Price Discovery Around Canadian Equity Trading Halts Using Intraday Data

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ABSTRACT

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This thesis, comprised of three essays, concentrates on price discovery and the properties associated with transactions and quotes surrounding trading halts on the Montreal (ME) and Toronto Stock Exchanges (TSE). Trading halts are imposed by exchanges on listed securities, namely; in response to informed trading at the expense of uninformed traders, in order to force companies to comply with proper and quick news dissemination, and in response to large depth imbalances. Since the maintenance of a fair and orderly market is the desired mandate of stock exchanges, the successful implementation of trading halts should reduce informational asymmetry surrounding specific announcements.

The first essay examines price discovery on the ME. It extends previous literature by examining returns, volatilities and trade activity over time and finds that trading halts are effective in disseminating news in a fair and orderly manner. Although most adverse information effects subside within a few hours of the resumption of trading, trading halt effectiveness varies somewhat over time. Volatility and trading activity preceding the trading halt are quickly impounded into prices post-halt.

The second essay investigates trade activity, direction, spreads, depths and volatility for stocks interlisted on the ME and TSE. Results indicate that asymmetric information impacts on both the market and the specialist covering the halted security. Specialists adjust their supply of liquidity around the trading halts and informed traders are less active prior to the trading halts. Although trade activity, spreads and volatility increase after trading resumes, only trade activity partially remains at its new higher level permanently.

The final essay decomposes the components of the bid/ask spread and examines specialist behaviour and quote/transaction revisions for stocks interlisted on the ME and TSE. Results indicate that specialists attempt to clear themselves of unwanted inventories accumulated around bad news announcements, by adjusting spreads and depths intraday to quickly dispose of unwanted inventory. Although asymmetric information is the largest component of the quoted spread around trading halts, severe biases are uncovered in component estimation. These are attributed to the use of serial covariance estimates in component estimation for some of the models currently used in the literature.

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Chapter 1: Introduction

Previous work (see, for example, Kryzanowski (1979), Ferris et al. (1992), Lee et al. (1994), Slezak (1994)) on the price discovery process around trading halts has attempted to determine whether trading halts are a necessary tool to properly disseminate information. Trading halts are imposed by exchanges on listed securities for a variety of reasons, namely; in response to informed trading at the expense of uninformed traders, in order to force companies to comply with proper and quick news dissemination, and in response to large depth imbalances. Since the maintenance of a fair and orderly market is the desired mandate of the majority of stock exchanges throughout the world, the intent of an exchange-imposed trading halt is to reduce any informational asymmetry amongst traders surrounding specific public announcements.

The primary purpose of this dissertation is three-fold: First, to investigate the relationship between trading halts and microstructure variables measuring price discovery, information flow and liquidity; second, to ascertain the applicability of using trading halts to facilitate the price discovery process from an informational efficiency viewpoint; and third, to determine the ability of specialists in detecting and correcting informational asymmetries by adjusting the liquidity they provide. To this end, the dissertation is organized in three essays.

The three essays comprising this dissertation focus on a number of issues pertaining to trading halts in an attempt to uncover the intraday behaviour of informed and uninformed traders and market makers, and their impact on the intraday price discovery process. This work is motivated by five reasons. First, trading halts should be accompanied by increased volume and volatility around the halt. Stickel and Verrecchia (1994), Harris (1986), and Karpoff (1987) find a strong relationship between volume and price changes. Therefore, the likely price change around the trading halt should be accompanied by higher volumes. Second, the number of trades should also increase around trading halts. Jones, Kaul and Lipson (1994) find a strong relationship between the number of trades and volatility. These measures should decline post-halt if the halt was successful in fulfilling its mandate of reducing volatility. Third, a positive relationship between the proportion of medium-sized trades and increased volume and volatility around trading halts should exist, if medium-sized trades serve as a good proxy for informed trades (Kryzanowski and Zhang (1996), amongst others). Fourth, the behaviour of the specialist to the above market statistics may have a discernible impact on quoted spreads and depths. Affleck-Graves et al. (1994) and Krinsky and Lee (1996), amongst others, find that component estimates and quote behaviour react to <u>expected</u> announcements through an increase in the adverse selection component implicitly charged by the specialist as compensation for providing liquidity. Thus, the behaviour of the specialist around <u>unexpected</u> announcements (trading halts) may have a differing impact on quoted spreads and depths. Finally, Huang and Stoll (1994) find that the difference between quote returns and subsequent transaction returns is positively related to quote returns and negatively related to transaction returns. Thus, an examination of quote/transaction revision behaviour around trading halts should highlight whether differences in return behaviour exist pre- and post-halt. Whether this return behaviour provides any insight on the composition of the components of the quoted spread, as well as the profit taking and wealth preserving motivations of the specialist is examined.

The first essay extends the literature on price discovery by examining returns, volatilities and trade activity across markets and over time. Ferris, Kumar and Wolfe (1992) examine SEC-imposed suspensions and find that volume and volatility increase surrounding these suspensions. Returns are devalued permanently for bad news suspensions only. Lee, Ready and Seguin (1994) find that volume and volatility associated with trading halts on the NYSE remain at heightened levels for one and three days after the resumption of trading, respectively. Brock and Kleidon (1992) find that transaction demand and volume increase around market closures. Blume, Easley and O'Hara (1994) suggest that volumes provide signals relating to the content of disclosed information.

If a trading halt is associated with information disclosure, large event interval returns should be observed. Post-halt, new prices should be set at levels that best match all market and limit orders given the newly disclosed information. If price discovery post-halt is erratic, the trading halt may not be totally effective in the incorporation of the disseminated information in order to reduce informational asymmetry. An examination of abnormal returns around a trading halt is used to test inferences based on the restoration of informational asymmetry.

The price discovery path may exhibit larger swings than during "normal" trading conditions if informed traders capitalize on their information at the expense of specialists and uninformed traders. Thus, conditional volatility estimates around trading halts based on Schwert and Seguin (1990) will determine whether halts are effective in reducing excessive volatility.

Specialists are fully exposed to any informational asymmetries existing on the securities they cover. Trading halts may be requested by specialists if they detect the existence of "abnormal" order imbalances. Trading activity pre- and post-halt can determine whether specialists and exchange officials react to these imbalances.

Thus, the first essay attempts to determine whether post-halt prices reflect all information disclosed during the halt, whether the halt reduces excess volatility as intended, and whether the halt initiated by exchange officials responds to increased trading activity. It is found that increased pre-halt volatility and trading activity are quickly reduced post-halt.

The second essay extends the first essay by examining trading activity, trade direction, spreads, depths and volatilities around trading halts for stocks interlisted on both the Montreal and Toronto Stock Exchanges. Thus, since traders have equal and easy access to quotes on both exchanges, total Canadian liquidity is addressed therein. It also examines the determinants of conditional volatility estimates around trading halts by expanding on the approach of Bessembinder and Seguin (1993). Further, this essay uncovers whether an increased proportion of medium-sized trades precedes trading halts, whether any increased proportions are news dependent, and whether uninformed traders and specialists react to this signal. If medium-sized trades serve as a good proxy for informed trades, then the proportion of medium-sized trades should increase around trading halts. Barclay and Warner (1993) and Kryzanowski and Zhang (1996) postulate that medium-sized trades are informed trades.

Jiang and Kryzanowski (1995b) find that volatility is positively related with the number of trades and spreads, and that volatility and depth are negatively related. Thus, a positive relationship between volatility and information flow proxies is expected. This essay finds that conditional volatility estimates increase significantly pre-halt and then decrease significantly once trading resumes. Although depth imbalances do not change significantly around the halt, spreads widen prior to the trading halt and slowly decline to original levels post-halt. Medium-sized (informed) traders are less active around the trading halt.

The third essay extends on essay two by examining the quoted bid/ask spread components and analyzing quote/transaction revisions around trading halts for stocks interlisted on the Montreal and Toronto Stock Exchanges. Stoll (1989) decomposes the quoted spread into three components, and finds that adverse selection, order processing costs, and inventory holding costs account for approximately 43%, 47% and 10% of the quoted spread, respectively. Affleck-Graves et al. (1994), using the Stoll approach, find that the adverse selection component is larger for NYSE stocks than NASD stocks, and that the order processing component is negligible on the NYSE. Krinsky and Lee (1996) also use the Stoll approach, and find that the adverse selection component increases around earnings announcements, and continues to increase post-announcement. These papers rely on return covariance estimates and transaction restrictions to estimate the component costs of the spread. This reliance can create severe biases when intraday data are employed. Masson (1993) corrects for some of the bias by incorporating quote revisions rather than serial covariances. Since the data used in this essay (as is the case for other studies) do not conform completely to the assumptions of the Stoll and Masson models, the inferences based on the component estimates may be somewhat fragile.

Huang and Stoll (1994) find that the difference between quote returns and subsequent transaction returns positively affects quote returns, and negatively affects transaction returns. During periods of potentially high informational asymmetries, quote/transaction interactions may be quite different. Since a trading halt and the information contained therein is not known prior to its occurrence, this essay examines spread components and specialist reactions to order arrival around these halts rather than to speculation as to the outcome of a specific known event (as in Krinsky and Lee (1996)). The differences in the spread component estimates obtained from various models are compared and reconciled. Quote/transaction revision is examined to determine the reaction of specialists to asymmetric information.

The remainder of this thesis is organized as follows: Chapter two uses a mean-return generating model to empirically test abnormal returns, and both parametric and non-parametric tests to determine the significance of the changes in liquidity and information flow around trading halts.

Chapter three examines the impact of informed traders on the price discovery process around trading halts, and examines the behaviour of trade direction, volatility and liquidity in the price discovery process around trading halts.

Chapter four examines the behaviour of the specialist and her ability to detect informational asymmetries. Quote/transaction behaviour and quoted spread components are examined to obtain insight into the changes in intraday liquidity around periods characterized by informational asymmetries.

Chapter five presents the main findings and implications of the thesis. It offers potential paths for future research in the area.

Chapter 2: Price Discovery Around Trading Halts on the Montreal Exchange Using Trade-By-Trade Data

2.1 Introduction

Ferris, Kumar and Wolfe (1992) find that returns are devalued permanently for bad news SEC suspensions, and that volatility and volume are higher prior to and after suspensions, but regain their prior levels at a later date. As in Kryzanowski (1979), who finds apparent news leakages prior to suspension for both types of information and significant excess returns after reinstatement for the unfavourable news sample only, their results are sensitive to the favourableness of the information disseminated during the halt. Lee, Ready and Seguin (1994) find that trading halts are associated with increased (not reduced) volume and volatility, which persist for one day and three days after reinstatement, respectively. Lee et al. conclude that halts are unsuccessful at fulfilling their mandate of reducing "excess volatility" for their sample of NYSE halts, and that the disruption of "learning by trading" is the only feasible explanation for their findings. Hopewell and Schwartz (1978) find rapid and permanent adjustments in the price levels over NYSE suspensions, but that the adjustments are more company specific than market specific. Howe and Schlarbaum (1986) find substantial devaluations prior to suspension and that these negative returns continue for a long time after reinstatement, but they find no anticipation of the suspension.

The contribution of this essay is to examine an expanded set of variables for a different market and for various time periods to assess whether price discovery, and regulatory and specialist effectiveness around trading halts are similar across markets and over time. To this end, abnormal returns, volatilities, and trade activity measures are examined using 30 minute intervals for a sample of 412 trading halts drawn from the Montreal Exchange. Results for these halts should differ from those on the NYSE, because the former is not only a smaller, less liquid and less followed market than the latter but it caters primarily to smaller capitalization firms. Since a halt on the Montreal Exchange disrupts a smaller order flow of trades, the disruption of a halt should be relatively smaller than on the NYSE. In addition, unlike the NYSE where only the specialist has access to the limit order book, all market participants on the Montreal Exchange have access to the specialist's market quotes and limit order book, and to transaction information on a real-time basis. Thus, by being able to learn about the beliefs of traders directly from the book, investors can rely less on learning from the observable order flow. According to Glosten (1994), an open limit order book provides the maximum liquidity that can be expected in environments of extreme adverse selection.

Results indicate that the effectiveness of trading halts, which are a regulatory response to pre-halt informational asymmetry, volatility and/or trade activity, varies over time on the Montreal Exchange. Trading halts are associated with a temporary increase in volatility and trade activity post-halt as new information is incorporated into prices within a few hours after reinstatement. The number of trades better measures the information flow associated with a trading halt than trading volume and value.

Section 2.2 continues with a discussion of trading halts in markets with specialists. The sample and data are presented in Section 2.3. An analysis of the test results for the measures of abnormal return, volatility, and trade activity around the trading halts is presented in Section 2.4. Some concluding remarks are offered in Section 2.5.

2.2 Trading Halts in Markets With Specialists

As on the NYSE, the Montreal Exchange can impose a trading halt on any listed security for various reasons. A trading halt can be imposed to force information disclosure to eliminate informational asymmetry, to await a pending announcement by a listed firm, a large imbalance of buy or sell orders, or anything else the exchange officials deem unfair to investors and shareholders.

A halt usually lasts for less than one trading day, and is lifted after a formal announcement of new information that may have an impact on the traded price (Canadian Securities Law Reports (1989)). If the halted company does not comply with the requests of the exchange, floor officials have the authority to extend halts, to levy fines, or to delist the "delinquent" firm.

Between information dissemination and trading resumption, the specialist for the halted stock sends out price indications to get a feel for the market. The price that appears to best balance all buy and sell orders is then the opening price. Like a regular opening, trading commences via a batch call market and switches into a dealer auction market thereafter.

A Montreal Exchange specialist may have an incentive to request a halt under certain trading situations because she is highly exposed to informational asymmetries, and her performance is measured by price continuity. The specialist's evaluation suffers if the price jumps are large due to the specialist's desire for protection against asymmetrical information and inventory risks. If the riskiness of the specialist's position outweighs the possible loss of orders due to the "reduced heterogeneity of opinion" and redirection of orders to other exchanges, then the best interests of the specialist are to ask for a halt. Her evaluation is unaffected because the large price change over the halt is expected. Similarly, the specialist must be prudent before reinitializing trading at a specific price, because resuming trading at other than the consensus price and spread may lead to an erratic price discovery path and a poor performance evaluation.

2.3 Sample, Data and Data Manipulation

The initial sample consists of 823 trading halts drawn from three arbitrarily chosen six month subperiods (March-August 1988, May-October 1989 and October 1990-March 1991) in order to test if any structural shifts occurred in the imposition of or market reaction to trading halts over time. Using subperiods also reflected the constraint that, while the reason for each halt can only be obtained by examining each company's file, the Quebec Securities Commission severely limits the number of company files that can be consulted on a twice weekly basis. Trading halts for preferred shares, warrants and units, and trading halts that did not trade at least once within the event window and at least once in 30 time intervals are deleted from the sample. The initial and final sample sizes, the number of halts deleted for each screen, the number of "good" and "bad" news halts in the final sample based on the tick test of Lee and Ready (1991) for the initial reinstatement prices, and descriptive statistics for halt length, day-of-the-week, time-of-the-day, and price level for each subperiod are reported in Table 1. Halts are also classified as "good", "bad" and "unknown" news based on an assessment of the favourableness of the information disseminated during the halts. These unreported findings are not materially different from those reported below. [1,2]

[Please place Table 1 about here.]

Most halts are for securities trading at $5 and over. The halts are fairly evenly distributed throughout the week. Since the majority of the halts occur at the opening and are subject to a batch call market at reinstatement and a dealer auction market thereafter, the price discovery process post-halt may be similar to the price discovery process for market opens.

The halt and resumption times, all intraday trades, and end-of-day bid/ask quotes are available for each of the halts. The trade data for each halt are summarized into 30 minute intervals (as in Lee, Mucklow and Ready (1993) for the NYSE). This half-hour sampling interval balances the potential loss of information associated with aggregating transaction data and non-trading for longer trade intervals with the increased frequency of non-trading intervals associated with shorter trade intervals.[3]

2.4 Empirical Findings

2.4.1 Abnormal Return Behaviour Around the Trading Halts

The first null hypothesis tested is that the price immediately after trading resumption completely reflects the disclosed information (i.e. full price discovery). If trading halts are associated with material information disclosures, then these event-interval returns should be relatively large. Full price discovery should occur if the specialist discovers a bid-ask spread and call auction opening price which clears the most orders and reflects the new equilibrium price. Actual price discovery also depends on the depth, breadth and resiliency of the market for the reinstated stock.

The following mean-adjusted return generating model with 20 dummy variables (ten on either side of the halt) is used to measure the abnormal returns (ARs) for each halted security:[4]

$$R_{jt} = \alpha_j + \sum_{i=1}^{n} \tau_{ji} D + \varepsilon_{jt} \quad (1)$$

where R_{jt} is the closing trade-to-trade return on halted stock j for 30-minute interval t;

α_j is the mean return on halted stock j over all t;

D is a dummy variable matrix with a value of one for each t in the event window of [-10, +10] and zero elsewhere, and captures the significance of each 30-minute interval abnormal return;

n is the number of intervals in the event window;

τ_{ji} is the AR for halted stock j for interval i in the event window; and

ε_{jt} are normally distributed (0, σ_j^2).

The returns for each halt cover the period [-400, +399], where [0] represents the halt (event). All measures, including the ARs and cumulative abnormal returns (CARs), are tested using both t- and sign-tests. All statistical significance is at the 0.05 level unless noted otherwise. The t-tests use cross-sectional standard errors since information events are generally associated with increased volatility.

The CAR for the three sets of good and bad news samples for the event window [-10, +10] are plotted in Figures 1 and 2, respectively, and tests of their significance for three periods within the event window are presented in Table 2. The mean event-interval ARs are large (5.86%, 9.07% and 9.46%) and significant for both tests (t-values of 5.07, 3.47 and 3.28) for the three samples of good news halts. The non-event ARs in the event window and the CARs in the periods [-5, -1] and [+1, +5] are not significant for the third subperiod sample. In contrast, the first two subperiod samples have significant CARs for the pre-event period [-5, -1] of 1.40% and 2.65%, respectively, and in the post-event period [+1, +5] of 2.63% and 4.03%, respectively. The mean ARs are significant (and positive) in 30-minute intervals [-5], [-3], [-1] and [+1] for the first subperiod sample (March-August 1988), and in intervals [-3], [-2], [-1], [+1], and [+2] for the second subperiod sample (October 1988-March 1989). However, the directional proportions of the ARs for these intervals are not significant based on the sign test. Thus, while the two earliest subperiods of good news halts are proceeded and followed by significant and positive ARs, the price discovery process is efficient since disclosed information is reflected in about one hour after the reinstatement of trading.

[Please place Figures 1 and 2 and Table 2 about here.]

The AR and CAR inferences for the three sets of bad news samples are similar. The mean event-interval ARs are large (-2.69%, -3.03% and -5.02%) and significant based on both tests (t-values of -3.22, -4.82 and -2.91) for the three samples of bad news halts. The mean CARs are significant (and positive) for [-5, -1] for the first two subperiod samples. The mean CARs are not significant for [+1, +5] for all three samples, although a significant proportion of the CARs are negative for the two most recent subperiod samples. No significant mean ARs occur for the first and third subperiod samples, although the mean ARs for [-5], ..., [-1] are all positive for the most distant sample. The mean ARs are significant and positive in intervals [-5] and [-1], and significant and negative in interval [+1] for the second subperiod sample. These findings also imply that trading halts are a response to pre-halt informational asymmetry, and are effective in that the price discovery process post-halt is efficient for bad news halts. Disclosures appear to be fully reflected within one hour of the reinstatement of trading.

The robustness of the (C)AR results reported above are examined next. As expected, given that information events are generally associated with increased volatility, the number of mean (C)ARs which are significant increases when the t-tests use standard error estimates from the pre-window, post-window or pre-and-post-window periods. As expected, the findings are not affected materially using returns measured over 60 and 120 minute intervals nor using continuous returns, which simply assume a structure to the incorporation of information into prices between trades.[5] While future prices affect present returns when continuous returns are used, Easley and O'Hara (1992), among others, argue that information is impounded in quotes with some stickiness between trades. Thus, the use of continuous returns is an attempt to determine the impact of the unavailability of intraday spread data on the Montreal Exchange for the halts studied herein.

2.4.2 Volatility Behaviour Around the Trading Halts

The null hypothesis tested next is that trading halts reduce any increased volatility exhibited pre-halt. The conditional variances are estimated using the absolute value of the mean-adjusted return times $\sqrt{\pi / 2}$ as in Schwert and Seguin (1990). The conditional volatilities are plotted in Figures 3 and 4 for the three sets of good and bad news samples, respectively, and tests of their significance for various time period pairings are presented in Table 3.

[Please place Figures 3 and 4 and Table 3 about here.]

The conditional volatility results are similar for the samples of good and bad news halts. The conditional volatilities increase (often significantly) during the five intervals prior to the halt compared to the period prior to the event-window, further increase significantly on the event interval, and then decrease significantly during the five intervals subsequent to the resumption of trading. The conditional volatilities for the five intervals immediately post-halt compared to the five intervals immediately pre-halt exhibit no clear pattern, since they are (in)significantly higher or lower depending on the sample examined. The conditional volatilities pre- and post-window generally are not significantly different. Thus, trading halts are a response to increased volatility pre-halt and are associated with a temporary increase in volatility post-halt as new information is reflected in stock prices (Ross (1989)). Volatility is down to its pre-window levels within five hours after the lifting of a trading halt.[6]

2.4.3 Trade Activity Around the Trading Halts

The null hypothesis tested next is that trading activity should decline post-halt if the reason for a trading halt is enhanced share trading frequency, volume or dollar value. If specialists and uninformed traders use these trade activity measures to learn about the information held by informed traders, the values of these indicators should increase during the period when informed traders exploit their informational advantage, and during the price discovery process following the resumption of trading after a trading halt. Given the strong relationship between volume and price changes found by Stickel and Verrecchia (1994), and between number of trades and volatility (Jones, Kaul and Lipson (1994)), these measures of trading activity should also decline post-halt if the halt is successful in eliminating increased volatility.

The mean and median traded share volumes per 30-minute interval for various time period pairings, and tests of their significance, for each of the six samples of halts are presented in Table 4. For the three samples of good news halts, the share volumes increase (generally significantly) from the period prior to the event window to the period consisting of the five intervals immediately prior to the halt, further increase significantly on the event interval, and then decrease (generally insignificantly) over the five intervals immediately after the resumption of trading. The share volumes for the five intervals immediately post-halt are significantly higher than for those immediately pre-halt. The share volumes for the post-window period are significantly higher (for at least one test for each sample) than those for the pre-event window period.

[Please place Table 4 about here.]

The results for the three samples of bad news halts are similar, except that less of the paired differences are significant. The results for the traded share values are not materially different, and, thus, are not reported herein.

To summarize, trading halts appear to be a response to increased trading volume and value, and are associated with a temporary increase in both measures in the immediate vicinity of the resumption of trading as new information is reflected in stock prices. While both measures subsequently decrease in magnitude, they remain above their levels in the period prior to the event window.

The number of trades per 30 minute interval are plotted in Figures 5 and 6 for the three sets of good and bad news samples of trading halts, respectively, and tests of their significance for various time period pairings are presented in Table 5.

[Please place Figures 5 and 6 and Table 5 about here.]

The number of trades results are similar for the samples of good and bad news halts. They increase significantly from the period prior to the event window to the five intervals immediately prior to the halt, further increase significantly on the event interval, and then decrease significantly during the five intervals immediately subsequent to the halt interval. The number of trades are higher for the five intervals immediately post-halt compared to those immediately pre-halt, and are significantly lower post-window compared to the five intervals immediately pre-halt. The number of trades are insignificantly lower and higher pre-window compared to post-window for the samples of good and bad news halts, respectively.

Thus, trading halts respond to an increased number of trades pre-halt which signify the possible existence of informational asymmetries. The number of trades also increases post-halt as a by-product of the price discovery process, and returns within a few days of trading resumption to a lower level.

2.5 Concluding Remarks

Trading halts on the Montreal Exchange are preceded by evidence of informational asymmetry in abnormal returns, volatility and trade activity (traded share frequency, volume or value). Much of the information disclosed during a trading halt is reflected in prices within the first half-hour, and most is reflected within a few hours. Both volatility and trade activity increase temporarily as new information is incorporated into prices around trading halts. Information flow around trading halts is best measured using the number of trades. The results indicate that price discovery, and regulatory and specialist effectiveness around trading halts differ somewhat from this stylized description depending on the time period and market studied.

The results support the multiperiod model of Slezak (1994) in which closures delay resolution of uncertainty by imposing more risk onto uninformed traders post-closure, and by increasing the risk of both informed and uninformed traders pre-closure. The results indicate that halts on the Montreal Exchange appear to be less of an impediment to uncertainty resolution than halts on the NYSE (Lee et al. (1994)), probably due to the former market's smaller order flow and open order book.

Chapter 3: Trade, Liquidity and Volatility Behaviour Around Trading Halts for Stocks Interlisted on the Montreal and Toronto Exchanges

3.1 Introduction

Lee, Ready and Seguin (1994) examine the behaviour of abnormal returns, volatilities and aggregate volumes around trading halts on US markets. This essay extends their work by examining depths, spreads, the determinants of conditional volatilities, and the informational role of trade size and trade direction around trading halts for interlisted stocks. If informed trades are executed at the expense of both uninformed traders and the specialist,[7] then the market behaviour associated with informed traders should differ from that of other market participants around trading halts.[8]

Since most large Canadian companies are cross-listed, this essay addresses total Canadian activity and liquidity, since traders on the floor of the two largest exchanges in Canada have easy access to quotes on either exchange, and can fill orders at the most competitive quote regardless of location. To this end, the robustness of trade activity measures, trade direction, spreads, depths and conditional volatilities around trading halts using 30 minute intervals are examined and tested for a sample of 170 trading halts dual listed on both the Montreal (ME) and Toronto Stock Exchanges (TSE) from December 1988 through June 1990.

Share volumes, values and frequencies in aggregate (and for informed investors only) increase significantly only after trading is resumed, and that increase includes both a permanent and temporary component. While depth imbalances do not change significantly around halts, spreads increase significantly during the halt interval, and decline slowly to historic levels thereafter. Thus, specialists adjust their supply of liquidity in a period of informational asymmetry by widening spreads, rather than adjusting depths. Volatility increases temporarily on the event interval, and significant determinants of conditional volatility include lagged conditional volatilities, spreads, number of trades, the event interval dummy, and day-of-the-week effects (for bad news halts only).

The remainder of this paper is organized as follows. The sample and data are discussed in Section 3.2. The results for measures of trade activity, direction, liquidity and volatility are reported and analyzed in Sections 3.3 through 3.6, respectively. Some concluding remarks are offered in Section 3.7. Pertinent institutional information on market organization and market making on the TSE are discussed in Appendix 1, and on trading halts on the ME and TSE in appendix 2.

3.2 Sample and Data

Over the period from June 1988 through June 1990, 649 halts were imposed on stocks interlisted on the ME and the TSE. Available data for these and resumed, trade-by-trade data for both exchanges, and quote-by-quote data for the TSE only.

Halts are deleted if the halted security was a preferred share, a warrant or a unit (401 deletions), it did not trade at least once per day during each of the five days prior to the halt (45 deletions), its trading price was less than $1 (22 deletions), and its event window encompassed the Ontario civic holiday in August (11 deletions).[9] The initial and final sample sizes, the number of halts deleted by each screen, the number of "good" and "bad" news halts for the final sample based on the tick test of Lee and Ready (1991) using the initial reinstatement prices, and descriptive statistics (including day-of-the-week, time-of-the-day, last pre-halt traded prices and halt length) on the final sample of 170 halts are reported in Table 6. Since most of the halted securities trade at $5.00 or greater, any price discreteness bias is minimized. The halts are distributed fairly evenly throughout the week, although their numbers seem to peak on Wednesdays.

[Please place Table 6 about here]

Data are grouped into 30-minute trading intervals as in McInish and Wood (92)[10] for the 20 days centered on the trading halt.[11] The event window [-20, +20] includes the 41 30-minute trading intervals centered on the event interval. The event interval includes the opening of trading after the lifting of a trading halt. For most tests, the five interval period immediately preceding [-5, -1] and immediately following [+1, +5] the event interval [0] are examined.

3.3 Trade Activity Around Trading Halts

The null hypothesis tested in this section is that trading halts are a regulatory response to increased trading activity pre-halt. Brock and Kleidon (1992) find that transaction demand and trading volume increase around periodic closures (particularly, opens and closes).

Blume, Easley and O'Hara (1994) suggest that volume provides information about the content of disclosed information, and not the directional impact of that information. Using a tick test as in Lee and Ready (1991), the quality and directional impact of the information conveyed can be assessed.

Increased volume and an increased proportion of the total number of medium size (MS) trades to total trades are expected to be accompanied by informational asymmetry pre-halt, if informed traders predominantly execute medium size trades. If the halt is initiated due to such asymmetry, uninformed traders and specialists are expected to react once they receive these signals. This increases volume and the number of shares traded during the price discovery process for small and large size trades post halt. If the halt speeds up the price discovery process, trade activity should quickly return to original levels post-halt.[12]

The mean numbers and dollar values of shares traded per 30-minute interval for the event window [-20, +20] are plotted in Figures 7 and 8, respectively. The mean and median traded share and dollar volumes per 30-minute interval for various time period pairings, and tests of their significance, for the good and bad news samples are summarized in Tables 7 and 8, respectively. For both samples (Table 7), share volume is significantly larger over the halt interval than during the period consisting of the five interval period immediately before or after the halt interval, and significantly higher for the period consisting of the five interval period immediately following compared to immediately preceding the halt interval. No significant change occurs in volume prior to the halt. While share volume decreases significantly post window, it is still significantly larger than that pre window. Based on Table 8, similar results are obtained for traded share values.

[Please place Tables 7 and 8 and Figures 7 and 8 about here]

The mean number of trades per 30-minute interval for the event window [-20, +20] are plotted in Figure 9 for the good and bad news samples. The mean and median number of trades per 30-minute interval for various time period pairings, and tests of their significance for both news samples are summarized in Table 9. The number of trades for both samples is significantly higher over the halt interval than in either of the immediately surrounding five interval periods, and lower in the five interval period immediately prior to the event than after. The number of trades does not increase significantly for the five interval period immediately before the halt compared to the pre-window period. The number of trades decreases significantly from the event window to the period consisting of the first five interval period after the halt interval, and significantly decreases further post-window. The number of trades is significantly higher post-window than pre-window.

[Please place Table 9 and Figure 9 around here]

Thus, share volumes, values and frequencies increase only after trading is resumed. Part of the increase is permanent since the post-window levels of these three measures remain above their pre-window levels.

The mean number of medium size trades per 30 minute interval for the event interval [-20, +20] are plotted in Figure 10 for both samples. The mean and median proportions of medium-size trades to total trades per interval for various time period pairings, and tests of their significance, for both samples are summarized in Table 10. No significant changes are identified in the proportions of medium size (MS) trades per interval around the bad news trading halts. In contrast, the mean number of medium size trades for the good news halts in the period consisting of the five interval period immediately preceding the event interval is significantly smaller than that during the event interval, the five interval period immediately post-halt, and the post-window period. Thus the proportion of medium-size trades increases permanently during the event interval for good news halts only.

[Please place Table 10 and Figure 10 about here]

3.4 Trade Direction Behaviour Around Trading Halts

The null hypothesis tested here is that trade direction, measured by the proportions of buy and of sell trades per interval, is related directly to the size of the trade executed around the halt. The expectation is that informed traders (as proxied by medium size trades) execute a relatively large (small) number of buys prior to good (bad) news halts.

As in Lee and Ready (1991), trades below (above) the quote midpoint are sells (buys). Trades at the quote midpoint which are (zero-) downticks are buys, and (zero-) upticks are sells. Since quotes less than five seconds old may be sequentially misaligned, only quotes that are at least five seconds old relative to the trade being classified are used.[13]

The mean proportions of buys per 30-minute interval for the event window [-20, +20] are plotted in Figure 11. The mean and median proportions of buys and sells per interval for various time period pairings, and tests of their significance for both samples are summarized in Table 11. The relative proportions of buys per interval increase (decrease) significantly from the five interval period immediately prior to the event window to the event interval, and then decrease (increase) significantly immediately post halt for the good (bad) news sample. The proportion of buys per interval is significantly larger during the post-window period compared to the period consisting of the five interval period immediately following the halt interval for the bad news sample only.

The relative proportions of sell frequencies per interval decrease (increase) significantly from the five interval period immediately prior to the event interval to the event interval, and then increase (decrease) significantly for the good (bad) news samples. The proportion of sells per interval is significantly larger during both the pre- and post-window periods compared to the period consisting of the five interval period immediately preceding the halt interval for the bad news sample only.

[Please place Table 11 and Figure 11 about here]

The mean proportions of medium size buys and sells per 30-minute interval for the event window [-20, +20] are plotted in Figures 12a and 12b. The mean and median proportions of medium size (MS) buys and sells per 30 minute interval for various time periods, and tests of their significance for both samples are presented in Table 12. The proportions of MS buys per interval increase significantly from the five interval period prior to the event interval to the event interval, decrease significantly immediately from the event interval to the five interval period immediately following the event interval for both samples, and then further decrease significantly thereafter for the bad news sample only. The proportion of MS buys per interval is significantly lower during the five interval period preceding the event interval compared to either the pre- or post-window period for the bad news sample only.

The proportions of MS sells per interval for both samples are significantly lower in the five interval period immediately preceding the event interval compared to the five interval period immediately following the event interval or the pre- or post-window periods. The proportions of MS sells per interval are significantly lower during the event interval compared to the five interval period immediately following the event interval for the good news sample only, and significantly higher during the event interval compared to the five interval period immediately prior to the event interval for the bad news sample only.

[Please place Table 12 and Figures 12a and 12b about here]

Unlike other market participants, informed traders as proxied by medium-size trades become relative less active on both the buy and sell sides prior to the imposition of trading halts. One possible reason is that these informed traders learn of the existence of non-public information, but are unable to determine whether the information is favourable or unfavourable. Like other market participants, these informed traders become relatively more active on the buy (sell) side for good (bad) news halts for a short period following the reinstatement of trading.

3.5 Liquidity Behaviour Around Trading Halts

The null hypothesis tested here is that depth imbalance (measured as the difference between volume at the ask and volume at the bid) and spreads, which are two joint components of market liquidity, are adjusted by specialists to deal with any informational asymmetry perceived around trading halts. Depth at the bid, depth at the ask and the relative spread (measured as the difference between the ask price and the bid price relative to the midpoint between the two) are also examined in this light. If specialists use medium-size trades as a signal of informedness, the largest adjustment in market liquidity will coincide with an increase in medium-size trades.

The specialist protects herself against informational asymmetry by either increasing the spread once she fills the order at her posted prices, and/or decreasing the depth (i.e., the supply available to informed traders). Although the specialist has decreased her exposure to subsequent informed trades by taking these actions, she has impacted negatively on her performance measures by decreasing liquidity, increasing the cost to trade, and disrupting price continuity. Therefore, the specialist must become quite adept at adjusting spreads and decreasing liquidity, increasing the cost to trade, and disrupting price continuity. Therefore, the specialist must become quite adept at adjusting spreads and depth to meet exchange performance benchmarks while simultaneously protecting herself from informed traders.

Since a specialist can request a halt based on a perceived inequitable imbalance of orders, liquidity is expected to decrease (especially from informed traders) prior to halts. Further, the largest reductions in liquidity are expected during periods of high concentration of information-based trades, as proxied by medium size trades. Thus, spreads and depths should have a positive and negative relationship, respectively, with the intensity of medium sized trades.

Mean bid depth, ask depth and absolute and relative spreads[14] per 30 minute interval for the event window [-20, +20] are plotted in Figures 13a, 13b, 14 and 15, respectively. The mean and median depth imbalance and spreads per 30 minute interval for various time period pairings, and tests of their significance for both samples are presented in Table 13. No significant changes are observed in the depth imbalance around the trading halts for both samples. In contrast, spreads adjust to informational asymmetry. For both samples, spreads increase significantly from the five interval period immediately prior to the event interval to the event interval, and decline slowly to levels post-window that are not significantly different from those that existed pre-window. Thus, specialists seem to adjust their liquidity by widening spreads with no apparent change to depth imbalance.

both the bid and ask increase from the five interval period preceding the event to the event interval, and continue to remain at these levels for the five interval period immediately post-halt. Depth levels do not return to their pre-halt levels for both samples. Thus, information shocks are associated with higher information risk (larger spreads) and higher market liquidity.

[Please place Tables 13 and 14 and Figures 13a, 13b, 14 and 15 about here]

Nonparametric chi-square contingency tables are examined next to discern whether the size of the spread relative to its median value is in any way related to depth imbalance relative to its median value. The null hypothesis tested is that the depth imbalance classification is independent of spread classification and that spreads and depths are uncorrelated. Based on the results presented in Table 15, the null hypothesis is rejected for all cases except for the good news sample immediately post-halt. Thus, spread values are significantly related to depth imbalance values except for the five interval (price discovery) period immediately following a good news halt. The same test was then run matching spreads against total depth. Results, presented in Table 16, are significant throughout.

[Please place Tables 15 and 16 about here]

[Please place Tables 15 and 16 about here]

3.6 Volatility Behaviour Around Trading Halts

The null hypothesis tested here is that trading halts reduce any enhanced volatility that occurs pre-halt. Jones, Kaul and Lipson (1994) find a positive relation between volatility (absolute residuals) and the number of transactions, and an insignificant relation with average trade size. Jiang and Kryzanowski (1995b) also find a positive relation between volatility and the number of trades, and that spreads and depth are positively and negatively related to volatility, respectively. Therefore, volatility is expected to be positively related to proxies for information flow such as unexpected increases in volume or increases in the number of trades. Volatility should increase with the arrival of new information around trading halts.

As in Bessembinder and Seguin (1993), an estimate of conditional volatility is obtained from:

$$R_{it} = a_i + \sum_{j=1}^{J} b_{ij} R_{i,t-j} + \sum_{i=1}^{J} c_{ij} \hat{\sigma}_{i,t-i} + \sum_{k=1}^{4} d_{ik} DOW + e_i E_t + \mu_{it} \qquad (2)$$

$$\hat{\sigma}_{it} = \left|\hat{\mu}_{it}\right| \left(\frac{\pi}{2}\right)^{1/2} \qquad (3)$$

$$\hat{\sigma}_{it} = \alpha_i + \sum_{j=1}^{J} \beta_{ij} \hat{\mu}_{i,t-j} + \sum_{m=1}^{M} \gamma_{im} A_{im,t} + \sum_{k=1}^{4} \tau_{ik} DOW_{ik} + \sum_{j=1}^{J} \lambda_{ij} \hat{\sigma}_{i,t-j} + \delta_i E_t + \varepsilon_t \qquad (4)$$

E_i is the event interval dummy;

DOW is the day-of-week dummy; and

$A_{im,t}$ is the vector of indicator variables (number of trades, spread and depth imbalance).

As in Bessembinder and Seguin (1993) and Schwert and Seguin (1988), the above model is estimated using a two-step procedure. The estimates of the unconditional residuals obtained using equation (3), after first regressing current period returns on lagged returns and the other variables as defined in equation (2), are incorporated into the estimate for conditional volatility in equation (4). Results for two models for both the good and bad news samples are reported in Table 17.[15,16] The first model incorporates 13 lags of returns, conditional and unconditional volatility in order to capture any effects within a complete trading day (13 30-minute intervals per day). The second model uses only 1 lag of each of the above variables. For both samples, only lagged depth and unconditional volatility have no impact on conditional volatility. The depth results are not surprising, since it was shown earlier that specialists do not adjust depths significantly around trading halts.

[Please place Table 17 around here]

The means of conditional volatility estimates (from equation (3)) per 30 minute interval for event window [-20, +20] based on close-to-close and midpoint-to-midpoint returns for the good news and bad news samples are plotted in Figures 16a and 16b, respectively. Conditional volatility estimates per 30 minute interval for various time period pairings, and tests of their significance for both samples are presented in Table 18. For the good news sample, the conditional volatilities based on both return measurements increase significantly from the five interval period immediately prior to the event interval to the event interval, decrease significantly in the five interval period immediately after the event interval, and decrease significantly thereafter to levels that are not significantly different post-window compared to pre-window. The conditional volatilities are higher in the five interval period immediately following the event interval than the five interval period immediately preceding the event window, but are only statistically significant based on midpoint returns.

[Please place Table 18 and Figures 16a and 16b about here]

For the bad news sample based on both return measurements, the conditional volatilities increase significantly from the pre-window period to the five interval period immediately prior to the event interval (for midpoint returns only), increase significantly from the five interval period immediately prior to the event interval to the event interval, decrease significantly from the event interval to the five interval period immediately following the event interval, and further decrease significantly to the post-window period. The conditional volatilities are significantly higher for the five interval period immediately after the halt interval compared to the five interval period immediately preceding the halt interval for midpoint returns only.

3.7 Autocorrelation of Returns Around Trading Halts

The autocorrelations of returns pre- and post-halt are examined in order to determine the degree of price adjustment as well as to highlight any differences in the autocorrelation structure around trading halts. Positive autocorrelations imply partial price adjustment and negative autocorrelations imply overshooting or oscillating prices.

The results based on close-to-close returns per interval for both news samples for thirteen lags (one trading day) are presented in Table 19.[17] Autocorrelations are significant and negative only for the first lag post-halt for both samples. This suggests that there exists some overshooting post-halt, implying possible price reversal, or possible bid/ask bounce. It is likely that pre-halt transactions were specialist buys (sells) for bad (good) news. Therefore, post-halt transactions may be specialist sells (buys) for good (bad) news.

The results based on quote midpoint-to-midpoint returns per interval exhibit a different pattern pre-halt compared to post-halt. For both news samples, all but one autocorrelation pre-halt are positive and only lag 13, and lag 12 and 13 are not significant pre-halt for the bad news and good news samples, respectively. Autocorrelations post-halt are negative for lags 7, 9 and 12, and only lag 5 is significant for the bad news sample. Autocorrelations are negative for lags 1, 3, 4, 7, 10, 11 and 12, but none are significant. Thus, pre-halt midpoint returns exhibit slow adjustment, whereas post-halt midpoint returns tend to overshoot, suggesting specialist liquidity as measured through quoted relative spreads are more erratic post-halt.

[Please place Table 19 about here.]

3.8 Concluding Remarks

Trading halts initiated on securities interlisted on the Toronto and Montreal (Stock) Exchanges provide support for asymmetric information affecting both the market and the specialist. Specialists adjust their supply of liquidity post-halt by only widening the spreads on their listed stocks, and by adjusting the depths. Trade activity as measured by the number of trades per interval increases significantly and permanently post-halt, and has a significant impact on the conditional volatility of the halted security. All indicators based on informed trades (medium size) increase significantly only post-halt.

The results suggest that temporary increases in all the indicator variables (excluding the number of trades) are in direct response to the newly imparted information, which is then quickly incorporated into prices once trading is resumed. Specialists attempt to protect themselves against informed traders by decreasing the liquidity for the halted security. Further, key determinants of conditional volatility estimates, such as the number of trades and the spread, react to this information quickly, suggesting that trading halts allow the flow of information to reach all market participants in a timely manner.

Chapter 4: Bid/Ask Components and Quote/Transaction Interaction Around Trading Halts for Stocks Interlisted on the Montreal and Toronto Stock Exchanges

4.1 Introduction

Previous microstructure work develops three competing and complementary theories about price behaviour within and around quoted spreads. Under the order processing theory, the specialist as provider of immediacy attempts to recover any costs to trading by retaining the spread as compensation. If no other effects exist, then the entire spread acts as compensation for order costs and the transaction price should bounce within the quoted spread.

The inventory holding theory suggests that specialists adjust quotes in an attempt to maintain a balanced inventory position. If the specialist fills a sell order at the quoted bid, then the specialist lowers the subsequent quoted ask in an effort to induce a buy order, and lowers the bid to dissuade further sales. The specialist, therefore, either clears her position or is compensated for holding excess inventory. Thus, in the absence of any information, price reversal or negative serial correlation is expected under the inventory holding theory (Roll (1984)).

The adverse selection theory stipulates that the specialist may transact with two types of traders in the market, informed and uninformed. When an uniformed specialist receives an order, a risk exists that it was initiated by an informed trader. An informed trader presumably will not trade unless the result of the trade is favourable. Therefore, the specialist quotes a wider spread in order to gain compensation from uninformed traders to cover losses from the trades filled with informed traders.

If a trade is executed at the ask (public buy, specialist sell), and the specialist assumes that the trade was initiated by an informed trader, the specialist has two possible "protective" options. By widening the spread, a public sell (at the bid) becomes more attractive to less informed investors. However, a risk still exists in that the quoted ask is low relative to the information possessed by the informed trader, and that informed traders may still purchase at the new higher ask. Therefore, the specialist may decrease depth on the "informed" side. This decreases the availability of shares to be bought at the ask, and forces stability or at least buys some time until information is properly disseminated. This may occur through a trading halt, if the imbalance is severe enough.

Huang and Stoll (1994) find that quotes adjust to reflect the information content imparted through the previous trade. Hasbrouck (1991) finds that informational asymmetry is positively related to the quoted spread and that trades impact on prices through a lag process. The larger the trade size, the wider the post-trade spread becomes. It is argued that these wide spreads eventually lead to a price movement. Hasbrouck (1988) suggests that dealers adjust quotes post-trade given the possibility that the trade was executed by an informed investor.

Asymmetric information in this context implies that specialists revise their quotes once a trade has been executed. Since specialists are assumed to be at an informational disadvantage relative to informed traders, they will adjust both depths and spreads to decrease their exposure to this disadvantage. Therefore, the spread implicitly compensates the specialist for providing liquidity to informed traders.

Glosten and Harris (1988) find that most of the spread on NYSE stocks is made up of an asymmetric information component. For NASDAQ stocks, Stoll (1989) finds that asymmetric information accounts for approximately 43% of the spread, order processing fees account for 47%, and inventory holding for the remaining 10%. Affleck-Graves et al. (1994) find that the adverse selection component of the spread is much higher for NYSE stocks compared to NASDAQ stocks, and that the order processing fee component is almost negligible on the NYSE. Franz et al. (1995) find that spreads decrease after company stock repurchases using NASDAQ stocks. They attribute this to a decline in asymmetric information after the open market transaction. Krinsky and Lee (1996) find that the adverse selection component increases around earnings announcements. They find that this component continues to increase post announcement as specialists are still exposed to traders who can process newly imparted information at quicker rates.

This essay differs from much of the previous work in that intraday data are used. However, unlike Krinsky and Lee (1996) who use intraday data to examine spread components around earnings announcements, this essay examines specific events involving asymmetric information which are not known to the specialist prior to their actual occurrence. Thus, this essay uncovers the reactions of the specialists to order arrival rather than to speculation as to the outcome of a specific upcoming announcement. Further, this essay examines the effect of using intraday data for component spread estimation and the biases inherent in the models presently used in the literature. The differences in the spread estimates obtained using the different approaches are compared and explained.

This essay addresses the above for exchange imposed trading halts on securities listed on both the Montreal and Toronto Stock Exchanges. These trading halts are imposed by floor officials at the request of market surveillance, and often are initiated by the specialists for the halted securities. A relatively large imbalance of buy and sell orders unaccompanied by public information on that security may imply that uninformed traders and specialists are at a larger informational disadvantage than under normal trading conditions. The intent of these exchange imposed trading halts is to reduce the degree of informational asymmetry by requesting public disclosure from the delinquent company prior to reinitiating trading.

Since the specialist may be highly exposed to informational asymmetry pre-halt, it is examined whether the components of the spread are different before and after the halt. During periods of high informational asymmetry, the specialist may be inclined to widen the spread and/or decrease the depth. Nonparametric tests of the differences in means on the relative spread and total depth values for selected periods around trading halts are performed to examine changes in these variables. Adjustments made to the spread due to informational asymmetry through an examination of the components of the spread around trading halts is also uncovered. The spread is decomposed into its components using the Stoll (1989) model, the zero-inventory model of George et al. (1991), and the quote revision model of Masson (1993).

Quote/transaction interactions around trading halts are also examined using the model of Huang and Stoll (1994), since such interactions may differ for periods with potentially greater informational asymmetry. Easley et al. (1995) find that informed trading is least likely for high volume stocks which have a higher arrival rate of informed and uninformed trades. The proportion of uninformed orders relative to informed orders is expected to exhibit different behaviour on the two sides of the halt. This essay examines whether a specialist can detect if the trade originates from an informed trader by including the proportion of medium-sized trades in the model as a proxy for informativeness.[18] If trading based on informational asymmetry exists prior to the halt, then medium-sized trades should dominate the order desk, if medium-sized trades are a good proxy for informed traders . If the specialist is astute and recognizes undue exposure to this asymmetry, she will widen the spread and/or decrease depth. Therefore, different quotes should be posted immediately after a transaction suspected of being informed.

The remainder of this essay is organized as follows: Section 4.2 discusses the sample and data set used. In Section 4.3, liquidity and the components of the spread are examined. Section 4.4 tests an empirical model of quote/transaction revision. Some concluding remarks are offered in Section 4.5.

4.2 Sample and Data

From June 1988 through June 1990, 649 halts were imposed on stocks interlisted on the ME and the TSE. Available data for these halts include the reason for the halt, the dates and times that trading was halted and resumed, trade-by-trade data for both exchanges, and quote-by-quote data for the TSE only.

Halts are deleted if the halted security is a preferred share, a warrant or a unit (401 deletions), it does not trade at least once per day during each of the five days prior to the halt (45 deletions), it does not contain a transaction in at least 70% of the examined intervals (73 deletions), its trading price is less than $1 (22 deletions), and its event window encompasses the Ontario civic holiday in August (11 deletions).[19] The initial and final sample sizes, the number of halts deleted by each screen, the number of "good" and "bad" news halts for the final sample based on the tick test of Lee and Ready (1991) using the initial reinstatement prices, and descriptive statistics (including day-of-the-week, time-of-the-day, last pre-halt traded prices and halt length) for the final sample of 97 halts are reported in Table 20. Since most of the halted securities trade at $5.00 or greater, any price discreteness bias is minimized. The halts are distributed fairly evenly throughout the week, although their numbers seem to peak on Wednesdays.

[Please place Table 20 about here.]

Data are grouped into 30-minute trading intervals as in McInish and Wood (1992)[20] for twenty days centered on the trading halt.[21] The event window [-20, +20] includes the forty-one 30-minute trading intervals centered on the event interval [0], which includes the opening interval after the lifting of a trading halt. For most sign tests, the five interval period immediately preceding [-5, -1] and immediately following [+1, +5] the event interval [0] are examined. In the spirit of Krinsky and Lee (1996), the pre- and post-halt periods are extended to [-26, -1] and [+1,+26] for the estimations of the component costs and quote/transaction models. Thus, five estimation periods are examined; the 'before' period consisting of trading days -10 through -3, the 'pre-26' including trading days -2 and -1, the 'event' period consisting of the event interval [0], the 'post-26' consisting of trading days +1 and +2, the 'after' period consisting of trading days +3 through +10.[22] All the trading days and intervals are centered on the event interval [0].

4.3 Components of the Bid/Ask Spread

Statistics on the spread and depth measures of liquidity before and after trading halts quoted immediately *after* the last transaction in each interval for both news samples are presented in Table 21, and graphed in Figures 17 and 18, respectively. Relative spreads (spread divided by the quote midpoint) decrease significantly from the pre-event to the post-event period for both samples. This suggests that spreads are wider during periods of asymmetry. Therefore, evidence exists for a structural shift from pre- to post-halt periods for this dimension of liquidity, as specialists react to market orders by altering the spread around the event.

Total depth (total bid volume plus total ask volume) is significantly higher pre-halt compared to post-halt for both samples. For the bad news sample only, depth during the five intervals immediately preceding the halt is significantly smaller than during the five intervals immediately following the halt. This suggests that the specialist provides less depth and offers a wider spread when potential exposure to informational asymmetry increases.

As expected, these results differ from Jennings (1994) who finds little support for information leakage and asymmetric information prior to takeover announcements. He finds that actual spreads are wider post-announcement relative to his benchmark, and return quickly to their original levels. Similarly, while depths decrease slightly prior to the announcement, they increase quickly post-announcement to original levels.

[Please place Table 21 and Figures 17 and 18 about here.]

Bid volume and ask volume exhibit similar behaviour to total depth (see Figures 19 and 20). Ask volume increases dramatically immediately post-halt for the bad news sample, and bid volume increases, albeit not as dramatically, for both samples. Thus, if the announced news is bad, the specialist attempts to induce public buys by making more securities available for sale at the ask.

[Please place Figures 19 and 20 about here.]

4.3.1 Empirical Findings Based on the Stoll (1989) Model

Since the specialist adjusts both dimensions of liquidity around trading halts, a strong justification exists to decompose the spread. In this section, the spread is decomposed into three components, the adverse selection cost (ASC), inventory holding cost (IHC) and order processing cost (OPC), using the model developed by Stoll (1989), and estimated by Affleck-Graves et al. (1994) and Krinsky and Lee (1996), amongst others. The model is specified as follows:

$$COV_{T_t} = a_0 + a_1 S_t^2 + e_t \qquad (5)$$

$$COV_{Q_t} = b_0 + b_1 S_t^2 + u_t \qquad (6)$$

where,

COV_T is the serial covariance of closing price returns (i.e., the last posted transaction price in each interval),

COV_Q is the serial covariance of bid-to-bid, or ask-to-ask returns (based on quotes immediately following the last posted transaction in each interval),

b_1 is the average of the coefficients obtained from the bid and the ask equation, and

S is the relative spread, defined as the actual spread divided by the quoted mid-spread.

In (5) and (6), a_0 and b_0 are assumed to be zero if the spread accounts for the only source of covariance. Coefficients estimated from the above regressions are then used to simultaneously solve the following system:

$$a_1 = \partial^2(1 - 2\pi) - \pi^2(1 - 2\partial) \qquad (7)$$

$$b_1 = \partial^2(1 - 2\pi) \qquad (8)$$

where π is the probability of a price reversal, and

$(1-\partial)$ is the price reversal as a proportion of the quoted spread.

The estimates of π and ∂ from (7) and (8) are then used to obtain the weights for the adverse selection, inventory holding and order processing components as a percentage of the quoted spread as follows:

$$\text{Adverse Selection: } [1 - 2(\pi - \partial)] \qquad (9)$$

Inventory Holding: $2(\pi - 0.5)$ (10)

Order Processing: $(1 - 2\partial)$ (11)

Initial estimates of a_1 and b_1 are obtained through OLS regressions. The system of equations (7) and (8) is then estimated using a bootstrapping technique, as in Affleck-Graves et al. (1994). A random sample of error terms is drawn from the same sample, and the model is regressed again to re-estimate a_1 and b_1. The procedure is repeated 10,000 times to generate 10,000 estimates of a_1 and b_1, which are used to calculate 10,000 π and ∂ estimates. The resulting standard errors of the normal distribution of 10,000 component estimates are used to test differences in means between the before, pre-, post- and after halt periods.

The realized spread, $2(\pi-\partial)S$, is defined as the proportion of the spread that the specialist expects to receive from two balancing trades. According to Stoll (1989), if order processing is the only spread component, then prices bounce between the bid and ask, and the realized spread encompasses the entire quoted spread. Since the adverse selection component is the difference between the actual quoted and realized spreads, the realized spread is zero when the adverse selection component is the only component of the quoted spread. If the inventory holding cost component accounts for the total spread, and the specialist attempts to clear portions of her inventory after executing a trade, the realized spread encompasses the entire quoted spread only if the specialist attempts to <u>completely</u> clear the position derived from the previous trade.

As is the case for all prior studies, the data studied herein does not completely conform to the assumptions of the Stoll model. Firstly, the model requires that all transactions occur at either the quoted bid or ask. Given the possibility of quotes within or outside of the quoted spread, and intraday price overreaction, π and ∂ may not conform to the structure imposed by the model. Secondly, the relative spread is assumed to be constant throughout the estimation period, although the model does allow for random parallel shifts in the relative spreads. The relative spreads examined herein are fairly constant except for the halt interval. Finally, trades are assumed to occur at the bid or ask with equal probability. For higher frequency data and periods of known and pronounced informational asymmetry, the likelihood of a trade at the bid or ask may no longer be equal.

Affleck-Graves et al. (1994) and Krinsky and Lee (1996) discuss the problem of non-convergence which they encounter during estimation. They both restrict ∂ to the range (0:0.5) when simultaneously solving for the covariances of transaction and quote price changes. They both restrict π, the probability of a price reversal, and (1-∂), the proportion of the spread that constitutes that reversal, to conform to the assumptions of the Stoll model. These additional empirically imposed restrictions have two implications. Firstly, a positive realized spread together with the restriction that $\partial < \pi$ ensures that the quoted spread will be greater than the realized spread. Secondly, the restriction that $\partial \leq 0.5$ is needed to ensure that a positive order processing cost component is obtained. Further, Affleck-Graves et al. (1994) are forced to restrict ∂ to 0.5 for portions of their sample in order to achieve convergence. This ensures that the order processing costs equal zero. However, as discussed next, a detailed examination of the model reveals that the serial covariance of returns, and not the appropriate choice of ∂ or π, is what is crucial to determining the meaning of the coefficients obtained.

As the provider of immediacy, the specialist has an obligation to trade at the posted quotes, and must provide reasonable price continuity to guarantee a satisfactory evaluation. The effect of this on the Stoll model for component estimates around trading halts can be illustrated for the case where bad news is disclosed. The specialist is likely to unknowingly accumulate unwanted inventory prior to the initiation of the halt. The specialist may perceive that informational asymmetry exists between herself and informed traders, but probably will not know the content of that information nor its likely impact on prices upon release. Once trading is reinstated, the specialist holds newly devalued inventory. After processing the information, the specialist will attempt to clear her position at the expense of less informed traders who have yet to correctly interpret the content of the news release. If the initial trade post-halt is a specialist buy at the bid (highly likely), the specialist will attempt to clear her position by sufficiently lowering the ask quote to a level that may be at least as low as the previous bid in an attempt to attract a specialist sale at the new, lower ask (i.e. possible price continuation). In fact, the specialist may let quotes drop to a level where the new ask is lower than the previous bid. Therefore, the realized spread could be negative. This implies that the specialist does not expect to earn any profit on two successive trades, since she is primarily concerned with clearing her newly devalued inventory due to the heightened adverse information exposure. The serial covariance of returns will be positive as price continuation persists downward. If the serial covariances are not confined to be negative, then the covariance of transaction returns will, in all likelihood, be greater than Roll's (1984) expected covariance of $-1/4S^2$. This may be exacerbated further by the possibility that intraday (higher frequency) data is likely to exhibit larger price overreaction behaviour when compared to daily (or closing) data.

Since the probability of a price reversal, π, can now intuitively be less than 0.5 post-halt (specifically for the bad news sample), then a non-negative serial covariance of transactions returns can only be obtained if $\partial \geq \pi$.[23] Thus, the adverse selection component is expected to be the predominant component of the quoted spread post-halt (specifically for the bad news sample). If the specialist wants to clear her position at any cost, the adverse selection component can be greater than one, and the realized spread can be less than zero! Furthermore, in defining the adverse selection, order processing and inventory cost components as comprising the entire quoted spread, negative costs are now mathematically possible, and economically rational.

Thus, by imposing the restriction $\partial \leq 0.5$, a severe limitation is placed on the interpretation of the results of the Stoll model. During periods of high asymmetry, the specialist generates quote and transaction paths that no longer conform to the assumptions of the model. Intraday data also may exhibit greater price overreaction, or continuation, particularly during periods of high and highly uncertain information flow. The possibility that the order processing cost component of the spread may be negative is a potential limitation of the Stoll model for higher frequency data. This negativity will be caused by heightened adverse selection and the specialist's determination to clear her position.

Results for the non-bootstrapped estimation procedure of the spread components are presented in Table 22. Most of the intercepts and slope coefficients are not significantly different from zero. A zero intercept suggests an informationally efficient market where the spread is the only source of serial covariance. As expected, the simultaneous equation system yields results consistent with the data. Initial restrictions on the convergence criteria of a realized spread less than the quoted spread (but greater than zero), and a probability of price reversal of at least 0.5, lead to an adverse selection component that encompasses at least 85% of the quoted spread during all estimation periods. The bad news sample post-halt yields an adverse selection component that encompasses the entire spread when it is confined to be less than one. When delta is no longer restricted to be less than the probability of a price reversal, the realized spread for the bad news sample becomes negative, which is consistent with the conjecture that the specialist attempts to clear long positions in the lower valued securities, whose values now have a greater probability of further devaluation, especially if specialists anticipate that some portion of the bad news is still only known to the informed traders.

[Please place Table 22 about here.]

Bootstrapped estimates of the spread components are presented in Table 23. Results for the most part are consistent with the initial non-bootstrapped regression estimates. The adverse selection cost component (ASC) of the spread is largest for the period after the 26 intervals post-halt for the bad news sample. The inventory holding cost component is largest immediately post-halt for both samples. Therefore, the specialist re-adjusts inventories post-halt (or at least dissuades further imbalances).

Results based on paired differences of the mean values obtained from the 10,000 estimates are presented in Panel B of Table 23. The adverse selection component is largest immediately pre-halt compared to post-halt for both news samples, and the adverse selection component is higher after the post-halt period compared to before the pre-halt period for the bad news sample only.

Similarly, the inventory holding cost component is larger post-halt compared to pre-halt, and the order processing cost component is largest pre-halt.

[Please place Table 23 about here.]

If transactions occur at prices outside of the quoted spread, the individual component costs are no longer confined to be less than 100% of the spread. If the transaction price takes place above the quoted ask (i.e. a dealer sale), and if the inventory holding model holds, the IHC component is expected to make up the entire spread, and be positively correlated with the high probability of a price reversal, π. Alternatively, if the transacted price is above the quoted ask and informational asymmetry drove the spread components, then the ASC component is expected to be high, and to be positively correlated with the high probability of a price continuation, ∂. Regardless of where the price occurs relative to the quoted spread, however, informational asymmetry is expected to be highest immediately prior to the halt (high ∂).

Therefore, not surprisingly, the adverse selection component is the predominant component regardless of the assumptions made. The adverse selection component is at least 75% of the spread for both samples, and is largest for the bad news sample. This implies that when transaction prices occur outside the quoted spread, future quotes and transaction prices can be expected to continue in the same direction when the underlying motivation of the specialist is to protect herself from further exposure to asymmetric information. The inventory holding cost component is largest immediately post-halt for both samples, implying that some price reversal (higher π) occurs after reinstatement as specialists attempt to equilibrate their inventory.

4.3.2 Empirical Findings Based on the George et al. (1991) Model

George et al. (1991) modify Stoll's (1989) model to account for time-varying expected returns. Based on the assumption that the inventory cost component of the spread is zero, they correct for the downward bias first identified by Roll (1984) by differencing the transaction and subsequent bid returns. Unlike for the Stoll model, only one covariance measure is estimated. Their model is formally stated as follows:

$$\hat{S}_t = \alpha_t + \beta_t SP_t + \varepsilon_t \tag{12}$$

where,

$\hat{S} = 2\sqrt{-\text{cov}(RD_{it}, RD_{it-1})}$

$RD_{it} = R_{iT,t} - R_{iB,t}$

R_{iT} = Transaction return at time t

R_{iB} = Subsequent bid return

SP_t = relative spread at time t

In this model, the slope estimate is the order processing component, and the remainder is the adverse selection cost component. Results based on this model are presented in Table 24. For both samples, the adverse selection component is lowest immediately post-halt, and lowest for the bad news sample regardless of the length of the pre- and post-halt periods.[24] Thus, by including a time-varying expected return estimate, the adverse selection component becomes much smaller, and in some cases, negative. This implies a realized spread greater than 100% of the quoted spread, and again a possible bias is encountered in interpreting the component estimates. Unlike Krinsky and Lee (1996) who find that the adverse selection component *increases* after earnings announcements, the results from this model for this data set suggest that specialists seem to react quickly and properly to the news release.

[Please place Table 24 about here.]

4.3.3 Empirical Findings Based on the Masson (1993) Model

Masson (1993), Brooks (1994), and Brooks and Masson (1994) use the Masson (1993) model to examine component estimates around both dividend and earnings announcements. The Masson model is based on the model of Glosten and Milgrom (1985), and uses quote revisions following transactions. Unlike the Stoll (1989) and George et al. (1991) models, the Masson model does not require spread constancy nor does it rely on serial covariances for component cost estimations.

The Masson model is based on the premise that a comparison of the midpoint of the revised spread relative to the preceding transaction provides unbiased estimates of the spread components (unlike George et al. (1991) who compare transaction returns to subsequent bid returns). In other words, quote revisions that occur after transactions are assumed to be induced by the previous trade. Intuitively, this implies that information enters the market only if a trade occurs, and that specialists do not adjust quotes unless that trade contains information.

Using transaction prices and subsequent bid and ask quotes, the Masson model decomposes the quoted spread into both a transitory (order processing) and adverse selection component. Given a transaction, the subsequent spread reflects the information content of the transaction by comparing the midpoint to that previous transaction price. As discussed earlier, the pure order processing model suggests prices bounce between two constant bid and ask quotes. The adverse selection cost model suggests that revisions to quotes are based on new information, especially if the specialist suspects the previous transaction has increased her exposure to that information. Therefore, the transitory component of the spread is estimated to be twice the difference between the previous transaction price and the new quoted midpoint. Formally;

$$\hat{\lambda}_t = \frac{2}{n}\sum_{j=1}^{n}\left|P_{j-1}^{T} - mid_j - e_j\right| \tag{13}$$

where $\hat{\lambda}_t$ is the transitory component (realized spread),

P_{j-1}^{T} is the previous transaction price,

mid_j is the subsequent quote midpoint,

$(1-\hat{\lambda}_t)$ is the remaining portion of the spread, that is, adverse selection plus inventory holding cost components, and

e_j is the innovation associated with new information entering the market.

The estimation results for this model are presented in Table 25. They are consistent with the findings in Brooks (1994). Transactions followed by quote revisions for the estimation periods containing days -10 to -1, -1 to the event, the transaction immediately after the reinstatement to day +1, and days +2 to +10, suggest that the transitory component is the largest component of the spread.[25] Regardless of the period, the transitory component makes up at least 70% of the spread. The adverse selection (non-transitory) component is largest in relative terms immediately preceding the halt, although its mean is not significantly different from the other estimation periods. This suggests that the specialist attempts to reduce possible exposure to informed traders. The absolute spread is significantly larger post-halt than during the following nine days after the halt for the bad news sample only.

[Please place Table 25 about here.]

However, some possible biases may still exist. During periods of high information innovation, the revised quotes are likely to contain elements of that innovation. Brooks (1994) finds that most quote revisions occur within 15 seconds of the preceding trade, and concludes that the likelihood of the innovation incorporated into the new quotes is unlikely. In other words, specialists initially and immediately react based on purely transitory issues, and are unable to process the innovation within the first 15 seconds. If revised quotes do contain some portion of the innovation, then the transitory component is upward biased, and the adverse selection component downward biased. Most quote revisions in the data set studied herein occur within one minute of the preceding trade (65.5% for the before period, 72.45% pre-halt, 82.18% post-halt, and 71.76% for the after period), and almost all occur within the first five minutes (85.5% for the before period, 88.34% pre-halt, 94.8% post-halt, and 89.12% for the after period). While most quote revisions occur within the first minute following a transaction, between 17.78% and 34.5% of the quote revisions contain elements of information innovation. This exceeds the values found in Brooks (1994).

Further, since the Masson model implicitly assumes that transactions occur at either the posted bid or ask, quote revisions contain the entire transitory and adverse selection components. However, if transactions occur within or outside of the quoted spread, then the component estimates may not be completely indicative of the true component costs expected from the Masson model. If a transaction occurs within the spread, and the subsequent posted quotes remain unchanged from their previous values, then the transitory component will be smaller in value than had the initial transaction taken place at either end of the spread. In other words, first assume that a transaction occurs at the spread midpoint. If subsequent quotes remain unchanged, then the difference between the transaction price and the subsequent midpoint will be zero. This implies pure adverse selection and zero transitory costs. For any transaction within the spread, a higher adverse selection estimate will exist if the subsequent quotes are unchanged. If the quotes change, then the estimate decreases.

Transactions that occur outside the posted quotes suggest a different bias. If a public purchase takes place at a price above the quoted ask and subsequent quotes remain unchanged, then the transitory component will be higher than if the previous trade had taken place at the ask. Thus, high transitory cost component estimates may be due to a number of factors beyond the implied revision.

Huang and Stoll (1996) compare effective spreads on both the NYSE and the NASD. They argue that effective spreads are higher on the NYSE due to the higher proportion of trades executed within the quoted spread. The specialist will fill a market order at better than the book if she can pass the risk on to the limit order book. According to Huang and Stoll (1996), the specialist will better the book when the incoming order is uninformed, and will be fully compensated for the adverse selection component. Thus, they expect to see price reversal whenever uninformed trades can be matched with informed limit orders.

For our data, most transactions occur at either end of the spread (ranging from 80% post-halt to 83.3% after the 13 intervals immediately post-halt). Transactions within the spread account for no more than 15% of the transactions on average, and transactions outside of the spread occur for no more than 6% of the transactions on average. Thus, the likelihood of a bias associated with transactions not occurring at either quote is slight.

The results for the Masson model are quite different from those found using the Stoll model, and from those reported in Affleck-Graves et al. (1994) and Krinsky and Lee (1996). High informational asymmetry should not be as prevalent in tick data when compared to closing or summary data. Price continuation is likely given adverse information, since the process should be slower on a tick basis. While adverse selection should be highest prior to the halt, the transitory component should constitute the majority of the spread using tick data. Return behaviour based on intraday summary data is likely to differ from that based on closing daily prices. Spreads may or may not be constant, and negative serial covariances are not guaranteed when using data of any frequency. Further, the assumption in both Affleck-Graves et al. (1994) and Krinsky and Lee (1996) that order processing costs are either non-existent or confined to a predetermined value imposes serious interpretive restrictions on the component estimates.

The results for the Masson model are somewhat more consistent with those for the George et al (1991) model. The majority of the spread consists of the transitory element, and the asymmetric component is at its highest immediately prior to the halt. However, the George et al. model still suffers from the same bias that plagues the Stoll model. Covariance estimates lead to many non-believable component estimates.

4.3.4 Recapitulation of the Spread Component Results

Since each of the spread component models used herein has limitations, caution must be taken when drawing inferences. Nevertheless, the behaviour of the spread is primarily as would be expected for each model. Specialists are fully exposed to informed traders immediately prior to the exchange-initiated halt, and often request trading halts due to their perceived exposure. While specialists are always exposed to informational asymmetry, it presumably is at its highest prior to the trading halt.

The adverse selection component is quite large prior to the halt using the Stoll model due to a number of factors. As outlined above, the asymmetric information component should be largest prior to the halt. The component importance is further augmented by the increased frequency of trades that are executed outside the previously quoted spread. Specialists may "chase" the equilibrium price by widening the spread after transacting. Thus, the adverse selection component, which is a function of the covariance of successive price changes, may be larger than the spread itself prior to the halt. The probability of a price reversal, π, may be less than 50%, and the inventory holding cost component may be small or negative.

In contrast, the findings based on the Masson model suggests that tick data are not best examined using the Stoll approach. Inventory costs are unlikely to be a factor trade-by-trade, as specialists may be more concerned with exposure to asymmetric information rather than holding costs intraday. The transitory component should be at its highest in the absence of major spread revisions, and spreads will adjust at a slower rate tick-by-tick when compared to summary or daily data. The assumption of Affleck-Graves et al. (1994) and Krinsky and Lee (1996) that the order processing cost is confined to a specified range may severely bias the resulting component cost inferences.

4.4 Quote/Transaction Revision

Based on Huang and Stoll (1994), return behaviour in the short run can be explained through an analysis of quote revisions relative to transactions returns. They argue that the difference between quote returns and subsequent transaction returns (Z_{t-1}) will positively affect quote returns, and negatively affect transaction returns.

Based on the results found for liquidity from the previous section, specialists react to informational asymmetries by decreasing depths and widening spreads around the halt. Therefore, in the context of trading halts, the predictability of stock returns based on quote midpoints relative to transactions prices is examined in both the pre- and post-halt periods herein. Since specialist behaviour is highly motivated by exposure to asymmetric information, the model specified herein is a direct empirical test of whether differences in quote and transaction return behaviour exist around trading halts particularly pre- versus post-halt. Once again, however, caution must be taken when intraday data is examined. Return behaviour based on 30-minute intervals will exhibit a different discovery path than will daily closing data.

The transaction and quote models are specified as follows:

$$\begin{aligned} RP_t = {} & \alpha_0 + \alpha_1 RQBEF_{t-1} + \alpha_2 RTSE_{t-1} + \alpha_3 ZBEF(PRE)_{t-1} + \\ & \alpha_4 ZBEF(POST)_{t-1} + \alpha_5 SPRDBEF(PRE)_t + \alpha_6 SPRDBEF(POST)_t + \\ & \alpha_7 DEPTHBEF(PRE)_t + \alpha_8 DEPTHBEF(POST)_t + \alpha_9 LQVOL_t + \\ & \alpha_{10} MED_t + \sum_{i=11}^{14} \alpha_i DOW_t + \alpha_{15} EVENT_t + \alpha_{16} OVER_t + \varepsilon_t \end{aligned} \quad (14)$$

for the transaction model,

and

$$\begin{aligned} RQAFT_t = {} & \alpha_0 + \alpha_1 RQBEF_{t-1} + \alpha_2 RTSE_{t-1} + \alpha_3 ZBEF(PRE)_{t-1} + \\ & \alpha_4 ZBEF(POST)_{t-1} + \alpha_5 SPRDBEF(PRE)_t + \alpha_6 SPRDBEF(POST)_t + \\ & \alpha_7 DEPTHBEF(PRE)_t + \alpha_8 DEPTHBEF(POST)_t + \alpha_9 LQVOL_t + \\ & \alpha_{10} MED_t + \sum_{i=11}^{14} \alpha_i DOW_t + \alpha_{15} EVENT_t + \alpha_{16} OVER_t + \varepsilon_t \end{aligned} \quad (15)$$

for the quote model.

For all variables;

BEF refers to the quote data immediately prior to the transaction, *AFT* is quote data immediately after the transaction;

$Z_t = \ln(P_t) - \ln(Q_t)$,

where $Q_t = (Bid_t + Ask_t)/2$

pre and *post* are dummy variables for 30-minute intervals (-130, -1) and (+1, +130) respectively, based on the total sample of 260 observations, and correspond to ten trading days on either side of the halt;

sprd is the relative spread, and depth is total volume quoted at the bid and ask.

med is the proportion of medium size trades relative to total trades per interval;

DOW is the day of the week dummy vector for Monday, Tuesday, Thursday, and Friday;

event and *over* are dummies to capture the event interval and the interval that includes an overnight component in the return, respectively.

4.4.1 Hypotheses and A Priori Expectations

The hypotheses associated with the above models are, initially, that present quote midpoint and/or transaction returns are a function of past midpoint returns. It is postulated that, if anything other than true order processing is employed on the part of the market maker, quote midpoints should move with transaction prices. For quote midpoint returns, a negative coefficient is expected on lagged quote midpoint returns if the specialist is attempting to clear her position. If quotes are adjusted to balance inventory holdings, liquidity is expected to increase following a dealer purchase, and to decrease following a sale. Therefore, spreads should decrease in order to induce a market purchase, and should coincide with a decrease in the stated quotes.

If quotes are adjusted in an attempt to protect against adverse information arising from the possibility of the previous trade originating from an informed trader, then a negative coefficient is expected on the lagged quote midpoint return. The specialist will again attempt to clear her position, only now the motivation is the risk reduction associated with asymmetric information.

According to Huang and Stoll (1994), Z_{t-1} serves as an indicator of public trade sentiment. If the past price and the past quote midpoint initially are assumed to be equal and a sale takes place at the bid, then the new transaction price will be less than the previous quote price by an amount $Z_{t-1} < 0$. In other words, if the trade is a public buy at the bid, then the specialist may either do nothing and clear her position at the next sell (implying pure order processing), or she may attempt to clear her position due to either inventory concerns or possible adverse information exposure by lowering the quoted bid and ask.

Therefore, if the coefficient on $Z_{t-1} = 0$, then the new transaction price does not differ from the previous quote, and the specialist retains the difference between bids and asks as compensation for providing immediacy (i.e., order processing). On the other hand, if the coefficient on $Z_{t-1} > 0$, then the previous quote midpoint impacts on the present transaction (i.e., inventory holding and/or adverse selection).

Relative spreads and total depths are included in the above models in order to assess the behaviour of the specialist around the halt. As outlined above, as specialists become exposed to what they believe to be informed trades, they may protect themselves by widening the spread and/or decreasing the depth of the security in question. Subsequent transactions will be influenced by the liquidity provided by the specialist. Further, quote revision should be more pronounced during periods of both price discovery and asymmetric information compared to "normal" trading times.

Cumulative signed volume and the proportion of medium-size trades are included in the above models in order to capture any effects that order flow may have on quote/transaction revision. Since a specialist buy implies negative volume and a specialist sale implies positive volume on the part of inventory accumulation, signed volume should have a positive impact on quote revisions (Huang and Stoll (1994)). In other words, if a specialist buy takes place at the midpoint or lower, and the specialist follows the inventory model in her quote postings, we should expect to see a reduction in the quote midpoint is expected as the specialist attempts to clear her position.

Medium-size trades again are assumed to be initiated by informed traders. The larger the proportion of such trades, the larger the likelihood of the specialist being exposed to informational asymmetry. The effect on quote revisions on the part of the specialist should be positive if exposure to adverse information is a concern of the specialist.

The day-of-the-week dummies are intended to capture any day effects, and the open/over dummy is intended to capture the overnight and weekend effects that may exist. The event dummy isolates the interval immediately after reinstatement, since we expect to see both a large price and quote shift once the halt is lifted and the price discovery process unfolds. Finally, pre- and post-event dummies are intended to isolate structural shifts due to informational asymmetries that may exist around the halt.

4.4.2 Empirical Findings

Cross-sectional results from equations (14) and (15) are presented in Table 26. In the transaction model incorporating quote data recorded prior to the previous transaction, the coefficient on Z_{t-1} is significant and positive for 38 and 43 of the 44 firms in the good news sample for the pre- and post-halt periods, respectively, and for 49 and 51 of the 53 firms in the bad news sample, for the pre- and post-halt periods, respectively. The mean Z_{t-1} coefficients are significantly different from zero, less than one and positive. This implies some price revision (i.e., not complete, and not overshooting). Therefore, the Z_{t-1} results are only partially consistent with the inventory holding model suggested by Huang and Stoll (1994). In the inventory holding model, price returns should exhibit negative serial correlation as dealers attempt to clear positions after trades.

[Please place Table 26 about here.]

The coefficient on prior quote returns is significant and positive for both models for both samples. When considered with the results reported previously for the spread component estimates, this suggests that specialists do not recoup their losses, nor do they protect themselves, on a trade-by-trade basis. The intradaily revisions are more smooth than what we may expect to see daily.

The coefficient on the cumulative signed square root of volume is significantly negative for 10 and 7 firms for the bad and good news samples, respectively. The only other significant variable is the event date dummy as expected.

Results for equation (15) for the post-transaction quote model, which incorporates quote returns immediately prior to the previous trade, are presented in Panel B of Table 26. The results indicate that the Z_{t-1} coefficients are significant and positive in 24 and 21 cases for the bad news sample during the pre- and post-halt periods, respectively, and for 19 and 13 cases for the good news sample for the pre- and post-halt periods, respectively. Mean Z_{t-1} coefficients are positive but not significant for both models for both samples. Therefore, dealers do not adjust their quotes significantly, in that a dealer buy is followed by a downward revision in quoted bids and asks. Support for the inventory model is weaker than that for the transaction model.

4.5 Concluding Remarks

Intraday component estimates and transaction/quote revisions were examined around unanticipated trading halts for stocks interlisted on the Montreal and Toronto Stock Exchanges. The content of the asymmetric information prior to the halts was not known to the specialist exposed to that information, and the behaviour of the specialist was examined both immediately prior to and immediately following the halt.

Results suggest that specialists protect themselves against the asymmetric information by adjusting depths and spreads around the halt. Spreads are widened and depths are increased as specialists attempt to clear themselves of unwanted inventory accumulated around bad news announcements. Quote/transaction revisions indicate that specialists attempt to rid themselves of unwanted inventory quickly. Spread component results indicate that specialists are fully exposed to asymmetric information prior to the trading halt, and are more concerned with asymmetric information than inventory considerations intradaily.

Some of the differences reported in previous work based on quote and transaction measures were reconciled. Models for component estimates rely on assumptions for which intraday data do not always conform. Thus, as shown, the results obtained are subject to biases. In some cases, this severely affects the inferences drawn from these models in that component estimates become unbelievable when data of different frequencies are examined.

Chapter 5: Concluding Remarks and Future Research

This dissertation dealt with price discovery around exchange imposed trading halts by examining intraday prices, quotes and microstructure variables measuring liquidity, volatility and information flow. Each of its three essays dealt with a different aspect of informational efficiency around these halts.

5.1 Major Findings

The main findings of the dissertation by essay are as follows: Firstly, evidence of decreasing abnormal returns post-halt suggests that newly imparted information was quickly impounded into post-halt prices. While significant abnormal returns are found for the event interval for all three ME samples, the CAR's and non-event AR's for the third ME sample are not significant. Liquidity and volatility estimates around trading halts suggest the existence of informational asymmetry. Volatility, trade frequency and liquidity are highest around the halt, and fall to pre-halt levels fairly quickly (within five hours of reinstatement). All microstructure variables increase temporarily around the trading halts in response to the information, with the exception of the number of trades which remains at its new higher level post-halt. Although the effectiveness of trading halts is time dependent, they are effective in disseminating news in a fair and orderly manner.

Secondly, based on total Canadian liquidity and activity (i.e. stocks listed on both the ME and TSE), informed traders are less active around trading halts, and all indicators based on informed trades only increase significantly post-halt. Share values, volumes and frequencies significantly increase once trading resumes. Conditional volatility estimates increase temporarily around the halt. In an attempt to protect themselves against informed traders, specialists adjust their supply of liquidity by widening spreads and by adjusting depths. Specialists protect themselves against bad news by widening spreads and decreasing depths around bad news announcements. Reaction to newly imparted information and its incorporation into prices is quick, and in most cases is complete within five hours.

Third, a detailed analysis of the quoted spread components finds that the adverse selection component is largest around trading halts. The adverse selection component is quite large prior to the trading halt, as expected, and the transitory (or order processing cost) component is a more significant factor than previously reported. The underlying assumptions of the models used and the findings reported herein suggest that inferences based on intraday data and small samples are fragile. The short-run behaviour of quote/transaction revisions reveals that the inventory holding model holds partially, in that partial price revision occurs on a tick basis. Further, as expected, specialists do not recoup their losses on a tick basis.

5.2 Implications

The implications of the findings of this dissertation by essay are as follows: Firstly, price discovery and regulatory and specialist effectiveness around trading halts differ depending on the time period and market studied. Halts on the ME seem to be less of an impediment to the resolution of uncertainty than on the NYSE, probably due to the former's smaller order flow or open order book. After hours trading may become more of an issue today, as information from other exchanges/trades will enhance the price discovery process.

Secondly, all indicator variables temporarily increase around halts, implying that the increase is a direct response to informational asymmetry. Post-halt prices are quick to adjust, implying newly disclosed information is quickly impounded into the new post-halt prices. Specialists protect themselves against informed traders by widening spreads prior to the halt and increasing depths post-halt, thereby reducing the overall liquidity they provide.

Finally, results presented herein indicate that specialists are fully exposed to asymmetric information, and rid themselves of unwanted inventories when the exposure is to bad news. This asymmetric information is more of a concern than is inventory clearing on an intraday basis, suggesting why the adverse selection component is larger than the inventory holding cost component intraday. Given situations of adverse information, price continuation is likely since the price discovery process is slowest tick-by-tick.

5.3 Directions for Future Research

Further work is needed on specifying a model for cross-sectional intraday data. The models studied herein that attempt to obtain component cost estimates are biased for intraday data and smaller samples. Not all transactions occur at either of the quotes, and may occur within or outside of the posted spread.

Stale quotes relative to current transactions need to be addressed. If the length of time between transactions is large, stale quotes will not contain much information. Easley and O'Hara (1992) suggest that informational content is contained in the length of time between trades. Information may also be contained in the age of the posted quotes. Whether old quotes are the source of the transaction prices, or whether an external event or shock created the incentive to trade is empirically testable.

Assumptions that suggest quotes and transactions follow similar paths regardless of data frequency are highly restrictive specifically around information events. The occurrence of an informationally revealing event suggests that uninformed traders (including specialists) are exposed to the adverse content of the newly released information. Masson (1993) suggests that covariance estimation be avoided, specifically for smaller samples, and that component estimates be based on the portion of the spread realized by the specialist. Further, Masson finds that models incorporating intraday data become more tractable once the time series is lengthened, although, the likelihood of spreads remaining constant over time lessens.

Thus, another appropriate extension of the work reported herein is to address both specialist and "true" quote/transaction behaviour during periods of high informational asymmetry. Non-reliance on serial covariance estimates, which no longer comply with previously documented daily results (Roll (1984)), is essential.

The research reported herein can be extended to examine other informationally asymmetric events. While Franz et al. (1994), for example, find that the asymmetric information cost component decreases immediately after the release of information, Krinsky and Lee (1996) find that it increases once information is released. Like Franz et al., the results reported herein find that, although asymmetric information is largest immediately prior to a halt, it decreases post-halt as the newly disseminated information is processed. Thus, the following questions concerning future component cost and liquidity estimation arise: What role does liquidity play in component interaction? Does the liquidity of the specialist, or perhaps the liquidity of informed traders play the major role in component cost adjustments?

Specialist liquidity around the implementation of the five-cent tick rule on the TSE relative to liquidity for interlisted securities on the NYSE is of interest. Since the minimum tick change was an expected event, the liquidity effects that specialists may have on different exchanges under different regimes can be studied.

Finally, since it was found that trading halts are preceded by less medium-sized activity pre-halt and significantly higher activity post-halt, the asymmetric information component should be expected to rise around a halt. Thus, the link between trade size and spread components, as in Lin et al. (RFS '95), can be extended to trading halts or to any event with known informational asymmetry.

Endnotes

[1] A complication may arise if this study were to be replicated using data from 1993 on. After-hours trading became more of an inevitability at this time, and the impact that it may have on price discovery is difficult to assess. If trades take place outside regular trading hours, then we can assume that the opening cry on the following day will contain information from the previous after-hour trades.

[2] Multi-period and overnight halts may have a similar impact on the price discovery process. Longer periods of non-trading afford more time to uninformed investors for processing the newly disclosed information.

[3] Summarized data consisting of 60- and 120-minute intervals were also examined. The results were identical to those found using 30-minute intervals, and are not reported herein.

[4] See Ross (1989) for a justification for this random walk (martingale-type) model. Such a dummy variable approach to measuring ARs is commonly used in event studies (e.g. Kryzanowski and Zhang (1993)).

[5] To deal with the so-called "missing data" problem (i.e. changing prices between trades), prices are assumed to follow a geometric growth function between trades. The trade-to-trade returns are first converted to one minute geometric mean returns, and then compounded to obtain 30 minute returns.

[6] T-tests on the mean conditional variances yielded robust results but are omitted due to the bias suggested in Skinner (1989) amongst others. The underlying returns are not necessarily i.i.d., and variances may systematically change throughout the estimation period. Thus, the nonparametric sign-test addresses the median values rather than the mean, testing whether the distribution remains the same, thereby reducing the bias.

[7] On the Toronto Stock Exchange (TSE), specialists are referred to as Registered Traders (RTs). Specialist, RT and market maker will be used interchangeably throughout this paper.

[8] Barclay and Warner (1993), among others, postulate that trades executed in the middle range of size are informed trades. In the literature, trade size is measured by either the number of shares traded, traded value, or both. An example of the former is Barclay and Warner (1993), where mid size ranges from 500 to 9900 shares. Lee (1992) and Kryzanowski and Zhang (1996) are examples of the latter, where mid size ranges from $10,000 to $99,000. In this study, trade size is as follows: Small-size trades are trades with a total dollar value less than $10,000, medium-size trades are trades between $10,000 and $99,000, and trades of $100,000 or more are large-size.

[9] Trading post-halt was fairly active for the securities that satisfy this filter. Since quotes were readily available through the Fête Nationale in Quebec, halts that cover this holiday were not deleted.

[10] Barclay and Litzenberger (1988) use 15-minute intervals, reflecting the higher volume associated with the NYSE relative to the TSE or ME.

[11] Since each day has 390 minutes, 3900 minutes pre-halt and 3900 minutes post-halt are examined for each halted security.

[12] The relationship between volume and price changes documented in Stickel and Verrecchia (1994), Harris (1986) and Karpoff (1987) suggests that volume should decline post-halt to its historic levels. Jones, Kaul and Lipson (1994) show that the number of trades and volatility will decline as well.

[13] If the executed trade is outside the quoted bid and ask, then the RT probably inputted the trade after revising her quotes.

[14] Depth and spread are calculated on a per interval basis and then averaged over the time period.

[15] Initial runs included share volume as an indicator variable. Due to its high correlation with the number of trades, its inclusion detracted from the impact of the number of trades variable on conditional volatility. DOW variables were not significant for either sample, nor were time-of-day dummies, and were excluded as well.

[16] The initial model also included an intraday equally-weighted index comprised of the TSE35 at the time of each halt. The impact on volatility was insignificant and was excluded from future runs.

[17] Close-to-close and midpoint-to-midpoint returns are calculated based on closing prices per interval and on quotes reported immediately prior to those closing prices, respectively.

[18] If the trade is of medium size, it is assumed to originate from an informed trader. Size is defined as in Kryzanowski and Zhang (1996) where small trades are those with a total dollar value less than $10,000. Large (or institutional) trades are $100,000 or more, and medium trades are those remaining.

[19] Trading post-halt was fairly active for the securities that satisfy this filter. Since quotes are readily available through the Fête Nationale in Quebec, halts that cover this holiday are not deleted.

[20] Barclay and Litzenberger (1988) use 15-minute intervals, reflecting the higher volume and number of trades associated with the NYSE relative to the TSE or ME.

[21] Since each day has 390 trading minutes, 1950 minutes pre-halt and 1950 minutes post-halt are examined for each halted security.

[22] Some model estimation examined shorter pre- and post-halt periods of 13 intervals, or one day, each.

[23] Following Stoll (1989), if $COV_T = S^2\{\partial^2(1-2\pi)-\pi^2(1-2\partial)\}$, and $COV_Q = S^2\{\partial^2(1-2\pi)\}$, then if $\pi \leq 0.5$, ∂ must be greater than π in order to obtain non-negative serial covariances. Intuitively, this implies that the realized spread expected by the specialist can be negative. Further, if the probability of a reversal is greater than 0.5, then the size of that reversal as a proportion of the spread must still be greater than π to obtain non-negative serial covariances.

[24] Estimates of the transitory component were carried out on two different pre- and post-halt periods, one containing 13 intervals, the other 26 (i.e. one and two trading days, respectively).

[25] Estimation periods incorporating 26 intervals during the pre- and post-halt intervals yielded results that were slightly less marked, suggesting that most component adjustments take place in the 13 intervals on either side of the halt.

[26] CATS trading is expected to be slowly phased out as automation progresses throughout the main trading floor.

[27] When trading US based or other Canadian based interlisted issues (where at least 25% of trading has taken place in the foreign market), the RT is exempt from this responsibility.

[28] The Equities Procedure Committee has the authority to disallow bid and ask quotes that are either equal or more than 5% apart. TSE Equities Trading Manual, 1994, p. 3.1-16.

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Appendix 1: Institutional Information on the TSE

The Toronto Stock Exchange

The TSE is an order driven auction exchange. There is trading on both the floor and through CATS (Computer Assisted Trading System). Both floor trading and CATS trades are executed by RTs, where RTs are market makers in the event of odd-lot orders etc., in an effort to maintain a fair, orderly and continuous market.

Orders pertaining to stocks listed on CATS are posted and available to all market participants. Price is determined through a pricing algorithm designed to best match all buys and sells, and maximize the amount of stock traded. Presently CATS trading comprises of approximately 20-25% of the activity of the TSE. Many of its listed stocks are inactive preferreds, but it does contain some TSE 300 stocks (Bramalea, Maclean Hunter, etc.).[26]

The Registered Trader

According to the TSE Equities Trading Manual, a registered trader (RT) is defined as an attorney (i.e. one who has power of attorney for a member firm) who trades regularly on the floor and has as a primary function, the responsibility of maintaining a fair and orderly market. RTs must qualify for both floor trading and CATS, based on experience and ability as outlined by the Exchange. The exchange selection committee may allocate a specific stock to an RT occasionally, in order to provide adequate depth in the form of a board lot market, and the RT is required to fill odd-lot orders at the same price as the board lot quotes.

Policies set out by the Equities Floor Procedure Committee, and adopted by CATS, are applicable to all RTs operating both on the floor and in CATS. Each RT is assigned a stock(s) of responsibility, where the RT must engage in predominantly market stabilizing trades (between 70-80% of their trades).[27] Stabilization in this context implies that the RT must purchase her stock of responsibility at a price below the last traded price, or buy at a price higher than the last traded price. Further, if the RT is executing a trade in order to clear a position, she must be on the passive side of the trade, in that there must be a matching order to trade against. The RT trades on her account only in order to ensure price continuity. Her ability to do so is frequently reviewed by the Equities Floor Procedure Committee, who can suspend or revoke RT privileges if said performance is not satisfactory. All market orders are handled by only the RT, and the RT must attempt to obtain the best price for the market order given its price on all listed exchanges. As for limit orders, members can enter orders into the book, and the RT ensures that the attorneys match trades in her book.

At the opening, a price is set by either the RT or a computer algorithm (at the discretion of the RT) that results in the maximum number of trades, the least in volume bid/ask imbalance, and the smallest in deviation possible from the previous close. Depth requirements are stock specific, and the RT is responsible for all odd lots at the market. Maximum allowable spreads are negotiated with market surveillance who develop a spread goal,[28] and minimum allowable spreads are at 1/8 for securities trading at $5.00 or more, $0.05 for securities trading between $3.00 and $5.00, $0.01 for securities trading between $0.50 and $3.00, and $0.005 for securities trading at less than $0.50.

Compensation and Incentive

The RT is at risk in terms of inventory exposure. She has to determine whether she is trading with informed or uninformed investors. The ability to detect usually (hopefully) comes with experience, as well as getting to know the habits of other traders.

Each order executed by an RT costs five dollars for computer line time, and twenty cents plus approximately 1/10 of one percent per share in TSE ticket fees. This is paid for by either the RT or the member firm, depending on the compensation package of the individual RT. A typical

RT will have between $2000-$4000 in monthly order processing costs (on gross profits ranging from $10,000-$40,000 - order processing costs depend solely on the number of trades executed, not on the profits made).

The RT is required to invest $50,000 with her member firm which is used as a reserve in the case of any margin calls or poor market making on the part of the RT. The typical compensation package for an RT is termed the 25/50, where a base salary of $25,000 and a 50% retention of the profits on trades executed is the norm. The less the base salary and the higher the retention, the more responsible is the RT for order costs. Performance evaluation by the member firm as well as market surveillance is ongoing. If performance is unsatisfactory in terms of stabilizing and market making according to surveillance, or in terms of excessive trading losses for the member firm, the RT will lose her investment, be placed on probation, and could eventually lose her job.

Therefore, by understanding the compensation available to the RT, the specific risks that she may face during the course of trading, and the institutional restrictions that she may face, we can better evaluate the performance of the RT in a given situation, specifically a trading halt. Although new information will eventually be disseminated to all market participants such that the market has impounded all that it wishes to, the initial path of price discovery will highly depend on the efforts of the RT.

Appendix 2: <u>TRADING HALTS ON THE ME AND TSE</u>

In an effort to reestablish price continuity, a halt on trading can be imposed by two floor governors or two of either the Chairman, Vice-Chairman and a floor official (similar for officials in CATS). Halts are executed for one of two reasons; an imbalance of orders or a pending news announcement. Pending news announcements usually come down from surveillance, where the listed firm will inform surveillance, and the floor official then conveys this information to the RT (Specialist on the ME) of the halted stock. In the case of a CATS halt, the information received from surveillance shows up directly on the RTs' screen. If there exists an imbalance of orders, or an abnormal order, the floor official can then determine whether a halt is required. The RT alone cannot execute a halt, rather if she feels that there is an excessive imbalance or an abnormal order, she must first execute the order and **<u>then</u>** request the halt from a floor official. Specialists will likely request halts when they suspect trading based on an abnormal amount of informational asymmetry. Once the RT feels that enough information has disseminated (by examining the order book), trading then resumes as it does at the open.

Figure 1: The mean CARs (Cumulative Abnormal Returns) for the three sets of good news samples centered on the trading halts [0]

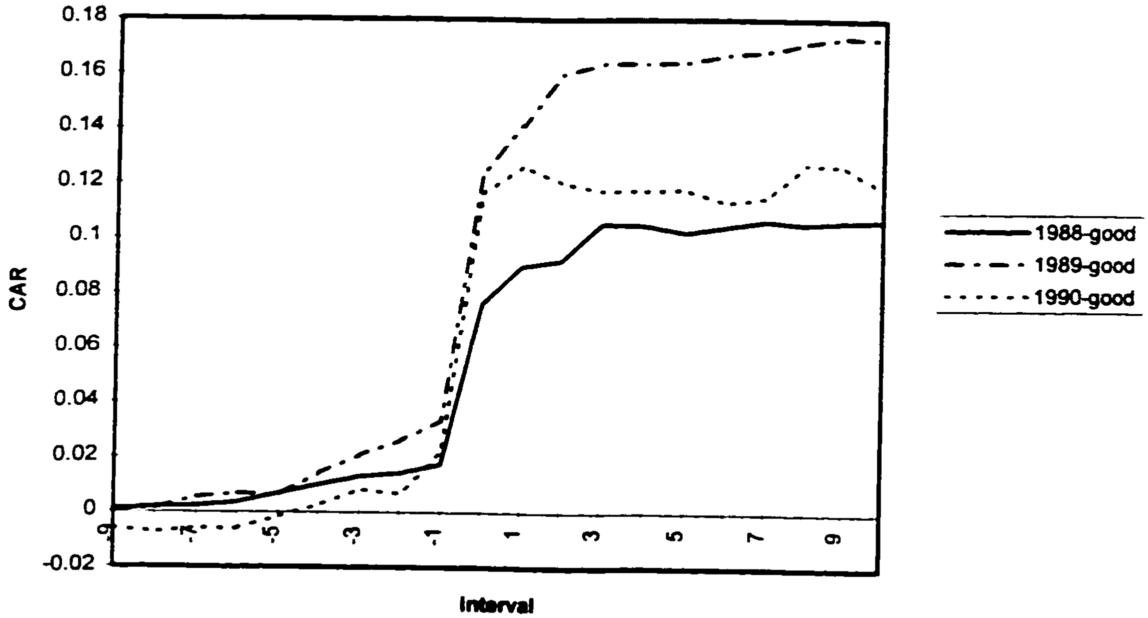

Figure 2: The mean CARs (cumulative Abnormal Returns) for the three sets of bad news samples centered on the trading halts [0]

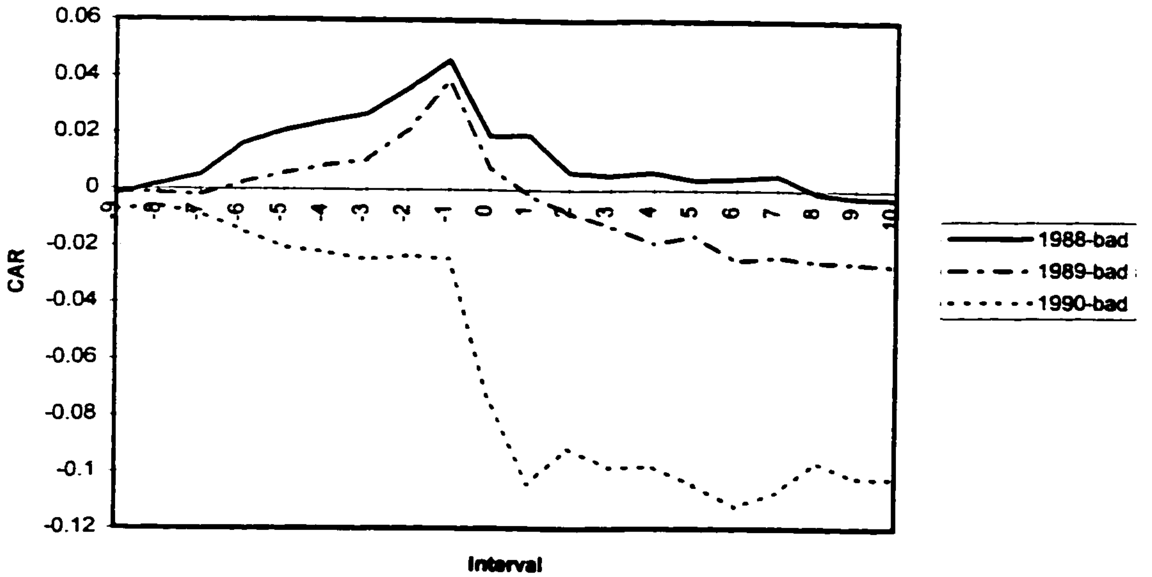

Figure 3: The mean conditional variances for the three sets of good news samples centered on the trading halts [0]

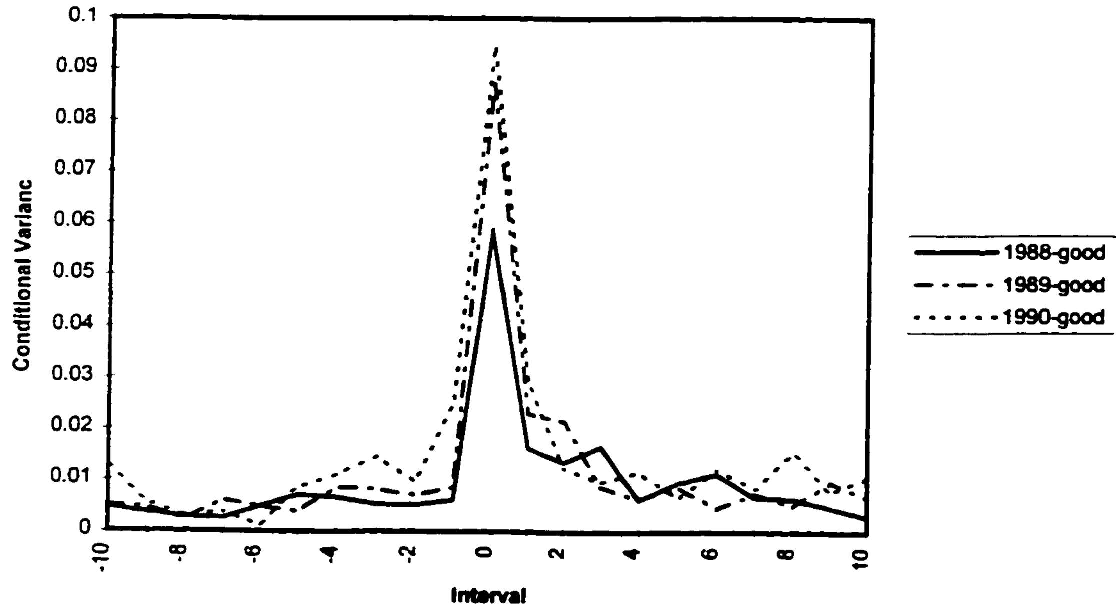

Figure 4: The mean conditional variances for the three sets of bad news samples centered on the trading halts [0]

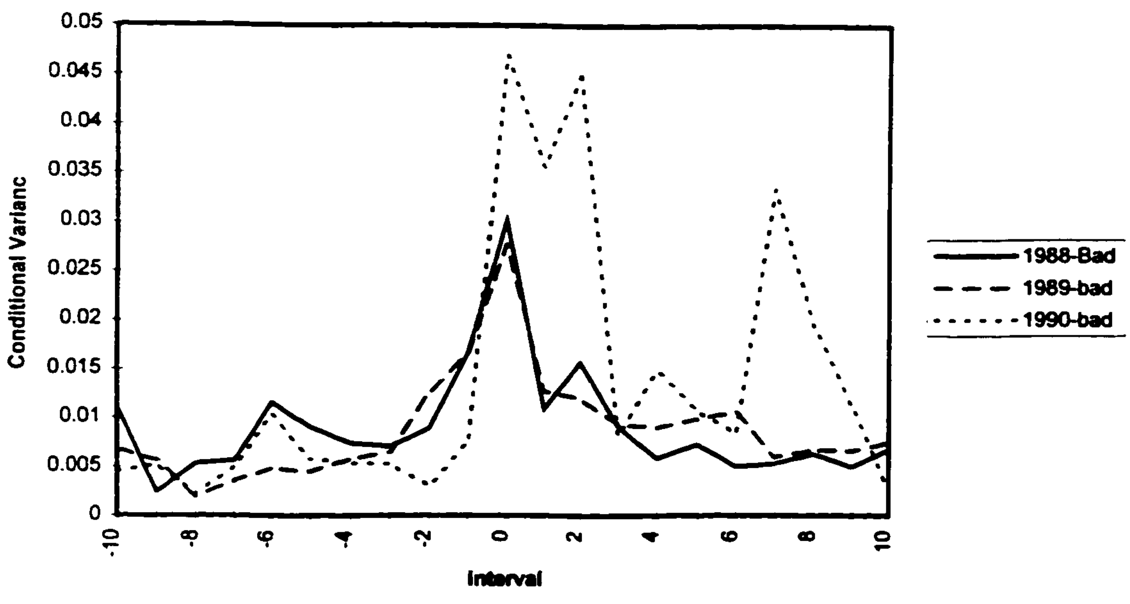

Figure 5: The number of trades per interval for the three sets of good new samples centered on the trading halts [0]

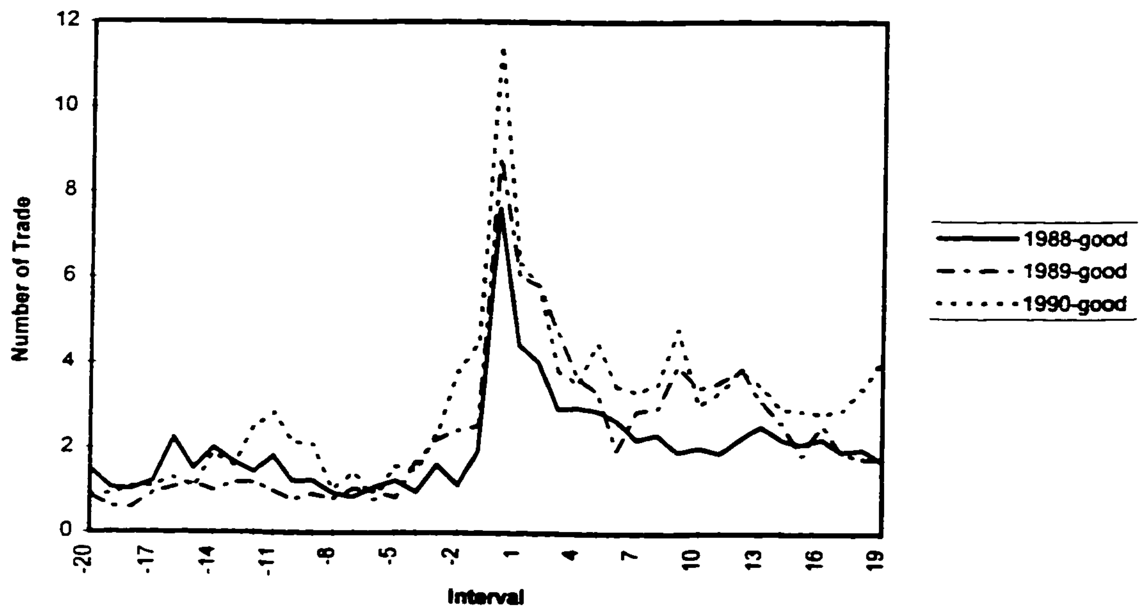

Figure 6: The number of trades per interval for the three sets of bad news samples centered on the trading halts [0]

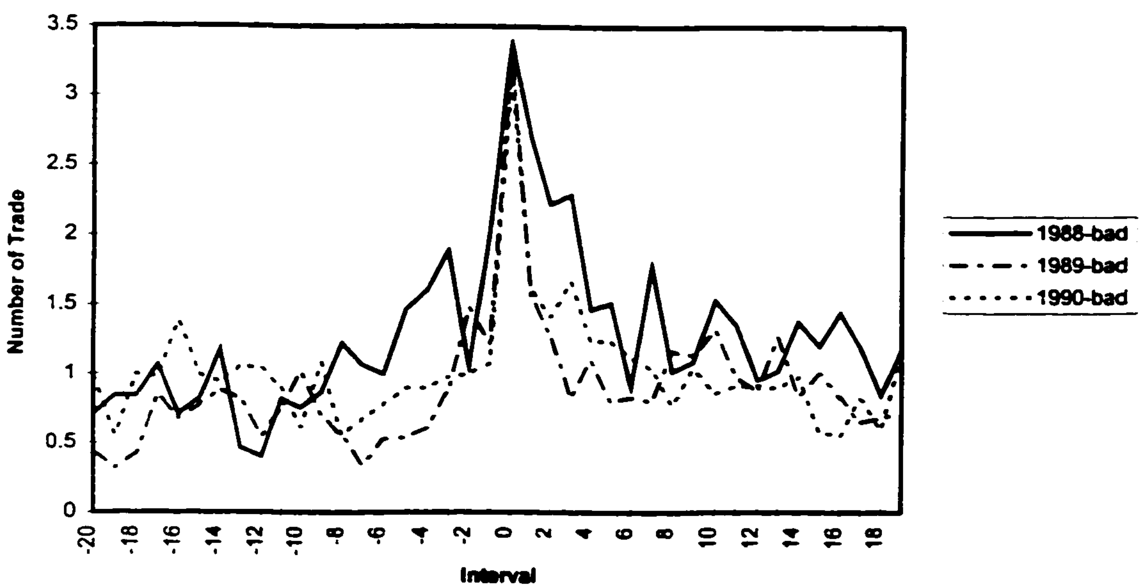

Figure 7: Average Share Volume per Interval, Good and Bad News

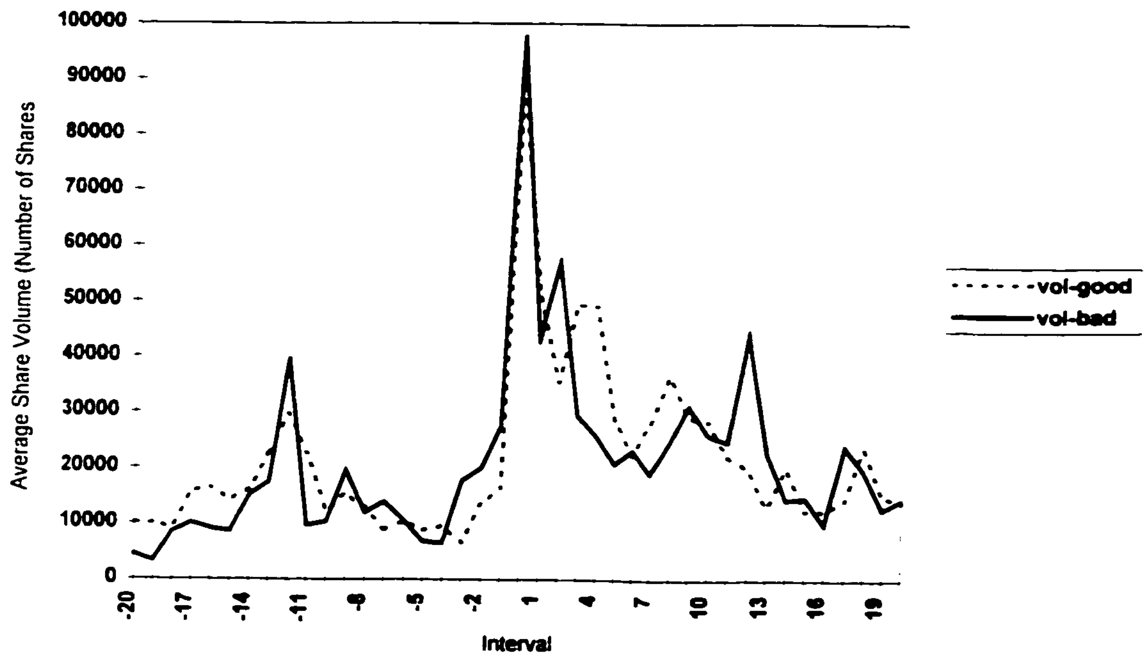

Figure 8: Average Dollar Value of Shares Traded per Interval, Good and Bad news

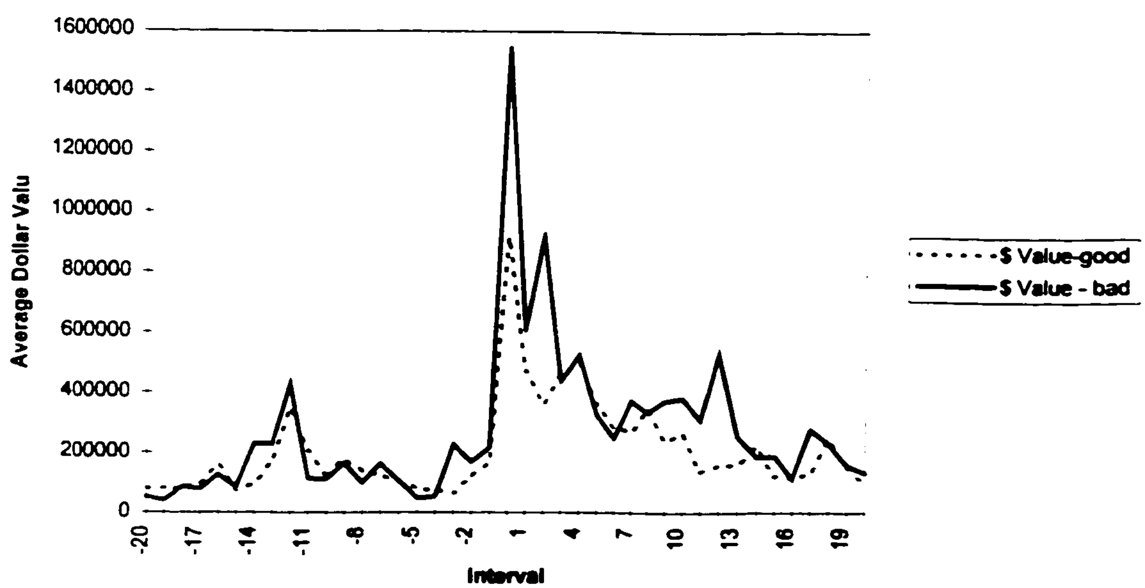

Figure 9: Average Number of Trades per Interval, Good and Bad news

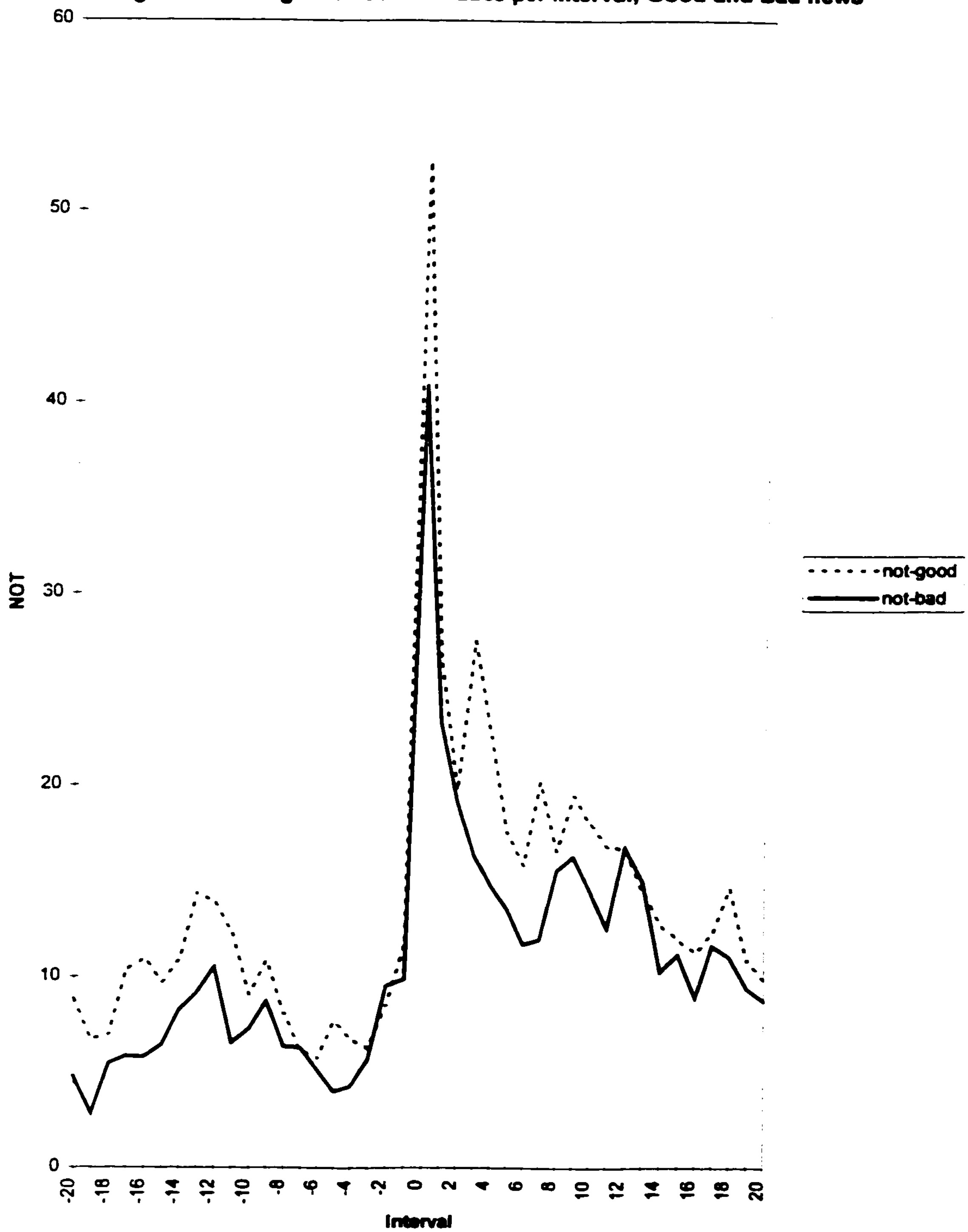

Figure 10: Proportion of Medium-Size Trades
[Medium trades relative to total trades]

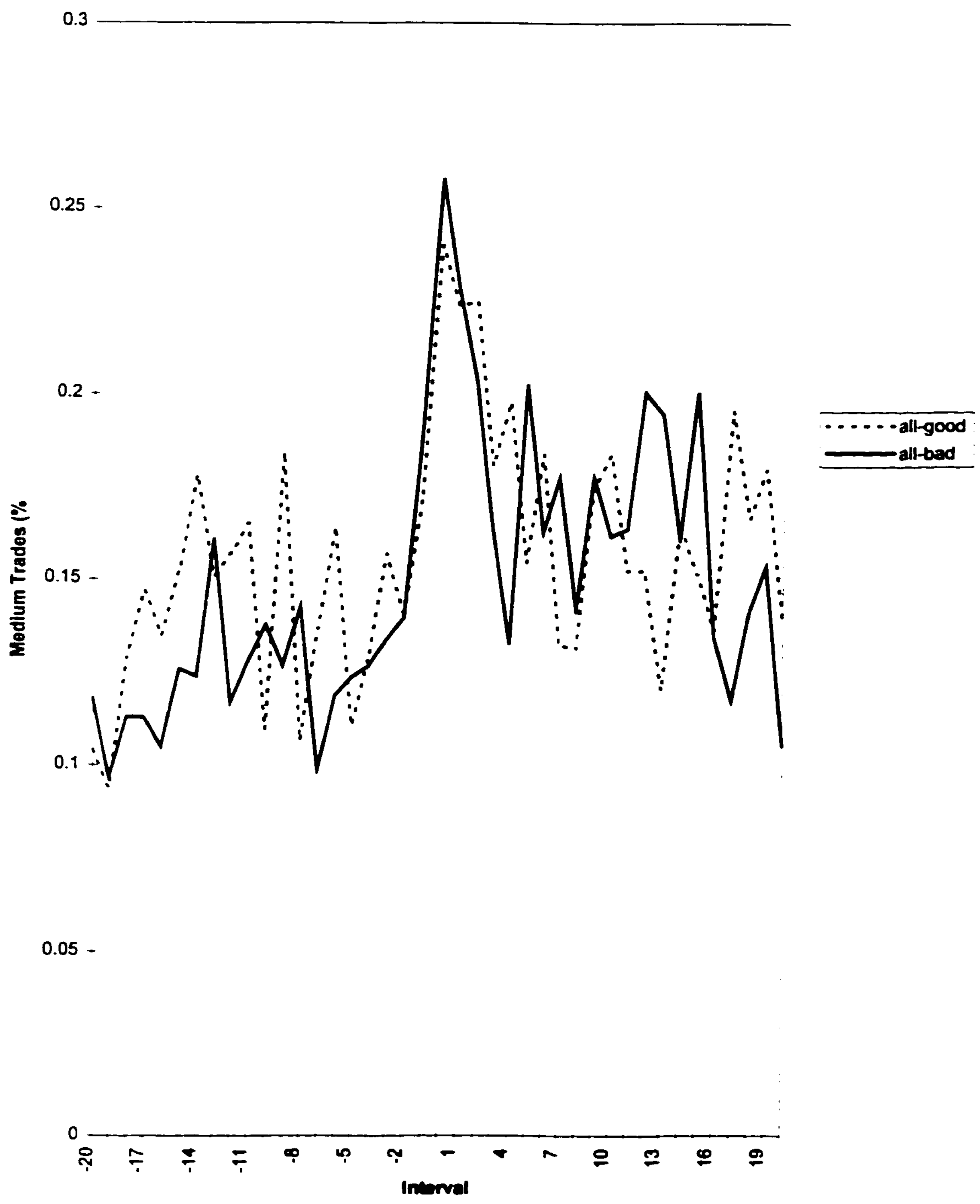

Figure 11: Proportion of Buys Relative to Total Trades per Interval - Good and Bad News

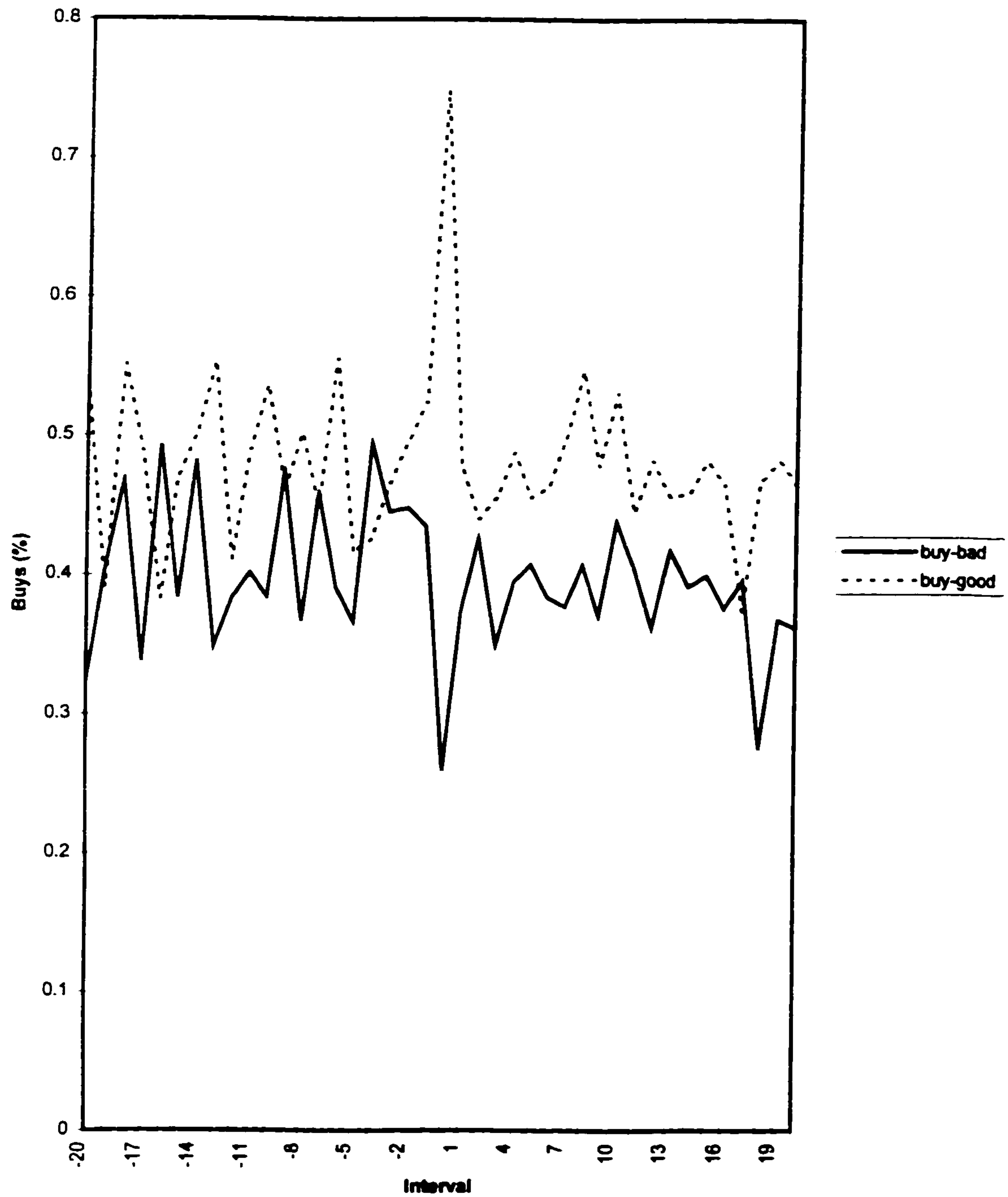

Figure 12a: Proportion of Medium-Size Buys per Interval, Good and Bad News Samples

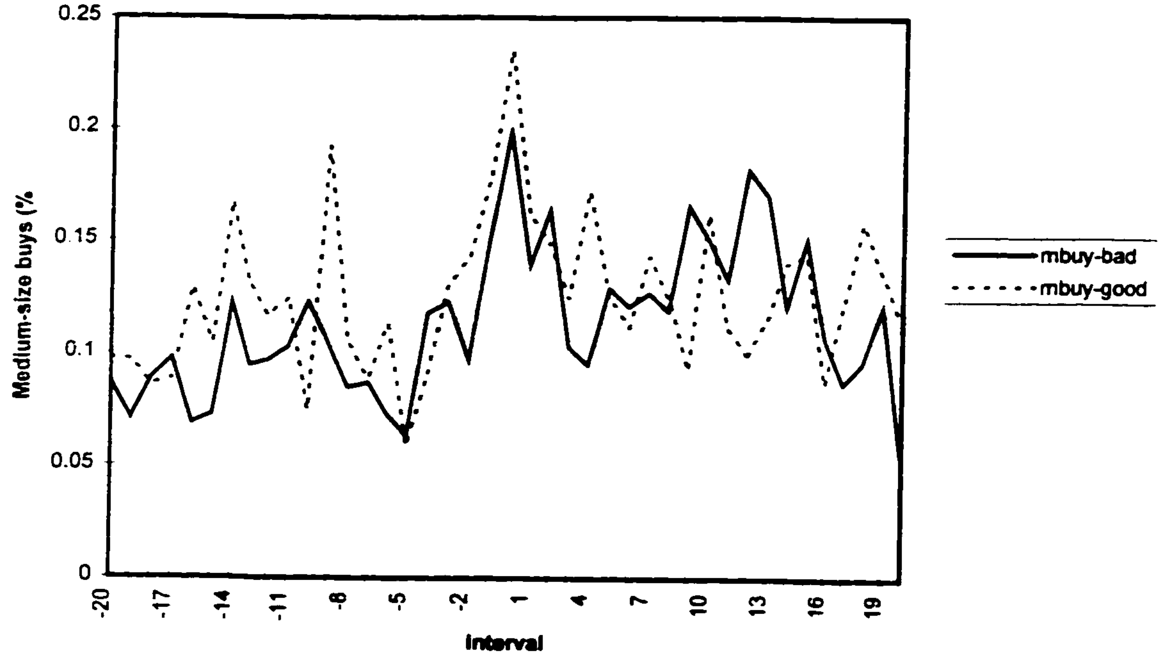

Figure 12b: Proportion of Medium-Size Sells per Interval, Good and Bad News Samples

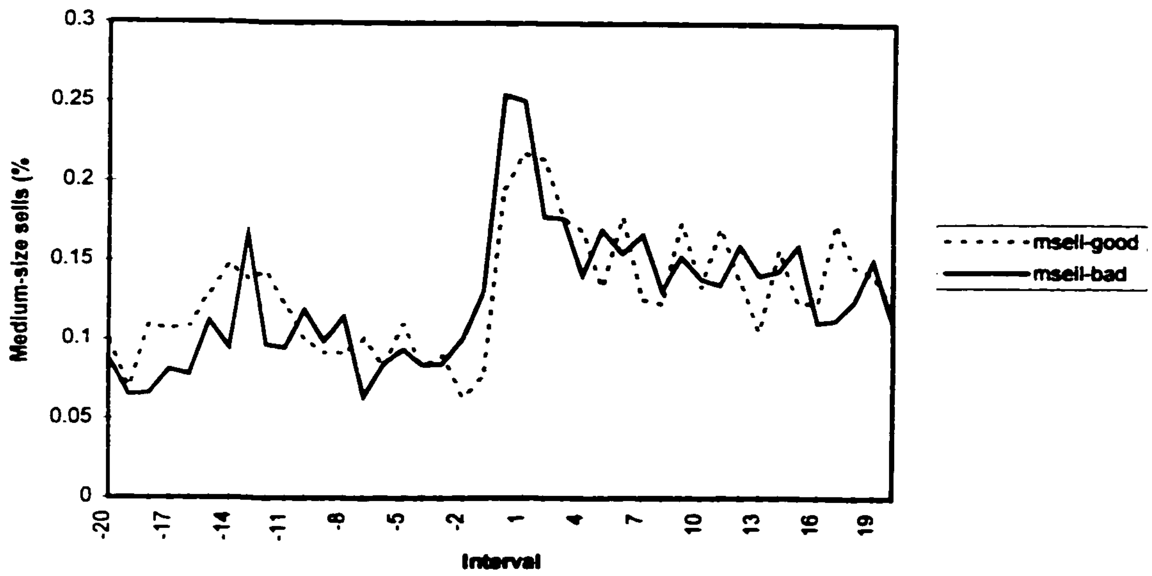

Figure 13a: Bid Volume per Interval, Good and Bad News

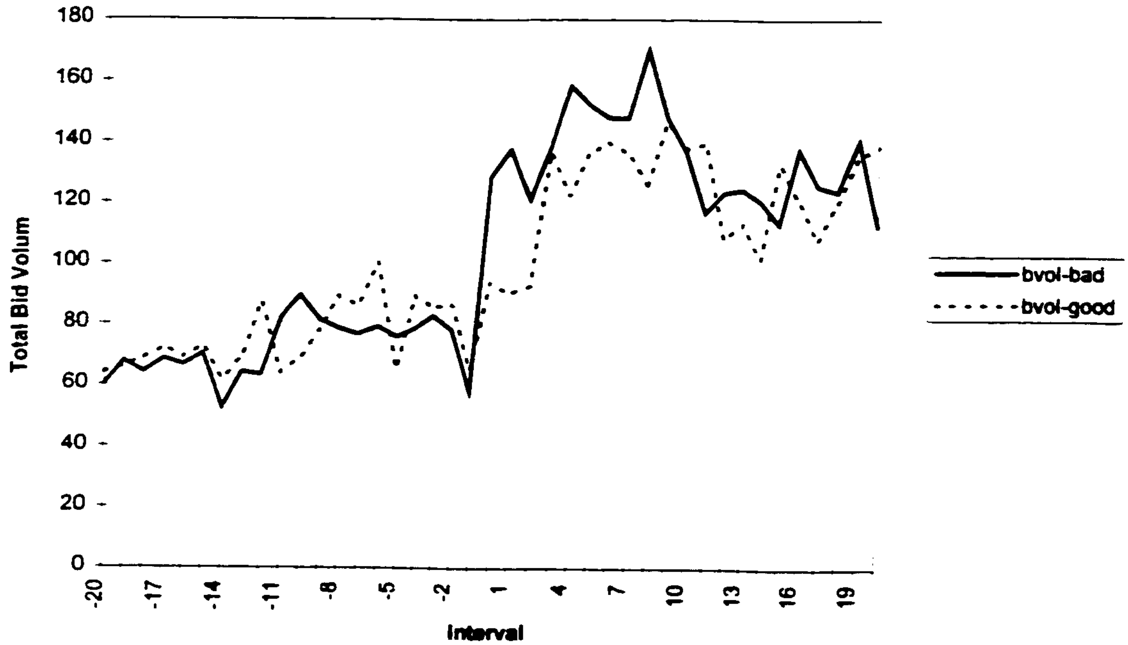

Figure 13b: Ask Volume per Interval, Good and Bad News

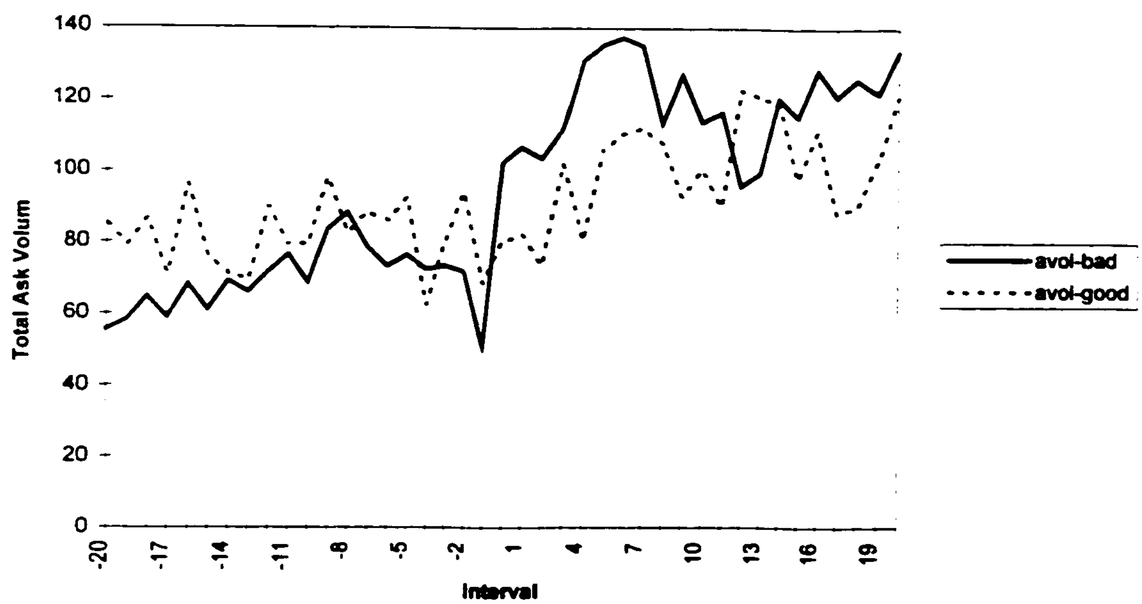

Figure 14:Absolute Spread, Good and Bad News

Figure 15: Relative Spread per Interval, Good and Bad News

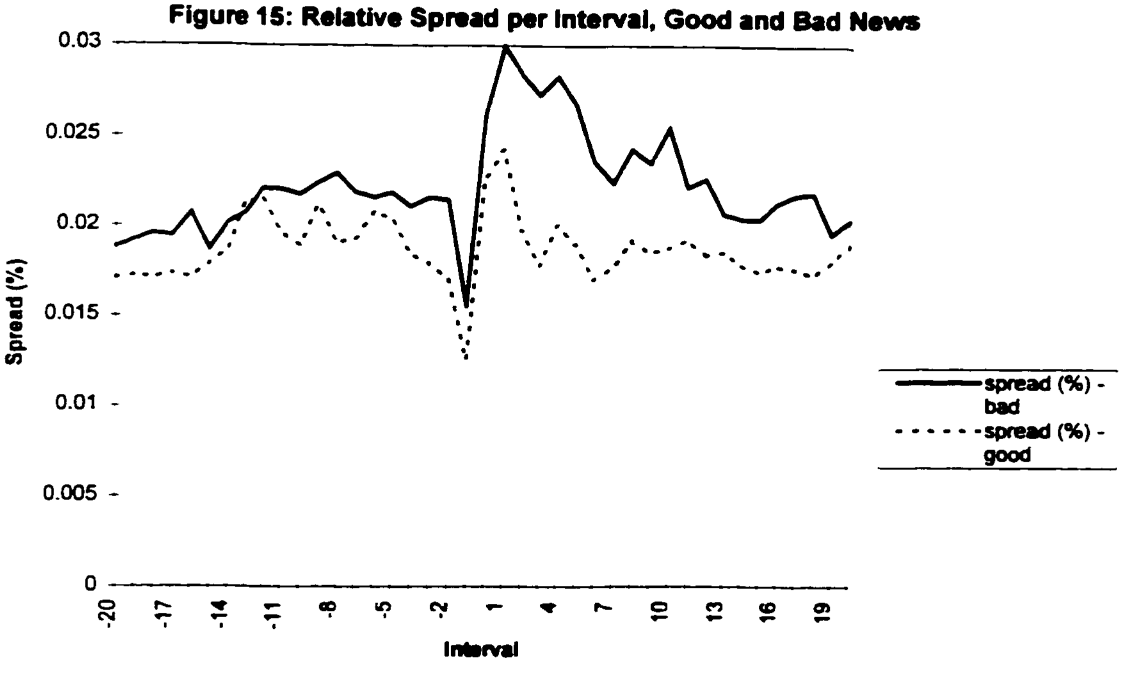

Figure 16a: Conditional Volatility on Returns on Closing Prices and Mid Points - Good News

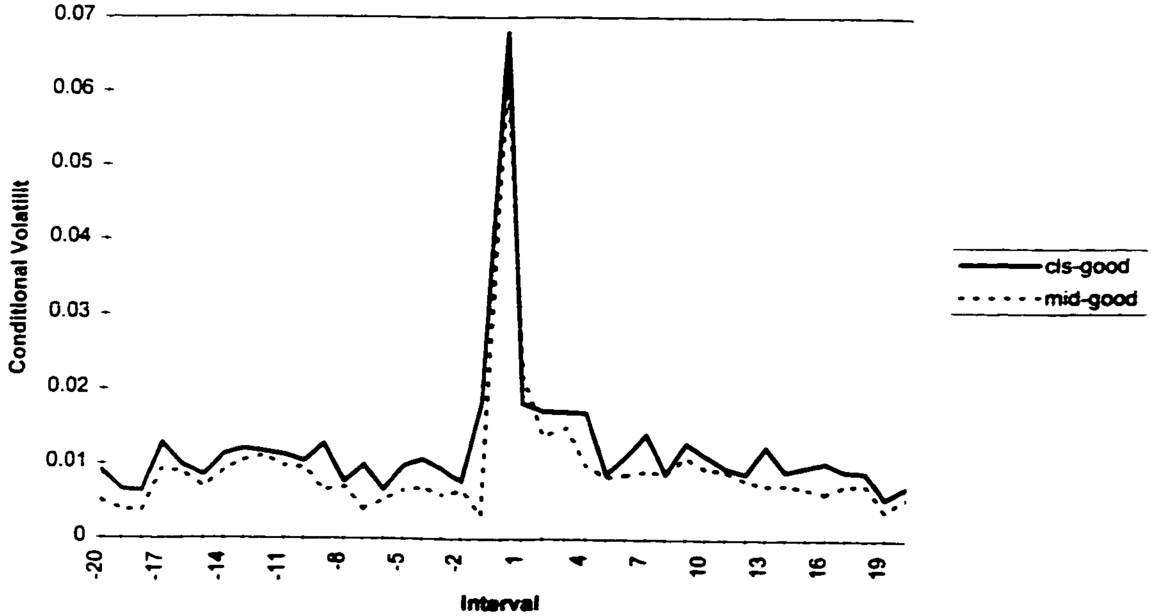

Figure 16b: Conditional Volatility on Returns on Closing Prices and Mid Points - Bad News

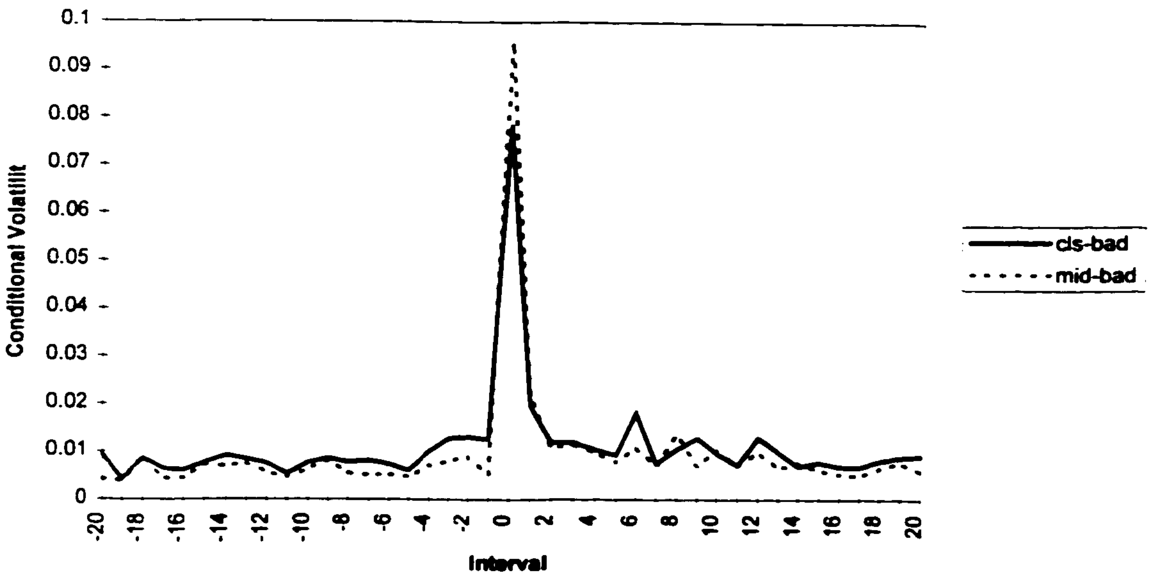

Figure 17: Relative Cross-Sectional Mean Spreads -- Quotes Immediately After the Last Transaction Per Interval

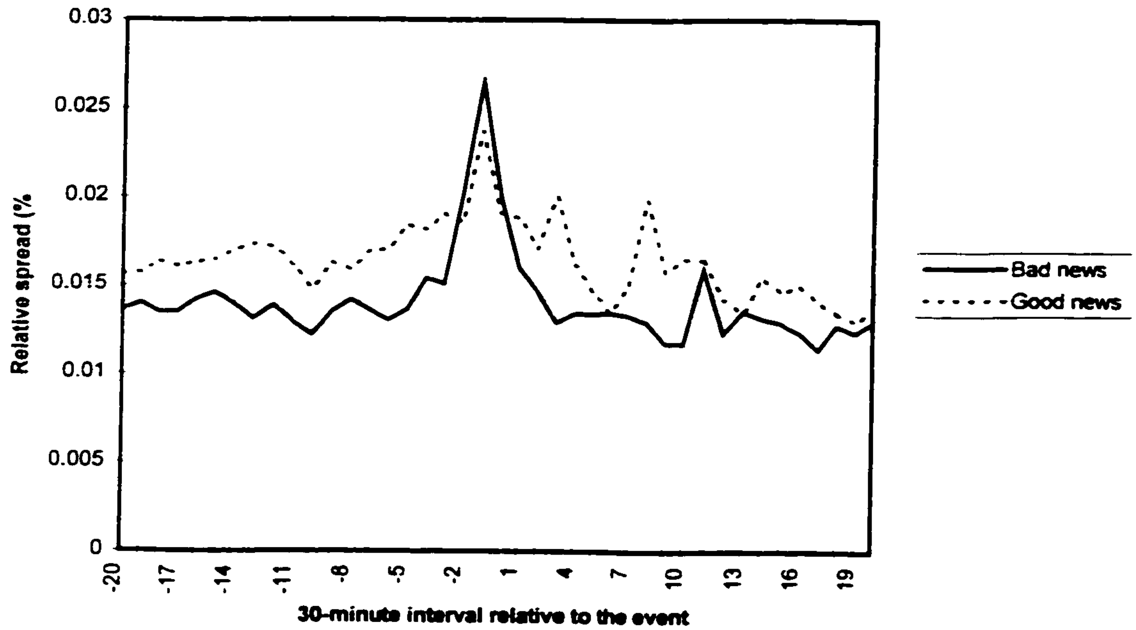

Figure 18: Total Cross-Sectional Mean Depth (ask plus bid) quoted immediately after the last transaction in the interval - in lots

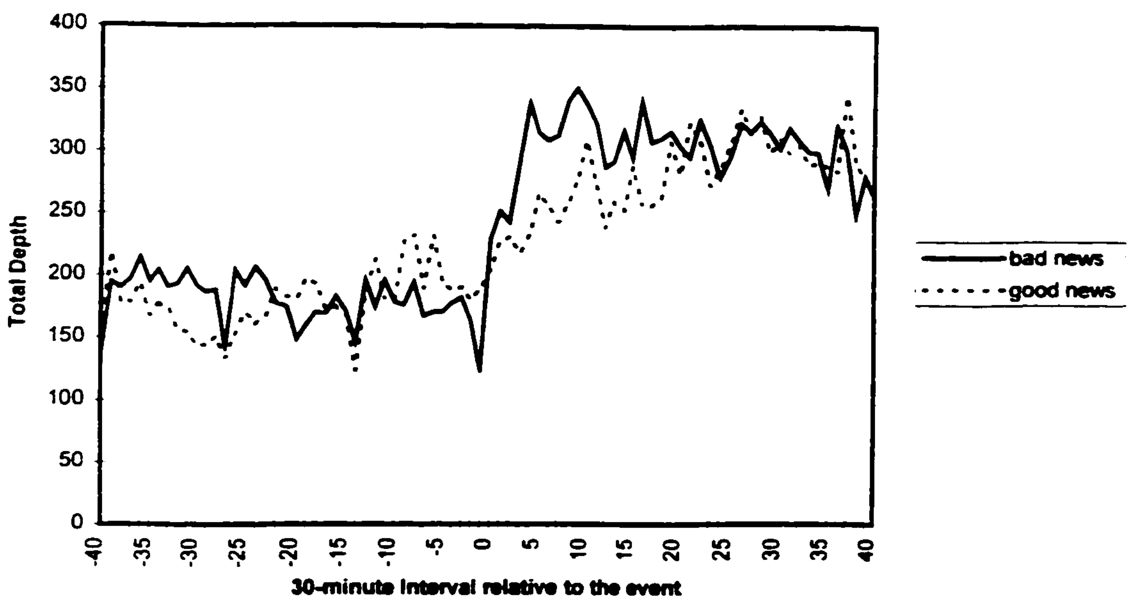

Figure 19: Mean Cross-Sectional Bid Volume quoted immediately after the last transaction in the interval - in lots

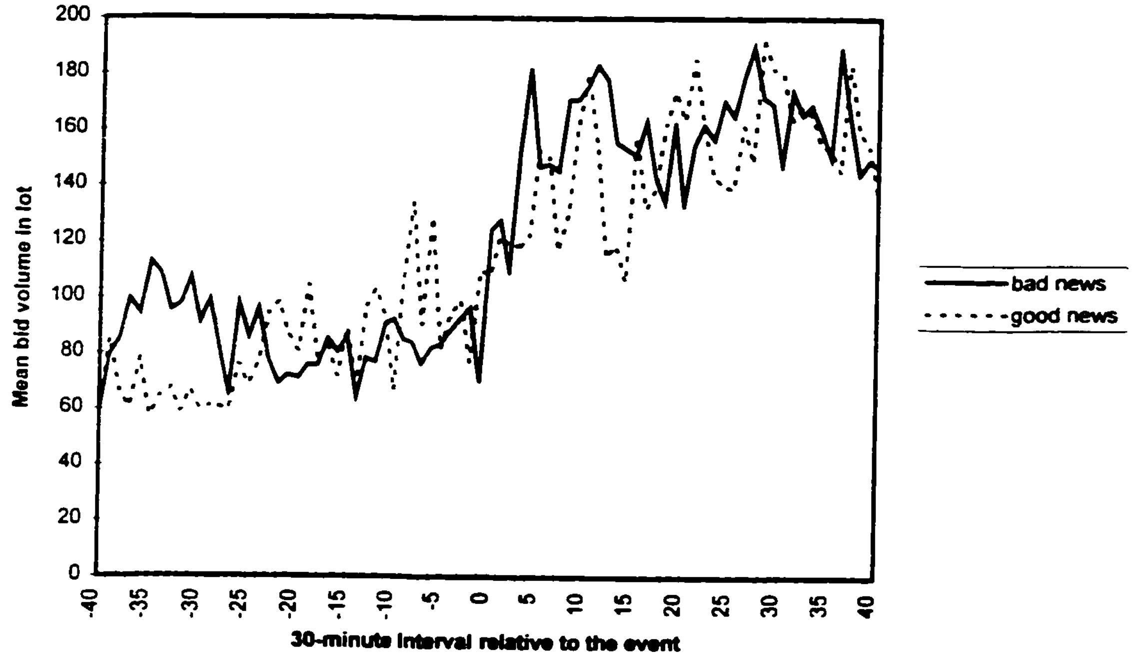

Figure 20: Mean Cross-Sectional Ask Volume quoted immediately after the last transaction in the interval - in lots

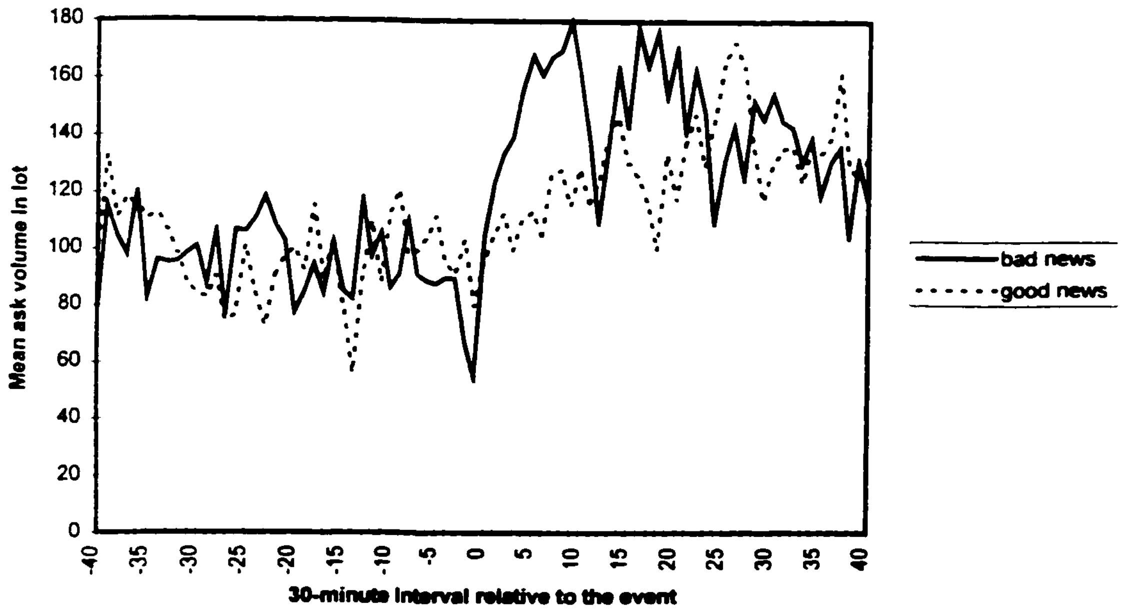

Table 1

Initial and final sample sizes of trading halts for the three six-month subperiods, the number of good and bad news halts based on the tick test of Lee and Ready (1991), and the number of halts deleted by each screen are presented in Panel A. Trading halts are deleted if at least 30 intervals with observations are not available (screen 1), if they are for a preferred, warrant or unit (screen 2), and if they are not traded during the event window of [-10, +10] (screen 3). Summary statistics for the length (in minutes), day-of-the-week, time-of-the-day and price at halt are presented in Panels B, C and D, respectively. The price ranges correspond to the minimum tick size categories on the Montreal Exchange.

PANEL A: The initial and final sample sizes, the number of good and bad news halts, and the number of halts deleted by each screen for each subperiod are presented herein.

Subperiod	Initial Sample	Deleted Screen			Final Sample		
		1	2	3	Total	Good	Bad
3-8/1988	297	108	28	11	150	104	46
10/88-3/89	280	90	22	10	158	86	72
12/89-5/90	246	109	24	9	104	52	52

PANEL B: Summary statistics for the halt lengths in minutes for the final subperiod samples are presented herein.

Subperiod	Mean	Median	Minimum	Maximum	σ
3-8/1988	221.67	150	1	2737	230.67
10/88-3/89	317.59	181	10	4302	478.14
12/89-5/90	298.30	146	20	4001	473.47

PANEL C: Summary statistics on the day-of-the-week and price at halt are presented herein.

	Day-of-week					Price			
Subperiod	M	T	W	Th	F	<$0.50	$0.50-$1.99	$2.00-$4.95	>$4.95
3-8/1988	29	24	36	33	31	15	27	39	72
10/88-3/89	34	34	41	28	21	10	36	32	80
12/89-5/90	21	18	18	24	23	14	29	21	40

PANEL D: Summary statistics on the time-of-the-day are presented herein.

	Subperiod		
Time-of-day	3-8/88	10/88-3-89	12/89-5/90
9:30	67	90	41
9:31-10:30	11	16	10
10:31-11:30	12	12	10
11:31-12:30	25	10	14
12:31-1:30	13	6	10
1:31-2:30	6	3	8
2:31-3:30	9	17	8
3:30-3:59	10	4	3
4:00	0	0	0

Table 2

The cross-sectional mean and median CARs (Cumulative Abnormal Returns) for each of the three subperiod samples are reported below. The significance of the CARs from zero are tested using t- and sign tests. '*' and '**' indicate significance at the 0.05 and 0.01 levels, respectively. Below and above indicate the number of CARs that are below and above zero, respectively.

Period	Mean	Median	T-value	Below	Above	Sign
Panel A: For the good news sample for the first subperiod						
[-5,+5]	0.0990	0.0607	6.2039**	16	88	0.0000**
[-5, -1]	0.0140	0.0007	3.7362**	40	62	0.0376*
[+1, +5]	0.0263	0.0005	2.1675*	49	55	0.6239
Panel B: For the bad news sample for the first subperiod						
[-5, +5]	-0.0125	-0.0066	-1.2776	30	17	0.0801
[-5, -1]	0.0298	0.0012	2.5200*	18	29	0.1447
[+1, +5]	-0.0154	-0.0006	-1.7162	27	20	0.3815
Panel C: For the good news sample for the second subperiod						
[-5, +5]	0.1576	0.1020	5.9004**	5	81	0.0000**
[-5, -1]	0.0265	0.0019	3.8634**	30	54	0.0121*
[+1, +5]	0.0403	0.0080	4.2536**	30	56	0.0070**
Panel D: For the bad news sample for the second subperiod						
[-5, +5]	-0.0182	-0.0213	-1.0627	51	21	0.0006**
[-5, -1]	0.0361	0.0005	2.6171**	28	41	0.1486
[+1, +5]	-0.0240	-0.0014	-1.8388	47	23	0.0060**
Panel E: For the good news sample for the third subperiod						
[-5, +5]	0.1240	0.0246	3.1334**	16	36	0.0084**
[-5, -1]	0.0276	0.0006	1.4613	21	31	0.2120
[+1, +5]	0.0018	-0.0009	0.1489	31	20	0.1614
Panel F: For the bad news sample for the third subperiod						
[-5, +5]	-0.0897	-0.0422	-4.222**	42	10	0.0000**
[-5, -1]	-0.0098	0.0002	-1.3053	25	27	0.8897
[+1, +5]	-0.0297	-0.0097	-1.2009	35	17	0.0184*

Table 3

Cross-sectional mean and median differences of the conditional variances for various time period pairings for each of the three sets of good and bad news halt samples are reported below. The significance of the paired differences are evaluated using sign tests. The "a" and "b" relative time periods refer to the estimation periods prior to and after the event window [-10,+10], respectively. The Pre and Post relative time periods refer to the five intervals immediately prior to and after the event, respectively. The Below and Above columns refer to the number of observations less than or greater than zero, respectively. "Sign" refers to the P-Value associated with the sign test. "*" and "**" indicate significance at the 0.05 and 0.01 levels, respectively. Each interval consists of 30 minutes.

PANEL A: For the good news sample for the first subperiod. Means for "a", "pre", "event", "post" and "b" are .0046, .0055, .0825, .0072 and .0042, respectively.

Relative Time	Mean	Median	Below	Above	Sign
[(a-b)]	0.0004	0.0004	36	65	0.0053**
[(a-pre)]	-0.0008	0.0013	39	65	0.0142*
[(a-post)]	-0.0250	-0.0021	30	73	0.0000**
[(b-pre)]	-0.0013	0.0009	39	64	0.0180*
[(b-post)]	-0.0030	0.0017	34	68	0.0011**
[(pre-post)]	-0.0017	-0.0000	45	48	0.8357
[(pre-event)]	-0.0771	-0.0354	68	23	0.0000**
[(post-event)]	-0.0754	-0.0319	72	29	0.0000**

PANEL B: For the bad news sample for the first subperiod. Means for "a", "pre", "event", "post" and "b" are .0059, .0110, .0422, .0035 and ..0053, respectively.

Relative Time	Mean	Median	Below	Above	Sign
[(a-b)]	0.0006	0.0003	22	25	0.7705
[(a-pre)]	-0.0051	0.0013	16	31	0.0411*
[(a-post)]	0.0025	0.0030	14	33	0.0087**
[(b-pre)]	-0.0057	0.0006	19	27	0.3020
[(b-post)]	0.0019	0.0025	14	33	0.0087**
[(pre-post)]	0.0076	0.0011	15	25	0.1547
[(pre-event)]	-0.0312	-0.0080	28	12	0.0177*
[(post-event)]	-0.0388	-0.0091	28	17	0.1360

Table 3 cont'd...

PANEL C: For the good news sample for the second subperiod. Means for "a", "pre", "event", "post" and "b" are .0041, .0098, .1232, .0215 and .0037, respectively.

[(a-b)]	0.0004	-0.0000	42	42	1.0000
[(a-pre)]	-0.0057	0.0004	42	44	0.9141
[(a-post)]	-0.0174	-0.0264	62	24	0.0001**
[(b-pre)]	-0.0061	-0.0005	43	43	1.0000
[(b-post)]	-0.0178	-0.0265	61	25	0.0002**
[(pre-post)]	-0.0116	-0.0159	59	25	0.0003**
[(pre-event)]	-0.1134	-0.0307	57	17	0.0000**
[(post-event)]	-0.1018	-0.0140	51	32	0.0482*

PANEL D: For the bad news sample for the second subperiod. Means for "a", "pre", "event", "post" and "b" are .0036, .0155, .0392, .0158, and .0045, respectively.

[(a-b)]	-0.0009	-0.0001	37	32	0.6301
[(a-pre)]	-0.0119	-0.0021	43	29	0.1255
[(a-post)]	-0.0122	-0.0055	50	22	0.0015**
[(b-pre)]	-0.0109	-0.0016	45	25	0.0232*
[(b-post)]	-0.0113	-0.0058	50	22	0.0015**
[(pre-post)]	-0.0003	-0.0004	39	31	0.4028
[(pre-event)]	-0.0238	0.0000	34	27	0.4424
[(post-event)]	-0.0234	-0.0001	36	33	0.8097

PANEL E: For the good news sample for the third subperiod. Means for "a", "pre", "event", "post" and "b" are .0058, .0264, .1336, .0250 and .0061, respectively.

[(a-b)]	-0.0004	-0.0003	30	21	0.2626
[(a-pre)]	-0.0206	-0.0029	31	20	0.1614
[(a-post)]	-0.0193	-0.0026	30	21	0.2626
[(b-pre)]	-0.0202	-0.0018	31	21	0.2120
[(b-post)]	-0.0189	-0.0029	32	20	0.1272
[(pre-post)]	0.0013	-0.0007	27	25	0.8897
[(pre-event)]	-0.1073	-0.0096	31	12	0.0061**
[(post-event)]	-0.1086	-0.0023	31	20	0.1614

PANEL F: For the bad news sample for the third subperiod. Means for "a", "pre", "event", "post" and "b" are .0058, .0138, .0664, .0339 and .0072, respectively.

[(a-b)]	-0.0014	-0.0008	31	19	0.1198
[(a-pre)]	-0.0079	-0.0003	26	26	1.0000
[(a-post)]	-0.0281	-0.0036	34	18	0.0375*
[(b-pre)]	-0.0066	0.0011	24	28	0.6774
[(b-post)]	-0.0267	-0.0043	36	16	0.0084**
[(pre-post)]	-0.0201	-0.0045	35	16	0.0117*
[(pre-event)]	-0.0526	0.0000	24	13	0.1002
[(post-event)]	-0.0325	0.0039	21	30	0.2626

Table 4

Cross-sectional mean and median differences of the total number of shares traded for various time period pairings for each of the three sets of good and bad news halt samples are reported below. The significance of the paired differences are evaluated using t- and sign tests. The "a" and "b" relative time periods refer to the estimation periods prior to and after the event window [-10,+10], respectively. The Pre and Post relative time periods refer to the five intervals immediately prior to and after the event, respectively. The Below and Above columns refer to the number of observations less than or greater than zero, respectively. "Sign" refers to the P-Value associated with the sign test. "*" and "**" indicate significance at the 0.05 and 0.01 levels, respectively. Each interval consists of 30 minutes.

PANEL A: For the good news sample for the first subperiod. Means for "a", "pre", "event", "post" and "b" are 1219.76, 1906.89, 23323, 5723.62, and 1848.80, respectively.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
[(a-b)]	-629.03	-59.21	-2.1292*	62	41	0.0488*
[(a-pre)]	-687.13	48.32	-1.4645	47	57	0.3775
[(b-pre)]	-58.09	71.77	-0.1226	41	63	0.0395*
[(a-post)]	-4503.85	-577.16	-2.5033*	66	38	0.0081**
[(b-post)]	-3874.82	-271.92	-2.2656*	61	43	0.0955
[pre-post]	-3816.72	-476.30	-2.0149*	68	29	0.0001**
[pre-event]	-21416.11	-1850.50	-2.3866*	72	20	0.0000**
[post-event]	-17599.38	-430.00	-1.9376	60	41	0.0923

PANEL B: For the bad news sample for the first subperiod. Means for "a", "pre", "event", "post" and "b" are 736.75, 1619.28, 104579.85, 3175.60, and 1012.33, respectively.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
[(a-b)]	-275.59	17.47	-1.0575	21	25	0.6583
[(a-pre)]	-882.53	56.25	-2.3324*	20	26	0.4610
[(b-pre)]	-606.95	-1.16	-1.5779	23	23	1.0000
[(a-post)]	-2399.44	-311.30	-2.4041*	28	19	0.2432
[(b-post)]	-2143.90	-126.97	-2.1384*	26	21	0.5596
[pre-post]	-1564.76	-160.00	-1.9894*	27	16	0.1273
[pre-event]	-102969.0	-26.80	-1.0328	24	15	0.2002
[post-event]	-101404.3	0.00	-1.0208	22	20	0.8744

Table 4 cont'd...

PANEL C: For the good news sample for the second subperiod. Means for "a", "pre", "event", "post" and "b" are 752.36, 3166.89, 13600.21, 8193.05, and 966.85, respectively.

[(a-b)]	-214.49	-68.74	-1.3183	54	32	0.0235*
[(a-pre)]	-2414.54	-9.86	-1.6122	43	43	1.0000
[(b-pre)]	-2200.05	18.90	-1.3676	41	45	0.7463
[(a-post)]	-7440.69	-974.80	-2.7575**	68	18	0.0000**
[(b-post)]	-7226.21	-940.74	-2.6700**	68	18	0.0000**
[pre-post]	-5026.16	-470.00	-1.8523	63	18	0.0000**
[pre-event]	-10433.32	-1000.00	-3.1305**	51	21	0.0006**
[post-event]	-5407.16	35.00	-1.4858	36	44	0.4338

PANEL D: For the bad news sample for the second subperiod. Means for "a", "pre", "event", "post" and "b" are 773.51, 1418.21, 10927.14, 1856.89, and 780.69, respectively.

[(a-b)]	-7.18	-21.43	-0.0669	43	29	0.1255
[(a-pre)]	-644.70	29.31	-1.7513	33	39	0.5557
[(b-pre)]	-637.52	30.51	-1.6648	34	38	0.7237
[(a-post)]	-1083.38	-18.21	-2.2350*	37	35	0.9062
[(b-post)]	-1076.20	-38.18	-2.3318*	38	34	0.7237
[pre-post]	-438.68	-42.50	-0.6992	39	26	0.1366
[pre-event]	-9508.92	-73.40	-1.6226	36	25	0.2004
[post-event]	-9070.24	0.00	-1.5828	33	29	0.7032

PANEL E: For the good news sample for the third subperiod. Means for "a", "pre", "event", "post" and "b" are 1650.99, 6251.12, 25198.62, 9491.22, and 2185.21, respectively.

[(a-b)]	-534.22	-84.37	-0.7593	34	18	0.0375*
[(a-pre)]	-4600.12	17.37	-2.3522*	24	28	0.6774
[(b-pre)]	-4065.90	88.69	-2.0675*	21	31	0.2120
[(a-post)]	-7840.23	-329.67	-2.7194**	33	19	0.0714
[(b-post)]	-7306.01	-63.87	-2.8260**	29	23	0.4881
[pre-post]	-3240.11	-260.00	-1.5826	32	16	0.0304*
[pre-event]	-18947.50	-1705.00	-2.8652**	33	14	0.0087**
[post-event]	-15707.39	-1320.00	-2.8768**	36	9	0.0001**

PANEL F: For the bad news sample for the third subperiod. Means for "a", "pre", "event", "post" and "b" are 1217.59, 2456.40, 9765.31, 7522.4, and 1234.26, respectively.

[(a-b)]	-16.67	51.84	-0.0711	22	30	0.3317
[(a-pre)]	-1238.81	112.12	-1.0165	19	33	0.0714
[(b-pre)]	-1222.14	140.36	-1.0366	17	35	0.0184*
[(a-post)]	-6304.81	7.66	-1.4123	26	26	1.0000
[(b-post)]	-6288.14	3.95	-1.4448	26	26	1.0000
[pre-post]	-5066.01	-170.80	-1.0916	30	15	0.0369*
[pre-event]	-7308.91	0.00	-1.4536	23	20	0.7604
[post-event]	-2242.90	35.00	-0.3567	20	27	0.3815

Table 5

Cross-sectional mean and median differences of the number of trades per interval for various time period pairings for each of the three sets of good and bad news halt samples are reported below. The significance of the paired differences are evaluated using t- and sign tests. The "a" and "b" relative time periods refer to the estimation periods prior to and after the event window [-10,+10], respectively. The Pre and Post relative time periods refer to the five intervals immediately prior to and after the event, respectively. The Below and Above columns refer to the number of observations less than or greater than zero, respectively. "Sign" refers to the P-Value associated with the sign test. "*" and "**" indicate significance at the 0.05 and 0.01 levels, respectively. Each interval consists of 30 minutes.

PANEL A: For the good news sample for the first subperiod. Means for "a", "pre", "event", "post" and "b" are .7019, 1.0962, 7.62, 3.09, and .8365, respectively.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
[(a-b)]	-0.1346	0.00	-0.7322	16	15	1.0000
[(a-pre)]	-0.3942	0.00	-1.5413	27	13	0.0398*
[(b-pre)]	-0.2596	0.00	-1.1650	26	13	0.0547
[(a-post)]	-2.3846	-1.0000	-4.5513**	55	6	0.0000**
[(b-post)]	-2.2500	-1.0000	-4.8125**	54	6	0.0000**
[pre-post]	-1.9904	0.0000	-4.3247**	47	7	0.0000**
[pre-event]	-6.5192	-3.0000	-7.2198**	76	4	0.0000**
[post-event]	-4.5288	-2.0000	-5.8050**	69	12	0.0000**

PANEL B: For the bad news sample for the first subperiod. Means for "a", "pre", "event", "post" and "b" are .3478, 1.3913, 4.68, 1.96, and .3043, respectively.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
[(a-b)]	0.0435	0.00	0.7032	3	5	0.7266
[(a-pre)]	-1.0435	0.00	-2.6968**	15	3	0.0075**
[(b-pre)]	-1.0870	0.00	-2.9158**	16	2	0.0013**
[(a-post)]	-1.5745	0.0000	-2.6777**	18	4	0.0043**
[(b-post)]	-1.5957	0.0000	-2.7978**	19	1	0.0000**
[pre-post]	-0.5319	0.0000	-1.3704	12	11	1.0000
[pre-event]	-3.2553	-1.0000	-2.4111*	28	5	0.0001**
[post-event]	-2.7234	-1.0000	-2.4895*	24	4	0.0003**

Table 5 cont'd...

PANEL C: For the good news sample for the second subperiod. Means for "a", "pre", "event", "post" and "b" are .2558, 1.6628, 8.79, 4.31, and .4884, respectively.

[(a-b)]	-0.2326	0.00	-2.6726**	17	4	0.0072**
[(a-pre)]	-1.4070	0.00	-2.2093*	27	3	0.0000**
[(b-pre)]	-1.1744	0.00	-1.8180	24	9	0.0148*
[(a-post)]	-4.0581	-1.0000	-4.1498**	46	0	0.0000**
[(b-post)]	-3.8256	-1.0000	-4.0897**	47	0	0.0000**
[pre-post]	-2.6512	0.0000	-2.9541**	39	7	0.0000**
[pre-event]	-7.1279	-1.0000	-4.5623**	50	3	0.0000**
[post-event]	-4.4767	-1.0000	-3.7737**	44	14	0.0001**

PANEL D: For the bad news sample for the second subperiod. Means for "a", "pre", "event", "post" and "b" are .2361, .6806, 3.28, 0.87, and .2222, respectively.

[(a-b)]	0.0139	0.00	0.2565	7	8	1.0000
[(a-pre)]	-0.4444	0.00	-3.0897**	22	8	0.0176*
[(b-pre)]	-0.4583	0.00	-3.4188**	22	6	0.0046**
[(a-post)]	-0.6389	0.0000	-4.0596**	25	7	0.0027**
[(b-post)]	-0.6528	0.0000	-4.8575**	25	3	0.0001**
[pre-post]	-0.1944	0.0000	-1.1157	19	15	0.6069
[pre-event]	-2.5972	-1.0000	-5.0256**	40	8	0.0000**
[post-event]	-2.4028	-0.5000	-5.0586**	36	5	0.0000**

PANEL E: For the good news sample for the third subperiod. Means for "a", "pre", "event", "post" and "b" are .9423, 2.4038, 11.44, 4.4, and 1.0769, respectively.

[(a-b)]	-0.1346	0.00	-0.4437	6	6	1.0000
[(a-pre)]	-1.4615	0.00	-2.1315*	15	3	0.0075**
[(b-pre)]	-1.3269	0.00	-1.8898	15	6	0.0784
[(a-post)]	-3.4615	0.0000	-2.7994**	24	2	0.0000**
[(b-post)]	-3.3269	0.0000	-2.9551**	24	2	0.0000**
[pre-post]	-2.0000	0.0000	-2.3591*	19	7	0.0310*
[pre-event]	-9.0385	-2.5000	-3.8791**	36	2	0.0000**
[post-event]	-7.0385	-2.0000	-4.1296**	36	1	0.0000**

PANEL F: For the bad news sample for the third subperiod. Means for "a", "pre", "event", "post" and "b" are .4038, .8654, 3.56, 1.5, and .3269, respectively.

[(a-b)]	0.0769	0.00	1.4283	1	4	0.3750
[(a-pre)]	-0.4615	0.00	-2.1795*	10	2	0.0386*
[(b-pre)]	-0.5385	0.00	-2.5428*	11	1	0.0063**
[(a-post)]	-1.0962	0.0000	-3.8187**	21	1	0.0000**
[(b-post)]	-1.1731	0.0000	-4.0968**	23	1	0.0000**
[pre-post]	-0.6346	0.0000	-2.3832*	18	4	0.0000**
[pre-event]	-2.6923	0.0000	-4.2564**	25	2	0.0000**
[post-event]	-2.0577	0.0000	-3.6544**	24	7	0.0041**

TABLE 6

The initial and final samples of trading halts are presented in Panel A. The first screen deletes all securities that are preferreds, warrants or units. The second screen deletes all firms that did not trade in at least one of the five days prior to the halt. The third screen deletes all firms with securities trading at less than $1, and the final screen deletes firms that had an event window that corresponded to the Ontario Civic Holiday in August. Summary statistics for the day-of-week, time-of-day, and length of the halt (in minutes) are presented in Panels B, C and D. The last transacted price prior to the halt is presented in Panel E, where the categories correspond to the minimum tick size requirements on the TSE.

PANEL A: The initial sample size, the number of firms deleted by each screen, and the final sample sizes for the total, "good" and "bad" news samples are presented herein.

	Deleted				Final sample		
Initial sample	Screen1	Screen2	Screen3	Screen4	Total	Good	Bad
649	401	45	22	11	170	68	102

PANEL B: Summary statistics for the day-of-the-week (DOW) are presented herein.

DOW	M	T	W	Th	F
Good	10	15	19	10	14
Bad	22	20	35	16	9

PANEL C: Summary statistics for the time-of-the-day (TOD) are presented herein.

TOD	Good	Bad
9:30	35	56
9:31-10:30	6	8
10:31-11:30	7	8
11:31-12:30	6	11
12:31-1:30	5	7
1:31-2:30	5	4
2:31-3:30	3	5
3:31-4:00	1	3

PANEL D: Summary statistics for the length of the halt in minutes are presented herein.

	Mean	Median	Std. Dev.	Min	Max
Good	196.5	135	221.54	15	1590
Bad	208.44	135	251.73	1	2031

PANEL E: Summary statistics for the price at the halt (LP) are presented herein.

LP	$1.00-$2.99	$3.00-$4.95	>$5.00
Good	11	10	47
Bad	15	14	73

Table 7

Cross-sectional mean and median differences of the total number of shares traded per interval for various time period pairings for the good and bad news halts are reported below. The significance of the paired differences are evaluated using t- and sign tests. The "a" and "b" relative time periods refer to the estimation periods prior to and after the event window [-10, +10], respectively. The pre and post time intervals refer to the five interval periods immediately prior to and following the event interval [0], respectively. The event time interval refers to the first interval immediately following the trading halt. The Below and Above columns refer to the number of observations less than or greater than zero, respectively. "Sign" refers to the p-value associated with the sign test. "*" and "**" indicate significance at the 5% and 1% levels, respectively. Each interval consists of 30 minutes.

PANEL A: Share volume results for the good news sample. Means for "a", "pre", "event", "post" and "b" are 11371.54, 11016.19, 89568.72, 42757.44 and 17789.91, respectively.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
[a-b]	-6418.37	-253.50	-2.2987*	40	28	0.1822
[a-pre]	355.35	560.50	0.1419	23	45	0.0109*
[a-post]	-31385.90	-4205.00	-3.6591**	51	17	0.0001**
[b-pre]	6773.72	1647.50	2.4882*	18	50	0.0002**
[b-post]	-24967.53	-2602.50	-3.6020**	45	23	0.0109*
[pre-post]	-31741.25	-4232.00	-3.9588**	54	14	0.0000**
[pre-event]	-78552.53	-24005.50	-5.0077**	63	5	0.0000**
[post-event]	-46811.28	-20396.00	-4.3956**	55	13	0.0000**

PANEL B: Share volume results for the bad news sample. Means for "a", "pre", "event", "post" and "b" are 10907.86, 15716.25, 97881.10, 35171.43 and 12217.31, respectively.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
[a-b]	-1309.45	-868.00	-0.4806	68	34	0.0011**
[a-pre]	-4808.38	603.50	-1.0764	36	66	0.0041**
[a-post]	-24263.57	-3038.00	-4.6392**	68	34	0.0011**
[b-pre]	-3498.93	977.00	-0.8903	33	69	0.0005**
[b-post]	-22954.12	-2714.00	-3.7534**	71	31	0.0001**
[pre-post]	-19455.19	-1943.00	-2.8917**	71	28	0.0000**
[pre-event]	-82164.85	-6108.50	-3.9532**	76	21	0.0000**
[post-event]	-62709.67	-7170.00	-3.3590**	73	23	0.0000**

Table 8

Cross-sectional mean and median differences of the total value of shares traded per interval for various time period pairings for the good and bad news halts are reported below. The significance of the paired differences are evaluated using t- and sign tests. The "a" and "b" relative time periods refer to the estimation periods prior to and after the event window [-10, +10], respectively. The pre and post time intervals refer to the five interval periods immediately prior to and following the event interval [0], respectively. The event time interval refers to the first interval immediately following the trading halt. The Below and Above columns refer to the number of observations less than or greater than zero, respectively. "Sign" refers to the p-value associated with the sign test. "*" and "**" indicate significance at the 5% and 1% levels, respectively. Each interval consists of 30 minutes.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
PANEL A: Dollar volume results for the good news sample. Means for "a", "pre", "event", "post" and "b" are 105315.74, 101825.03, 913699.55, 430435.65 and 162960.25, respectively.						
[a-b]	-57644.50	-2641.47	-2.6653**	42	26	0.0689
[a-pre]	3490.72	4104.89	0.1777	22	46	0.0053**
[a-post]	-325119.91	-32465.14	-3.6543**	51	17	0.0001**
[b-pre]	61135.22	16606.95	2.5185*	18	50	0.0002**
[b-post]	-267475.41	-18201.37	-3.2841**	46	22	0.0053**
[pre-post]	-328610.63	-44814.94	-3.7386**	54	14	0.0000**
[pre-event]	-811874.53	-170994.19	-4.2058**	63	5	0.0000**
[post-event]	-483263.90	-119544.00	-2.8431**	55	13	0.0000**
PANEL B: Dollar volume results for the good news sample. Means for "a", "pre", "event", "post" and "b" are 148094.49, 142248.13, 1548491.81, 563381.41 and 153209.42, respectively.						
[a-b]	-5114.93	-6466.37	-0.1605	70	32	0.0002**
[a-pre]	5846.37	4657.50	0.1220	36	66	0.0041**
[a-post]	-415286.91	-32944.11	-2.8352**	68	34	0.0011**
[b-pre]	10961.30	11519.04	0.2750	32	70	0.0002**
[b-post]	-410171.99	-22990.28	-2.4211*	70	32	0.0002**
[pre-post]	-421133.28	-23783.80	-2.3340*	71	28	0.0000**
[pre-event]	-1406243.7	-77523.19	-3.3300**	76	21	0.0000**
[post-event]	-985110.41	-45638.50	-3.2446**	73	23	0.0000**

Table 9

Cross-sectional mean and median differences of the total number of trades (NOTs) per interval for various time period pairings for the good and bad news halts are reported below. The significance of the paired differences are evaluated using t- and sign tests. The "a" and "b" relative time periods refer to the estimation periods prior to and after the event window [-10, +10], respectively. The pre and post time intervals refer to the five interval periods immediately prior to and following the event interval [0], respectively. The event time interval refers to the first interval immediately following the trading halt. The Below and Above columns refer to the number of observations less than or greater than zero, respectively. "Sign" refers to the p-value associated with the sign test. "*" and "**" indicate significance at the 5% and 1% levels, respectively. Each interval consists of 30 minutes.

PANEL A: NOT results for the good news sample. Means for "a", "pre", "event", "post" and "b" are 7.0398, 8.2147, 52.5735, 22.8735 and 11.4045, respectively.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
[a-b]	-4.3647	-0.4916	-2.6078**	43	25	0.0393*
[a-pre]	-1.1749	0.1125	-0.8409	29	39	0.2751
[a-post]	-15.8337	-4.9833	-4.4263**	63	5	0.0000**
[b-pre]	3.1898	0.6375	1.8562	28	40	0.1822
[b-post]	-11.4690	-4.1791	-4.0175**	55	13	0.0000**
[pre-post]	-14.6588	-4.6000	-4.7039**	58	8	0.0000**
[pre-event]	-44.3588	-21.9000	-5.9967**	64	3	0.0000**
[post-event]	-29.7000	-19.2000	-5.1446**	60	7	0.0000**

PANEL B: NOT results for the bad news sample. Means for "a", "pre", "event", "post" and "b" are 5.6212, 6.6922, 40.9510, 17.5020 and 7.7028, respectively.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
[a-b]	-2.0816	-0.5417	-2.2240*	69	33	0.0005**
[a-pre]	-1.0710	0.2417	-1.0316	43	58	0.1636
[a-post]	-11.8808	-3.5958	-5.6728**	81	21	0.0000**
[b-pre]	1.0106	0.7459	0.8283	40	62	0.0376*
[b-post]	-9.7992	-2.9708	-4.7577**	80	22	0.0000**
[pre-post]	-10.8098	-3.5000	-4.9854**	77	20	0.0000**
[pre-event]	-34.2588	-11.7000	-6.2865**	82	15	0.0000**
[post-event]	-23.4490	-7.9000	-5.7016**	81	15	0.0000**

Table 10

Cross-sectional mean and median differences of the relative number of medium-size trades per interval for various time period pairings for the good and bad news halts are reported below. The significance of the paired differences are evaluated using t- and sign tests. The "a" and "b" relative time periods refer to the estimation periods prior to and after the event window [-10, +10], respectively. The pre and post time intervals refer to the five interval periods immediately prior to and following the event interval [0], respectively. The event time interval refers to the first interval immediately following the trading halt. The Below and Above columns refer to the number of observations less than or greater than zero, respectively. "Sign" refers to the p-value associated with the sign test. "*" and "**" indicate significance at the 5% and 1% levels, respectively. Each interval consists of 30 minutes.

PANEL A: Medium-size trade results for the good news sample. Means for "a", "pre", "event", "post" and "b" are 0.1944, 0.1633, 0.2402, 0.2112 and 0.1967, respectively.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
[a-b]	-0.0023	0.0045	-0.2577	31	37	0.5443
[a-pre]	0.0311	0.0283	1.8195	26	41	0.0872
[a-post]	-0.0167	-0.0056	-1.2005	37	31	0.5443
[b-pre]	0.0334	0.0531	1.9558*	24	42	0.0364*
[b-post]	-0.0145	-0.0014	-1.0139	35	32	0.8070
[pre-post]	-0.0479	-0.0377	-2.2440*	40	22	0.0309*
[pre-event]	-0.0770	-0.0209	-2.8871**	37	19	0.0231*
[post-event]	-0.0291	-0.0235	-1.2068	39	23	0.0568

PANEL B: Medium-size trade results for the bad news sample. Means for "a", "pre", "event", "post" and "b" are 0.1991, 0.2249, 0.2582, 0.2194 and 0.2062, respectively.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
[a-b]	-0.0071	-0.0039	-0.6959	53	48	0.6906
[a-pre]	-0.0258	0.0080	-1.1960	47	52	0.6877
[a-post]	-0.0202	-0.0018	-1.2372	52	47	0.6877
[b-pre]	-0.0187	0.0083	-0.7886	43	54	0.3099
[b-post]	-0.0131	0.0000	-0.8928	50	46	0.7595
[pre-post]	0.0056	0.0000	0.2189	46	45	1.0000
[pre-event]	-0.0333	0.0000	-1.0372	49	36	0.1931
[post-event]	-0.0389	0.0000	-1.5538	47	33	0.1461

Table 11

Cross-sectional mean and median differences of the relative number of total buys and sells per interval for various time period pairings for the good and bad news halts are reported below. The significance of the paired differences are evaluated using t- and sign tests. The "a" and "b" relative time periods refer to the estimation periods prior to and after the event window [-10, +10], respectively. The pre and post time intervals refer to the five interval periods immediately prior to and following the event interval [0], respectively. The event time interval refers to the first interval immediately following the trading halt. The Below and Above columns refer to the number of observations less than or greater than zero, respectively. "Sign" refers to the p-value associated with the sign test. "*" and "**" indicate significance at the 5% and 1% levels, respectively. Each interval consists of 30 minutes.

PANEL A: Total buy results for the good news sample. Means for "a", "pre", "event", "post" and "b" are 0.4774, 0.4299, 0.7483, 0.4486 and 0.4648, respectively.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
[a-b]	0.0126	0.0086	0.7794	32	35	0.8070
[a-pre]	0.0476	0.0284	1.2540	30	38	0.3960
[a-post]	0.0289	0.0266	1.1128	29	38	0.3284
[b-pre]	0.0350	0.0260	0.9539	29	39	0.2751
[b-post]	0.0163	-0.0050	0.6492	37	31	0.5443
[pre-post]	-0.0187	-0.0217	-0.4188	36	30	0.5383
[pre-event]	-0.3184	-0.2870	-6.4218**	49	18	0.0002**
[post-event]	-0.2997	-0.2568	-8.1656**	59	9	0.0000**

PANEL B: Total buy results for the bad news sample. Means for "a", "pre", "event", "post" and "b" are 0.3935, 0.4077, 0.2275, 0.3494 and 0.4094, respectively.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
[a-b]	-0.0158	-0.0164	-1.0013	54	48	0.6205
[a-pre]	-0.0142	0.0246	-0.4282	46	56	0.3729
[a-post]	0.0441	0.0083	1.7468	49	53	0.7664
[b-pre]	0.0016	0.0199	0.0473	48	54	0.6205
[b-post]	0.0600	0.0553	2.4916*	40	62	0.0376*
[pre-post]	0.0583	0.0165	1.4980	41	52	0.2998
[pre-event]	0.1803	0.1497	5.1324**	23	63	0.0000**
[post-event]	0.1219	0.0604	4.6732**	23	68	0.0000**

PANEL C: Total sell results for the good news sample. Means for "a", "pre", "event", "post" and "b" are 0.5226, 0.5260, 0.2517, 0.5514 and 0.5352, respectively.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
[a-b]	-0.0126	-0.0086	-0.7794	35	32	0.8070
[a-pre]	-0.0034	-0.0064	-0.0862	35	33	0.9035
[a-post]	-0.0289	-0.0266	-1.1128	38	29	0.3284
[b-pre]	0.0091	-0.0121	0.2424	36	32	0.7160
[b-post]	-0.0163	0.0050	-0.6492	31	37	0.5443
[pre-post]	-0.0254	0.0000	-0.5806	33	33	1.0000
[pre-event]	0.2743	0.2450	5.5876**	20	46	0.0021**
[post-event]	0.2997	0.2568	8.1656**	9	59	0.0000**

PANEL D: Total sell results for the bad news sample. Means for "a", "pre", "event", "post" and "b" are 0.6065, 0.4942, 0.6451, 0.5721 and 0.5906, respectively.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
[a-b]	0.0158	0.0164	1.0013	48	54	0.6205
[a-pre]	0.1122	0.0964	3.1055**	46	56	0.3729
[a-post]	0.0343	0.0232	1.0672	45	57	0.2761
[b-pre]	0.0964	0.0809	2.6940**	44	58	0.1980
[b-post]	0.0185	-0.0104	0.6588	54	48	0.6205
[pre-post]	-0.0779	-0.0355	-1.8197	55	40	0.1509
[pre-event]	-0.1509	-0.1497	-3.3436**	63	30	0.0009**
[post-event]	-0.0729	-0.0459	-2.0212*	65	30	0.0005**

Table 12

Cross-sectional mean and median differences of the relative number of medium-size buys and sells relative to total medium-size trades per interval for various time period pairings for the good and bad news halts are reported below. The significance of the paired differences are evaluated using t- and sign tests. The "a" and "b" relative time periods refer to the estimation periods prior to and after the event window [-10, +10], respectively. The pre and post time intervals refer to the five interval periods immediately prior to and following the event interval [0], respectively. The event time interval refers to the first interval immediately following the trading halt. The Below and Above columns refer to the number of observations less than or greater than zero, respectively. "Sign" refers to the p-value associated with the sign test. "*" and "**" indicate significance at the 5% and 1% levels, respectively. Each interval consists of 30 minutes.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
PANEL A: Medium-size buy results for the good news sample. Means for "a", "pre", "event", "post" and "b" are 0.4864, 0.3309, 0.5461, 0.3967 and 0.4643, respectively.						
[a-b]	0.0220	0.0000	0.6567	33	32	1.0000
[a-pre]	0.1555	0.1902	3.0895**	23	42	0.0256*
[a-post]	0.0897	0.1046	1.8118	24	42	0.0364*
[b-pre]	0.1334	0.1228	2.9263**	21	42	0.0117*
[b-post]	0.0676	0.0323	1.6419	23	39	0.0568
[pre-post]	-0.0658	0.0000	-1.1643	32	22	0.2207
[pre-event]	-0.2152	-0.0785	-3.8569**	36	16	0.0084**
[post-event]	-0.1494	-0.0897	-2.5584*	41	16	0.0015**
PANEL B: Medium-size buy results for the bad news sample. Means for "a", "pre", "event", "post" and "b" are 0.4339, 0.3307, 0.1952, 0.2731 and 0.4379, respectively.						
[a-b]	-0.0040	0.0000	-0.1317	49	48	1.0000
[a-pre]	0.1032	0.1245	2.6396**	34	57	0.0211*
[a-post]	0.1609	0.1076	4.9350**	27	61	0.0004**
[b-pre]	0.1072	0.1436	2.7866**	32	62	0.0028**
[b-post]	0.1649	0.1447	5.0204**	26	69	0.0000**
[pre-post]	0.0577	0.0000	1.3097	34	40	0.5611
[pre-event]	0.1355	0.0000	3.2351**	20	42	0.0077**
[post-event]	0.0778	0.0000	2.5744*	25	41	0.0648
PANEL C: Medium-size sell results for the good news sample. Means for "a", "pre", "event", "post" and "b" are 0.4989, 0.3014, 0.2186, 0.4857 and 0.5063, respectively.						
[a-b]	-0.0073	0.0053	-0.2176	31	34	0.8041
[a-pre]	0.1975	0.3039	3.8751**	20	45	0.0029**
[a-post]	0.0133	-0.0413	0.2640	36	30	0.5383
[b-pre]	0.2048	0.2352	4.0005**	22	44	0.0097**
[b-post]	0.0206	-0.0004	0.4216	35	30	0.6198
[pre-post]	-0.1842	-0.0549	-3.2258**	35	19	0.0412*
[pre-event]	0.0829	0.0000	1.7767	19	27	0.3020
[post-event]	0.2671	0.1890	5.4815**	9	47	0.0000**
PANEL D: Medium-size sell results for the bad news sample. Means for "a", "pre", "event", "post" and "b" are 0.5269, 0.3163, 0.4714, 0.4818 and 0.5032, respectively.						
[a-b]	0.0236	0.0000	0.7183	48	50	0.9195
[a-pre]	0.2106	0.2181	5.0212**	30	64	0.0007**
[a-post]	0.0450	0.0000	0.9997	46	47	1.0000
[b-pre]	0.1869	0.2210	4.3840**	32	62	0.0028**
[b-post]	0.0214	-0.0089	0.6073	51	43	0.4703
[pre-post]	-0.1655	-0.0945	-2.9384**	56	29	0.0048**
[pre-event]	-0.1551	0.0000	-2.9537**	50	22	0.0015**
[post-event]	0.0104	0.0000	0.2312	39	37	0.9087

Table 13

Cross-sectional mean and median differences of the actual spreads and depth imbalance per interval for various time period pairings for the good and bad news halts are reported below. The significance of the paired differences are evaluated using t- and sign tests. The "a" and "b" relative time periods refer to the estimation periods prior to and after the event window [-10, +10], respectively. The pre and post time intervals refer to the five interval periods immediately prior to and following the event interval [0], respectively. The event time interval refers to the first interval immediately following the trading halt. The Below and Above columns refer to the number of observations less than or greater than zero, respectively. "Sign" refers to the p-value associated with the sign test. "*" and "**" indicate significance at the 5% and 1% levels, respectively. Each interval consists of 30 minutes.

PANEL A: Spread results for the good news sample. Means for "a", "pre", "event", "post" and "b" are 0.1866, 0.1526, 0.2077, 0.1972 and 0.1771, respectively.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
[a-b]	0.0095	0.0040	1.2273	28	39	0.2218
[a-pre]	0.0340	0.0126	1.5945	20	48	0.0011**
[a-post]	-0.0106	0.0073	-0.4895	29	38	0.3284
[b-pre]	0.0245	0.0067	1.0935	27	41	0.1149
[b-post]	-0.0201	-0.0050	-0.8142	37	29	0.3889
[pre-post]	-0.0445	0.0000	-2.2324*	33	19	0.0714
[pre-event]	-0.0551	-0.0060	-3.2831**	36	16	0.0084**
[post-event]	-0.0105	0.0000	-0.7528	28	22	0.4795

PANEL B: Spread results for the bad news sample. Means for "a", "pre", "event", "post" and "b" are 0.1757, 0.1682, 0.2236, 0.1927 and 0.1919, respectively.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
[a-b]	-0.0162	0.0031	-0.7909	48	53	0.6906
[a-pre]	0.0075	0.0104	0.4734	36	66	0.0041**
[a-post]	-0.0170	-0.0005	-0.9856	51	50	1.0000
[b-pre]	0.0237	0.0092	0.9926	38	63	0.0169*
[b-post]	-0.0008	-0.0037	-0.0310	56	44	0.2713
[pre-post]	-0.0245	0.0000	-2.0001*	49	27	0.0160*
[pre-event]	-0.0554	0.0000	-2.4166*	47	22	0.0039**
[post-event]	-0.0309	0.0000	-1.4071	42	26	0.0689

PANEL C: Depth results for the good news sample. Means for "a", "pre", "event", "post" and "b" are 0.9663, 1.2441, -13.2647, -26.7206 and -15.3196, respectively.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
[a-b]	16.2859	1.0130	1.2929	32	36	0.7160
[a-pre]	-0.2778	-1.7290	-0.0169	36	32	0.7160
[a-post]	27.6869	-2.3420	1.9238	35	33	0.9035
[b-pre]	-16.5637	0.9960	-0.7909	33	35	0.9035
[b-post]	11.4010	1.9625	0.6854	33	35	0.9035
[pre-post]	27.9647	0.7000	1.1242	33	34	1.0000
[pre-event]	14.5088	3.8000	0.4444	29	38	0.3284
[post-event]	-13.4559	-1.9000	-0.4870	38	28	0.2679

PANEL D: Depth results for the bad news sample. Means for "a", "pre", "event", "post" and "b" are -17.2648, -5.5902, -25.7451, -23.8137 and -27.3311, respectively.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
[a-b]	10.0663	-5.9540	1.1500	58	44	0.1980
[a-pre]	-11.6746	-1.6705	-1.2297	57	45	0.2761
[a-post]	6.5489	-4.1165	0.4917	54	48	0.6205
[b-pre]	-21.7409	1.3460	-1.7435	49	53	0.7664
[b-post]	-3.5174	-3.5290	-0.2589	56	46	0.3729
[pre-post]	18.2235	-2.4000	1.2251	56	44	0.2713
[pre-event]	20.1549	-1.9000	0.9165	53	47	0.6171
[post-event]	1.9314	1.7000	0.1226	39	56	0.1007

Table 14

Cross-sectional mean and median differences of the relative spreads and depths at the bid and at the ask per interval for various time period pairings for the good and bad news halts are reported below. The significance of the paired differences are evaluated using t- and sign tests. The "a" and "b" relative time periods refer to the estimation periods prior to and after the event window [-10, +10], respectively. The pre and post time intervals refer to the five interval periods immediately prior to and following the event interval [0], respectively. The event time interval refers to the first interval immediately following the trading halt. The Below and Above columns refer to the number of observations less than or greater than zero, respectively. "Sign" refers to the p-value associated with the sign test. "*" and "**" indicate significance at the 5% and 1% levels, respectively. Each interval consists of 30 minutes.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
PANEL A: Relative spread results for the good news sample. Means for "a", "pre", "event", "post" and "b" are 0.0205, 0.0173, 0.0227, 0.0202 and 0.0178, respectively.						
[a-b]	0.0027	0.0007	1.9963*	45	21	0.0046**
[a-pre]	0.0032	0.0018	2.3325*	47	20	0.0015**
[a-post]	0.0003	0.0006	0.1488	41	26	0.0872
[b-pre]	0.0005	0.0006	0.6209	38	30	0.3960
[b-post]	-0.0023	-0.0004	-1.3019	26	41	0.0872
[pre-post]	-0.0029	-0.0003	-1.5465	30	34	0.7077
[pre-event]	-0.0054	-0.0011	-3.0010**	25	40	0.0825
[post-event]	-0.0025	-0.0001	-1.9405	27	34	0.4424
PANEL B: Relative spread results for the bad news sample. Means for "a", "pre", "event", "post" and "b" are 0.0206, 0.0203, 0.0261, 0.0281, and 0.0222 respectively.						
[a-b]	-0.0016	0.0003	-0.9506	55	46	0.4260
[a-pre]	0.0003	0.0010	0.1676	65	34	0.0026**
[a-post]	-0.0075	0.0004	-1.6764	55	45	0.3681
[b-pre]	0.0019	0.0011	1.4243	63	38	0.0169*
[b-post]	-0.0059	-0.0002	-1.6510	46	55	0.4260
[pre-post]	-0.0078	-0.0007	-2.0945*	35	62	0.0083**
[pre-event]	-0.0058	-0.0003	-2.5457*	34	57	0.0211*
[post-event]	0.0020	0.0000	0.4358	36	45	0.3741
PANEL C: Bid volume results for the good news sample. Means for "a", "pre", "event", "post" and "b" are 75.6912, 78.1618, 93.5294, 115.2941 and 113.0588, respectively.						
[a-b]	-37.3676	-2.0000	-2.3895*	28	38	0.2679
[a-pre]	-2.4706	2.0000	-0.1357	36	30	0.5383
[a-post]	-39.6029	1.0000	-2.2711**	35	31	0.7119
[b-pre]	34.8971	18.0000	1.5702	45	22	0.0072**
[b-post]	-2.2353	10.5000	-0.1484	40	27	0.1426
[pre-post]	-37.1324	-3.0000	-1.4926	26	37	0.2077
[pre-event]	-15.3676	-2.0000	-0.6784	28	36	0.3816
[post-event]	21.7647	4.5000	1.1155	38	24	0.0987
PANEL D: Bid Volume results for the bad news sample. Means for "a", "pre", "event", "post" and "b" are 85.1471, 74.4902, 128.3039, 141.2549 and 116.6176, respectively.						
[a-b]	-31.4706	1.5000	-2.3266*	53	48	0.6906
[a-pre]	10.6569	9.0000	0.9434	68	31	0.0003**
[a-post]	-56.1078	-1.0000	-3.1382**	49	52	0.8423
[b-pre]	42.1275	10.5000	2.7784**	63	38	0.0169*
[b-post]	-24.6373	1.0000	-1.4393	53	46	0.5465
[pre-post]	-66.7647	-11.0000	-3.4003**	37	61	0.0202*
[pre-event]	-53.8137	-5.5000	-2.3566*	38	54	0.1179
[post-event]	12.9510	0.0000	1.0417	49	38	0.2837

Table 14 cont'd

PANEL E: Ask volume results for the good news sample. Means for "a", "pre", "event", "post" and "b" are 76.7059, 79.4853, 80.2647, 88.7059 and 97.7059, respectively.

[a-b]	-21.0000	-6.0000	-2.0382*	26	40	0.1096
[a-pre]	-2.7794	1.5000	-0.2346	36	28	0.3816
[a-post]	-12.0000	0.0000	-0.8134	33	32	1.0000
[b-pre]	18.2206	12.0000	1.3120	45	20	0.0029**
[b-post]	9.0000	3.5000	0.7207	37	27	0.2606
[pre-post]	-9.2206	-11.0000	-0.4832	26	41	0.0872
[pre-event]	-0.7794	4.0000	-0.0291	38	28	0.2679
[post-event]	8.4412	4.0000	0.6084	40	24	0.0608

PANEL F: Ask volume results for the bad news sample. Means for "a", "pre", "event", "post" and "b" are 67.8529, 68.8529, 102.5588, 117.3922 and 89.3431, respectively.

[a-b]	-21.4902	-4.0000	-2.4420*	40	59	0.0704
[a-pre]	-1.0000	6.0000	-0.0903	65	34	0.0026**
[a-post]	-49.5392	-12.0000	-3.2685**	38	63	0.0169*
[b-pre]	20.4902	10.5000	1.5703	67	32	0.0006**
[b-post]	-28.0490	-2.0000	-1.8157	47	53	0.6171
[pre-post]	-48.5392	-15.5000	-3.3413**	28	68	0.0001**
[pre-event]	-33.7059	-2.5000	-2.2805*	41	54	0.2183
[post-event]	14.8333	1.5000	1.3950	54	36	0.0731

Table 15

Results for the non-parametric chi-square contingency test comparing the rank of spreads relative to their median values against depth imbalance relative to its median value for both news samples for selected periods are reported below. Expected values are in parentheses. Bef and after refer to the estimation periods prior to and after the event window [-10, +10]. Pre and post refer to the five interval period immediately preceding and immediately following the event interval [0]. "**" and "***" indicate significance at the 5% and 1% levels, respectively.

bad-bef		spread		
		below	equal	above
	below	864 (982.1122)	3426 (3403.7712)	1309 (1213.1167)
depth	equal	332 (198.7378)	561 (688.7788)	240 (245.4833)
	above	951 (966.1500)	3454 (3348.4500)	1103 (1193.4000)
	Chi-Sq. test	145.5261**		

good-bef		spread		
		below	equal	above
	below	560 (592.1496)	2265 (2296.2400)	912 (848.6104)
	equal	93 (102.0456)	435 (395.7127)	116 (146.2417)
	above	640 (598.8048)	2314 (2322.0473)	825 (858.1479)
	Chi-Sq. test	22.0041**		

bad-pre		spread		
		below	equal	above
	below	17 (12.9569)	73 (90.2588)	22 (8.7843)
depth	equal	12 (34.8216)	279 (242.5706)	10 (23.6078)
	above	30 (11.2216)	59 (78.1706)	8 (7.6078)
	Chi-Sq. test	88.8618**		

good-pre		spread		
		below	equal	above
	below	18 (7.4118)	44 (56.7529)	10 (7.8353)
	equal	8 (19.5588)	173 (149.7647)	9 (20.6765)
	above	9 (8.0294)	51 (61.4824)	18 (8.4882)
	Chi-Sq. test	48.1828**		

bad-post		spread		
		below	equal	above
	below	14 (16.0078)	119 (120.3667)	24 (20.6255)
depth	equal	13 (20.3922)	171 (153.3333)	16 (26.2745)
	above	25 (15.6000)	101 (117.3000)	27 (20.1000)
	Chi-Sq. test	19.8502**		

good-post		spread		
		below	equal	above
	below	8 (10.3235)	89 (85.6853)	20 (20.9912)
	equal	7 (9.6176)	86 (79.8265)	16 (19.5559)
	above	15 (10.0588)	74 (83.4882)	25 (20.4529)
	Chi-Sq. test	7.0509		

bad-after		spread		
		below	equal	above
	below	737 (844.2230)	3654 (3441.2181)	1039 (1144.5588)
depth	equal	404 (220.6174)	669 (899.2797)	346 (299.1029)
	above	762 (838.1596)	3434 (3416.5022)	1195 (1136.3382)
	Chi-Sq. test	265.3019**		

good-after		spread		
		below	equal	above
	below	601 (597.5000)	2384 (2382.5020)	839 (843.9980)
	equal	177 (107.5000)	342 (428.6510)	169 (151.8490)
	above	497 (570.0000)	2358 (2272.8471)	793 (805.1529)
	Chi-Sq. test	77.1599**		

Table 16

Results for the non-parametric chi-square contingency test comparing the rank of spreads relative to their median values against total depth relative to its median value, for both samples for selected periods are reported below. Expected values are in parentheses. "Bef" and "aft" refer to the estimation periods prior to and after the event window [-10, +10], respectively. "Pre" and "post" refer to the five intervals immediately preceding and immediately following the event interval [0], respectively. "**" indicates significance at the 1% level.

bad-bef

		spread		
		below	equal	above
depth	below	2431 (2235.33)	1029 (1237.6)	2252 (2239.07)
	equal	193 (283.721)	276 (157.083)	256 (284.195)
	above	2166 (2270.95)	1347 (1257.32)	2290 (2274.74)
	Chi-Sq. test	185.541**		

good-bef

		spread		
		below	equal	above
depth	below	1674 (1545.32)	622 (698.005)	1476 (1528.68)
	equal	215 (251.135)	121 (113.435)	277 (248.43)
	above	1454 (1546.55)	767 (698.56)	1554 (1529.89)
	Chi-Sq. test	42.4195**		

bad-pre

		spread		
		below	equal	above
depth	below	58 (19.1059)	37 (81.6549)	21 (15.2392)
	equal	11 (48.4235)	268 (206.953)	15 (38.6235)
	above	15 (16.4706)	54 (70.3922)	31 (13.1373)
	Chi-Sq. test	195.391**		

good-pre

		spread		
		below	equal	above
depth	below	26 (10.5059)	30 (52.7529)	20 (12.7412)
	equal	6 (25.1588)	169 (126.329)	7 (30.5118)
	above	15 (11.3353)	37 (56.9176)	30 (13.7471)
	Chi-Sq. test	111.291**		

bad-post

		spread		
		below	equal	above
depth	below	45 (33.7647)	75 (94.8627)	44 (35.3725)
	equal	24 (40.3529)	148 (113.373)	24 (42.2745)
	above	36 (30.8824)	72 (86.7647)	42 (32.3529)
	Chi-Sq. test	41.3419**		

good-post

		spread		
		below	equal	above
depth	below	30 (24.8118)	50 (61.0235)	34 (28.1647)
	equal	16 (22.4176)	70 (55.1353)	17 (25.4471)
	above	28 (26.7706)	62 (65.8412)	33 (30.3882)
	Chi-Sq. test	13.439**		

bad-aft

		spread		
		below	equal	above
depth	below	2381 (2181)	1225 (1295.47)	2051 (2180.53)
	equal	257 (321.925)	273 (191.218)	305 (321.857)
	above	2081 (2216.08)	1305 (1316.31)	2362 (2215.61)
	Chi-Sq. test	96.8271**		

good-aft

		spread		
		below	equal	above
depth	below	1672 (1602.25)	681 (733.249)	1480 (1497.5)
	equal	165 (177.656)	85 (81.3021)	175 (166.042)
	above	1574 (1631.09)	795 (746.449)	1533 (1524.46)
	Chi-Sq. test	13.7214**		

Table 17

Conditional volatility regression results for good and bad news halts are reported below. "1e" and "13e" refer to models for both 1 and 13 lags including the event window, respectively. The "b" and "g" indicators refer to bad and good news samples, respectively. "*" and "**" indicate significance at the 5% and 1% levels, respectively. L1SC through L13SC refer to the conditional volatility estimates lagged 1 through 13 times. LUNC1 through LUNC13 are the unconditional volatility estimates, lagged 1 through 13 times. Spread is defined as the difference between the ask and the bid. Depth is defined as the difference between the ask volume and the bid volume. NOTS is the number of trades executed per interval. M, T, Th and F are DOW dummies. DUME is the event interval dummy, and CONST is the estimated intercept.

PANEL A: Good and bad news results for the model including a dummy for the event interval and 13 lags.

Bad news	Mean	Median	T-Value	Good news	Mean	Median	T-Value
L1SC	0.0267	-0.0063	2.4084*	L1SC	0.0403	0.0278	3.4698**
L2SC	-0.0055	-0.0106	-0.5947	L2SC	-0.0019	-0.0049	-0.2098
L3SC	0.0024	0.0008	0.3382	L3SC	-0.0005	0.0009	-0.0619
L4SC	-0.0282	-0.0295	-4.5565**	L4SC	-0.0032	0.0089	-0.3997
L5SC	-0.0119	-0.0169	-1.7250	L5SC	-0.0047	-0.0158	-0.5094
L6SC	-0.0170	-0.0152	-2.6014**	L6SC	-0.0012	-0.0011	-0.1504
L7SC	-0.0162	-0.0171	-3.0010**	L7SC	-0.0118	-0.0169	-1.6131
L8SC	-0.0148	-0.0141	-2.2864*	L8SC	-0.0029	-0.0045	-0.3875
L9SC	-0.0055	-0.0037	-0.8004	L9SC	-0.0104	0.0002	-1.2705
L10SC	-0.0180	-0.0150	-2.7802**	L10SC	-0.0092	-0.0127	-1.0974
L11SC	0.0049	-0.0055	0.7222	L11SC	0.0014	-0.0004	0.1948
L12SC	-0.0077	-0.0106	-1.1227	L12SC	-0.0052	0.0046	-0.6453
L13SC	0.0021	-0.0069	0.3130	L13SC	0.0244	0.0204	3.0400**
LUNC1	-0.0015	-0.0044	-0.1558	LUNC1	-0.0147	-0.0166	-1.2623
LUNC2	0.0040	0.0013	0.3680	LUNC2	-0.0122	-0.0153	-1.4799
LUNC3	-0.0072	-0.0034	-0.7335	LUNC3	-0.0020	0.0046	-0.1483
LUNC4	-0.0046	0.0002	-0.5841	LUNC4	-0.0171	-0.0144	-1.3133
LUNC5	-0.0048	-0.0016	-0.5107	LUNC5	-0.0154	-0.0118	-1.3719
LUNC6	-0.0248	0.0073	-0.8166	LUNC6	-0.0107	-0.0063	-1.0003
LUNC7	-0.0390	-0.0086	-1.1219	LUNC7	-0.0183	-0.0098	-1.7685
LUNC8	0.0258	0.0041	1.4242	LUNC8	-0.0150	0.0029	-1.4358
LUNC9	-0.0150	-0.0111	-1.4025	LUNC9	-0.0035	0.0024	-0.4661
LUNC10	0.0095	0.0015	0.9243	LUNC10	-0.0219	-0.0105	-1.8628
LUNC11	0.0006	-0.0003	0.0636	LUNC11	-0.0004	-0.0059	-0.0446
LUNC12	-0.0205	-0.0040	-1.3312	LUNC12	-0.0074	-0.0182	-0.6412
LUNC13	-0.0184	-0.0042	-1.0296	LUNC13	0.0085	0.0027	0.8568
SPREAD	0.0164	0.0083	2.9326**	SPREAD	0.0304	0.0141	3.2676**
DEPTH	-0.0000	0.0000	-1.2953	DEPTH	0.0000	0.0000	1.0000
NOTS	0.0018	0.0006	6.3163**	NOTS	0.0012	0.0006	6.5086**
M	0.0017	0.0009	4.0801**	M	0.0003	0.0002	0.8118
T	0.0011	0.0003	2.6582**	T	0.0002	0.0002	0.4439
TH	0.0008	0.0003	2.1703*	TH	0.0001	0.0001	0.1041
F	0.0009	0.0006	2.1251*	F	0.0002	0.0003	0.3811
DUME	0.0536	0.0180	4.7012**	DUME	0.0339	0.0176	4.3999**
CONST	0.0012	0.0011	2.1286*	CONST	0.0015	0.0004	2.1244*

PANEL B: Good and bad news results for the model including a dummy for the event interval and 1 lag.

Bad news	Mean	Median	T-Value	Good news	Mean	Median	T-Value
L1SC	0.0324	0.0173	3.3974**	L1SC	0.0369	0.0328	3.4936**
LUNC1	0.0273	0.0279	1.8473	LUNC1	0.0174	0.0244	1.5495
SPREAD	0.0167	0.0090	2.9149**	SPREAD	0.0304	0.0129	2.9047**
DEPTH	0.0000	0.0000	0.4982	DEPTH	0.0000	0.0000	0.0000
NOTS	0.0018	0.0006	6.2143**	NOTS	0.0012	0.0006	6.4542**
M	0.0012	0.0006	3.6728**	M	-0.0000	-0.0001	-0.1447
T	0.0011	0.0003	3.0660**	T	-0.0002	0.0000	-0.5080
TH	0.0007	0.0004	2.1143*	TH	-0.0001	-0.0001	-0.3530
F	0.0009	0.0004	1.7985	F	0.0000	0.0001	0.0213
DUME	0.0533	0.0166	4.6925**	DUME	0.0353	0.0188	4.5780**
CONST	0.0010	0.0003	1.6023	CONST	0.0019	0.0009	2.3048*

Table 18

Cross-sectional mean and median differences of the conditional variances per interval based on closing price and midpoint returns for various time period pairings for the good and bad news halts are reported below. The significance of the paired differences are evaluated using sign tests. The "a" and "b" relative time periods refer to the estimation periods prior to and after the event window [-10, +10], respectively. The pre and post time intervals refer to the five interval periods immediately prior to and following the event interval [0], respectively. The event time interval refers to the first interval immediately following the trading halt. The Below and Above columns refer to the number of observations less than or greater than zero, respectively. "Sign" refers to the p-value associated with the sign test. "*" and "**" indicate significance at the 5% and 1% levels, respectively. Each interval consists of 30 minutes.

Relative Time	Mean	Median	Below	Above	Sign
PANEL A: Closing price results for the good news sample. Means for "a", "pre", "event", "post" and "b" are 0.0079, 0.0122, 0.0680, 0.0156 and 0.0078, respectively.					
[a-b]	0.0001	0.0001	30	37	0.4635
[a-pre]	-0.0032	0.0002	32	36	0.7160
[a-post]	-0.0077	-0.0026	49	19	0.0004**
[b-pre]	-0.0033	-0.0001	35	33	0.9035
[b-post]	-0.0078	-0.0029	52	16	0.0000**
[pre-post]	-0.0044	-0.0023	39	27	0.1757
[pre-event]	-0.0569	-0.0326	61	7	0.0000**
[post-event]	-0.0524	-0.0307	59	9	0.0000**
PANEL B: Closing price results for the bad news sample. Means for "a", "pre", "event", "post" and "b" are 0.0059, 0.0109, 0.0786, 0.0127 and 0.0069, respectively.					
[a-b]	-0.0010	-0.0007	66	36	0.0041**
[a-pre]	-0.0051	0.0002	46	56	0.3729
[a-post]	-0.0068	-0.0029	65	37	0.0075**
[b-pre]	-0.0040	0.0001	50	52	0.9211
[b-post]	-0.0058	-0.0009	60	42	0.0923
[pre-post]	-0.0018	-0.0001	51	43	0.4703
[pre-event]	-0.0677	-0.0277	77	13	0.0000**
[post-event]	-0.0659	-0.0279	77	15	0.0000**
PANEL C: Quote midpoint results for the good news sample. Means for "a", "pre", "event", "post" and "b" are 0.0060, 0.0058, 0.0624, 0.0137 and 0.0062, respectively.					
[a-b]	-0.0002	0.0002	31	37	0.5443
[a-pre]	0.0002	0.0010	22	46	0.0053**
[a-post]	-0.0077	-0.0030	52	16	0.0000**
[b-pre]	0.0004	0.0014	19	49	0.0004**
[b-post]	-0.0075	-0.0035	55	13	0.0000**
[pre-post]	-0.0079	-0.0042	51	15	0.0000**
[pre-event]	-0.0566	-0.0306	61	4	0.0000**
[post-event]	-0.0486	-0.0225	52	15	0.0000**
PANEL D: Quote midpoint results for the good news sample. Means for "a", "pre", "event", "post" and "b" are 0.0047, 0.0069, 0.0957, 0.0124 and 0.0053, respectively.					
[a-b]	-0.0006	-0.0003	62	40	0.0376*
[a-pre]	-0.0022	0.0010	35	67	0.0021**
[a-post]	-0.0077	-0.0030	74	28	0.0000**
[b-pre]	-0.0016	0.0009	36	66	0.0041**
[b-post]	-0.0071	-0.0019	70	31	0.0002**
[pre-post]	-0.0055	-0.0030	70	23	0.0000**
[pre-event]	-0.0889	-0.0480	86	9	0.0000**
[post-event]	-0.0833	-0.0412	85	13	0.0000**

Table 19

The autocorrelations (ρ), based on close-to-close returns and midpoint-to-midpoint returns for the good and bad news samples are reported herein. "*" indicates statistical significance at the 5% level. Q refers to the Ljung-Box-Pierce χ^2 statistic.

LAG	close-to-close (bad news)				close-to-close (good news)			
	pre-halt		post-halt		pre-halt		post-halt	
	ρ	Q	ρ	Q	ρ	Q	ρ	Q
1	0.11	1.72	-0.18	4.47*	-0.06	0.46	-0.18	4.46*
2	0.06	2.18	-0.08	5.27	-0.06	0.90	0.05	4.77
3	0.15	5.33	0.03	5.39	-0.13	3.03	-0.01	4.77
4	0.06	5.74	0.00	5.39	0.00	3.03	0.09	5.99
5	0.04	5.95	-0.01	5.40	0.02	3.07	0.04	6.16
6	0.09	6.95	0.15	8.55	-0.02	3.15	0.06	6.68
7	-0.07	7.73	-0.09	9.67	-0.01	3.15	0.10	8.18
8	0.01	7.76	0.04	9.91	0.10	4.42	-0.06	8.69
9	0.15	11.05	0.00	9.91	0.01	4.42	0.10	10.07
10	-0.03	11.16	-0.07	10.56	0.07	5.04	-0.12	12.19
11	0.08	12.18	0.01	10.57	0.05	5.37	0.06	12.67
12	-0.01	12.19	0.13	12.85	-0.05	5.8	-0.03	12.81
13	0.10	13.05	0.10	14.78	0.09	7.55	0.10	13.64

LAG	midpoint-to-midpoint (bad news)				midpoint-to-midpoint (good news)			
	pre-halt		post-halt		pre-halt		post-halt	
	ρ	Q	ρ	Q	ρ	Q	ρ	Q
1	0.34	15.61*	0.16	3.21	0.24	7.37*	-0.05	0.31
2	0.15	18.45*	0.04	3.42	0.04	7.56*	0.10	1.74
3	0.13	20.76*	0.05	3.73	0.10	8.83*	-0.08	2.68
4	0.03	20.91*	0.14	6.54	0.16	12.39*	-0.02	2.72
5	0.04	21.10*	0.18	11.13*	0.13	14.81*	0.09	3.74
6	0.04	21.35*	0.05	11.47	0.19	19.64*	0.18	7.96
7	-0.01	21.36*	-0.13	13.78	0.01	19.66*	-0.05	8.32
8	0.00	21.36*	0.03	13.88	0.02	19.75*	0.18	13.02
9	0.01	21.38*	-0.03	14.02	-0.01	19.75*	0.02	13.09
10	0.02	21.42*	0.09	15.27	0.01	19.76*	-0.06	13.53
11	0.05	21.82*	0.07	15.94	0.04	19.94*	-0.01	13.54
12	0.05	22.24*	-0.11	17.54	0.00	19.95	-0.05	13.85
13	0.10	22.24	0.10	17.67	0.10	19.95	0.10	14.28

Table 20

Initial and final sample sizes of trading halts for the good and bad news halts based on the tick test of Lee and Ready (1991), and the number of halts deleted by each screen are presented in Panel A. Trading halts are deleted if they did not trade at least once per day during each of the five days prior to the halt (screen 1), if they are for a preferred share, warrant or unit (screen 2), if its trading price was less than $1 (screen 3), if its event window encompassed the Ontario civic holiday in August (screen 4), and if a transaction did not occur in at least 70% of the intervals (screen 5). Summary statistics for the length (in minutes), day-of-the-week, time-of-the-day and price at halt are presented in Panels B, C and D, respectively.

PANEL A: The initial and final sample sizes for the number of good and bad news halts, and the number of halts deleted by each screen for each sample are presented herein.

Total	Screen1	Screen 2	Screen 3	Screen 4	Screen 5	Good	Bad
649	45	401	22	11	73	44	53

PANEL B: Summary statistics for the halt lengths in minutes for the final good and bad news samples are presented herein.

Sample	Mean	Median	Minimum	Maximum	σ
Good	228.58	150	15	1590	283.78
Bad	179.21	130	30	960	172.32

PANEL C: Summary statistics on the day-of-the-week and price at halt are presented herein.

	Day-of-the-week					Price at halt		
Sample	M	T	W	Th	F	$1.00-$1.99	$2.00-$4.95	>$4.95
Good	5	10	13	7	9	2	9	33
Bad	10	11	18	8	6	4	7	42

PANEL D: Summary statistics on the time-of-the-day of the halts are presented herein.

Time-of-day	Good	Bad
9:30	25	26
9:31-10:30	3	5
10:31-11:30	4	5
11:31-12:30	6	6
12:31-1:30	1	4
1:31-2:30	4	3
2:31-3:30	1	3
3:30-3:59	0	1
4:00	0	0

Table 21

Cross-sectional mean and median differences of the relative spreads and total depths per interval for various time period pairings for the good and bad news halts are reported below. The significance of the paired differences are evaluated using t- and sign tests. The "a" and "b" relative time periods refer to the estimation periods prior to and after the event window [-26, +26], respectively. The "pre" and "post" relative time periods refer to the 26 interval estimation periods prior to and after the event interval [0], respectively. The Below and Above columns refer to the number of observations less than or greater than zero, respectively. "Sign" refers to the Probability Value associated with the sign test. "*" and "**" indicate significance at the 5% and 1% levels, respectively. Each interval consists of 30 minutes.

Relative Time	Mean	Median	T-Value	Below	Above	Sign
PANEL A: Relative spread results for the good news sample based on quotes prior to the transaction. Means for "a", "pre", "event", "post" and "b" are .0174, .0155, .0181, .0170 and .0146, respectively.						
[a-b]	0.00276	0.00077	2.1300*	17	27	0.1748
[a-pre]	0.00188	0.00112	1.2418	15	29	0.0500*
[a-post]	0.00032	0.00099	0.1190	14	30	0.0237*
[b-pre]	-0.00088	0.00050	-0.8117	19	25	0.4510
[b-post]	-0.00244	0.00032	-0.9461	19	25	0.4510
[pre-post]	-0.00156	0.00053	-0.5434	18	26	0.2913
[pre-event]	-0.00264	0.00017	-1.0705	19	25	0.4510
[post-event]	-0.00108	-0.00002	-0.7356	23	16	0.3367
PANEL B: Relative spread results for the bad news sample based on quotes prior to the transaction. Means for "a", "pre", "event", "post" and "b" are .0139, .0130, .0154, .0127 and .0123, respectively.						
[a-b]	0.00157	0.00052	1.9736*	20	33	0.0993
[a-pre]	0.00088	0.00107	1.0598	21	32	0.1696
[a-post]	0.00120	0.00042	1.3887	19	34	0.0545
[b-pre]	-0.00069	-0.00017	-1.0060	27	26	1.0000
[b-post]	-0.00038	0.00000	-0.7315	26	26	1.0000
[pre-post]	0.00032	0.00003	0.3720	25	27	0.8897
[pre-event]	-0.00235	0.00000	-1.2899	26	26	1.0000
[post-event]	-0.00267	0.00000	-1.7373	23	24	1.0000
PANEL C: Total depth results for the good news sample based on quotes prior to the transaction. Means for "a", "pre", "event", "post" and "b" are 130.864, 190.432, 186.159, 222.341, and 227.773, respectively.						
[a-b]	-96.909	-54.00	-3.6537**	33	11	0.0015**
[a-pre]	-59.568	2.00	-1.6028	19	25	0.4510
[a-post]	-91.477	-5.50	-1.9155	25	18	0.3602
[b-pre]	37.341	51.50	0.8583	11	32	0.0023**
[b-post]	5.432	9.50	0.1702	17	27	0.1748
[pre-post]	-31.909	-16.00	-0.6254	25	19	0.4510
[pre-event]	4.273	-24.50	0.0727	26	18	0.2913
[post-event]	36.182	20.00	1.0186	16	28	0.0973
PANEL D: Total depth results for the bad news sample based on quotes prior to the transaction. Means for "a", "pre", "event", "post" and "b" are 158.415, 138.925, 234.528, 266.491, and 248.679, respectively.						
[a-b]	-90.264	-38.00	-3.1966**	33	20	0.0993
[a-pre]	19.491	10.00	0.8248	21	31	0.2120
[a-post]	-108.075	-29.00	-2.8483**	34	19	0.0545
[b-pre]	109.755	46.00	3.3377**	13	40	0.0004**
[b-post]	-17.811	-3.00	-0.4978	28	24	0.6774
[pre-post]	-127.566	-72.00	-2.6390**	39	14	0.0010**
[pre-event]	-95.604	-31.00	-1.7531	32	21	0.1696
[post-event]	31.962	20.00	1.0669	20	32	0.1272

Table 21 cont'd...

Relative Time	Mean	Median	T-Value	Below	Above	Sign
PANEL E: Relative spread results for the good news sample based on quotes after the transaction. Means for "a", "pre", "event", "post" and "b" are .0205, .0196, .0191, .0174, and .0155, respectively.						
[a-b]	0.00499	0.00110	1.2929	13	31	0.0104*
[a-pre]	0.00088	-0.00023	0.2177	22	22	1.0000
[a-post]	0.00312	0.00084	0.7318	18	26	0.2913
[b-pre]	-0.00412	-0.00053	-2.5196*	26	18	0.2913
[b-post]	-0.00188	0.00011	-1.1164	21	23	0.8802
[pre-post]	0.00224	0.00111	1.5166	16	28	0.0973
[pre-event]	0.00046	0.00102	0.1945	15	27	0.0896
[post-event]	-0.00178	0.00000	-0.8892	21	20	1.0000
PANEL F: Relative spread results for the bad news sample based on quotes after the transaction. Means for "a", "pre", "event", "post" and "b" are .0171, .0182, .0201, .0141, and .0136, respectively.						
[a-b]	0.00354	0.00035	1.0424	20	33	0.0993
[a-pre]	-0.00107	-0.00054	-0.2787	29	24	0.5827
[a-post]	0.00304	0.00044	1.0771	21	32	0.1696
[b-pre]	-0.00460	-0.00179	-2.0557*	35	18	0.0280*
[b-post]	-0.00049	0.00006	-0.4433	25	28	0.7835
[pre-post]	0.00411	0.00108	1.7353	22	30	0.3317
[pre-event]	-0.00186	0.00117	-0.5214	21	29	0.3222
[post-event]	-0.00597	0.00000	-1.1665	21	25	0.6583
PANEL G: Total depth results for the good news sample based on quotes after the transaction. Means for "a", "pre", "event", "post" and "b" are 126.182, 154.795, 195.591, 214.432, and 215.5, respectively.						
[a-b]	-89.318	-54.50	-3.4441**	32	12	0.0042**
[a-pre]	-28.614	-0.50	-0.9299	22	21	1.0000
[a-post]	-88.250	-3.00	-1.7359	23	21	0.8802
[b-pre]	60.705	37.00	1.5675	10	34	0.0005**
[b-post]	1.068	16.00	0.0296	15	28	0.0673
[pre-post]	-59.636	-18.50	-1.1876	28	16	0.0973
[pre-event]	-40.795	-33.50	-0.8759	30	14	0.0237*
[post-event]	18.841	-6.00	0.5391	24	20	0.6511
PANEL H: Total depth results for the bad news sample based on quotes after the transaction. Means for "a", "pre", "event", "post" and "b" are 150.811, 124.83, 215.17, 269.811, and 236.962, respectively.						
[a-b]	-86.151	-22.00	-3.1209**	35	18	0.0280*
[a-pre]	25.981	18.00	1.3076	19	34	0.0545
[a-post]	-119.000	-34.00	-3.1736**	38	15	0.0025**
[b-pre]	112.132	50.00	3.5049**	11	42	0.0000**
[b-post]	-32.849	-7.00	-0.9140	31	21	0.2120
[pre-post]	-144.981	-67.00	-3.1439**	44	9	0.0000**
[pre-event]	-90.340	-20.00	-1.9010	34	19	0.0545
[post-event]	54.642	39.00	2.2814*	16	35	0.0117*

Table 22

Cross-sectional results for the coefficient estimates from equations (1) and (2) are presented below. The coefficients are used to calculate the adverse selection, inventory holding, and order processing cost components reported in Panel B. The coefficient "avg. b1" is the average of the bid and ask coefficient estimates from Panel A.

Panel A:

	coefficient	t-stat
before		
b1-bid	0.008046	2.0760*
b0-bid	-0.000095	-3.6447**
b1-ask	-0.019099	-6.0330**
b0-ask	-0.000026	-1.2250
a1	-0.009254	-23.4792**
a0	-0.000015	-5.6299**
pre		
b1-bid	-0.051851	-1.2660
b0-bid	0.000000	0.0197
b1-ask	0.048472	1.3988
b0-ask	0.000010	0.5392
a1	-0.008889	-0.4092
a0	-0.000002	-0.1461

post-bad	coefficient	t-stat	**post-good**	coefficient	t-stat
b1-bid	-0.085052	-1.3531		-0.062618	-0.4913
b0-bid	0.000003	0.1744		-0.000078	-1.1727
b1-ask	-0.049092	-1.4019		-0.049228	-0.9848
b0-ask	-0.000004	-0.4054		-0.000032	-1.2236
a1	-0.004735	-0.0738		-0.064705	-0.9094
a0	-0.000018	-0.9319		-0.000039	-1.0612

after-bad	coefficient	t-stat	**after-good**	coefficient	t-stat
b1-bid	-0.056828	-2.9212**		-0.028604	-1.5814
b0-bid	-0.000003	-0.2464		0.000000	0.0269
b1-ask	-0.007154	-1.1934		0.001721	0.1224
b0-ask	-0.000002	-0.5306		-0.000007	-1.0054
a1	-0.002638	-0.3662		-0.017931	-0.5819
a0	-0.000016	-4.3087**		-0.000021	-1.4501

Panel B:

	a1	avg. b1	pi	delta	asc	ihc	opc
before	-9.25E-03	-0.00553	0.504219	0.49267	0.976901	0.008438	0.014661
pre	-8.89E-03	-0.00169	0.504427	0.485853	0.962852	0.008854	0.028295
post-bad	-4.74E-03	-0.06707	0.532929	0.609743	1.153628	0.065858	-0.21949
after-bad	-2.64E-03	-0.03199	0.51576	0.555173	1.078825	0.031521	-0.11035
post-good	-6.47E-02	-0.05592	0.504614	0.482756	0.956283	0.009228	0.034489
after-good	-1.79E-02	-0.01344	0.536985	0.492215	0.910462	0.073969	0.015569

Table 23

Bootstrapped results from the component estimation procedure are reported below. ASC, IHC and OPC refer to the estimated component costs of adverse selection, inventory holding, and order processing, respectively. Before, pre, post and after refer to the estimation periods from days -10 to -3, -2 and -1, +1 and +2, and +3 to +10, respectively. Panel A presents results based on the cross-sectional component means, and Panel B presents results based on select paired differences. "*" and "**" indicate significance at the 5% and 1% levels, respectively. The Before and Pre periods are estimated for the entire sample, and the Post and After periods are by news release. In Panel B, (G) refers to the good news sample, (B) refers to the bad news sample. All results are based on cross-sectional regressions of the serial covariances of each return measure, and then averaged across the 10,000 resulting estimates.

Panel A:

	mean	min	max	std. err.
before				
$\hat{c}$	0.4928	0.4831	0.5315	0.0047**
π	0.5113	0.5014	0.5501	0.0046**
ASC	0.9630	0.9559	0.9685	0.0016**
IHC	0.0225	0.0027	0.1003	0.0092*
OPC	0.0145	-0.0629	0.0338	0.0094
pre				
$\hat{c}$	0.4239	0.2452	0.8950	0.1133**
π	0.4188	0.1485	0.9948	0.1263**
ASC	1.0102	0.4997	1.6074	0.1180**
IHC	-0.1623	-0.7029	0.9896	0.2526
OPC	0.1521	-0.7899	0.5095	0.2266
post-bad				
$\hat{c}$	0.5946	0.0655	1.1666	0.1096**
π	0.5963	0.3138	0.8336	0.0558**
ASC	0.9966	-0.0059	2.2910	0.2627**
IHC	0.1927	-0.3724	0.6671	0.1116
OPC	-0.1892	-1.3333	0.8689	0.2193
after-bad				
$\hat{c}$	1.0021	-0.2345	2.0753	0.3872**
π	0.5529	0.3960	1.8924	0.1653**
ASC	1.8983	-2.9648	4.1447	1.0158
IHC	0.1058	-0.2080	2.7848	0.3306
OPC	-1.0041	-3.1506	1.4690	0.7743
post-good				
$\hat{c}$	0.4730	0.0118	1.0102	0.1267**
π	0.5977	0.2489	1.2908	0.1087**
ASC	0.7506	-0.6557	1.8596	0.2502**
IHC	0.1955	-0.5021	1.5816	0.2174
OPC	0.0539	-1.0204	0.9763	0.2534
after-good				
$\hat{c}$	0.4901	0.1498	0.6840	0.0587**
π	0.5266	0.3558	0.6489	0.0249**
ASC	0.9269	0.3109	1.3203	0.1191**
IHC	0.0532	-0.2884	0.2978	0.0498
OPC	0.0199	-0.3679	0.7004	0.1173

Table 23, cont'd...

Panel B:

	mean	median	min	max	t-value
ASC					
bef-aft-(g)	0.0361	0.0235	-0.3594	0.6537	30.3094**
bef-aft-(b)	-0.9353	-0.8650	-3.1806	3.9265	-92.0847**
bef-pre	-0.0472	-0.0319	-0.6431	0.4651	-39.9833**
pre-pst-(g)	0.2596	0.2292	-0.9217	1.6170	93.7871**
pre-pst-(b)	0.0136	0.0091	-1.2709	1.2797	4.7212**
pst-aft-(g)	-0.1763	-0.1571	-1.5501	0.8418	-63.5284**
pst-aft-(b)	-0.9018	-0.9434	-3.5281	4.1196	-86.1453**
IHC					
bef-aft-(g)	-0.0307	-0.0320	-0.2804	0.3060	-60.5819**
bef-aft-(b)	-0.0833	-0.0082	-2.7655	0.2297	-25.1697**
bef-pre	0.1848	0.2807	-0.9739	0.7197	73.1024**
pre-pst-(g)	-0.3578	-0.3969	-1.7856	0.9576	-107.3748**
pre-pst-(b)	-0.3550	-0.4116	-1.0953	0.8860	-128.3298**
pst-aft-(g)	0.1423	0.1375	-0.5486	1.5329	63.7293**
pst-aft-(b)	0.0869	0.1450	-2.6007	0.6452	24.9157**
OPC					
bef-aft-(g)	-0.0054	0.0083	-0.6995	0.3856	-4.5846**
bef-aft-(b)	1.0186	0.8805	-1.4540	3.1663	131.5567**
bef-pre	-0.1377	-0.2174	-0.4884	0.8114	-60.6736**
pre-pst-(g)	0.0982	0.1440	-1.3192	1.3855	28.8180**
pre-pst-(b)	0.3413	0.3713	-0.8874	1.6566	108.4168**
pst-aft-(g)	0.0341	0.0173	-1.0505	1.0780	12.2217**
pst-aft-(b)	0.8149	0.7710	-2.0071	3.5192	101.4844**

Table 24

The George et al. (1991) zero-inventory model cross-sectional results, where the pre- and post-halt periods contain 26 intervals each, are reported in Panel A, and 13 intervals each in Panel B. β corresponds to the transitory or order processing component, and (1-β) corresponds to the adverse selection component. The before and Pre periods are estimated for the entire sample, and the Post and After periods are estimated according to the disclosed news. "*" and "**" refer to significance at the 5% and 1% levels, respectively.

Panel A: 26 intervals

	α	t-stat	β	t-stat
before	0.0118	7.0090**	0.2549	5.3920**
pre	0.0037	0.9139	0.6931	3.1270**
post-bad	-0.0009	-0.3556	0.9799	5.4390**
after-bad	0.0107	1.1580	0.3873	0.6936
post-good	0.0035	0.7432	0.8089	3.0970**
after-good	0.0030	1.3440	0.6333	5.0650**

Panel B: 13 intervals

	α	t-stat	β	t-stat
before	.01075	7.126**	.28366	6.220**
pre	.00641	1.224	.56797	2.115*
post-bad	-.00352	-.9378	1.1548	4.706**
after-bad	.01043	1.172	.39050	.7105
post-good	.00294	.4571	.97369	2.877**
after-good	.002855	1.334	.64692	5.383**

Table 25

The Masson model results based on tick data using the pre- and post-halt periods of 13 intervals of 30 minutes each are reported below. Lambda is the transitory component (relative spread), adv. sel. is the adverse selection component, and spread refers to the actual spread. All numbers (unless %) are in dollars. Panel A uses a dollar-weighted midpoint spread, weighted by the bid and ask volume, Panel B uses the quote midpoint. Mean numbers are the cross-sectional mean values obtained from the time series regressions.

Panel A:		Mean-Pooled	% spread		
before	Transitory	0.132438	86.84%		
	Adv. Sel.	0.020073	13.16%		
	spread	0.15251			
pre	Transitory	0.125896	89.14%		
	Adv. Sel.	0.015344	10.86%		
	spread	0.14124			
		Mean-Good	% spread	Mean-Bad	% spread
post	Transitory	0.133114	93.88%	0.132865	87.30%
	Adv. Sel.	0.008682	6.12%	0.019327	12.70%
	spread	0.141795		0.152192	
after	Transitory	0.150568	106.37%	0.121615	87.60%
	Adv. Sel.	-0.00902	-6.37%	0.017212	12.40%
	spread	0.141545		0.138827	

Panel B:		Mean-Pooled	% spread		
before	Transitory	0.11596	76.03%		
	Adv. Sel.	0.03655	23.97%		
	spread	0.15251			
pre	Transitory	0.10691	75.69%		
	Adv. Sel.	0.03433	24.31%		
	spread	0.14124			
		Mean-Good	% spread	Mean-Bad	% spread
post	Transitory	0.11150	78.63%	0.12042	79.13%
	Adv. Sel.	0.03030	21.37%	0.03177	20.87%
	spread	0.14180		0.15219	
after	Transitory	0.13566	95.84%	0.10698	77.06%
	Adv. Sel.	0.00589	4.16%	0.03185	22.94%
	spread	0.14155		0.13883	

Table 26

Transaction/quote revision results based on equations (14) and (15) are presented in Panels A and B, respectively. Panel A reports results from the transaction revision model using quote data immediately before the last transaction per interval. Panel B reports results from the quote revision model using the quote return immediately following the last transaction in the interval as the dependant variable. The t-values<0 and >0 are based on the number of **significant** (5%) coefficients per variable by firm.

Panel A:

bad news	mean	median	min	max	std. err.	t-value<0	t-value>0
rqbef	0.62571	0.73050	-0.00003	0.97125	0.29932	0	45
rtse	0.10954	0.06980	-1.10075	1.11562	0.35651	1	5
zbpre	0.69437	0.76436	0.00060	1.17154	0.30230	0	49
zbpst	0.82180	0.84868	0.36470	1.13435	0.18802	0	51
spbpre	0.03696	0.03340	-0.20998	0.31387	0.11249	3	5
spbpst	0.05701	0.03758	-0.61268	0.85703	0.25171	3	9
dpbpre	0.00000	0.00000	-0.00006	0.00014	0.00002	2	3
dpbpst	0.00000	0.00000	-0.00002	0.00005	0.00001	3	2
qvol	0.00000	0.00000	0.00000	0.00000	0.00000	10	3
med	0.00014	0.00053	-0.04570	0.01778	0.00746	0	4
m	0.00011	-0.00008	-0.00357	0.00804	0.00162	0	2
t	-0.00028	-0.00033	-0.00986	0.00485	0.00213	1	4
th	0.00015	0.00001	-0.00317	0.00753	0.00164	4	0
f	-0.00002	-0.00030	-0.00461	0.01152	0.00222	4	1
event	0.00874	-0.00364	-0.18973	0.32105	0.07687	16	15
open/over	0.00018	0.00011	-0.00468	0.00457	0.00181	2	2
constant	0.00031	0.00011	-0.01113	0.02409	0.00421	3	6

good news	mean	median	min	max	std. err.	t-neg	t-pos
rqbef	0.61636	0.74358	-0.00041	0.95090	0.32362	0	37
rtse	0.10241	0.09006	-0.97767	1.59342	0.38804	1	2
zbpre	0.62505	0.69192	-0.01236	1.05363	0.33102	0	38
zbpst	0.77865	0.86580	0.01703	1.10498	0.24235	0	43
spbpre	0.02087	0.00992	-0.30218	0.36306	0.13860	3	3
spbpst	-0.03281	-0.00414	-1.06692	0.31195	0.23094	5	1
dpbpre	0.00000	0.00000	-0.00013	0.00006	0.00002	1	1
dpbpst	0.00000	0.00000	-0.00010	0.00003	0.00002	4	1
qvol	0.00000	0.00000	0.00000	0.00000	0.00000	7	0
med	-0.00128	-0.00029	-0.03171	0.01405	0.00664	1	1
m	0.00012	0.00025	-0.00876	0.00563	0.00232	3	4
t	-0.00033	-0.00014	-0.01320	0.00448	0.00285	1	2
th	-0.00017	-0.00018	-0.00819	0.00534	0.00241	1	3
f	0.00017	-0.00007	-0.00631	0.00840	0.00254	3	1
event	0.01087	0.00634	-0.14782	0.19006	0.05146	10	15
open/over	0.00096	0.00008	-0.00323	0.00966	0.00318	4	6
constant	0.00155	0.00014	-0.00668	0.02629	0.00588	2	4

Table 26 cont'd...

Panel B:

bad news	mean	median	min	max	std. err.	t-neg	t-pos
rqbef	0.71203	0.72979	0.04991	1.01232	0.21109	0	51
rtse	0.23989	0.11472	-0.78975	3.37860	0.57138	0	11
zbpre	0.15926	0.11764	-0.47678	0.97615	0.21896	1	24
zbpst	0.17054	0.12500	-0.03269	0.73133	0.17039	0	22
spbpre	-0.05348	-0.05550	-0.61258	0.35123	0.18162	11	2
spbpst	-0.05332	-0.02575	-0.40770	0.33667	0.15275	9	2
dpbpre	0.00001	0.00000	-0.00004	0.00011	0.00002	0	6
dpbpst	0.00000	0.00000	-0.00002	0.00003	0.00001	0	1
qvol	0.00000	0.00000	0.00000	0.00000	0.00000	3	1
med	-0.00033	0.00056	-0.03888	0.00833	0.00645	2	2
m	-0.00007	0.00013	-0.01489	0.00275	0.00227	0	0
t	-0.00007	0.00018	-0.00581	0.00285	0.00155	0	0
th	0.00002	0.00012	-0.00363	0.00385	0.00121	0	1
f	0.00031	0.00013	-0.00183	0.00430	0.00112	0	1
event	-0.01096	-0.00419	-0.31736	0.11010	0.06268	19	15
open/over	0.00036	-0.00030	-0.01220	0.02287	0.00479	8	6
constant	0.00080	0.00023	-0.00580	0.02543	0.00430	2	5

good news	mean	median	min	max	std. err.	t-neg	t-pos
rqbef	0.75483	0.78521	0.09301	1.01330	0.20762	0	43
rtse	0.20809	0.10003	-0.70135	3.30256	0.60237	0	6
zbpre	0.12316	0.11043	-0.35201	0.60666	0.15555	1	19
zbpst	0.13803	0.10761	-0.37843	0.73980	0.18130	1	13
spbpre	-0.02473	-0.02558	-0.43654	0.22593	0.11578	3	2
spbpst	-0.01070	-0.02229	-0.33510	0.34092	0.13346	4	2
dpbpre	0.00000	0.00000	-0.00011	0.00004	0.00002	0	3
dpbpst	0.00000	0.00000	-0.00003	0.00004	0.00001	0	0
qvol	0.00000	0.00000	0.00000	0.00000	0.00000	1	0
med	0.00058	0.00022	-0.01645	0.01842	0.00525	0	3
m	-0.00022	0.00002	-0.01229	0.00314	0.00228	0	0
t	0.00008	0.00016	-0.00440	0.00314	0.00146	0	0
th	0.00004	-0.00013	-0.00320	0.00499	0.00143	0	0
f	0.00010	0.00000	-0.00270	0.00280	0.00102	1	0
event	0.00112	0.00003	-0.14663	0.12045	0.04529	16	14
open/over	0.00013	-0.00029	-0.00680	0.01266	0.00382	5	4
constant	0.00075	0.00016	-0.00467	0.01842	0.00360	1	1