Minimum Trading Unit and Investor Base, Liquidity, Noise Trading, and Brokerage Promotion

Hee-Joon Ahn
College of Economics and Commerce
Sookmyung Women's University
Seoul, Korea

Jun Cai
Department of Economics and Finance
City University of Hong Kong
Kowloon, Hong Kong

Yasushi Hamao
Department of Finance and Business Economics
Marshall School of Business
University of Southern California
Los Angeles, California

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Abstract

This paper provides a comprehensive study of the impact of changes in lot size or the Minimum Trade Unit (MTU) on the Tokyo Stock Exchange (TSE). The event of the MTU changes in Japan provides an ideal setting to explore several interesting issues related to the investor base, liquidity, noise trading, brokerage commission, and stock value. From a sample of 118 TSE listed firms that reduced their MTU during the 1996-2000 period, we find a substantial increase in the number of individual investors and improvement in liquidity for small trades. Our results suggest that there is a shift in order flow from large to small trades after the MTU change: trading activity for small-size trades intensifies while activity for large trades dwindles. Our investigation of return volatility also reveals that noise trading increases as more uninformed, small investors enter the market after the MTU change. Further, MTU changes appear to attract more brokerage firms to cover the stock, possibly induced by increased commission income. Our empirical results support the idea that the expanded investor base, improved liquidity, and enhanced brokerage efforts to market the stocks are significantly associated with the rise in the stock value around the MTU change.

JEL Classification: G10, G15, G20

1. Introduction

Price and quantity are the two dimensions that every investor considers when trading stocks. Most exchanges in the world impose a minimum price increment or tick size. At the same time, exchanges also impose a lot size or a minimum unit of trading that investors are allowed. Following the tick size reduction instituted in the U.S., Canada, and Japan, numerous research has been produced to examine the impact of tick size change[1]. In sharp contrast, however, there is little work on the impact of lot size change. To a large extent, this is due to the fact that there are relatively few events associated with the lot size change in major stock exchanges in the world.[2] Nevertheless, lot size changes have as broad and deep implications as tick size changes.

Lot size is important since it determines the minimum amount of money needed for trading. Too large a lot size would prohibit small investors from entering the market for the stock. Meanwhile, too small a lot size would be costly because of indirect costs related with problems with corporate control due to dispersion of share ownership. Furthermore, small shareholders are expensive to service. Every year corporations spend a nontrivial sum of money to mail out annual reports, interim statements, and circulars to each of their shareholders, large or small, and to enter shareholders' names in the share register.[3]

Rules on lot size differ across stock markets. In North American stock markets, the lot size is fixed across all stocks. For example, the New York Stock Exchange or the Toronto Stock Exchange mandates its lot size at 100 shares for all of its listed stocks. In some other stock markets in the world, however, lot sizes are variable across stocks. These markets include the Tokyo Stock Exchange, the Italian Stock Exchange, and the Hong Kong Stock Exchange, among others. The case of the Tokyo Stock Exchange (TSE) is of particular interest for several reasons. First, the lot size or the Minimum Trade Unit

[1] Harris (1997) provides an extensive summary of the studies on the area of tick size change.

[2] According to Bloomberg News Service, the countries in which there exist MTU changes from January 1, 1995 to June 11, 2001 include Brazil (98), Denmark (26), Finland (9), Hong Kong (58), Italy (225), Japan (341), Norway (93), Spain (1), Sweden (186), Thailand (3), and US (1). The numbers in parentheses are the sample size in each country. The sample includes both listed and OTC firms.

(MTU) at the TSE is determined by individual listed companies.[4] Accordingly, lot size changes are not rare events on the TSE. For example, there were more than 340 lot size changes reported between 1995 and the first half of 2001. Second, the magnitudes of the changes are substantial, with most firms reducing their MTU by one-tenth from 1,000 to 100 shares. Third, odd lot trading is not allowed on the TSE. With odd lot trading, investors can still trade an amount smaller than the minimum trading value governed by the lot size.[5] However, on the TSE, investors cannot trade an amount smaller than the MTU. Hence, the lot size on the TSE binds investors' trading strategies more than in stock markets where odd lot trading is permitted.

In this paper, based on 118 events of MTU reductions initiated by TSE-listed firms between June 1996 and October 2000, we provide a comprehensive investigation of several important issues related with lot size. First, we investigate the impact of lot size change on the investor base of a stock. Lot size limits the investor base of a stock, by disallowing investors who want to trade a small amount. Therefore, reducing the MTU will effectively increase the investor base. Merton (1987) suggests that an increase in the relative size of the firm's investor base will reduce the firm's cost of capital and increase the market value of the firm. Amihud, Mendelson, and Uno (2000) recently provide a formal test for this investor base hypothesis and report significant announcement effect associated with the reduction in MTU on the TSE.

Lot size change also has an important implication for the liquidity of the stock. Liquidity is related to the number of investors following the stock. Since a lot size reduction will increase the small-investor base, competition among investors will intensify. As traders post more aggressive quotes, bid-ask spreads will decline. Earlier research shows that average risk-adjusted returns on stocks increase

[3] The problems that firms face due to too small a lot size is similar to the problems caused by odd-lot shareholders.
[4] Individual firms can decide the lot size of their stock in accordance with Article 16, Paragraph 1 of the Supplemental Provision of the Commercial Code (1981) of the Tokyo Stock Exchange.

significantly with their bid-ask spreads (Amihud and Mendelson, 1986). Therefore lower spreads following lot size reduction will increase the market value of stocks. Spreads provide information only about the cost of trading per a quoted number of shares. If a reduction in MTU lowers the quoted depth, the market may be less liquid even if spreads narrow. Consequently any study on liquidity change must examine both the price and depth (Lee, Mucklow, and Ready, 1993). Moreover, whether trading and quoting activities have altered significantly and whether small and large trades are affected in different ways following the MTU change remain unanswered. We refer to these questions as the liquidity hypothesis.

Lot size can also affect brokerage firms' income. Brokerage commissions on the TSE generally increase as the trade size decreases.[6] The inverse relation between brokerage commission and trade size suggests that brokerage firms will find trading more profitable after the MTU reduction. A substantial reduction in the MTU will give brokerage firms a huge incentive to do research on and promote a given stock (Brennan and Hughes, 1991).

Existing theoretical and empirical research on stock market volatility primarily focus on private information that are revealed through trades (Kyle, 1985; Admati and Pfleiderer, 1988; Barclay, Litzenberger, and Warner, 1990; Lee, Mucklow, and Ready, 1993; Barclay and Warner, 1993, among others). A number of authors raise the possibility that volatility can also be caused by traders' overreaction to each other (Shiller, 1981, 1986; Black, 1986; French and Roll, 1986, Summers, 1986; Delong, Shleifer, Summers, and Waldmann, 1990). Barclay, Litzenberger, and Warner (1990) investigate several aspects of this noise trading hypothesis by examining weekly variances with and without Saturday

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[5] Odd lot trading is a common practice in many of the world's stock markets. For example, while the lot size is 100 shares on the NYSE, investors can trade fewer than 100 shares through odd-lot trading. On the Korea Stock Exchange, the lot size or the Trading Unit is fixed at 10 shares but odd lot trading is permitted.

[6] Before the deregulation on the TSE brokerage fees in the summer of 1999, an exchanged mandated schedule determined what brokers charge their customers for their service. Under this schedule, brokerage fee per share rises as the trade size becomes smaller. Even after the deregulation, individual brokerage firms apply fee schedules that decrease with trade size.

trading on the TSE but find no evidence supporting the hypothesis. However, the noise trading hypothesis has not yet been fully tested, primarily due to the fact that there is a lack of appropriate testing events.

The events of MTU reduction provide an ideal environment to test the noise trading hypothesis. Lot size reduction attracts small orders. Small orders are more likely to be liquidity-motivated than information-based. This implies that noise trading will increase after the MTU change. Noise trading puts noise into the prices. Consequently the hypothesis is that return volatility will increase after the MTU change. In addition, if asset prices respond to noise and if errors of noise traders are temporary, then asset prices revert to the mean (De Long, Shleifer, Summers, and Waldmann, 1990). Stock returns will show a stronger mean-reverting pattern following the MTU reduction. The increase in the amount of noise trading will also affect the components of the spread. Improvement in liquidity from noise trading means smaller spreads. However, the reduction in the spread is more likely to come from the adverse selection component as the proportion of noise traders increases in the market. This prediction can be readily tested by comparing the behaviour of bid-ask components before and after the MTU change.

In many ways, MTU changes are similar to stock splits. Like MTU reduction, stock splits also reduce the minimum amount of money needed for trading stocks. However, MTU changes are free from the side effects that make stock splits less ideal for testing the investor base, liquidity, or noise trading hypotheses. First, the increase in firm value following stock splits may come from many factors other than the increase in the number of individual investors.[7] Second, stock splits accompany cosmetic price reductions that affect proportional spreads. As share prices become lower after the splits, the proportional spreads increase. Market making is more profitable. This provides incentives to brokers who are at the same time market makers to promote the stock (Angel, 1997). The source of increased brokerage revenue

[7] Firms may use split to signal improved performance (Brennan and Copeland, 1988). Firm value will increase as informed trading increases when the post-split relative tick becomes larger (Anshuman and Kalay, 1997). The value of tax-trading option will increase as post-split stock price volatility increases (Lamoureux and Poon, 1987).

comes mainly from the increased spreads (Schultz, 2000).[8] Ohlson and Penman (1985) show that return volatilities increase by as much as 30 percent after the splits. They interpret the evidence as consistent with the noise trading hypothesis. Others have suggested that bid-ask spread and other measurement effects may be responsible for the change in return distribution around the stock splits.[9] Koski (1998) recently reports that changes in the bid-ask spreads contribute at least partially to the increase in return volatility following the splits. The problem is mitigated with MTU change because they do not suffer from any cosmetic price changes.[10]

In this paper, we provide a comprehensive test of the investor base, liquidity, brokerage promotion, and noise trading hypotheses, using a comprehensive market microstructure data on the TSE, which has been available only recently. We examine whether investors' quoting and trading patterns change significantly following MTU reductions and whether these changes are related with the afore mentioned four hypotheses. Then, we analyze the stock return behavior around MTU reductions and investigate whether it is explained by the hypotheses. Our work is closely related to Amihud, Mendelson, and Uno (2000) but differ in many important ways. Amihud, Mendelson, and Uno (2000) use a daily data. We use a comprehensive transaction-level data, which allows us to examine trading and quoting behavior in close detail. But more importantly, while Amihud, Mendelson, and Uno (2000) focus primarily on the investor base hypothesis by examining the announcement effect associated with changes in the investor

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[8] Angel (1997), Harris (1997) and Grossman et al. (1997) argue that a larger relative tick size following the split may reduce the cost of making a market. For example, with a larger tick, there may be fewer trading errors and misunderstanding about the transaction prices. A larger tick may also minimize costly negotiation between traders. Finally, a large tick may increase the incentive to provide firm quotes, as front-running or quote-matching become costly. However, the evidence of declining market making cost is weak (Schultz, 2000).

[9] See Amihud and Mendelson (1987), Kaul and Nimalendran (1990), Conroy, Harris, and Benet (1990), and Dubofsky (1991).

[10] The sample of large stock splits in Japan is much smaller than that in the U.S. According to data provided by TSE, the total number of stock splits (more than 1.5-to-1) among TSE listed firms from 1991 to 2000 is only 46. The total number of MTU change over the same period is 190. This is consistent with the fact that MTU changes and stock splits are close substitutes. It is also consistent with Angel's (1997) prediction that markets (such as TSE)

base, we examine the four hypotheses together. These four hypotheses are not independent of each other. However, they provide sharp predications on different aspects of the market quality and stock characteristics after the MTU reduction.

The rest of the paper is organized as follows. Section 2 describes the sample construction, details the data sources, and provides summary statistics. Section 3 reports the empirical results, including changes in the investor base, changes in liquidity provision, and trading and quoting activities surrounding the MTU changes. The announcement effect is also examined. Finally, Section 4 concludes the paper.

2. Sample Selection, Tick-by-Tick Data, and Summary Statistics

2.1 MTU Sample

TSE provides the initial 123-MTU change events between June 1996 and October 2000. The data include the name, code, listing section, effective date, and MTUs before and after the changes. We confirmed the effective date and MTU changes by searching through the Bloomberg News Service. We also collected the announcement dates of these changes from Bloomberg and Nikkei News Service. From this we dropped five firms that had either a stock split or a stock dividend 60 days before and after the MTU change date. The final sample contains 118 firms. Table 1 shows that out of these 118 firms, 91 decreased their MTU by a factor of ten, from 1,000 shares to 100 shares. Eight firms reduced their MTU by a factor of five. Nineteen firms reduced their MTU by a factor of 2. We focus our analysis on two sample groups: the full sample including all 118 stocks and a sub-sample containing only those 91 stocks that reduced their MTU from 1,000 shares to 100 shares. We will refer to the second sample as the 10-to-1 sample.

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for which the absolute tick size is a step function based on price will have fewer splits. A step function of tick sizes

2.2 Tick-by-tick Transaction Data

We obtained the real-time TSE trades and quotes data from the Nikkei Economic Electronic Database System (NEEDS) historical tick data. The database is time-stamped to the nearest minute and includes price information on all quotes and the price and quantity information on all transactions. It also has detailed flags indicating the conditions of each trade and quote. These flags include the opening/closing trade indicators, buy/sell indicators, and special and warning quote indicators, among others. The NEEDS database essentially reflects all the trade and quote information broadcast to TSE members by the TSE (64K Data). The database is the most detailed and extensive ever among the known data sets on the Japanese stock market.

2.3 NEEDS Accounting and PACAP Stock Return Data

The NEEDS Corporate Financial Affairs Data provided the investor base information used in this study. We obtained the shareholding information for each of the 118 stocks at the end of the fiscal year before the MTU reduction (year –1) and at the end of the fiscal year of the reduction (year 0). The shareholding information includes the total number of shares, total number of shareholders, number of shares held by individuals and others, and number of individual and other shareholders.

The Pacific Basin Capital Markets Database (PACAP) provided daily returns on 118 individual stocks and accumulative adjustment factors that we used to identify stock splits or stock dividends for particular stocks during the 1996-2000 period. Datastream International provided the daily aggregate trading volume, the daily TOPIX index, the index on medium-size stocks, the index on small-size stocks, and the index on second section stocks. Medium-size stocks refer to those firms that have 60 million or more shares but under 200 million shares listed. Small-size stocks refer to those firms that have less than 60 million shares listed.

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would reduce the need to split stocks to adjust tick sizes.

2.3 Summary Statistics

Table 2 shows descriptive statistics of the variables that represent the price and liquidity characteristics of the sample firms. The statistics include cross-sectional means, first quartiles, medians, third quartiles of average stock price, market capitalization, quoted spreads in yen and percentage terms, ask and bid quotation sizes in number of shares, daily number of trades, and daily share volume for the two samples. The statistics are calculated using tick-by-tick transaction data from days –60 to –1 prior to the MTU changes.[11]

For the full sample of 118 firms, the cross-sectional mean of stock prices is ¥4,154. The mean quoted spread is ¥60.45 or 1.89 percent. The mean depth at the ask side is 2,443 shares. The mean depth at the bid side is 2,323 shares.[12] On a typical trading day, there are on average 27.6 transactions. The average trading volume is 54,216 shares. The average market capitalization is ¥107 billion. The statistics from the 10-to-1 sample of 91 firms are similar as they represent the majority of the first sample.

3. Empirical Results

3.1 Investor Base

In a frictionless, perfect market the unit of trading does not matter for investors. They can buy or sell any amount of assets. In reality, however, stock markets maintain minimum trading units, which effectually restrain investors who want to trade small amounts from entering the markets. A reduction in the trading unit can allow these investors to trade and, therefore, result in an increase in the investor base

[11] When calculating the quoted spread, we only use regular and warning quotes with valid prices. Opening or closing quotes, special quotes, and quotes outside the exchange opening hours are excluded. If the bid-ask spread is greater than a quarter (25 percent) of the bid-ask mid-point, we treat the observation as a coding error and discard it.

[12] The depth data is available only from November 1998. Therefore the sample size is smaller for depth information, being 61 and 42 firms respectively for the full sample and the second sample with a MTU reduction factor of ten.

for the stock. It is likely that the increase in the investor base is mainly due to small individual investors since they are those who would benefit most from smaller trading units.

To find out whether the MTU reductions in the TSE enlarged the investor base and whether individual investors contributed significantly to the increase in the investor base, we investigate the pattern of changes in the numbers of all and individual shareholders around the MTU changes. To be more specific, we compare the shareholder information at the fiscal yearend prior to the MTU change with that at the subsequent fiscal yearend. We obtained the shareholding information on the TSE from the NEEDS-MT Corporate Financial Affairs Data. Some of our sample firms changed their MTUs after March 2000. For these firms the post-MTU change shareholder information was not yet available from the dataset. This leaves the sample size to 90 firms, of which 70 changed their MTU from 1,000 shares to 100 shares.

Panel A of Table 3 summarizes the pattern of changes in numbers of all and individual shareholders. The panel shows that the number of shareholders increases significantly after the MTU change. For the full sample, the average number of all shareholders is 2,531 before the MTU change. It rises by 1,557 (a 62 percent jump) to 4,088. The change measured in log difference is significant at one percent level on the standard t-test. In the case of the sub-sample of firms that changed their MTU from 1,000 to 100 shares, the mean percentage change is 66 percent and significant at the one percent level. For both samples, similar results are obtained when medians are used. The jump of more than 60 percent in the average number of shareholders provides strong support that the shareholder base indeed grows substantially after the MTU change.

Panel A also confirms that the number of individual shareholders increases significantly after the MTU change. For the full sample, the average number of individual shareholders is 1,755 under the old MTU. The number more than doubles to 3,608 after the change in the MTU. We also calculate the proportion of individual shareholders among all shareholders before and after the MTU change and check whether there is a significant increase in the proportion. If the increase in the investor base is mainly due to an increase in individual investors, it should be reflected in a rise in the proportion of individual shareholders after the MTU change. The results are also reported in Panel A of Table 3. The average ratio of individual shareholders to all shareholders for the full sample is 73 percent before the MTU change and 88 percent afterwards. The change is highly significant at the one percent level. We further test the equality in the magnitudes of the changes measured in number of shareholders between all shareholders and individual shareholders. For the full sample, the mean change of the number of all shareholders is 1,557 while the mean change of the number of individual shareholders is 1,853. The median changes are 1,699 for all shareholders and 1,665 for individual shareholders. Both the standard t-test and sign test cannot reject equality in magnitude of changes between the two groups of shareholders. The subgroup provides qualitatively the same results with the two statistical tests not being able to find any differences. These results provide unambiguous evidence that the increase in the investor base is solely due to individual investors.

Panel B shows the total numbers of shares collectively held by individual shareholders and the average numbers of shares per individual shareholder before and after the MTU change. It is clear from the panel that the total number of shares held by individual shareholders increases significantly while the average number of shares per individual investor decreases dramatically. For example, in the case of the full sample, the mean and median increases in aggregate individual shareholders' holding are nine percent and seven percent, respectively. Both mean and median changes are significant at the one percent level. Meanwhile, the average number of shares per individual shareholder drops almost by a half from 6,291 shares to 3,347 shares. The above patterns are well-expected results since the shareholders added after the MTU change are those who trade small amounts of shares.

3.2 Spread and Depth

Minimum trading unit determines the minimum amount of money needed for trading. With odd-lot trading forbidden on the TSE, too large a lot size would prohibit small investors from entering the market for the stock and hence reduce competition among liquidity suppliers. Since a lot-size reduction increases the small-investor base, competition among investors will intensify. On the other hand, with a smaller lot size, penalties for pricing errors by traders become smaller. Hence, some of the liquidity suppliers would quote more aggressively with small orders, i.e., submit small quantity orders at improved quotes. These effects lead to reductions in the bid-ask spread. Table 4 shows that for the full sample, the average quoted spread decreased from ¥60.5 to ¥41.6 or 23 percent. The effective spread decreased from ¥34.2 to ¥28.8 or about nine percent. These changes are significant at one percent level. The results from the 10-to-1 sample that reduces MTU from 1,000 shares to 100 shares are stronger with a larger percentage drop in both the quoted and effective spreads.[13] Figure 1 shows the average daily quoted and effective spreads (Panel A) and average ask and bid depths (Panel B) for the full sample over 120 trading days surrounding the MTU change date. Both quoted and effective spreads exhibit a drop after the MTU reduction, with the pattern more notable for the quoted spread. The daily depths provide a much clearer pattern of a drop. Both ask and bid depths fall dramatically on the day of the MTU change.

Market liquidity has both a price dimension (the spread) and a quantity dimension (the depth). A narrower spread does not indicate a liquid market if the corresponding quoted depth is small. Table 3 examines the quoted depth surrounding the MTU change. Using the full sample as an example, the quoted depth at the ask side dropped from 2,443 shares to 1,649 shares before and after the lot-size reduction. The quoted depth at the bid side dropped from 2,323 shares to 1,352 shares. The log differences are highly significant at one percent level. Therefore, for liquidity demanders trading sizes

[13] The reductions in percentage spreads are even greater. For the quoted spread, the mean reductions are –50.9 and –58.7 percent for the full and second sample. For the effective spread, the mean reductions are –14.9 percent and –15.7 percent respectively.

less than or equal to the reduced quoted depth have realized a transaction cost decrease, i.e., liquidity has improved. However, for liquidity demanders with trading sizes exceeding the reduced quoted depth, lower spreads after the lot-size change apply to only a fraction of their trading size. To fully assess the impact of lot-size reduction on overall liquidity especially for large size orders, one needs to have access to the entire limit-order book and calculate the changes in cumulative depth near the inside quotes (Goldsein and Kavajecz, 2000), which unfortunately is not available for our sample.[14, 15]

However, we can analyze the ex-post changes in spread and depth for small and large trades by sorting the effective spread and depth according to trade size categories. The effective depth is defined as the size of the ask (bid) quote that is effective when a buy (sell) trade takes place. Table 5 reports the effective spread and effective depth sorted by multiples of old MTU before and after the MTU reduction. The results must be interpreted carefully because they reflect the following two effects. First, when a large market buy order is submitted against a small sell quote, the market buy order will be broken to match the sell depth, resulting in a small-size transaction. The remaining part of the market buy order will either be transformed into a limit buy order or walk up the book depending on the situation, and be eventually matched at a less favorable price. Second, understanding that the limit book has become thinner, market participants may adjust their strategies to submit the orders. For example, they may split their single large order into several small orders to avoid walking up the limit order book. Of course, they incur additional costs such as brokerage commissions by adopting more sophisticated trading strategies.

The results in Table 5 indicate that the reduction in the effective spread, which is a more accurate measure of what investors pay, comes mainly from small orders. In other words, liquidity improvements in the price dimension are due largely to small quantity limit orders. At the same time, liquidity

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[14] TSE started to provide three best price-quantity pairs to investors since December 2000.

[15] The reductions in depth at the best quotes are also observed for tick size reduction in both U.S., Canada, and Japan. See Harris (1997) for review of the literature on the NYSE, AMEX, NASDAQ, and the Toronto Stock Exchange. Ahn, Cai, and Hamao (2001) analyze the impact of tick size reduction on the TSE.

deterioration in the quantity dimension also concentrates on small orders. For large orders, say orders between 6 and 9 MTUs and more than 10 MTUs, the changes in liquidity are not significant.

Another noticeable pattern is that the effective spread decreases as the size of trade increases. However, this pattern is less conspicuous after the MTU change. On average, small orders are at a less disadvantage in terms of bid-ask spread after the MTU reduction. Certainly, this provides a more favorable trading environment for small traders or noise traders. Also it works favorable for the brokers who target small investors. The savings in bid-ask spreads for these investors might more than offset the higher brokerage commissions.

3.3 Trading Activity

The fact that the investor base has been increased and trading cost has been lower for small transactions imply that the daily number of trades should increase following the reduction of MTU. Panel A of Table 6 tests for the differences in daily number of trades surrounding the MTU change. The average daily number of trades increases significantly from 27.6 to 61.7 for the full sample. Panel B further shows that, as expected, this increase in number of trades is accompanied by a decrease in average trade size. For the full sample, the average size is cut almost in half from 2.28 to 1.19 old MTUs. The reduction in trade size is highly significant at one percent level. Figure 2 illustrates the daily pattern of trading activity. Panel A of Figure 2 presents the average daily number of trades over 120 days surrounding the MTU change date. It is clear from the figure that trading activity picks up substantially right from the day when the new, smaller MTU becomes effective. Panel B of Figure 2 depicts the average trade size and average minimum trade size over the same period. The trade size produces an opposite image of the daily number of trades. The average trade size goes down dramatically on the day of MTU change. The average of minimum trade size also plummets in the same fashion.

Panel C of Table 6 reports the combined effect on trading volume.[16] While trading frequency increased significantly subsequent to the MTU changes, trading volume did not increase at all. Actually, it showed signs of a slight decrease.[17] While the trading volume showed a sign of decline, it is not certain whether the decline is triggered by the MTU change or due to some general market movement. To account for the fluctuations in the overall market trading activities, we scale each firm's trading volume by the total trading volume on the TSE. Panel D presents the results of the test using the market-adjusted volume. The results reveal that after the scaling the decreasing pattern of share volume disappears and share volume remains unchanged for both the full sample and sub-samples. The evidence contrasts with that in Amihud, Mendelson, and Uno (2000), who report that the reduction in MTU brought about a statistically significant increase in trading volume compared to a sample of control stocks.

Table 7 breaks down the daily number of trades and share volume by trade size. It is apparent that the smallest trades have increased significantly. In fact, trades at exactly one old-MTU witnessed a significant decline, an indication that the old MTU has been binding small volume traders. The majority of the smallest trade category now trade at less than one old-MTU. Trades between two and five old-MTUs have also increased significantly. However, for trades between six and nine old MTUs and at least ten old-MTUs, there is a significant decrease in trading activities. One explanation is related to large incoming market orders being broken into several smaller transactions as quote sizes become smaller. Second, as the chance of large limit orders being executed becomes smaller, traders are reluctant to submit large orders as frequently as before. As the limit order book becomes thinner with fewer large limit orders, it becomes more difficult for large market orders to be executed.

3.4 Quoting Activity

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[16] Panel C of Figure 2 shows the daily average volume pattern surrounding the MTU change date.

As more traders submit small orders and competition intensifies, the frequency of quote updates is expected to increase. Table 8 compares the quoting activities before and after the MTU change. Indeed, the daily number of quotes almost doubles from 57 to 107 for the full sample. More interestingly, the trade-to-quote ratio increases from 56.8 percent to 62.8 percent, with the change highly significant at one percent level. This implies that the increase in number of trades is greater than the increase in number of quote updates. This is opposite to evidence from the decimalization on NASDAQ (NASDAQ Economic Research, 2001) and tick size reduction on the TSE (Ahn, Cai, and Hamao, 2001). In the case of decimalization or tick size reduction, both the number of quotes and the number of trades increase but the number of quotes increases more, resulting in a lower trade-to-quote ratio.

We conjecture that the pattern is related to the following four facts. First, as the quote sizes become smaller, the incoming market orders get broken up. Consequently the number of trades increases. The increase in trade-to-quote ratio is an outcome driven mechanically by smaller quote sizes. Second, as bid-ask spreads become smaller, quote conditions are more attractive. Investors are more responsive to quotes. Since the number of trades cannot exceed the number of quote updates, the increase in trade-to-quote ratio indicates that more quotes have been matched. For example, prior to the MTU change, some quotes are not favorable to investors who want to submit market orders. After the change, the problem of stale quotes becomes less significant with reduced MTU and improved quotes. Third, noise traders are more likely to submit market orders as they tend to be price takers (Kyle, 1985). If noise traders use market orders more than limit orders, the trade-to-quote ratio will increase. Fourth, increased marketing by brokers could also increase the trade-to-quote ratio if brokers recommend market orders more than limit orders. From the perspectives of the brokers, market orders are sure source of commissions since the orders are guaranteed to be matched. Limit orders, however, are not guaranteed.

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[17] The cross-sectional distribution of mean daily volume is heavily skewed. Therefore, while the changes of share and yen volume measured in logarithmic differences are significantly negative, the average volume after the MTU change is greater than the average before the change.

3.5 Distribution of Buyer-Initiated Transactions

With the MTU reduced, those who were not allowed to trade small amounts before will enter the market and buy the stock. At the same time, brokers will find trading the stock more profitable after the MTU change. A substantial reduction in the MTU offers brokerage firms strong incentives to promote the stock. Therefore, the prediction is that buy orders will increase following the MTU reduction. Moreover, the increased buy orders will concentrate on small trades. This increase in buy orders cannot be empirically separated from the increase in buy orders resulting from the enlarged investor base or increased noise traders.

Table 9 examines the changes in the percentage of buyer-initiated transactions categorized by trade size. The results suggest that small buys increase substantially after the MTU change. For trade size less than or equal to one old-MTU in the full sample, the average percentage of buys in number of trades is 47.5 percent before versus 52.7 percent after the MTU reduction. The increase of 5.2 percent is highly significant. Measured in share volume, the average percentage of buys increases by 2.2 percent. The increase in small buys is even more pronounced for the 10-to-1 sample, with average percentage of buys increasing by 6.6 and 5.1 percent, respectively, when measured in number of trades and share volume. Table 9 also shows that for medium and large trade sizes, the proportions of buys remain essentially the same before and after the MTU change, except for trades between six and nine old-MTUs in the full sample, where there is some evidence that the proportion of buys decreases by 2-3 percent.

Panel A of Figure 3 presents the average daily numbers of small buy and sell trades. A small buy (small sell) is defined as a buy (sell) trade with a size smaller than or equal to one old-MTU. Before the MTU change, the average daily number of small buys is not much different from the average daily number of small sells. As the MTU changes, the frequency of both small buys and sells increase dramatically. But there are more small buys than small sells. During the 60-day period following the MTU changes, in almost every trading day, the number of small buys exceeds the number of small sells.

In Panel B of Figure 3 we show the average daily net small buy volume measured in number of shares (i.e., small buy volume less small sell volume). The average small net buy volume is close to zero before the MTU change. But with the MTU reduction, it shifts upward and stays above 100,000 shares most of the time during the first 40 days or so. Then, the abnormal net buy volume gradually disappears. The pattern appearing in Figure 3 is consistent with the increase in small investors subsequent to the MTU change, with small investors beginning to purchase the stock as soon as the new MTU becomes effective. But after a period of two months or so, the excessive buying by small investors lessens and the amounts of small buy and sell volume maintain status quo.

3.6 Return Volatility

Empirical research on stock market volatility primarily focus on private information revealed through trading. There is little pure empirical test for the noise trading hypothesis. Stock splits, as cosmetic changes with no real economic consequences, seem to offer a close-enough pure test for the hypothesis. Several authors, including Ohlson and Penman (1985), Dravid (1987), Dubofsky (1991), Angel, Brooks, and Mathew (1998), and Schultz (2000) report that volatilities indeed increase following stock splits, consistent with the hypothesis that noise traders prefer low-priced stocks and intensify their trading following the splits (Black, 1986). However, stock splits are accompanied by an increase in the bid-ask spread, which leads to an upward bias in the calculation of return variance. For example, Schultz (2000) reports that for small trades, the mean effective spread is 0.96 percent between the announcement and the split, and 1.28 percent in the month following the split. The significant increase in effective spreads is also found for large trades and for a longer period after the splits. Koski (2000) finds that quoted spreads increase from 0.93 percent to 1.21 percent for small splits and from 0.58 percent to 0.99 percent for large splits. These changes in spreads represent approximately 16-20 percent of the total change in daily return variances following the splits. In contrast to stock splits, the MTU changes are accompanied by a decrease in spread. For the full sample, the quoted spreads drop from 1.89 percent to 1.38 percent. The effective spreads drop from 1.09 percent to 0.94 percent. Therefore the return variance will actually be biased downward after the MTU reduction. This effect works in favor of rejecting the noise trading hypothesis.

In this section, we compare the volatility before and after the MTU reduction. We use the variances of daily, half-day, and half-hour returns to measure return volatility. All returns are calculated based on quote midpoints to avoid the possible bias due to bid-ask bounces. The daily returns are calculated based on daily closing quote midpoints. The half-day returns during the morning session (from 9:00 a.m. to 11:00 a.m.) or the afternoon session (from 12:30 p.m. to 3:00 p.m.) are based on the changes in the opening and closing quote midpoints during the session. Hence, the half-day returns are free from the volatility caused by non-trading during the overnight exchange closure or the lunch break. To calculate the intraday half-hour returns, we use the midpoints of the quotes recorded last during each half-hour interval except for the first 30 minutes for both opening and afternoon sessions. For the opening half-hour interval for each session, we match the first and last quote midpoints during the intervals to avoid the intraday exchange closures.

Panel A of Table 10 reveals a clear pattern regarding the daily return volatility before and after the MTU change. At the daily level, volatility is higher after the MTU reduction. Using the results from the full sample as an example, the median daily close-to-close variance increases from 0.00064 during the pre-event days to 0.00074 during the post-event days. Fifty-eight percent of the sample firms experience an increase in volatility. Formal binomial tests also in general reject the hypothesis that 50 percent of events have lower volatility, indicating that more than half of the MTU reductions are associated with an elevation in the post-event volatility. The reduction in the spread reported earlier would produce a downward bias to the volatility change. Nevertheless, the results in Panel A provide strong support for the noise trading hypothesis.

The evidence from the half-day return volatility is somewhat mixed. Panel B of Table 10 indicates that, for both morning and afternoon sessions, the median volatility increases. However, the increase is statistically significant only for the afternoon session. Panel C reports the results on half-hour volatility. Again, median volatility is greater after the MTU change for both morning and afternoon sessions. However, for either of both sessions, the change is not statistically different from zero.

To distinguish between information-induced volatility and noise trading-induced volatility, we also compare the intraday variance ratios surrounding the MTU change. In the presence of noise trading, asset returns exhibit the mean reversion documented by a great deal of empirical work (De Long, Shleifer, Summers, and Waldman, 1990). On the other hand, the arrival of new information that leads to a permanent update in prices would elevate volatility without altering variance ratios (Bessembinder, 2000). By examining the intraday variance ratio statistics, we can determine whether the pattern of serial correlation has changed before and after the MTU change. Since there is a lunch break during a typical trading day on the TSE, we separately calculate intraday variance ratios for morning and afternoon sessions. To be more specific, the variance ratios are computed as $\mathrm{Var}[r_t(q)]/\{q \cdot \mathrm{Var}[r_t]\}$, where r_t denotes half-hour return, $r_t(q)$ is the summation of half-hour returns over the consecutive q half-hour intervals, q = 4, and 5 respectively. Panel D reports the variance ratios. In general, variance ratios exceed one, implying the existence of noise trading. However, the variance ratio remains essentially the same before and after the MTU reduction. The difference is not significant. However, recent work by Andersen, Bollerslev, and Das (2000) suggests that the variance ratio statistics are biased when there is a pronounced intraday U-shaped pattern in volatility.[18]

3.7 Spread Components

[18] The testing procedure developed by Andersen et al. (2000) applies to the level and curvature of the intraday absolute return and does not apply to the case of testing the intraday serial correlation.

The increase in the amount of noise trading will have an effect on both the spread and its components. We have shown earlier that improvements in the price dimension of liquidity result in smaller spreads. This reduction in spreads is more likely to come from the reduction in the adverse selection component. This is because an increase in noise trading means a greater chance of trading with uninformed traders. An increase in noise trading will also trigger an increase in information collection and trading (Black, 1986). But excessive information trading is risky and there is a limit as to how large a position an informed trader will take. Overall, the relative proportion of the spread for adverse selection will decline. On the other hand, the order-processing component of the spread will not decrease. Order-processing costs decrease as the trade size increases due to economies of scale for large orders. Hence, the increase in small or noise trades will lead to a rise in the order-processing component in the spread.

Table 10 compares the adverse selection component of the spread (θ), the order-processing component of the spread (ϕ), and the proportion of the adverse selection component in the implied spread ($\gamma = 2\theta/(2\theta+2\phi)$) surrounding the MTU change. We estimate the components of the spread, θ and ϕ, using the Glosten and Harris (1988) regression.[19] Panels A and B report the cross-sectional means and medians of the estimates. The cost components are expressed as a percentage of the stock price. It is clear that the adverse selection component has dropped significantly after the MTU reduction, whereas the order-processing component has remained essentially the same. As a result, the proportion of the adverse selection component has dropped from 49.9 to 45.4 percent. The difference of 4.5 percent is highly significant at the one percent level.

The results from MTU change stand in sharp constrast to those for tick size changes. In the case of tick size reduction on the TSE, Ahn, Cai, and Hamao (2001) report that the reduction in the order-processing cost is significantly greater than the reduction in the adverse selection component. Therefore,

[19]The model is specified as follows: $p_t - p_{t-1} = -\phi I_{t-1} + (\phi + \theta) I_t + \varepsilon_t$, where p_t is the transaction price. The trade indicator variable I_t takes the value of 1 if the trade is buyer-initiated and –1 if the trade is seller-initiated. Opening

the relative proportion of the adverse selection component is much higher after the tick size change. This is due to the fact that a smaller tick size will increase the value of private information and hence elevate the level of informed trading (Anshuman and Kalay, 1998).

3.8 Brokerage Coverage

Before the 1999 Big Bang, the brokerage commissions on the TSE were fixed and inversely related with trade size. Even after brokerage commissions were deregulated, brokerage firms at varying degrees maintained commission schedules that moved inversely with trade size. In Section 3.3 and Table 7 we show that the significant increase in the number of trades after the MTU change mainly comes from the increased number of small trades. From the inverse relation between trade size and brokerage commission, we can easily conjecture that with the substantial market-wide shift to small trades after the MTU reduction, total brokerage commissions for the brokerage houses that cover the stock increase significantly. Hence, more brokerage firms will show interest in the stock, helping to improve its liquidity.

A direct test to see if brokerage coverage increases with the MTU reduction would be to examine whether security analyst coverage has increased following the event (Brennan and Hughes, 1991). We compare the numbers, before and after the MTU change, of brokerage firms whose analysts provide forecasts on the earnings of the stock.[20] The information on the number of broker firms whose analysts cover the sample stocks is obtained from the I/B/E/S data. For each firm we identify one-year horizons before and after the MTU change. Then we count the number of brokerage firms that provided earnings forecasts during each period. The results are presented in Table 12. As noted by Elton and Gruber (1989), the number of suppliers of forecast data in Japan is much smaller than in the U.S. For the full sample, the average number of brokerage firms before the MTU change is 8.3. With the new MTU the average is 11.3.

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and closing trades for the morning and afternoon sessions as well as trades executed against special quotes are excluded in the regressions.

The change of 2.9 is significant at the one percent level. We also have similar results when we look at the medians. The median change of one firm from six to eight firms is also highly significant. As many as 65 firms experienced an increase in brokerage coverage while only 21 firms experienced a decrease. There are 26 firms in the sample that did not have any analyst following before the MTU change. Inclusion of these firms could provide an upward bias in the changes in the number of brokerage firms since any change for these firms must be a positive one. Thus, we exclude the firms with zero brokerage coverage before the MTU change and repeat the same test for the remaining firms. The results, shown in Panel B, are similar to those from the full sample. The firms that were covered by brokerage firms before the MTU change attracted on average 3.3 more brokerage firms after the event.

To investigate whether the increase in brokerage coverage varies depending on firm size, we partition the sample firms into three groups based on market capitalization. The prediction is that brokerage coverage will improve if the firm is smaller and less well known. The NEEDS-MT Corporate Financial Affairs Data provide shareholding information only for 91 firms in the sample, so each subgroup contains 30 or 31 firms. The results are reported in Panel 3 of Table 12. Surprisingly, the firms that attracted most brokers' attention are those in the mid-size range. The stocks in the medium-size range experienced greater increase in brokerage coverage than the small or large firms' stocks. For example, the median increase for the medium firms is three while the medians for small and large firms are 0.5 and one, respectively.

3.9 Announcement Effect

Enlarged investor base, improved liquidity, more brokerage promotion, and more participation of noise traders in the market will all affect the value of the stock in the positive direction. In an efficient capital market, prices respond instantaneously to new information. Therefore the increase in firm value

[20] We also compared the number of analysts following the stock before and after the MTU change. The results are

will be immediately observed at the time of the announcement. In this section we examine the announcement effect of the MTU change. We estimate the following model:

$$R_{it} = \alpha_i + \beta_{1i} R_{mt} + \beta_{2i} RSIZE_{it} + \varepsilon_{it},$$

where R_{it} is the return on stock I on day t, R_{mt} is the return on the TOPIX index, and $RSIZE_{it}$ is the return on the size index that corresponds to firm i. We use three indices provided by Datastream International: TSE first section medium-size stocks, TSE first section small size stocks, and TSE second section stocks. We calculate the cumulative abnormal returns for the following three windows: [ad-2, ad+2], [ad-2, cd+2], and [cd-2, cd+2], where 'ad' denotes the announcement date and 'cd' denotes the change date. The first window captures the cumulative abnormal returns (CAR) around the announcement date. The second captures the CAR from the announcement to the actual change. The last window captures the CAR surrounding the change date.

Table 13 reports the mean and median CARs for the 81 firms that are used in the regressions.[21] The average CAR for the five-day period surrounding the announcement date, i.e., [ad-2, ad+2], is 1.74 percent, which is only marginally significant at the 10 percent level. The average CAR over the [ad, cd] window is 9.57 percent, which is highly significant at one percent level. The median CAR is 6.67 percent and also highly significant. Of the 81 firms, 55 firms, or 68 percent, have a positive CAR. For the [cd-2, cd+2] window, we estimate CARs for all 118 firms in the full sample as well as the 81 firms with announcement dates known. For both groups, there is a small positive price effect surrounding the change date, with an average (median) CAR equal to 1.61 percent (1.22 percent) for the full sample and 2.04

virtually the same as the results from the number of brokers.

[21] We have searched both Bloomberg News Service and Nikkei News Service and are able to identify 81 announcments among the 118 firms in the full sample.

percent (1.26 percent) for the sub-sample of firms with announcement dates known. For both cases, the mean and median CARs are significant at one percent level.

Figure 4 plots the evolution of the CARs surrounding the announcement and change dates. As in Amihud, Mendelson, and Uno (2000), we divide the entire window from five trading days before the announcement date to five days past the change date into 12 subwindows: the first subwindow, [ad-5, ad], covering six days from day –5 to day zero relative to the announcement, the next 10 equal-length sub-windows dividing the entire period from one day after the announcement date to one day prior to the change date, and the last sub-window, [cd, cd+5], covering six days from the change date. The pattern is similar to what Amihud, Mendelson, and Uno (2000) found. The increase in stock price is gradual, as the benefit from a small MTU cannot be fully realized until the actual reduction takes place.

3.10 Cross-Sectional Regression of Announcement Returns

In this section, we examine the importance of enlarged investor base, improved liquidity, brokerage promotion, and noise trading in explaining the positive price reaction to the MTU change in a cross-sectional regression framework. We regress the CARs from the [ad-2, cd+2] window on variables we believe proxy for the above four explanations or their combination. As pointed out previously, all four stories of an investor-base increase, liquidity improvement, expanded brokerage coverage, and increased noise trading are closely interrelated. For example, an increase in the investor base implies improvements in liquidity. But at the same time, an improvement in liquidity such as reductions in the bid-ask spread can attract more investors, enlarging the investor base. Likewise, involvement of more brokerage firms can lead to a greater influx of small investors. Or, the other way is also possible. Because of this endogenous nature of cross effects among the factors, it is difficult to separate one explanation from the other(s) when we analyze the return patterns surrounding the MTU change. Nevertheless, for each of the four explanations, we try to come up with some measures that we believe are more representative of the direct consequence(s).

As measures representing the improvement in liquidity caused by the MTU change, we use the change in percentage spreads, *Δ%Spread*, the log-differences in the average daily number of trades, *ΔNTrades*, and average daily share volume, *ΔSVolume*, between the 60-day period before the announcement and the 60-day period after the change date. To use the values measured during the period before the announcement date is to avoid any problems arising from endogeneity between the dependent variable and the independent variables. We use the change in average daily bid-ask midpoint return standard deviations, *ΔVolatility*, as the proxy for the increase in noise trading. As to the proxies for expanded investor base, we use the log-difference in the number of all shareholders, *ΔAllSH*, as well as in individual shareholders, *ΔIndSH*. Lastly, to test the effect of the increase in broker participation, we use two measures: the changes in the number of brokers, *ΔNbrokers*, and the difference in the ratios of the daily average number of trades to number of brokers, $\Delta\frac{NTrades}{NBrokers}$. The last variable, $\Delta\frac{NTrades}{NBrokers}$, measures the profitability of individual brokers as a greater number of trades per broker implies greater brokerage commission income. The regression estimation is performed using weighted least squares, where the weights are the residual variances from the market model regressions to estimate the CARs. If our predictions on the relations between the four hypotheses and the stock value are right, we should observe a negative coefficient for *ΔSpread* and positive coefficients for *ΔNTrades*, *ΔSvolume*, *ΔVolatility*, *ΔAllSH*, *ΔIndSH*, *ΔNbrokers*, and $\Delta\frac{NTrades}{NBrokers}$.

The regression results are reported in Table 14. Surprisingly, the spread change does not have a significant impact on the stock value change. Even if the sign of the coefficient is in the right direction, its t-values are never close to any significant level. On the other hand, the changes in the number of trades and share volume are both positive and significant. The change in share volume is, in particular, highly significant at the one percent level. The change in volatility is also highly significant, indicating that the noise trading story is not inconsistent with the return pattern. Both the changes in all shareholders and individual shareholders have the predicted positive coefficients and are statistically significant at the five percent level, rendering support for the investor base explanation. The measures of the changes of brokerage coverage offer some mixed results. The variable measuring the influx of new brokers, *ΔNbrokers*, turns out to be insignificantly related with the return pattern. On the other hand, $\Delta \frac{NTrades}{NBrokers}$ is highly significantly associated with the firm value changes. Its *p*-value is less than 0.001. Since the numerator of $\Delta \frac{NTrades}{NBrokers}$ is the change in the average daily number of trades, the highly significant result could be driven by the change in the number of trades. However, the coefficient of *ΔNTrades*, the change in the number of trades, itself is only marginally significant and, therefore, cannot be the main factor driving the significant result. This implies that how much commission income the customer orders generate for the brokers, as proxied by $\Delta \frac{NTrades}{NBrokers}$, may be more important in explaining the positive stock returns than the sheer increase in the number of brokerage firms covering the stock. The bottom part of Table 14 presents the regression results with combinations of the independent variables that are significantly related with the CAR when regressed separately. Both *ΔIndSH* and $\Delta \frac{NTrades}{NBrokers}$ remain significant factors while the influence of *ΔSVolume* and *ΔVolatility* washes away. This result indicates that the expanded investor base and the active participation of brokerage firms are the two strongest factors that explain the gain in firm value related with MTU reductions. The coefficients of both variables are significant at the five percent level.

However, generally the cross-sectional regression results are not that strong with R^2 ranging from 2 to 31 percent. Such a result is expected because the market's responses to the MTU changes are reflected in the stock price over a long period of time. On average the period between the announcement date and the actual change date is about 60-days long. Hence, it is possible that the CARs themselves are attenuated with noises coming from various factors that were not captured in our data filtering process. Nevertheless, the cross-sectional regression results support the notion that the empirical pattern of the firm value change is significantly associated with the enlarged investor base as well as the active participation of brokers lured by the increased commission income. The empirical result is also not inconsistent with the liquidity effect and increased noise trading.

4. Conclusion

This paper provides a comprehensive study of the impact of changes in minimum trading unit on the TSE. Our sample covers 118 listed firms that reduced MTU during the 1996-2000 period. Our major findings are as follows. First, there is a significant increase in the total number of investors and individual investors, with the mean increase over the event year being 79 percent and 118 percent, respectively. Second, quoted spreads on average drop from 1.89 to 1.38 percent. Effective spreads drop from 1.09 to 0.94 percent. Liquidity improvements from spreads are primarily associated with small quantity limit orders. Depths at the best ask quotes decline from 2,443 shares to 1,649 shares, while depths at the bid side decline from 2,551 shares to 1,763 shares. The deterioration in liquidity from depths also concentrates on small orders. The average daily number of trades increases from 27.6 to 61.7, with the average trade size almost cut in half from 2.3 to 1.2 pre-event MTUs. Small trades registered the most significant increase while large trades witness a significant decline. The net effect is a highly significant increase in trading volume for small trades, and a moderate decrease in trading volume for large trades. The trade-to-quote ratio increases from 56.8 to 62.8 percent. Small trade category receives a

5.2 and 2.2 percentage increase in buyer-initiated transactions measured in number of trades and share volume. Third, brokerage coverage increases on average from 8 to 11 firms. Fourth, return volatility increases for more than 58 percent of the events in the sample. Adverse selection component of the spread drops from 49.9 to 45.4 percent. Our results provide strong support for the investor base, liquidity, brokerage promotion, and noise-trading hypotheses. Consequently, firms that reduce their MTUs are rewarded on average by a 9.6 percent increase in the firm value from the announcement date to effective date. The results from the cross-sectional regressions of stock returns generally support the idea that the afore-mentioned factors are significantly associated with the positive stock price movement around the MTU change.

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Table 1. Description of the MTU Change Sample

This table presents the size of the Minimum Trading Unit (MTU) before and after the change date. The sample consists of 118 TSE firms that changed their MTUs between June 1996 and August 2000.

Adjustment Ratio	Size of MTU		Number of Stocks
	Before	After	
10 to 1	1,000 shares	100 shares	91
5 to 1	500	100	6
	50	10	2
2 to 1	2,000	1,000	1
	1,000	500	16
	100	50	2
Full Sample			118

Table 2. Descriptive Statistics for the Sample Stocks

This table presents the descriptive statistics for the average price, market capitalization, quoted spreads in yen and percentage terms, ask and bid quotation sizes in number of shares, daily number of trades, and daily share volume. The statistics are calculated for the 60 trading day period prior to the change of the Minimum Trading Unit (MTU). Panels A and B report the statistics for the full sample of 118 firms and a sub-ample of 91 firms that reduced their MTU from 1,000 shares to 100 shares.

A. Full Sample (N=118)	Mean	1st quartile	Median	3rd quartile
Price (¥)	4,154	1,600	2,516	3,461
Market Capitalization (in 1,000 shares)[a]	32,679	14,400	20,250	37,170
Market Capitalization (in ¥ million)[a]	107,752	22,840	49,186	97,289
Spread (¥)	60.45	22.33	34.22	61.89
Spread (%)	1.89	1.00	1.49	2.22
Ask Size in No. of Shares[c]	2,443	1,778	2,225	2,866
Bid Size in No. of Shares[c]	2,323	1,609	2,136	2,607
Daily No. of Trades	27.60	5.96	13.61	26.81
Daily Share Volume	54,216	9,800	24,034	56,746
B. Changes of 1,000 to 100 shares (N = 91)				
Price (¥)	3,447	1,777	2,549	3,397
Market Capitalization (in 1,000 shares)[b]	36,202	17,820	23,000	41,240
Market Capitalization (in ¥ million)[b]	127,074	33,575	60,887	127,185
Spread (¥)	58.78	24.06	34.07	62.41
Spread (%)	1.88	0.99	1.47	2.20
Ask Size in No. of Shares[d]	2,551	1,790	2,253	2,866
Bid Size in No. of Shares[d]	2,484	1,776	2,241	2,839
Daily No. of Trades	25.72	5.77	13.08	24.83
Daily Share Volume	58,420	10,263	25,417	56,746

[a] Based on a sample of 91 stocks for which the shares outstanding information is available.
[b] Based on a sample of 71 stocks for which the shares outstanding information is available.
[c] Based on a sample of 61 stocks for which depth information is available.
[d] Based on a sample of 42 stocks for which depth information is available.

Table 3. The Number of Individual Shareholders

Panels A and B present the cross-sectional means and medians of the numbers of all and individual shareholders and the number of shares held by individual shareholders recorded at the yearends prior to ('Before') and subsequent to ('After') the MTU change. The information on the number of all and individual shareholders and their holdings is obtained from the NEEDS-MT Corporate Financial Affairs Data. *** indicates statistical significance at the one percent level based on the standard t-test. $^{+++}$ indicates statistical significance at the one percent level based on the sine-test.

A. Number of Shareholders

	Number of All Shareholders			Number of Individual Shareholders			Individual / All Shareholders		
Full Sample (N=90)	Before	After	Log Diff.	Before	After	Log Diff.	Before	After	Diff.
Mean	2,531	4,088	0.58^{***}	1,755	3,608	0.78^{***}	0.73	0.88	0.15^{***}
Median	1,856	3,555	0.36^{+++}	1,439	3,104	0.59^{+++}	0.76	0.89	0.13^{+++}
Changes of 1,000 to 100 shares (N = 71)									
Mean	2,592	4,311	0.61^{***}	1,722	3,820	0.85^{***}	0.70	0.88	0.18^{***}
Median	1,828	3,657	0.38^{+++}	1,287	3,244	0.64^{+++}	0.71	0.89	0.17^{+++}

B. Number of Shares Held by Individual Shareholders

	Number of Shares Held by Individual Shareholders (in 1,000 shares)			Average Number of Shares Held by Individual Shareholders		
Full Sample (N=90)	Before	After	Log Diff.	Before	After	Log Diff.
Mean	9,167	9,869	0.09^{***}	6,291	3,347	-0.69^{***}
Median	7,118	7,787	0.07^{+++}	5,339	3,080	-0.53^{+++}
Changes of 1,000 to 100 shares (N = 71)						
Mean	9,468	10,107	0.08^{***}	6,339	3,221	-0.77^{***}
Median	7,652	7,820	0.07^{+++}	5,574	2,884	-0.60^{+++}

Table 4. The Spread and Depth

Panels A, B, and C present the means and medians of the quoted spread measured in yen, the effective spread in yen, and the quotation sizes in number of shares for the 60 trading day periods before and after the change of the Minimum Trading Unit (MTU). The last two columns report the percentage changes in spread measures, the log-differences in quote sizes, and the corresponding *p*-values from the standard t-tests or Wilcoxon two-sample signed rank tests. The quoted spread is measured as the difference between the ask and bid prices. The effective spread is measured as $2 \times | p_t - q_t |$, where p_t is the price of a trade at time t and q_t is the midpoint of the quotes in effect at the time of the trade. The analysis is carried out for the full sample of 118 firms and a sub-sample of 91 firms that reduced their MTU from 1,000 shares to 100 shares.

A. The Quoted Spread Measured in Yen

Full Sample (N=118)	Before	After	% Change	*p*-value
Mean	60.5	41.6	-23.1	0.000
Median	34.2	24.7	-24.6	0.000
Changes of 1,000 to 100 shares (N = 91)				
Mean	58.8	38.1	-27.7	0.000
Median	34.1	24.1	-29.6	0.000

B. The Effective Spread Measured in Yen

Full Sample (N=118)	Before	After	% Change	*p*-value
Mean	34.2	28.8	-8.8	0.007
Median	22.0	19.5	-12.5	0.000
Changes of 1,000 to 100 shares (N = 91)				
Mean	31.8	26.5	-11.2	0.005
Median	21.9	18.7	-14.8	0.000

C. Quote Sizes in Number of Shares

Full Sample (N= 61)		Before	After	Log-Diff.	*p*-value
Ask	Mean	2,443	1,649	-0.45	0.000
	Median	2,225	1,354	-0.45	0.000
Bid	Mean	2,323	1,352	-0.60	0.000
	Median	2,136	1,169	-0.66	0.000
Changes of 1,000 to 100 shares (N = 42)					
Ask	Mean	2,551	1,763	-0.47	0.000
	Median	2,253	1,362	-0.47	0.000
Bid	Mean	2,484	1,460	-0.62	0.000
	Median	2,241	1,269	-0.66	0.000

Table 5. The Effective Spread and Effective Depths by Trade Size

This table presents the cross-sectional means by trade size categories of the average yen and percentage effective spreads (Panel A) and the average ask and bid quotation sizes in number of shares (Panel B) for the 60 trading day periods before and after the change of the Minimum Trading Unit (MTU). Changes in the variables are measured in percentage changes (Spread in ¥), differences (% Spread), and log-differences (depth). Trade size categories are based on multiples of the MTU prior to the change. Also presented in the table are the *p*-values from the *t*-test for the significance of the changes in the mean numbers before and after the MTU change. *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively based on the standard t-tests. $^{+}$, $^{++}$, and $^{+++}$ indicate statistical significance at the 10, 5, and 1 percent levels, respectively based on the Wilcoxon two-sample signed rank tests.

A. Effective Spread

	Spread in ¥			Spread in Percentage of Stock Price		
Full Sample (N=118)	Before	After	% Change	Before	After	Difference(%)
Trade Size≤1 MTU	33.6	26.4	-10.99***	1.12	0.95	-0.17***
Trade Size<1 MTU	–	27.8	–	–	0.94	–
Trade Size=1	33.6	26.0	-14.91***	1.12	0.87	-0.25***
2≤Trade Size≤5	31.6	27.7	1.37	0.95	0.88	-0.07
6≤Trade Size≤9	26.4	25.3	0.29	0.75	0.73	-0.02
10≤Trade Size	24.9	24.3	26.19	0.65	0.72	0.07
Changes of 1,000 to 100 shares (N = 91)						
Trade Size≤1 MTU	32.2	26.2	-13.65***	1.09	0.90	-0.19***
Trade Size<1 MTU	–	26.3	–	–	0.91	–
Trade Size=1	32.2	24.4	-17.46***	1.09	0.83	-0.27***
2≤Trade Size≤5	28.7	25.2	-0.52	0.93	0.86	-0.07
6≤Trade Size≤9	21.4	18.9	-1.69	0.73	0.69	-0.04
10≤Trade Size	17.5	19.6	31.21	0.62	0.73	0.11

B. Depth

	Ask			Bid		
Full Sample (N=62)	Before	After	Log Diff.	Before	After	Log Diff.
Trade Size≤1 MTU	2,225	1,520	-0.43***	2,157	1,278	-0.56***
Trade Size<1 MTU	–	1,487	–	–	1,232	–
Trade Size=1	2,225	1,948	-0.13***	2,157	1,710	-0.20***
2≤Trade Size≤5	2,972	2,346	-0.24***	3,007	2,200	-0.30***
6≤Trade Size≤9	5,169	5,041	-0.03	5,300	4,311	-0.22***
10≤Trade Size	11,153	11,265	0.06	6,735	6,362	-0.25
Changes of 1,000 to 100 shares (N = 42)						
Trade Size≤1 MTU	2,270	1,479	-0.51***	2,321	1,185	-0.72***
Trade Size<1 MTU	–	1,435	–	–	1,141	–
Trade Size=1	2,270	2,015	-0.13***	2,321	1,738	-0.26***
2≤Trade Size≤5	3,040	2,354	-0.28***	3,167	2,302	-0.33***
6≤Trade Size≤9	5,215	5,587	0.05	5,708	4,822	-0.26**
10≤Trade Size	12,166	12,328	0.10	8,048	7,402	-0.50

Table 6. Trading Activity

Panels A, B, and C present the cross-sectional means and medians of average daily number of transactions, share and yen volume, and average trade size measured in old trading units for the 60 trading day periods before and after the change of the Minimum Trading Unit (MTU). The last two columns report the log differences in the daily number of transactions and trading volume, the percentage changes in average trade size, and the corresponding *p*-values from the standard t-tests or Wilcoxon two-sample signed rank tests. The analysis is carried out for the full sample of 118 firms and a sub-sample of 91 firms that reduced their MTU from 1,000 shares to 100 shares.

A. Daily Number of Trades

Full Sample (N=118)	Before	After	Log-Diff.	*p*-value
Mean	27.6	61.7	0.69	0.000
Median	13.6	27.8	0.67	0.000
Changes of 1,000 to 100 shares (N = 91)				
Mean	25.7	66.2	0.80	0.000
Median	13.1	27.1	0.76	0.000

B. Trade Size in Old MTU

Full Sample (N=118)	Before	After	% Change	*p*-value
Mean	2.28	1.19	-49.2	0.000
Median	2.03	0.95	-54.4	0.000
Changes of 1,000 to 100 shares (N = 91)				
Mean	2.30	1.07	-55.1	0.000
Median	2.06	0.83	-58.5	0.000

C. Daily Volume

Full Sample (N=118)		Before	After	Log-Diff.	*p*-value
Share Volume	Mean	54,216	57,999	-0.09	0.065
	Median	24,034	22,808	-0.10	0.021
Yen Volume in ¥1,000	Mean	295,540	343,335	-0.10	0.084
	Median	77,108	70,611	-0.13	0.013
Changes of 1,000 to 100 shares (N = 91)					
Share Volume	Mean	58,420	63,888	-0.08	0.179
	Median	25,417	24,807	-0.09	0.039
Yen Volume in ¥1,000	Mean	326,346	387,585	-0.09	0.177
	Median	77,501	72,451	-0.13	0.016

Table 6. Trading Activity (Continued)

D. Market Adjusted Daily Volume

Full Sample (N=118)		Before	After	Difference	*p*-value
Share Volume	Mean	0.12	0.13	0.01	0.648
	Median	0.05	0.05	0.00	0.710
Yen Volume	Mean	0.44	0.48	0.04	0.331
	Median	0.10	0.12	0.00	0.793
Changes of 1,000 to 100 shares (N = 91)					
Share Volume	Mean	0.13	0.14	0.01	0.578
	Median	0.07	0.06	0.00	0.724
Yen Volume	Mean	0.48	0.54	0.06	0.293
	Median	0.10	0.14	0.00	0.928

Table 7. The Average Daily Number of Trades and Share Volume by Trade Size

Panels A and B present the cross-sectional means of average daily number of transactions and share volume, categorized by trade size, for the 60 trading day periods before and after the change of the Minimum Trading Unit (MTU). Changes in the trading activity variables are measured in log-differences. Trade sizes are measured in multiples of the MTU prior to the change. The last column in each panel reports the *p*-values from the standard t-tests. The analysis is carried out for the full sample of 118 firms and a sub-sample of 91 firms that reduced their MTU from 1,000 shares to 100 shares.

A. Average Daily Number of Trades

Full Sample (N=118)	Before	After	Log- Diff.	*p*-value
Trade Size≤ 1 MTU	15.4	48.2	1.08	0.000
Trade Size< 1	0.0	41.7	–	–
Trade Size=1	15.4	6.6	-0.91	0.000
2≤Trade Size≤5	6.9	9.5	0.25	0.002
6≤Trade Size≤9	1.5	1.2	-0.35	0.005
10≤Trade Size	0.5	0.4	-0.32	0.006
Changes of 1,000 to 100 shares (N = 91)				
Trade Size≤ 1 MTU	15.8	53.2	1.19	0.000
Trade Size< 1	0.0	47.2	–	–
Trade Size=1	15.8	6.0	-0.98	0.000
2≤Trade Size≤5	6.1	9.4	0.32	0.000
6≤Trade Size≤9	1.3	0.9	-0.39	0.000
10≤Trade Size	0.4	0.3	-0.45	0.000

B. Average Daily Share Volume

Full Sample (N=118)	Before	After	Log- Diff.	*p*-value
Trade Size≤ 1 MTU	14,420	17,403	0.20	0.003
Trade Size< 1	0	11,606	–	–
Trade Size=1	14,420	5,798	-0.91	0.000
2≤Trade Size≤5	14,273	18,300	0.11	0.165
6≤Trade Size≤9	6,848	5,386	-0.31	0.001
10≤Trade Size	5,057	4,673	-0.19	0.160
Changes of 1,000 to 100 shares (N = 91)				
Trade Size≤ 1 MTU	15,815	19,424	0.21	0.007
Trade Size< 1	0	13,420	–	–
Trade Size=1	15,815	6,005	-0.98	0.000
2≤Trade Size≤5	15,093	20,477	0.17	0.047
6≤Trade Size≤9	7,431	5,582	-0.34	0.001
10≤Trade Size	5,518	4,773	-0.26	0.065

Table 8. The Number of Quotes and the Trade-to-Quote Ratio

Panels A and B present the cross-sectional means and medians of the average daily number of quotes and average trade-to-quote ratio for the 60 trading day periods before and after the change of the Minimum Trading Unit (MTU). The trade-to-quote ratio is defined as the ratio of the number of trades to the number of quotes, excluding the opening and closing trades and quotes before the opening trade and after the closing trade. The last two columns report the log differences in the daily number of quotes, the differences in the trade-to-quote ratio, and the corresponding *p*-values from the standard t-tests or Wilcoxon two-sample signed rank tests. The analysis is carried out for the full sample of 118 firms and a sub-sample of 91 firms that reduced their MTU from 1,000 shares to 100 shares.

A. Daily Number of Quotes

Full Sample (N=118)	Before	After	Log-Diff.	*p*-value
Mean	57.0	107.0	0.54	0.000
Median	25.3	43.7	0.50	0.000
Changes of 1,000 to 100 shares (N = 91)				
Mean	53.9	111.3	0.63	0.000
Median	23.3	40.3	0.56	0.000

B. Percentage Proportion of Numbers of Trades to Number of Quotes

Full Sample (N=118)	Before	After	Difference (%)	*p*-value
Mean	56.8	62.8	5.93	0.001
Median	53.0	57.2	9.01	0.000
Changes of 1,000 to 100 shares (N = 91)				
Mean	57.9	65.0	7.06	0.001
Median	57.4	64.1	10.51	0.000

Table 9. Changes in Percentages of Buys by Trade Size

Panels A and B present the cross-sectional means of the percentages of buys in number of trades and share volume, categorized by trade size, for the 60 trading day periods before and after the change of the Minimum Trading Unit (MTU). Each transaction is classified as buy or sell according to the trade flags assigned in the original NEEDS data. Trade sizes are measured as multiples of the MTU prior to the change. Changes in the percentage of buys are measured in differences. The last column in each panel reports the *p*-values from the standard t-tests. The analysis is carried out for the full sample of 118 firms and a sub-sample of 91 firms that reduced their MTU from 1,000 shares to 100 shares.

A. Percentage of Buys in Number of Trades

Full Sample (N=118)	Before	After	Difference	*p*-value
Trade Size≤ 1 MTU	47.5	52.7	5.2	0.000
Trade Size< 1	–	53.9	–	–
Trade Size=1	47.5	46.9	-0.6	0.704
2≤Trade Size≤5	49.8	49.1	-0.7	0.636
6≤Trade Size≤9	51.8	49.1	-2.7	0.060
10≤Trade Size	56.7	58.4	1.7	0.600
Changes of 1,000 to 100 shares (N = 91)				
Trade Size≤ 1 MTU	47.5	54.1	6.6	0.000
Trade Size< 1	–	55.2	–	–
Trade Size=1	47.5	47.5	0.0	0.980
2≤Trade Size≤5	48.8	50.0	1.2	0.385
6≤Trade Size≤9	51.1	48.5	-2.6	0.244
10≤Trade Size	54.8	55.3	0.5	0.525

B. Percentage of Buys in Number of Shares

Full Sample (N=118)	Before	After	Difference	*p*-value
Trade Size≤ 1 MTU	47.5	49.6	2.1	0.095
Trade Size< 1	–	51.2	–	–
Trade Size=1	47.5	47.0	-0.5	0.704
2≤Trade Size≤5	49.9	49.7	-0.2	0.897
6≤Trade Size≤9	52.0	48.8	-3.2	0.030
10≤Trade Size	56.6	59.5	2.9	0.403
Changes of 1,000 to 100 shares (N = 91)				
Trade Size≤ 1 MTU	47.5	50.6	5.1	0.037
Trade Size< 1	–	52.1	–	–
Trade Size=1	47.5	47.5	0.0	0.980
2≤Trade Size≤5	48.9	50.4	1.5	0.264
6≤Trade Size≤9	51.4	48.1	-3.3	0.145
10≤Trade Size	54.1	56.6	2.5	0.285

Table 10. Return Variances

This table presents the cross-sectional means and medians of the daily return variance, half-hour return variance, and variance ratio statistics for the 60 trading day periods before and after the change of the Minimum Trading Unit (MTU). The daily returns are calculated based on the closing quote midpoint. The intraday half-hour returns are calculated using the last quote midpoint recorded in each of the nine half-hour intervals. The variance ratios for the morning and afternoon sessions are computed as $\mathrm{Var}[r_t(q)]/\{q \cdot \mathrm{Var}[r_t]\}$, where r_t denotes half-hour return, $r_t(q)$ is the summation of half hour returns over the consecutive q half-hour intervals, q = 4, and 5 respectively. The last two columns report the percentage of events with an increase in return variances, the differences in variance ratio statistics, and the corresponding *p*-values from the standard t-tests or sign tests. The analysis is carried out for the full sample of 118 firms and a sub-sample of 91 firms that reduced their MTU from 1,000 shares to 100 shares.

A. Daily Return Variances (Daily Close-to-Close Quote Midpoint Returns)

	Return Variance (%^{2})			
	Before	After	% with increase	p-value from sign test
Full Sample (N=118)	6.35	7.36	57.6	0.019
Changes of 1,000 to 100 shares (N = 91)	5.66	6.86	56.0	0.071

B. Half-Day Return Variances (Morning Open-to-Close & Afternoon Open-to-Close Returns)

	Morning Session				Afternoon Session			
	Return Variance (%^{2})				Return Variance (%^{2})			
	Before	After	% with increase	p-value from sign test	Before	After	% with increase	p-value from sign test
Full Sample (N=118)	1.96	2.38	52.5	0.604	1.49	2.42	60.2	0.093
1,000 to 100 shares (N = 91)	1.70	2.16	52.8	0.695	1.30	2.05	60.4	0.080

C. Half-Hour Return Variances

	Morning Session				Afternoon Session			
	Return Variance (%^{2})				Return Variance (%^{2})			
	Before	After	% with increase	p-value from sign test	Before	After	% with increase	p-value from sign test
Full Sample (N=118)	0.51	0.66	55.9	0.692	0.35	0.48	57.6	0.376
1,000 to 100 shares (N = 91)	0.43	0.62	58.2	0.460	0.33	0.46	57.1	0.431

D. Variance Ratios

	Morning Session				Afternoon Session			
	Return Variance (%^{2})				Return Variance (%^{2})			
	Before	After	After – Before	p-value from t-test	Before	After	After – Before	p-value from t-test
Full Sample (N=118)	1.22	1.22	0.00	0.856	1.35	1.21	-0.14	0.104
1,000 to 100 shares (N = 91)	1.21	1.24	0.02	0.711	1.35	1.20	-0.15	0.140

Table 11. The Cost Components of the Spread

This table compares the adverse selection component of the spread (θ), the order-processing component of the spread (ϕ), and the proportion of the adverse selection component in the implied spread ($\gamma=2\theta/(2\theta+2\phi)$) for the 60 trading day periods before and after the change of the Minimum Trading Unit (MTU). We estimate the components of the spread, θ and ϕ, using the Glosten and Harris (1988) model. Opening and closing trades for the morning and afternoon sessions, as well as trades executed against special quotes, are excluded in the regressions. The bid-ask components are expressed in percentage of stock price. The last two columns report the differences in bid-ask components, the differences in the proportion of adverse selection component, and the corresponding *p*-values from the standard t-tests or Wilcoxon two-sample signed rank tests. The analysis is carried out for the full sample of 118 firms and a sub-sample of 91 firms that reduced their MTU from 1,000 shares to 100 shares.

A. Percentage Adverse Selection Cost (θ)

Full Sample (N=70)	Before	After	Difference	*p*-value
Mean	0.13	0.10	-0.03	0.000
Median	0.12	0.09	-0.02	0.000
Changes of 1,000 to 100 shares (N = 58)				
Mean	0.13	0.10	-0.03	0.000
Median	0.12	0.09	-0.02	0.000

B. Percentage Order Processing Cost (ϕ)

Full Sample (N=70)	Before	After	Difference	*p*-value
Mean	0.13	0.12	-0.01	0.188
Median	0.11	0.12	0.00	0.291
Changes of 1,000 to 100 shares (N = 58)				
Mean	0.13	0.12	-0.01	0.223
Median	0.11	0.11	-0.01	0.316

C. Percentage of the Adverse Selection Cost in the Implied Spread ($\frac{\theta}{\theta+\phi}$)

Full Sample (N=70)	Before	After	Difference	*p*-value
Mean	49.9	45.4	-4.5	0.000
Median	48.3	45.5	-5.6	0.000
Changes of 1,000 to 100 shares (N = 58)				
Mean	50.0	44.9	-5.1	0.000
Median	48.8	44.8	-5.8	0.000

Table 12. The Average Number of Brokerage Firms Per Stock

This table presents the cross-sectional statistics of the number of brokerage firms covering the stock during one year before and one year after the MTU change. Also presented in each panel are the *p*-values from the standard *t*-test (sign test) for the significance of the mean (median) changes in the number of brokerage firms. The information on the number of brokerage firms is obtained from the I/B/E/S data.

A. Full Sample (N=118)

	Before	After	Difference	*p*-value
Mean	8.3	11.3	2.9	0.000
Median	6	8	1	0.000
Maximum	68	66	19	
Minimum	0	0	-5	

	Increase	No Change	Decrease
Number of Stocks	65	32	21

B. Subgroups Based on the Number of Brokers Before the MTU Change

Number of Brokers Before MTU Change > 0 (N = 92)	Before	After	Difference	*p*-value
Mean	10.7	14.0	3.3	0.000
Median	8	11	2.5	0.000
Number of Brokers Before MTU Change = 0 (N = 26)				
Mean	0	1.5	1.5	0.034
Median	0	0	0	0.016

C. Subgroups Based on Market Capitalization

	Before	After	Difference	*p*-value
Market Capitalization: Small (N = 30)				
Mean	3.5	5.3	1.8	0.027
Median	4	4.5	0.5	0.053
Market Capitalization: Medium (N = 30)				
Mean	5.3	9.2	3.9	0.000
Median	6	9	3	0.000
Market Capitalization: Large (N = 31)				
Mean	10.4	14.7	4.3	0.002
Median	6	12	1	0.002

Table 13. Cumulative Abnormal Returns

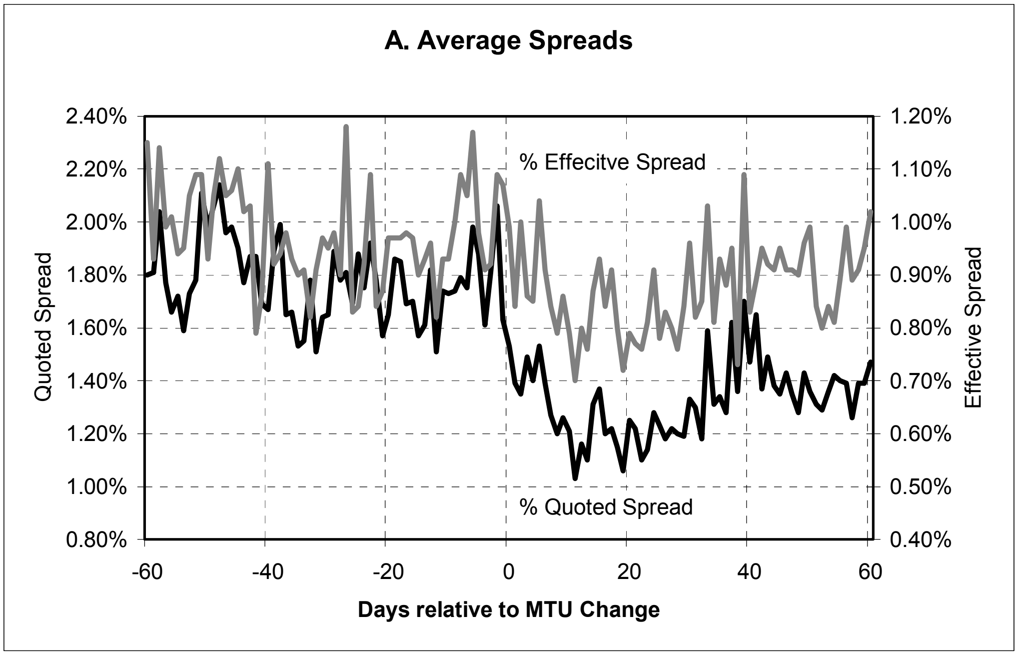
This table examines the announcement effects of the changes in Minimum Trading Unit (MTU). We calculate the cumulative abnormal returns from the announcement date to the effective date of the MTU change and cumulative returns around the effective date. We cumulate the average excess returns that are net of the market return and a corresponding size effect over four event windows. The announcement date is denoted '*ad*' while the change date is denoted as '*cd*'. The announcement dates were collected from Bloomberg News Service and Nikkei News Service. Only 81 firms are used in calculating the cumulative abnormal returns between the announcement and change dates because announcement dates are not identified for the rest of the firms in the sample. *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively based on the standard t-tests. $^{+}$, $^{++}$, and $^{+++}$ indicate statistical significance at the 10, 5, and 1 percent levels, respectively based on the Wilcoxon test.

Measurement Interval	Mean	Median	% positive
[ad-2, ad+2] (N=81)	1.74 *	1.26	58
[ad-2, cd+2] (N=81)	9.57 ***	6.67 $^{+++}$	68
[ed-2, cd+2]			
Entire Sample (N=118)	1.61 ***	1.22 $^{+++}$	62
Annc. Date Known (N=81)	2.04 ***	1.26 $^{+++}$	62

Table 14. Cross-Sectional Regression of CARs between Announcement to Change Dates

This table presents the coefficient estimates and their p-values (in parentheses) from the cross-sectional regression of the cumulative abnormal return from the announcement date to the MTU change date for the 81 sample firms whose announcement dates are known. Explanatory variables are the changes between the 60 day period before the announcement and the 60 day period after the MTU change and defined as follows: (1) *ΔSpread*, the difference in percentage spread; (2) *ΔNTrades*, the log difference of daily average number of trades; (3) *ΔSVolume*, the log difference of daily average share volume; (4) *ΔVolatility*, the difference in standard deviation of daily returns; (5) *ΔNBrokers*, the change in number of brokers; (6) *ΔAll SH*, the log difference in the number of all shareholders; (7) *ΔInd. SH*, the log difference in the number of individual shareholders; (8) $\Delta \frac{NTradse}{NBrokers}$, the difference in the ratio of the daily average number of trades to the number of brokers.

Intercept	*ΔSpread*	*ΔNTrades*	*ΔSVolume*	*ΔVolatility*	*ΔNBrokers*	*ΔAll SH*	*ΔInd. SH*	$\Delta \frac{NTradse}{NBrokers}$	R^2
0.11 (0.01)	-0.04 (0.22)								0.02
0.09 (0.05)		0.08 (0.09)							0.04
0.16 (0.00)			0.14 (0.00)						0.10
0.17 (0.00)				6.04 (0.00)					0.08
0.13 (0.00)					-0.01 (0.41)				0.01
0.11 (0.03)						0.13 (0.03)			0.10
0.10 (0.09)							0.12 (0.03)		0.10
0.07 (0.06)								0.11 (0.00)	0.16
0.11 (0.04)			0.07 (0.20)				0.13 (0.02)		0.15
0.09 (0.10)				-1.06 (0.69)			0.13 (0.03)		0.10
0.05 (0.27)			-0.04 (0.55)					0.14 (0.00)	0.18
0.15 (0.00)				4.34 (0.08)				0.05 (0.15)	0.13
0.04 (0.54)			-0.04 (0.53)	0.58 (0.84)			0.12 (0.04)	0.09 (0.02)	0.31



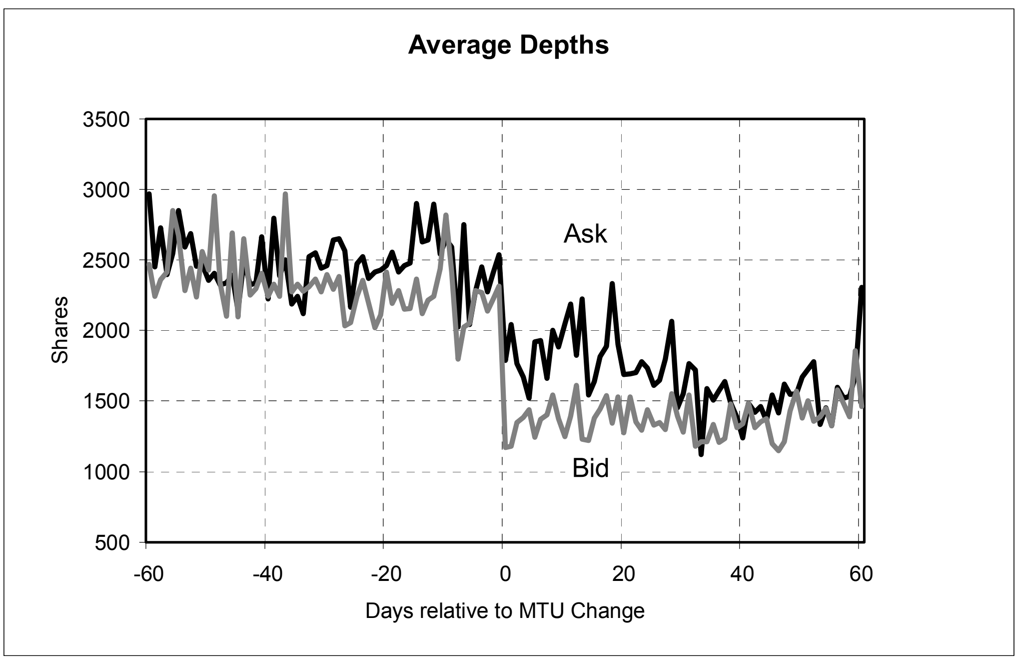
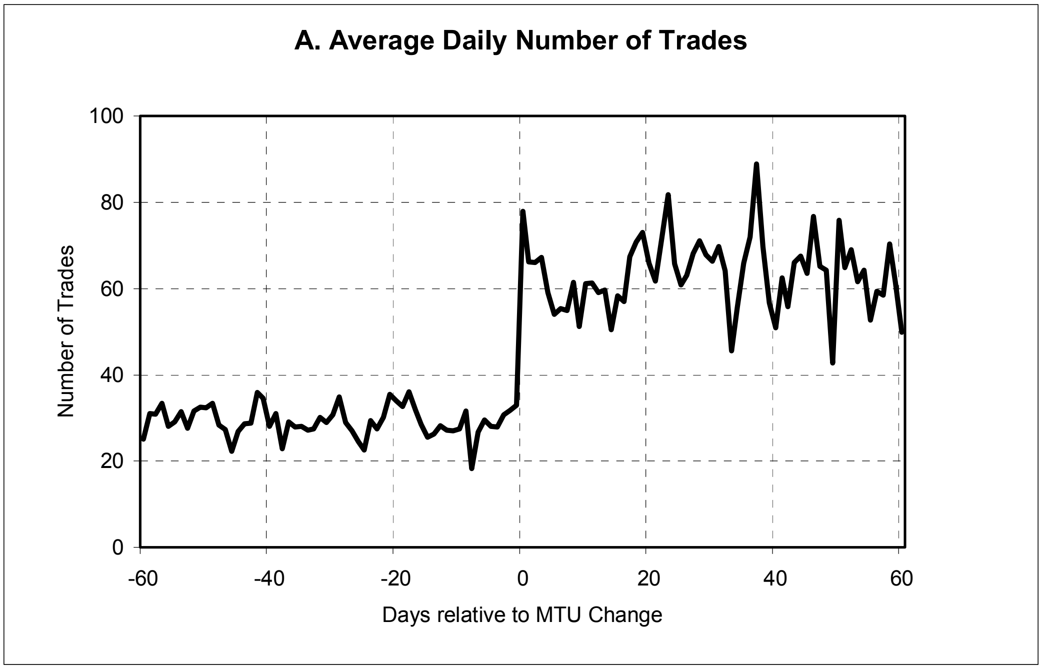


Figure 1. The Daily Average Spread and Depth Around MTU Change



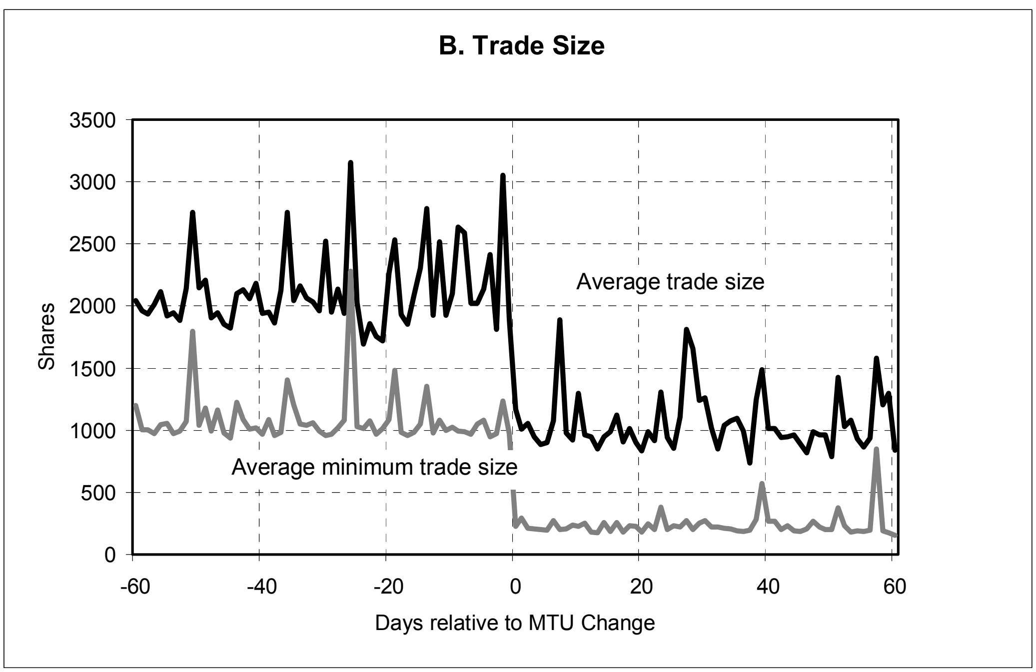


Figure 2. Trading Activity Around MTU Change

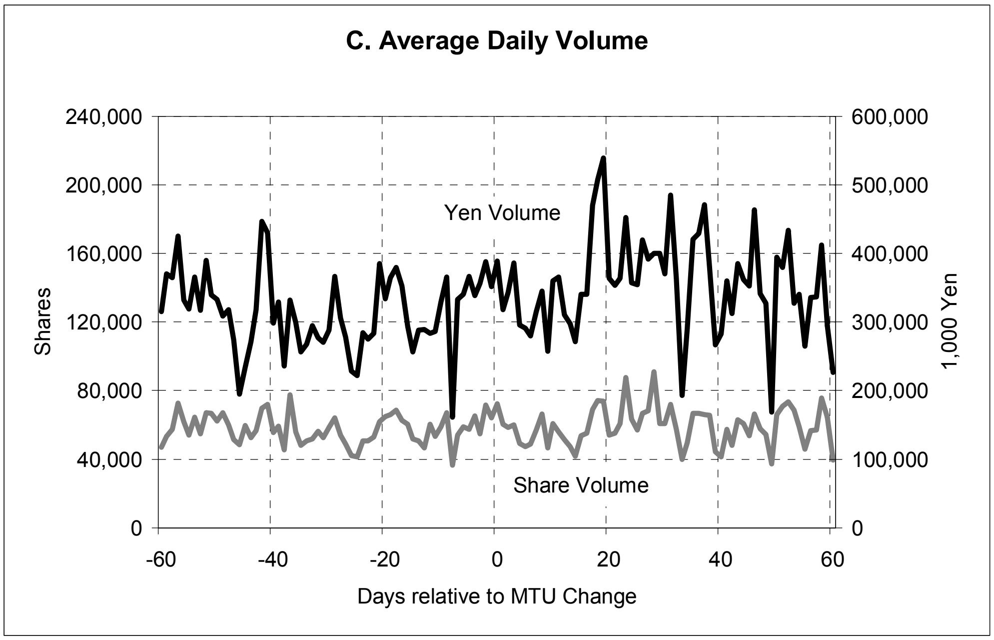
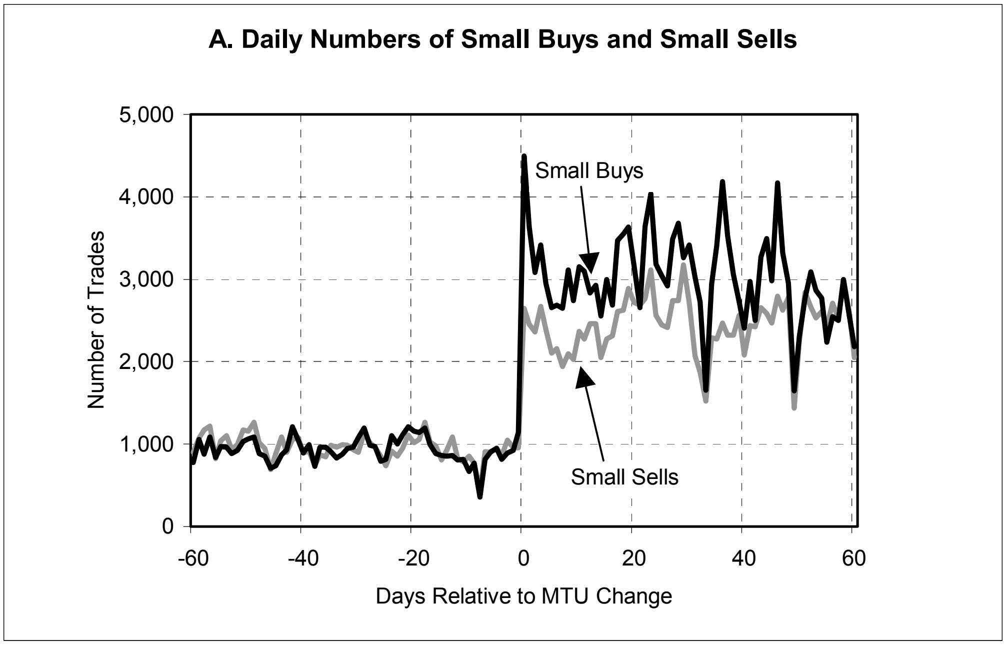


Figure 2. Trading Activity Around MTU Change (Continued)



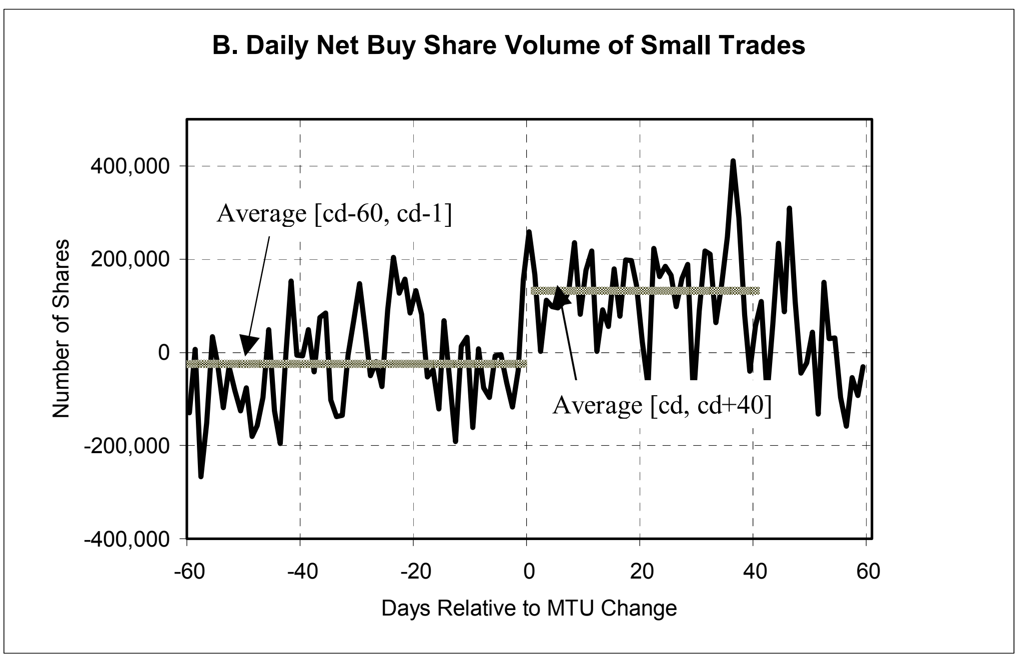


Figure 3. The Daily Numbers of Small Buys and Sells and Net Small Buy Volume

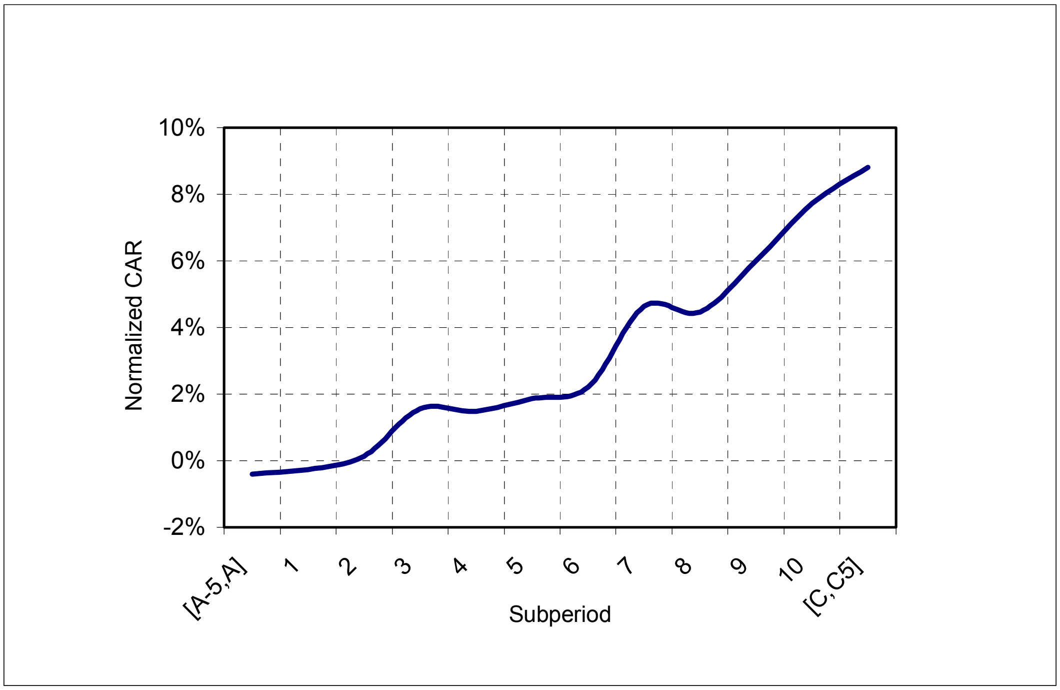


Figure 4. Normalized Cumulative Abnormal Returns Over 12 Sub-periods