Nasdaq Trading Halts:
The Impact of Market Mechanisms on Prices, Trading Activity, and Execution Costs

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ABSTRACT

We study the effects of alternative halt and reopening procedures on prices, transaction costs, and trading activity for a sample of news-related trading halts on Nasdaq. For intraday halts that reopen after only a five-minute quotation period, inside quoted spreads more than double following halts and volatility increases to more than nine times normal levels. In contrast, halts that reopen the following day with a longer 90-minute quotation period are associated with insignificant spread effects and significantly dampened volatility effects. These results are consistent with the hypothesis that increased information transmission during the halt results in reduced posthalt uncertainty.

THE USE OF INDIVIDUAL-SECURITY trading halts is common on both U.S. and international stock exchanges. However, the costs and benefits of trading halts are widely debated. Proponents argue that halts allow investors time to react to material news events and allow market makers to search for a new price level. Detractors argue that halts are an unnecessary barrier to trading and point to empirical studies that find unusually high levels of volatility following halts. One critical factor in this debate is how market

structure and specific halt mechanisms relate to trading halt effects. To address this issue, we study a sample of news-related trading halts on Nasdaq to examine the effects of alternative halt mechanisms on prices, trading activity, and transaction costs.

The fragmentation of order flow across multiple market makers on Nasdaq presents unique challenges for handling trading halts. Unlike specialist markets such as the NYSE, Nasdaq does not use a series of central indicator quotes to convey information and attract order flow throughout the halt. Instead, price discovery for Nasdaq halts that reopen during normal trading hours consists of a five-minute quotation period prior to the resumption of trading. This quotation period allows dealers to signal their information to other market makers through nonbinding quotes. Continuous trading then resumes at the end of the five-minute quotation period and does not involve the use of a centralized auction. As a result, Nasdaq halt and reopening mechanisms differ substantially from those used on other previously studied markets.

Nasdaq also provides a natural setting to examine the relation between halt effects and information dissemination during the halt. If a Nasdaq halt is lifted after 4:00 p.m., trading reopens the following morning with a 90-minute rather than a 5-minute quotation period.[1] Thus, the Nasdaq sample includes examples of two alternative reopening mechanisms within the same market. This difference in reopening procedures allows us to directly test whether the extent of information dissemination during the halt affects posthalt market conditions. This information is relevant to Nasdaq and other markets as they consider the use of alternative halt and opening procedures.

We study a sample of 714 news-related halts on Nasdaq between September 1997 and December 1998. We distinguish between trading halts initiated prior to the open (delayed openings) versus during the trading day (intraday halts) and between halts reopened with a 5-minute versus a 90-minute quotation period. In general, we find that both share volume and the number of trades are over six times normal levels during the 30 minutes after the halt and remain unusually high for up to two hours. These results are consistent with previous studies from other markets and suggest that the response of investors to trading halts is similar across markets.

Our results also indicate that the uncertainty associated with Nasdaq trading halts is not resolved by the time the halt is lifted. The median inside spread more than doubles when trading resumes and the posthalt period is characterized by unusually high volatility. However, we find that these results stem primarily from halts reopened with a five-minute quotation period. For halts that reopen the following morning with a longer quotation period, inside spreads are no wider than on nonhalt days and volatility increases are significantly dampened. These results suggest that the longer period of quote-based price discovery, combined with the opportunity to trade

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[1] See Cao, Ghysels, and Hatheway (2000) for an analysis of the morning opening process on Nasdaq.

on other venues prior to the open, significantly reduces uncertainty following Nasdaq halts.

Interestingly, we find that the inside ask (bid) moves immediately to its new level following positive (negative) price change halts, while the opposite-side quote drifts to its new level over a period of 10 to 15 minutes. This asymmetric response of the spread to the trading halt is inconsistent with standard adverse selection and inventory explanations of the evolution of inside spreads since market makers immediately update only the side of the spread at which they are most likely to face better-informed traders. The period immediately following Nasdaq halts is also characterized by a large number of unusually small trades. This trading pattern is consistent with that found by Chan, Christie, and Schultz (1995) at the morning open on Nasdaq and suggests that investors are reluctant to commit to large trades during the period of high price uncertainty following halts.

This work makes several contributions to previous research on the costs and benefits of trading halts. Greenwald and Stein (1988, 1991), for example, argue that trading halts can be beneficial if they are used to transmit information during times of unusually high transaction-price uncertainty. As evidence of this information transmission, Schwartz (1982) finds that indicator quotes during NYSE trading halts converge toward the reopening price and Corwin and Lipson (2000) find that traders actively reposition their limit orders during NYSE halts. Consistent with the arguments in Greenwald and Stein, we find that halt mechanisms that allow for increased information dissemination during the halt appear to reduce uncertainty relative to halt mechanisms with little information transmission.

Grossman (1990) takes the opposing view, criticizing trading halts as an unnecessary impediment to trading. Adding to this critical view of trading halts, Lee, Ready, and Seguin (1994) find that both volume and volatility are unusually high following NYSE halts. They interpret this as inconsistent with the reduction in uncertainty that trading halts are intended to achieve. Consistent with this prior work, we find that even with information transmission during the halt, posthalt volume and volatility are unusually high following Nasdaq halts. This finding suggests that either trading halts result in increased uncertainty or trading halts are called in response to high expected volatility. This latter explanation is consistent with Spiegel and Subrahmanyam (2000), who find that liquidity during normal market conditions can be improved if disclosure rules require firms to report high variance events to the exchange.

The rest of the paper is organized as follows. In Section I, we provide an overview of Nasdaq procedures for initiating and resolving trading halts. Section II describes our sample of Nasdaq halts and provides descriptive statistics. Section III contains our empirical analysis of bid-ask spreads, volume, and volatility. In Section IV, we present results separated by the length of the reopening quotation period. In Section V, we test the robustness of our results using a matched sample of halt and nonhalt days. Section VI presents our conclusions.

I. Procedures for Halting Trading on Nasdaq

An integral part of the oversight role of NASD Regulation, Inc. (NASDR) is to ensure that investors are not disadvantaged when news is released that could materially affect the value of stocks traded in the Nasdaq market. To fulfill this responsibility, Nasdaq's StockWatch Department can authorize individual-security trading halts.[2] There are typically two paths through which a trading halt can be initiated on Nasdaq.[3] The first is associated with pending news announcements. Traditionally, companies are required to supply StockWatch with a press release no less than 15 minutes prior to the public disclosure of information. Analysts at NASDR then evaluate the information and determine whether the news will materially affect the stock price. If a halt is deemed necessary, StockWatch notifies the news wires and all markets where the Nasdaq issue or its derivative securities are traded. News events that require advanced disclosure to the NASD include corporate control announcements, unusual earnings or dividends, the acquisition or loss of a material contract, new products or discoveries, and adverse R&D test results, among others.

Trading halts can also result from the surveillance actions of StockWatch. StockWatch, in real time, monitors various activity components (volume, price volatility, etc.) and flags issues whose trading activity falls outside a predetermined range. When unusual activity is identified, the stock is assigned to an analyst who contacts the issuing firm and the market makers to determine the source of the abnormal activity. StockWatch, pending notification of the issuing firm, can then halt trading to allow dissemination of the information and to maintain an orderly market.

In March of 1999, the NASD passed a rule change permitting Nasdaq to halt trading without notifying the issuing firm (NASD (1999)). The motivation for this rule change was twofold. First, material news could be released by a source other than the issuer or could reflect rumor rather than fact. Second, the notification process could be time consuming and continued trading might impair the ability of market makers to ensure an orderly and fair trading environment. This rule change allows Nasdaq the flexibility to halt trading if they believe that the public needs additional time to assess the impact of new information (or misinformation) on stock value. However, during our entire sample period, NASD rules required that the issuing company be notified prior to the implementation of a trading halt.

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[2] Howe and Schlarbaum (1986) and Ferris, Kumar, and Wolfe (1992) study SEC-mandated trading suspensions, which are imposed when questions of investor protection arise (e.g., adequacy of financial statements, possible manipulation, etc.). Nasdaq also halts trading in response to market-wide circuit breakers. See Goldstein and Kavajecz (2000) for an analysis of the market-wide circuit breaker on October 27, 1997.

[3] Details on Nasdaq's trading halt procedures are obtained from the online NASD manual (see www.nasdaqnews.com/about/rules/4120.html and www.nasdaqnews.com/about/rules/IM4120-1.html).

The reopening process is initiated after sufficient time has elapsed for information to be widely disseminated and broadcast to investors through various news sources. Nasdaq trading screens are then updated by displaying two times. The first signals the time that market makers can resume entering quotes. The second, which is generally five minutes later, signifies the time that market makers and other investors can resume trading. The preresumption quotation period allows market makers to engage in price discovery and communication through nonbinding quotes. Continuous trading is resumed after this quotation period and does not involve the use of a call auction. For the subset of halts lifted after the close of trading, trading is resumed the following morning after the normal 90-minute preopening quotation period and preopen trading may be possible on other trading venues.[4]

II. Data and Sample Selection

We study a sample of Nasdaq trading halts between September 1997 and December 1998. We identify the sample by combining two data sets. First, we use the TAQ database to identify quotes that are consistent with a trading halt in a Nasdaq-listed security. These quotes are characterized by nonstandard condition codes and entries of zero for the bid and ask prices and associated depths. These potential trading halts are then compared to a sample of trading halts provided by NASDR.[5] For each halt, the NASDR data set provides the ticker symbol of the associated firm, the halt date and halt time, the resumption date and resumption time, and a brief statement concerning the reason for the halt. Unfortunately, the NASDR data does not allow us to distinguish between halts called in response to pending news announcements and halts initiated by market surveillance in response to unusual trading activity. A trading halt is included in the sample only if it can be verified using both data sets.

We define halt times and resumption times based on quote data in TAQ. Halt times are defined using the time stamp for the first nonstandard quote associated with the halt. Resumption times are defined based on the time stamp associated with the first subsequent quote that includes a normal condition code and positive entries for bid price, ask price, bid depth, and ask depth. In some cases, Nasdaq reports the cancellation of a halt after the close of trading. In these cases, we define the resumption time as 9:30 a.m. on the following day. To make meaningful empirical statements concerning the impact of halts on prices and spreads, we exclude all halts that are initiated after the close and resolved prior to the open.

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[4] Cao et al. (2000) analyze the 90-minute morning preopen and find evidence of price discovery through the use of active quote revisions that often include crossed and locked inside quotes.

[5] A 30-day history of trading halts can be viewed on the web at www.nasdaqtrader.com.

Our selection procedure yields a sample of 1,167 halts, reflecting an average of approximately 3 halts per day. We then apply the following data restrictions. Issues that have missing data or are delisted following the halt are removed from the sample (20 halts). We also exclude halts for which trading is not resumed prior to the close on the following trading day (14 halts). Stocks with prices less than $5.00 (measured by the average of the inside bid and ask immediately prior to the halt) are removed to minimize the effects of low-priced stocks (415 halts). Finally, we delete halts that last for less than five minutes (4 halts). Our final sample includes 714 trading halts.

Figure 1 plots the frequency of trading halts by month (Panel A) and time of day (Panel B). As Panel A shows, there are at least 27 halts in each month and there is no evidence of a strong seasonal pattern. Examining Panel B, we see that 297 halts are actually delayed openings. The remaining 417 intraday halts are distributed relatively evenly between 9:30 a.m. and 4:00 p.m., with the largest frequency occurring during the first 30 minutes of trading. Throughout the remaining analysis, we provide separate results for the subsamples of delayed openings and intraday halts.

Table I provides frequencies for the events that trigger halts, the resolution time of halts, and the duration of halts. For halts that are not resolved by the end of the trading day, duration excludes the nontrading period from 4:00 p.m. on the halt day through 9:30 a.m. on the following day. For example, a halt initiated at 3:30 p.m. on day t and reopened at 11:00 a.m. on day $t + 1$ has a duration of two hours.

The most common events that trigger Nasdaq halts include announcements of pending mergers or acquisitions, and earnings announcements that deviate significantly from expectations. Other less common corporate events that result in halts include announcements of litigation, senior management turnover, and unexpected dividend changes.[6] The highest frequency of halt duration is between 31 and 60 minutes, followed closely by a duration of between one and two hours. In addition, only five percent of the halts remain unresolved after four hours. Turning to resolution times, we see that 289 delayed openings (97 percent) and 318 intraday halts (75 percent) are resolved prior to the close on the same trading day. Of the remaining 107 halts, 98 (93 percent) are resolved prior to the open on the following day. Notably, these 98 halts are reopened using the normal 90-minute quotation period associated with the morning open on Nasdaq. The effects of this 90-minute quotation period relative to the 5-minute quotation period used for most halts are addressed in Section IV.

Table II presents summary statistics for price effects and duration. The percentage price change is defined from the last valid quote prior to the halt to the first valid quote after the halt. The table indicates that the median

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[6] We find no evidence that halt characteristics differ according to the type of event that triggered the halt. For this reason, we do not distinguish between the various news events in the analysis to follow.

PANEL A: Distribution of Trading Halts by Month

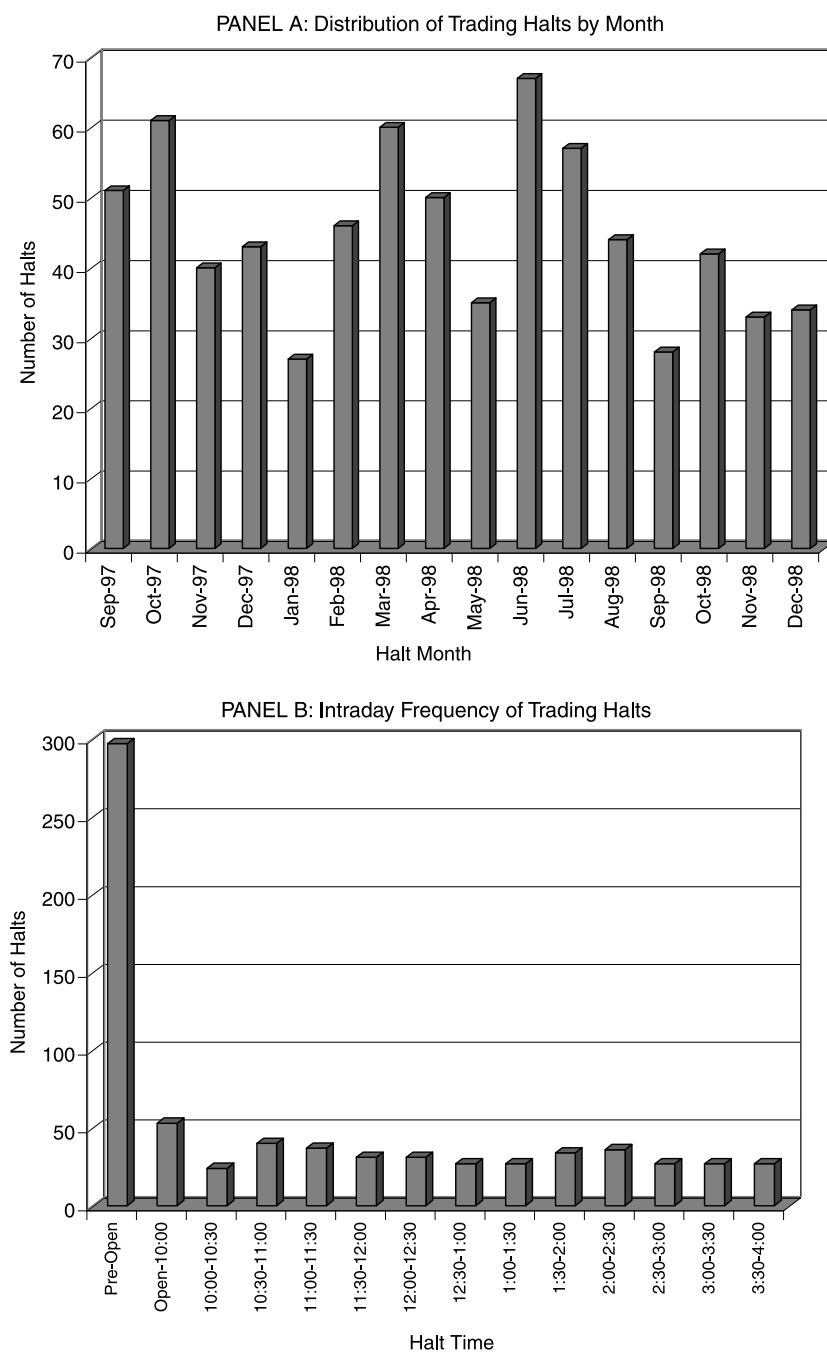PANEL B: Intraday Frequency of Trading Halts

Figure 1. Distribution of trading halts by month and time of day. The sample includes the 714 Nasdaq trading halts between September 1997 and December 1998. Panel A presents the number of delayed openings and intraday trading halts by month, while Panel B presents the intraday timing of the initiation of the delayed openings and intraday halts.

Table I

Event Type, Resolution Time, and Duration
for the Sample of Nasdaq Trading Halts

The table provides frequencies for halt reasons, halt resolution times, and halt duration. The sample includes the 714 Nasdaq trading halts between September 1997 and December 1998 that are resolved by the close of trading on the following day. If a halt is not resolved prior to the close on the day that it was initiated, we calculate duration excluding the time during the nontrading interval subsequent to the close and prior to the open the following day.

	Halt Type		
	Delayed Openings	Intraday Halts	All Trading Halts
Reason for trading halt			
Acquisition/merger	167	155	322
Security offering	10	15	14
Earnings announcement	71	135	206
Other corporate event	49	112	161
Resolution of trading halt			
Same trading day	289	318	607
Next day's open	6	92	98
Next trading day	2	7	9
Duration of trading halt			
< 15 minutes	14	9	23
16–30 minutes	97	19	116
31–60 minutes	82	184	266
61–120 minutes	59	135	194
121–240 minutes	26	53	79
241–360 minutes	11	16	27
> 360 minutes	8	1	9
Total	297	417	714

absolute return is significantly larger for delayed openings (7.06 percent) than for intraday halts (4.60 percent). Of the sample halts, 378 resulted in positive price effects, 320 resulted in negative price effects, and 16 resulted in no price change. The median halt duration for intraday halts (59 minutes) is significantly longer than for delayed openings (43 minutes), and may reflect the additional information that can accumulate during the nontrading period for delayed openings. The results in Table II are generally consistent with previous research on NYSE trading halts. For example, Lee et al. (1994) report median returns for news pending and news dissemination halts of 2.3 percent and 3.7 percent, respectively, and Corwin and Lipson (2000) report a mean absolute price change of 3.62 percent for news-related halts.[7]

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[7] Hopewell and Schwartz (1976, 1978) were among the first to identify large price reactions during trading halts. They also document that price reactions are larger for news halts than for order-imbalance halts.

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Table II

Summary Statistics for the Sample of Nasdaq Trading Halts
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The table lists median price effects and duration for a sample of 714 Nasdaq trading halts between September 1997 and December 1998. For Duration and Absolute price change, the table lists cross-sectional medians. Duration is defined as the number of minutes from the beginning of the halt to the first reopening quote. If a halt is not resolved prior to the close on the day that it was initiated, we calculate duration excluding the time during the nontrading interval subsequent to the close and prior to the open the following day. Price change is defined as the percentage change from the last valid quote midpoint prior to the halt to the first valid quote midpoint after the halt. Valid quotes are defined as quotes with normal condition codes, positive bid and ask prices, and positive bid and ask depths. Medians for delayed openings and intraday halts are compared using the Wilcoxon rank-sum test. The symbols ** and * indicate that medians are significantly different at the one and five percent levels, respectively.

Sample	Number of Halts	Duration (in Minutes)	Absolute % Price Change
Full sample	714	54.14	5.48
Positive price change	378	54.83	5.56
Zero price change	16	52.74	0.00
Negative price change	320	54.01	5.71
Delayed openings	297	43.87	7.06
Positive price change	171	45.03	7.43
Zero price change	4	53.98	0.00
Negative price change	122	34.99	6.80
Intraday halts	417	59.48**	4.60**
Positive price change	207	62.48**	4.96**
Zero price change	12	52.25	0.00
Negative price change	198	58.78**	4.60*

The trading halts described in Tables I and II involve 615 Nasdaq firms. Of these firms, 532 were involved in one halt, 72 were involved in two halts, 9 were involved in three halts, 1 was involved in five halts, and 1 was involved in six halts. Table III presents summary statistics for these 615 firms. For these statistics, quote midpoint and bid-ask spread are measured immediately prior to the halt, the number of market makers is measured on the day prior to the halt, and means for daily volume and number of trades per day are calculated over the 100 days prior to the halt.[8] We provide results for the full sample, as well as the subsamples of delayed openings and intraday halts. However, we discuss only the full-sample results, since firm characteristics do not appear to differ across halt types.

The median firm has a quote midpoint of $14.44, and a 10th percentile price of $6.44, indicating that our sample is not concentrated around the minimum price of $5. The median firm is also associated with an average of 30 trades per day and volume of over 43,000 shares per day. The median

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[8] If a firm is involved in multiple halts, summary statistics are calculated based on the first halt date for that firm.

Table III

Summary Statistics for Nasdaq Firms Involved in Trading Halts

The sample includes 615 Nasdaq firms involved in 714 trading halts between September 1997 and December 1998. The quote midpoint, the dollar bid-ask spread, and the percentage bid-ask spread are based on the last valid quote prior to the halt. Valid quotes are defined as quotes with normal condition codes, positive bid and ask prices, and positive bid and ask depths. Average daily share volume and average number of trades per day are calculated over the 100 days prior to the trading halt. Number of market makers is defined as the number of market makers who posted quotes in the stock on the day prior to the trading halt. For firms involved in multiple halts, all summary statistics are calculated relative to the earliest halt date for that firm.

	Quote Midpoint	Dollar Bid-Ask Spread	Percentage Bid-Ask Spread	Average Daily Share Volume	Average Trades per Day	Number of Market Makers
Full sample						
10th percentile	6.44	0.0625	0.47	5,059	4.19	5.0
25th percentile	9.19	0.1250	1.00	13,724	9.81	7.0
Median	14.44	0.2500	2.05	43,887	30.00	12.0
75th percentile	24.22	0.5000	3.58	120,574	93.21	18.0
90th percentile	36.44	1.0000	5.46	393,214	302.78	26.0
Delayed openings						
10th percentile	6.72	0.0625	0.45	4,930	4.15	4.0
25th percentile	9.33	0.1250	0.92	12,609	9.69	7.0
Median	14.56	0.2500	1.72	46,913	30.80	13.0
75th percentile	25.63	0.5000	3.32	128,871	95.83	20.0
90th percentile	38.31	1.0000	4.98	388,242	296.62	27.0
Intraday halts						
10th percentile	6.25	0.0625	0.51	5,059	4.19	5.0
25th percentile	9.06	0.1250	1.06	13,811	10.37	8.0
Median	14.36	0.2656	2.20	41,804	29.66	12.0
75th percentile	22.91	0.5000	3.77	114,387	91.73	17.0
90th percentile	35.00	1.0000	5.83	407,638	320.89	24.0

number of dealers is 12, with values ranging from 5 to 26 in the 10th and 90th percentiles, respectively. Finally, the median dollar and percentage bid-ask spreads are $0.25 and 2.05 percent, respectively. These results are comparable to the general population of Nasdaq firms.

III. Overall Results

This section presents empirical evidence on the impact of delayed openings and intraday trading halts on measures of transactions costs (dollar inside spreads), volatility (absolute price change and number of quote revisions), and trading activity (share volume, number of trades, and average trade size). To place these results in context, we compare each variable on the halt-day to the mean value of the variable across "nonhalt" days for the same firm. We define *nonhalt days* as the 100 days prior to and 100 days after each halt. This procedure controls for security characteristics that may affect the variables of interest. We provide results at 30-minute intervals before and after the halt, where we measure prehalt periods backwards from the halt time to the open of trading and posthalt periods forward from the resumption time to the close of trading. In addition, we define time periods identically on both halt and nonhalt days to control for time-of-day effects in the variables that we analyze.

While we present the bulk of our results graphically, we also provide statistical tests to examine whether differences across halt and nonhalt days are meaningful. To test the statistical significance of halt day versus nonhalt day differences, we follow Lee et al. (1994) and Corwin and Lipson (2000) in calculating abnormal measures of halt-day activity. For each variable and each time period, the abnormal measure is defined as

$$100 * \left[\frac{Halt\ Day\ Value - Mean\ Value\ Across\ Nonhalt\ Days}{Mean\ Value\ Across\ Nonhalt\ Days} \right]. \quad (1)$$

This measure can be interpreted as the percentage difference between the halt-day value and the mean value across the nonhalt days. A summary of the abnormal activity measures is provided in Table IV. Results for delayed openings and intraday halts are listed in Panels A and B, respectively. For each measure and each time period, the table lists the median value of the abnormal measure. Except where noted, the results based on means are consistent. Statistical inferences are based on the signed-rank test.

A. *Quoted Inside Spreads and the Speed of Price Adjustment*

Median dollar inside spreads are presented in Figure 2. Panel A presents the results for delayed openings, while Panel B reports our findings for intraday halts. Panel A shows that the median inside spread for the first valid posthalt quote is $0.75 per share, while the comparable value for the

Table IV

A Comparison of Activity Variables between
Halt Days and Nonhalt Days

The table lists median values for several abnormal activity variables. For each period, the abnormal spread is defined as the dollar spread on the halt day minus the mean dollar spread across nonhalt days, stated as a percentage of the nonhalt day mean. Abnormal measures for other variables are defined similarly. Nonhalt days include the 100 days before and 100 days after the halt, where available. The sample includes the 714 Nasdaq trading halts between September 1997 and December 1998. The halt period is defined as the last valid quote prior to the halt, while the reopen is defined as the first valid quote after the halt. Valid quotes are defined as quotes with normal condition codes, positive bid and ask prices, and positive bid and ask depths. Thirty-minute prehalt periods are measured backward from the beginning of the halt to the open. Thirty-minute posthalt periods are measured forward from the reopening time to the close. The symbols ** and * indicate statistical significance at the one or five percent levels, respectively, based on a signed-rank test.

		Abnormal Measures				
Period	$ Spread	Absolute Return	Number of Quote Revisions	Share Volume	Number of Trades	Average Trade Size
Panel A: Delayed Openings (N = 297)						
Reopen	111.36**	832.93**	—	—	—	—
+1	−16.46	713.96**	1708.08**	575.81**	723.70**	0.14
+2	−21.20**	138.62**	462.15**	374.80**	354.81**	7.92**
+3	−29.58**	48.77**	247.83**	187.77**	237.84**	5.27**
+4	−30.25**	2.47	131.85**	184.91**	210.44**	3.51*
Panel B: Intraday Halts (N = 417)						
−4	−7.19	−35.36	−25.43**	−61.54	−25.97*	−22.83*
−3	−3.03	−48.60	−7.04**	−62.48	−25.25**	−23.06**
−2	−9.86	−46.67	−5.68**	−48.82	−11.88**	−21.33**
−1	−11.65	−59.67	116.05**	27.89**	80.13**	−18.70**
Halt	−3.98	48.54**	—	—	—	—
Reopen	76.60**	538.13**	—	—	—	—
+1	−5.10	636.69**	1983.33**	629.20**	739.43**	−9.16*
+2	−15.21*	141.03**	462.74**	245.04**	310.66**	−6.71
+3	−12.74	106.64**	348.08**	175.63**	255.08**	−7.33
+4	−14.99**	26.93**	220.80**	74.80**	134.72**	−8.34

nonhalt day interval is approximately $0.30 per share. Thus, investors face inside spreads following halts that are over 100 percent wider than usual. The results for intraday halts (Panel B) are similar, with the median spread jumping to $0.625 at the reopen and returning to normal levels within 30 minutes. Spreads do not appear to increase prior to intraday halts, suggesting that the majority of these halts precede the release of private information. Statistical tests of the abnormal quoted spread, reported in Table IV, confirm these results. On average, dollar inside spreads at the reopen are more than 110 percent higher than nonhalt day levels for delayed openings and
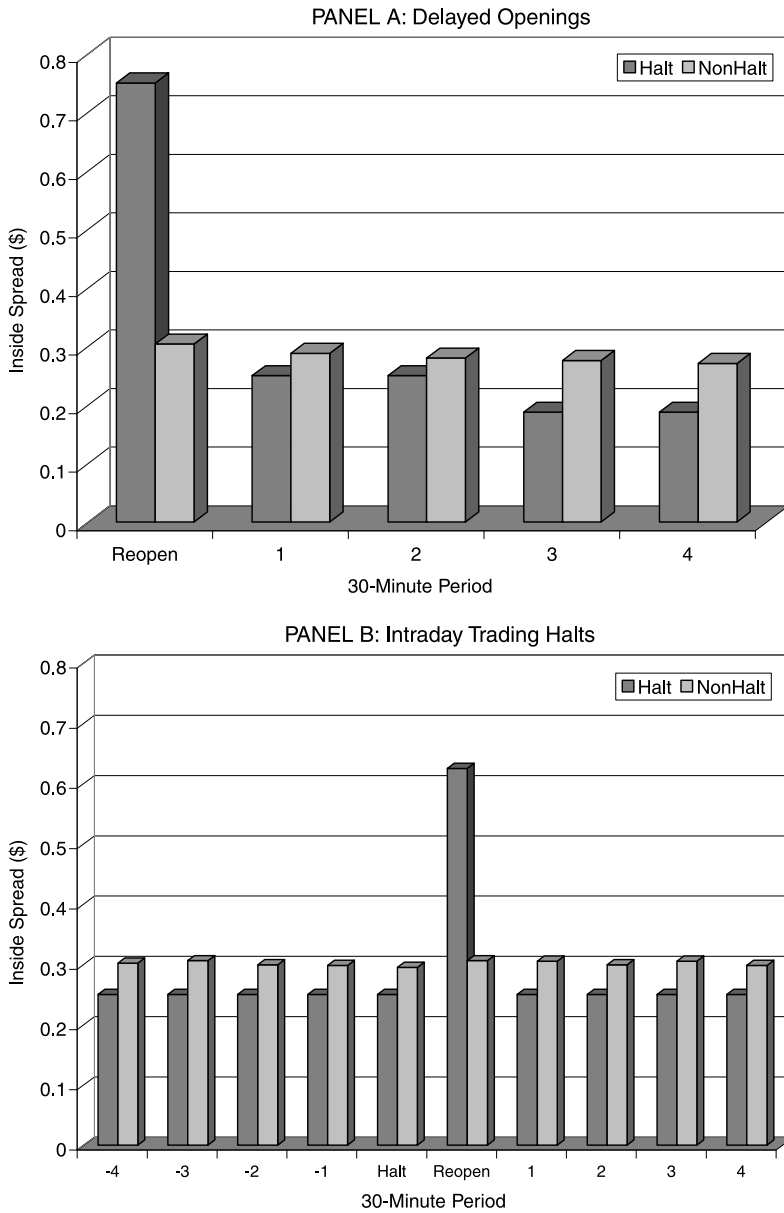
Figure 2. Inside dollar spreads surrounding delayed openings and intraday trading halts. The sample includes the 714 Nasdaq trading halts between September 1997 and December 1998. Panel A presents the median inside spread for halt and nonhalt days associated with delayed openings, while Panel B presents the median inside spread for halt and nonhalt days surrounding intraday trading halts. Nonhalt days include the 100 days before and 100 days after the halt, where available. The reopen is defined as the first valid quote after the halt. Valid quotes are defined as quotes with normal condition codes, positive bid and ask prices, and positive bid and ask depths. The 30-minute prehalt periods are measured prior to the beginning of the halt. The 30-minute posthalt periods are measured from the reopening time.

more than 75 percent higher for intraday halts, and these spreads return to normal levels within 30 minutes.[9]

To better assess the speed with which spreads converge to normal levels, we plot median inside spreads at 15-second intervals surrounding trading halts in Figure 3. The discreteness in Figure 3 is an artifact of our use of medians. The same general patterns emerge using mean dollar spreads. Panel A presents the results for the sample of delayed openings. The median inside spread narrows from $0.75 immediately after the halt to $0.50 one minute later, decreases further to $0.375 within five minutes, and returns to the prehalt level of $0.25 within 10 minutes. However, results from signed-rank tests suggest that the difference in inside spreads relative to prehalt levels is significant for at least 36 minutes after the halt. This difference in interpretation suggests that the inside spread for the median firm reverts to zero within 10 minutes, while the cross-sectional distribution of inside spreads across all firms differs significantly from the prehalt distribution for over three times that long.[10]

Similar results are obtained for intraday halts (Panel B). The median inside spread increases to $0.625 immediately following the halt, decreases to $0.375 within 4 minutes, and decreases further to $0.25 within 14 minutes. Again, results based on signed-rank tests suggest that the distribution of inside spreads is significantly different from the prehalt distribution for nearly 37 minutes.

The unusually wide spreads evident at the reopen suggest that the uncertainty associated with Nasdaq trading halts is not fully resolved prior to the resumption of trading. In contrast, Corwin and Lipson (2000) report that percentage spreads rise by only 30 percent at the resumption of trading for news-related halts on the NYSE. This difference in results may be due to differences in security characteristics across markets. However, the difference is more likely a result of the different price discovery and reopening mechanisms used in the two markets. Nasdaq dealers are allowed five minutes of quote-based price discovery prior to the resumption of trading and may face incomplete knowledge of aggregate order flow. In contrast, NYSE specialists post indicator quotes and observe order flow throughout the halt and reopen trading with a call auction. These differences may result in less efficient price discovery during Nasdaq halts and a higher level of posthalt uncertainty. In Section IV, we examine the effects of the reopening mechanisms more directly by comparing the effects of halts reopened with 5-minute quotation periods and 90-minute quotation periods.

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[9] In Figure 2, halt-day spreads are slightly less than the nonhalt-day mean in all periods except the posthalt period. These differences are economically small and reflect the fact that nonhalt-day means are affected by large outliers. Similar effects are evident in subsequent figures. However, the statistical tests reported in Table IV confirm that these differences are statistically insignificant.

[10] This calculation is based on a signed-rank test of the median difference in inside spreads after the halt relative to inside spreads 60 minutes prior to the halt. The test is significant at the five percent level through minute 36.
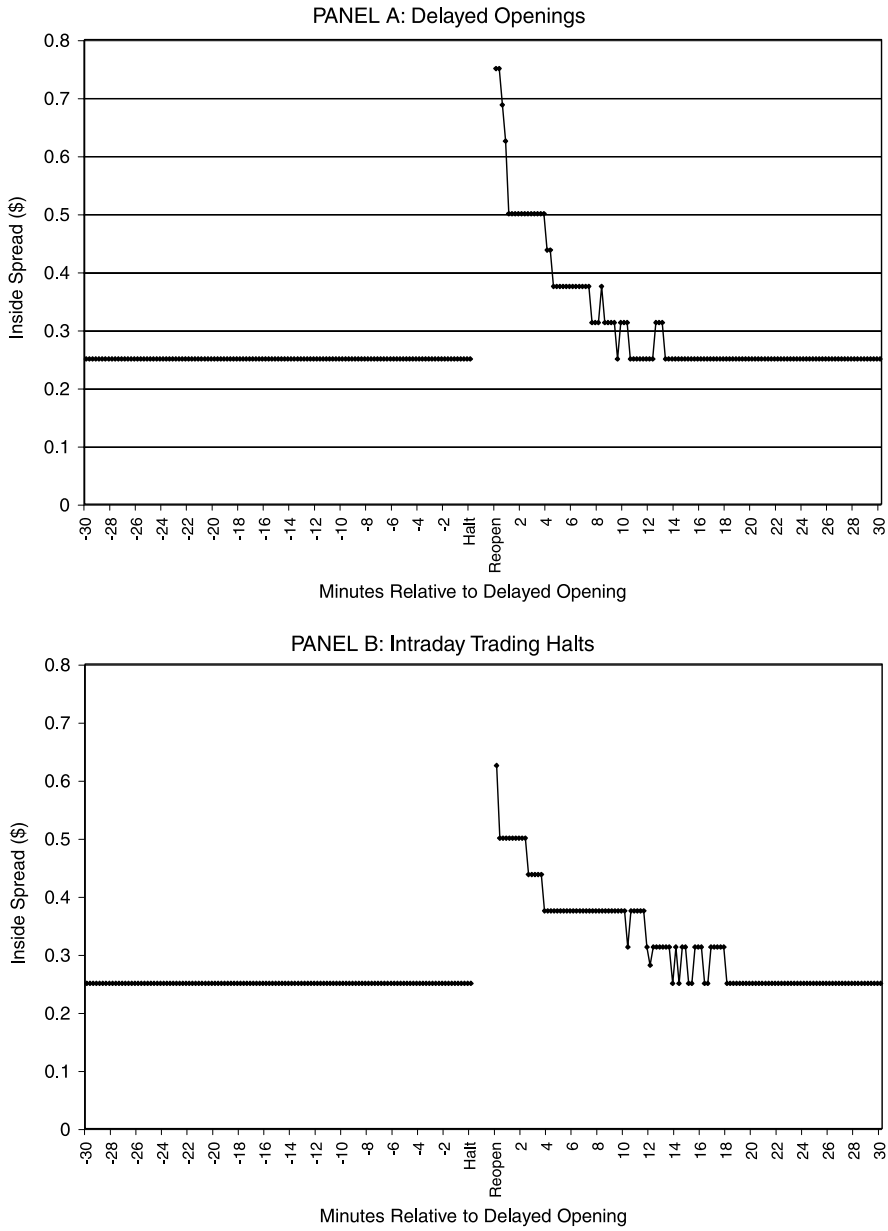
PANEL A: Delayed Openings

PANEL B: Intraday Trading Halts

Figure 3. Speed of adjustment of inside spreads surrounding delayed openings and intraday trading halts. The sample includes the 714 Nasdaq trading halts between September 1997 and December 1998. Median spreads are computed over 15-second intervals. Panel A presents the median inside spread for delayed openings, while Panel B presents the results for intraday trading halts. The reopen is defined as the first valid quote after the halt. Valid quotes are defined as quotes with normal condition codes, positive bid and ask prices, and positive bid and ask depths. Trading time is considered continuous between the close on day $t - 1$ and the open on day t.

B. Bid and Ask Price Adjustments

Figures 2 and 3 provide evidence of a substantial increase in bid-ask spreads immediately following Nasdaq trading halts. Two potential explanations for this increase in spreads are inventory management and asymmetric information.

Investor-initiated trades resulting from the significant information shocks associated with trading halts are likely to force market makers away from desired inventory levels. For example, investor purchases following positive price changes are likely to push market maker inventories below desired levels. If bid and ask quotes reflect inventory management, we would then expect to see market makers increase both the bid and ask to discourage buying and encourage selling following these halts (see Ho and Stoll (1981, 1983)) beyond the levels dictated by the information effects alone. The opposite effect should be evident following negative price change halts. Further, inventory management implies that halts will be followed by price reversals as dealer inventories return to desired levels.

Asymmetric information models of the spread suggest that market markers will set wide spreads around the new consensus price in order to avoid losses to better-informed traders (see Glosten and Milgrom (1985) and Easley and O'Hara (1987)). If bid and ask prices reflect high levels of asymmetric information following halts, we would expect both the bid and ask quotes to widen around the reopening price and narrow over time as uncertainty is resolved. In addition, informed trading will result in price continuations following halts if information is not fully incorporated into prices prior to the reopen.

Figure 4 plots the time series of median bid and ask prices at 15-second intervals for the period from 30 minutes before until 30 minutes after the halt. Panels A and B present results for positive price change halts and negative price change halts, respectively. To allow aggregation across securities, we standardize bid and ask prices for each halted security by the prehalt midpoint for that security.

It is apparent from Figure 4 that bid and ask prices do not respond symmetrically to halt-related price shocks. On average, for positive price changes (Panel A), the inside ask reopens substantially higher and remains at approximately the same level over the subsequent 30 minutes. In contrast, the inside bid reopens above its prehalt level, but continues to drift up over a period of 10 to 15 minutes. The results for negative price changes (Panel B) are reversed, with the inside bid reopening substantially lower and remaining steady, and the inside ask drifting downwards.

The return persistence evident in Figure 4 is inconsistent with standard asymmetric information or inventory management explanations for wide posthalt spreads as market makers immediately adjust only the side of the quote at which they are most likely to face better informed traders. The opposite-side quote is then adjusted over time as market makers process the new information and as competition prevents market makers from continuing to buy below (sell above) competitive prices.
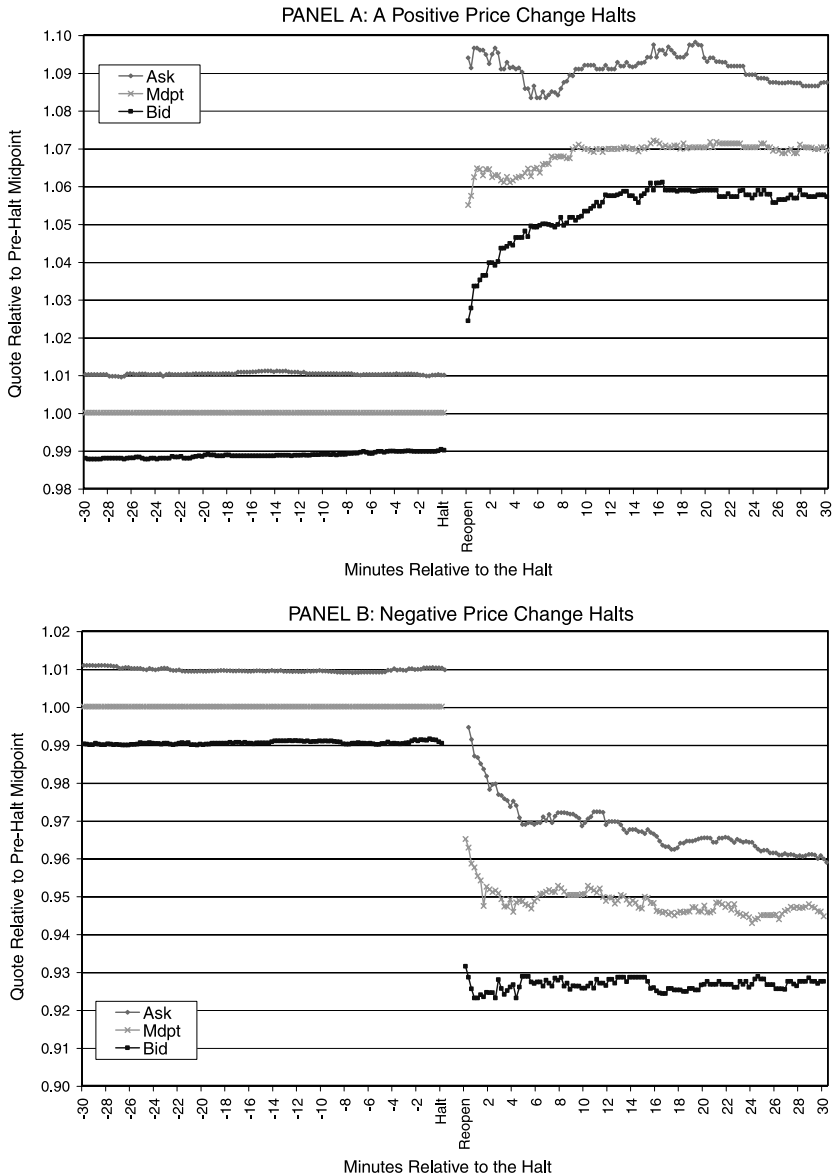
PANEL A: A Positive Price Change Halts

PANEL B: Negative Price Change Halts

Figure 4. Bid and ask prices as a proportion of the prehalt midpoint. The figure plots median bid and ask prices at 15-second intervals around Nasdaq trading halts, where bid and ask prices are standardized by the prehalt midpoint. The full sample includes 714 Nasdaq trading halts between September 1997 and December 1998. Panel A shows results for the subsample of halts that result in a positive price change. Panel B shows results for the subsample of halts that result in a negative price change. Price change categories are defined based on the return from the prehalt midpoint to the midpoint outstanding one hour after the resumption of trading. Medians are calculated at 15-second intervals across all halts in the subsample. The reopen is defined as the first valid quote after the halt. Valid quotes are defined as quotes with normal condition codes, positive bid and ask prices, and positive bid and ask depths.

C. Price Changes and Number of Quote Revisions

The results for absolute percentage price changes and the number of quote revisions are shown in Figures 5 and 6. In one respect, these variables can be interpreted as measures of volatility; more volatile prices will result in both larger price changes and an increased necessity for market makers to update their quotes. In addition, absolute price changes can be thought of as a measure of price discovery; if the information associated with the halt is not resolved prior to the reopen of trading, then this information will be reflected in price changes after the halt. We measure the absolute percentage price change from the last quote midpoint of the previous interval to the last quote midpoint of the current interval. We measure quote revisions as the number of inside quotes posted during the period for which either the ask price or the bid price changed.

Figure 5 illustrates both the price impact of the halts and the unusually high volatility of prices during the ensuing two hours. Consistent with Table I, the median absolute return from the halt time to the reopen is 7 percent for delayed openings and 4.5 percent for intraday halts. Absolute returns remain unusually high 30 minutes after the halt and diminish during the ensuing two hours. The abnormal test statistics reported in Table IV confirm the significance of these results. The abnormal absolute return declines during the two hours subsequent to the halt, but remains significant at the 1 percent level for this entire period.

Results for quote revisions are presented in Figure 6. For delayed openings (Panel A), the median number of quote revisions during the first posthalt period is 34 on the halt day relative to a mean of only 1.8 on nonhalt days. While this difference declines rapidly, halt-day quote revisions remain more than double the nonhalt-day average after two hours. Table IV confirms the statistical significance of these results. On average, quote revisions are over 1,700 percent higher than nonhalt-day levels during the 30 minutes following halts and decrease over the subsequent two hours.

The posthalt results for intraday halts (Panel B) are similar to those reported above. However, Panel B shows that quote revisions begin to increase *prior* to the initiation of intraday halts. As the statistical tests in Table IV indicate, the number of quote revisions during the 30 minutes prior to the halt averages 116 percent higher than during the corresponding period on nonhalt days. Despite our evidence that neither prices nor spreads respond prior to the halt, the increase in the quote revisions during this period may reflect some leakage of the impending news or the inclusion of halts that result from market surveillance actions.

Notably, the magnitude of the increase in absolute returns and quote revisions immediately following the resumption of trading is far greater than that reported by Lee et al. (1994) and Corwin and Lipson (2000) following NYSE halts. For example, Corwin and Lipson report that abnormal returns are 285 percent above normal levels and quote revisions are 535 percent above normal levels during the 30 minutes after NYSE halts. In comparison,
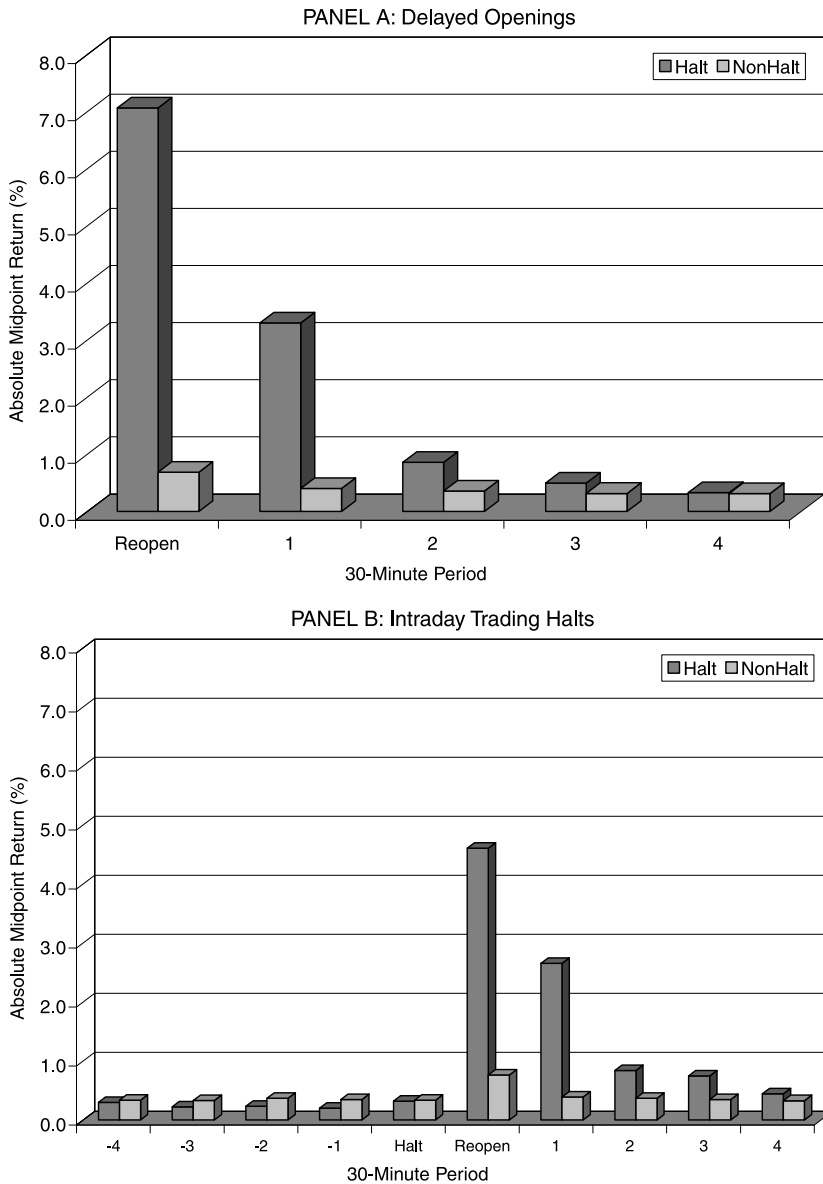
PANEL A: Delayed Openings

PANEL B: Intraday Trading Halts

Figure 5. Absolute price change associated with delayed openings and intraday trading halts. The sample includes the 714 Nasdaq trading halts between September 1997 and December 1998. Panel A presents the median absolute midpoint return for halt and nonhalt days associated with delayed openings, while Panel B presents the median absolute midpoint return for halt and nonhalt days surrounding intraday trading halts. Nonhalt days include the 100 days before and 100 days after the halt, where available. The reopen is defined as the first valid quote after the halt. Valid quotes are defined as quotes with normal condition codes, positive bid and ask prices, and positive bid and ask depths. The 30-minute prehalt periods are measured prior to the beginning of the halt. The 30-minute posthalt periods are measured from the reopening time.
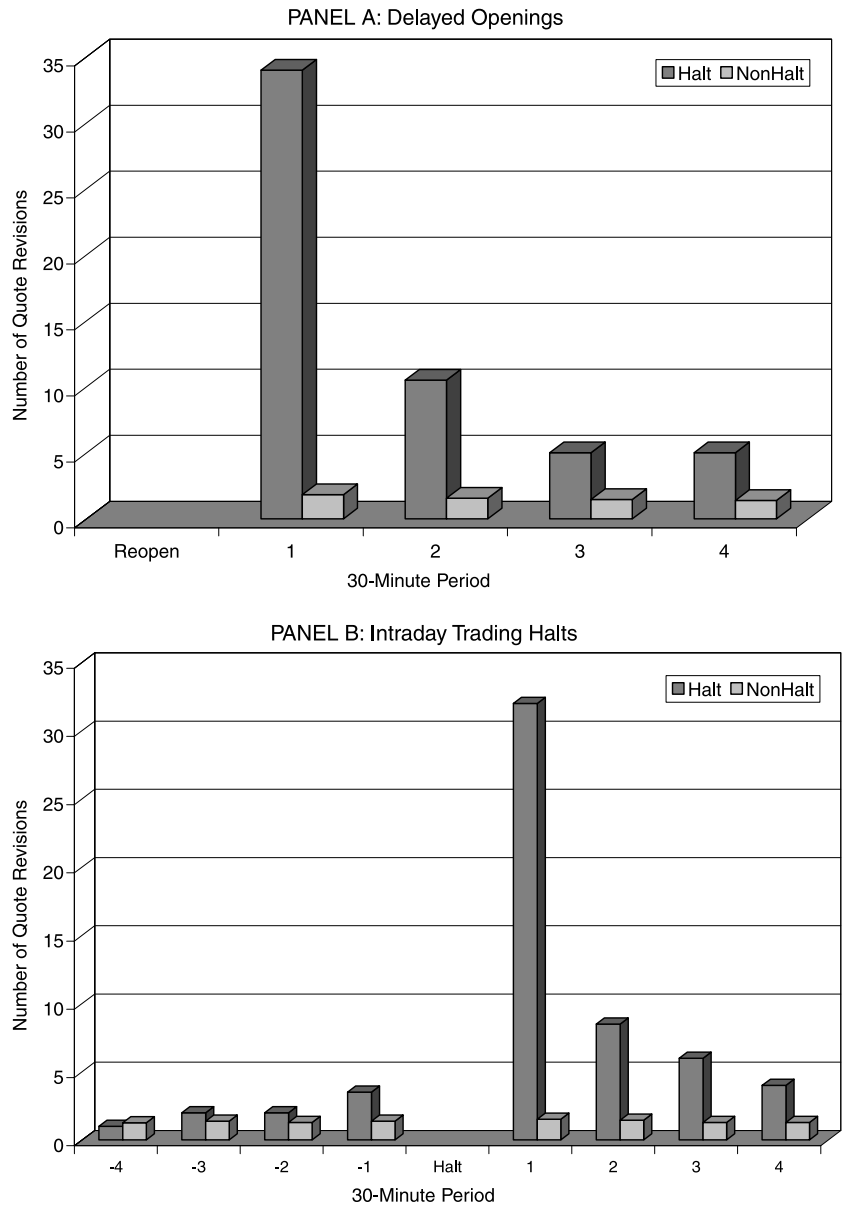
PANEL A: Delayed Openings

PANEL B: Intraday Trading Halts

Figure 6. Number of quote revisions associated with delayed openings and intraday trading halts. The sample includes the 714 Nasdaq trading halts between September 1997 and December 1998. Panel A presents the median number of inside quote revisions for halt and nonhalt days associated with delayed openings, while Panel B presents the median number of inside quote revisions for halt and nonhalt days surrounding intraday trading halts. Nonhalt days include the 100 days before and 100 days after the halt, where available. The reopen is defined as the first valid quote after the halt. Valid quotes are defined as quotes with normal condition codes, positive bid and ask prices, and positive bid and ask depths. The 30-minute posthalt periods are measured from the reopening time.

we find that absolute returns and quote revisions are at least 600 percent and 1,700 percent respectively above levels observed on nonhalt days during the 30 minutes following Nasdaq halts.[11] This difference may reflect the decentralized process of price discovery in the Nasdaq market or the difference in halt mechanisms across exchanges. We address this issue in more detail in Section IV.

D. Volume, Number of Trades, and Average Trade Size

We present results for median share volume, number of trades, and trade size in Figures 7, 8, and 9, respectively. As in previous figures, separate results for delayed openings and intraday halts are shown in Panels A and B. In Figure 7, we see that share volume is extremely high following the resumption of trading and decays more slowly than spreads or quote revisions. This result holds for both opening delays and intraday halts and is strengthened by the statistical tests in Table IV. The first 30 minutes of trading are characterized by a sixfold increase in share volume, and volume remains significantly higher than nonhalt-day levels for at least two hours. In addition, share volume exhibits a significant increase in the 30 minutes prior to intraday halts. As noted in Section III.C, these prehalt effects may reflect leakage of information or the inclusion of halts called in response to market surveillance activities.

Figures 8 and 9 reveal the source of the volume increase. The average number of trades mimics the increase in average share volume. For delayed openings, the median number of trades in the first posthalt period is 50 on the halt day relative to a mean of 5.8 on nonhalt days. For intraday halts, the comparable numbers are 38 and 4.5, respectively. Again, Table IV confirms that the difference between halt and nonhalt days is statistically significant for at least two hours, with an increase of over 700 percent in the 30 minutes immediately following the halt. And, like volume, number of trades exhibits a significant increase in the 30 minutes prior to intraday halts.

In contrast to the volume results, Figure 9 shows that the median trade size across 30-minute intervals is virtually unaffected by halts. While Table IV reveals a slight decrease in average trade size during the first posthalt period following intraday halts, the change is economically small and is only marginally significant. Prehalt trade size also appears to be significantly smaller than on comparable nonhalt days. However, as we discuss in Section V below, this result is not robust to alternative matching procedures.

Figures 3 and 4 reveal unusually high trading costs during the 5 to 10 minutes immediately following Nasdaq halts. To more closely examine trading activity during this period, we present volume and trade size results for

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[11] For comparison to Lee et al. (1994), we calculated mean abnormal measures in addition to the medians reported above. During the 30 minutes following NYSE halts, Lee et al. find that abnormal returns are nearly six times normal levels, on average. The mean results for our sample of Nasdaq halts reflect absolute returns that are over 17 times normal levels during this period.
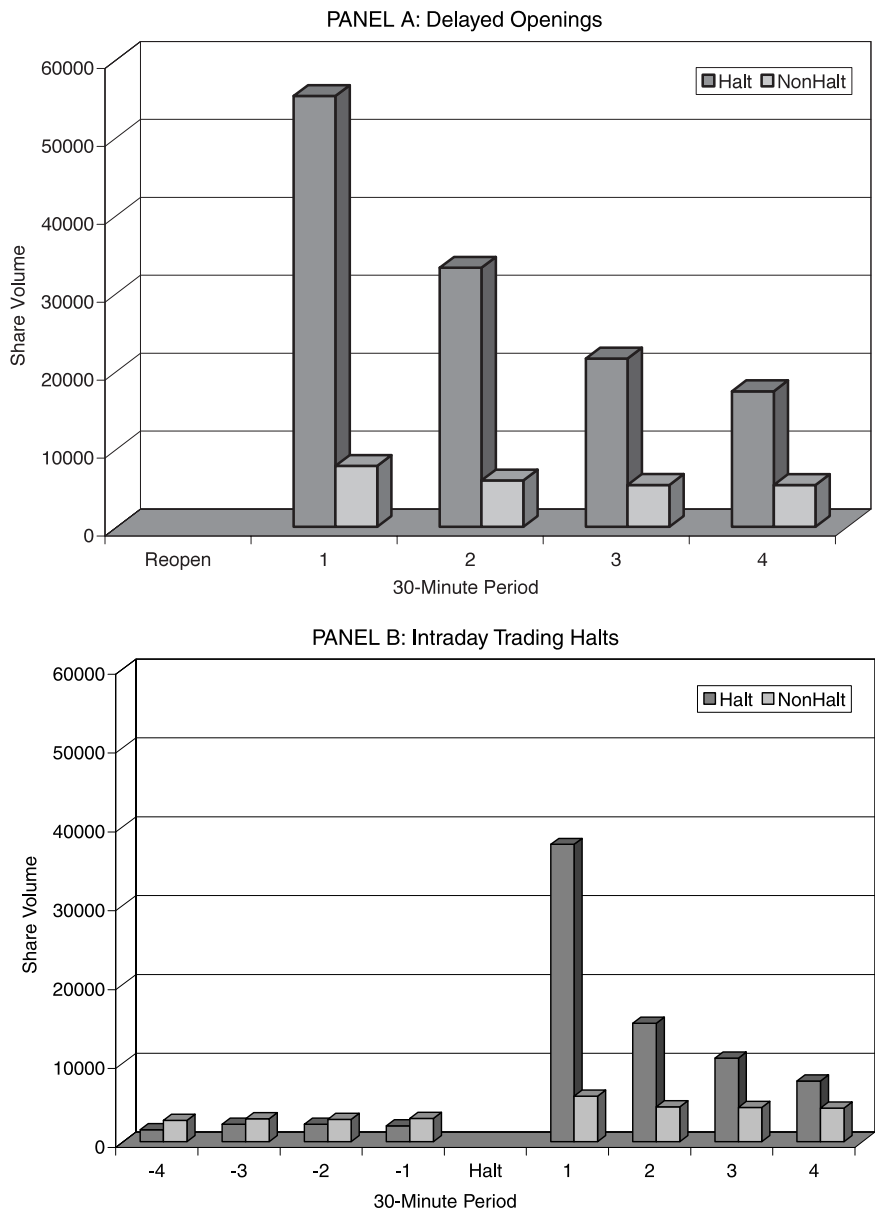
PANEL A: Delayed Openings

PANEL B: Intraday Trading Halts

Figure 7. Share volume associated with delayed openings and intraday trading halts.
The sample includes the 714 Nasdaq trading halts between September 1997 and December
1998. Panel A presents the median share volume for halt and nonhalt days associated with
delayed openings, while Panel B presents the median share volume for halt and nonhalt days
surrounding intraday trading halts. Nonhalt days include the 100 days before and 100 days
after the halt, where available. The reopen is defined as the first valid quote after the halt.
Valid quotes are defined as quotes with normal condition codes, positive bid and ask prices, and
positive bid and ask depths. The 30-minute prehalt periods are measured prior to the beginning
of the halt. The 30-minute posthalt periods are measured from the reopening time.

PANEL A: Delayed Openings

PANEL B: Intraday Trading Halts

Figure 8. Number of trades associated with delayed openings and intraday trading halts. The sample includes the 714 Nasdaq trading halts between September 1997 and December 1998. Panel A presents the median number of trades for halt and nonhalt days associated with delayed openings, while Panel B presents the median number of trades for halt and nonhalt days surrounding intraday trading halts. Nonhalt days include the 100 days before and 100 days after the halt, where available. The reopen is defined as the first valid quote after the halt. Valid quotes are defined as quotes with normal condition codes, positive bid and ask prices, and positive bid and ask depths. The 30-minute prehalt periods are measured prior to the beginning of the halt. The 30-minute posthalt periods are measured from the reopening time.
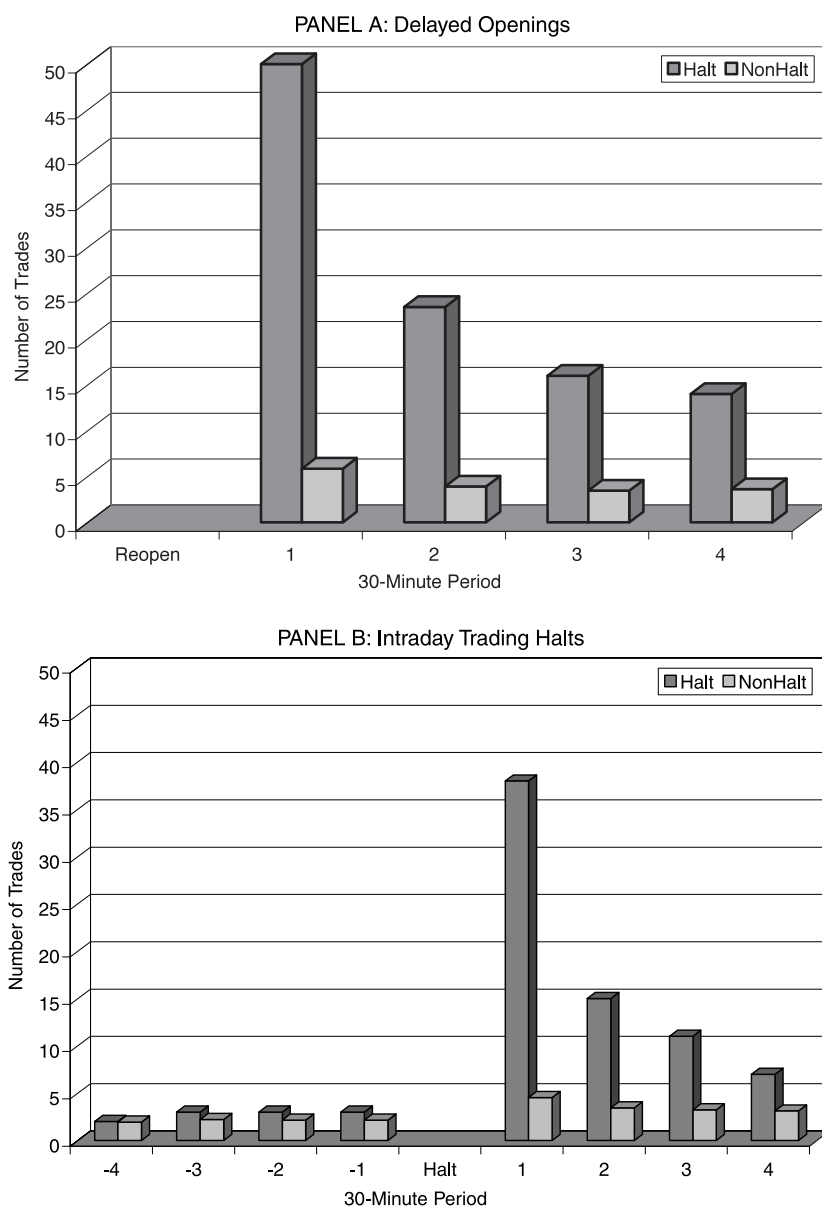
PANEL A: Delayed Openings

PANEL B: Intraday Trading Halts

Figure 9. Trade size associated with delayed openings and intraday trading halts. The sample includes the 714 Nasdaq trading halts between September 1997 and December 1998. Panel A presents the median trade size for halt and nonhalt days associated with delayed openings, while Panel B presents the median trade size for halt and nonhalt days surrounding intraday trading halts. Nonhalt days include the 100 days before and 100 days after the halt, where available. The reopen is defined as the first valid quote after the halt. Valid quotes are defined as quotes with normal condition codes, positive bid and ask prices, and positive bid and ask depths. The 30-minute prehalt periods are measured prior to the beginning of the halt. The 30-minute posthalt periods are measured from the reopening time.
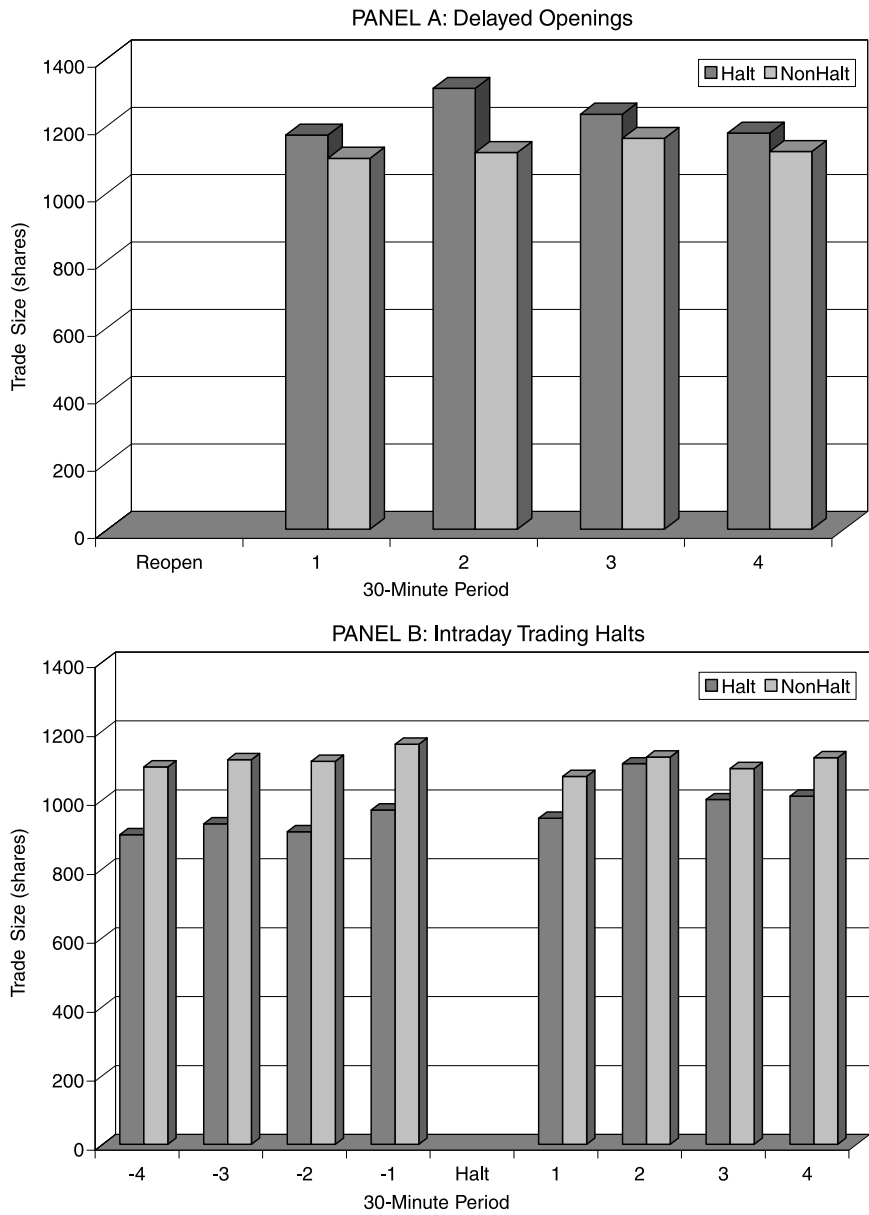
one-minute intervals in Figures 10 and 11. During the first minute after halts, Figure 10 shows that the median volume is 2,500 shares for intraday halts and 3,500 shares for delayed openings. Share volume falls quickly, reaching a median of 200 shares 15 minutes after delayed openings and 150 shares 15 minutes after intraday halts. Based on these results, it appears that trading volume is greatest at precisely the time when uncertainty and transaction costs are highest.

Figure 11 shows that the median trade size is smallest during the first minute of trading. For delayed openings (Panel A), the median trade size is 570 shares during the first minute and increases to approximately 1,000 shares by minute 4. Following intraday halts (Panel B), the median trade size is 650 shares during the first minute of trading and increases to 1,000 shares by minute 7. While trade size returns to normal levels within 30 minutes, these results suggest that the period immediately following Nasdaq halts is characterized by an unusually high number of relatively small trades. This result is consistent with the results in Chan et al. (1995) for morning openings on Nasdaq and suggests that market makers are unwilling to commit to large trades until price uncertainty is reduced.

The pattern in trading volume following Nasdaq halts is quantitatively similar to that reported in Lee et al. (1994) and Corwin and Lipson (2000) following NYSE trading halts. For example, Corwin and Lipson report that trading volume is seven times normal levels during the 30 minutes following NYSE halts. The similarity in volume effects across markets contrasts sharply with the results for volatility discussed in Section III.C. This consistency in volume patterns suggests that the response of investors to trading halts is independent of market structure and halt mechanisms.

IV. Length of the Preresumption Quotation Period

The results in Section III suggest that the 5-minute quotation period used to reopen Nasdaq trading halts may be inadequate to fully alleviate the uncertainty associated with trading halts. To more directly address this issue, we provide separate results for halts reopened with a 5-minute quotation period and halts reopened with a 90-minute quotation period. Based on the arguments in Greenwald and Stein (1991), we hypothesize that reopenings following 90-minute quotation periods will be associated with less uncertainty than reopenings following 5-minute quotation periods.

Before presenting the results, we address two important points. First, halts that persist until the subsequent morning provide additional time for market makers to obtain and interpret information about the news event. In addition, once the halt is lifted, aftermarket trades may be executed on other venues such as electronic communication networks (ECNs). The additional nontrading period associated with these halts and the potential for preopening trading on other venues may result in reduced uncertainty independent of the length of the reopening quotation period.

PANEL A: Delayed Openings

PANEL B: Intraday Halts

Figure 10. Share volume at one-minute intervals following delayed openings and intraday trading halts. The sample includes the 714 Nasdaq trading halts between September 1997 and December 1998 that survive the exclusion criteria provided in Table I. Panel A presents median share volume at one-minute intervals following delayed openings, while Panel B presents median share volume at one-minute intervals following intraday trading halts.

PANEL A: Delayed Openings
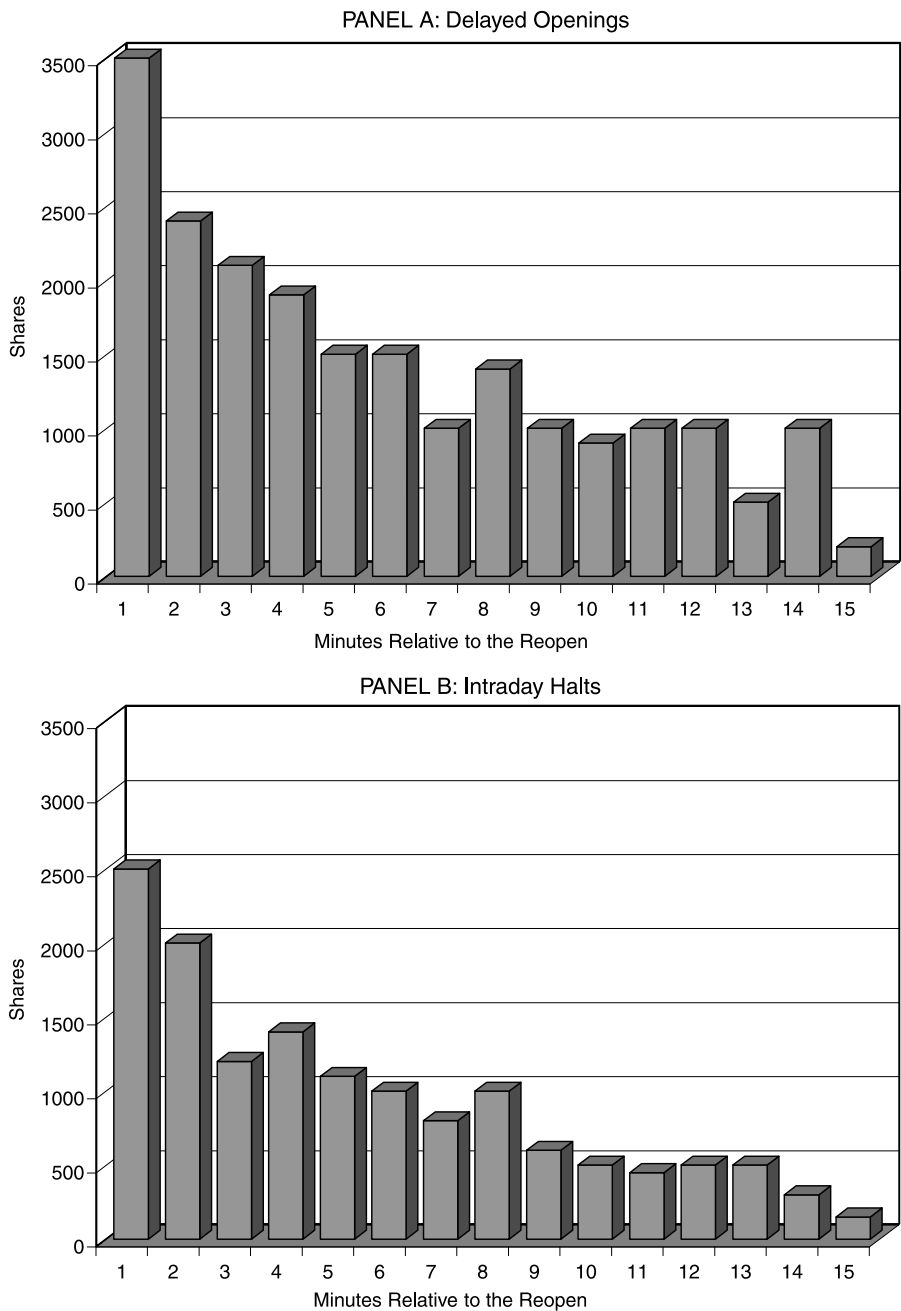
PANEL B: Intraday Halts

Figure 11. Trade size at one-minute intervals following delayed openings and intraday trading halts. The sample includes the 714 Nasdaq trading halts between September 1997 and December 1998 that survive the exclusion criteria provided in Table I. Panel A presents median trade size at one-minute intervals following delayed openings, while Panel B presents median trade size at one-minute intervals following intraday trading halts.
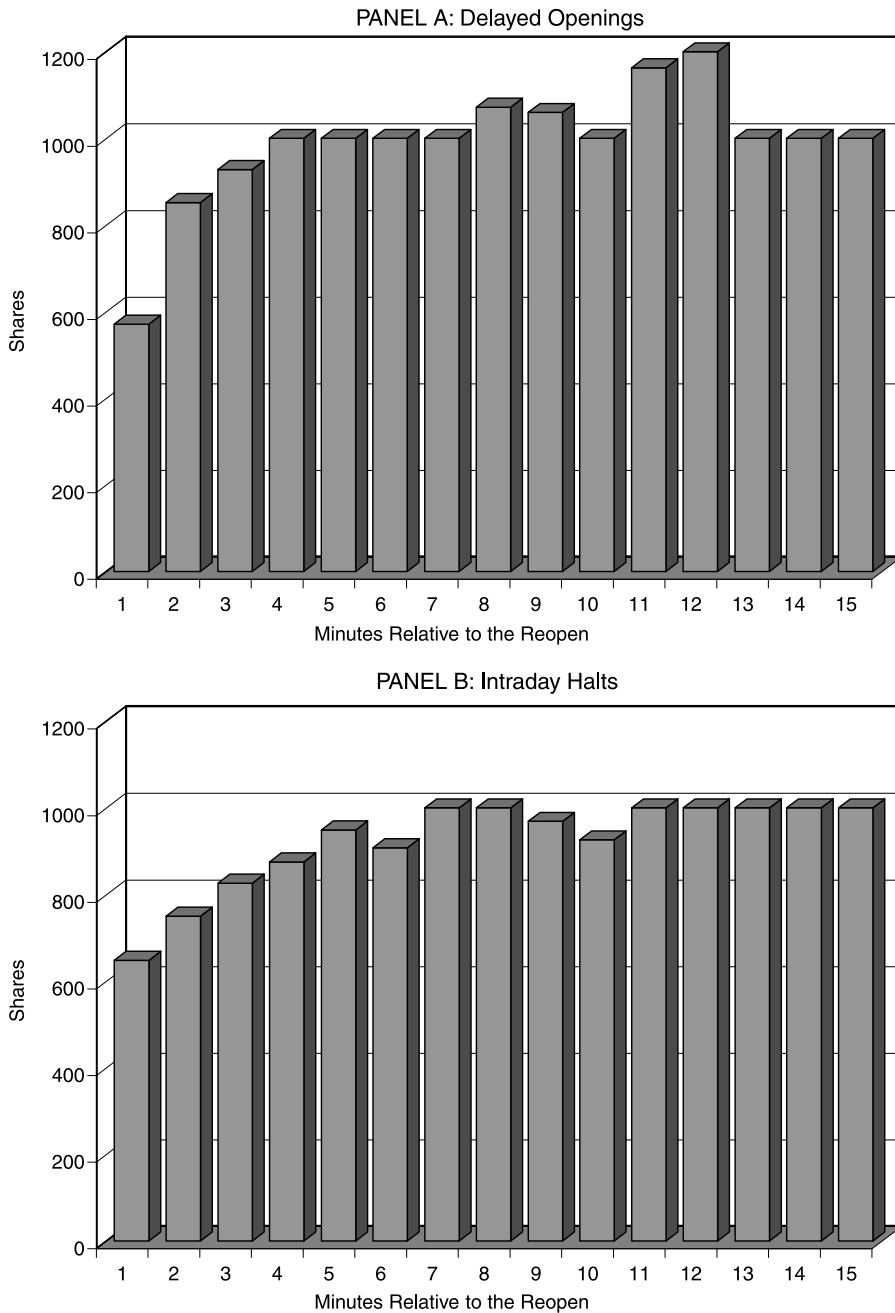
Second, halts that are resolved on the subsequent morning may differ fundamentally from halts resolved during the trading day, resulting in significant differences in halt effects across the two subsamples. To address this possibility, we compared the characteristics of halts across these two categories. We find no systematic differences in halt duration or halt reasons that would appear to bias our results. In fact, the most striking difference across the two categories is that morning reopenings are associated with larger absolute price changes than intraday reopenings (medians of 12.7 percent and 7.0 percent, respectively), biasing against our hypothesis that 5-minute reopenings result in higher uncertainty than 90-minute reopenings. Not surprisingly, we also find that the majority of halts carried over to the subsequent day are called near the end of the trading day.

We present a summary of abnormal activity for the subsamples of halts utilizing 5-minute quotation periods and 90-minute quotation periods in Panels A and B of Table V, respectively. As in the previous analyses, the table reports median abnormal measures relative to nonhalt days. In Table V, however, we also test for differences *across* the two subsamples using a signed-rank test. Because only six delayed openings involve 90-minute quotation periods, we report results for intraday halts only.

The results for the posthalt periods are consistent with the hypothesis that uncertainty is lower for halts reopened at the open following an extended period of quote revisions. The wide posthalt spreads observed in the full sample are *not* evident in the sample of halts where trading resumes at 9:30 the following morning. While absolute returns and the number of quote revisions are unusually high for both subsamples, these abnormal volatility effects are significantly lower for 90-minute reopenings than for 5-minute reopenings. In addition, the spread and volatility results for 90-minute quotation periods are quantitatively similar to results from Lee et al. (1994) and Corwin and Lipson (2000) for NYSE halts. For example, we find that absolute returns on Nasdaq are 340 percent above normal levels following 90-minute quotation periods and more than 800 percent above normal levels following 5-minute quotation periods. Similarly, we find that quote revisions are 814 percent above normal levels following 90-minute quotation periods and over 2,400 percent above normal levels following 5-minute quotation periods. These results suggest that the 5-minute reopening process is inefficient relative to the 90-minute reopening process on Nasdaq and the call-auction reopening process on the NYSE. Further, the similarity in results between 90-minute quotation periods on Nasdaq and previous studies of NYSE halts suggest that the results for 5-minute reopenings are driven by differences in the length of the quotation period rather than differences in market structure.

In contrast to the volatility results, neither abnormal share volume nor abnormal number of trades differs significantly across the two subsamples of Nasdaq halts. For example, share volume is 653 percent above normal levels during the 30 minutes following 90-minute quotation periods and 620 percent above normal levels following 5-minute quotation periods. Again, these values are quantitatively similar to results from previous studies of NYSE halts.

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Table V

**A Comparison of Activity Variables between
5-Minute and 90-Minute Quotation Periods**

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The table lists median values for several abnormal activity variables. The abnormal spread is defined as the dollar spread on the halt day minus the dollar spread on the matched nonhalt day, standardized by the mean spread across all nonhalt days. Abnormal measures for other variables are defined similarly. Nonhalt days include the 100 days before and 100 days after the halt, where available. The halt period is defined as the last valid quote prior to the halt, while the reopen is defined as the first valid quote after the halt. Valid quotes are defined as quotes with normal condition codes, positive bid and ask prices, and positive bid and ask depths. Thirty-minute prehalt periods are measured backward from the beginning of the halt to the open. Thirty-minute posthalt periods are measured forward from the reopening time to the close. The original sample includes the 714 Nasdaq trading halts between September 1997 and December 1998. The table lists results for the subsample of 417 halts called during the trading day. Panel A lists results for the subsample of halts that reopen during the trading day with a 5-minute preopening quotation period. Panel B lists results for the subsample of halts that reopen the following morning with a 90-minute preopening quotation period. Bold type indicates statistical significance at the five percent level, based on a signed-rank test. The symbols $\wedge\wedge$ and $\wedge$ ($\vee\vee$ and $\vee$) indicate that the median is significantly higher (lower) in Panel B than in Panel A at the one or five percent levels, respectively, based on a Wilcoxon rank-sum test.

			Abnormal Measures			
Period	$ Spread	Absolute Return	Number of Quote Revisions	Share Volume	Number of Trades	Average Trade Size
Panel A: Intraday Halts with 5-Minute Quotation Periods ($N = 325$)						
−4	−6.65	**−15.13**	−25.89	−62.51	−25.45	**−22.16**
−3	−1.81	−55.98	**−14.93**	−67.00	−33.11	**−21.26**
−2	−10.65	−54.82	−34.29	−58.77	−26.73	**−19.59**
−1	−11.87	**−79.56**	**57.82**	**−11.87**	**49.37**	**−24.90**
Halt	−1.11	**−4.08**	—	—	—	—
Reopen	**118.88**	**669.08**		—	—	—
+1	**4.05**	**810.82**	**2428.22**	**620.55**	**765.55**	**−16.93**
+2	−11.01	**161.73**	**514.22**	**222.37**	**305.73**	−7.77
+3	−8.43	**115.49**	**342.62**	**166.01**	**246.19**	−10.45
+4	−7.72	**18.79**	**181.69**	**69.90**	**125.00**	−8.21
Panel B: Intraday Halts with 90-Minute Quotation Periods ($N = 92$)						
−4	−13.10	−60.02	−12.67	−59.26	−31.20	**−23.23**
−3	−10.66	−42.89	**27.39**	−41.11	**31.58**	**−25.49**
−2	−4.76	**−14.47**	**117.33**$^{\wedge\wedge}$	**42.40**$^{\wedge\wedge}$	**84.63**$^{\wedge\wedge}$	**−24.69**
−1	−9.83	**−14.28**	**467.86**$^{\wedge\wedge}$	**287.45**$^{\wedge\wedge}$	**343.95**$^{\wedge\wedge}$	−11.52
Halt	−9.80	**241.32**$^{\wedge\wedge}$	—	—	—	—
Reopen	**−23.37**$^{\vee\vee}$	**360.75**$^{\vee\vee}$	—	—	—	—
+1	**−38.49**$^{\vee\vee}$	**343.60**$^{\vee\vee}$	**814.81**$^{\vee\vee}$	**653.95**	**611.33**	**18.03**$^{\wedge\wedge}$
+2	**−23.06**$^{\vee}$	**98.29**	**420.42**	**301.23**	**325.63**	−5.42
+3	**−22.30**$^{\vee}$	**86.74**	**403.03**	**197.61**	**268.78**	−4.47
+4	**−32.74**$^{\vee\vee}$	**51.50**	**283.86**	**137.51**	**193.20**	−10.48

To highlight the time series differences in bid-asks spreads across the two subsamples, Figure 12 plots median inside spreads at 15-second intervals surrounding trading halts. For halts reopened with a 5-minute quotation
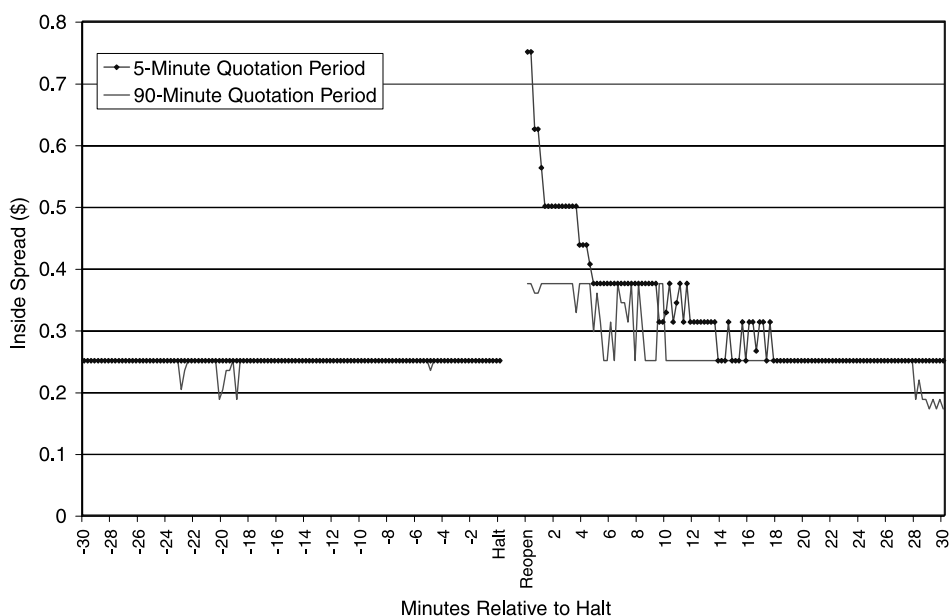
Figure 12. Median dollar spreads around morning and intraday reopenings. The figure plots median bid-ask spreads around Nasdaq trading halts that reopen during the trading day (intraday reopenings) and the following morning (morning reopenings). The full sample includes the 714 Nasdaq trading halts between September 1997 and December 1998. Results in the figure are based on the subsample of 417 halts called during the trading day. Medians are calculated at 15-second intervals across all halts in the subsample. The reopen is defined as the first valid quote after the halt. Valid quotes are defined as quotes with normal condition codes, positive bid and ask prices, and positive bid and ask depths. Trading time is considered continuous between the close on day $t - 1$ and the open on day t.

period, median inside spreads increase from a prehalt level of $0.25 to $0.75 immediately after the halt. Spreads drop to $0.375 in approximately 5 minutes and return to prehalt levels within 10 to 15 minutes. In contrast, for halts that reopen with a 90-minute quotation period, median inside spreads increase from $0.25 prior to the halt to only $0.375 after the halt and return to prehalt levels within 5 minutes. In addition, the statistical tests in Table V suggest that this increase in spreads following 90-minute reopenings is due to a time-of-day effect and is no larger than the increase in spreads near the open on nonhalt days.

Overall, the results in this section are consistent with the hypothesis that increased information transmission during the halt results in reduced uncertainty; 5-minute quotation periods are associated with significantly larger volatility and spread increases than 90-minute quotation periods. In fact, the unusually wide spreads observed immediately after halts in the full sample appear to result exclusively from the subsample of halts that reopen

with a 5-minute quotation period. These findings persist despite the fact that 90-minute quotation halts are associated with larger price changes.

Notably, Table V shows that halts reopened with a 90-minute quotation period exhibit unusually high levels of quote revisions, trades, and share volume up to 90 minutes before the halt. In addition, absolute returns for this subsample are unusually high in the 30 minutes prior to the halt. These prehalt results may result from a relatively high proportion of halts called by Nasdaq market surveillance rather than as a result of direct company announcements. Alternatively, these halts may be associated with a higher level of information leakage or informed trading prior to the halt.

V. Matched-Sample Results

The comparison to nonhalt days that we employ throughout Sections III and IV controls for security characteristics and time-of-day effects in the variables of interest. However, this procedure does not control for information effects associated with trading halts. For example, high posthalt levels of volume and volatility relative to nonhalt days may not be surprising given the endogenous price effects associated with trading halts. To examine whether our results are robust to these information effects, we employ a matching procedure similar to that used in Lee et al. (1994).

For each halt, we select one security-specific nonhalt day for direct comparison to the halt day. Matching nonhalt days are chosen as follows: First, we measure the absolute price change during the halt period on each of the 200 nonhalt days. For example, if the halt occurred between 1:00 and 2:30 p.m., we examine returns during this same 90-minute period on each of the nonhalt days. For each halt, we then select the one nonhalt day with an absolute return during the halt period that is closest to, but larger than, the associated halt return. Using this procedure, we are able to match 421 of the 714 sample halts. Not surprisingly, the matching procedure eliminates many of the halts associated with extremely large price moves. The median absolute return across the 421 halts in the matched sample is 3.65 percent, compared to a median absolute return of 5.5 percent in the full sample.

We repeat all of the analysis from Section III based on this matched sample of halt and nonhalt days. Abnormal measures for each variable are calculated as follows:

$$100 * \left[\frac{Halt\ Day\ Value - Matched\ Nonhalt\ Day\ Value}{Mean\ Value\ Across\ Nonhalt\ Days} \right]. \qquad (2)$$

We standardize by the nonhalt-day mean, rather than the matched-day value, to eliminate the missing values that result from a zero in the denominator. Results are presented in Table VI. The table lists the median value of each abnormal measure and statistical significance is based on a signed-rank test. In addition, separate results for delayed openings and intraday halts are presented in Panels A and B, respectively.

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Table VI

A Comparison of Activity Variables between Halt Days and Matched Nonhalt Days

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The table lists median values for several abnormal activity variables. The abnormal spread is defined as the dollar spread on the halt day minus the dollar spread on the matched nonhalt day, standardized by the mean spread across all nonhalt days. Abnormal measures for other variables are defined similarly. Nonhalt days include the 100 days before and 100 days after the halt, where available. To choose the matching nonhalt day, we first identified all nonhalt days that had an absolute return during the halt period at least as large as return during the halt. If multiple nonhalt days met these criteria, we then chose the single nonhalt day for which the return during the halt period was closest to the return on the halt day. The original sample includes the 714 Nasdaq trading halts between September 1997 and December 1998. The matching procedure resulted in 421 matched pairs of halt and nonhalt days. The halt period is defined as the last valid quote prior to the halt, while the reopen is defined as the first valid quote after the halt. Valid quotes are defined as quotes with normal condition codes, positive bid and ask prices, and positive bid and ask depths. Thirty-minute prehalt periods are measured backward from the beginning of the halt to the open. Thirty-minute posthalt periods are measured forward from the reopening time to the close. The symbols ** and * indicate statistical significance at the one or five percent levels, respectively, based on a signed-rank test. In some cases, the median point estimate is zero but the hypothesis that the distribution is centered around zero is rejected due to skewness. To clarify these cases, we include + or − signs to indicate whether the mean abnormal measure is positive or negative.

			Abnormal Measures			
Period	$ Spread	Absolute Return	Number of Quote Revisions	Share Volume	Number of Trades	Average Trade Size
Panel A: Delayed Openings (N = 156)						
Reopen	91.42**	−9.05**	—	—	—	—
+1	0.00	606.65**	1627.00**	381.59**	385.43**	18.52**
+2	0.00	53.26**	284.33**	169.07**	212.88**	42.73**
+3	0.00	23.90*	146.45**	123.24**	114.01**	31.87**
+4	0.00	+0.00*	76.89**	112.63**	117.04**	25.19**
Panel B: Intraday Halts (N = 265)						
−4	0.00	+0.00**	+0.00**	+0.00**	+0.00**	−1.44
−3	0.00	+0.00**	+0.00**	+0.00**	+0.00**	1.60
−2	−0.00**	+0.00**	+0.00**	+0.00**	+0.00**	8.44
−1	0.00	0.00	108.82**	43.06**	73.13**	11.23
Halt	0.00	44.33**	—	—	—	—
Reopen	76.40**	−8.41**	—	—	—	—
+1	0.00	491.38**	1502.35**	380.80**	465.12**	15.35*
+2	0.00	61.05**	329.94**	201.07**	204.74**	22.46**
+3	0.00	77.23**	276.19**	188.60**	195.73**	18.27**
+4	−0.00**	+0.00**	136.05**	90.52**	104.05**	27.62**

Table VI shows that the dollar spread at the reopen is 91 percent higher than on the matched day for delayed openings and 76 percent higher for intraday halts. Recall that the matched sample is constructed to minimize differences in absolute return between halt and nonhalt days. Thus, the wide

spreads immediately following halts appear to be the result of the halt mechanism rather than the difference in information effects between the halt and nonhalt days.[12]

To highlight the implications of the matching procedure, we plot median absolute price changes for the halt day and matching nonhalt day in Figure 13. Consistent with our matching procedure, Figure 13 and Table VI show that the absolute return during the halt period is lower on the halt day than on the matched nonhalt day. However, despite matching on absolute price change during the halt, absolute returns are unusually high both before and after the halt. For delayed openings (Panel A), absolute returns are over 600 percent higher than nonhalt-day levels in the first posthalt period. Similar results are found for intraday halts (Panel B), where absolute returns are 44 percent higher in the 30 minutes prior to the halt and 490 percent higher in the 30 minutes immediately following the halt. For both intraday halts and delayed openings, absolute returns decrease over time, but remain unusually high for up to 90 minutes after the halt. This result suggests that, even compared to nonhalt periods with similar price changes, the period following Nasdaq halts is characterized by unusually high levels of uncertainty.

The results for number of quote revisions also suggest that volatility is unusually high around Nasdaq halts. Quote revisions in the 30 minutes after delayed openings are more than 1,600 percent higher than on matching nonhalt days and quote revisions immediately after intraday halts are 2,000 percent higher than nonhalt-day levels. Again, this unusual activity decreases over time, but remains significant for at least two hours after the halt.

The matched-sample results for trading activity variables are similar to the full-sample results. Share volume and the number of trades are unusually high immediately after the halt and decrease gradually over the subsequent two hours for both intraday halts and delayed openings.

Overall, the results for the price change matched sample are similar to the full-sample results and suggest that our results are not explained solely by price effects. A final point worth emphasizing is that the median absolute price change for our matched sample drops dramatically during the 30 minutes following the halt period, while the absolute price change following the halt itself is unusually large (see Figure 13). In fact, this price change is similar in magnitude to the absolute return during the halt, reinforcing the observation that trading is an essential ingredient for the eventual resolution of uncertainty following Nasdaq halts.

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[12] While economically insignificant, the dollar spread results for periods −2 and +4 deserve a point of clarification. In these cases, the point estimate for the median is zero, but the signed-rank test rejects the null hypothesis that the distribution is centered around zero. These rejections, which are also evident for several other abnormal measures, result from skewness in the abnormal activity variable. To clarify these cases, we include a positive (negative) sign on the median point estimate if the mean abnormal measure is positive (negative).
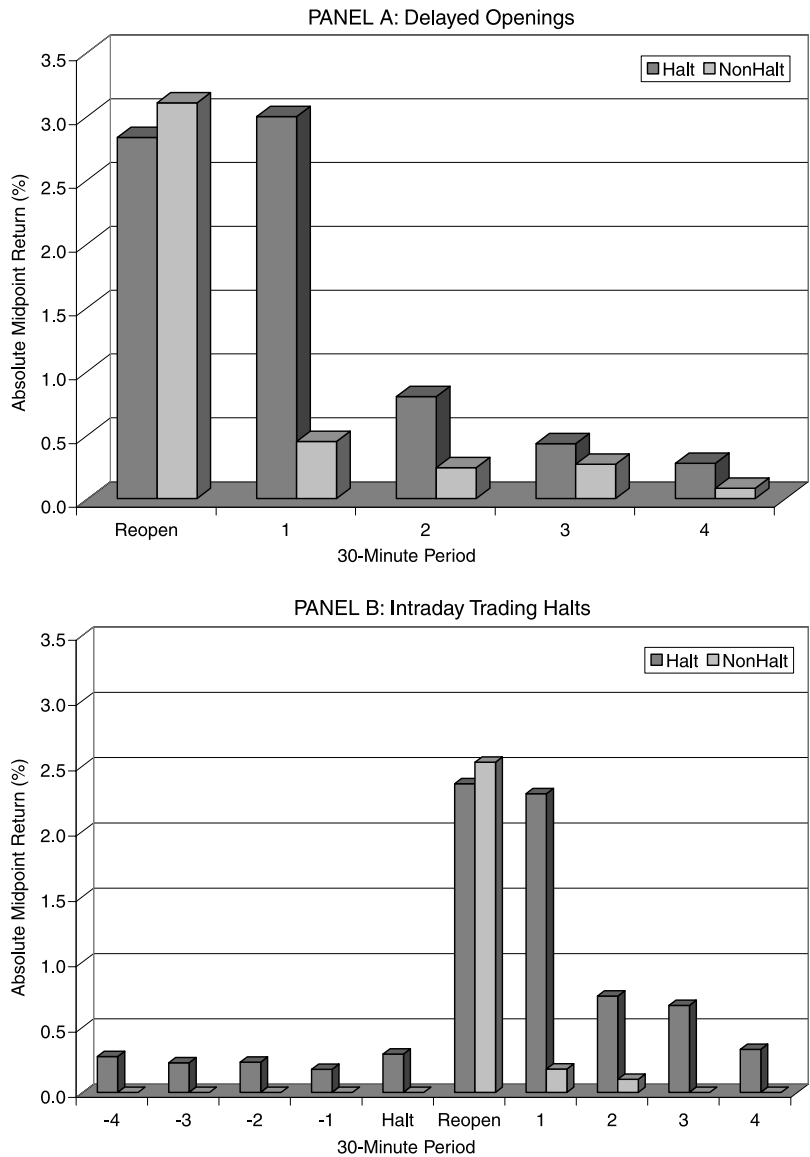
PANEL A: Delayed Openings

PANEL B: Intraday Trading Halts

Figure 13. Absolute price change associated with trading halts and matched nonhalt days. The sample includes the 714 Nasdaq trading halts between September 1997 and December 1998. The figure presents the median absolute midpoint return for halt days and matched nonhalt days. Nonhalt days include the 100 days before and 100 days after the halt, where available. To choose the matching nonhalt day, we first identified all nonhalt days that had an absolute return during the halt period at least as large as the return during the halt. If multiple nonhalt days met these criteria, we then chose the single nonhalt day for which the return during the halt period was closest to the return on the halt day. The matching procedure resulted in 421 matched pairs of halt and nonhalt days. The reopen is defined as the first valid quote after the halt. The 30-minute prehalt periods are measured prior to the beginning of the halt. The 30-minute posthalt periods are measured from the reopening time.

VI. Summary and Conclusions

We study a sample of news-related trading halts on Nasdaq to test the effects of alternative halt mechanisms on trading activity, volatility, and transaction costs. We find that posthalt volatility and transaction cost effects are significantly larger following Nasdaq halts reopened with a 5-minute quotation period than for either Nasdaq halts reopened with a 90-minute quotation period or NYSE halts. These results are consistent with Greenwald and Stein (1991), who show that trading halts that allow for information dissemination during the market closure can improve market liquidity. Consistent with the apparent benefits of increased information flow, Nasdaq recently increased the length of the preopening quotation period for IPOs from 5 to 15 minutes. Our results suggest that similar changes during Nasdaq trading halts may be warranted.

We also find significant increases in posthalt volume and volatility following halts reopened the subsequent morning with a 90-minute quotation period. However, these effects are notably smaller than those associated with 5-minute quotation periods and are quantitatively similar to the effects following NYSE halts, as reported in Lee et al. (1994) and Corwin and Lipson (2000). These findings suggest that trading halts have important effects independent of market structure and specific halt mechanisms. In particular, we find that trading halts are followed by unusually high volatility even when the halt mechanism allows for information transmission during the halt.

Our results also provide new insights into the actions of market makers following extreme information events. We find that market makers immediately adjust the side of the quote at which they face the highest risk of losses to better informed traders. We also show that trade size is unusually low immediately after Nasdaq halts. This trading pattern is consistent with that found following the morning open on Nasdaq (Chan et al. (1995)) and suggests that market makers are unwilling to commit to large trades during this period of high uncertainty. An interesting extension of this research would be to investigate the price discovery process through quote revisions during the five-minute quotation period associated with Nasdaq intraday halts. The study of price discovery during nontrading periods is not without precedent. Most recently, Cao et al. (2000) examine market maker quotes during normal morning openings on Nasdaq. Trading halts provide a unique opportunity to investigate the actions of market makers during a far more compressed period of price discovery, particularly in the presence of significant information shocks.

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