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The impact of tick size on intraday stock price behavior: evidence from the Taiwan Stock Exchange

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Abstract

This research examines the impact of tick size on intraday stock price behavior for stocks listed on the Taiwan Stock Exchange over the 2-year period of 1998–1999. The sample involves the same 80 firms that trade under the tick size of (New Taiwan Dollars) NT$0.1 and NT$0.5, respectively. The sample firms display a U-shaped intraday pattern of bid–ask spread, volatility, autocorrelation, and trading volume. The empirical results indicate that a larger tick size is associated with a wider bid–ask spread, larger volatility, and more negative autocorrelation. Moreover, a larger tick size is associated with a higher percentage increase of bid–ask spread and volatility in the middle of the trading period. Finally, the effect of tick size on trading volume is insignificant.

JEL classification: G14; G15; G18
Keywords: Tick size; Intraday prices; Taiwan Stock Exchange

1. Introduction

This paper examines the impact of tick size, or minimum price variation, on intraday stock price behavior for stocks listed on the Taiwan Stock Exchange. The issue of how tick size affects stock price behavior is important for the design of a market trading mechanism. Specifically, if tick size was larger than warranted by the equilibrium

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condition, tick size would become a binding constraint on stock prices. If so, a reduction in tick size has the potential benefit of reducing transaction costs and increasing trading volume (Harris, 1991, 1994).

Motivated by the potential benefit of a lower tick size, several major stock exchanges in the world have reduced tick size for quoting and trading stocks in the past decade. The New York Stock Exchange (NYSE) reduced tick size from 1/8 to 1/16 of a dollar on June 24, 1997. The American Stock Exchange (AMEX) reduced tick size from 1/8 to 1/16 on September 3, 1992 for stocks priced in the range from $1 to 5. The Nasdaq Stock Market reduced tick size from 1/8 to 1/16 on June 2, 1997 for stocks priced above $10. The Toronto Stock Exchange reduced tick size from (Canadian Dollars) C$0.125 to C$0.05 for stocks priced over C$5 on April 15,1996. The Stock Exchange of Singapore reduced tick size from (Singapore Dollars) S$0.5 to S$0.1 for stocks trading at S$25 or above on July 18, 1994. Finally, the Tokyo Stock Exchange reduced tick sizes for stocks priced in different ranges on April 13, 1998.

The issue of how tick size affects market quality has received much attention (Lau and McInish, 1995; Ahn et al., 1996; Porter and Weaver, 1997; Bessembinder, 2000; Goldstein and Kavajecz, 2000; Huang et al., 2000; Van Ness et al., 2000). Lau and McInish (1995) note that transaction costs would increase unnecessarily if tick size is set higher than that justified by economic fundamentals. However, except for a limited number of previous studies (e.g., Chung and Van Ness, 2001), most previous research does not examine the impact of tick size on intraday stock price behavior.

On the other hand, the intraday patterns of stock prices have also received much attention in the literature. In particular, previous research has documented empirical evidence of a U-shaped intraday pattern of bid–ask spread (McInish and Wood, 1992; Brock and Kleidon, 1992; Ahn and Cheung, 1999), return volatility (Jain and Joh, 1988; Foster and Viswanathan, 1993), autocorrelation (McInish and Wood, 1991; Rhee and Wang, 1997), and trading volume (Jain and Joh, 1988; Foster and Viswanathan, 1993) using data from different stock exchanges.

The intraday pattern of stock prices is consistent with the information asymmetry hypothesis of market microstructure (e.g., Copeland and Galai, 1983; Foster and Viswanathan, 1990). First, the intraday pattern of bid–ask spread is consistent with the information asymmetry hypothesis. In equilibrium, uninformed traders would require larger spreads to compensate their loss when trading with informed traders if the information asymmetry between informed traders and uninformed traders becomes greater. Foster and Viswanathan (1993) report that the adverse selection problem faced by uninformed traders is more severe at the market open and close. If so, bid–ask spreads would be wider near market open and close.

Second, the intraday pattern of return volatility and trading volume is consistent with the information asymmetry hypothesis. Foster and Viswanathan (1993) suggest that informed traders who acquire private information in the nontrading period tend to trade more aggressively after the market open if they believe the information will become public information quickly. Brock and Kleidon (1992) propose that higher trading volume at the open and close reflects the need to rebalance portfolios after the market open and before the market close. This is due to portfolios that may not be optimal at the market open that resulted from the arrival of new information in the nontrading period. Similarly, portfolios that are optimal in the midday of the trading period may no longer be optimal at the market close due to the coming nontrading period.

Third, the intraday pattern of autocorrelation is consistent with the information asymmetry hypothesis. If an informed trader chooses to divide a large trade into several small trades, holding other things constant, the return autocorrelation will be more positively correlated. This positive correlation reflects the strategic trading behavior of the informed trader; therefore, the information is revealed gradually through several small trades. Moreover, if intensive trades occur more frequently around market open and close due to the accumulation of information in the nontrading period or the reluctance of traders to hold position overnight, return autocorrelation will be more likely to be positive during these periods. The positive autocorrelation induced by the informed trading, together with the negative autocorrelation generated by bid–ask errors, will lead to an intraday pattern of autocorrelation (Rhee and Wang, 1997).[1]

Although the issue of intraday price behavior has received much attention, most previous research does not integrate tick size into the analysis of intraday price behavior. In this paper, we examine the impact of tick size on intraday bid–ask spread, autocorrelation, return volatility, and trading volume. We select sample stocks that trade in different tick sizes but resemble in other respects. Our approach is similar to that in Huang et al. (2000). However, their focus is restricted to the impact of tick size on daily closing prices. In contrast, we concentrate on intraday price behavior derived from transaction data in this paper.

The Taiwan Stock Exchange employs different tick sizes for stocks priced in different ranges. Specifically, tick size is (New Taiwan Dollars) NT$0.1 for stocks priced in NT$15–50 and NT$0.5 for stocks priced in NT$50–150.[2] Since tick size for stocks priced immediately above NT$50 is five times of that for stocks priced immediately below NT$50, the impact of tick size on intraday stock price behavior can be analyzed conveniently for stocks traded in the proximity of NT$50. In this paper, we examine the intraday stock price behavior for the same stocks traded in both the NT$40–50 and NT$50–60 ranges over the sample period 1998–1999. This research design allows a robust test of the impact of tick size while at the same time controls potential confounding effects due to firm-specific factors.

Our major empirical findings are as follows. First, tick size has a significant impact on intraday bid–ask spread, autocorrelation, and return volatility. A larger tick size is associated with a wider bid–ask spread, larger return volatility, and more negative autocorrelation. Second, a larger tick size is associated with a higher percentage increase in bid–ask spread and return volatility in the middle than in other part of the trading period. Since intraday patterns of bid–ask spread and return volatility are U-shaped, a

[1] If the intraday bid–ask spread is U-shaped, the noise component of autocorrelation caused by bid–ask errors will be reverse U-shaped (due to the negative sign of autocorrelation). However, the combined effect on autocorrelation can still be U-shaped if the positive information effect is greater than the negative noise effect around market open and close.

[2] Tick size varies in different price ranges, P. Tick size is (1) NT$0.01 for $P <$ NT$5; (2) NT$0.05 for NT$5 $\leq P <$ NT$15; (3) NT$0.1 for NT$15 $\leq P <$ NT$50; (4) NT$0.5 for NT$50 $\leq P <$ NT$150; (5) NT$1.0 for NT$150 $\leq P <$ NT$1000; (6) NT$5.0 for NT$1000 $\leq P$.

large tick size tends to be binding in the middle than in other part of the trading period. Finally, the impact of tick size on intraday trading volume is less significant.

The remainder of this paper is organized as follows. Section 2 provides a brief literature review. Section 3 presents institutional background of the Taiwan Stock Exchange. Section 4 develops our research hypotheses. Section 5 describes the data and the methodology. Section 6 reports the empirical results. Section 7 concludes the paper.

2. Literature review

Previous research has investigated the impact of tick size reduction on stock price behavior using data from different stock exchanges. Lau and McInish (1995) examine the effect of tick size reduction on bid–ask spread and trading volume for stocks listed on the Stock Exchange of Singapore. Minimum tick size reduced from (Singapore Dollars) S$0.50 to S$0.10 for stocks priced at S$25 or more on July 18, 1994 on the Stock Exchange of Singapore. Lau and McInish find that the tick size reduction results in a significant reduction in both bid–ask spreads and quotation sizes. Moreover, the decrease in bid–ask spreads is larger for stocks that were more constrained by the pre-reduction tick size. The results are consistent with the prediction of the Harris (1994) model. However, they report an insignificant change in trading volume before and after the change of tick size.

Ahn et al. (1996) examine the impact of tick size reduction on bid–ask spreads and trading volume for stocks listed on the AMEX. The AMEX reduced tick size from 1/8 to 1/16 of a dollar on September 3, 1992. Ahn, Cao, and Choe find a substantial reduction in both quoted and effective spreads following the reduction in tick size. However, they find that the tick size reduction affects neither trading volume nor market depth.

Goldstein and Kavajecz (2000) examine the impact of tick size reduction on liquidity using limit order data provided by the NYSE. The NYSE reduced tick size from 1/8 to 1/16 of a dollar on June 24, 1997. Goldstein and Kavajecz find that both bid–ask spreads and market depths decline after the tick size reduction. Similarly, Van Ness et al. (2000) examine the impact of tick size reduction on market quality for stocks listed on the AMEX, Nasdaq, and NYSE in mid-1997. They document a reduction in the bid–ask spread, effective spread, and a significant increase in the number of quotes following the reduction in tick size.

Bacidore (1997) examines the impact of tick size reduction on market quality for stocks listed on the Toronto Stock Exchange. The Toronto Stock Exchange reduced tick size from (Canadian Dollars) C$0.125 (1/8 of a dollar) to C$0.05 following its shift to decimal trading on April 15, 1996. Bacidore reports a significant decline in bid–ask spreads and quoted depths for stocks trading above C$5 after the reduction in tick size. However, the average daily trading volume does not increase significantly. Similarly, Porter and Weaver (1997) examine the impact of tick size reduction on market quality for stocks listed on the Toronto Stock Exchange. They report that the reduction in tick size is associated with a reduction in execution costs, especially for low-priced, high-volume stocks.

Ahn et al. (2001) examine the impact of a change in tick size on April 13, 1998 by the Tokyo Stock Exchange. They find that the quoted spread declines significantly by 20% to

50% after changing the tick size. However, they find no definite evidence of an increase in trading volume. They interpret their results as consistent with the hypothesis that price competition in the limit order book increases substantially after the tick size changes.

For some stock exchanges, tick size varies in different price ranges. Thus, an alternative approach to study the impact of tick size is to examine the price behavior for stocks whose prices pass through different tick size ranges. Bessembinder (2000) investigates changes in trade execution costs and market liquidity for Nasdaq-listed firms whose tick size changes as their share prices pass through $10 during 1995. He finds that the bid–ask spreads are narrower by three to five cents per share under smaller tick size but no evidence of a reduction in liquidity.

Huang et al. (2000) examine the impact of tick size on daily closing prices for stocks listed on the Taiwan Stock Exchange. Their study is pertinent to ours in analyzing the stock price behavior under different tick sizes in the Taiwan stock market. However, their study is restricted to the stock price behavior derived from daily closing prices. In contrast, our study focuses on the intraday stock price behavior derived from transaction data. They find that stocks traded in smaller tick sizes are associated with narrower effective bid–ask spread and lower return volatility.

Chan and Hwang (2001) examine the stock market quality for stocks traded in different tick sizes on the Stock Exchange of Hong Kong. They find that bid–ask spreads decrease and market depth improves when tick sizes become smaller. Moreover, when tick sizes become smaller, trading volume for stocks trading below (Hong Kong Dollars) HK$5 increases.

Finally, a limited number of previous studies have investigated the impact of tick size on intraday stock price behavior. Chung and Van Ness (2001) document that the tick size reduction on the Nasdaq is associated with a significant decline in spreads. Moreover, the magnitude of the decline in spreads is larger when tick size was binding in the pre-reduction period. Chung and Ness note that the bid–ask spread is higher at the open and lower near the close of the trading period for Nasdaq stocks. Prior to the tick size reduction, tick size tends to be binding near the market close. Chung and Ness find a larger decline in bid–ask spreads near the market close following the tick size reduction.

In summary, previous research has provided empirical evidence that tick size has a significant impact on stock price behavior. However, only a limited number of previous studies investigate the impact of tick size on intraday stock price behavior. This paper addresses this important issue of how tick size affects intraday stock price behavior.

3. Institutional background

The Taiwan Stock Exchange utilizes a call market method to determine the opening and all subsequent trading prices. No formal specialists or dealers are involved in the market making. Buy and sell orders are matched by a computer system. As a result, bid–ask spreads reflect the highest bid price and the lowest ask price of unmatched orders.

Specifically, for each batching period, all buy orders and sell orders are sorted according to their order prices in an ascending manner. The clearing price is selected as the one that clears the maximum trading volume. All buy orders with prices greater than

Table 1
Distribution of daily closing prices and summary statistics of sample firms in the sample period 1998–1999

Panel A. Distribution of daily closing prices (%)

	1998	1999	1998–1999
~ NT$10	0.8	14.2	7.4
NT$10–20	22.7	35.9	29.2
NT$20–30	23.2	18.2	20.7
NT$30–40	16.5	10.1	13.4
NT$40–50	9.9	6.4	8.1
NT$50–60	7.4	3.7	5.6
NT$60–70	5.8	2.9	4.4
NT$70–80	3.6	1.6	2.6
NT$80 ~	10.1	7.1	8.6
Average stock price	NT$42.4	NT$32.2	NT$37.4

Panel B. Summary statistics of sample firms

	NT$40–50	NT$50–60	NT$40–60
No. of firms	80	80	80
No. of trading days	81	71	76
Firm size (in million NT$)	33,871	40,532	37,202
Trading volume (1000 shares)	8266	8100	8183

the clearing price must be filled. Similarly, all sell orders with prices lower than the clearing price must be filled. The highest order price of the unfilled buy order is disclosed as the bid price. Likewise, the lowest order price of the unfilled sell order is disclosed as the ask price. As such, the transaction price must fall between the bid and ask price. Rhee and Wang (1997) provide a thorough description of the price determination on the Taiwan Stock Exchange and note that the transaction prices also bounce between bid and ask prices under a call market method as in a continuous auction market.

For the opening price, buy and sell orders are submitted and accumulated over the half-hour period from 8:30 AM to 9:00 AM prior to market open at 9:00 AM. The opening price is determined by selecting the price that maximizes the cleared volume. All buy and sell orders with prices better than the cleared price must be filled. During the trading period from 9:00 AM through 12:00 noon, the same call market method is adopted to determine the trading price for each run of order matching. For each run, orders are batched over a period of around 1 min. For some actively traded stocks, the cycle of matching could be shorter. This process proceeds until the market close at noon.[3]

The Taiwan Stock Exchange requires all listed stocks to have a par value of NT$10. Panel A of Table 1 indicates that, over the sample period of 1998–1999, 8.1% of stock

[3] Empirical evidence based on the Taiwan Stock Exchange indicates that return volatility is lower under the call market method than that under the continuous auction method (Chang et al., 1999). Moreover, return volatility becomes higher under greater trading frequency (Lang and Lee, 1999).

daily closing prices fall in the range of NT$40–50 and 5.6% in NT$50–60. The average stock price is NT$37.4 over the sample period 1998–1999.

To restrict excessive price movements, the Taiwan Stock Exchange requires trading prices in each run to be no more than two ticks away from the trading prices in the preceding run. Thus, the bid–ask spread is typically no more than four ticks. Aside from the intraday price constraint, daily price limit of 7% is imposed. Thus, all trading prices cannot exceed 7% from the closing price in the previous trading day.

4. Hypotheses: Tick size and intraday prices

To fasten the process of matching buy and sell orders, traders may prefer to quote prices at certain convenient price grids (Harris, 1991). If tick size is lower than the convenient price grid, traders may quote prices at certain multiples of tick size. However, if tick size is larger than warranted by the economic equilibrium condition, tick size may become a binding constraint that could have a significant impact on intraday stock price behavior.

When tick size represents a binding constraint on stock prices, a larger tick size could lead to higher bid–ask spread, higher return volatility, and more negative return autocorrelation. For example, assuming the intrinsic value of a stock falls in the middle of the bid and the ask prices, an increase in tick size could force the bid price to become lower and the ask price to be higher. As a result, the bid–ask spread would become wider.

When bid–ask spread becomes wider under a larger tick size, return volatility would be greater due to the higher bid–ask error. Kaul and Nimalendran (1990) note that the major source of price reversals in the short-run is the bid–ask error. For simplicity, assume that the stock return consists of an information component and a noise component, or $r = r_{\text{info}} + r_{\text{noise}}$, where the correlation between r_{info} and r_{noise} is assumed to be zero. The return variance would contain an information component and a noise component, or $\sigma^2 = \sigma^2_{\text{info}} + \sigma^2_{\text{noise}}$. The noise component may reflect mainly the bid–ask error, which tends to be larger under a wider bid–ask spread.

Similarly, a larger tick size could lead to more negative return autocorrelation due to larger bid–ask bouncing errors. Assuming the intrinsic value of stock falls in the middle of the bid–ask spread, the bid price would become lower and the ask price would be higher under a larger tick size. The number of shares offered at the higher ask price and demanded at the lower bid price would increase.[4] Under thicker market depth, the degree of bid–ask bouncing would increase due to the increased supply of and demand for liquidity. Thus,

[4] The positive association between spreads and depths applies to a particular point in time in the intraday period. That is, the information asymmetry is held constant at this point in time. In contrast, Ahn and Cheung (1999) find a negative association between spreads and depths due to the changing information asymmetry over the trading period. Ahn and Cheung note that the adverse selection problem is more severe around market open and close than in the midday of the trading period. Hence, spreads are wider and depths are lower around market open and close. Over time, the negative association between spreads and depths is driven by the varying degree of information asymmetry in the intraday period.

return autocorrelation would be more negative due to the higher degree of bid–ask errors when tick size is larger.

Aside from the above impact, tick size may affect bid–ask spreads and volatility more in the middle than in other part of the trading period. For a U-shaped intraday bid–ask spread, the bid–ask spread is narrower in the midday of the trading period. When tick size increases, the bid–ask spread in the midday of the trading period would be constrained to be at least as large as the magnitude of the tick size. Thus, the bid–ask spread would increase more in the middle of the trading period. Under a large tick size, the intraday U-shaped bid–ask spread would become flatter due to the constrained bid–ask spread in the middle of the trading period. Similarly, for a U-shaped intraday pattern of return variance, an increase in tick size would affect intraday return variance more in the middle than in other part of the trading period.

Finally, the impact of tick size on trading volume would be less obvious. Under a wider bid–ask spread, the supply of liquidity would tend to increase at both the lower bid price and the higher ask price. However, the demand for liquidity would tend to decline due to higher trading costs. The combined effect of a larger tick size on trading volume would be less obvious since an increased supply and a decreased demand may cause trading volume to increase, decrease, or remain unchanged. The actual impact of different tick sizes on trading volume would be a subject of empirical tests.

5. Data and methodology

The data contain intraday trading prices over the 2-year period of 1998–1999. Moreover, only stock prices in the range of NT$40–60 are examined. This selection allows an examination of the impact of tick size on intraday stock price behavior. Specifically, selected firms must have at least 30 daily trading prices in the NT$40–50 range and another 30 trading days with prices in the NT$50–60 range in the 1998–1999 sample period. For the NT$40–50 group, all intraday trading prices, including daily low and daily high, must fall within the range of NT$40–50. Although selected trading days in the NT$40–50 group may not be consecutive, tick size must always be constant at NT$0.1 for this group. Similarly, tick size is constant at NT$0.5 for the NT$50–60 group. This screening process excludes trading days with prices moving back and forth between the NT$40–50 range and the NT$50–60 range on a particular day. Since both the NT$40–50 and the NT$50–60 groups correspond to the same firms, the sample selection procedure eliminates firm-specific factors and allows for a focus on examining the impact of tick size on intraday stock price behavior.

Panel B of Table 1 indicates that the screening process results in 80 sample firms with an average of 81 trading days in the price range of NT$40–50 and 71 trading days in the price range of NT$50–60. The average market value for these sample firms is NT$37.2 billion. The average daily trading volume is slightly over 8000 round lots where each lot consists of 1000 shares.

To examine the intraday stock price behavior and to evaluate the impact of tick size on intraday price behavior, measures of market quality for the NT$40–50 and the NT$50–60 groups are estimated separately. The intraday price behavior is examined for the 36 5-minute subperiods from 9:00 AM to 12:00 noon. These measures of market quality include bid–ask spreads, variance of returns, coefficients of autocorrelation, and trading volume. Of these measures, the first three of bid–ask spreads, variance of returns, and coefficients of autocorrelation are related to liquidity, which are important measures of market quality. The fourth measure, trading volume, is an important indicator of market activity.

For each selected trading day, the bid–ask spread is estimated for every 5-minute subperiod, say 9:00–9:05 AM, by averaging the observed bid–ask spreads for all runs of order matching in this subperiod. The estimated bid–ask spread is then averaged across all selected days and across all selected firms in the groups of NT$40–50 and NT$50–60, respectively.

Similarly, the 5-minute return and the trading volume are estimated for each 5-minute subperiod of each selected trading day first. The return variance and the average trading volume of each subperiod are estimated across all selected trading days and averaged across all firms for the NT$40–50 and NT$50–60 groups, respectively. Finally, the coefficient of autocorrelation is estimated over a 20-minute window, rolling on a 5-minute interval, from 9:00 AM to 9:20 AM, 9:05 AM to 9:25 AM, until 11:40 AM to 12:00 noon. For each 20-minute window, the trading price is first selected for each minute as the closest settling price. For each selected trading day, the coefficient of autocorrelation is estimated from trading prices in the 20-minute subperiod. The estimated coefficients of autocorrelation are averaged across trading days and firms in the NT$40–50 and NT$50–60 groups, respectively. Differences in bid–ask spreads, variance of returns, coefficients of autocorrelation, and trading volume are assessed between the NT$40–50 and the NT$50–60 groups to evaluate the impact of tick size.[5,6]

[5] The standard deviation of returns over a 5-minute interval is computed as follows:

(1) The 5-minute return on the sth interval (i.e., 9:00–9:05 is the first interval, 11:55–12:00 is the 36th interval) for stock i on day t is computed as the logarithm of the price relative: $r_{it}^{s} = \ln(p_{it}^{s}/p_{it}^{s-1})$, where p_{it}^{s} is the last transaction price in the sth 5-minute interval; $s = 1,2,\ldots,36$.
(2) The mean of returns on the sth interval for firm i over the sample period is estimated as the average of returns over available sample days: $\bar{r}_i^s = (\sum_{t=1}^{T} r_{it}^{s})/T$, where T is the number of available sample days for stock i on interval s.
(3) The standard deviation of returns on the sth interval for firm i over the sample period is computed as $\sigma_i^s = \sqrt{\sum_{t=1}^{T}(r_{it}^{s} - \bar{r}_i^s)^2/(T-1)}$.
(4) The average of standard deviation for the sth interval is computed across firms as: $\sigma^s = \frac{\sum_{i=1}^{N}\sigma_i^s}{N}$, where N is the number of sample firms.

[6] The coefficient of autocorrelation over a 20-minute interval is computed as follows:

(1) The sth 20-minute interval (i.e., 9:00–9:20 is the first interval, rolling on a 5-minute interval, till the 33rd interval of 11:40–12:00) for stock i on day t is first partitioned into 20 1-minute time grids or $\tau = 1,\ldots,20$. The last transaction price in each 1-minute time grid is used to compute the return on the 1-minute time grid: $r_{it}^{s,\tau} = \ln(p_{it}^{s,\tau}/p_{it}^{s,\tau-1})$, $\tau = 1,\ldots,20$; $s = 1,\ldots,33$.
(2) The 20 1-minute returns over the sth interval are used to compute the autocorrelation for stock i on day t: $\rho_{it}^{s} = \mathrm{cov}(r_{it}^{s,\tau}, r_{it}^{s,\tau+1})/\mathrm{var}(r_{it}^{s})$, $\tau = 1,\ldots,19$.
(3) The autocorrelation over the sth interval for stock i is averaged across sample days as: $\rho_i^s = \sum_t^T(\rho_{it}^s)/T$, $s = 1,\ldots,33$.
(4) The autocorrelation over the sth section is averaged across sample firms as: $\rho^s = (\sum_{i=1}^{N}\rho_i^s/N)$, $s = 1,\ldots,33$.

6. Empirical results

6.1. Tick size and intraday stock prices

The empirical results indicate that the intraday patterns of bid–ask spreads, return variance, and autocorrelation coefficients are generally U-shaped. Moreover, a larger tick size is associated with wider bid–ask spreads, larger return variance, and more negative autocorrelation.

Table 2 and Fig. 1 report the intraday patterns of bid–ask spreads for both the NT$40–50 and NT$50–60 groups. The bid–ask spreads are U-shaped which are higher at both the open and the close of the trading period for both groups. In the NT$40–50 group, the average bid–ask spread is NT$0.171 for the first and the last 5-minute intervals, respectively, which are 19% higher than the NT$0.144 in the middle of the trading period. In the NT$50–60 group, the bid–ask spreads in the opening and the closing 5-minute intervals are around 9% higher than that in the middle of the trading period. The U-shaped patterns of bid–ask spreads are consistent with the information asymmetry hypothesis suggested in Foster and Viswanathan (1993).

Table 2 also indicates that bid–ask spreads are significantly higher under a large tick size than those under a small tick size. Over the whole trading period, the average bid–ask spread increases from NT$0.151 in the NT$40–50 group to NT$0.531 in the NT$50–60 group. Thus, the average bid–ask spread of the NT$50–60 group is 3.51 times of that of the NT$40–50 group. The t-value 67.02 for the difference in the average bid–ask spreads between the two groups indicates that tick size has a significant impact on the bid–ask spreads. That is, the average bid–ask spread is significantly larger when tick size increases from NT$0.1 to NT$0.5.[7]

Moreover, a larger tick size is associated with a higher percentage increase of bid–ask spread in the middle than in other part of the trading period. The last four rows of Table 2 indicate that the average bid–ask spread has the highest percentage increase in the middle hour under a larger tick size. In the 10:00–11:00 subperiod, the average bid–ask spread of NT$0.522 of the NT$50–60 group is 3.60 times of the NT$0.145 of the NT40–50 group. In contrast, the corresponding ratio is only 3.44 and 3.52 times, respectively, in the first and the last hour of the trading period. To provide a comparison of intraday patterns, we scale the intraday bid–ask spread for the NT$40–50 group by 3.51 times (the dotted curve in Fig. 1) to make the two groups (the NT$50–60 and the scaled NT$40–50) have equal average bid–ask spread. The intraday bid–ask spread of the NT$50–60 group appears to be flatter than that of the scaled NT$40–50 group.

Table 3 and Fig. 2 report U-shaped return standard deviations for both the NT$40–50 and the NT$50–60 groups. In the NT$40–50 group, the average standard deviations of returns are NT$0.0060 and NT$0.0061, respectively, in the opening and the closing 5-minute

[7] Bid–ask spreads range from one tick to four ticks. In the NT$40–50 group, the average percentage for one-tick bid–ask spread is 60.81%, 30.69% for two-tick bid–ask spreads, 5.32% for three-tick bid–ask spreads, and 3.19% for four-tick bid–ask spreads. In the NT$50–60 group, the average percentage for one-tick bid–ask spread is 94.32%, 5.36% for two-tick bid–ask spreads, 0.23% for three-tick bid–ask spreads, and 0.10% for four-tick bid–ask spreads.

Table 2
The intraday bid–ask spreads for the NT$40–50 and NT$50–60 groups over 1998–1999

Time	NT$40–50 group (1)	NT$50–60 group (2)	Difference (2) – (1)	*t*-Value for (2) – (1)
9:00–9:05	0.171	0.568	0.397	44.00*
9:05–9:10	0.173	0.559	0.386	42.05*
9:10–9:15	0.167	0.547	0.380	48.61*
9:15–9:20	0.161	0.542	0.381	51.39*
9:20–9:25	0.157	0.540	0.383	48.23*
9:25–9:30	0.155	0.533	0.378	62.69*
9:30–9:35	0.152	0.533	0.381	54.21*
9:35–9:40	0.151	0.533	0.383	50.87*
9:40–9:45	0.150	0.528	0.378	62.97*
9:45–9:50	0.150	0.531	0.381	45.48*
9:50–9:55	0.148	0.528	0.380	60.34*
9:55–10:00	0.147	0.527	0.380	66.71*
10:00–10:05	0.146	0.523	0.376	64.54*
10:05–10:10	0.146	0.523	0.377	64.49*
10:10–10:15	0.146	0.522	0.376	72.64*
10:15–10:20	0.145	0.524	0.379	64.03*
10:20–10:25	0.145	0.522	0.377	69.59*
10:25–10:30	0.144	0.518	0.374	83.27*
10:30–10:35	0.143	0.522	0.378	72.77*
10:35–10:40	0.145	0.521	0.376	81.53*
10:40–10:45	0.143	0.523	0.380	78.24*
10:45–10:50	0.145	0.522	0.378	79.36*
10:50–10:55	0.146	0.523	0.378	67.23*
10:55–11:00	0.146	0.524	0.378	73.41*
11:00–11:05	0.145	0.524	0.379	76.31*
11:05–11:10	0.145	0.523	0.377	79.99*
11:10–11:15	0.146	0.522	0.376	77.38*
11:15–11:20	0.146	0.524	0.378	71.71*
11:20–11:25	0.147	0.526	0.379	69.34*
11:25–11:30	0.147	0.523	0.376	85.11*
11:30–11:35	0.148	0.525	0.377	77.91*
11:35–11:40	0.150	0.526	0.376	80.85*
11:40–11:45	0.152	0.528	0.376	81.52*
11:45–11:50	0.155	0.532	0.377	74.36*
11:50–11:55	0.158	0.540	0.382	69.17*
11:55–12:00	0.171	0.570	0.399	60.51*
Average				
9:00–10:00	0.157	0.539	0.382	53.13*
10:00–11:00	0.145	0.522	0.377	72.59*
11:00–12:00	0.151	0.530	0.379	75.35*
9:00–12:00	0.151	0.531	0.380	67.02*

The asterisk * indicates significance at the 5% level (two-sided).

intervals, which are 58% and 60% higher than the NT$0.0038 in the middle of the trading period. Similarly, in the NT$50–60 group, the average return standard deviations are NT$0.0088 in the first and NT$0.0094 in the last 5-minute intervals, which are 40% and 49% higher, respectively, than the NT$0.0063 in the middle of the trading period.

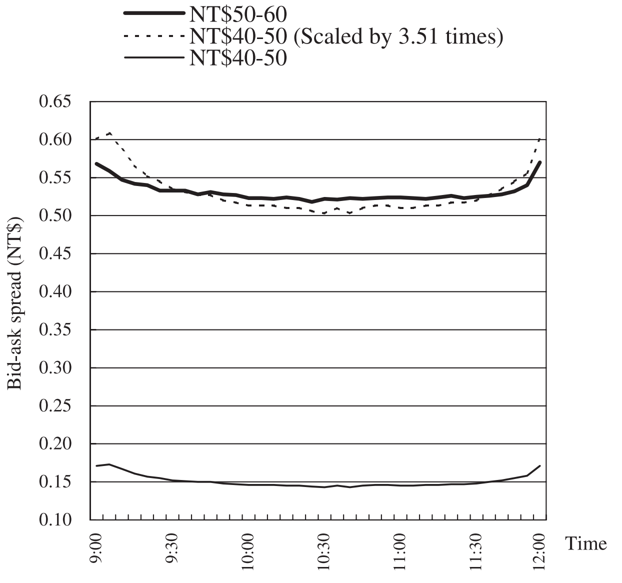

Fig. 1. Bid–ask spreads for the three groups of NT$40–50, NT$50–60, and NT$40–50 (scaled by 3.51 times).

Table 3 also indicates that a larger tick size is associated with a higher average standard deviation of returns. Over the whole trading period, the average 5-minute standard deviation increases by 50% from NT$0.0046 in the NT$40–50 group to NT$0.0069 in the NT$50–60 group. The *t*-value 11.94 for the difference in the standard deviations between the two groups indicates a significant impact of tick size on the standard deviation of returns.

Similarly, the last four rows of Table 3 indicate that a larger tick size is associated with a higher percentage increase in return volatility in the middle trading hour. The return variance 0.64% of the NT$50–60 group is 1.63 times of the 0.39% of the NT$40–50 group in the 10:00–11:00 period. In contrast, the corresponding ratio is only 1.36 and 1.57 times, respectively, in the first and the last hour of the trading period. Again, Fig. 2 indicates that the NT$50–60 group has a flatter intraday return volatility than the corresponding scaled NT$40–50 group.

Table 4 and Fig. 3 report a less negative autocorrelation coefficient around the market open. In the NT$40–50 group, the autocorrelation coefficient is − 0.24 in the first 20 minutes of the trading period, which is around two-thirds (in absolute value) of the − 0.33 in the middle of the trading period. The less negative autocorrelation around the market open is consistent with the information asymmetry hypothesis in that informed traders reveal private information through several small trades. The autocorrelation coefficients remain stable in the second half of the trading period except for a slightly upward trend near the market close. The same intraday pattern of autocorrelation coefficients is observed in the NT$50–60 group.

Table 4 also indicates that the autocorrelation is more negative under a larger tick size than that under a smaller tick size. Over the whole trading period, the average coefficient

Table 3
Standard deviation of returns for the NT$40–50 and NT$50–60 groups over 1998–1999

Time	NT$40–50 group (1)	NT$50–60 group (2)	Difference (2) – (1)	*t*-Value for (2) – (1)
9:00–9:05	0.0060	0.0088	0.0028	8.81*
9:05–9:10	0.0084	0.0096	0.0012	2.87*
9:10–9:15	0.0068	0.0083	0.0015	5.09*
9:15–9:20	0.0060	0.0076	0.0016	5.98*
9:20–9:25	0.0056	0.0075	0.0019	8.26*
9:25–9:30	0.0051	0.0074	0.0022	9.56*
9:30–9:35	0.0051	0.0072	0.0020	8.93*
9:35–9:40	0.0053	0.0069	0.0017	5.53*
9:40–9:45	0.0046	0.0067	0.0021	10.42*
9:45–9:50	0.0048	0.0071	0.0024	9.29*
9:50–9:55	0.0046	0.0069	0.0023	10.36*
9:55–10:00	0.0044	0.0066	0.0022	10.24*
10:00–10:05	0.0042	0.0066	0.0023	11.82*
10:05–10:10	0.0042	0.0062	0.0020	11.37*
10:10–10:15	0.0042	0.0065	0.0023	13.07*
10:15–10:20	0.0039	0.0065	0.0026	13.98*
10:20–10:25	0.0038	0.0063	0.0025	16.30*
10:25–10:30	0.0038	0.0063	0.0025	15.88*
10:30–10:35	0.0037	0.0064	0.0027	15.55*
10:35–10:40	0.0038	0.0063	0.0025	12.67*
10:40–10:45	0.0039	0.0063	0.0024	13.25*
10:45–10:50	0.0037	0.0064	0.0026	16.63*
10:50–10:55	0.0038	0.0064	0.0025	15.21*
10:55–11:00	0.0039	0.0062	0.0023	14.94*
11:00–11:05	0.0039	0.0063	0.0024	13.70*
11:05–11:10	0.0037	0.0063	0.0026	15.60*
11:10–11:15	0.0038	0.0065	0.0027	14.65*
11:15–11:20	0.0039	0.0065	0.0026	14.48*
11:20–11:25	0.0043	0.0065	0.0022	10.69*
11:25–11:30	0.0041	0.0065	0.0025	14.35*
11:30–11:35	0.0042	0.0066	0.0024	14.23*
11:35–11:40	0.0043	0.0067	0.0024	14.66*
11:40–11:45	0.0046	0.0067	0.0021	11.61*
11:45–11:50	0.0047	0.0073	0.0026	14.20*
11:50–11:55	0.0051	0.0073	0.0022	12.11*
11:55–12:00	0.0061	0.0094	0.0033	13.56*
Average				
9:00–10:00	0.0056	0.0076	0.0020	7.95*
10:00–11:00	0.0039	0.0064	0.0024	14.22*
11:00–12:00	0.0044	0.0069	0.0025	13.65*
9:00–12:00	0.0046	0.0069	0.0023	11.94*

The asterisk * indicates significance at the 5% level (two-sided).

of autocorrelation -0.47 of the NT$50–60 group is 47% larger (in absolute magnitude) than the -0.32 of the NT$40–50 group. The more negative autocorrelation that appears in the NT$50–60 group is consistent with the explanation of larger bid–ask errors resulted from a larger tick size.

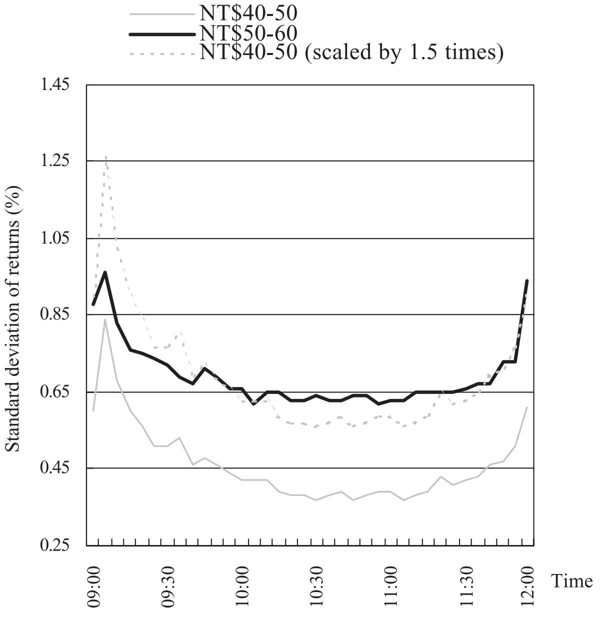

Fig. 2. Standard deviation of returns for the three groups of NT$40–50, NT$50–60, and NT$40–50 (scaled by 1.5 times).

Likewise, the intraday pattern of autocorrelation appears to be flatter under a larger tick size. The last four rows of Table 4 indicate that the average autocorrelation coefficient − 0.49 of the NT$50–60 group in the 10:00–11:00 period is (in absolute value) 1.44 times of the − 0.34 of the NT$40–50 group. In contrast, the autocorrelation in the first trading hour is more negative for the NT$50–60 group. The autocorrelation coefficient − 0.45 of the NT$50–60 group in the first trading hour is (in absolute value) 1.61 times of the − 0.28 of the NT$40–50 group. This more negative autocorrelation for the NT$50–60 group in the first trading hour is consistent with the explanation that the bid–ask errors play a more important role in determining autocorrelation under a larger tick size. Under a larger tick size, the bid–ask bouncing errors become larger and are more likely to offset the positive information effect around market open and close.

Finally, Table 5 and Fig. 4 indicate that the intraday trading volume is U-shaped. In the NT$40–50 group, the average logarithmic trading volume is 5.1 round lots in the first and the last 5-minute intervals of the trading period, which are 28% higher than the 4.0 round lots in the middle of the trading period. Similarly, in the NT$50–60 group, the average logarithmic trading volume is 5.6 round lots in the first and the last 5-minute intervals of the trading period, which are 33% higher than the 4.2 round lots at 10:30 AM.

Table 5 and Fig. 4 also indicate that the trading volume of the NT$50–60 group is slightly higher than that of the NT$40–50 group, although the increase in trading volume is insignificant. Table 5 indicates that the average algorithmic 5-minute trading volume 4.52 round lots of the NT$50–60 group is 7% higher than the 4.22 round lots of the NT$40–50 group.

Table 4
Autocorrelation coefficients of returns for the NT$40–50 and NT$50–60 groups over 1998–1999

Time	No. of firms	NT$40–50 group (1)	NT$50–60 group (2)	Difference (1) – (2)	*t*-Value for (1) – (2)
9:00–9:20	51	– 0.24	– 0.39	0.15	4.55*
9:05–9:25	52	– 0.25	– 0.41	0.16	5.02*
9:10–9:30	54	– 0.25	– 0.43	0.18	5.67*
9:15–9:35	54	– 0.27	– 0.45	0.18	5.79*
9:20–9:40	53	– 0.28	– 0.45	0.17	5.54*
9:25–9:45	54	– 0.29	– 0.45	0.17	5.53*
9:30–9:50	54	– 0.29	– 0.46	0.17	5.58*
9:35–9:55	53	– 0.31	– 0.47	0.16	5.50*
9:40–10:00	54	– 0.31	– 0.47	0.16	5.35*
9:45–10:05	55	– 0.31	– 0.48	0.16	5.34*
9:50–10:10	55	– 0.33	– 0.48	0.15	4.96*
9:55–10:15	54	– 0.33	– 0.48	0.15	5.05*
10:00–10:20	55	– 0.33	– 0.49	0.15	5.09*
10:05–10:25	53	– 0.33	– 0.49	0.16	5.43*
10:10–10:30	53	– 0.33	– 0.49	0.16	5.19*
10:15–10:35	54	– 0.33	– 0.48	0.16	5.05*
10:20–10:40	54	– 0.34	– 0.49	0.15	4.79*
10:25–10:45	53	– 0.34	– 0.48	0.14	4.63*
10:30–10:50	55	– 0.34	– 0.48	0.13	4.30*
10:35–10:55	55	– 0.35	– 0.48	0.13	4.25*
10:40–11:00	54	– 0.35	– 0.48	0.13	4.24*
10:45–11:05	52	– 0.34	– 0.49	0.15	4.82*
10:50–11:10	52	– 0.33	– 0.48	0.15	4.89*
10:55–11:15	53	– 0.34	– 0.48	0.14	4.64*
11:00–11:20	52	– 0.34	– 0.48	0.14	4.54*
11:05–11:25	53	– 0.34	– 0.48	0.14	4.74*
11:10–11:30	53	– 0.33	– 0.48	0.15	4.85*
11:15–11:35	55	– 0.33	– 0.48	0.15	5.01*
11:20–11:40	55	– 0.33	– 0.48	0.15	4.93*
11:25–11:45	54	– 0.33	– 0.47	0.15	4.98*
11:30–11:50	54	– 0.32	– 0.48	0.16	5.33*
11:35–11:55	57	– 0.32	– 0.47	0.15	4.85*
11:40–12:00	56	– 0.32	– 0.47	0.15	4.69*
Average					
9:00–10:00	54	– 0.28	– 0.45	0.16	5.35*
10:00–11:00	54	– 0.34	– 0.49	0.15	4.80*
11:00–12:00	54	– 0.33	– 0.48	0.15	4.86*
9:00–12:00	54	– 0.32	– 0.47	0.15	5.00*

The asterisk * indicates significance at the 5% level (two-sided).

6.2. Sensitivity analysis based on other price ranges

Panel A of Table 1 indicates that stocks are traded in a variety of price ranges. It is interesting to examine the stock price behavior in price ranges other than NT$40–60. Results from other price ranges allow a further evaluation of the impact of tick size on stock price behavior. If the difference in stock price behavior between NT$40–50 and

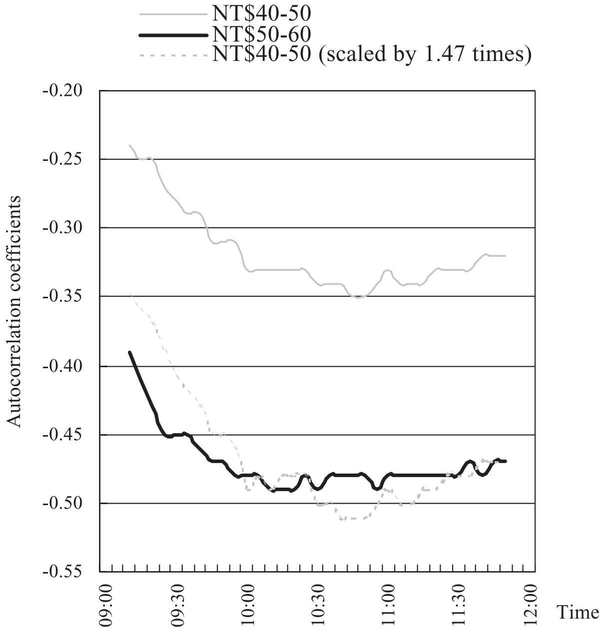

Fig. 3. Autocorrelation coefficients for the three groups of NT$40–50, NT$50–60, and NT$40–50 (scaled by 1.47 times).

NT$50–60 groups as reported in the previous section is contributed mainly by difference in tick size, holding tick size constant for two adjacent price groups would eliminate much of the difference in stock price behavior.

The sensitivity analysis examines the intraday stock price behavior for stocks in three adjacent price ranges, namely, NT$20–30 versus NT$30–40, NT$60–70 versus NT$70–80, and NT$10–15 versus NT$15–20, respectively. Stocks in the first two pairs are traded under the same tick size, respectively, while stocks in the last pair are traded under different tick sizes. To control for firm-specific factors, similar screening criteria for selecting firms in the NT$40–50 versus NT$50–60 price ranges are adopted. The screening process results in 152 sample firms in the NT$20–30 and NT$30–40 price ranges, 25 sample firms in the NT$60–70 and NT$70–80 price ranges, and 146 sample firms in the NT$10–15 and NT$15–20 price ranges. The smaller number of selected sample firms for the NT$60–80 group is due to the smaller price data for this price range as can be seen in Table 1. To preserve space, we report major results on sensitivity analysis below without presenting detailed tables.[8]

Stocks traded in NT$20–30 and NT$30–40 are subject to the same tick size of NT$0.1. The differences in the intraday bid–ask spreads, standard deviations, and autocorrelation coefficients are statistically insignificant between the NT$20–30 and

[8] Detailed results on the sensitivity analysis are available from the authors upon request.

Table 5
Logarithmic trading volumes (ln(# round lots)) for the NT$40–50 and NT$50–60 groups over 1998–1999

Time	NT$40–50 group (1)	NT$50–60 group (2)	Difference (2) – (1)	*t*-Value for (2) – (1)
9:00–9:05	5.105	5.565	0.460	2.05*
9:05–9:10	4.499	4.992	0.493	2.21*
9:10–9:15	4.479	4.890	0.412	1.83
9:15–9:20	4.465	4.819	0.354	1.59
9:20–9:25	4.421	4.722	0.301	1.37
9:25–9:30	4.371	4.679	0.309	1.43
9:30–9:35	4.366	4.594	0.228	1.06
9:35–9:40	4.316	4.555	0.240	1.14
9:40–9:45	4.266	4.536	0.271	1.28
9:45–9:50	4.226	4.502	0.276	1.31
9:50–9:55	4.184	4.460	0.276	1.31
9:55–10:00	4.175	4.417	0.242	1.15
10:00–10:05	4.114	4.356	0.242	1.14
10:05–10:10	4.095	4.339	0.244	1.17
10:10–10:15	4.075	4.339	0.263	1.27
10:15–10:20	4.054	4.315	0.261	1.24
10:20–10:25	4.019	4.304	0.285	1.38
10:25–10:30	3.987	4.224	0.238	1.15
10:30–10:35	3.961	4.214	0.253	1.22
10:35–10:40	3.992	4.275	0.283	1.35
10:40–10:45	3.960	4.251	0.291	1.40
10:45–10:50	3.987	4.266	0.279	1.34
10:50–10:55	4.014	4.302	0.289	1.35
10:55–11:00	4.003	4.351	0.348	1.67
11:00–11:05	4.010	4.295	0.285	1.38
11:05–11:10	3.997	4.308	0.311	1.49
11:10–11:15	4.027	4.347	0.320	1.51
11:15–11:20	4.040	4.309	0.268	1.28
11:20–11:25	4.065	4.379	0.314	1.49
11:25–11:30	4.113	4.344	0.231	1.09
11:30–11:35	4.120	4.396	0.275	1.31
11:35–11:40	4.192	4.456	0.263	1.25
11:40–11:45	4.316	4.579	0.263	1.23
11:45–11:50	4.395	4.661	0.267	1.20
11:50–11:55	4.543	4.840	0.297	1.35
11:55–12:00	5.148	5.553	0.405	1.80
Average	4.225	4.520	0.295	1.38

The asterisk * indicates significance at the 5% level (two-sided).

NT$30–40 groups. Over the whole trading period, the average bid–ask spreads are NT$0.137 and NT$0.138, respectively, for the NT$20–30 and the NT$30–40 groups. The average standard deviations are NT$0.0080 and NT$0.0072, respectively, for the NT$20–30 and NT$30–40 groups. The average autocorrelation coefficients are -0.35 and -0.34, respectively, for the NT$20–30 and NT$30–40 groups. Finally, the trading volume of the NT$30–40 group is higher than that of the NT$20–30 group. The average logarithmic 15-minute trading volume 5.4 round lots of the NT$30–40 group is 8% higher than the corresponding 5.0 round lots of the NT$20–30 group. Overall, stock price

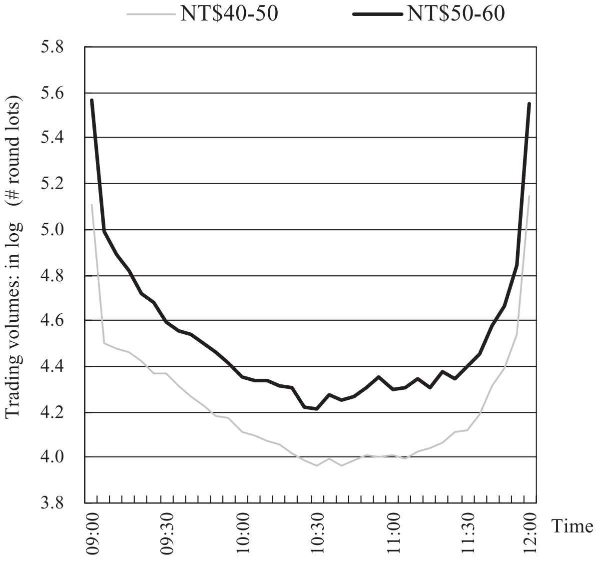

Fig. 4. Trading volumes (ln(# round lots)) for the NT$40–50 and NT$50–60 groups.

behaviors for the NT$20–30 and NT$30–40 groups are quite similar in terms of intraday bid–ask spread, standard deviation, and autocorrelation.

Similarly, stocks traded in NT$60–70 and NT$70–80 are subject to the same tick size of NT$0.5. The intraday stock price behaviors for the NT$60–70 and NT$70–80 groups are quite similar. Over the whole trading period, the average bid–ask spreads are NT$0.528 and NT$0.529, respectively, for the NT$60–70 and NT$70–80 groups. The average standard deviations are NT$0.0078 and NT$0.0076, respectively, for the NT$60–70 and NT$70–80 groups. Both groups have the same average autocorrelation coefficient of − 0.45. Finally, the differences in intraday trading volume for the two price groups are statistically insignificant. The average logarithmic 15-minute trading volume is 5.8 round lots for the NT$70–80 group, which are 5% higher than the corresponding 5.5 round lots of the NT$60–70 group.

In contrast, stocks traded in NT$10–15 and NT$15–20 are subject to different tick sizes. The tick size of NT$0.1 for the NT$15–20 group is twice as large as the NT$0.05 for the NT$10–15 group. However, the relative tick size for the NT$15–20 group is, on average, only 43% larger than that for the NT$10–15 group. Assuming that stock prices are uniformly distributed over NT$10–20, the average stock price would be NT$12.5 for the NT$10–15 group and NT$17.5 for the NT$15–20 group. Under this assumption, the average percentage tick size would be 0.4%, or NT$0.05/NT$12.5, for the NT$10–15 group. Similarly, the average percentage tick size would be 0.57%, or NT$0.1/NT$17.5, for the NT$15–20 group.

The results indicate that the NT$15–20 group is associated with larger average bid–ask spreads and more negative average autocorrelation coefficients than those of the NT$10–15 group. The average bid–ask spread NT$0.123 of the NT$15–20 group is 58% larger than the NT$0.078 of the NT$10–15 group. The average autocorrelation − 0.41 of the NT$15–20 group is more negative than the − 0.35 of the NT$10–15 group. Thus, bid–

ask spreads are larger and autocorrelation coefficients are more negative under a larger tick size than those under a smaller tick size.

In brief, the results in the sensitivity analysis are consistent with the notion drawn from Section 6.1 for the price groups of NT$40–50 and NT$50–60. When holding tick size constant, the intraday stock price behaviors are qualitatively the same for the two adjacent price groups. The intraday price behaviors are similar for the price groups of NT$20–30 and NT$30–40 and for the price groups of NT$60–70 and NT$70–80, respectively. In contrast, when two adjacent price groups are subject to different tick sizes, the NT$10–15 group and the NT$15–20 group have different intraday stock price behaviors. The NT$15–20 group traded under a larger tick size is associated with wider bid–ask spreads, higher standard deviation, and more negative autocorrelation than the corresponding NT$10–15 group.

6.3. Discussion

The empirical results of U-shaped intraday bid–ask spreads and return volatility in this study are consistent with those documented in McInish and Wood (1992), Brock and Kleidon (1992), and Jain and Joh (1988), among others. Similarly, the results of U-shaped autocorrelation coefficients are consistent with those documented in McInish and Wood (1991) and Rhee and Wang (1997), among others. The U-shaped intraday patterns of bid–ask spreads, return volatility, and autocorrelation are consistent with the information asymmetry hypothesis that suggests higher degree of information asymmetry near market open and close.

Moreover, the empirical results in this study indicate that a larger tick size is associated with wider bid–ask spreads, higher return volatility, and more negative autocorrelation. The results are consistent with the theoretic model developed in Harris (1991, 1994) that predicts a narrower bid–ask spread for stocks traded in a reduced tick size. However, the difference in trading volume is less significant under different tick sizes.

Finally, the empirical results in this study indicate that a larger tick size is associated with a higher percentage increase of bid–ask spreads and return volatility in the middle of the trading period. A larger tick size tends to be binding when bid–ask spreads are narrower and return volatility is smaller in the middle of the trading period. The results differ from those documented in Chung and Van Ness (2001) for the Nasdaq stocks due to the different patterns of intraday bid–ask spreads. Chung and Van Ness find that, for the Nasdaq stocks, the intraday bid–ask spread is the widest near market open, declines steadily throughout the day, and drops sharply during the last half trading hour. They find that the magnitude of the bid–ask spread reduction is the largest (smallest) during the last (first) trading hour when tick size is reduced from 1/8 to 1/16 of a dollar on June 2, 1997. Thus, their results are consistent with ours in that a larger tick size affects bid–ask spreads more when such spreads are narrower.

7. Conclusions

This paper examines the impact of tick size on intraday stock price behavior for stocks listed on the Taiwan Stock Exchange. The tick size increases from NT$0.1 to NT$0.5

when stock prices cross NT$50. The sharp change in tick size provides an opportunity to analyze the impact of tick size on intraday stock price behavior.

The sample involves 80 stocks traded in both the NT$40–50 and NT$50–60 ranges over the 2-year period of 1998–1999. The intraday patterns of bid–ask spread, return volatility, autocorrelation, and trading volume are U-shaped. The U-shaped patterns are consistent with the information asymmetry hypothesis in that the degree of information asymmetry between informed traders and uninformed traders is higher near market open and close.

The empirical results indicate that a larger tick size is associated with wider bid–ask spreads, larger return variance, and more negative autocorrelation. Moreover, a larger tick size is associated with a higher percentage increase of intraday bid–ask spread and return volatility in the middle than in other part of the trading period. This is consistent with the binding effect of tick size in that the impact of tick size is more significant when the bid–ask spread and volatility are smaller in the middle trading hour.

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