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Does Pre-trade Transparency Affect Market Quality in the Tokyo Stock Exchange?

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Abstract

This paper examines 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 analyze this relation using evidence from a change in the TSE disclosure policy in the 2000s. We find a positive relation between pre-trade transparency and market quality. This result implies that the change in the TSE disclosure policy was effective in improving market quality.

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1. Introduction

Disclosure policy reforms in financial markets have been undertaken for several stock exchanges worldwide. The main objective of these reforms is to increase market liquidity for the purpose of increasing revenue from investor transaction fees. Investors prefer to trade in a highly transparent market, because transparency helps them to avoid losses caused by information asymmetry. The inverse relation between market liquidity and information asymmetry among investors is presented in previous theoretical studies such as Kyle (1985). As a result, stock exchanges seek to enhance transparency in financial markets in an attempt to attract more investors. Tokyo Stock Exchange (TSE), which is one of the largest order-driven markets in the world, increased the public availability of stock price and quote data for investors on December 25, 2000. In this paper, we focus on this change in the TSE disclosure policy and assess the policy's effectiveness.

The aim of this paper is to reveal empirically whether or not increases in market liquidity and decreases in information asymmetry have been realized under this change in the TSE disclosure policy. We also adopt panel data analysis controlling for volume and price. Our empirical results are summarized as follows. We find that following the disclosure change, market liquidity increases with the degree of market transparency of the disclosed information. In addition, the degree of information asymmetry among investors is reduced. Using panel data analyses, our results support the effectiveness of disclosure policy change. Therefore, we conclude that market quality on the TSE is an increasing function of pre-trade transparency that reflects the level of trading information that investors can access before they buy or sell stocks.

The remainder of this paper is organized into five sections. Previous studies are summarized in section 2. We introduce the data, methodology, and descriptive statistics in Section 3. Section 4 presents the hypotheses of this paper. In Section 5, we summarize the empirical results. Finally, we conclude this paper in Section 6.

2. Previous Literatures

An optimal market design is a very important issue. O'Hara (2001), for example, argues that exchange size, technology, and market design are critical in realizing efficient pricing and increased market liquidity. In order to increase market liquidity, the market design that meets the needs of market participants is required. Therefore, many stock exchanges seek to disclose more information in order to minimize information asymmetry among investors even during pre-trade periods. It is also important to examine the effectiveness of disclosure in the pre-trade period for optimal market design. O'Hara (1995) defines transparency as "the ability of market participants to observe the information in the trading process". In particular,

pre-trade transparency is defined as public releases of buy and sell orders before the orders are executed.

Previous theoretical studies have examined pre-trade and post-trade transparency. Madhavan (1996) shows that pre-trade transparency improves market quality in a sufficiently large market. Baruch (2005) shows that an increase in market quality concomitantly with an increase in pre-trade transparency. The theoretical studies of Naik et al. (1999) and Madhavan (1995) analyze post-trade transparency, which is defined as the public release of buy orders and sell orders after the orders are executed.

There is little consensus in relation to the effectiveness of pre-trade transparency in improving market quality. Madhavan et al. (2005) empirically analyze the Toronto Stock Exchange (TSX)'s policy change in 1990 and show that the increase in pre-trade transparency engendered decreased market quality. In contrast, Boehmer et al. (2005) find that greater pre-trade transparency of the limit order book improves market quality. Hendershott and Jones (2005) also find that reduction in the pre-trade transparency of the order book of the Island ECN decreased market quality.

3. Data, Methodology, and Descriptive Statistics

We determine the sample period to examine whether or not the change in market quality is effective. We use a time period of 100 trading days because a longer period is necessary to determine whether any change in market quality is maintained. The sample period includes the 50 trading days before and after the two events described above. Therefore, the sample periods for our event studies are October 12 to December 22, 2000 and December 25, 2000 to March 9, 2001.

Our dataset includes all transactions and quotes for the 225 stocks. 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 Historical Tick database. This database is time stamped to the nearest minute; each datum includes information related to all quotes and trades for both prices and quantities.

Our data filtering processes can be summarized as the following two steps. We first select a sample of firms from the Nikkei 225 component stocks whose minimum tick sizes are ¥1, ¥5, and ¥10 as pointed out by Ahn et al. (2002). Second, we included only sample firms that traded at a rate of more than six trades per half hour following by Lin et al. (1995). As a result, our final sample consists of 149 firms.

The objective of our analyses is to discover whether or not pre-trade transparency improves market quality. We test whether or not the market quality of the TSE has improved using a disclosure change event. We compare market quality before and after the events, and measure market quality. We first measure market liquidity using the quoted spread and effective spread. The bid–ask spread represents the reward for immediacy of execution

(O'Hara (1995)). Investors need to submit market orders at the time they want to trade. They face transaction costs of the bid–ask spread for immediacy of execution. In higher liquidity markets, many limit order traders submit their limit orders and the bid–ask spread narrows. In other words, market liquidity increases as the bid–ask spread narrows.

We also use a measure of volatility to determine whether the market fluctuations resulting from information asymmetry are weakened by the disclosure reform. Information asymmetry among investors is another important factor affecting market quality. The market microstructure literature provides a mechanism for assessing the components of the spread that represents the costs to the trader of information asymmetry, known simply as the asymmetric information cost. Several empirical models have been used to decompose the quoted spread into various components (e.g., De Jong et al. (1996), Glosten and Harris (1988), Huang and Stoll (1997), Madhavan et al. (1997), and Stoll (1989)). For the examination of the TSE, Ahn et al. (2002) use Madhavan et al.'s (1997) model and we adopt Madhavan et al.'s (1997) model to measure the asymmetric information cost. The estimation methods of high-low volatility and adverse selection cost are explained in Appendix 1 and 2. We further use panel data analysis controlling for change of trading volume and prices of stocks which are determined endogenously and are known to affect the market quality. This methodology is explained in Appendix 3.

Table 1 shows the 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 the sample firms is 340.8 billion yen. The respective averages of the three groups' market capitalizations 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 shows that the daily average number of trades is almost identical for the pre- and post-event periods.

Table 1 Descriptive statistics

Group	# of Firms	Market cap. (billion ¥) Mean	Average volume (1,000 shares) Mean		Average number of trades (/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	50	50.8	734.1	678.8	141.4	132.5	377.4	363.9
Medium	50	185.3	1615.4	1692.8	239.3	244.4	666.8	639.3
Large	49	763.0	2932.2	3172.2	418.7	420.3	1261.5	1229.4

4. Hypotheses Development

No consensus exists regarding whether bid–ask spreads are decreasing in pre-trade transparency; rather, theoretical predictions and empirical evidence are mixed. Baruch (2005) shows theoretically that an improvement in pre-trade transparency increases information efficiency and engenders the tightening of spreads. An empirical study by Boehmer et al. (2005) confirms this effect. On the other hand, a theoretical study by Madhavan (1996) and empirical work by Madhavan et al. (2005) reveal that the spread increases with improvement in pre-trade transparency. They conclude that quote disclosure increases the costs for limit order traders and spreads increase because of their reduced limit orders. Our null hypothesis related to the change in the quoted and effective spread is as follows. The following pairs of null hypotheses are tested respectively: 1A and 1B for changes in *quoted spread (sp)* and *effective spread* (*esp)*. We respectively compare these two measures before and after the event.

Hypothesis 1A: Pre-trade transparency increases do not affect quoted spread (*sp*).

Hypothesis 1B: Pre-trade transparency increases do not affect effective spread (*esp*).

As for the volatility of stock returns, Madhavan (1996) shows 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 at the KRX. Therefore, our null hypothesis of the relation between the volatility of stock returns and pre-trade transparency becomes hypothesis 2. We test the null hypothesis for changes in the volatility of stock returns (σ). We respectively compare the volatility before and after the events.

Hypothesis 2: Pre-trade transparency increases do not affect volatility (σ).

The adverse selection costs related to pre-trade transparency are similarly discussed by Madhavan et al. (2005). Informed traders have larger expected profits in a more transparent market because they more efficiently use liquidity available through limit orders. In contrast, uninformed traders are less likely to choose limit orders in a more transparent market. Therefore, the adverse selection components of the spread are widened. However, evidence is mixed 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 in pre-trade transparency. On the other hand, Eom et al. (2007) show that the decrease in the adverse selection components is a concave function in pre-trade transparency. We construct null hypothesis 3. We test the null hypothesis for changes in adverse selection cost (θ). In hypothesis 3, we compare the adverse selection cost before and after the events.

After testing the event study method, we provide a panel data analysis for dealing with possible endogeneity problems.

Hypothesis 3: Pre-trade transparency increases do not affect adverse selection cost.

5. Empirical Results

Our empirical results show the change in market quality from the event study for all samples. Table 2 presents the estimated results of the spread (*sp*), effective spread (*esp*), high–low volatility (σ), and Madhavan et al.'s (1997) adverse selection cost component (θ). Differences in market quality are tested using Wilcoxon's (nonparametric) signed-rank test in Table 2.

Table 2 Market Quality Changes pre and post the event

	Pre 50 Days	Post 50 Days	Wilcoxon's signed rank
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 structures of each null hypothesis mean that (*sp*, *esp*, σ, θ) are statistically the 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.

For the quoted bid–ask spread (*sp*) and effective spread (*esp*), the null hypotheses of the daily spread (H1A and H1B) are negatively rejected for all samples, suggesting an increase in market quality. The decreases in the bid–ask and effective spreads are about 5.5% after the event. These two results imply that market liquidity measured as bid–ask spreads or effective spreads is enhanced by the improvement in pre-trade transparency.

The change in high–low volatility (σ) is insignificant. In other words, the null hypothesis of H2 is not significantly negative. Therefore, we cannot infer any relation between volatility and market quality. There might be a possibility that the fluctuations in prices or volumes are affected in this case. Therefore, we also check the relevance of the results using panel data control methods in Table 3.

The null hypothesis of H3 is rejected for all samples. The decrease in the adverse selection cost (θ) is about 3% and the null hypothesis H3 is rejected at the 1% level. This result indicates that the degree of information asymmetry among traders is significantly reduced by the disclosure event.

In a comparison of the empirical results of our four market quality measures, the null hypotheses H1 and H3 are rejected. Changes in high–low volatility are insignificant. These

results imply that changes in the bid–ask spread, effective spread, and adverse selection cost indicate a positive relation between pre-trade transparency and market quality.

Table 3 Panel data analysis controlling for endogenous variables: price and volume

	β_0	β_1	β_2	β_3
Panel A				
# of firms	149(100)			
sp (spread)	-1.995***	-0.081***	-0.110***	0.901***
	(0.000)	(0.000)	(0.000)	(0.000)
esp (effective spread)	-2.013***	-0.079***	-0.109***	0.901***
	(0.000)	(0.000)	(0.000)	(0.000)
σ (high–low volatility)	-0.0016**	-0.0001***	-0.0007***	-0.0001***
	(0.049)	(0.001)	(0.000)	(0.000)
Panel B				
# of firms (observations per firm)	149(20)			
θ（adverse selection cost）	0.972***	-0.007***	-0.014***	-0.108***
	(0.000)	(0.000)	(0.000)	(0.000)

Note: The Hausman test rejects the random effects specification, which indicates that endogeneity is an issue. Table 3 reports the coefficients and p-values from a panel data analysis, using fixed effects estimation, robust to endogeneity problems. ** and *** denote statistical significance at the 5% and 1% level, respectively.

We further examine the relevance of these empirical results, controlling for the endogenous relations of price and volume. We adopt panel data analysis controlling for price and volume. Using an event study methodology without controlling for price or volume, only one of the market quality variables, high–low volatility, does not show a significant result whereas the other three variables show improvements in market quality. There is a possibility that an endogenous relation exists between market quality and price or volume, and we use the panel data analysis to control for price and volume using equation (3). Our concern is whether or not the market quality improvement in the post-event period is effective after controlling for the variation in price and volume, which would be endogenously determined by market quality.

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 (*sp*), effective spread (*esp*), and high–low volatility (σ). We focus on the coefficient of the post-event dummy variable (β_1) to examine whether or not each of the null hypotheses is rejected. Panel A shows that after the event, and controlling for volume and price in the panel dataset, the bid–ask spread, effective spread, and high–low volatility are all significantly negative at the 1% level. These results

indicate an improvement in market quality after the event in 2000. Madhavan et al.'s (1997) adverse selection cost (θ) is estimated using weekly observations and reported in panel B. We find that this coefficient (β_1) is also significant and negative.

Using panel data analysis, we find that the post-event dummy variables are all significantly negative at the 1% level. This result is consistent with improvement in the three market quality variables shown in Table 2: quoted spread, effective spread, and adverse selection cost. In addition, the decrease in volatility, which is insignificant in Table 2, is observed to be significant after controlling for endogeneity of price and volume. Therefore we conclude that the event improved market quality.

6. Conclusions

This paper examined the relation between pre-trade transparency and market quality on the TSE, a large order-driven market. For this analysis, we examined a TSE event: increased disclosure of the number of quotes from one to three, introduced on December 25, 2000. We adopted four market quality variables: quoted spread, effective spread, high–low volatility, and adverse selection cost.

This study revealed the effect of increased disclosure on the TSE. We compared the changes in the market quality measures pre and post the event. The changes in the bid–ask spread, effective spread, and adverse selection cost indicate a positive relation between pre-trade transparency and market quality. Controlling for price and volume, bid–ask spread, effective spread, high–low volatility, and adverse selection cost in a panel data setting, the post-event dummies are all significantly negative. These results imply that positive relations exist between market quality and pre-trade transparency.

In conclusion, we provided evidence of a positive relation between pre-trade transparency and market quality on the TSE. This evidence has policy implications for growing markets, suggesting that greater market liquidity may benefit developing financial markets. Additional evidence for stock exchanges worldwide would be useful in guiding the reforms of other developing markets. This remains as a valuable task for future research.

Appendix

1. High-low volatility

Wiggins (1992) shows that volatility is an extreme-value estimator, and that it is used because it is more efficient than estimators based on closing prices. Therefore, we use the high–low volatility defined by equation (1).

$$Volatility_{it} = \left(\frac{\ln(High_{it})}{\ln(Low_{it})} \right) \qquad (1)$$

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. Volatility is averaged across each day in order to produce one observation per stock per day.

2. Adverse Selection Cost

We adopt Madhavan et al.'s (1997) model because Ahn et al. (2002) point out that their model can be readily applied to the study of bid–ask components in an order-driven market such as the TSE. We derive two components of the spread—adverse selection and transitory cost—using the structural model described by Madhavan et al. (1997), which is shown in equation (2).

$$\Delta P_t = \theta(x_t - \rho x_{t-1}) + \phi(x_t - x_{t-1}) + u_t, \qquad (2)$$

where 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)). Furthermore, θ denotes the effects of revisions in beliefs, where a positive θ measures the adverse selection cost arising from information asymmetry among traders, and ϕ reflects the effects of bid–ask bounce, where a positive ϕ measures the transitory cost of supplying liquidity attributed to the limit order trader. In fact, ρ is the serial autocorrelation of the indicator x. The three parameters (θ, ϕ, ρ) in equation (2) can be estimated using the generalized method of moments (GMM).

3. Panel Data Analysis of Controlling Price and Volume

We control for the change in market quality using a panel data analysis following Eom et al. (2007). We obtain the coefficients and p-values using fixed effect estimation, which is robust to endogeneity problems. Because there are an insufficient number of trades per day to accurately estimate Madhavan et al.'s (1997) model on a daily basis within 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 Madhavan et al.'s (1997) measure, and 100 per firm per event for the other measures of market quality. For each measure of market quality y, our panel data specification is as in equation (3).

$$y_{it} = \beta_0 + \beta_1 PostDummy_{it} + \beta_2 \log(volume_{it}) + \beta_3 \log(price_{it}) + c_i + \varepsilon_{it}, \qquad (3)$$

where the subscript i indexes the firm, t indexes the period, and *PostDummy* is a dummy variable equal to 1 after the event. *Volume* and *Price* denote the average daily volume and average daily price, respectively. We take the logarithm of *Volume* and *Price*. c_i denotes individual firm-specific effects, and $\varepsilon_{it} \sim i.i.d(0, \sigma_\varepsilon^2)$.

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