Trading Halts or Price Limits: Which is Better?

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Current version: August, 2003

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Abstract

We compare the relative performance of trading halts to price limits using Spanish market data. According to our empirical evidence, trading activity increases after trading halts and limit hits. Volatility stays at the same level after trading halts, but increases after limit hits. Our evidence also shows that the bid-ask spread is reduced after trading halts, but is even higher after lower limit hits. For price discovery, information is efficiently reflected into stock prices once trading resumes after trading halts, but there is evidence of market overreaction for upper limit hits. Overall, our result is consistent with Subrahmanyam (1995); trading halts seem to perform better than price limits in achieving their intended goals.

Current version: August, 2003

JEL Classification: G14, G18, G19
Keywords: Trading halts; Price limits; Market quality; Price discovery.

Trading Halts or Price Limits: Which is Better?

In efficient markets, asset prices reflect all publicly available information, and prices change only in response to relevant new information (Fama, 1970). That is, any artificial interruption imposed on the market should have little impact on the price movements. However, organized exchanges generally have special rules or procedures that come into play in connection with events that result in, or are likely to result in, large changes in asset prices. Following the 1987 Crash, the level of interest in procedures for limiting large and sudden changes in prices has increased. The Brady Report (1988) suggests the imposition of circuit breaker mechanisms, such as trading halts and price limits, to protect the market system. It appears that stock exchanges in the U.S. prefer trading halts to price limits. The NYSE has imposed both market-wide trading halts, known as Circuit Breakers, and individual news or order-imbalance trading halts. The news-related trading halts also exist in the Nasdaq. However, unlike those stock exchanges, the U.S. futures markets seem to favor price limits. Many countries in Europe and Asia also impose price limits on their stock markets[1]. Our objective is to compare trading halts with price limits in terms of their relative effectiveness in achieving their intended goals. We answer this question by examining data from the Spanish stock market where trading halts and price limits co-exist.

By definition, trading halts represent a temporary interruption in the trading of an individual asset on an exchange, while price limits are boundaries set by market regulators to confine daily movements of security prices within a predetermined price range. Even though trading halts and price limits are both considered circuit breakers, they differ in several ways[2]. First, trading halts imply a complete cessation of trading activity, but, in the case of price limits, trading is still permissible as long as it is within the preset trading range. Second, trading halts do not have limitations on price movements as price limits do. Third, trading halts are not mechanically or predictably imposed. They are subjectively imposed under certain circumstances by exchange officials or supervising authorities. That is, it is easier for investors to observe when a price will hit the limits than to predict when a trading halt will be called.

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[1] For example, Austria, Belgium, France, Greece, Italy, Netherlands, Spain, Switzerland, and Turkey in Europe and China, Japan, Korea, Malaysia, Taiwan, and Thailand in Asia have price limits in stock markets.

[2] We focus on individual trading halts. For details on market-wide circuit breakers imposed on the NYSE, please see Goldstein and Kavajecz (2000).

When circuit breakers are activated, proponents argue, investors have more time to evaluate new information and make rational decisions. In the case of trading halts, trading is suspended so investors have a cooling-off period to obtain and digest new information. Price limits prevent investors from trading outside the predetermined range; therefore, after a limit is hit, they can either trade at the limit price or simply decide not to trade. In the latter case, the effect is similar to trading halts because there is a cooling-off period for investors to re-evaluate the market information. Based on this cooling-off argument, it is expected that with trading halts and price limits stock prices become more informative, uncertainty is reduced, and investors are protected from excessive price movements.

In previous literature, trading halts and price limits are either treated equally or studied separately. Telser (1981) informally argues that the rule-based price limits are superior to the discretionary trading halts because the former are more predictable. Unfortunately, no theoretical model is developed nor any empirical test performed to support that argument. To the best of our knowledge, there are only two studies formally comparing trading halts with price limits. Subrahmanyam (1995) analyzes theoretically the relative desirability of discretionary and rule-based procedures to halt trade. He argues that discretionary closures allow exchange regulators to bring more information (e.g., market liquidity and volatility) into the closure decision than just the size of the price movement, so they can be more effective than price-triggered closures. Since trading halts are considered discretionary closures and price limits are rule-based procedures, based on Subrahmanyam, trading halts should be more effective than price limits. Coursey and Dyl (1990) conduct an experimental study to compare the market's adjustment to significant new information when price limits or trading halts are present. Their findings seem to support that the adjustment of asset prices to new information is more effective in markets with price limits than in ones with trading halts. Apparently, this result contradicts Subrahmanyam's argument. We attempt to provide empirical evidence to resolve these conflicting views. As far as we know, this paper is the first to empirically compare the performance of trading halts and price limits using market data.

The Continuous Spanish Stock Market, known as the SIBE[3], provides an excellent natural setting for empirically comparing the performances of trading halts and price limits because both mechanisms have been adopted in this market. Since trade-to-trade movements are essential for conducting microstructure studies, we examine the transaction data from the

[3] SIBE stands for Sistema de Interconexión Bursátil Español, which means the Spanish Stock Exchange Interconnection System.

SIBE. In the spirit of Subrahmanyam (1995), we hypothesize that trading halts are more effective than price limits because exchange officials incorporate relevant information into the trading halt decision and can ask companies to provide related information. For the purpose of this paper, we call this the discretion hypothesis. In essence, we investigate the pattern of trading activity, liquidity, volatility, and the speed of price discovery in the period surrounding trading halts and limit hits, and then compare the performances of these two circuit-breaking mechanisms. On average, halted firms are larger in size and more actively traded than limit-hitting firms. Furthermore, reasons for trading halts are usually announced while the triggers for limit hits are oftentimes unclear, especially for small firms that are not followed by the press. That is, trading halts are called discretionarily (thus the discretion hypothesis) with a reason, but limit hits are reached solely based on the price movement without a clear reason.

Our results show that trading activity increases after trading halts and limit hits. Volatility stays at the same level after trading halts, but increases after limit hits. We also show that the bid-ask spread is reduced after trading halts, but increases after lower limit hits. Our spread decomposition analysis provides weak evidence showing that the information asymmetry is reduced after trading halts, but not after price limits. For price discovery, information is efficiently reflected into stock prices once trading resumes after trading halts, but there is evidence of market overreaction for upper limit hits. Overall, our results are consistent with Subrahmanyam (1995). Trading halts seem to perform better than price limits in achieving their intended goals, namely, to reduce information asymmetry and increase market liquidity.

The remainder of this paper is organized as follows. The next section summarizes the theoretical predictions and empirical findings of related studies. Section II describes the institutional background of the SIBE. Section III outlines four hypotheses and presents our research methodology. Data selection and sample descriptions are discussed in Section IV. Section V provides empirical results of various tests of trading halts and price limits as well as comparisons between them. Section VI concludes.

I. Related literature

Proponents of trading halts generally argue that they provide time for rational reassessment of new information by investors and thus decrease market volatility. Trading halts, in this view, ensure that investors have fair access to market information, reduce possible excessive price fluctuations, and thus provide orderly and equitable trading in financial markets. Greenwald and Stein (1988) argue that when prices are uninformative, the risks of trading discourage agents from placing their orders. The resulting reduction in trading volume decreases the informativeness of prices relative to prices following a trading cessation. Greenwald and Stein (1991) further argue that the "time out" provided by trading halts can mitigate the transactional risk caused by informational imperfection. With trading halts, price discovery is enhanced by allowing better information transmission during the price adjustment process.

On the other hand, proponents of price limits emphasize loss reduction and risk sharing among investors. Brennan (1986) shows that price limits may act as a partial substitute for margin requirements without resorting to costly litigation. During periods of volatile price movements, price limits lower conditionally expected losses so investors are more likely to pay margin calls on time rather than default. Kodres and O'Brien (1994) examine the welfare effects of price limits. They distinguish two types of implementation risk, namely, initiation risk and transactional risk. Initiation risk concerns shocks to the underlying value of the asset that lead to price adjustments between the time an investor decides to place an order and the time the order is submitted. Transactional risk concerns shocks that lead to price adjustments between the time orders are placed and the time they are executed. Based on these risks, their model shows that price limits may promote better risk sharing than unconstrained trading when price fluctuations are driven by news about fundamentals.

In contrast, a number of models suggest that trading halts and price limits may actually reduce the informativeness of prices. In these models, trading is necessary for information distributed across multiple participants to be reflected in prices (Brown and Jennings, 1989; Grundy and McNichols, 1989). Critics of price limits insist that price limits reduce market liquidity by artificially interfering with trading activity, delay the price discovery process and weaken market efficiency (Fama, 1989; Lee et al., 1994; Kim and Rhee, 1997). The volatility of a stock price on the limit day will spill over to the following day(s) because the remaining information will not be reflected until after new limits have been established.

Previous empirical evidence does not help clarify these conflicting views of theoretical positions. Supporting the argument that trading halts can be beneficial if they are used to transmit information during times of unusually high transaction price uncertainty, Schwartz (1982) finds that indicator quotes during NYSE trading halts converge toward the reopening price. In addition, Corwin and Lipson (2000) find that traders actively reposition their trades during NYSE halts and that the changes in the limit order book during the halt are informative about the new equilibrium price. Similarly, Christie, Corwin and Harris (2002) find that halt mechanisms that allow for increased information dissemination during the halt (e.g., Nasdaq halts that reopen with a 90-minute quotation period), appear to reduce more uncertainty relative to halt mechanisms with little information transmission (e.g., Nasdaq halts that reopen with a five-minute quotation period). With regard to the effects of limit hits, Ma, Rao and Sears (1989b) provide evidence that is consistent with the argument that price limits provide a "cooling-off period" for the market. Ma et al. (1989a) find that prices tend to stabilize or reverse while volatility decreases following limit hits.

On the other hand, there is empirical evidence supporting the opposing view that both trading halts and price limits interfere with trading activity and delay the price discovery process. Ferris, Kumar, and Wolfe (1992) analyze the effect of SEC trading suspensions and find that volatility and volume are higher prior to and after suspensions, but return to their prior levels at a later date. Lee et al. (1994) find that NYSE trading halts are associated with increased volume and volatility, which persist for one day and three days, respectively, after reinstatement. Christie et al. (2002) reach similar conclusions for Nasdaq news-related halts. In non-U.S. markets, Kryzanowski and Nemiroff (1988) examine trading halts on the Montreal Exchange and conclude that trading activity and volatility increase around the halts. Wu (1998) also finds higher variance and trading volume in the post-suspension period than the pre-suspension period on the Stock Exchange of Hong Kong, and concludes that suspensions do not immediately ease unusual volatility.

Because price limits are not imposed on the U.S. equity markets, there is relatively less empirical evidence on the effects of price limits. Besides, results from these studies are mixed. Chen (1993) examines the Taiwanese market and finds no significant evidence that price limits reduce return volatility. Kim and Rhee (1997) study the effects of price limits on the Tokyo Stock Exchange and also conclude that price limits are not useful in mitigating volatility. However, Lee and Kim (1995) investigate the effect of price limits on stock price volatility using the Korea Stock Exchange data and find that price limits serve to reduce stock price volatility.

All of the previous studies analyze the consequences of trading halts and price limits separately. Instead of using market data, Coursey and Dyl (1990) turn to experimental methods to compare the effects of price limits and trading suspensions. They find that following the dissemination of significant news, the price adjustment process is most efficient when trading continues without a halt. It takes longer to find equilibrium prices following a trading halt than when trading is unconstrained. The results for price limits fall between those for the unconstrained market and the market with the trading halt rule. These results suggest that trading halts are worse than price limits, and that both are worse than simply letting the markets trade. Although these experimental results are intriguing, we must treat them with some caution. First of all, in their experiments, all traders had the same information, which is unlikely in the real world. Second, since extreme volatility in the real world is due more to uncertainty about common values than to uncertainty about the distribution of quantity among traders who value assets differently, their results may have limited relevance (Harris, 1998).

In sum, the current literature on the performance of trading halts and price limits does not provide consistent results. In addition, since both mechanisms are studied separately, there is no clear empirical evidence supporting the relative superiority of one form of circuit breaker over the other. This paper makes the first attempt to empirically find an answer from the Spanish stock market, where a unique opportunity for research exists because both mechanisms are practiced.

II. Institutional background

According to the Annual Report on the securities market 2000 of the *Comisión Nacional del Mercado de Valores* (CNMV), at the end of 2000, there were 155 companies listed on the Spanish electronic market. The trading volume during 2000 reached 454.6 billion dollars. The Spanish electronic market is relatively small as compared to other international markets. For example, for the same year trading volume was (all in billion dollars) 11,060.0 in the NYSE, 2,315.5 in Tokyo, 4,558.7 in London, 2,120.1 in Germany, and 1,161.9 in France. However, the Spanish stock market has experienced significant growth in the last several years, becoming the fourth most active market in the European Union and the seventh worldwide in 2000.

The Spanish electronic market, known as the SIBE, is an order-driven market with automatic dissemination of real-time trading information. Trading is managed through a computerized system that allows the four Spanish stock exchanges (Madrid, Barcelona, Bilbao and Valencia) to submit their orders through terminals connected to the mainframe. The SIBE is managed by the *Sociedad de Bolsas*, a limited company that is owned equally by the four Spanish Stock Exchanges' Governing Bodies. Appendix 1 provides more information about this market.

In the Spanish stock market, there are two different categories of security-specific trading halts on the SIBE: CNMV-initiated suspensions that are related to news and *Sociedad de Bolsas*-initiated suspensions that are initiated after price limits are hit. The CNMV, the Spanish version of the Securities and Exchange Commission (SEC), is responsible for regulation, supervision, and inspection of the stock market and related activities of all individuals and legal entities. The CNMV's aim is to watch over the transparency of the Spanish stock markets and the formation of prices as well as to protect investors. One of the instruments adopted by the CNMV to achieve these objectives is trading suspensions. Although the rules of suspension are formulated in broad and vague terms, the CNMV is authorized to suspend trading on any stock in the Spanish stock exchanges for any duration it deems necessary. The trading suspensions are regulated by Article 33 of the *Ley de Mercado de Valores*[4], which states that the CNMV can suspend trading activity under circumstances that can disturb the normal development of trading. A trading suspension remains in force until authorities believe that new information related to the security has been released or that the circumstances provoking the suspension no longer exist. Trading is reopened with a call auction similar to that used at the opening in the morning. Also, the CNMV is obligated to suspend trading when a tender offer is presented at the CNMV. According to Article 13 of *Real Decreto 1197/1991*, *de 26 de Julio*, the trading of shares affected by tender offers will be suspended from the time the application of authorization is presented at the CNMV until the time when the conditions of the tender offer become public. The objective is to ensure that sufficient information is available for investors to make rational, informed decisions and to reduce information asymmetry among market participants.

In the Spanish markets, between November 1999 and May 2001, trading could also be interrupted due to a trading halt called by the *Comisión de Contratación y Supersivisión* of the *Sociedad de Bolsas*. When stock prices hit the limits, the *Sociedad de Bolsas*, after studying several characteristics of a stock (e.g., liquidity, volatility, accumulated volume, number of orders, existence of any significant events), could suspend trading and decide whether to widen the price limits of that particular stock or not.

The SIBE sets daily upper and lower price limits at a predetermined rate based on the previous day's closing price. The daily maximum price fluctuation limit was 15% (25% for

[4] Regulating law of security markets.

stocks in Nuevo Mercado) during our study period[5]. Tick sizes (the minimum allowable unit that stock price may deviate) vary with market prices. In January 1999, tick size changed because of the adoption of Euros as the currency for trading stocks. Appendix 2 provides the tick size during the period 1998-2001. Stocks that hit their price limits are still allowed to trade as long as the transaction prices are within the limits. Thus, the price limits are simply boundaries not triggers for trading halts, except for the case when the SIBE decides to widen the boundaries. In such case, trading is halted until a decision is made. However, this unique system was in force only between November 1999 and May 2001.

III. Hypotheses and Methodology

Proponents of circuit breakers argue that trading halts and price limits aid in increasing market efficiency by providing time for new information to be released, evaluated and incorporated into stock prices. Hence, these mechanisms avoid traders' overreaction, making markets more stable. On the other hand, opponents suggest that these mechanisms interfere with trading and therefore harm the price discovery process and weaken market efficiency. Furthermore, if price discovery is delayed and trading activity is interrupted, the volatility will spill over to the days following trading halts or limit hits.

To date, the effectiveness of trading halts and price limits is still under regulatory and academic debate. It is extremely difficult to examine the effectiveness empirically because we do not know what would have happened without trading halts and price limits. Rather than testing the absolute effectiveness of these two mechanisms, this paper focuses on comparing their performance relative to each other. In other words, we intend to answer the question of relative superiority.

To compare the efficacy of trading halts and price limits, we examine the trading activity, liquidity, volatility, price discovery and efficiency around trading halts and limit hits. As stated earlier, we form the *Discretion Hypothesis* following the argument advanced by Subrahmanyam (1995). The rationale is that trading halts allow policymakers to bring more information (e.g., market liquidity and volatility) into the system at their discretion while

[5] Starting from May 14, 2001, this price limit system was replaced by a new method of managing price fluctuations. Instead of the maximum 15% daily fluctuations (25% for *Nuevo Mercado* stocks), each stock has two fluctuation ranges (static and dynamic), which are calculated on the basis of its historical volatility. Any variation in prices beyond the limits, whether with respect to the latest auction (static price) or the price of the previous trade (dynamic price), will automatically trigger a 5-minute volatility auction that randomly terminates within a 30-second period. This change is in response to the latest requirements in financial markets and to the harmonization of trading systems in Europe.

price limits depend solely on the size of the price movement. More importantly, during trading halts, firms are required to release information related to the cause of the halt and thus reduce the degree of information asymmetry among market participants. No such requirement exists for price limits. Therefore, prices become more informative after trading halts and investors are more willing to provide liquidity to the market. If the Discretion Hypothesis holds, we expect trading halts to perform better than price limits in improving liquidity and decreasing information asymmetry, which in turn assists price discovery and reduces volatility.

A. *Analysis of market quality*

We begin our analysis by obtaining the values of different measures (i.e., trading activity, liquidity and volatility) for the period starting 10 days prior to trading halts or limit hits to ten days after these events. To examine the relative performance of trading halts and price limits, we perform two kinds of analyses. First, we define a pre-event and post-event period. The pre-event period covers days from -10 to -1, with 0 being the event day. The post-event period covers days from +1 to +10. Then, we examine the changes in means and medians from the pre-event period to the post-event period. Specifically, for each firm we calculate the mean daily values in the pre- and post-event periods separately and then we obtain the cross sectional means and medians. This analysis gives us a broad idea of the relative performance of trading halts and price limits. Secondly, we perform a day-by-day analysis to provide further insight into the daily changes. We focus more on the days surrounding the event day. If the impact of trading halts and price limits on trading activity, liquidity, and volatility is transitory, the daily analysis will provide direct evidence concerning their relative performance.

For the impact of trading halts and limit hits on trading activity, we examine three measures: trading frequency, trading volume, and trading value. Trading frequency is the number of trades executed each day for each firm. Trading volume is the number of shares traded each day for each firm. Trading value is the total euro value traded each day for each firm.

As to liquidity measures, the concept of stock liquidity in the literature has been defined in terms of spreads and depths. Bid-ask spreads reflect the cost of transactions in the market. We obtain the quoted spread, the difference between the ask price and the bid price, and calculate the relative quoted spread (RQS), the quoted spread divided by the bid-ask midpoint. We also estimate the effective spread, which is twice the absolute value of the difference between the trade price and the bid-ask midpoint, and calculate the relative effective spread (RES), the effective spread divided by the bid-ask midpoint. The effective spread can differ from the quoted spread if transactions are executed at prices above the ask or below the bid[6]. On the other hand, measures of depth reflect the ability to trade at the prevailing bid and ask quotes. We calculate depth in terms of the number of shares and the value in euros available at the prevailing bid and ask prices.

To examine changes in volatility, and with the intention of gaining robustness, we look at four volatility measures: daytime volatility (DV), high-low (HL), standard deviation of trade price (SDTP), and standard deviation of midpoint (SDMP). DV is the square of the daytime return from the midpoint of the first quote of the day to the midpoint of the last quote of the day. HL is the natural logarithm of the ratio of the highest bid-ask midpoint to the lowest bid-ask midpoint on each day. SDTP is the standard deviation of the transaction prices on each day. SDMP is the standard deviation of the bid-ask midpoints on each day.

In order to gain more insight into the performance of trading halts and price limits, we further divide both mechanisms into two sub-samples. For trading halts, we identify good and bad news trading halts. The tick test of Lee and Ready (1991) is used to classify individual trades as buys or sells. If the first trade after a halt is classified as a buy, the trading halt is related to good news. On the other hand, if the first trade following a halt is classified as a sell, the trading halt is related to bad news. Kryzanowski and Nemiroff (1998, 2001) also apply the same methodology to identify bad and good news halts. As to limit hits, we identify both upper limit hits and lower limit hits. Upper limit hits occur when the price hits the upper limit and lower limit hits occur when the price hits the lower limit.

B. *Price discovery and efficiency*

To analyze the efficiency of the price discovery around both trading halts and price limits, we implement two different analyses. First, we examine the immediate stock price movement subsequent to the event day. Second, we apply the traditional event-study methodology to examine the abnormal return around trading halts and limit hits.

For the price discovery, we apply the Kim and Rhee (1997) methodology to analyze the immediate stock price movement after trading halts and limit hits. Although they only

[6] In the Spanish market, transactions cannot be closed inside the quotes, so the effective spread is always equal to or greater than the quoted spread.

study the effects of upper and lower limit hits, we apply their procedure for both limit hits and trading halts, assimilating upper (lower) limit hits to good (bad) news-related trading halts. The daytime return (r_t^d) represents open-to-close return measured by $\ln(P_t^c / P_t^o)$ and the overnight return (r_t^n) represents close-to-open return measured by $\ln(P_{t+1}^o / P_t^c)$, where P^c and P^o denote closing and opening prices respectively and t represents the event day. Stock returns can be positive (+), negative (-) or zero (0), and therefore nine returns series are possible. For upper limit hits and good-news halts, we classify the set of $\{[r_t^d, r_t^n]$ [+,+],[0,+]} as price continuation, the set of $\{[r_t^d, r_t^n]$ [+,-],[0,-],[-,+],[-,0], [-,-]} as price reversals, and the set of $\{[r_t^d, r_t^n]$ [+,0],[0,0]} as no change. For lower limit hits and bad-news halts, we classify the set of $\{[r_t^d, r_t^n]$ [-,-],[0,-]} as price continuation, the set of $\{[r_t^d, r_t^n]$ [-,+],[0,+],[+,-],[+,0], [+,+]} as price reversals, and the set of $\{[r_t^d, r_t^n]$ [-,0],[0,0]} as no change. More price continuations imply that the price discovery process is delayed at a higher degree. That is, the halting mechanism prevents prices from efficiently reaching their equilibrium levels. Since there is no limitation on the size of price movements for trading halts, we expect to see the percentage of price continuations following trading halts to be smaller than that after limit hits.

We examine how effective the trading halts and price limits are in conveying new information by investigating stock return behavior around the event day using event study methodology. In this analysis we use the daily individual stock returns and daily returns of a value-weighted market index for the 35 most liquid stocks listed on the SIBE (IBEX35). Returns are measured by logarithmic price differences adjusted by cash dividends, stock splits and rights issues. Excess returns are calculated for a study period of ±10 trading days around the event date (day 0) based on the *market adjusted returns* model. We define the abnormal return of firm i on day t (AR_{it}) as:

$$AR_{it} = R_{it} - R_{mt} \quad (1)$$

where R_{it} is the observed return for security i, and R_{mt} is the return of the IBEX35 index on day t. In the literature, alternative methods have been used to detect abnormal returns, like the market model or the mean-adjusted returns model. We choose the market-adjusted returns for the following reasons. First, in our study, especially in the limit-hit sample, it is difficult to apply the other two models because the estimation period needed to generate expected or normal returns may be contaminated by the occurrence of other trading halts and limit hits. Furthermore, Brown and Warner (1985) and Dyckman, Philbrick, and

Stephan (1984) show that the abilities of the three models to correctly detect the presence of abnormal performance are similar when analyzing non-clustered daily returns data.

The daily average abnormal return (AAR_t) for a given day t across n events is defined as:

$$AAR_t = \frac{1}{n}\sum_{i=1}^{n} AR_{i,t} \tag{2}$$

Based on the event window [-10, +10], we compute the CAAR from a set of windows embedded in this event window. The Cumulative Average Abnormal Return in the window (T_1, T_2) ($CAAR_{(T_1,T_2)}$) is:

$$CAAR_{(T_1,T_2)} = \sum_{t=T_1}^{T_2} AAR_t \tag{3}$$

We perform both parametric t- tests and non-parametric Wilcoxon signed rank tests to determine the statistical significance of the abnormal returns.

Since trading halts and limit hits are usually associated with the arrival of new information, we examine the process of the market adjustment before, during and after the occurrence of these events. If both control mechanisms are effective, we expect to find no abnormal returns prior to or after each trading halt or limit hit. In other words, we expect that the new equilibrium price will be adjusted within the day when trading halts and limit hits occur.

IV. Data selection and sample description

In this study we use trade and quote data supplied by the *Sociedad de Bolsas*. The data include trading volume, trading price, transaction time, the best quotes at the bid and offer side of the limit order book, and ask and bid prices as well as depth, immediately prior to each trade.

We examine trading halts and limit hits occurring between January 1st, 1998 and April 30th, 2001. Our main focus is on the stocks traded in the Main trading market of the SIBE, so stocks listed on Nuevo Mercado and Latibex are excluded[7]. In order to avoid problems and biases arising from different trading systems, we do not consider those shares traded in the Fixing system during the analysis period. Moreover, given the fact that stocks in the Fixing system are by definition less liquid, we also eliminate the problem of thin trading.

[7] Please see Appendix 1 for details on these markets.

The sample of trading halts is drawn from the Register of relevant events of the CNMV[8]. The initial sample consists of 115 trading suspensions corresponding to 67 firms. In order to make a valid comparison, we exclude halts for which trading is not resumed prior to the opening of the following trading day because our price limit sample contains only single-day limit hits. By doing so, we eliminate 31 observations. Secondly, to avoid possible contaminant effects, we exclude 7 trading halts with limit hits on the previous, the same or the following day. Thirdly, we also eliminate one special trading halt because the *Sociedad de Bolsas* decided to widen the usual price limits when trading resumed. Finally, we exclude trading halts that happened within 10 trading days after the previous trading halts for the same firm. The main reason is to avoid overlapping data for our 21-day window (from –10 to +10) analysis. The final sample consists of 66 trading halts corresponding to 48 firms.

Table I subdivides these trading halts according to suspension time, resolution time and reasons for trading halts and provides the mean of trading-halt durations. According to the initiation time of each trading halt, we differentiate two types of halts: intraday halts and delayed openings. The former is initiated during the trading session, while the latter is initiated prior to the opening. The sample includes 47 delayed openings and 19 intraday halts. The resumption time is based on the time stamp associated with the first trade after each trading halt. In the case that the CNMV reports the resumption of the trading after the closing of a trading session, we consider the resumption time as the opening on the following day. There are 45 trading halts with trading resumption on the same trading day and 21 trading halts with trading resumption on the next day's open. Regarding the reasons for trading halts, the most frequent cause of suspension was the release of price-sensitive information. There are 58 observations of this kind. The majority of these cases are disclosures of significant events relating to possible takeovers and mergers. Also, 8 temporary suspensions were triggered by the presentation of tender offers at the CNMV. To measure the halt duration, we consider only trading hours. For halts that are not resolved by the end of the trading day, duration excludes the non-trading period from closing on the halt day to the opening on the following day. The mean (median) duration of trading halts is 4.76 (5.26) hours.

Among the 66 trading halts, there are 49 good-news halts and 17 bad-news halts. In Table I, we can see that, on average, the duration of good-news halts is longer than that of bad-news halts. For good-news halts, the mean (median) duration is 5.19 (5.78) hours. However, for bad-news halts, the mean (median) duration is only 3.54 (2.76) hours. This

[8] That is, we do not consider permanent suspensions by delisting.

seems to suggest that firms are eager to provide information to clarify unfavorable rumors so bad-news halts are usually resolved within a shorter period of time.

Unlike trading halts, limit-hit observations are not recorded and reported by the CNMV. We identify limit hits using our transaction data, the 15% price limits, and tick sizes. An upper limit is reached for a stock when $H_t = C_{t-1} + LT_t$, where H_t represents the highest price on day t, C_{t-1} is the previous day´s closing price, and LT_t is 15% of C_{t-1} adjusted for tick sizes. With tick sizes, the actual price limits are usually a little less than 15%. Similarly, a lower limit is reached for a stock when $L_t = C_{t-1} - LT_t$, where L_t represents the lowest price on day t. After verifying all transactions, we observe 342 limit hits corresponding to 92 different firms. In our sample, each day on which a limit is reached is treated as an independent observation. We apply several filters on this initial sample. First, we eliminate 28 limit-hit observations because the *Sociedad de Bolsas* decided to widen the boundaries after price limits were hit. Second, to avoid possible contaminant effects, we exclude 17 limit hits when trading halts were called by the CNMV on the previous, the same or the following trading day. Finally, we eliminate 5 limit hits associated with IPOs or delisting. We also exclude those observations that occurred within 10 trading days after the previous limit hits for our 21-day window analysis. Thus, limit hits that occur on consecutive trading days are eliminated. The final sample is composed of 160 events corresponding to 76 firms. Among those events, 53 observations are lower limit hits and 106 are upper limit hits. There is one case where both lower and upper limit hits are identified on the same day.

Table II reports some characteristics of the sample trading-halt and limit-hit firms: market capitalization, stock price, trading value, beta, residual risk, and total risk. Market capitalization (in millions of euros) is based on the ending value in the year prior to the year when trading halts or limit hits occurred. Stock price (in euros) is the previous year-end closing price. Daily trading value is the average daily trading volume in thousands of euros in the year prior to the trading-halt and limit-hit year. Beta is estimated from the standard market model using daily stock and IBEX35 returns in the year prior to the year when the events occurred. Residual risk is the standard deviation of the residuals from the market model. Total risk is the standard deviation of the daily stock returns in the year prior to the year when trading halts or limit hits occurred. The daily stock returns are calculated as $\ln(P_t/P_{t-1})$, where P is the closing price adjusted for dividends, stock splits and rights offerings. The t-student test is used to test the differences in means while the Man-Whitney test is used to determine the difference in medians between the trading-halt and limit-hit samples.

In terms of market capitalization, trading-halt firms are on average larger than limit-hit ones. The results are consistent with Kim and Limpaphayom's (2000) finding that small market capitalization stocks hit price limits more often than others and Bhattacharya and Spiegel's (1998) finding that larger capitalization stocks are suspended more often on the NYSE. Stock prices are higher for trading-halt firms than for limit-hit firms, but the difference in means is not significant. On average, trading-halt firms are more active than their limit-hit counterparts based on the daily trading value. As to the average firm risk in terms of beta, residual risk, and total risk, we do not observe any significant difference between the trading-halt and limit-hit samples. The only exception is that the median of the residual risk is higher for limit-hit firms than for trading-halt firms.

V. Empirical results

A. *Analysis of market quality*

A.1. *10-day average analysis*

Table III reports the means and medians of the cross sectional 10-day average trading activity and liquidity prior to (Before) and following (After) trading halts and limit hits. Panel A presents the results from full samples of trading halts and limit hits. We use t-test and the Wilcoxon signed rank test to determine the significance level of the differences between Before and After means and medians, respectively. We use three different measurements of trading activity: frequency, trading volume, and trading value. All three measures show that trading activity is significantly higher after trading halts and limit hits. This result is consistent with Lee et al. (1994) and Kim and Rhee (1997) for trading halts and price limits, respectively. One explanation for this significant increase in trading activity is that trading halts and price limits have interfered with trading.

Since investors were not able to trade due to the halts and limits, they had to wait until trading resumed or new price limits were established on the following day(s) to fulfill their desired trades. Therefore, after trading halts and price limits, trading activity is ab-normally high. However, this should be a short-term phenomenon. Our daily analysis provides more insight into this issue.

As to liquidity, Panel A of Table III reports results from various measures of spreads and depths: relative quoted spread (RQS), relative effective spread (RES), depth (shares), and depth (€). All four measures are equally weighted. Daily depth measures are scaled by their

21-day average. After trading halts, both RQS and RES decrease significantly, while depth (shares) and depth (€) both increase significantly. That is, liquidity increases following trading halts. However, for limit hits, the results are just the opposite. Both spread measures increase and both depth measures decrease significantly after limit hits. In other words, liquidity decreases following limit hits. Apparently, trading halts are more effective than price limits in increasing market liquidity. This result is consistent with Subrahmanyam (1995) and thus supports our Discretion Hypothesis.

Our result that liquidity increases following trading halts contradicts current literature. Corwin and Lipson (2000) and Christie et al. (2002) find that liquidity decreases following NYSE and Nasdaq trading halts, respectively. One possible reason for this conflicting result is that we are conducting daily analyses while their studies are based on intraday analyses. Our daily analysis, especially from day 0 to day +1, in the next section provides results more comparable to the findings of these studies. Since our purpose is to compare the performance of trading halts and price limits, intraday analysis is difficult to perform given the fact that limit hits can occur consecutively within a short period of time (e.g., 10 limit hits in 20 minutes) on the limit-hit day but trading halts usually last for hours. Thus, we believe daily analysis is more appropriate. In fact, our result is consistent with the prediction by Spiegel and Subrahmanyam (2000) that liquidity during normal market conditions can be improved if rules require the disclosure of high variance events (such as quarterly earnings) to the exchange. Since during trading halts, firms are required to either announce news or clarify rumors, the degree of information asymmetry is expected to decrease following trading halts. The 10-day average liquidity increase we observed matches the prediction of their model. In fact, to better capture the degree of information asymmetry, we decompose the spread in Section A.3.

Panel B of Table III shows the results of trading activity and liquidity for good- and bad-news trading halts. There are 49 good-news halts and 17 bad-news halts. Given the small sample size, statistical inference needs to be treated cautiously. For trading activity, we observe greater frequency, trading volume and value after good-news trading halts than before. For bad-news halts, trading activity also increases after halts, but most of them are not significant except for the median trading value at the 10% level. Both spread measures are significantly lower after good-news trading halts, but the change is not significant for bad-news halts. Depth increases significantly after good-news trading halts but the increase is not significant for bad-news halts. That is, overall trading activity and liquidity increase only after good-news trading halts.

Panel C of Table III reports the results of trading activity and liquidity from upper and lower limit-hit samples. There are 106 upper limit hits and 53 lower limit hits. We drop one observation from our limit-hit sample because both upper and lower limits were hit on the same day. Unlike the contrasting results observed in Panel B, upper and lower limit hits have similar results. Trading activity increases significantly after limit hits for both upper and lower cases. Spread measures increase following limit hits with stronger evidence observed in the lower case. Depth measures are either unchanged or reduced following upper and lower limit hits. Overall trading activity is increased and liquidity is reduced after upper and lower limit hits.

Table IV reports the volatility changes from Before to After trading halts and limit hits. We use four different volatility measures to gain robustness. Results from those four measures are similar. Basically, Panel A shows that volatility increases significantly after limit hits, but no significant change is observed after trading halts. The volatility increase after limit hits is consistent with Kim and Rhee (1997). Although Lee et al. (1994) and Christie et al. (2002) find higher volatility after trading halts on the NYSE and the Nasdaq, Engelen and Kabir (2001) do not find any significant changes in stock return volatility around trading suspensions on the Brussels Stock Exchange. Our results seem to be more in line with Engelen and Kabir. However, as mentioned earlier, this different result could be due to our daily analysis and their intraday analysis. Since the primary objective of trading halts and price limits is to reduce excess volatility, price limits are not effective in achieving their intended goal. From this volatility perspective, price limits are less effective than trading halts.

Panel B of Table IV reports the volatility change for both good-news and bad-news trading halts. No significant change in volatility is observed. Panel C of Table IV presents the volatility change for both upper and lower limit hits. The fact that all volatility measures show significant increases after upper and lower limit hits is consistent with the overall limit-hit results in Panel A. In conclusion, trading halts do not seem to have a significant impact on volatility. We do not observe different results between upper and lower limit hits. Price limits are ineffective with regard to curbing volatility.

Overall, the 10-day average analysis suggests that trading halts perform better than price limits. Trading activity increases after both trading halts and limit hits due to trading interference. Since their impact on trading activity is the same, we are unable to judge the relative performance from the perspective of trading activity. However, from the changes of liquidity and volatility, we find sufficient evidence to show that trading halts perform better than price limits. First of all, liquidity increases following trading halts. For price limits, liquidity actually decreases after limit hits. Secondly, volatility increases after limit hits, but no significant change of volatility is observed after trading halts. Apparently, price limits are ineffective in achieving their intended goal to curb volatility.

For the robustness check, we also perform both 3-day and 5-day average analyses. Results are not reported due to similarity and space limitation. Basically, the results are similar to those from the 10-day average analysis. The only noticeable difference is from the bad-news trading halts. Even though we do not observe significant changes in trading activity, liquidity, and volatility from Before to After for the 10-day average analysis, the 5-day average analysis shows that trading activity increases significantly after bad-news trading halts. Our daily analysis in the next section helps us explain the difference.

A.2. *Daily analysis*

The purpose of our daily analysis is to provide more insight into the daily changes in trading activity, liquidity, and volatility for both trading halts and limit hits. The daily analysis covers the event window [-10, +10], from –10, 10 days before 0, to 10, 10 days after 0. The event day, 0, is defined as either the trading-halt day or the limit-hit day. Table V reports the cross-sectional medians of daily figures for the event window [-3, +3] because our focus is on days surrounding day 0. Figure 1 depicts the results of trading activity for the event window [-10, +10]. Panel A of Table V presents the results from full samples of trading halts and limit hits. Results from the three measures of trading activity are similar. Panel A reports only the results from frequency and trading value. For trading halts, figures on day 0 are calculated using the 50 trading halts (out of the 66 sample trading halts) that had non-zero trading activity on that day. Trading activity is relatively low on day 0 for trading halts and highest on day 0 for limit hits. The former is reasonable because trading was halted and trading activity was interfered. As to the latter, since investors are able to trade as long as their prices are within the allowable range, the highest trading activity on day 0 is understandable. The comparison between day –1 and day 1 shows that the trading activity increases significantly for both trading halts and limit hits. However, trading activity gradually decreases after day 1. This trend can be easily seen from Panel A of Figure 1.

For liquidity measures, we report only the relative quoted spread (RQS) and depth (€) results. Other measures generate similar outcomes. Although the 10-day average RQS is lower after trading halts than before the halts in Table III, we do not observe any significant changes on the daily basis. For limit hits, the RQS is highest on day 0, but it gradually decreases afterwards. The highest RQS on day 0 suggests that the degree of information asymmetry is high so investors require a larger spread to compensate for their potential loss to informed traders. However, the 10-day average figure is higher after limit hits than before hits, as reported in Table III. Depth is highest on day 0 in both cases. This is interesting because we would expect to see low depth for limit hits on day 0 given the fact that investors are unwilling to provide liquidity to the market due to the high degree of information asymmetry. The high depth on day 0 indicates that investors are willing to trade more shares at the prevailing bid and ask quotes. However, the 10-day average liquidity increases for trading halts, but not for limit hits. Panel B of Figure 1 depicts the liquidity measures. Apparently, there is a big gap between the RQS of trading halts and limit hits. The RQS of trading halts is much smaller than that of limit hits. This is understandable because Table II shows that on average trading-halt firms are larger and more actively traded than limit-hit firms.

As to volatility, we report only the results from the standard deviation of midpoint (SDMP). The other three measures generate similar results. Volatility is highest on day 0 for limit hits, but not for trading halts. Further, the days surrounding the limit hits are the most volatile. Again, volatility gradually decreases after day 0. Even though volatility on day 0 is not the highest for trading halts, the comparison between day –1 and day 1 shows that volatility increases and reaches the highest level on day 1. This result is consistent with Lee et al. (1994), Corwin and Lipson (2000) and Christie et al. (2002) that volatility increases following trading halts. Since their results are based on intraday analysis, our daily analysis from day 0 to day 1 provides comparable evidence. Panel C of Figure 1 clearly shows the daily changes on volatility.

Panel B of Table V reports the medians of the cross sectional daily average figures from day –3 to day +3 for both good-news and bad-news trading halts. Figure 2 depicts these results from day –10 to day +10. For bad-news trading halts, trading activity does not change dramatically on the daily basis. Frequency on the event day is significantly less than that on day –1, which is understandable given the fact that trading was halted on the event day. Even though the magnitude of trading value is also smaller on the event day than on day –1, the difference is not significant. Results for good-news trading halts show that trading activity increases significantly from the event day to day 1 and then decreases significantly from day 1 to day 3. Again, the results are understandable because trading was halted on the event day and investors had to wait until the next day when trading resumed to fulfill their desired trades for those with trading resolution on the next day's open. However, the evidence from good-news trading halts is stronger than that from bad-news halts. For liquidity, there is no significant change in the daily basis for bad-news halts, but for good-news halts the depth (€) increases from day –1 to the event day and reaches its highest level on day 1. The result from volatility is interesting. For bad-news halts, volatility reaches its highest level on the event day, but for good-news halts, it reaches its highest level on day 1. That is, volatility decreases after bad-news halts, but it increases following good-news halts. Since the sample size of bad-news halts is small, the overall trading-halt results in Panel A are driven by good-news halts.

Panel C of Table V reports the medians of the cross sectional daily average figures from day –3 to day +3 for both upper and lower limit hits. Figure 3 depicts the results from day –10 to day +10. Trading activity reaches its highest level on day 0 and then gradually declines for both upper and lower limit hits. RQS does not change significantly on the daily basis for upper limit hits surrounding day 0. However, for lower limit hits, RQS is the highest on day 0. Even though RQS also gradually reduces after the event day, the average level is still higher than that before the limit hits. Interestingly, even though the RQS of lower limit hits is similar to the RQS of higher limit hits before day –3, it reaches its highest level on day 0 and then stays at a relatively high level at least until day +10. That is, lower limit hits lead to a high degree of information asymmetry so investors require a larger spread to compensate for their potential loss to informed traders. Our spread decomposition analysis in the next section provides more details. Additionally, depth (€) also reaches its highest level for upper limit hits, but not for lower limit hits, on day 0. That is, investors are willing to provide liquidity to the market after upper limit hits, but not after lower limit hits. This explains the strange observation from Panel A that both RQS and depth (€) reach their highest levels on day 0. The main reason for the former is from the lower limit hits while for the latter is from the upper limit hits. For both upper and lower limit hits, the event day is the most volatile day. As depicted by Panel C of Figure 3, the patterns of daily volatility movements of upper and lower limit hits are similar.

In summary, from the daily analysis of market quality, we obtain a better understanding of day-to-day movements and find evidence consistent with current literature. Trading activity is relatively low on day 0 for trading halts and highest on day 0 for limit hits. Volatility is highest on day 0 for limit hits, but it reaches the highest level on day 1 for trading halts. For liquidity, significant daily changes are observed from the limit-hit sample. Unlike good-news and bad-news halts, upper and lower limit hits generate different results.

A.3. *Spread decomposition*

To further investigate the change in the information asymmetry following trading halts and price limits, we use the Hasbrouck-Foster-Viswanathan model suggested by Brennan and Subrahmanyam (1996) to decompose the spread into two components, the adverse-selection cost component and the fixed-costs component. It is argued that the advantage of using this approach is that it is valid for a relatively broad range of theoretical specifications. The model focuses on the price response to unexpected volume as the measure of the adverse selection component of the price change. The rationale is that if trades are autocorrelated or predictable from past price changes, then part of the contemporaneous order flow is predictable and should not be included in measuring the information content of a trade.

Let Δp_t be the price change for transaction t, let q_t be the signed (positive sign for a buyer-initiated trade and negative sign for a seller-initiated trade) trade quantity corresponding to the price change, and let D_t be the indicator corresponding to the direction of a trade (+1 for a buyer-initiated trade and -1 for a seller-initiated trade). The following model with five lags is estimated:

$$q_t = \alpha_q + \sum_{j=1}^{5} \beta_j \Delta p_{t-j} + \sum_{j=1}^{5} \gamma_j q_{t-j} + \tau_t, \tag{4}$$

$$\Delta p_t = \alpha_p + \psi [D_t - D_{t-1}] + \lambda \tau_t + \nu_t, \tag{5}$$

The informativeness of trades in Eq. (5) is measured by the coefficient of τ_t, the residual from the regression in Eq. (4). Thus, it is the response to the unexpected portion of the order flow in Eq. (4) (measured by τ_t) that measures the trade informativeness. The coefficient of (D_t D_{t-1}) measures the fixed cost component of the trading cost.

For each asset, we estimate this model separately for the pre-event (from day -10 to -1) and post-event period (from +1 to +10). Following Brennan and Subrahmanyam (1996), we omit the overnight price change, using missing values for the lags that involve the overnight price change. The model of Hasbrouck-Foster-Viswanathan represented by equations (4) and (5) are estimated by ordinary least squares for each asset, retaining the resulting estimates of λ and ψ. Securities for which no estimate of λ is available (for lack of transactions data) are omitted. Also, we omit firms with negative estimates of λ.

Like Brennan and Subrahmanyam (1996), it is necessary to make an assumption about the sizes of the transactions in the securities in order to take into account the variable proportional cost of transacting in different securities. A natural approach is to use the average of measured trade sizes. Thus, one measure of the variable proportional cost of transacting is C_q *ëq/P,* where q is the average size of a transaction in the security.

A limitation to this measure is that, if transaction sizes in extremely illiquid securities were sufficiently small, this approach might yield a lower estimated variable cost for illiquid securities than for the relatively liquid ones. One way to overcome this is to assume that, in the absence of differential liquidity, the average transaction would be proportional to the total number of shares outstanding. The relevant measure of the variable cost then becomes C_n *ën/P,* where n is the number of shares outstanding. We report the indicator variable based on *ë,* as well as transformations of C_q and C_n.

Table VI reports the results from our spread decomposition analysis. The adverse selection component decreases for both good-news and bad-news trading halts, but the decrease is significant only for median measure in the case of bad-news halts. For price limits, the adverse selection component increases, but the increase is not significant. On the other hand, the fixed component of trading costs decreases after trading halts, but it increases after price limits. For the case of lower limit hits, the increase of the fixed component is significant for both mean and median measures.

In sum, our spread decomposition analysis shows that the information asymmetry is reduced following trading halts, but the evidence is weak due to the lack of significance. However, the increase in information asymmetry after price limits implies that, relatively speaking, trading halts do a better job in reducing the information asymmetry. This result is consistent with Subrahmanyam (1995).

B. *Price discovery and efficiency*

We analyze the price discovery process and efficiency around trading halts and limit hits using two different methodologies: the Kim and Rhee (1997) method and the event-study methodology. Table VII reports the percentage of price continuations, price reversals, and no change on prices following trading halts and limit hits based on the Kim and Rhee method. Since their method requires the closing price on the event day, results of trading halts reported in Tabel VII are generated from those with resolution on the same day. Results from the event-study methodology are reported in Table VIII. Figure 4 further plots CAARs for the event window [-10, +10].

For trading halts, in Table VII, we observe more price reversals than continuations for both good-news and bad-news halts. In other words, we do not find evidence that trading halts delay the price discovery process. However, since the differences between reversals and continuations are not significant, the argument that trading halts provide a cooling-off period to avoid investor overreaction is only weakly supported.

For good-news trading halts, we find that AAR is equal to 4.43% on day 0, and the *t* and Wilcoxon tests show that this abnormal return is significantly different from 0 at the 1% level in Table VIII. This is understandable because stock prices reflect the new information on the trading-halt day and thus generate significant abnormal returns. This evidence is consistent with the fact that trading halts are imposed so new information can be released or so rumors can be clarified to the market. On the day immediately prior to good-news trading halts, we also find a 0.81% abnormal return, which is statistically significant at a 5% level according to both the t- test and the non-parametric test. This could indicate the presence of anticipatory behavior, information leakages, or insider trading. Similarly, on day +1, the abnormal return reaches a significant value of 2.31%. This seems to suggest that price discovery has been delayed by trading halts and that the market does not efficiently reflect all information on the trading-halt day.

Before making the final conclusion, we further investigate our trading-halt sample to test the price discovery and market efficiency. As reported in Table I, among the 49 good-news halts, there are 32 cases with resolution on the same trading day. We perform the AAR analysis based on these 32 cases and find that the significant abnormal return is only observed on day 0, but not on day 1[9]. That is, if trading resumes on the trading-halt day, information can be fully reflected and there is no delayed price discovery. For the 17 cases with resolution on the next day's open, we find that there is no abnormal return on day 0, but a positive abnormal return is observed on day 1. Apparently, the positive abnormal return observed on day 1 from our overall results using the 49 good-news halts is driven by these 17 cases. The significant abnormal return observed on the resolution day suggests that stock prices adjust quickly and completely to the new information released during the suspension.

The analysis of CAAR for event windows [-5, -1] and [+1, +5] confirms the above conclusion. CAAR corresponding to window [-5, -1] is significantly positive at a 10% level

[9] Results are not reported, but they are available upon request.

based on the t-test. This evidence is consistent with the possible information leakage on day -1. Panel A of Figure 4 also shows that CAAR is increasing prior to trading halts. On the other hand, the insignificant CAAR for [+1, +5] shows no sign of inefficient stock price adjustment.

In the case of bad-news trading halts, we do not observe significant abnormal returns around day 0. That is, there is no apparent information leakage or delayed price discovery associated with bad-news trading halts. However, due to the small sample size, we do not want to overemphasize our interpretation of this sub-sample's results.

For upper limit hits, we observe more price continuations than reversals from the Kim and Rhee method. Table VII shows that for stocks hitting their upper limits, price continuations occur 65 percent of the time and price reversals occur only 27 percent of the time. This evidence seems to suggest that price limits delay the price discovery process and cause the price to move in the same direction toward its equilibrium level following limit hits. However, another possibility is that price limits fail to counter investor overreaction so prices keep moving up after hitting the upper limits. This possibility can be verified if we observe negative abnormal returns following upper limit hits. As shown in Table VIII and Panel B of Figure 4, we find a significant positive AAR of 10.74% on the event day and significant negative AARs on both day +1 and day +2 for upper limit hits. Also, CAAR for window [+1, +5] is negative and significant at the 1% level for both *t*-test and non-parametric test. This return reversal suggests that investors overreact to the good news on the limit-hit day and prices eventually reverse once the overreaction is corrected. It should be noted that the return reversal is not caused by the cooling-off effect of price limits. If price limits have a cooling-off effect, we should observe both price reversals from the Kim and Rhee method and return reversals from the event-study methodology following limit hits. Our evidence of price continuations and return reversals rejects the possibility of cooling-off effect and indicates that upper price limit does not reduce overreaction. Since the popular objective of price limits is to reduce overreaction, upper price limit fails to achieve its intended goal. The analysis of window [-5, -1] shows that there is no significant CAAR during the five-day period. That is, there is no apparent information leakage prior to upper limit hits.

For lower limit hits, we observe opposite results. In table VII, there is more price reversals (83%) than continuations (11%) and the difference is statically significant at 1% level. Besides, Table VIII reports a significant AAR of –5.29% on day 0, but the abnormal returns on the following days are not significant. These results suggest lower price limits function positively to prevent investor from overreacting by providing a *cooling-off* period.

These contrasting results for upper and lower limit hits are consistent with the asymmetric property of price limits addressed by Choi and Lee (2001).

In summary, for trading halts, we find that there is no delayed price discovery and information is efficiently reflected into stock prices once trading resumes. For limit hits, we find contrasting results. There is evidence of market overreaction for upper limit hits. We observe a price continuation at the open of day +1 and significant negative abnormal returns on the following days. However, we find evidence consistent with the cooling-off argument for lower limit hits. We observe more price reversals from the analysis of the immediate stock price movement subsequent to lower limit hits on day 0, and no significant abnormal returns afterwards.

C. *Robustness check*

As reported in Table II, it is clear that there are significant differences in market capitalization between halted stocks and limit-hitting firms. On average, the halted firms are larger than limit-hitting ones— raising the possibility of our results being driven by a size effect. To test this possibility, we examine firms that experienced both trading halts and limit hits. Apparently, the difference in size between the trading-halt and the limit-hit samples does not exist in this case. There are 26 trading halts and 30 limit hits. We perform all previous analyses based on the new sample and find that the results are similar to those reported previously[10]. The notable difference is that the levels of significance are weaker. Of course, we have to consider that the size of the new sample is very small. Nevertheless, the fact that the results are virtually identical suggests that the main findings of this paper are not driven by the firm size effect.

D. *Summary Results*

Table IX summarizes the findings of the relative performance of trading halts and price limits. Trading activity increases following trading halts and limit hits. From the liquidity perspective, trading halts perform better than price limits. Spreads decrease and depths increase following trading halts, but the opposite is observed for price limits. With

[10] Due to the space limitation and the similarity of results, we do not report the new results here. Results are available from the authors upon request.

trading halts, the degree of information asymmetry is reduced after the release of information by firms and thus investors are willing to provide liquidity to the market. However, price limits prevent market participants from trading beyond the limits and information cannot be fully transmitted. The outcome is an increase of information asymmetry and traders' unwillingness to provide liquidity. As to the volatility, it increases after limit hits but no change was observed following trading halts. Since the primary objective of price limits is to reduce volatility, price limits not only fail to achieve the intended goal but also make it worse. Results on the price discovery and efficiency are mixed. We find that prices efficiently reflect information following trading halts and lower limit hits. However, for upper limit hits, we find evidence of market overreaction. Overall, our results support the discretion hypothesis that trading halts are more effective than price limits in achieving their intended goals.

VI. Conclusion

Even though the performance of trading halts and price limits has been studied extensively and separately following the 1987 market crash, the relative performance between trading halts and price limits has not been examined from market data. In this paper, we are able to make the comparison between these two mechanisms using data from the Spanish stock market where both trading halts and price limits are imposed. We make no attempt to test the effectiveness of either trading halts or price limits, but focus instead on the relative desirability of these two mechanisms.

Based on Subrahmanyam (1995), we hypothesize that trading halts are more effective than price limits because exchange officials can incorporate related information into their trading-halt decision and can ask companies to provide relevant information. Specifically, we investigate the pattern of trading activity, liquidity, volatility, and the speed of price discovery in the period surrounding trading halts and limit hits. Our results show that trading activity increases after trading halts and limit hits. Volatility stays at the same level after trading halts, but increases after limit hits. We also show that the degree of information asymmetry is decreased after trading halts, but increased after limit hits. For price discovery, information is efficiently reflected into stock prices once trading resumes after trading halts, but there is evidence of market overreaction for upper limit hits. Overall, our result is consistent with Subrahmanyam (1995). Trading halts seem to perform better than price limits in achieving their intended goals, namely, to reduce information asymmetry and increase market liquidity.

Recent regulatory changes concerning price limits in several countries seem to support our finding. First of all, the Spanish stock market has replaced the previous price limit system with one that combines both trading halts and price limits. When price limits are hit, trading is halted for a certain period of time before it resumes. Thus, the new price limit system is a trigger for trading halts. Furthermore, the increases of the price-limit rate from 6% to 15% in Korea (1998) and from 10% to 30% in Thailand (1997) cast doubt on the effectiveness of price limits from a regulatory perspective. Since our results demonstrate that trading halts perform better than price limits, security regulators in countries imposing price limits may consider the imposition of trading halts instead if circuit breakers are indeed necessary.

Appendix 1
Facts about the SIBE

In the SIBE, there are three submarkets: Main Trading, Block Trading and Special Operations. Most shares listed on the SIBE are traded through the Main Trading market, so this submarket accounted for 86.1% of the effective daily trading volume in 2000. Within this principal trading market, there are two different trading systems: *General* trading and *Fixing* trading. The most liquid shares are traded in the General trading while the Fixing trading is reserved for less liquid shares within the SIBE. In the fixing modality, purchases and sales are grouped together two times during a trading session that consists of two auctions. In addition, there are two market segments with specific trading mechanisms aimed at addressing the individual characteristics of certain stocks. These segments are *Nuevo Mercado*, encompassing technological stocks with strong growth potential, and *Latibex*, comprised of Latin American stocks listed in euros on the SIBE. *Nuevo Mercado* was founded on April 10, 2000 and *Latibex* started on December 1, 1999.

The timetable of trading sessions changed over time. Until October 11, 1999, markets were open between 10:00 am and 5:00 pm from Monday to Friday on legal calendar working days. Before the markets open, between 9:30 am and 10:00 am, Opening Auction took place where orders could be entered, altered and cancelled, but not executed. The Opening Auction determined the opening price. Between October 11, 1999 and January 17, 2000, the adjustment period was from 9:00 am to 9:30 am and the electronic trading was carried out between 9:30 am and 5:00 pm. Finally, starting January 17, 2000 the adjustment period is from 8:30 am to 9:00 am and the open trading session is from 9:00 am to 5:30 pm.

Prior to June 1, 2000, the closing price was the trading price of the last 500 traded shares that was the closest to the share-weighted average price of those 500 shares. If two prices were equally close to the weighted average price, the closing price was the one executed last. If less than 500 shares were traded during the trading session, the closing price was the closing price of the previous session. However, the closing mechanism and the calculation of closing prices have changed since the introduction of the closing auction on June 1, 2000. The closing auction lasts from 5:30 pm to 5:35 pm with a random closing of 30 seconds.

Appendix 2
Tick size

Panel A: Before January 1, 1999	
Price < 1000 ptas.	1 ptas.
1000 ptas. < Price < 5000 ptas.	5 ptas.
Price > 5000 ptas	10 ptas.
Panel B: After January 1, 1999	
Price < 50 euros	0.01 euros
Price > 50 euros	0.05 euros

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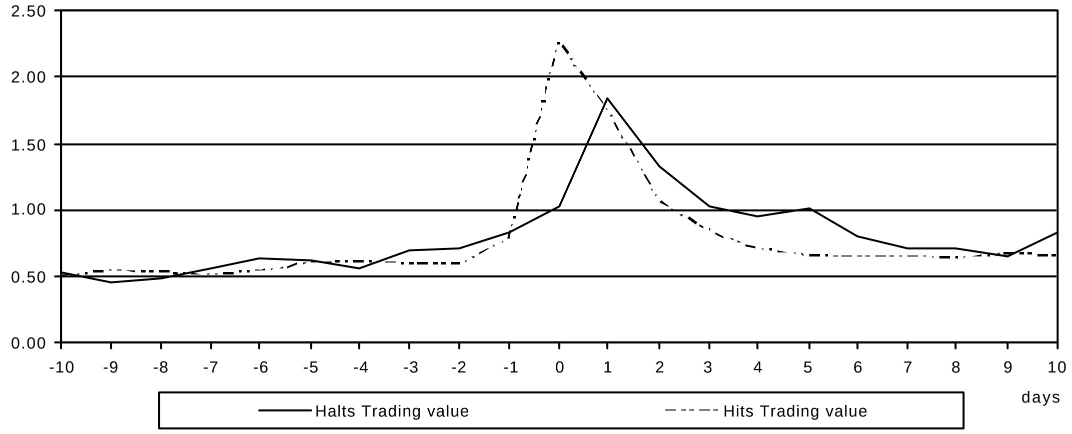
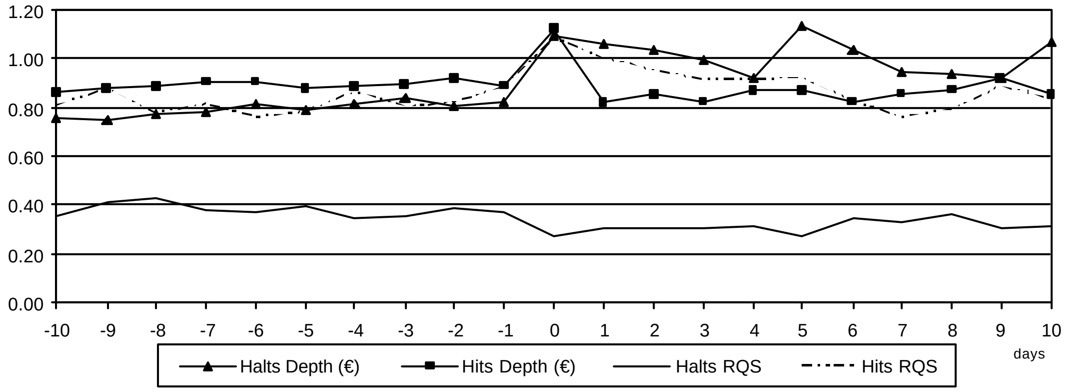
Figure 1
Daily cross-sectional analysis around trading halts and limit hits

Event date (day 0) is defined as either the trading-halt day or the limit-hit day. Trading value is the trading volume in euros; RQS is the quoted bid-ask spread divided by the bid-ask midpoint; depth (€) is the sum of euro value of shares available at the bid and ask quotes; SDMP is the standard deviation of all bid-ask midpoints on each day. Trading value and depth (€) are scaled by their 21-day (from –10 to +10) average.

Panel A: Trading activity



Panel B: Liquidity



Panel C: Volatility

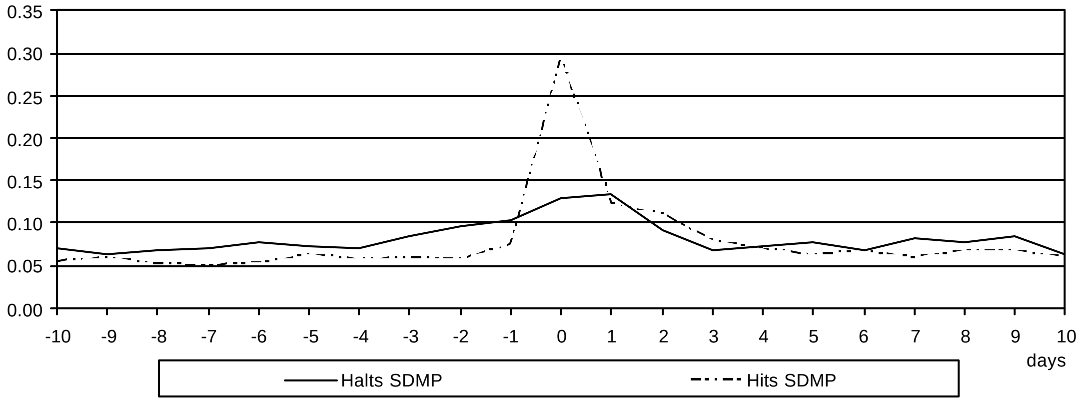
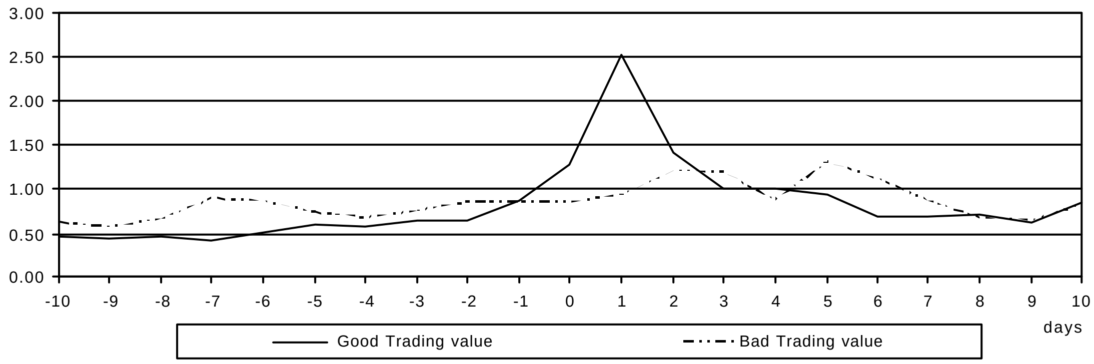


Figure 2

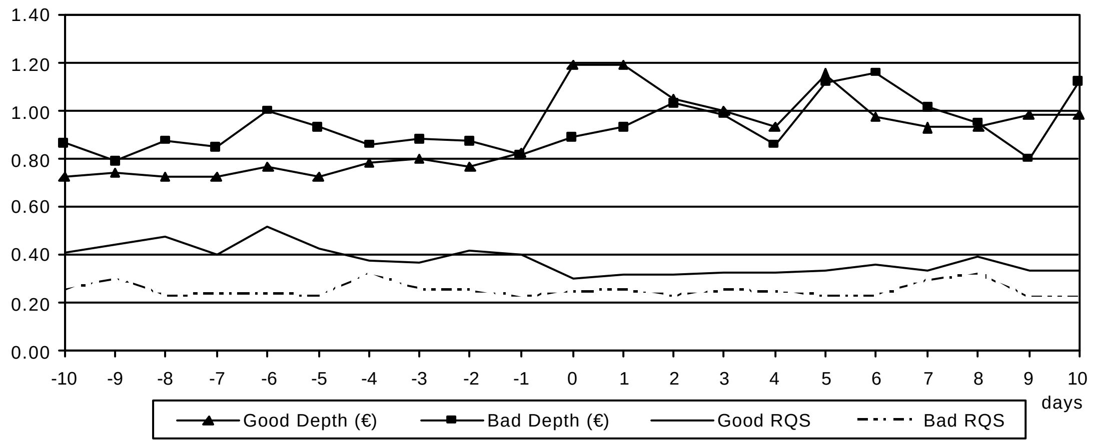
Daily cross-sectional analysis around good-news and bad-news trading halts

We use the tick test of Lee and Ready (1991) and the reopening prices to identify “good” and “bad” news halts. If the first trade after a trading halt is classified as a buy (sell), the trading halt is related to good (bad) news. Event date (day 0) is defined as the trading-halt day. Trading value is the trading volume in euros; RQS is the quoted bid-ask spread divided by the bid-ask midpoint; depth (€) is the sum of the euro value of the shares available at the bid and ask quotes; SDMP is the standard deviation of all bid-ask midpoints on each day. Trading value and depth (€) are scaled by their 21-day (from –10 to +10) average.

Panel A: Trading activity



Panel B: Liquidity



Panel C: Volatility

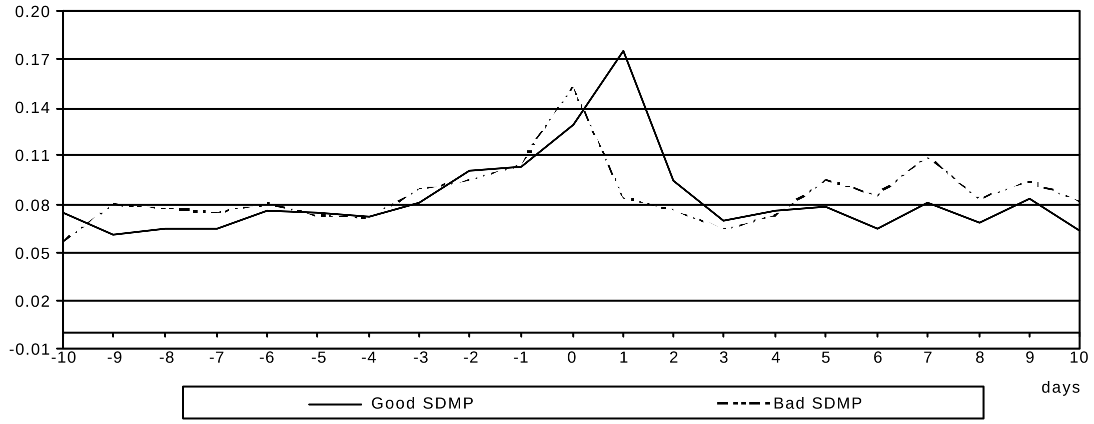
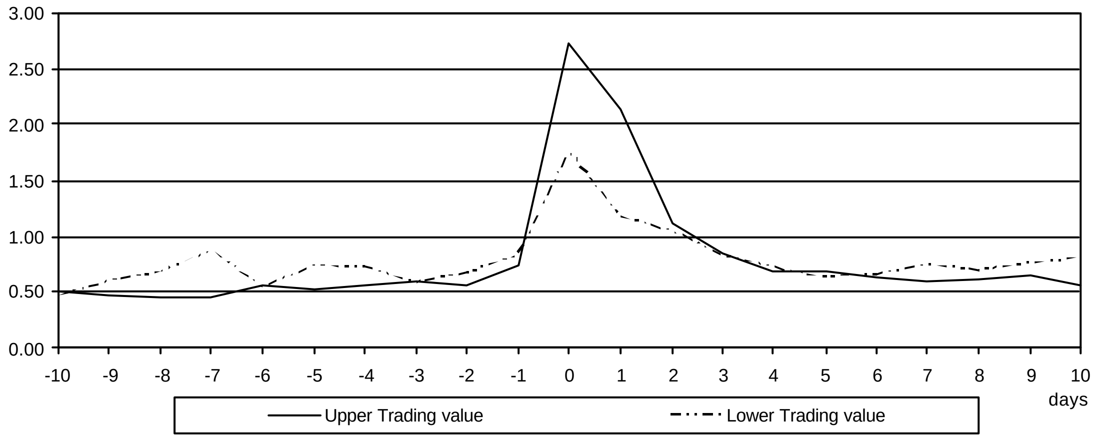


Figure 3

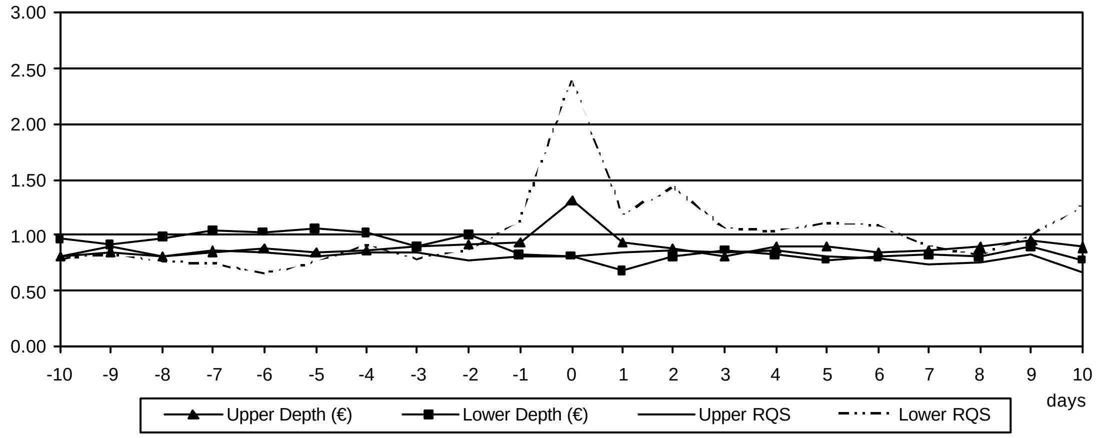
Daily cross-sectional analysis around upper and lower limit hits

An upper (lower) limit hit occurs when the price hits the upward (downward) price limits. Event date (day 0) is defined as the limit-hit day. Trading value is the trading volume in euros; RQS is the quoted bid-ask spread divided by the bid-ask midpoint; depth (€) is the sum of the euro value of the shares available at the bid and ask quotes; SDMP is the standard deviation of all bid-ask midpoints on each day. Trading value and depth (€) are scaled by their 21-day (from –10 to +10) average.

Panel A: Trading activity



Panel B: Liquidity



Panel C: Volatility

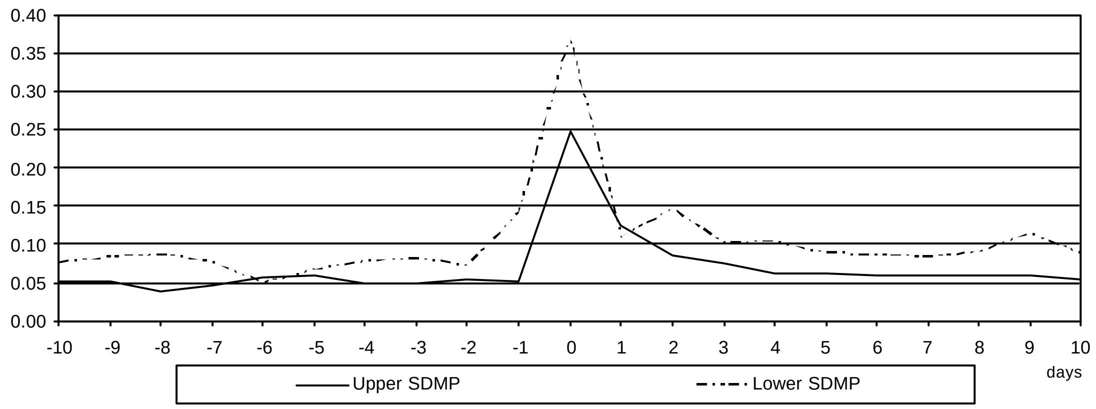
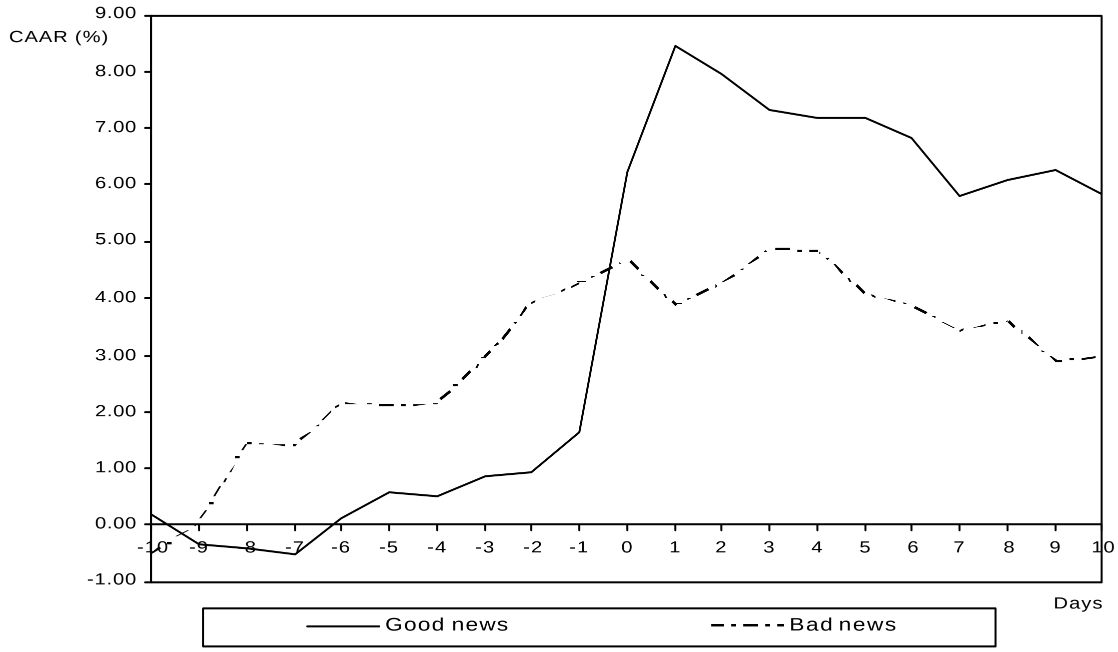


Figure 4
Cumulative average abnormal returns around trading halts and limit hits

This figure plots the cumulative average daily abnormal returns (CAAR) from day -10 to day +10. Event date (day 0) is defined as either the trading-halt or the limit-hit day. Abnormal returns are estimated based on market-adjusted return model. Panel A presents results from good- and bad-news trading halts. We use the tick test of Lee and Ready (1991) and the reopening prices to identify "good" and "bad" news halts. Panel B represents the values for upper and lower limit-hit samples. An upper (lower) limit hit occurs when price hits the upward (downward) price limits.

Panel A: Good and bad news trading halts



Panel B: Upper and lower price limit hits

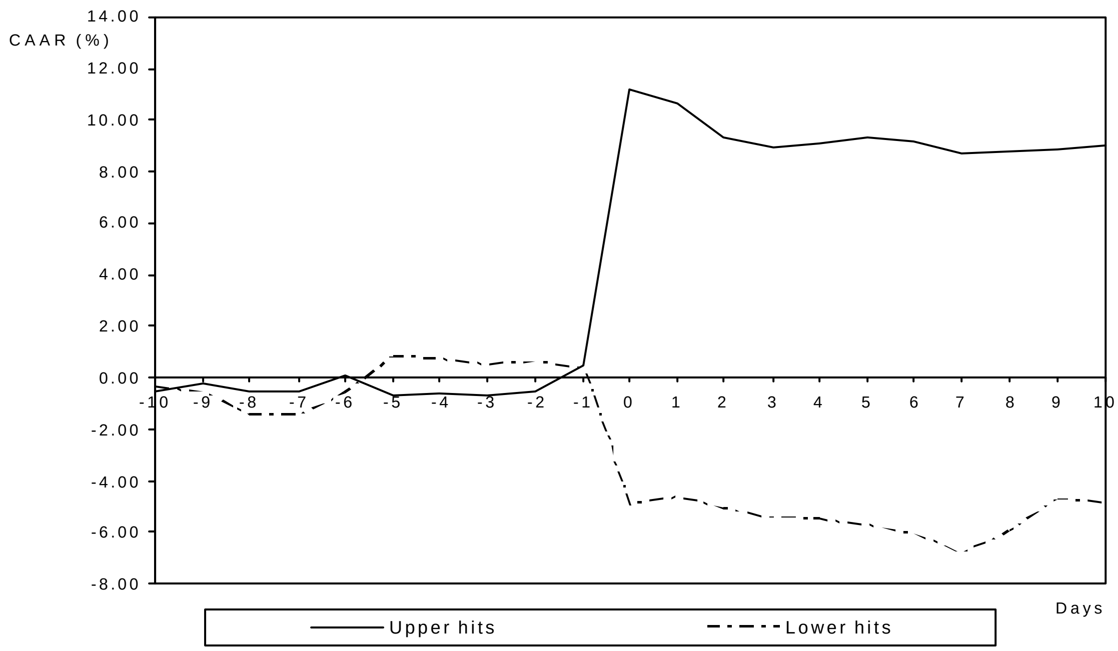


Table I
Summary statistics for trading halts

This table subdivides the sample trading halts according to suspension time, resolution time and reasons for trading halts and provides the mean of trading-halt durations. Intraday halts are trading halts initiated during the trading session, while delayed openings are halts initiated prior to the opening. To measure the halt duration, we consider only trading hours. For halts that are not resolved by the end of the trading day, duration excludes the non-trading period from closing on the halt day to the opening on the following day. The sample includes the 66 trading halts called by the CNMV during the period January 1998- April 2001. All trades are resumed by the closing of the following trading day. We use the tick test of Lee and Ready (1991) and the reopening prices to identify "good" and "bad" news halts. If the first trade after the trading halt is classified as a buy (sell), the trading halt is related to good (bad) news.

	All halts	Good-news halts	Bad-news halts
Number of observations	66	49	17
Halt time of day			
Delayed opening	47	37	10
Intraday halts	19	12	7
Resolution of trading halts			
Same trading day	45	32	13
Next day's open	21	17	4
Reasons for trading halts			
By release of information	58	43	15
By presentation of tender offers	8	6	2
Mean (median) of trading-halt duration (in hours)	4.76 (5.26)	5.19 (5.78)	3.54 (2.76)

Table II
Firm characteristics

This table reports some characteristics of the sample trading-halt and limit-hit firms. Market capitalization (in millions of euros) is based on the ending value in the year prior to the year when trading halts or limit hits occurred. Stock price (in euros) is the previous year-end closing price. Daily trading value is the average daily trading volume in thousands of euros in the year prior to the trading-halt and limit-hit year. Beta is estimated from the standard market model using daily stock and IBEX35 returns in the year prior to the year when the events occurred. Residual risk is the standard deviation of the residuals from the market model. Total risk is the standard deviation of the daily stock returns in the year prior to the year when trading halts or limit hits occurred. The daily stock returns are calculated as $\ln(P_t/P_{t-1})$, where P is the closing price adjusted for dividends, stock splits and rights offerings. The t-student test is used to test the differences in means while the Man-Whitney test is used to determine the difference in medians between the trading-halt and limit-hit samples. *p*-values are reported in parenthesis.

Firm characteristics	**Trading halts**	**Limit hits**	***t*-test (p-value)**	**Z (p-value)**
Market capitalization (in millions of euros)				
Mean	5,406.93	1,489.11	2.69	6.45
Median	994.87	157.37	(0.01)	(0.00)
Stock price (in euros)				
Mean	20.67	15.88	1.54	3.32
Median	14.06	9.40	(0.12)	(0.00)
Daily trading value (in thousands of euros)				
Mean	18,046.66	4,289.48	3.10	5.37
Median	2,970.59	561.90	(0.00)	(0.00)
Beta				
Mean	0.653	0.616	0.60	1.10
Median	0.665	0.524	(0.55)	(0.27)
Residual risk				
Mean	0.022	0.025	-0.79	-2.61
Median	0.018	0.021	(0.43)	(0.00)
Total risk				
Mean	0.025	0.027	-0.55	-1.70
Median	0.020	0.024	(0.58)	(0.09)

Table III
10-day average analysis of trading activity and liquidity around trading halts and limit hits

This table reports the means and medians of the cross sectional 10-day average trading activity and liquidity prior to (Before) and following (After) trading halts and limit hits. Panel A presents the results from full samples of trading halts and limit hits. Panel B shows the results for good- and bad-news trading halts. Panel C reports the results from upper and lower limit-hit samples. The measures of trading activity are: Frequency, number of trades executed each day; Volume, number of shares traded each day; Trading value, trading volume in euros. Each daily figure is scaled by the 21-day (from -10 to +10) average. The liquidity measures are: Relative quoted spread (RQS), the quoted bid-ask spread divided by the bid-ask midpoint, where quoted bid-ask spread is the difference between ask quote and bid quote; Relative effective spread (RES), effective spread divided by the bid-ask midpoint, where effective spread is twice the absolute value of the difference between trade price and the bid-ask midpoint. Both RQS and RES are reported in percentage. Depth (shares) is the number of shares available at the prevailing bid and ask quotes; Depth (€) is the sum of euro value of the shares available at the bid and ask quotes. Daily depth measures are scaled by their 21-day average. The *t* test and the Wilcoxon signed rank test are used to determine the significance level of the differences between Before and After means and medians, respectively.

	Mean		Median		Mean		Median	
	Before	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**
Panel A: All trading halts and limit hits								
	Trading halts (N=66)				**Limit hits (N=160)**			
Frequency	0.833	1.145 (x)	0.880	1.103 (x)	0.803	1.049 (x)	0.777	1.049 (x)
Volume	0.767	1.186 (x)	0.740	1.204 (x)	0.789	1.018 (x)	0.779	1.000 (x)
Trading value	0.748	1.203 (x)	0.744	1.191 (x)	0.778	1.027 (x)	0.740	1.016 (x)
RQS	0.500	0.409 (a)	0.431	0.336 (a)	1.109	1.212 (z)	0.861	0.944 (z)
RES	0.548	0.446 (a)	0.468	0.367 (a)	1.203	1.320 (y)	0.946	1.061 (y)
Depth (shares)	0.877	1.108 (x)	0.919	1.056 (x)	1.006	0.927 (a)	1.011	0.940 (b)
Depth (€)	0.860	1.122 (x)	0.910	1.063 (x)	0.997	0.933 (b)	0.993	0.965
Panel B: Good and bad news trading halts								
	Good news (N= 49)				**Bad news (N=17)**			
Frequency	0.788	1.181 (x)	0.833	1.124 (x)	0.962	1.042	0.981	1.059
Volume	0.722	1.216 (x)	0.699	1.231 (x)	0.898	1.101	0.945	1.063
Trading value	0.702	1.234 (x)	0.665	1.225 (x)	0.884	1.114 (z)	0.903	1.108 (z)
RQS	0.533	0.435 (a)	0.446	0.355 (a)	0.404	0.335	0.256	0.257
RES	0.585	0.476 (a)	0.493	0.383 (a)	0.440	0.359	0.281	0.278
Depth (shares)	0.845	1.132 (x)	0.904	1.058 (x)	0.969	1.038	0.958	1.031
Depth (€)	0.827	1.147 (x)	0.896	1.063 (x)	0.954	1.051 (z)	0.925	1.035 (z)
Panel C: Upper and lower limit hits								
	Upper (N=106)				**Lower (N=53)**			
Frequency	0.788	1.044 (x)	0.752	1.051 (x)	0.827	1.058 (x)	0.802	1.048 (x)
Volume	0.786	0.985 (x)	0.783	0.961 (x)	0.789	1.079 (x)	0.758	1.072 (x)
Trading value	0.739	1.024 (x)	0.710	1.025 (x)	0.848	1.030 (y)	0.836	1.008 (y)
RQS	1.101	1.097	0.848	0.841	1.135	1.449 (y)	0.872	1.197 (x)
RES	1.202	1.203	0.961	0.922	1.214	1.560 (y)	0.947	1.349 (x)
Depth (shares)	1.008	0.904 (a)	1.008	0.933 (a)	1.000	0.973	1.011	0.967
Depth (€)	0.960	0.944	0.938	0.997	1.067	0.911 (a)	1.088	0.895 (a)

Note:(a), (b) and (c) mean that After is significantly less than Before at the 1%, 5% and 10% level, respectively.
(x), (y) and (z) mean that After is significantly higher than Before at the 1%, 5% and 10% level, respectively.

Table IV
10-day average analysis of volatility around trading halts and limit hits

This table reports the means and medians of the cross sectional 10-day average volatility prior to (Before) and following (After) trading halts and limit hits. Panel A presents the results from full samples of trading halts and limit hits. Panel B shows the results for good- and bad-news trading halts. Panel C reports the results from upper and lower limit-hit samples. This table reports the volatility changes in terms of four different measures: Daytime volatility (DV) is the square of the daytime return from the midpoint of the first quote of the day to the midpoint of the last quote of the day; HL is the natural logarithm of the ratio of the highest bid-ask midpoint to the lowest bid-ask midpoint on each day; SDTP is the standard deviation of all transaction prices on each day; SDMP is the standard deviation of all bid-ask midpoints on each day. The *t* test and the Wilcoxon signed rank test are used to determine the significance level of the differences between Before and After means and medians, respectively.

	Mean		Median		Mean		Median	
	Before	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**
Panel A: All trading halts and limit hits								
	Trading halts (N=66)				**Limit hits (N=160)**			
DV	0.047	0.042	0.025	0.033	0.138	0.303	0.062	0.085 (x)
HL	0.026	0.027	0.024	0.025	0.036	0.047 (x)	0.034	0.042 (x)
SDTP	0.143	0.141	0.097	0.102	0.144	0.174 (x)	0.085	0.114 (x)
SDMP	0.124	0.129	0.093	0.097	0.132	0.160 (x)	0.071	0.094 (x)
Panel B: Good and bad news trading halts								
	Good news (N= 49)				**Bad news (N=17)**			
DV	0.044	0.045	0.026	0.036	0.056	0.032	0.023	0.028
HL	0.025	0.027	0.023	0.025	0.029	0.025	0.026	0.025
SDTP	0.149	0.154	0.097	0.107	0.124	0.104	0.098	0.097
SDMP	0.128	0.140	0.091	0.098	0.114	0.098	0.096	0.096
Panel C: Upper and lower limit hits								
	Upper (N=106)				**Lower (N=53)**			
DV	0.123	0.187	0.066	0.081 (y)	0.168	0.538	0.051	0.102 (y)
HL	0.037	0.045 (x)	0.036	0.042 (x)	0.033	0.049 (x)	0.029	0.042 (x)
SDTP	0.132	0.159 (y)	0.073	0.098 (x)	0.169	0.203 (x)	0.103	0.136 (x)
SDMP	0.121	0.147 (y)	0.061	0.091 (x)	0.152	0.184 (x)	0.092	0.128 (y)

Note:(a), (b) and (c) mean that After is significantly less than Before at the 1%, 5% and 10% level, respectively.
(x), (y) and (z) mean that After is significantly higher than Before at the 1%, 5% and 10% level, respectively.

Table V
Daily analysis

This table reports the cross-sectional medians of daily figures for the event window, [-3, +3], with day 0 being the event day. An event day is either a trading-halt day or a limit-hit day. Panel A presents the results from full samples of trading halts and limit hits. Panel B shows the results for good- and bad-news trading halts. Panel C reports the results from upper and lower limit-hit samples. For all trading halts, figures on day 0 are calculated from 51 observations with non-zero trading activity on that day. Frequency is the number of trades executed each day; trading value is the trading volume in euros; RQS is the quoted bid-ask spread divided by the bid-ask midpoint (expressed in %); depth (€) is the sum of euro value of shares available at the bid and ask quotes; SDMP is the standard deviation of all bid-ask midpoints on each day. Frequency, trading value and depth (€) are scaled by their 21-day (from –10 to +10) average. RQS is reported in percentage. The significance level of the change between each pair of consecutive days is determined by the Wilcoxon signed rank test.

	Trading activity				Liquidity				Volatility	
Day	**Frequency**		**Trading value**		**RQS**		**Depth (€)**		**SDMP**	
Panel A: All trading halts (N=66) and limit hits (N=160)										
	Halts	**Hits**	**Halts**	**Hits**	**Halts**	**Hits**	**Halts**	**Hits**	**Halts**	**Hits**
-3	0.834	0.741	0.693	0.593	0.360	0.802 (c)	0.835	0.898	0.084 (y)	0.059
-2	0.917 (y)	0.715	0.716 (z)	0.587	0.388	0.818	0.804	0.918	0.097	0.058
-1	0.999	0.901 (x)	0.831	0.786 (x)	0.368	0.885	0.822	0.894	0.103	0.075 (x)
0	0.992	2.139 (x)	1.026	2.258 (x)	0.277	1.086 (x)	1.097 (x)	1.125 (x)	0.130	0.292 (x)
1	1.800 (x)(x)	1.876 (a)(x)	1.830 (z)(x)	1.741 (a)(x)	0.304 (·)(c)	1.003(a)(z)	1.062 ( )(x)	0.820 (a)( )	0.135 ( )(y)	0.122 (a)(x)
2	1.328 (a)	1.177 (a)	1.322 (a)	1.065 (a)	0.304	0.953	1.042	0.852	0.093 (a)	0.111 (a)
3	1.110 (a)	0.999 (a)	1.035 (a)	0.842 (a)	0.309	0.912	0.994	0.823	0.069	0.080 (a)
Panel B: Good (N=49) and bad (N=17) news trading halts										
	Good	**Bad**	**Good**	**Bad**	**Good**	**Bad**	**Good**	**Bad**	**Good**	**Bad**
-3	0.738	0.936	0.643	0.752	0.368	0.254	0.802	0.882	0.081 (z)	0.089
-2	0.822	1.113 (z)	0.633	0.844	0.421	0.251	0.771	0.872	0.100	0.095
-1	0.975	1.087	0.811	0.847	0.402	0.222	0.827	0.814	0.103	0.104
0	1.190	0.905 (b)	1.251 (z)	0.847	0.298	0.244	1.186 (x)	0.890	0.130	0.152
1	2.030 (x)(x)	1.067	2.543 (z)(x)	0.926	0.321 (·)(c)	0.254	1.188 ( )(x)	0.932	0.176 (.)(y)	0.084 (b)( )
2	1.464 (a)	1.062	1.412 (a)	1.194	0.322	0.228	1.052	1.032	0.095 (a)	0.076
3	1.100 (a)	1.121	1.022 (a)	1.177	0.328	0.250	0.999	0.987	0.070	0.064
Panel C: Upper (N=106) and lower (N=53) limit hits										
	Upper	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
-3	0.745	0.704 (c)	0.593	0.581	0.835	0.774 (c)	0.898	0.884	0.048	0.081
-2	0.729	0.666	0.560	0.663	0.766	0.864	0.911	1.003	0.053	0.071
-1	0.834 (x)	1.060 (x)	0.747 (y)	0.827 (x)	0.797	1.118 (x)	0.943	0.817 (a)	0.052	0.141 (x)
0	2.433 (x)	1.984 (x)	2.740 (x)	1.756 (x)	0.809	2.382 (x)	1.313 (x)	0.806	0.247 (x)	0.367 (x)
1	2.177 (b)(x)	1.319 (a)(z)	2.128 (a)(x)	1.176 (a)(·)	0.845	1.178(a)(y)	0.936 (a)(.)	0.667(b)(b)	0.124 (a)(x)	0.108 (a)(·)
2	1.232 (a)	1.150 (a)	1.104 (a)	1.042	0.859	1.420	0.877	0.801 (z)	0.086 (a)	0.147
3	0.972 (a)	1.109	0.844 (a)	0.826 (b)	0.848	1.054 (b)	0.805	0.859	0.075 (a)	0.100 (a)

Note: (a), (b) and (c) mean that the day *t* value is significantly less than the day *t*-1 value at the 1%, 5% and 10% level, respectively. (x), (y) and (z) mean that the day *t* value is significantly higher than the day *t*-1 value at the 1%, 5% and 10% level, respectively. On day 1, the second letter refers to the comparison between day –1 and day 1.

Table VI
Spread decomposition

The adverse selection component (ë) and the fixed cost component (ø) are estimated from the following two equations.

$$q_t = \boldsymbol{a}_q + \sum_{j=1}^{5} \boldsymbol{b}_j \Delta\, p_{t-j} + \sum_{j=1}^{5} \boldsymbol{g}_j q_{t-j} + \boldsymbol{t}_t, \qquad \Delta\, p_t = \boldsymbol{a}_p + y\,[D_t - D_{t-1}] + l\,t_t + \boldsymbol{n}_t,$$

where Ä p_t is the price change for transaction t, q_t is the signed trade quantity corresponding to the price change, D_t is the indicator corresponding to the direction of a trade (+1 for a buyer-initiated trade and -1 for a seller-initiated trade), and $\hat{o}_t$ is the residual. C_q equals ë times the average trade size divided by the daily average closing price; C_n equals ë times the daily average number of shares outstanding divided by the daily average closing price; ø/P denotes the fixed component of trading costs as a proportion of the daily average closing price. This table reports the means and medians of the cross sectional estimations prior to (Before) and following (After) trading halts and limit hits. The *t* test and the Wilcoxon signed rank test are used to determine the significance level of the differences between Before and After means and medians, respectively.

	Mean			**Median**		
	Before	**After**	**Test t**	**Before**	**After**	**W-test**
			Panel A. Good halts (N=32)			
ë * 10000	0.0028	0.0022	-0.90	0.0007	0.0002	-1.38
Cq*100	0.0176	0.0144	-0.90	0.0090	0.0027	-1.29
Cn	0.8946	0.6036	-1.41	0.3180	0.2127	-1.42
Ø	0.0248	0.0196	-1.74*	0.0171	0.0140	-1.61
ø/P (%)	0.1766	0.1343	-2.45**	0.1512	0.1184	-2.69***
			Panel B. Bad halts (N=10)			
ë * 10000	0.0006	0.0002	-1.61	0.0002	0.0001	-1.68*
Cq*100	0.0075	0.0030	-1.63	0.0026	0.0014	-1.38
Cn	0.6306	0.2442	-1.70	0.3114	0.1174	-1.58
Ø	0.0121	0.0118	-0.09	0.0087	0.0100	1.48
ø/P (%)	0.0985	0.0930	-0.29	0.0753	0.0808	1.58
			Panel C. Upper hits (N=93)			
ë * 10000	0.0067	0.0069	0.14	0.0033	0.0043	0.68
Cq*100	0.0492	0.0542	0.99	0.0292	0.0348	1.50
Cn	3.5087	3.3034	-0.40	0.8326	1.3469	-0.31
Ø	0.0292	0.0321	1.28	0.0197	0.0213	2.94***
ø/P (%)	0.3532	0.3560	0.19	0.2750	0.2815	-0.45
			Panel D. Lower hits (N=39)			
ë * 10000	0.0099	0.0122	0.94	0.0038	0.0036	1.17
Cq*100	0.0443	0.0697	1.55	0.0283	0.0262	0.88
Cn	2.3125	3.0630	1.09	1.0046	1.0100	1.05
Ø	0.0542	0.0657	2.24**	0.0333	0.0355	2.23**
ø/P (%)	0.3087	0.3909	2.25**	0.2756	0.3598	3.60***

(***) significant at 1%, (**) significant at 5%., and (*) significant at 10%

Table VII
Delayed price discovery: Price continuations and reversals

This table reports the total proportions of price continuations, reversals, and no change for limit hit (upper and lower) and trading halts (good and bad news). We apply the Kim and Rhee (1997) method. We examine daytime return (r_t^d) for the event day (day 0) and the immediate following overnight return (r_t^n). The daytime return is the open-to-close return measured by $\ln(P_t^c / P_t^o)$ and overnight return represents close-to-open returns measured by $\ln(P_{t+1}^o / P_t^c)$, where P^c and P^o denote closing and opening prices respectively and *t* represents the event day. We examine daytime return for day *t* and the immediate following overnight return. Stock returns can be positive (+), negative (-) or zero (0). For upper limit hits and good news halts, we classify the set of $\{[r_t^d, r_t^n]$ [+,+],[0,+]} as price continuation, the set of $\{[r_t^d, r_t^n]$ [+,-],[0,-],[-,+],[-,0], [-,-]} as price reversals, and the set of $\{[r_t^d, r_t^n]$ [+,0],[0,0]} as no change. For lower limit hits and bad news halts, we classify the set of $\{[r_t^d, r_t^n]$ [-,-],[0,-]} as price continuation, the set of $\{[r_t^d, r_t^n]$ [-,+],[0,+],[+,-],[+,0], [+,+]} as price reversals, and the set of $\{[r_t^d, r_t^n]$ [-,0],[0,0]} as no change. In the trading halts sample, we remove those with trading resumption on the next day's open because of the lack of closing price on trading halt day.

	Trading halts		Limit hits		Binomial Test (Z value)	
	Good news (N=32)	**Bad news (N=13)**	**Upper (N=106)**	**Lower (N=53)**	**Good news -Upper**	**Bad news - Lower**
Price behavior						
Continuation	0.44	0.31	0.65	0.11	-1.50	0.77
Reversal	0.53	0.69	0.27	0.83	1.75	-0.985
No change	0.03	0.00	0.08	0.06		
Binomial Test (Z)						
Continuation - Reversal	-0.52	-1.29	3.42***	-3.78***		

Note: (***) significant at 1%, and (*) significant at 10%.

Table VIII
Return behavior around trading halts and limit hits

This table reports the Daily Average Abnormal Returns (*AAR*) and Cumulative Average Abnormal Returns (*CAAR*) around trading halts and limit hits. The abnormal returns are estimated from market-adjusted returns. Excess returns are calculated for a study period of ±10 trading days around the event date (day 0). Event date is defined as either the trading-halt day or the limit-hit day. We use both t-test and the Wilcoxon signed rank test (Z-W) to determine whether the *AAR* and *CAAR* are significantly different from zero.

	Trading halts						Limit hits					
	Good news (N=49)			Bad news (N=17)			Upper (N=106)			Lower (N=53)		
Day	***AAR* (%)**	***t-test***	**Z-W**	***AAR* (%)**	***t-test***	**Z-W**	***AAR* (%)**	***t-test***	**Z-W**	***AAR* (%)**	***t-test***	**Z-W**
-10	0.219	0.79	0.67	-0.533	-1.60	-1.49	-0.548	-1.74*	-2.13**	-0.382	-0.92	-1.76*
-9	-0.504	-2.06**	-2.36**	0.569	1.01	0.97	0.273	0.89	0.55	-0.210	-0.49	-0.62
-8	-0.008	-0.02	-0.30	1.401	1.47	1.11	-0.257	-1.09	-1.22	-0.881	-2.38**	-2.54**
-7	-0.118	-0.39	-0.50	-0.039	-0.08	0.26	0.011	0.05	-0.19	-0.008	-0.03	0.06
-6	0.699	1.70*	1.38	0.763	1.22	0.78	0.583	1.75*	1.04	0.835	2.47**	2.68***
-5	0.410	1.39	1.16	-0.057	-0.09	-0.07	-0.782	-2.56**	-2.94***	1.404	3.77***	3.22***
-4	-0.102	-0.44	-0.62	0.014	0.03	0.26	0.084	0.27	-0.22	-0.040	-0.10	-0.16
-3	0.376	0.90	-0.22	0.829	1.66	1.63	-0.038	-0.12	-0.31	-0.263	-0.81	-0.94
-2	0.108	0.32	-0.38	0.960	2.42**	2.11**	0.174	0.56	0.70	0.110	0.33	0.79
-1	0.809	2.16**	2.02**	0.357	0.60	0.50	0.958	2.26**	1.14	-0.231	-0.48	-0.26
0	4.433	3.37***	4.40***	0.412	0.71	0.54	10.744	18.18***	8.60***	-5.286	-6.77***	-5.40***
1	2.313	3.34***	2.82***	-0.825	-1.55	-1.49	-0.618	-1.45	-1.97**	0.266	0.31	1.18
2	-0.493	-1.67*	-1.64	0.397	0.56	0.07	-1.259	-3.94***	-4.02***	-0.421	-0.81	-0.83
3	-0.694	-2.18**	-2.06**	0.614	1.29	0.64	-0.364	-1.38	-1.12	-0.366	-0.87	-1.11
4	-0.120	-0.38	-0.60	-0.024	-0.05	-0.12	0.063	0.21	-0.46	-0.064	-0.16	-0.36
5	-0.045	-0.16	-0.20	-0.767	-1.49	-1.44	0.314	1.03	0.52	-0.215	-0.66	-0.76
6	-0.333	-1.29	-1.13	-0.207	-0.73	-0.21	-0.170	-0.63	-0.98	-0.359	-0.96	-1.54
7	-1.070	-3.19***	-3.45***	-0.445	-1.37	-1.35	-0.494	-1.71*	-1.80	-0.757	-1.79*	-1.85
8	0.303	0.75	0.16	0.169	0.32	0.64	0.081	0.27	-0.46	0.864	2.05**	2.08**
9	0.175	0.74	0.70	-0.701	-1.43	-1.02	0.065	0.24	0.33	1.249	3.06***	2.67***
10	-0.426	-1.66	-1.27	0.058	0.13	0.78	0.162	0.60	0.35	-0.143	-0.37	-0.31
(-5,-1)	1.602	1.96*	1.22	2.102	1.65	1.73*	0.395	0.42	-0.26	0.979	1.02	1.05
(+1,+5)	0.962	0.99	0.78	-0.605	-0.41	-0.17	-1.864	-3.10***	-3.26***	-0.799	-0.69	-0.05

Note: (***) significant at 1%, (**) significant at 5% and (*) significant at 10%.

Table IX
Summary table on trading halts and price limits performance

Category	Analyzed Variables	Trading halts	Price limits
Trading activity	Frequency Volume Trading value	Increased	Increased
Liquidity	Relative quoted spread Relative effective spread Depth (shares) Depth (€)	Increased	Decreased
Volatility	Daytime volatility High-Low Standard deviation of transaction prices Standard deviation of bid-ask midpoints	No change	Increased
Price Discovery and efficiency	Price continuation Abnormal returns	No delayed price discovery Market is efficient	Overreaction observed from upper price limit Lower price limit has cooling-off effect