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Analysis of the Impact of Tick Size on Price Changes

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Abstract

In this study, we investigated the effect of tick size using the data of the Tokyo Stock Exchange. Tick size refers to the price that an investor can specify when buying or selling a stock. By changing this, stock exchanges aim to realize a desirable market for investors. We used a discontinuous regression design for the analysis and investigated the effect of tick size on two indices, High Low Range and Liquidity Index. As a result of the analysis, for both indicators, the liquidity is deteriorating when the tick size is large. This suggests that the method implemented by the Tokyo Stock Exchange in 2014 to reduce the tick size may be the desired result. In addition, this research spans multiple fields such as finance, information communication, and decision making.

Keywords: Tick Size, Tokyo Stock Exchange, High Low Range, Liquidity Index.

1 Introduction

Many stock exchanges are open to competition. Therefore, managers are making changes to make their markets more attractive and attract investors. They hope these changes will make the market more accessible and desirable for investors.

There have been many changes in recent years, one of which is the change in tick size. Tick size refers to the price increments an investor can specify when ordering a stock. When they place orders for stocks, they cannot do so at any price. Only discrete prices can be specified and this level is set by each stock exchange. The Tokyo Stock Exchange implemented a tick size change in 2014.

In this study, we examine the impact of this tick size change by excluding the impact of price. Specifically, we use a regression discontinuity design to estimate the impact at the boundary of tick size changes.

The Tokyo Stock Exchange is the largest stock exchange in Japan. It also has a trading system similar to many stock exchanges in the world. Therefore, the results of this study are not just one case study, but are also applicable to many other markets. Therefore, the contribution of this research is significant. Especially in the stock market, stock prices play a major role, and it is possible that system changes are affected by this. Therefore, an analysis that excludes these effects will lead to a more accurate evaluation.

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In addition, this research is a problem that spans the fields of finance, decision making, and information communication. As a matter of finance, it belongs to the important issue of setting up an efficient market. Such an efficient market may be realized by changing the tick size. In terms of decision-making, this issue is a matter of decision-making by market managers and investors. For managers, these changes are issues that determine the management of their company, and for investors, they are issues that determine whether an investment is good or bad. Finally, for information and communications, recent innovations in information and communications technology have made the relationship between finance and information and communications important.

This area includes high-speed high-frequency trading and fintech. Especially in relation to tick size, a smaller tick size means a lower minimum profit per share, but information and communication technology makes up for it with high-frequency trading.

2 Analysis

This analysis is an empirical study using data. Regarding the data, the following conditions were set.

2.1 Data

2.1.1 Sample Period

- 3 months from the tick size change date [1].

2.1.2 Stocks

- Stocks are TOPIX100 constituent stocks.
- The stock's price over the period must be within the same tick size range.

The sample period was set to 3 months in this study. This is intended to ensure a sufficient number of samples for estimation.
Regarding stocks, the first condition is that the tick size changes in 2014 are for TOPIX100 constituent stocks. Also, for the second condition, the tick size is determined by the price range. Therefore, even for the same issue, the tick size may differ depending on the price. In this study, we set the price range conditions to eliminate such cases.
Data satisfying these conditions were obtained from the JPX Data Cloud.

2.2 Index

In this analysis, the following two indicators were analyzed.
The first is High Low Range devised by Chung and Zhang (2014) [2]. Będowska-Sójka (2019) defined this High Low Range by the following easy-to-calculate equation [3].

$$HLR_{it} = (P_{it}^{high} - P_{it}^{low})/(0.5 \times (P_{it}^{high} + P_{it}^{low})) \quad (1)$$

Here, HLR_{it} is the High Low Range of stock i on day t, P_{it}^{high} is the high price of stock i on day t, and P_{it}^{low} is the low price of stock i on day t.

This index is an index that represents the fluctuation of stock prices on a single day. Also in this research, calculations are performed according to this equation.
The second is the Liquidity Index devised by Danyliv, Bland, and Nicholas (2004) [4]. Liquidity Index is defined by the following equation.

$$LIX_{it} = \log_{10}\left(\frac{V_{it}P_{it}^{close}}{P_{it}^{high}-P_{it}^{low}}\right) \quad (2)$$

where 〖LIX_{it} is the liquidity index of stock i on day t, $V_{it}$is the trading volume of stock i on day t, P_{it}^{close} is the closing price of stock i on day t, P_{it}^{high} is stock i on day t The high, P_{it}^{low}, represents the low of stock i on day t.
This index is an index that shows how much the stock price has changed by buying and selling stocks.

2.3 Method

This study uses a regression discontinuous design. A regression discontinuity design is a technique used when some reference value determines whether there is a change or not. Specifically, it is defined by the following equation.

$$y_i = \alpha + \rho D_i + \beta R_i + e_i \quad (3)$$

Here, for each variable, y_i is the outcome variable, D_i is the dummy variable, R_i is the assignment variable, and e_i is the error.
In this formula, the dummy variable D_i takes 1 when $R_i$exceeds the reference value and takes 0 otherwise. So by looking at ρ, the coefficient for this variable, we can see the effect of the change.
In this research, we set High Low Range and Liquidity Index as y_i. Also, D_i is a dummy that represents a tick size change, and R_i is a stock price.

3 Results

Table 1 shows the estimation results for High Low Range.
Similarly, the estimation results for the Liquidity Index are shown in Table 2.

Table 1: Estimation Results for High Low Range.

	Estimate	SE	t value	p value	
α	0.006	0.000	140.855	0.000	***
β	0.000	0.000	-1.950	0.051	.
ρ	0.001	0.000	3.539	0.000	***

Note: *** indicates significant at the 0.001 level. . indicates significant at the 0.001 level.

Table 2: Estimation Results for Liquidity Index

	Estimate	SE	t value	p value	
α	8.477	0.007	1242.515	0.000	***
β	0.000	0.000	-28.763	0.000	***
ρ	-0.140	0.038	-3.631	0.000	***

Note: *** indicates significant at the 0.001 level.

4 Discussions

Figure 1 shows the distribution of HLR. Also, in Table 1, the estimated value of the coefficient of ρ was 0.001. This indicates that the High Low Range value rises when the stock price reaches the price range of 10000 yen or more, that is, the tick size becomes 5 yen. This means that the volatility of the stock price increases as the tick size increases.
Therefore, it suggests that liquidity is adversely affected when the tick size is large.
Similarly, Figure 2 shows the distribution of Liquidity Index. Also, in Table 2, the estimated value of the coefficient of ρ was −0.140. This indicates that the value of the Liquidity Index will decrease as the stock price rises above 10,000 yen, i.e., the tick size becomes 5 yen. This suggests that liquidity is deteriorating for this indicator as tick sizes rise.
Regarding the two indicators, both indicators are indicators using high and low prices. And both showed that liquidity is worsening when the tick size is large. This suggests that the tick size reduction implemented by the Tokyo Stock Exchange may improve liquidity in the market and bring about desirable results.

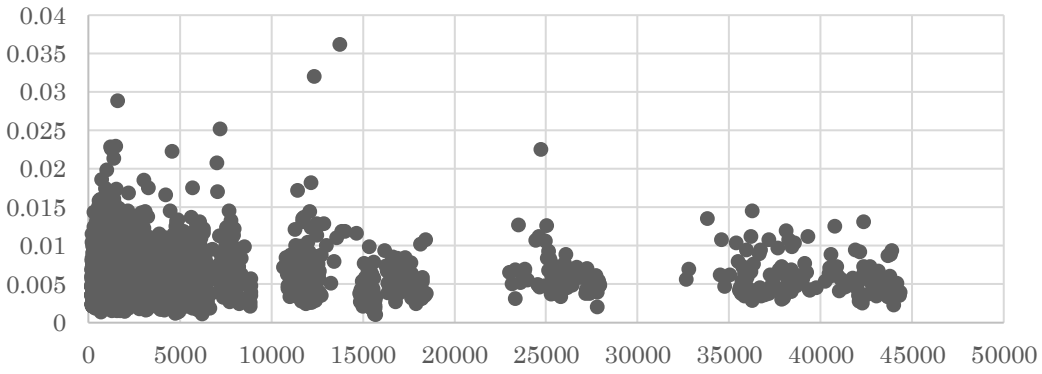

Figure 1: High Low Range Scatterplot.

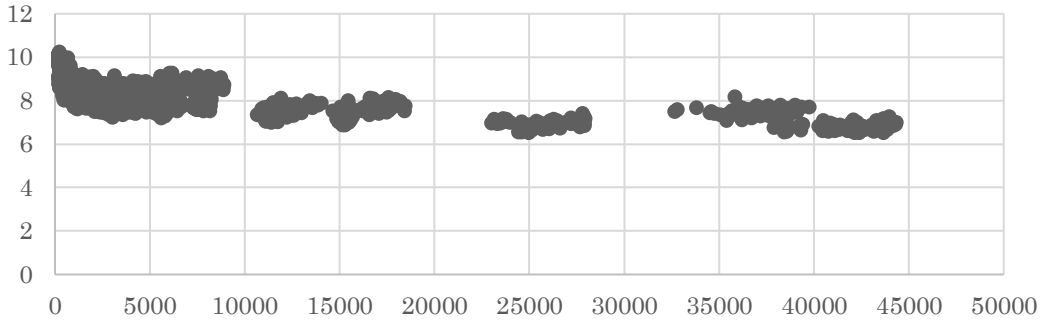

Figure 2: Liquidity Index Scatterplot

5 Conclusions

In this study, we analyzed the impact of tick size on the Tokyo Stock Exchange. In this study, a regression discontinuous design was used to examine the effects on High Low Range and Liquidity Index. In both cases, the results showed that liquidity deteriorated as the tick size increased. This suggests that a desirable market may be realized by reducing the tick size.

As future research, we would like to conduct research similar to this research on other indicators.

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