIZE) as one of my control variables. Although analysis coverage, dividend payment and free float are closely related to stock liquidity (Dhiensiri et al., 2010; Gupta and Banga, 2010; Hamon et al., 1999), these variables may not change through years. Thus, in order to have a more comprehensive study of all the A-share stocks in SSE, I do not include these variables as my control variable so that I can have more stocks to be included in the regression.

Then, I also consider the control variables related to trading and price disclosure. Since return has a relation with the liquidity (Jun et al., 2003), I expand the variable related to return into overnight return (OR). Furthermore, suspension would increase trading volume (Frino et al., 2011). I also include turnover by volume (TUR_VOL) as a control variable.

5.1.2. Statistics summary

Table 4 shows the statistics summary of all the variables. As shown in Table 4, there are more suspended stocks related to suspensions lasting longer than 81 hours than suspended stocks related to suspensions lasting within an hour since the mean of the sum of suspended stocks related to suspensions within one hour is smaller than the one related to suspensions longer than 81 hours. Furthermore, there are more informationally related stocks than locally related stocks to the suspended stock, where the maximum of the total number of the other stocks in the same industry as the suspended one is 34, while the maximum of the total number of the other stocks in the same province as the suspended one is 55. Besides, mean of suspension caused by limit hits, neutral news and negative news are 0.0006, 0.021 and 0.013 respectively, which indicating that neutral news is the most frequent suspension reason among them. In Table 5, I find out that suspension due to neutral news is highly related with suspension. The correlation between suspension and suspension due to neutral news is 0.834 while the correlation between suspension and suspension due to limit hits is 0.425.

For a stock's liquidity, the maximum of bid-ask spread is 0.137 and the mean is 0.002. The average of trade value in a trading day is 1.978 billion RMB, and the average of shares traded in a trading day is 14.891 million shares. The average of the ratio of issued shares available for ordinary traders is 52.936%, which means that for each stock, there are more than a half shares of stock which can be traded in the secondary market. Those results denote that SSE has a high liquidity. Besides, the maximum of total number of analysis coverage in a trading day is 1. The average size of all the A-share stocks is 18.271 billion RMB. The mean of net return is 2.70

bps. And the mean of overnight return is lower than the one of daily, which are -0.091% and 0.171% respectively.

5.2 Method for liquidity impact

5.2.1. Liquidity impact of suspensions on reference stocks

Guo et al. (2017) analyze the market liquidity through different liquidity measures. And Fernandez (1999) indicates the importance to measure the liquidity in different ways in order to have a clear view of all the aspects of the liquidity. Therefore, I choose spread as the quote-based liquidity measure to study the tightness of liquidity supply and trade value as the trade-based liquidity measure to evaluate the changes of liquidity demand. (Guo et al. 2017)

I investigate the liquidity impact by calculating the percentage of increase(decrease) of the liquidity measure of the reference stock on day D when the suspension occurs to the liquidity measure of the reference stock during the benchmark period from day D-5 to day D-1. For the liquidity measure x, I use the following equation to define the liquidity impact of the suspended stock k on a reference stock k_i:

$$a_{k_i}^x = \frac{x_{k_i} - \overline{x_{k_i}}}{\overline{x_{k_i}}} \times 100\%$$

where x_{k_i} represents the liquidity measure of the i-th reference stock k_i on the day when stock k is suspended, and $\overline{x_{k_i}}$ represents the liquidity measure of the reference stock k_i from day D-5 to day D-1.

After I evaluate all the $a_{k_i}^x$ for $i = 1, \cdots, I$, the liquidity impact of the suspended stock k on its I-reference stocks is calculated as below:

$$a_k^x = \frac{1}{I} \sum_{i=1}^{I} a_{k_i}^x$$

Then, I conduct the Wald test to analyze whether the liquidity impact of the suspension during the sample period is significantly not equal to one. And the whole process is done for different liquidity measure of the stocks in every reference group.

5.2.2 Determinants of the liquidity impact of the suspension on the stocks in the same industry

I now extend my investigation to evaluate and examine the determinants on the stock level instead of only focusing at the suspension level. I use the same methodology as Jiang et al. (2009) and Guo et al. (2017)'s. I evaluate spread and trade volume for suspensions for the whole suspension period, on the first day of suspension after its announcement and on the first day of suspension after its first announcement. And my dependent variables are the percentage increase(decrease) of every liquidity measure on the suspension day to the one during the benchmark period for informationally related stocks. The logarithm is to get rid of nonlinearities.

To select the determinants of liquidity impact in my regression model, I first consider the control variables of temporal patterns which can affect the level of increase(decrease) of every liquidity measure. I include the dummy variable $Amnth$ which equals to 1 if the suspension occurs in January, April, July and October, which are the typical announcement months, and 0 otherwise. Moreover, I also consider the firm size as the one of the factor of liquidity impact on the point of microstructure market. To control for these features, I use CSMAR data to estimate three variables, $Lnrcap$, $Lnrvol$ and $Lnrprc$, which are the logarithms of market capitalization, turnover by volume and closing price of the reference stocks on the day before the suspension respectively.

Tookes (2008) indicates that the liquidity impact of suspension should be increased by the higher market share of the suspended stock (in the year when the suspension happens), $Hmkt$. Moreover, there is a positive relation between the product of the market shares of the suspended stock and the reference stock, $Lntrmkt$, and the liquidity impact. And she also indicates that the suspension has a stronger effect on the smaller companies than the larger companies, which means that the higher the logarithm of market capitalization of the reference stock one trading day before the suspension day, $Lnrprc$, the smaller changes on the liquidity impact. And Jiang et al. (2009) and Guo et al. (2017) also involve the market share of the reference stock, $Rmkt$, to manage the relative influence between market capitalization and market share. Besides, the correlation of volatility, $Vcor$, is included to test the relation between suspension and informational relationship. To control the length of suspension, the ratio of the suspension time in a trading day, $Hdur$, is added to the regression.

What is more, I also concern about the influence of the suspension reasons on the liquidity impact. Guo et al. (2017) studies the liquidity impact for lower and upper limit hits. Therefore, I distinguish my suspension reasons into two groups: limit hits and other reasons. And for suspension of other reasons, I also separate them into two parts depending on the press news and the returns around the suspension: neutral news and negative news. So I add the dummy variable $News\ Neutral$ in regression of other reasons to investigate the relation between suspensions due to other reasons and liquidity impact. Thus, I use the following regression model:

$$LnLiqR_{i,k} = \propto + \beta_1 Amnth_k + \beta_2 Hmkt_k + \beta_3 Rmkt_{i,k} + \beta_4 Lntrmkt_{i,k} + \beta_5 Lnrcap_{i,k} + \beta_6 Lnrvol_{i,k} + \beta_7 Lnrprc_{i,k} + \beta_8 Vcor_{i,k} + \beta_9 Hdur + \beta_{10} News\ Neutral + \varepsilon_{i,k}$$

where k_i represents the i-th reference stock k_i with the suspended stock k.

6. Results

In this section, I will first describe the results of the panel data regression. Then, to separate the results, I also use Guo et al. (2017) methodology to analyze the suspension data from 2016 to 2017. At last, I will discuss the difference of the results from those two methods.

6.1. Panel data regression

6.1.1. Ask-bid spread after suspension

Table 6 represents the results of the regressions of bid-ask spread on suspension calculated by mean group estimator. First of all, I check the effect of suspension of the stock on its own liquidity at the end of the day. As mentioned in Guo et al. (2017) study, if the investors notice an approaching suspension, the signal impact of suspension will rapidly extend in the market. In order to spread out the short-term fluctuations and focus on the longer-term trends, I add a 5-day-period backward moving average of spread and range to the regression of spread, as shown in Panel A. I chose day D-5 as my benchmark period since the day instantly before the suspension day might not be a clean benchmark day. (Guo et al., 2017)

In Panel A, Column (1), I find out that the coefficient of the dummy variable of suspension is 1.700 bps, which is positive and significant. Furthermore, if the suspension occurs, it will have 2.871 bps of effect on bid-ask spread when the suspension ends, indicating that suspension would decrease the liquidity at the end of the day. Besides, the period from suspension happens to the closure of the market on a trading day has a positive and significant relation with bid-ask spread. This indicates that the earlier the suspension happens in a trading day, the wider the bid-ask spread will be at the end of the suspension.

Second, I test whether the suspension of a stock would affect the liquidity of the related firms. In Column (2), I run the regression including only observations when the observed stock was not suspended. It shows that suspension has a positive and significant relation with the bid-ask spread of the other stocks in the same industry and in the same province. The coefficient of the sum of suspended stocks in the same industry as the suspended stock is 0.21 bps. Thus, for each additional standard deviation of suspended stock in the same industry, the standard deviation of bid-ask spread of non-suspended stock will increase 3.898%. Consistent to Guo et al. (2017) and Jiang et al. (2009) results, when a stock is suspended, traders tend to treat it as a sign and move to other industries. However, differing from suspension in US market and limit hits in Taiwan market, suspensions longer than one-day account for a large proportion of the total suspension period in the Chinese market. What is more, Christie et al. (2002) studies the trading halts on Nasdaq and prove that during the suspension period, the more information transmits on the market, the less uncertainty there will be after the resumption. This means that the relation between bid-ask spread and the sum of stocks in the same industry as the suspended stock varies in different suspension periods. Hence, in Column (3) and (4), I separate all the suspensions into two different groups according to their suspension periods and study how the relation changes for different length of suspensions. In Column (3), the coefficient of the sum of stocks in the same industry as the suspended stock whose whole suspension period is one hour is 0.380 bps, indicating that for every additional stocks informationally related to suspended stocks which last one hour has 2.466 bps effect on bid-ask spread. In Column (4), I find that although the sum of stocks informationally related to stocks which suspend more than 81 hours has a positive and significant relation with bid-ask spread, its coefficient is 0.170 bps, which is less than the one of stocks informationally related to one-hour suspended stocks. The result of Wald test is significant at conventional levels. Therefore, consistent with Christie et al. (2002) finding, suspensions lasting for a longer period have a weaker impact on liquidity of informationally related stocks than suspensions lasting within one hour since investors have more time to process information they get and make their decisions. According to the results in Column (3) and (4), I find out that for suspension which lasts for a shorter period, investors will treat it as a sign of the industry which it belongs to, and they will choose stocks in other industries to trade. But for stocks suspended for a longer time, since investors can get more information about the suspension before they make the decision, which lowers the uncertainty after the suspension, some of them may still prefer to invest in same industry as the suspended stock. Thus, the bid-ask spread of stocks informationally related to suspensions lasting for a longer time is narrower than the one of stocks related to suspensions lasting for a short period.

Besides, concerning the location, as the results shown in Column (2), each additional stock in the same province as the suspended stock has the same effect on bid-ask spread as stocks in the same industry as the suspended stock. In general, suspension has a positive and significant relation with bid-ask spread of non-suspended stocks in the same province. The coefficient of the sum of other suspended stock in the same province as the suspended stock is 0.220 bps. For one standard deviation of the number of suspended regionally related stock, the standard deviation of bid-ask spread will increase by 7.2%. Consistent with Shive (2012) findings, the bid-ask spread of non-suspended stock becomes wider when suspension occurs in the same province. Besides, conforming to Christie et al. (2002) findings, suspensions lasting for a longer period of time have less impact on the bid-ask spread of regionally related non-suspended stocks. In Column (3) and (4), the coefficient of the sum of stocks in the same industry as one-hour suspended stock is 0.38 bps, and the coefficient of the sum of stocks in the same industry as stock suspended longer than 81 hours is 0.17 bps. Thus, for each additional stock in the same industry as the one-hour suspended stock and suspended stock lasting longer than 81 hours, it has 2.482 bps and 2.422 bps of effect respectively on bid-ask spread. I do the Wald test to check the effect of suspension caused by different reasons on the spread of regionally related stocks. It turns out that consistent with Christie et al. (2002) findings, suspensions lasting for a longer period have a weaker impact on liquidity of regionally related stocks than suspensions lasting within one hour since investors have more time to process information they get and make their decisions. For stocks suspended for a short period of time, there is less information transmitted in the market. Meanwhile, for local traders, it is rational to trade local stocks when they think that they are informed (Shive, 2012). Hence, when the stock is suspended within a trading day, traders would not choose other stocks in the same province to trade due to lack of information. But if the suspension lasts for a longer period, traders may prefer to invest in stocks in the same industry due to less adverse selection, which makes the effect of suspension lasting longer than 81 hours on the bid-ask spread of regionally related stocks weaker than suspension within one hour.

In Panel A, Column (5), I discuss the relation between suspension reasons and liquidity. It turns out that both the suspension caused by limit hits and the suspension caused by neutral news do not have a different impact on the liquidity as suspension caused by negative news in terms of their t-statistics. Therefore, I discuss whether the suspension reasons will have the effect on liquidity when the stocks are informationally or regionally related. In Column (6), I find that the suspension caused by limit hits has a negative and significant relation with bid-ask spread of the firms in the same industry and location. The coefficient of the sum of stocks informationally related to stock which is suspended by limit hits is -0.45 bps, and the coefficient of the sum of stocks regionally related to stock which is suspended by limit hits is -0.33 bps. If one stock is suspended due to limit hits, for one standard deviation of each additional stock, the bid-ask spread of other stocks in the same industry will decrease 0.480% of standard deviation and the bid-ask spread of other stocks in the same province will decrease 0.593% of standard deviation, indicating that the informed traders will still invest in the same industry and province as the suspended stock caused by limit hits. The reason is that investors can predict the suspension due to limit hits since it only occurs after several continuous days of price hits.

Thus, investors would still invest in the same industry and province when suspensions due to limit hits happen. Colum (7) represents the relation between bid-ask spread of related non-suspended stocks and the sum of stocks suspended due to neutral news in the same industry or province. The coefficients of the sum of suspended stocks caused by neutral news in the same industry and in the same province are 0.17 bps and 0.19 bps respectively. These coefficients mean that for each additional unit of suspended stock due to neutral news, it has 2.403 bps of effect on the bid-ask spread of non-suspended stocks in the same industry as the suspended stocks and 2.406 bps of effect on the bid-ask spread of non-suspended stocks in the same province as the suspended stocks. In Column (8), the coefficients of the sum of stocks suspended caused by negative news in the same industry and in the same province are 0.36 bps and 0.34 bps respectively. This indicates that for each additional unit of stock suspended due to negative news, it will have 2.489 bps of effect on the bid-ask spread of informationally related non-suspended stocks and 2.486 bps of effect on the bid-ask spread of regionally related non-suspended stocks. Corresponding to Chordia et al. (2002) finding, the result of Wald test shows that investors have greater action when the suspension is caused by negative news than neutral news. Thus, the bid-ask spread of non-suspended stocks informationally or regionally related to stocks suspended by negative news is wider than the bid-ask spread of stocks related to suspended stocks caused by neutral news.

Besides, all the control variables conform with the previous studies. First, corresponding to Kempf et al. (2008), the price range has a positive and significant impact on bid-ask spread. The net return has a negative and significant relation with bid-ask spread, which means that return is sensitive to the fluctuation of liquidity (Acharya and Pedersen, 2005; Amihud, 2002). The coefficient of market capitalization is positive and significant, which indicates that firms with smaller size have a higher liquidity. Since trade volume is treated as a proxy for liquidity (Lagos et al., 2009), the coefficient of trading volume is positive and significant to bid-ask spread.

6.1.2. Range and return after suspension

In Table 7, I use price range to examine the relation between suspension and volatility. As mentioned before, price range has a positive relation with bid-ask spread (Kempf et al., 2008) so that the results are expected to be qualitatively similar to bid-ask spread. In Table 7 Panel A, I find that suspension has a positive and significant relation with price range, indicating that suspension will increase the volatility when the suspension ends. The coefficient of suspension is 0.014, indicating that suspension has 7.193% of effect on the bid-ask spread when the suspension ends. Column (2) shows that the sum of stocks informationally or regionally related to the suspended stock has a positive and significant relation with the volatility of the non-suspended stocks. The coefficient of the sum of other suspended stocks in the same industry as the suspended stock is 3.80 bps, indicating that for each additional suspended stock, it will have 3.00% of effect on the volatility of non-suspended stocks in the same industry. What is more, the coefficient of the sum of other suspended stocks in the same province as the suspended stock is 3.73 bps, which means that each additional suspended stock will increase 6.112% of standard deviation of the volatility of non-suspended stocks in the same province.

6.2. Comparison of methodologies

6.2.1. Robustness check with Guo et al. (2017) methodology

Table 8, Panel A, shows that both spread and trade volume of the reference stocks in the same industry increase significantly during the whole suspension period for all the suspension reasons. The increase happened in trade volume is about 12.9% higher than the one in spread. These results are similar with Guo et al. (2017) result of the lower limit hits during the whole limit-hit period, where the relative spread increase 13.035% of the spread and trade volume increase 25.995% of the trade volume. Thus, the increase of the mean of spread during two years is 1.83 bps. I also find that spread and trade volume of reference stocks related to different suspension reasons are all significantly positive during the suspension. Moreover, spread of reference stocks related to suspended stocks for limit hits reason is the lowest among the three suspension reasons, which supports my result in Table 6, Panel A that when the reason of suspension is limit hits, the spread of all the other stocks in the same industry will decrease after the suspension. The spread for neutral news increases 13.208% of spread during the suspension, which is the highest among all the suspension reasons. The increase of spread of reference stocks related to suspensions caused by neutral news is 1.849 bps. This indicates that neutral news has the strongest impact of lowering the liquidity in the same industry. Furthermore, the trade volume of the reference stocks related to the stocks suspended due to neutral news increases only 17.312% of trade volume, which is lower than the other two reasons. Besides, the increase of trade volume for suspensions due to negative news is higher than limit hit. According to the observations in Panel A, Panel B and Panel C, I can find that suspensions due to negative news would take a longer time before resumption of trading. Therefore, when I consider the whole suspension period, investors have a longer time to make a decision, so for the longer period, negative news will cause higher increase in the trade volume of the reference stocks than limit hits.

To compare with the result of my approach of panel data regression on bid-ask spread, I run the regressions of bid-ask spread from 2016 to 2017 using mean group estimator. Results are shown in Table 6, Panel B, Column (1) to (4). I find that suspension has a negative and insignificant relation with bid-ask spread of stocks informationally related, which is different from the result in Table 8, Panel A. Besides, the relation between stocks informationally related to stocks suspended by different reasons and bid-ask spread is not significant. This might be caused by the definition of the reference group. In my approach, I include all the non-suspended stocks informationally related to the suspended stock. I only include stocks with more than 250 observations during two years in order to dismiss stocks that are not tradeable for half of the time. However, in Jiang et al. (2009) definition of reference group, they exclude the stocks which do not have a high correlation with the suspended stock. As shown in Table 1, the average of companies in a reference group is 11.34. However, in Table 2, the average number of companies in the same industry in 2017 is 18.20. Thus, in my approach, I have more non suspended stocks used than Jiang et al. (2009) have. In addition, Jiang et al. (2009) deletes all the suspensions that happened on the same trading day, while my approach includes all the suspensions in the market. Besides, Guo et al. (2017) methodology only calculates the percentage change of the liquidity measure, but my methodology can get the percentage change while considering control variables. I run the regression separately for each stock while Guo et al. (2017) methodology study all the stocks together so that Guo et al. (2017) methodology might have heterogeneity bias. It turns out that my approach is more suitable for bigger market with long time of trading history while Guo et al. (2017) method would deal well with studying market during a short period of time.

Panel B and Panel C shows the same significant increase in spread and trade volume as Panel A. The difference is that the increase of spread is higher than the one of trade volume. This may be caused by the fact that Panel B and Panel C only captures the liquidity on the first day of the suspension. Since investors do not have enough time to investigate the suspension, the liquidity of the reference stocks in the same industry will not increase a lot, which is comparable to the upper limit hits result of Guo et al. (2017), where trade volume increases 34.935% higher than relative spread. Since the suspension due to limit hits usually takes one or a few days, the results of limit hits reason is similar to the ones in Panel A. However, for suspensions caused by neutral news and negative news, the trade volume of reference stocks related to neutral news suspension is lower than the one related to negative news suspension. This indicates that investors would rather invest in the industry where the suspension due to negative news happens on the first day of suspension. Meanwhile, the increase of spread of reference stocks related to the suspension of neutral news is higher than the one of negative news, which means that the suspension caused by neutral news will lower the liquidity in the industry on the first day of suspension.

6.2.2. Determinants of suspension liquidity impact

Table 9 represents the regression results for volatility reference group for different suspension periods, which are the whole suspension period (Panel A), the first suspension day after each announcement (Panel B) and the first suspension day after first suspension announcement (Panel C). In Panel A, I mainly analyze the result of trade volume regression for other reasons. I believe that the feature of informed traders can be better reflected by this regression when they select the trading targets. The cogitation is that the informed trading will grow when the trade volume increases. What is more, the regression for other reason has more observations, which can give us a better view of the market. My findings are that for the suspended companies, the liquidity impact of suspension is rising in their market share, and traders prefer small companies to trade, which conform to Tookes (2008) results. The coefficient of HMKT is significantly positive and the coefficient of LNRCAP is significantly negative. Consistent with Tookes (2008)'s result, the coefficient of INTRMKT is 0.24 bps and significant, which indicates that when the product of market share of the suspended stock and reference stock increase, it will have a greater influence on the liquidity. Besides, I find that the coefficient of HDUR is 0.541 and significant, which means if the suspension stays longer, it will have a greater impact on the liquidity. The coefficient of NEWS_NEUTRAL is significantly negative, indicating that suspension caused by neutral news has a smaller impact on liquidity, which supports my results in Table 6, Panel A that suspensions due to neutral news do not have a significant relation with spread. For results of spread regression for other reason, I find that the coefficient of HMKT is significantly negative and the coefficient of NEWS_NEUTRAL is insignificant. The rest of results are qualitatively the same to trade volume.

For the trade volume regression for limit hits in Column (3), the coefficient of HMKT is -0.007 and significant, indicating that when the stock is suspended due to limit hits, its market share will have lower liquidity impact. Moreover, for the spread regression for limit hits in Column (1), the coefficient of LNRCAP is significantly negative, which means that the traders still prefer to trade small companies when the suspension reason is limit hits. What is more, HDUR has a positive relation with the liquidity variable. Combined with my result in Column (4), no matter what the suspension is, the longer the suspension holds, the greater impact on liquidity.

In Panel B, I only consider the suspensions happened after each announcement. In Column (4), I find that informed traders would not simply concentrate on small companies, they would also consider the balance between firm size and the related company's market share before they finish the trade. The coefficient of RMKT is 0.001 and significant. In Column (1), the coefficient of HMKT is 0.009 and significant, which indicates that on the first day of the suspension, the market share of the suspended stocks due to limit hits has increasing impact on liquidity. The coefficient of LNCAP is -0.245 and significant, which provides a solid evidence of traders' preference on small companies. But the coefficient of HDUR is insignificant in the four columns and the coefficient of NEWS_NEUTRAL is positive and significant in Column (2). This might be caused by the fact that I only consider the first day of suspension and usually those suspensions caused by other reasons would last for a long time, so the result in Panel B can only provide us a short-term and incomplete view. Furthermore, the results presented in Panel C, which contains the results only on the first day of suspension after its first announcement, are qualitatively similar to the results in Panel B. Since both tables contain the incomplete suspension, the result might have some difference with Panel A which contains all the suspensions happened in two years.

7. Conclusion

In general, I study a sample of suspension data on all the A-share stocks on Shanghai Stock Exchange market from 1997 to 2017 to learn how suspensions affect the liquidity of other stocks in the same industry or province. Consistent to Jiang et al. (2009) and Guo et al. (2017) studies, I find that for each additional suspended stock in the same industry or province as the suspended stock, the liquidity of the non-suspended stock will decrease when the suspension occurs. Besides, Christie et al. (2002) find that investors need time to process all the information on the market so that the suspension period has an effect on investors' actions. Thus, I separate all the suspensions into two groups according to their suspension period, within one hour and more than 81 hours. I find that if a suspension lasts within an hour, each additional stock in the same industry or province as the suspended stock has a positive effect on the bid-ask spread of the non-suspended stock. According to the result of Wald test, we find that suspensions lasting within one hour have a stronger impact on the liquidity of informationally and regionally related stocks than stocks suspending longer than 81 hours. Besides, I also study the relation between bid-ask spread and suspensions due to different reasons. For suspensions caused by limit hits, the relationship between the sum of other stocks in the same industry or province and the bid-ask spread of non-suspended stock is significant and negative. This might be caused by the fact that stocks hitting the price limits for several continuous trading days will be suspended due to limit hits for an hour to cool off so that investors can predict the suspension in advance. However, for suspensions caused by negative news and neutral news, each additional stocks in the same industry or province as the suspended stock has a significant and positive influence on the bid-ask spread of non-suspended stock. Besides, suspensions caused by negative news have a greater impact on the liquidity of informationally and regionally related stocks than suspensions caused by neutral news do.

Besides, I also use Guo et al. (2017) methodology to study the liquidity impact of suspension from 2016 to 2017. It turns out that both bid-ask spread and trade volume of the reference stocks increase on the trading day when suspension happens in the same industry. The results are stronger with Guo et al. (2017) methodology, which might be caused by different sample size of reference group, the inclusion of control variables and different methodologies. An interesting extension of this study is to study the effects of suspension on liquidity of related stocks on the Shenzhen Stock Exchange (SZSE). The difference between SSE and SZSE is that SZSE contains more small and medium size firms while there are more state-owned and large size firms in SSE. Moreover, the P/E ratio in SZSE is usually higher than the one in SSE. Then, it would be possible, through comparing the results on these two exchanges, to find out whether the effect of suspension on liquidity of related stocks is magnified by size or P/E ratio.

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Table 1. Statistics for stock volatility reference group

According to 2012 CSRC Industry Code, I analyze stocks in the same industry as the suspended stock for possible involvement in volatility reference group. For the reference group, I involve the stock informationally related to the suspended stock which has a significant Pearson correlation with the suspended stock. And I make the reference group for suspension including for the whole period, suspension after each of its announcement and suspension after its first announcement. Panel A shows the characteristics of suspensions from 2016 to 2017. Panel B presents the characteristics of the reference group.

	SUS	SUS_START	SUS_DISCONTINOUS
Panel A: Characteristics of sample suspensions			
Total number of suspensions			
2016	13053	808	633
2017	14011	727	599
Suspension reasons			
Limit hits	204	161	159
Neutral news	17241	1042	834
Negative news	9619	332	239
Suspension duration (hour)			
Mean	3.988	3.785	3.727
Min	1	1	1
Max	4	4	4
Median	4	4	4
Suspended stock market share			
Mean	5.612	5.824	5.759
Min	0.018	0.018	0.018
Max	98.067	98.067	98.067
Panel B: Reference group characteristics			
Reference Group characteristics			
Mean companies per group	11.346	11.331	11.387
Min companies per group	1	1	1
Max companies per group	38	38	38
Median companies per group	9	10	9
Reference company market shares			
Mean	7.496	7.246	7.187
Min	0.009	0.009	0.009
Max	108.801	108.801	108.801

Table 2. Summary of stocks in the same industry

Number of companies in the same industry		
	2016	2017
Max	67	83
Min	1	1
Average	16.08	18.20

Table 3. Variable description

Firm features		
SIZE	Market capitalization	$SIZE_{i,t} = SHARE_{i,t} \times Closing\ price_{i,t}$
Spread, trading and price disclosure		
SPREAD	Bid-ask spread	$spread_{i,t} = \frac{ask\ price_{i,t} - bid\ price_{i,t}}{(ask\ price_{i,t} + bid\ price_{i,t}) \times 0.5}$
RANGE	Price range	$RANGE_{i,t} = \lg(high\ price_{i,t}) - \lg(low\ price_{i,t})$
NETR	Net return	$NETR_{i,t} = \lg(\text{Total return index}_{i,t}) - \lg(\text{Total return index}_{i,t-1})$
OR	Overnight return	$OR_{i,t} = \frac{opening\ price_{i,t} - closing\ price_{i,t-1}}{closing\ price_{i,t-1}}$
TUR_VOL	Turnover by volume	Number of shares traded for a stock on a trading day.
Variables related to suspension		
SUS	Suspension	Dummy variable, equals to 1 if the stock is suspended, 0 otherwise.
SUS_END	Duration from suspension till the market closes	$\text{SUS\_END} = 15{:}00 - \text{the time when suspension happended}$
SAMEINDU_SUS	Total number of the other stocks in the same industry as the suspended one	$\text{SAMEINDU\_SUS}_k = \sum_{i=1}^{I} sus\_industry_i - sus_k$
SAMELOCA_SUS	Total number of the other stocks in the same province as the suspended one	$\text{SAMELOCA\_SUS}_k = \sum_{i=1}^{I} sus\_location_i - sus_k$
SUS_ONE	Suspension within one hour	Dummy variable, equals to 1 if the stock is suspended within one hour, 0 otherwise.
SUS_81H	Suspension longer than 81 hours	Dummy variable, equals to 1 if the stock is suspended longer than 81 hours, 0 otherwise.
SAMEINDU_SUS_ONE	Total number of the other stocks in the same industry as the stock suspended within one hour	$\text{SAMEINDU\_SUS\_ONE}_k = \sum_{i=1}^{I} sus\_ONE\_industry_i - sus\_ONE_k$
SAMELOCA_SUS_ONE	Total number of the other stocks in the same province as the stock suspended within one hour	$\text{SAMELOCA\_SUS\_ONE}_k = \sum_{i=1}^{I} sus\_ONE\_location_i - sus\_ONE_k$

SAMEINDU_SUS_81H	Total number of the other stocks in the same industry as the stock suspended longer than 81 hours	$\mathrm{SAMEINDU\_SUS\_81H}_k = \sum_{i=1}^{I} sus\_81H\_industry_i - sus\_81H_k$
SAMELOCA_SUS_81H	Total number of the other stocks in the same province as the stock suspended longer than 81 hours	$\mathrm{SAMELOCA\_SUS\_81H}_k = \sum_{i=1}^{I} sus\_81H\_location_i - sus\_81H_k$
SUS_LIMIT	Suspension due to limit hits	Dummy variable, equals to 1 if the stock is suspended due to limit hits, 0 otherwise.
SUS_NEUTRAL	Suspension due to neutral news	Dummy variable, equals to 1 if the stock is suspended due to neutral news, 0 otherwise.
SUS_NEGATIVE	Suspension due to negative news	Dummy variable, equals to 1 if the stock is suspended due to negative news, 0 otherwise.
SAMEINDU_SUS_LIMIT	Total number of the other stocks in the same industry as the suspended stock caused by limit hits	$\mathrm{SAMEINDU\_SUS\_LIMIT}_k = \sum_{i=1}^{I} sus\_limit\_industry_i - sus\_limit_k$
SAMELOCA_SUS_LIMIT	Total number of the other stocks in the same location as the suspended stock caused by limit hits	$\mathrm{SAMELOCA\_SUS\_LIMIT}_k = \sum_{i=1}^{I} sus\_limit\_location_i - sus\_limit_k$
SAMEINDU_SUS_NEUTRAL	Total number of the other stocks in the same industry as the suspended stock caused by neutral news	$\mathrm{SAMEINDU\_SUS\_NEUTRAL}_k = \sum_{i=1}^{I} sus\_neutral\_industry_i - sus\_neutral_k$
SAMELOCA_SUS_NEUTRAL	Total number of the other stocks in the same location as the suspended stock caused by neutral news	$\mathrm{SAMELOCA\_SUS\_NEUTRAL}_k = \sum_{i=1}^{I} sus\_neutral\_location_i - sus\_neutral_k$
SAMEINDU_SUS_NEGATIVE	Total number of the other stocks in the same industry as the suspended stock caused by negative news	$\mathrm{SAMEINDU\_SUS\_NEGATIVE}_k = \sum_{i=1}^{I} sus\_negative\_industry_i - sus\_negative_k$
SAMELOCA_SUS_NEGATIVE	Total number of the other stocks in the same location as the suspended stock caused by negative news	$\mathrm{SAMELOCA\_SUS\_NEGATIVE}_k = \sum_{i=1}^{I} sus\_negative\_location_i - sus\_negative_k$

Table 4. Statistics summary for variables

	Min	Max	Mean	Median	Standard Deviation
SUS	0.000	1.000	0.051	0.000	0.220
SUS_END	0.000	4.000	0.054	0.000	0.434
SAMEINDU_SUS	0.000	34.000	0.989	0.000	2.131
SAMELOCA_SUS	0.000	55.000	2.109	1.000	3.780
SAMEINDU_SUS_ONE	0.000	1.000	0.008	0.000	0.090
SAMELOCA_SUS_ONE	0.000	2.000	0.028	0.000	0.166
SAMEINDU_SUS_81H	0.000	12.000	0.572	0.000	1.219
SAMELOCA_SUS_81H	0.000	24.000	1.294	0.000	2.342
SUS_LIMIT	0.000	1.000	0.001	0.000	0.026
SUS_NEUTRAL	0.000	1.000	0.022	0.000	0.145
SUS_NEGATIVE	0.000	1.000	0.013	0.000	0.114
SAMEINDU_SUS_LIMIT	0.000	2.000	0.015	0.000	0.122
SAMELOCA_SUS_LIMIT	0.000	2.000	0.041	0.000	0.206
SAMEINDU_SUS_NEUTRAL	0.000	8.000	1.407	1.000	1.524
SAMELOCA_SUS_NEUTRAL	0.000	13.000	3.186	2.000	2.802
SAMEINDU_SUS_NEGATIVE	0.000	5.000	0.586	0.000	0.940
SAMELOCA_SUS_NEGATIVE	0.000	8.000	1.275	1.000	1.512
SPREAD	0.000	0.137	0.002	0.001	0.001
RANGE	0.000	1.778	0.040	0.026	0.025
NETR	-0.816	2.483	0.000	0.000	0.029
SHARE	0.000	356000000.000	2912979.000	736250.000	18423133.000
SIZE	16538.500	8050000000.000	18271035.000	10170227.000	97966424.000
OR	-0.602	8.051	-0.001	-0.001	0.017
TUR_VOL	0.000	209000000.000	14890.790	7370.400	140598.300
TRADE VALUE	1.810	104000000.000	197844.700	88758.900	654288.400

Table 5. Correlation matrix of dependent variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
SUS																					
SUS_END_	0.03																				
INDU_SUS	-0.02	0.00																			
LOCA_SUS	0.03	0.01	0.07																		
INDU_ ONE	0.00	0.00	0.06	0.00																	
LOCA_ ONE	0.00	0.00	0.01	0.07	0.04																
INDU_ 81H	-0.02	0.00	0.90	0.05	0.01	0.01															
LOCA_ 81H	0.03	0.01	0.05	0.95	0.00	0.05	0.05														
SUS_LIMIT	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00													
SUS_NETRUAL	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17												
SUS_NEGATIVE	0.86	0.02	-0.02	0.04	0.01	0.00	-0.02	0.04	0.00	0.00											
INDU_ LIMIT	0.00	0.00	0.10	0.00	0.71	0.03	0.04	0.00	0.00	0.00	0.00										
LOCA_ _LIMIT	0.01	0.00	0.01	0.10	0.03	0.79	0.00	0.07	0.00	0.00	0.01	0.06									
INDU _NEUTRAL	-0.02	0.00	0.90	0.05	0.01	0.00	0.79	0.04	0.00	0.00	-0.02	0.04	0.00								
LOCA_ NEUTRAL	0.02	0.01	0.06	0.92	0.00	0.07	0.05	0.89	0.00	0.00	0.03	0.00	0.10	0.06							
INDU_ NEGATIVE	-0.01	0.00	0.75	0.06	0.02	0.01	0.71	0.05	0.00	0.00	-0.01	0.04	0.01	0.40	0.04						
LOCA_ NEGATIVE	0.03	0.01	0.05	0.77	-0.01	0.03	0.05	0.75	0.00	0.00	0.04	0.00	0.06	0.03	0.50	0.07					
NETR	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	-0.01	-0.01	0.00	0.00	0.00	-0.01				
OR	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.00	0.00	-0.01	-0.01	-0.01	0.01	0.00	0.00	0.41			
RANGE	-0.01	0.00	0.05	-0.01	-0.01	-0.03	0.04	-0.03	0.01	0.01	-0.01	0.03	0.02	0.07	-0.02	0.01	0.00	-0.04	-0.14		
SIZE	0.05	0.00	-0.11	0.06	0.00	0.00	-0.11	0.07	0.00	0.00	0.06	0.00	0.00	-0.13	0.06	-0.05	0.04	0.01	0.00	-0.09	
TUR_VOL_	0.01	0.01	-0.05	-0.01	0.00	-0.02	-0.05	-0.01	0.00	0.00	0.01	0.01	-0.01	-0.05	-0.01	-0.03	-0.01	0.07	-0.01	0.17	0.31

Table 6. The liquidity measure of bid-ask spread after the suspension.

Panel A represents the results of regressions of bid-ask spread with dynamic statistics on suspension calculated by mean group estimator. I add 5-period backward moving average to spread and range variables. SPREAD represents the ratio of difference between ask price and bid price to the mean of ask price and bid price, excluding the observations during the suspension and these negative ones. SUS equals 1 when the stock is suspended on that day and 0 otherwise. SUS_END denotes the duration from the time when suspension happens to the closure of the market on the trading day. SAMEINDU_SUS and SAMELOCA_SUS represent all the other suspended stocks in the same industry or in the same province when one stock is suspended. SAMEINDU_SUS_ONE and SAMELOCA_SUS_ONE represent all the other suspended stocks in the same industry or in the same province when one stock is suspended for one hour. SAMEINDU_SUS_81H and SAMELOCA_SUS_81H represent all the other suspended stocks in the same industry or in the same province when one stock is suspended longer than 81 hours. SUS_LIMIT, SUS_NEUTRAL and SUS_NEGATIVE are the dummy variables which equal to 1 if the suspension reason is limit hit, neutral news and negative news respectively, and 0 otherwise. SAMEINDU_SUS_LIMIT and SAMELOCA_SUS_LIMIT represent all the other suspended stocks in the same industry or in the same province when suspension reason is limit hits. SAMEINDU_SUS_NEUTRAL and SAMELOCA_SUS_NEUTRAL represent all the other suspended stocks in the same industry or in the same province when suspension reason is neutral news. SAMEINDU_SUS_NEGATIVE and SAMELOCA_SUS_NEGATIVE represent all the other suspended stocks in the same industry or in the same province when suspension is caused by negative news. SPREAD(-1) denotes the liquidity one day before the suspension day. RANGE is the difference between the logarithm of high price and the logarithm of low price. NETR denotes the difference between the logarithm of total return index and the logarithm of total return index one day before. SIZE, OR, DR and TUR_VOL are the market capitalization, overnight return, daily return and turnover by volume respectively.

Panel B represents the result of regressions of bid-ask spread with all the other stocks in the same industry or location as the suspended stock from 2016 to 2017 calculated by mean group estimator. Parameter coefficients and standard error are informed. Statistical significance at the 1%, 5% and 10% levels are denoted by ***, ** and *.

Panel A

	(1) SPREAD	(2) SPREAD	(3) SPREAD	(4) SPREAD	(5) SPREAD	(6) SPREAD	(7) SPREAD	(8) SPREAD
SUS	0.000170*** (0.0000)				0.000095 (0.0002)			
SUS_END	0.000010*** (0.0000)							
SAMEINDU_SUS		0.000021*** (0.0000)						
SAMELOCA_SUS		0.000022***						

		(0.0000)						
SAMEINDU_SUS_ONE			0.000038***					
			(0.0000)					
SAMELOCA_SUS_ONE			0.000048***					
			(0.0000)					
SAMEINDU_SUS_81H				0.000017***				
				(0.0000)				
SAMELOCA_SUS_81H				0.000014***				
				(0.0000)				
SUS_LIMIT					-0.000065			
					(0.0002)			
SUS_NEUTRAL					0.000127			
					(0.0002)			
SAMEINDU_SUS_LIMIT						-0.000045***		
						(0.0000)		
SAMELOCA_SUS_LIMIT						-0.000033**		
						(0.0015)		
SAMEINDU_SUS_NEUTRAL							0.000017***	
							(0.0000)	
SAMELOCA_SUS_NEUTRAL							0.000019***	
							(0.0000)	
SAMEINDU_SUS_NEGATIVE								0.000036***
								(0.0000)
SAMELOCA_SUS_NEGATIVE								0.000034***
								(0.0000)
SPREAD(-1)	0.024094***	0.022148***	0.022617***	0.022289***	0.028009***	0.022258***	0.022138***	0.022463***
	(0.0013)	(0.0015)	(0.0015)	(0.0015)	(0.0011)	(0.0015)	(0.0015)	(0.0015)

RANGE(-1)	0.003007***	0.002960***	0.002796***	0.002965***	0.003520***	0.002920***	0.002949***	0.002907***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
@MAV(SPREAD(-1),5)	0.335413***	0.307104***	0.321459***	0.309470***	0.355256***	0.320460***	0.307539***	0.311679***
	(0.0046)	(0.0054)	(0.0054)	(0.0055)	(0.0050)	(0.0054)	(0.0054)	(0.0055)
@MAV(RANGE(-1),5)	0.000457***	0.000279**	0.000360**	0.000601***	0.002425***	0.000575***	0.000268**	0.000614***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
NETR(-1)	-0.001166***	-0.001037***	-0.001038***	-0.001041***	-0.001312***	-0.001078***	-0.001040***	-0.001039***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
OR(-1)	-0.000514***	-0.000242**	-0.000334**	-0.000273**	-0.000904***	-0.000332**	-0.000269***	-0.000268***
	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0002)	(0.0002)	(0.0002)
SIZE(-1)	0.000000***	0.000000***	0.000000***	0.000000***	0.000000***	0.000000***	0.000000***	0.000000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
TUR_VOL(-1)	0.000000***	0.000000***	0.000000***	0.000000***	0.000000***	0.000000***	0.000000***	0.000000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
C	0.001670***	0.001595***	0.001580***	0.001605***	0.001705***	0.001594***	0.001594***	0.001621***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Observations	2973034	3144294	3095089	2922807	226315	3123671	3139140	3101496
R-squared	0.145191	0.148420	0.148910	0.148769	0.164262	0.147327	0.148620	0.295589
Mse	0.002235	0.002179	0.002178	0.002181	0.002179	0.002189	0.002179	0.002187

Panel B	(1) SPREAD	(2) SPREAD	(3) SPREAD	(4) SPREAD
SAMEINDU_SUS	-0.000005 (0.0000)			
SAMELOCA_SUS	-0.000001 (0.0000)			
SAMEINDU_SUS_LIMIT		0.000012 (0.0000)		
SAMELOCA_SUS_LIMIT		-0.000016 (0.0000)		
SAMEINDU_SUS_NEUTRAL			-0.000002 (0.0000)	
SAMELOCA_SUS_NEUTRAL			-0.000002 (0.0000)	
SAMEINDU_SUS_NEGATIVE				-0.000004 (0.0000)
SAMELOCA_SUS_NEGATIVE				0.000003 (0.0000)
SPREAD(-1)	0.009391*** (0.0036)	0.010767*** (0.0037)	0.009292*** (0.0036)	0.010060*** (0.0036)
RANGE(-1)	0.001423*** (0.0002)	0.001444*** (0.0002)	0.001454*** (0.0002)	0.001409*** (0.0002)
@MAV(SPREAD(-1),5)	0.050002*** (0.0066)	0.071318*** (0.0065)	0.049368*** (0.0066)	0.049758*** (0.0066)

@MAV(RANGE(-1),5)	0.002503***	0.002371***	0.002539***	0.002540***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
NETR(-1)	-0.000265***	-0.000281***	-0.000283***	-0.000271***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
OR(-1)	0.000512**	0.000509**	0.000571**	0.000506**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
SIZE(-1)	0.000000***	0.000000***	0.000000***	0.000000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
TUR_VOL(-1)	0.000000***	0.000000***	0.000000***	0.000000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
C	0.001844***	0.001803***	0.001857***	0.001861***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Observations	321342	274006	317259	305928
R-squared	0.135392	0.133005	0.134578	0.136506
Mse	0.000858	0.000853	0.000861	0.000863

Table 7. Range after the suspension.

Panel A represents the results of regressions of price range with dynamic statistics on suspension calculated by mean group estimator. I add 5-period backward moving average to spread and range variables.

Panel A

	(1) RANGE	(2) RANGE
SUS	0.013598****	
	(0.0003)	
SAMEINDU_SUS		0.000380***
		(0.0000)
SAMELOCA_SUS		0.000373***
		(0.0000)
SPREAD(-1)	0.121120***	0.155743***
	(0.0101)	(0.0178)
RANGE(-1)	0.144658***	0.144391***
	(0.0011)	(0.0012)
@MAV(SPREAD(-1),5)	-0.029168	-0.064974*
	(0.0204)	(0.0348)
@MAV(RANGE(-1),5)	0.512405***	0.497651***
	(0.0019)	(0.0021)
NETR(-1)	-0.032138***	-0.033443***
	(0.0006)	(0.0007)
OR(-1)	0.042130***	0.044600***
	(0.0015)	(0.0017)
SIZE(-1)	0.000000*	0.000000***
	(0.0000)	(0.0000)
TUR_VOL(-1)	0.000000***	0.000000***
	(0.0000)	(0.0000)
C	0.011071***	0.010367***
	(0.0002)	(0.0002)
Observations	3069463	3207840
R-squared	0.345418	0.356343
Mse	0.018663	0.018596

Table 8. Liquidity impact of stocks suspended for different reasons in volatility reference group

Panel A represents the percentage difference for two liquidity measures: spread and trade volume for different suspension reasons when all suspensions are included. The liquidity impact is defined as the increase(decrease) ratio of the liquidity measures when the suspension occurs to the liquidity measure during the benchmark period, which is from D-5 day to D-1 day.

Panel B represents the percentage difference of the liquidity measures on the first day of the suspension after each of its announcement.

Panel C represents the percentage difference of the liquidity measures on the first day of the suspension after its first announcement. Statistical significance at the 1%, 5% and 10% levels are denoted by ***, ** and *.

Panel A: SUS				
	All Reasons	Limit Hits	News Neutral	News Negative
Spread (%)	13.0347***	10.6097***	13.2076***	12.7874***
Observations	275952	1535	170372	104045
Trade Volume (%)	25.9950***	20.7427***	17.3119***	39.8251***
Observations	226077	1175	137886	87016

Panel B: SUS_START				
	All Reasons	Limit Hits	News Neutral	News Negative
Spread (%)	10.5277***	10.9820***	11.57447***	6.9966***
Observations	16328	1226	11527	3575
Trade Volume (%)	4.4158***	23.7447***	2.3526***	5.2801***
Observations	13973	929	9985	3059

Panel C: SUS_DISCONTINOUS				
	All Reasons	Limit Hits	News Neutral	News Negative
Spread (%)	10.6972***	10.0930***	11.8536***	6.8591***
Observations	13071	1210	9261	2600
Trade Volume (%)	4.4200***	23.4476***	1.7229***	6.3928***
Observations	11091	908	8002	2181

Table 9. Determinants of suspension liquidity impact in volatility reference group.

Panel A represents the results of the following regression when all the suspensions are included:

$$LnLiqR_{i,k} = \propto + \beta_1 Amnth_k + \beta_2 Hmkt_k + \beta_3 Rmkt_{i,k} + \beta_4 Lntrmkt_{i,k} + \beta_5 Lnrcap_{i,k} + \beta_6 Lnrvol_{i,k} + \beta_7 Lnrprc_{i,k} + \beta_8 Vcor_{i,k} + \beta_9 Hdur + \beta_{10} News\ Neutral + \varepsilon_{i,k}$$

where $LnLiqR$ is the logarithm of the liquidity measure, spread and trade volume. $Amnth$ takes the value of 1 when the suspension happens in January, April, July and October, and 0 otherwise. $Hmkt$ and $Rmkt$ are the share of sales of the suspended stocks and reference stocks during the suspended year respectively. $Lntrmkt$ is calculated by the share of sales of suspended stocks multiplying share of sales of reference stocks. $Lnrcap$, $Lnrvol$ and $Lnrprc$ are the logarithms of market capitalization, turnover by volume and closing price of the reference stocks on the day before the suspension. $Vcor$ denotes the correlation coefficient of suspended stocks and reference stocks. $Hdur$ is the ratio of the suspension time in a trading day. $News\ Neutral$ is 1 when the suspension reason is neutral news, and 0 otherwise.

Panel B represents the results of the above regression when the suspension on the first day of each announcement is included.

Panel C represents the results of the above regression when only the suspension on the first day of its first announcement is included. Parameter coefficients and standard error are informed. Statistical significance at the 1%, 5% and 10% levels are denoted by ***, ** and *.

Panel A: SUS				
SUS Reason	limit hits (1) Log spread ratio	other reasons (2) Log spread ratio	limit hits (3) Log trade volume ratio	other reasons (4) Log trade volume ratio
C	1.140465***	1.293686***	1.695665***	0.634468***
	(0.3389)	(0.0734)	(0.2582)	(0.0596)
AMNTH	0.077545*	0.008166**	0.073839**	-0.012221***
	(0.0441)	(0.0034)	(0.0350)	(0.0026)
HMKT	0.003054	-0.002480***	-0.007477**	0.000902***
	(0.0043)	(0.0003)	(0.0035)	(0.0002)
RMKT	-0.001108	-0.002244***	0.001025	-0.000746***
	(0.0031)	(0.0002)	(0.0024)	(0.0002)
LNTRMKT	0.000052	0.000185***	-0.000073	0.000024***
	(0.0002)	(0.0000)	(0.0002)	(0.0000)
LNRCAP	-0.225799***	-0.174531***	-0.022646	-0.010240***
	(0.0522)	(0.0048)	(0.0393)	(0.0037)
LNRVOL	-0.023294	-0.009459**	-0.065308*	0.110306***
	(0.0473)	(0.0043)	(0.0355)	(0.0033)
LNRPRC	1.398195***	0.762761***	-0.002334	0.020092***
	(0.0809)	(0.0068)	(0.0639)	(0.0053)
VCOR	-0.272527**	-0.119898***	0.001325	-0.056888***
	(0.1081)	(0.0074)	(0.0831)	(0.0057)
HDUR	0.219880***	0.391618***	0.042942	0.540860***
	(0.0584)	(0.0670)	(0.0446)	(0.0549)
NEWS_NEUTRAL		0.048505		-0.018818***
		(0.0032)		(0.0025)

Observations:	1351	181146	1091	181709
R-squared:	0.2554	0.0877	0.0203	0.0097
F-statistic:	51.1001	1742.0928	2.4889	177.2855

Panel B: SUS_START

SUS Reason	limit hits (1) Log spread ratio	other reasons (2) Log spread ratio	limit hits (3) Log trade volume ratio	other reasons (4) Log trade volume ratio
C	1.056633***	2.174304***	1.649316***	1.397027***
	(0.3684)	(0.1438)	(0.2741)	(0.0964)
AMNTH	0.032466	0.061935***	0.048944	0.024094***
	(0.0485)	(0.0138)	(0.0383)	(0.0093)
HMKT	0.009305**	0.000214	-0.002021	0.000820
	(0.0045)	(0.0009)	(0.0037)	(0.0006)
RMKT	-0.000955	-0.002094**	0.002519	0.001033*
	(0.0032)	(0.0008)	(0.0024)	(0.0006)
INTRMKT	-0.000063	0.000030	-0.000192	-0.000110***
	(0.0002)	(0.0000)	(0.0001)	(0.0000)
LNRCAP	-0.244740***	-0.313411***	0.016443	0.029554**
	(0.0575)	(0.0190)	(0.0423)	(0.0124)
LNRVOL	0.019301	-0.057644***	-0.106492***	-0.052354***
	(0.0501)	(0.0166)	(0.0367)	(0.0109)
LNRPRC	1.442924***	1.193334***	-0.089796	-0.124716***
	(0.0833)	(0.0263)	(0.0638)	(0.0175)
VCOR	-0.219797*	-0.042400	0.036651	-0.017156
	(0.1148)	(0.0302)	(0.0860)	(0.0204)
HDUR	0.068143	-0.007721	-0.026899	-0.030673
	(0.0660)	(0.0810)	(0.0504)	(0.0540)
NEWS_NEUTRAL		0.031388**		-0.016871*
		(0.0151)		(0.0102)
Observations:	1225	15075	928	12983
R-squared:	0.2709	0.1824	0.0188	0.0060
F-statistic:	50.1581	336.0247	1.9528	7.8111

Panel C: SUS_DISCONTINOUS				
SUS Reason	limit hits	other reasons	limit hits	other reasons
	(1)	(2)	(3)	(4)
	Log spread ratio	Log spread ratio	Log trade volume ratio	Log trade volume ratio
C	1.019925***	2.232844***	1.757048***	1.454251***
	(0.3733)	(0.1586)	(0.2770)	(0.1047)
AMNTH	0.048166	0.065254***	0.055864	0.020300**
	(0.0483)	(0.0155)	(0.0381)	(0.0103)
HMKT	0.008843*	-0.000201	-0.002190	0.000986
	(0.0045)	(0.0011)	(0.0037)	(0.0007)
RMKT	-0.001152	-0.001649*	0.003103	0.001039
	(0.0032)	(0.0010)	(0.0024)	(0.0006)
INTRMKT	-0.000063	0.000035	-0.000203	-0.000144***
	(0.0002)	(0.0001)	(0.0001)	(0.0000)
LNRCAP	-0.245096***	-0.322243***	-0.002278	0.019190
	(0.0582)	(0.0217)	(0.0425)	(0.0139)
LNRVOL	0.024371	-0.058343***	-0.098089***	-0.043799***
	(0.0508)	(0.0190)	(0.0369)	(0.0123)
LNRPRC	1.445450***	1.191012***	-0.095110	-0.125005***
	(0.0846)	(0.0299)	(0.0649)	(0.0196)
VCOR	-0.185297	-0.064282*	0.034476	-0.018369
	(0.1166)	(0.0345)	(0.0871)	(0.0229)
HDUR	0.082539	-0.005333	-0.049337	-0.052907
	(0.0681)	(0.0818)	(0.0520)	(0.0537)
NEWS_NETURAL		0.034681**		-0.019955*
		(0.0176)		(0.0119)
Observations:	1209	11835	907	10122
R-squared:	0.2675	0.1807	0.0209	0.0067
F-statistic:	48.6475	260.8008	2.1271	6.7722

Table 10. Result of Wald test

$$H_0: Coef(1) = Coef(2)$$
$$H_1: Coef(1) \neq Coef(2)$$

Chi-square is calculated as $\frac{(Coef(1)-Coef(2))^2}{se(Coef(1))^2+se(Coef(2))^2}$, and the Chi-square is distributed with one degree of freedom.

Coefficient 1 & Coefficient 2	Chi-square	P-value
SAMEINDU_ONE & SAMEINDU_81H	4.067	0.044
SAMELOCA_ONE & SAMELOCA_81H	4.512	0.034
SAMEINDU_ NEGATIVE & SAMEINDU_ NEUTRAL	7.288	0.007
SAMELOCA_ NEGATIVE & SAMELOCA_ NEUTRAL_	10.707	0.001