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Abstract

This paper presents an examination of the relation between pre-trade transparency and market quality in the Tokyo Stock Exchange (TSE). Mixed evidence related to this relation has been reported worldwide. We analyzed this relation using a discrete change of disclosure policy in the 2000s. A positive relation pertains between pre-trade transparency and market quality. This result implies that the change of disclosure policy on the TSE might be effective for market quality improvement to some extent.

JEL Classifications: G14; G15; G18

Keywords: Pre-trade transparency; Market quality; Quote Disclosure

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1. Introduction

Rule changes enhancing pre-trade transparency have been undertaken for several stock exchanges worldwide. These disclosure reforms are expected to increase market quality, but no consensus exists in relation to their effectiveness for market quality improvement. This paper is intended to reveal whether or not the increase of pre-trade transparency improves market quality. We analyze a disclosure event in an order driven market, the Tokyo Stock Exchange (TSE), and attempt to provide new evidence to clarify the relation between pre-trade transparency and market quality.

Trade transparency in a stock market is defined by O'Hara (1995) as "the ability of market participants to observe the information in the trading system". Pre-trade transparency is generally defined as a public release of buy and sell orders before the orders are executed.

The increase of pre-trade transparency affects market quality in the following ways. First, the higher the pre-trade transparency becomes, the lower the precision of each trader's inference of the true stock value. Second, each trader must change their optimal strategy in accordance with changes of other traders' optimal strategies. Consequently, a new equilibrium is realized after the change of disclosure rules.

Mixed evidence pertains to the effect of change for disclosure policy. In 1990, both the floor and the Computer Aided Trading System (CATS) at the Toronto Stock Exchange (TSX) began to disclose the limit order book publicly. Madhavan et al. (2005) empirically analyze this

TSX policy change and show that the increase of pre-trade transparency engenders decreased market quality. This effect is especially apparent for so-called floor stocks, for which pre-trade transparency is lower than that of CATS. In contrast, Boehmer et al. (2005) found that greater pre-trade transparency of the limit order book improves market quality. Hendershott and Jones (2005) also found that reduction in the pre-trade transparency of the order book of the Island ECN decreased market quality. Eom et al. (2007) support effectiveness of disclosure changes with evidence from their analyses of two disclosure changes of the Korean Exchange (KRX) in 2000 and 2002. They show that market quality is increased and concave in pre-trade transparency. Eom et al. (2007) examine two discrete disclosure changes in pre-trade transparency; the effect of improving market quality in the latter disclosure change is weaker than that in the former one.

Previous theoretical studies have examined pre-trade and post-trade transparency. Madhavan (1996) shows that the pre-trade transparency improves market quality in a sufficiently large market. Baurch (2005) shows an increase of market quality occurring concomitantly with increased pre-trade transparency. Theoretical studies of Naik et al. (1999) and Madhavan et al. (1995) analyze post-transparency, which is defined as the public release of buy orders and sell orders after the orders are executed. Gemmill (1996) empirically show that less post-transparency does not affect the spread on the London Stock Exchange.

Experimental studies of Bloomfield and O' Hara (1999) and Flood et al. (1999) also

confirm the relation between transparency and market quality. Bloomfield and O'Hara (1999) confirm that the informational efficiency and spreads increases with increased transparency. Flood et al. (1999) find that market depth and trading volume increase with increased transparency.

In this paper, we focus on the former event on 2000 and analyze whether or not pre-trade transparency improve the market quality in TSE. On December 25, 2000, the publicly disclosed number of prices and quotes was increased from one to three ((the bid and the next two buy prices, the ask and next two sell prices)[1]. Until then, the TSE only disclosed the best buy and sell prices and quotes.

There are few studies of these disclosure reforms in TSE, a large order-driven market. Comerton-Forde et al. (2005) show that the removal of broker identities effectively improved the market quality. On June 30, 2003, TSE abandon disclosure of broker identities from a trading screen that information had been provided only to its trading participants. Their paper also shows that the removal of broker identities improved the market quality in KRX at 1999. In other words, the degree of pre-trade anonymity of TSE on the former event on 2000 is less than that of KRX because broker IDs are displayed only to brokers.

This paper examines the relation between pre-trade transparency and market quality. We

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[1] There are two recent events of two discrete disclosure events on the TSE at 2000 and 2003. On June 30, 2003, the disclosed number was increased from three to five. This latter event also includes another disclosure change. The TSE abandoned this policy of disclosure to prevent confusion and misunderstanding among investors, especially among individual investors. However, this latter event becomes a weaker natural experiment because the increase of pre-trade transparency is occurred in same time.

measure market quality as the quoted spread, effective spread, high-low volatility, and the decomposed component of bid-ask spread: adverse selection cost following the model of Madhavan et al. (1997) (hereinafter, MRR).

Our event study makes use of four market quality variables. We find that the event increased market quality. Three market quality measures—bid-ask spread, effective spread and the MRR adverse selection cost —improved after the event, although the high-low volatility is insignificantly improved.

In market micro-structure event studies, variables such as volume and price affect the market quality and are endogenously determined[2]. Eom et al. (2007) adopt panel-data analysis controlling for volume and price. In this paper, we also reran our event using panel-data setting, controlling for volume and price. We find that market quality improved after the event. Therefore, we can conclude that market quality is increasing function of pre-trade transparency.

The empirical results are summarized as a following point. The market quality is weakly increasing with the expanding disclosed quantities of quotes. This effect is lower than the same type of disclosure events of KRX.

The remainder of this paper is organized into the following four sections. In section 2, we

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[2] In event studies, the changes of other relevant variables need to be adequately controlled. If they are not adequately controlled, they may contaminate the event study. If the other relevant variables are exogenous, controlling is straightforward.

introduce data, methodology, and event features. Section 3 describes hypotheses of this paper. In addition, section 4 summarizes the empirical results. Finally, we conclude this paper in section 5.

2. Data and Methodology

2.1. Data Sources and Sample periods

The sample period includes the 50 trading days before and after the two events described above. The sample periods for our event are October 12 – December 22, 2000 and December 25, 2000 – March 9, 2001.

Our dataset includes all transactions and quotes for the 225 stocks that constitute the Nikkei Price Average Index. The component stocks of the Nikkei 225, which are selected from the TSE 1st section, are commonly used as an index of the Japanese stock market.

We use real-time TSE trade and quote data from the Nikkei Economic Electronic Database System (NEEDS) historical tick data. The database is time-stamped to the nearest minute; each datum includes information related to all quotes and trades in both price and quantity. Flags of the data include buy/sell indicators, opening/closing indicators, and special and warning quotes indicators.

The data filtering processes are explained as follows:

· We selected a sample firms from among Nikkei 225 component stocks whose minimum tick sizes were ¥1, ¥5, and ¥10. The stocks priced less than or equal to ¥2000 have a tick size of ¥1; those between ¥2000 and ¥3000 have ¥5; and those between ¥3000 and ¥30000 have ¥10. In our sample periods, the number of stocks whose tick size is greater than ¥10 are eight firms. We removed them to avoid possible effects attributable to the considerably larger tick size, as pointed out by Ahn et al. (2002) who analyzed the component stocks of Nikkei 225's intraday pattern.

· We required the sample firms to be traded as those with more than six trades per half-hour during the sample periods following the data filtering method used by Lin et al. (1995).

· We removed firms whose minimum tick size changed during the sample period to prevent its effect on the quote spread and other market statistics measures.

The final samples consist of 149 for our event.

2.2. Methodology

The objective of these analyses is to discover whether or not pre-trade transparency affects market quality improvement. Using a market-micro structure event-study method, we test whether or not the market quality of TSE is improved by the disclosure event. Our test is to

compare differences of market quality before and after the events.

We measure market quality using the following variables: quoted spread, effective spread, high-low volatility, and MRR adverse selection cost. These market quality measures were also adopted for the order driven market analysis undertaken by Eom et al. (2007).

We use a disclosure reform event on the TSE, a large order-driven market. The TSE publicly discloses a specified number of best buy and sell prices and their number of shares at each price. On December 25, 2000, the number of disclosed prices and shares was increased from one to three (the bid and the next two buy prices, the ask and the next two sell prices). This event related to the change of the disclosure policy are helpful to reveal the effects of pre-trade transparency on market quality, which is not analyzed by the previous study of Camerton-Forde et al. (2005).

In the market micro-structure event study method, trading volume and prices of stocks are determined endogenously and are known to affect the market quality. We control for the change of market quality using a panel-data analysis same as Eom et al. (2007). We obtain the coefficients and p-values using fixed effect estimation, which is robust to endogeneity problems[3]. Because there are insufficiently many trades per day to accurately estimate MRR model on a daily basis within the small- and medium-size firms, we aggregate each five-day period into a single period; for the other variables, we use daily data. Thus, the number of observations for each measure of market quality is about 20 per firm per event for MRR, and

100 per firm per event for the other measures of market quality. For each of market quality

measures *y*, our panel-data specification is following equation (1):

$$y_{it} = \beta_0 + \beta_1 PostDummy_{it} + \beta_2 \log(volume_{it}) + \beta_3 \log(price_{it}) + c_i + \varepsilon_{it} \qquad (1)$$

Where the subscript *i* means each of firms, *t* indexes the period, *PostDummy* is a dummy

variable which becomes 1 after the event. The *Volume* denotes average of daily volume and

Price denotes average daily price. c_i denotes individual firm-specific effects, and

$\varepsilon_{it} \sim i.i.d(0, \sigma^2)$.

3. Hypotheses

The TSE is an order-driven market in which there is no market maker. Lacking market

makers, the limit order is the only source of liquidity. The limit order's free option properties

are identified and analyzed by Copeland and Galai (1983), Easley and O' Hara (1991), Seppi

(1997), and Foucault (1999)[4]. Foucault (1999) describes that the limit order trader's risk is

'picked off' by market orders when stock values change with the arrival of new information.

In other words, the efficiency of market orders becomes higher and the monitoring cost of

limit order traders are also raised by the increased pre-trade transparency. After all, limit orders

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[3] The Hausman test rejects the random effect specification.
[4] A limit order trade at a specified price becomes a free option at a specified strike price after the trade.

are less likely to be provided as free options in the market, and market liquidity decreases, with widening spreads, and increased price volatility.

The change of bid-ask spread components are explained as follows. The adverse selection costs related to pre-trade transparency are similarly discussed by Madhavan et al. (2005). The expected profits of informed traders are larger in a more transparent market because they more efficiently use liquidity available through limit orders. On the other hand, uninformed traders are less likely to choose limit orders in a more transparent market. Therefore, the adverse selection components of the spread are widened.

In the following subsection 3.1, we produce hypotheses of changes in market quality after events enhancing pre-trade transparency.

3.1. Changes in Market Statistics

3.1.1.   Liquidity Change: Bid-Ask spread

No consensus pertains of whether a spread is decreasing in pre-trade transparency. Brauch (2005) shows theoretically that the improvement of pre-trade transparency increases information efficiency, and engenders the tightening of spreads. An empirical study by Boemer et al. (2005) confirms this effect. On the other hand, a theoretical study by Madhavan (1996) and empirical work of Madhavan et al. (2005) reveal that the spread increases with improvement of pre-trade transparency. They conclude that quote disclosure increases the cost

of limit order traders and spread increases because of their reduced limit orders.

Our null hypothesis related to the change of the bid-ask spread is the following.

H1: Pre-trade transparency increases do not affect the spread width.

The following pairs of null hypotheses for changes of *spread (Sp)* and effective spread (*Esp*) are tested respectively. We respectively compare these two measures before and after the events. We first calculate the quoted bid-ask spread defined as the difference between the best bid and ask price. When calculating the quoted spread, we exclude the opening/closing quotes and special quotes; quotes outside the exchange opening hours are excluded.

The daily spread is the transaction time-average of the spread between the best bid and ask quotes. The effective spread is defined as $2|p_t - q_t|$, where p_t is the transaction price and q_t is the midpoint of the quote at the time of the trade. We average the daily spread and daily effective spread over the sample for the before and after periods.

3.1.2.   Volatility

No consensus pertains on the relation between pre-trade transparency and volatility of stock returns. Madhavan (1996) show theoretically that the volatility of stock returns might increase with pre-trade transparency in a market that is insufficiently large. This theoretical

implication is confirmed empirically by Madhavan et al. (2005) by a similar event at the TSX.

On the other hand, Eom et al. (2007) show empirically that transient volatility of stock returns

decreases with pre-trade transparency in the order driven market of KRX.

Therefore, our null hypothesis of the relation between the volatility of stock returns and

pre-trade transparency becomes the following.

H2: Pre-trade transparency increases do not affect volatility.

We test the null hypothesis for changes of the volatility of stock returns (σ). We

respectively compare the volatility before and after the events. We adopt "high-low volatility"

to test the null hypothesis of H2 following the earlier study of Comerton-Forde et al. (2005).

Volatility is measured as following equation (2).

$$Volatility_{it} = \ln\left(\frac{High_{it}}{Low_{it}}\right) \qquad (2)$$

where High is the highest price during each 30-min interval of the trading day and Low is the

lowest price during each 30-min interval of the trading day. Wiggins (1992) show that this

volatility is an extreme value estimator, and is used because it is more efficient than estimators

based on closing prices. Volatility is averaged across each day in order to produce one

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observation per stock per day. The high-low volatility is that for all trading days in each period.

3.1.3.   Adverse Selection Cost

Mixed evidence pertains for relations between pre-trade transparency and the adverse selection components of the spread. Madhavan et al. (2005) find that the adverse selection components increased after improvement of pre-trade transparency. On the other hand, Eom et al. (2007) show that the decrease of adverse selection components is concave in pre-trade transparency.

We derive the implied spread and its two components—adverse selection and transitory cost—using the structural model described by Madhavan et al. (1997)[5] (Hereinafter, we call MRR model).

$$\Delta P_t = \theta(x_t - \rho x_{t-1}) + \phi(x_t - x_{t-1}) + u_t, \tag{3}$$

In that equation, P is the stock's trading price, x is the buy-sell trade indicator variable for the transaction price (if buyer (seller) initiated order $x=1(-1)$). Also, θ denotes the effects of revisions in beliefs, where positive θ measures adverse selection cost arising asymmetric information among traders, and ϕ reflects the effects of bid-ask bounce, where positive

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ϕ measures the transitory cost of supplying liquidity attributed to the limit-order trader.

Actually, ρ is the serial autocorrelation of the indicator x.

The three parameters (θ, ϕ, ρ) in equation (3) can be estimated using the generalized method of moments (GMM).

We test the null hypothesis H3 as follows:

H3: Pre-trade transparency increases do not affect the asymmetric component of the spread.

The following null hypothesis for changes of adverse selection cost (θ) is tested. We compare the adverse selection cost before and after the events.

4.   Empirical Results

4.1. Descriptive Statistics

Table 1 shows descriptive statistics of our sample firms classified into three firm groups: small, medium, and large. The table lists the number of firms, the firms' average market capitalizations (in billions of yen), average daily volume (in thousands of shares), and average daily closing prices in each group.

The market capitalization of sample firms is 340.8 billion yen. The respective averages of

the three groups' market capitalization range from 50.8 billion yen to 763 billion yen. Table 1

also presents the increase in trading volume from before to after the event. Table 1 portrays that

the daily average number of trades is almost identical for the sample period.

(Insert Table 1)

4.2. Empirical Results

Our empirical results show the change of market quality using the spread, effective spread,

transient volatility, and MRR adverse cost component. Differences of market quality are tested

using Wilcoxon's (nonparametric) signed-rank test. Table 2 presents results of liquidity,

volatility, and MRR adverse selection cost component from the event study for all samples.

(Insert Table 2)

As for bid-ask spread, the null hypothesis of the daily spread: H1 is negatively rejected for

any sample and three groups, suggesting an increase of market quality. The decrease in bid-ask

spread is by about 5.5% after the event. For effective spread, the null hypothesis: H1 is

negatively rejected at 1% level. These two results imply that market liquidity measured as

bid-ask and effective spread are enhanced by the improvement of pre-trade transparency.

The change of high-low volatility was averaged over all transactions during each of the two sample periods. The change is not significant for all groups. In other words, the null hypothesis of H2 is not significantly negative. Therefore, we cannot infer any relation between volatility and market quality.

The null hypothesis of H3 is negatively rejected for all samples. The decrease of adverse selection cost (θ) is about 3 % at event, which indicates that the degree of asymmetric information among traders is reduced by disclosure event.

In comparing the empirical results of our four market quality measures, changes of bid-ask spread, effective spread and adverse selection cost indicates the positive relation between pre-trade transparency and market quality. However, changes of high-low volatility are insignificant. We imply that market quality is weakly increasing in pre-trade transparency in TSE after the quote disclosure on 2000. However, there is a possibility that the endogenous relations market quality and volume or price. We adopt panel data analysis controlling for price and volume in next section.

4.3. Panel Data Analysis Controlling for price and volume

Using event-study methodology without controlling for volume or price, only one of market quality variables: high-low volatility does not show a significant result and other three variables show the improvements of market quality. Thus, we cannot strongly conclude that

market quality is improved after the event 1 by the standard event-study methodology.

However we use the panel-data analysis to control for volume and price.

(Insert Table 3)

Table 3 reports the results of our panel data analysis. In panel A, we use daily observation

for three market quality variables: bid-ask spread, effective spread, and high-low volatility.

Since MRR model cannot be estimated on a daily basis for firms with insufficiently trading

observations, it is estimated using weekly observations and reported in panel B. We focus on

the coefficient β_1 which indicates the post event dummy variable. This table shows that post

the event, controlling by a panel-data setting for volume and price, bid-ask spread, effective

spread, transient volatility, and MRR adverse selection cost are all significantly negative,

indicating an improvement in market quality.

We conclude that the event improved market quality using this panel-data analysis.

5. Conclusions

This paper presents results of an examination of the relation between pre-trade

transparency and market quality in the TSE, a large order driven market. For this examination,

we analyzed TSE event: increased disclosure of the number of quotes from one to three on

December 25, 2000. We measure the market quality by spread, effective spread, transient volatility, MRR adverse selection cost.

We compare the changes of market quality measures before and after the event using an event study method. The same type of disclosure reform was established in the order driven market of KRX. We find only weak positive relations for the event of TSE between market quality and pre-trade transparency.

The different interpretation can be made of the differences between our results and those of Eom et al. (2007). We might interpret that these differences depend on the degrees of pre-trade anonymity before the disclosure reforms. Comparing the degrees of pre-trade anonymity, that of TSE is less than that of KRX for the event because broker IDs, which is displayed only to brokers, affects the lower market quality in TSE than KRX in which broker IDs are publicly disclosed.

In conclusion, we provide evidence of a positive relation between pre-trade transparency and market quality in TSE: an order driven market. This positive relation might depend on the degree of pre-trade anonymity. For examination of this possibility, more evidence for stock exchanges worldwide would be helpful. This remains as a valuable task for future study.

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Table 1

Descriptive statistics

Group (based on volume)	No. of Firms	Market cap. (billion ¥) Mean	Average Volume (1,000 shares) Mean		Average Trading Number (/day) Mean		Average Closing Price (Yen) Mean	
			Pre	Post	Pre	Post	Pre	Post
ALL	149	340.8	1752.7	1839.1	265.4	264.7	765.3	740.9
Small-firm	50	50.8	734.1	678.8	141.4	132.5	377.4	363.9
Medium-firm	50	185.3	1615.4	1692.8	239.3	244.4	666.8	639.3
Large-firm	49	763.0	2932.2	3172.2	418.7	420.3	1261.5	1229.4

Table 2

Spread, effective spread, volatility, and adverse selection cost before and after the event

	Event		
	Pre	Post	Wilcoxon's Signed-rank
Panel : Estimated Results of all firms			
All Firms			
sp	2.137	2.022	0.000
esp	2.140	2.026	0.000
σ	1.089	1.096	0.306
θ	0.098	0.095	0.001

Note: The cross-sectional means of the spread (sp), effective spread (esp), high-low volatility (Σ), and the adverse selection cost components of the implied spread (θ) are estimated for the 50 trading days before and after event day. The structures of each null hypothesis mean that (sp, esp, σ, θ) are statistically same before and after the events. Reported in the 4th columns are the *p*-values for Wilcoxon's signed-rank test for nonparametric testing of the null hypotheses.

Table 3

Panel Data Analysis controlling for endogenous variables: price and volume

Event 1				
	β_0	β_1	β_2	β_3
Panel A				
No. of firms (observations per firm)	149(100)			
Sp (Spread)	-1.99468***	-0.08130***	-0.11037***	0.90118***
	(0.000)	(0.000)	(0.000)	(0.000)
Esp (Effective Spread)	-2.01278***	-0.07945***	-0.10897***	0.90136***
	(0.000)	(0.000)	(0.000)	(0.000)
Volatility (Hi-Lo Volatility)	-0.00016**	-0.00001***	0.00007***	-0.00010***
	(0.049)	(0.001)	(0.000)	(0.000)
Panel B				
No. of firms (observations per firm)	149(20)			
θ (MRR adverse selection cost)	0.97246***	-0.00678***	-0.01418***	-0.10775***
	(0.000)	(0.000)	(0.000)	(0.000)

Note: The hausman test rejects the random effects specification which indicates that endogeneity is an issue. This Table reports the coefficients and p-values from a panel data analysis, using fixed effects estimation, which is robust to endogeneity problems. For each measure of market quality, we estimate the equation (2). We use daily observations in Panel A; since MRR cannot be readily computed on a daily basis for infrequently-traded firms, it is calculated using weekly observations and reported in Panel B. ** and ***denote statistical significance at the 5% and 1% level, respectively.