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Abstract

Firms listed on JASDAQ can select either the order-driven (hereafter OD) system, where formal market makers are not involved, or the market-maker (hereafter MM) system for the trading of stocks. How differences in trading systems affect pricing and liquidity is a key issue in the study of market microstructure. This paper examines empirical analyses of spread patterns for stocks listed on JASDAQ in order to ascertain the implications of differences in trading systems on price formation.

For MM issues, two-way prices are quoted for most of the trading day irrespective of market capitalization, spreads are stable, and their standard deviation is tighter than for OD issues. MM issue spreads tend to be wider than two ticks, but the percentage of trades executed within spreads is higher than that of OD issues at about 30 percent. In other words, the average effective spread for MM issues, calculated from execution prices and prevalent spreads, tends to differ from the average observed spread.

For OD issues, there is a risk that orders cannot be executed at the desired timing as quotes may not always be available, and the average spread is twice as wide than is the case for MM issues. Nevertheless, the ability of potential buyers/sellers to adjust bid/ask prices could lead to narrower spreads when potential buyers/sellers requiring the quick execution of orders raise/lower bid/ask prices. That is, OD issue spreads are

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influenced by individual market participants who, emphazing execution prices, place limit orders.

A difference in spread patterns was observed not only through comparative analyses of MM and OD issues but also through analyses of changes in spreads before and after issues switched trading system. Such difference stems from differences in the behavior of market participants placing orders for OD issues and that of market makers. In particular, the behavior of market makers may be influenced by the existence of the Small Trade Execution System and “leave order” system for MM issues, as has been noted in empirical studies in the US.

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1. Introduction

As part of "Big Bang" reforms in the Japanese securities markets, the JASDAQ market which evolved from the *Tento* stock market, literally the "over-the-counter" market for stocks, was accorded a role as important as the established stock exchanges. One significant reform in this respect was instituting the more extensive use of market makers. As of end-September 2001, 314 issues listed on the JASDAQ market were traded with designated market makers, more than one-third of the 902 issues listed on this market. The market-making system, as introduced into the Japanese JASDAQ market in December 1998, was aimed at a) enhancing the competitiveness of the market vis-á-vis the established stock exchanges, and b) building a market structure exploiting the benefits of the market-making functions of dealers. Presently, JASDAQ is the only market in Japan that employs formal market-making.

For the pricing and trading of stocks, firms listed on JASDAQ can select either the order-driven system (hereafter OD issues), where formal market makers are not involved, or the market-maker system (hereafter MM issues). Taking into account the fact that many of the stocks listed on JASDAQ are not as liquid as those on established exchanges, OD issues face great uncertainties as to the immediacy of execution, and investors cannot necessarily buy or sell the issues as they desire. In contrast, trading in MM issues is facilitated by market makers, and liquidity could be enhanced through increased trading volume. This paper will examine empirical analyses of patterns in spread formation for stocks listed on the JASDAQ market, to examine the implications of differences in trading systems on price formation.

How differences in trading systems affect pricing and liquidity is a key issue in the study of market microstructure. Such analyses often focus on spreads, with a particularly rich body of literature involving stocks listed on the New York Stock Exchange (hereafter, NYSE) and NASDAQ, the two leading stock markets in the United States. Many of these analyze spreads on listed issues to examine how particular trading systems influence efficiencies in pricing and execution costs.[1] The two US markets are both market-maker systems, but have differences in terms of market microstructure: NYSE has the "specialist", who

[1] See Hung and Stoll (1994) for a detailed list of literature.

exclusively makes market for a particular issue; whereas NASDAQ permits competing market makers to quote for a certain issue. In addition, limit order book trading is also available on NYSE.[2]

Comparing the order-driven and the market-maker systems in JASDAQ, limit orders are matched through a central limit order book for OD issues, without any involvement of market makers. Meanwhile, two or more designated market makers provide quotes for MM issues, and there are no limit order books for these issues. The existence of such contrasting designs has enabled a dierct comparison of auction and dealer markets in this paper, a feature not seen in existing analyses of NYSE and NASDAQ.

This paper will examine the size and pattern of spreads in the two trading regimes. The size of the spread has a strong relation to the trading cost of a certain issue. Patterns and changes in the spread reveal how easy it is to trade an issue.

For MM issues, the spread is defined as the difference between the best ask and best bid quoted by market makers. Market makers are obliged to continuously provide firm quotes, and potential buyers or sellers can always enjoy immediate execution of orders. Under the best price rule, the market maker with the highest bid or the lowest asking price receives the order. This should result in a narrowing of spreads as market makers compete to attract orders. On the other hand, this competition among market makers will never drive down the bid/ask spread to zero, as they are obliged to trade even in cases when they might incur losses.

Meanwhile, the spread for OD issues is defined as the difference between the best buy and best sell limit orders in the market. Since no one is responsible for continuously providing quotes as in MM issues, quotes may not always be available for stocks with low liquidity, and there is a risk that orders cannot be executed at the desired timing. Nevertheless, the ability of potential buyers/sellers to adjust their asking prices could lead to narrower spreads when potential buyers (sellers) requiring quick execution of orders raise (lower) their bids (asking prices).

As explained in more detail in Section 4, in the real-world market, there are various factors that would widen and narrow the spreads. The net effects of market microstructure – such as information on orders and trade execution, and order matching systems – on price

[2] NYSE employs a central limit order book, where all limit orders are pooled into a single book.

formation and trading costs must be explored through empirical studies.

The results of the empirical examination conducted for this paper are as follows.

Concerning the observed spreads for JASDAQ-listed OD and MM issues, first, the duration of two-way prices was different between the two. For MM issues, two-way prices were quoted for 87 percent of the trading day, or 235 minutes out of 270 minutes, irrespective of the market capitalization of an issue. On the other hand, two-way prices for OD issues were observed for an average of 82 minutes. This, however, masks differences between large- and small-cap issues: for the 49 large-cap (market capitalization exceeding 100 billion yen) OD issues, two-way prices existed for an average of 244 minutes, which is comparable to that of MM issues; and for 820 small-cap (market capitalization of less than 2 billion yen) issues, two-way prices were observed for 39 minutes, or only 14 percent of the trading day.

Second, spreads of OD issues narrow considerably immediately before trades are consummated, compared with average spreads observed through the trading day. The average spread during the trading day was 20.4 ticks, whereas the average spread when trades were consummated was only about half of this, or 11.5 ticks. For OD issues, some limit orders may deviate from the market price, as market participants are free to express their own views on valuation and leave orders at any price. The significant narrowing of spreads when trades are consummated seems to indicate that spreads are narrowed by market participants aiming to improve the immediacy of trade execution and the market price.

For MM issues, the average spread through the trading day was 13.2 ticks, and that at consummation of trades, 13.7 ticks. Unlike OD issues, for MM issues spreads do not fluctuate as visibly and are actually wider at the time of trade execution compared with OD issues. This observation of wider spreads for MM issues than OD issues immediately before trades are consummated could reflect the risks and costs for market makers associated with continuously providing firm quotes.

Finally, looking at the distribution of spreads at the time of trade consummation, approximately one half of observed spreads for OD issues amount to just one tick, the mimimum, whereas for MM issues, one-tick spreads are observed only 22 percent of the time. The narrowing of spreads to the minimum in OD issues should reflect the behavior of market participants placing priority on the immediate execution of trades. On the other

hand, for MM issues, such willingness of non-market-making market participants to trade would not affect observed spreads, because there are no channels through which such behavior could be directly reflected in the quotes.

Turning to other features of trading systems, one factor that warrants attention is the possibility of negotiation over prices for MM issues. This difference in the trade execution process between MM and OD issues means that the (best) observed spread is not always reflected in the execution price. Average effective spread for MM issues, calculated from execution prices and the then prevalent spreads, is significantly narrower at 9.6 ticks versus the 13.7 ticks for the average observed spread.[3] On the other hand, the average effective spread for OD issues is 10.5 ticks, not very different from the 11.5 ticks for the average observed spread.

The significant narrowing of the average effective spread for MM issues relative to the average observed spread at trade execution is the result of trades being executed within the observed spreads at the time of trades. The proportion of trades consummated inside the observed spreads amounts to 28.7 percent of trades in MM issues, compared with 2.2 percent for OD issues. In other words, trades in MM issues tend to be executed at better prices from market participants' standpoint than the prevailing best quotes. Such prices, better than those realized through the use of the JASDAQ Small Trade Execution System, are the results of negotiations between potential buyers and sellers.

This feature probably reflects the behavior of market makers in quoting prices to the market — market makers would take into account quotes from other market makers. Once market makers quote prices, they are obliged to trade at least one trading unit at those prices against orders coming through the JASDAQ Small Trade Execution System. If they post better quotes than other market makers, they are more likely to "hit" orders queuing (and not visible) in the system. Market makers, in order to control this risk, will have the incentive to quote the same prices as other market makers. Meanwhile, market makers will be able to increase their trading volume without being exposed to inventory risk, if they are able to receive large-lot "leave" orders. The patterns of spreads and execution prices observed through analyses conducted in this paper support such presumptions with respect

[3] Effective spread is calculated by a formula that will result in equal effective and observed spreads just before trades are consummated, if all trades are consummated at the best observed bid and asking prices. See Section 5.1 for a detailed description of the methodology.

to market makers' behavior.

The rest of this paper is organized as follows. Section 2 summarizes the market microstructure of the JASDAQ market. Section 3 outlines the features of JASDAQ through basic data. Section 4 examines factors underlying patterns in spread formation for OD and MM issues. Sections 5, 6, and 7 describe the results of empirical analyses, and Section 8 is a summary, touching upon future issues for study.

2. Market Microstructure in the JASDAQ Market

This section will briefly explain the market-making system, an important feature of the JASDAQ market.[4] Section 2.1 will look at the background leading to the introduction of the market-making system and the steps by which it was introduced to the JASDAQ market. Section 2.2 describes details of the market-making system, and 2.3 outlines the course of a trade in MM issues, from order to execution. Finally, Section 2.4 explains trading in OD issues for comparison.

2.1 Market Reforms in the JASDAQ Market and Market Making

2.1.1 Development of the JASDAQ Market, from Inception until Most Recent Reforms

Before extensive reforms under the Japan's 1998 Big Bang were instituted in the JASDAQ market, the JASDAQ market was in fact the market for trading stocks delisted from established exchanges and for grooming stocks of emerging companies before listing on authorized exchanges. As summarized in Table 2.1, various measures to enhance the functioning of the market were also implemented. These efforts, however, were not necessarily effective because market participants thought JASDAQ should play only a supplementary role to the established exchanges.

[4] The number and market capitalization of stocks listed on the JASDAQ market as of end-2000 was 887 issues and 10 trillion yen. For the Tokyo Stock Exchange (hereafter TSE) Second Section, respective figures were 581 issues and 7 trillion yen, and for the TSE First Section, 1,447 issues and 352 trillion yen.

2.1.2 Financial Big Bang in Japan and the JASDAQ Market

Reforms in the JASDAQ market have accelerated since 1998 in response to calls to enhance market activity and integrity, as well as to adapt to the trend of globalization of financial markets. In December 1998, the Securities Trading Act was revised and the JASDAQ market was accorded a comparable role to the authorized exchanges instead of its former "supplementary role". At the same time, a market-making system was introduced in December 1998 with the aim of enhancing market liquidity.[5]

Table 2.1 History of the *Tento* Market

From end-WWII To February 1963	During the period when trading on authorized exchanges was halted, the *Tento* market functioned as a market where securities companies traded directly with each other. After trading resumed on authorized exchanges in 1949, it evolved into an impromptu market for trading stocks of companies not yet listed on authorized exchanges.
From February 1963 to November 1978	The *Tento* market functioned as a market where investors and shareholders could cash out otherwise untradable stocks. Albeit with numerous restrictions, the *Tento* Market became a market where stocks delisted from authorized exchanges could be traded. In 1976, the Japan OTC Securities Company (now JASDAQ) was established to enhance the liquidity of OTC securities and to ensure the smooth functioning of pricing mechanisms in the *Tento* Market.
From November 1978 To December 1998	During this period, many reforms were initiated in the JASDAQ market. Even so, it was commonly thought that issues traded in the JASDAQ market would be eventually listed on the authorized exchanges.

Source: Hirata (1999)

[5] Markets trading with market makers include NASDAQ in the US, Neuer Markt in Germany, and MTS cash government bond market in Japan. In respect to trading of stocks, the JASDAQ market is the only market in Japan where certain issues are traded solely through the market-maker system.

2.1.3 Development of the Present Market-making System in the JASDAQ Market

According to interviews with major market makers in Japan, orders were executed manually in the months immediately after the introduction of the present market making system, as market makers had not implemented order processing systems. For this reason, when the volume of orders was high, as in the case of IPOs, market makers would, at times, widen spreads or could not be reached over the phone. From 2000 onwards, however, market makers began to review their order processing systems, and in May 2001, the new JASDAQ system was launched. These improvements in infrastructure, which increased the efficiency of trade processing and provided timely dissemination of market information, are said to have enhanced the transparency and efficiency of pricing.

The number of MM issues saw a steady growth from the initial three to more than one-third of all JASDAQ stocks at end-September 2001 (Table 2.2). Supporting this growth was not only the enthusiasm of the three major Japanese securities firms in expanding market-making activities, but also the entrance of other securities firms as market makers.

Table 2.2 Increase in the Number of MM Issues

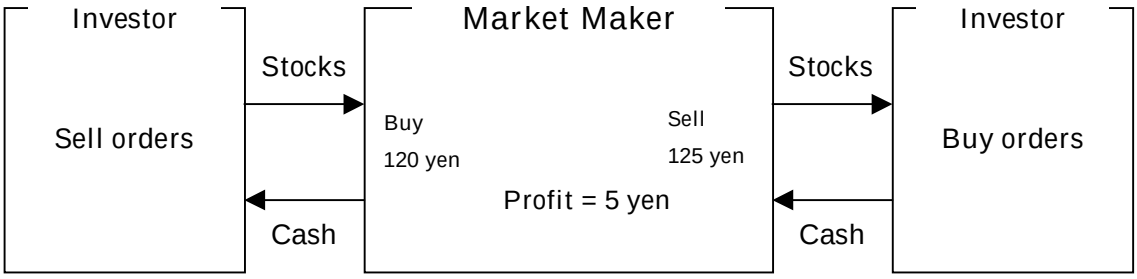
	Dec 1999	June 2000	Dec 2000	June 2001	end-Sept 2001
MM issues	3	156	238	284	314
Total JASDAQ listing	871	880	887	880	902

2.2 Overview of the Market-making System

Generally, market making involves securities companies known as market makers quoting prices on a security, and other market participants that wish to buy or sell the security transacting with these market makers. Trades are consummated when market makers buy from market participants that submit sell orders and sell to those that submit buy orders. In practice, there is no guarantee that buyers or sellers will come at the same time. Since market prices may fluctuate in the interim, market makers do not necessarily make profits. The basic approach for market makers to earn profit margins is to buy low from sellers and sell high to buyers (Figure 2.1). However, where there are several market makers for one issue, a market maker needs to make competitive quotes, because it will not receive orders

unless its quote is the most favorable to the customer. Some securities companies also charge brokerage commissions in this process.

Figure 2.1 Role of Market Makers



Present market-making rules in the JASDAQ market are outlined below:

a) Members of the Japan Securities Dealers Association (hereafter JASD) are qualified to become market makers if they register with the JASD as to which issues they will be making markets for.

b) Only those issues registered with the JASD become MM issues, and other issues listed on JASDAQ will be traded under the order-driven system (OD issues). MM issues are strictly traded under the market-making system, and are never traded simultaneously under the order-driven system.

c) Market-maker securities firms are obliged to continuously provide two-way quotes, i.e., asking price and quantity, and bids and quantity.

d) Securities companies are free to choose for which issues they will make markets. However, issuers can request that their stocks become MM issues, or to reject offers to make markets.

e) Two or more securities firms need to be market makers for any stock to become an MM issue.

f) When securities companies that are not market makers for a particular MM issue wish to make bilateral purchases/sales of an issue with their customers, they need to trade within the best bid-best ask spread as long as market makers are making two-way quotes.

2.3 Trade Execution for MM Issues

There are two ways of trading MM issues in the JASDAQ market. One is to negotiate with a single market maker, and the other is to send an order through the JASDAQ Small Trade Execution System, which automatically matches the order with the best bid or best asking price. Only small orders up to 5 trading units can be routed through this automated system. From the perspective of market makers, orders arrive either through the JASDAQ trade execution system or directly from securities companies (including their own branch offices) via telephone and other communication systems.

Orders placed through the JASDAQ Small Trade Execution System are matched automatically with the best bid or the best asking price quoted by market makers. Where several market makers quote the same prices, priority is given to the market maker who first posted the quote. Even when the current quote on the screen is valid for only one unit, other market makers might be prepared to trade more than one unit. As a result, trades of up to 5 units, depending on the order, could be executed at one time.

Meanwhile, orders coming in directly from securities firms may be orders of their firm's own customers or those of other securities firms' customers. These orders can be in lots of larger than five units. Faced with such orders, a market maker may choose from three courses of action: carrying the positions on its own books; simultaneously executing offsetting trades with other market makers; or routing the orders to the Small Trade Execution System. In terms of price, orders can be executed at the quoted price of market makers or any better price. This means that orders may be executed at better prices than the best bid or best asking prices observed in the market.

When customers place leave orders with market makers, orders are executed when market quotes match these limit orders.[6] Some securities companies also accept orders electronically from "online brokerage firms", on the condition that the orders will be

[6] The "leave order" system was started from October 1999 (JASD, "Rules and Conditions of Trade", May 2001, p.98). When market makers receive orders from customers that do not match the current best bid or best asking price they are quoting, they will lodge these on the order book as "leave orders". These leave orders are later executed when market makers' quotes, as they fluctuate during the day, match order prices, or when matching orders are received from other customers. Market-making became more effective with the introduction of this leave order system as it enabled market makers to develop order books by accumulating leave orders from investors.

executed at the best market quotes. Market makers in such case are, in effect, offering the same services as the JASDAQ Small Trade Execution System.

Orders that market makers receive directly over the phone or through their computer systems are reported to the JASDAQ system after they are executed. Reported information in these cases comprises the name of the issue, execution price, quantity and the time of trade.

From the perspective of investors, the payment of commissions for MM issues depends on the circumstances of the trades. Retail investors usually pay commission in addition to the value of the trade. Institutional investors and other investors in the wholesale market usually avoid paying commission by placing their orders directly with securities firms that make markets.

This means that market-making securities firms' trading revenues are not totally determined by the spreads between buy and sell orders. They may also be affected by commission income, which firms may or may not secure depending on the incoming routes of orders and the identity of the party placing orders. However, it is not possible to take into account the existence of such commission, as there was no information regarding the differences in order routing and patterns in the data available for the empirical analyses conducted in this paper.

2.4 Trade Execution for OD Issues

Trade execution rules for OD issues are simple compared to those for MM issues. Limit orders from investors to sell or buy a certain stock are executed when matching orders exist on the order book. If there are no matching orders, the order is recorded on the order book and matched with subsequent incoming orders. At the opening of trading hours, the opening price is determined through a booking rule. Subsequent matching is conducted continuously during trading hours, applying the best price/first come rule. In addition to matching orders through the central order book, securities firms may internally aggregate the same amounts of buy and sell orders and cross them by entering them simultaneously in the order processing system.

3. Characteristics of MM Issues

As seen in Section 2, stocks become MM issues when they are selected by securities companies that will make markets in the stocks. If securities companies deliberately select those stocks in which they can make markets more easily, the differences in observed liquidity and trading costs between MM and OD issues may not result from differences in trading mechanisms, but from selection bias. In order to analyze the price formation of MM issues, it would be desirable if MM and OD issues had similar characteristics. If factors other than differences in trading mechanisms could influence the liquidity or pricing of the two types of issues, these factors would need to be controlled in the analyses. In this light, the characteristics of MM and OD issues will be examined in this section.

3.1 Factors Influencing the Characteristics of Issues

Factors that might influence liquidity and price formation of issues include firm size and industry. Firm size can be represented by market capitalization. Market capitalization is the product of the outstanding number of shares of an issue and the stock price – these component elements also influence the characteristics of an issue. The outstanding number of shares, after compensating for differences in minimum trading units, tells us the amount of stocks that can be traded. This has an influence on the minimum trading unit and the ease with which market makers could secure the stock through borrowing as such needs arise for market making. On the other hand, the stock price has a significant bearing on trading costs through minimum price unit or tick size in trading. As the tick size is determined by stock price levels, it should be noted that the effects tend to be discontinuous at price levels where the tick sizes change. These are the four elements that influence the characteristics of issues.

3.2 Characteristics of MM Issues

a) Distribution of market capitalization (as of end-2000)

Figure 3.1 shows the distribution of the market capitalization of MM and OD issues. The dominant market capitalization category for MM issues is between 1 to 2 billion yen,

accounting for 22 percent of all MM issues. The next largest is the 2 to 3 billion yen category at 16 percent. As with MM issues, the most dominant market capitalization category for OD issues is 1 to 2 billion yen at 16 percent, but the category that ranks second is the 3 to 4 billion yen category at 14 percent. A characteristic feature of the distribution of market capitalization for MM issues is the high incidence of issues in the 1 to 4 billion yen range, amounting to 49 percent of the total. On the other hand, there is a significant concentration of OD issues in the 10 to 15 billion yen range and in the over 60 billion yen range. Furthermore, the larger stocks are in terms of market capitalization, the more likely they are to become OD issues.

By applying the Kolmogorov-Smirnov Goodness-of-Fit Test, it was found that the distributions of the two types of issues were significantly different reflecting the features just mentioned (results shown in the lines plotted in Figure 3.2).[7]

Figure 3.1 Distribution by Market Capitalization

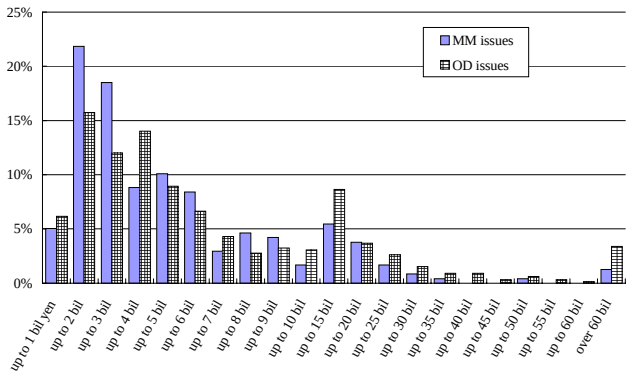
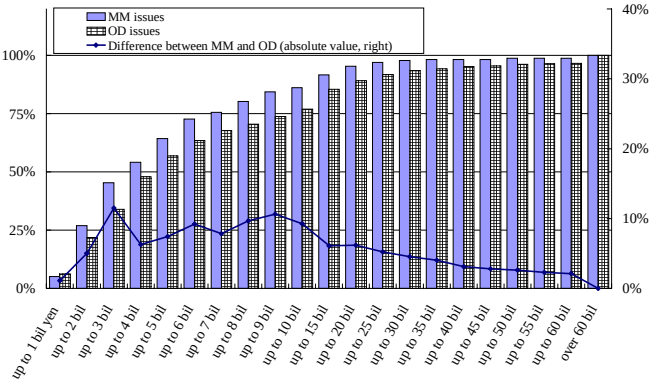


Figure 3.2 Cumulative Distribution by Market Capitalization



b) Distribution of issues by stock price (as of end-2000)

Figure 3.3 plots the distribution of stock prices for MM and OD issues. There is a relatively higher proportion of OD issues than MM issues in the under 200 yen category. This may reflect the fact that market-maker securities firms may be refraining from making markets for the stocks of companies which have a relatively high probability of default.

[7] This analysis is conducted to test whether two samples belong to the same population. The samples for OD and MM issues can be regarded as belonging to the same population at a 99 percent confidence level if the largest difference in cumulative distributions is less than 3.34 percent, and at a 90 percent confidence level if the difference is less than 4.33 percent.

On the other hand, MM issues are more concentrated in the 300 to 600 yen category. For both types of issues, there is a high incidence of issues in the 2,000 to 5,000 yen range, but this is more evident for OD issues.

By applying the Kolmogorov-Smirnov Goodness-of-Fit Test, it was found that the distributions of the two types of issues were significantly different reflecting the features just mentioned (results shown in the lines plotted in Figure 3.4).[8]

Looking at the relationship between stock price levels and ticks,[9] the fact that there is a large population of OD issues up to 300 yen and MM issues in the 500 to 600 yen range would affect the ratio of trading spreads to prices. That is, expressed in terms of percentages of prices, compared with MM issues, a relatively larger proportion of OD issues is in the price range where a one-tick spread would translate into a higher percentage spread. This fact should be considered in interpreting the results of the analyses described in Section 5 and beyond.

Figure 3.3 Distribution by Stock Prices

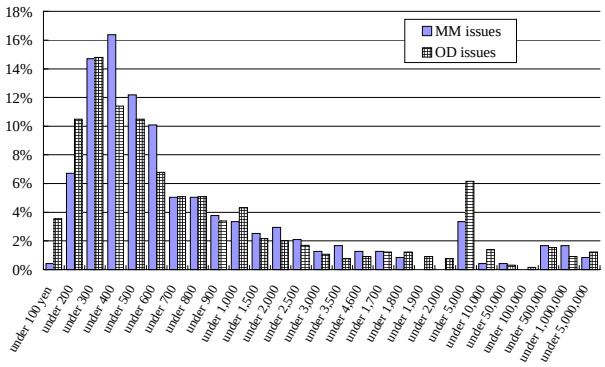
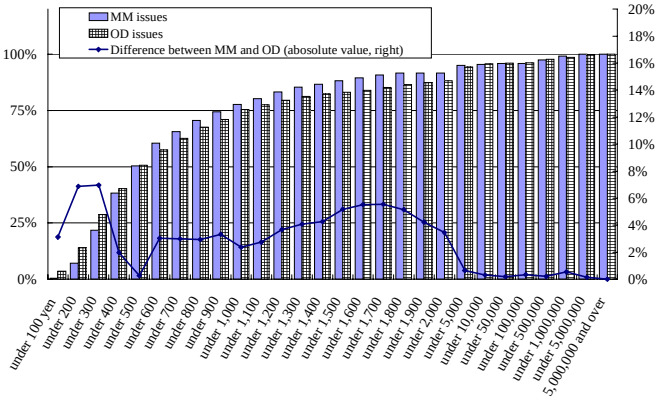


Figure 3.4 Cumulative Distribution by Stock Prices



c) Outstanding number of shares (adjusted for trading units)

Figure 3.5 plots the distribution of the outstanding number of shares for MM and OD issues adjusted for trading units. MM issues are concentrated in the under-8,000 unit range, accounting for 58 percent of all MM issues. On the other hand, more than 10 percent of

[8] See footnote 7.

[9] In the JASDAQ market, tick is determined under the following rules. For stocks in the 1 to 1,000 yen price range, the tick is in units of 1 yen. For those in the 1,000 to 10,000 yen range 10 yen, and for those in the 10,000 to 100,000 yen range, 1,000 yen. For those in the 100,000 to 1,000,000 yen range 10,000 yen, and those in the over-1,000,000 yen range 50,000 yen.

OD issues are in the over 70,000 unit class, a significantly higher proportion than MM issues (at 4 percent). By applying the Kolmogorov-Smirnov Goodness-of-Fit Test, it was found that the two distributions were significantly different reflecting the features just mentioned (see line figure in Figure 3.6).[10]

Figure 3.5 Distribution by the Number of Shares Outstanding

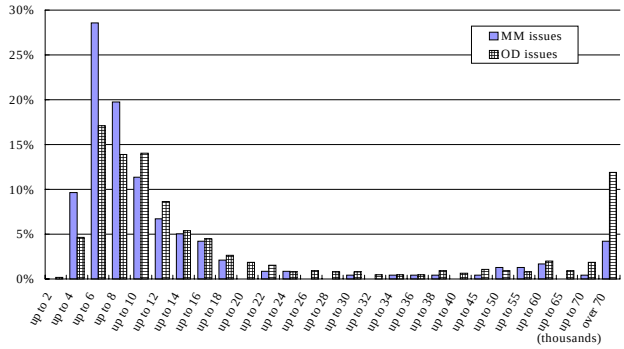
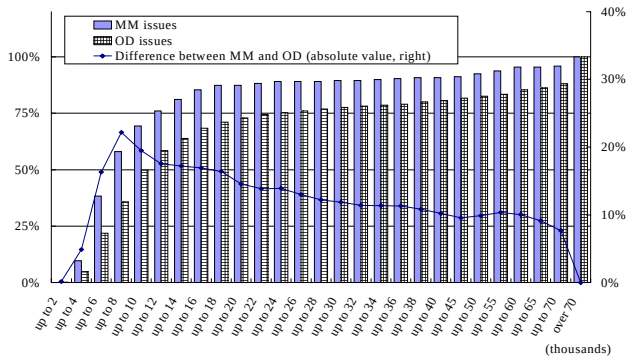


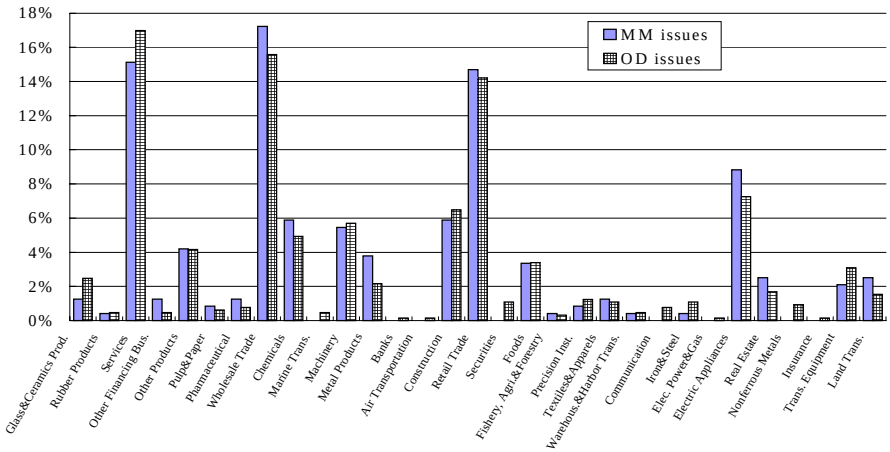
Figure 3.6 Cumulative Distribution by the Number of Shares Outstanding



d) Distribution by Industry

Figure 3.7 plots the distributions of MM and OD issues by industry. There are no significant differences in the two groups of data, but there is a slightly higher incidence of wholesalers and manufacturers of electronic appliances in the case of MM issues.

Figure 3.7 Trading Systems and Industry



[10] See footnote 7.

In this section, MM and OD issues were compared in regard to four factors. Statistically significant differences were observed between the two types of trading mechanisms for three factors except industry. The analyses in the following sections take into account these differnces in MM and OD issues.

4. Determinants of Spreads

Studies on market makers have been extensively conducted in the United States since the 1970s. Early studies focused on issues related to pricing and inventory models, regarding spreads as a function of fixed costs, such as personnel costs, and inventory costs.[11] Copeland and Galai (1983) identified the risk of adverse selection associated with trades with informed traders as a major risk in market making. Subsequent empirical analyses employed analytical tools developed in this work, and disaggregated actual market spreads into fixed, inventory, and adverse selection costs. The results show that adverse selection cost is relatively larger than the other two components.[12]

In 1994, Christie and Schultz reported that the bid-ask spreads posted by NASDAQ market makers tend to be even multiples of trading ticks. This led to a debate in the 1990's as to whether such phenomenon was the result of an implicit collusion.[13] Such developments also led to studies on market-maker behavior different from the previous studies based on the view that competition between several market makers will lead to competitive pricing. These studies revealed, for instance, that in the United States, trading practices such as preferencing and payment-for-orderflow, and the existence of the Small Trade Execution System are strong determining factors influencing market makers' behavior.[14] The findings of these studies have important implications for the studies of market-maker behavior in Japan.

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[11] For more details on the inventory model, see O'Hara (1995).

[12] Uno and Ohmura (1998a, b).

[13] Uno and Ohmura (1998c).

[14] Kandel and Marx (1999), Hansch, Naik, and Viswanathan (1999).

Pagano and Röell (1993, 1996) developed a theoretical framework on the differences between order-driven and market-maker markets, and defined the following three factors as the key differentiating factors of trading systems: 1) the speed with which information on order and trade execution is transmitted to market participants, 2) disclosure of the order book recording outstanding limit orders, 3) availablity of information on whether an order is from an informed trader or not. The following analyses in this section, look at these factors in the context of determining spreads for OD and MM issues in the JASDAQ market.

In the JASDAQ trading system, order and trade execution information on OD issues is disclosed immediately. The order book is also disclosed, so pricing is considered to reflect information on all orders immediately before and after trade execution. On the other hand, order information for MM issues is not pooled, so each market maker only has information on the orders that they receive. Other market participants can only speculate on market conditions through market makers' bid and ask quotes. Disclosure of trade execution information (immdediate for OD issues) is not necessarily full and immediate for MM issues as it relies to some extent on manual data input by market makers. When markets are thus segmented, pricing may be less efficient than in markets where full information is available. Market makers price these differences in the amount of information available in setting their spreads. Trading costs for OD issues will likely be lower, because information shared at the time when prices are determined is limited in the case of MM issues.

Turning to the risk of adverse selection, it is the risk where stock prices may move against market makers after they trade with informed traders and before they can consummate offsetting trades. This risk influences the size of the spread. Meanwhile, market participants placing limit orders for OD issues are interested in having their buy or sell orders executed, so they will choose between market orders and limit orders balancing the probability of price improvement and trade execution.[15] Market participants can have their orders executed immediately by placing limit orders that would hit the best bid or ask in the market, if such prices are satisfactory. On the other hand, if they seek better prices, they can place limit orders at the price they desire and wait for other market participants to

[15] For example, a buyer is seeking "price improvement" when they place a limit order at a lower bid than the prevailing market price.

hit the order. A market participant may behave like a market maker for OD issues, but the risk is higher than market-making in MM issues, because the market participant must compete on a level playing field with other participants under the price-time priority rule. As seen here, spreads for OD issues will narrow if market participants placing orders are more interested in the immediacy of trade execution. Because order book information is not disclosed for MM issues in the JASDAQ market, market-maker quotes are not directly influenced by the flow of limit orders from non-market maker participants.

It is generally considered that spreads for MM issues narrow because of competition, when several market makers quote for the same stock. In comparison to OD issues, individual market makers can only handle a portion of orders in the market. In addition, information disclosed is also limited for MM issues. This would mean that the marginal cost to sustain market-making activities would increase. Therefore, the spreads for MM issues will likely not come down to levels seen for OD issues, even with competition.

It should be noted, however, that there is a “leave order” system for MM issues in the JASDAQ market. This system could alleviate the risk of adverse selection for market makers. A leave order for MM issues allows investors to entrust their orders to market makers to have them executed later. As limit order books for OD issues can be viewed by all market partipants, informed traders have a disincentive to post large orders. Meanwhile, the leave order system would lessen market impact. Furthermore, market makers could trade against such leave orders from informed traders without taking their own positions, and this could alleviate adverse selection risk. It remains to be empirically seen whether this factor sufficiently outweighs those factors that lead to adverse selection risks.

These comparisons of the trading costs of OD and MM issues on the JASDAQ market reveal opposing factors at work. Trading costs for MM issues are likely to be higher than OD issues as market makers are obliged to continuously provide two-way prices. Meanwhile, average costs for MM issues may become lower if the “leave order” system alleviates the market impact of large orders. These factors will be considered in the empirical observations and analyses in Section 5.

5. Empirical Analyses of Spreads

5.1 The Data Set

The data set constisted of 904 stocks. Included were the 887 stocks listed on the JASDAQ market as of end-December 2000 and newly listed stocks from January to June 2001 according to the following selection criteria. As the analyses were based on monthly average data, newly listed stocks were added to the data set from that month, if they were listed before the fifteenth of the month. Those listed after the fifteenth had been added to the data set from the following month. In addition, stocks that were delisted from JASDAQ were included until the month before they were delisted. The 904 stocks analyzed included 56 issues for which the trading system was changed within the period being analyzed. These were not included in the data set for the analyses in this section, but analyzed separately as seen in Section 7. As a result, data in this section was composed of 611 OD issues and 237 MM issues.

Tick data for the JASDAQ market was used for the analyses conducted in this paper. Some tick data for MM issues, as seen in Section 4, is entered manually, so timing may not be totally correct and there may be some input errors in the information on quoted prices and execution.[16] Data for price and trading volume were filter-checked for errors. Errors found through this process were corrected as much as possible using daily data and with information from the Japan Securities Dealers Association.[17] Data on prices were thus corrected to a level deemed suitable for analyses. However, this was not the case for trading volume data, so analyses on trading volume was limited to daily analyses.

Two measures are used in the empirical analyses. The first spread is the "quoted spread",

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[16] See Section 5.3 and footnote 23.

[17] The price filter identified possible errors in prices, when changes in prices between two consecutive trades exceeded 5 percent, or when prices did not fall within the bid-ask spread immediately before trades. Of the data thus flagged, 75 were cases where price changes exceeded 30 percent, all of which were errors. Price changes exceeding 5 percent and within 30 percent numbered 206, of which 17 were errors. Information from two information vendors is used in cross-checking for error data. Opening, high, low, and closing prices are used as data reference range, and where the historical information from the two vendors did not match, the accuracy of data was confirmed by checking with the Japan Securities Dealers Association. There is no guarantee that the corrected data set was completely free of errors through this process of error checking, but the larger errors that might influence the results of the analyses have probably been successfully removed.

which, for MM issues, is the difference between the best ask and best bid among quotes by all market makers. The quoted spread divided by the mid-market price yields the quoted spread ratio.

Quoted spread = Best ask – Best bid

Quoted spread ratio = Quoted spread / Mid-market price

Mid-market price = (Best ask + Best bid) / 2

The second spread is the "effective spread". This is calculated as the difference in the actual execution price and the mid-market price just before execution. The result of this calculation is doubled so as to be comparable with the quoted spread.

Effective spread = (Execution price - Mid-market price) x 2

Effective spread ratio = Effective spread / Mid-market price

Quoted spread is, in effect, the cost of liquidity demanded by market makers and market participants placing limit orders. In contrast, effective spread is the spread that consumers of liquidity actually agree to pay, or the trading cost for the consumer of liquidity.

5.2 Quoted Spreads

One clear distinction between OD and MM issues is the existence of market makers responsible for quoting two-way prices for the latter. Table 5.1 shows that for MM issues, spreads are observed for 235 minutes out of 270 minutes of total trading hours for the day, or just under 90 percent of the time. In contrast, spreads for OD issues only exist for 82 minutes per day, one-third of that for MM issues. Of OD issues, while spreads are observed 244 minutes per day for large-cap issues, which is comparable to the average for MM issues, average duration is significantly shorter for small-cap issues. Spreads are observed for an average of 39 minutes for OD issues with market capitalization under 2 billion yen, but for MM issues with comparable market capitalization, spreads are observed for 230 minutes. The presence of market makers ensures that two-way quotes are available at times when orders from other market participants are sparse, and it is evident that there is a longer time period when trades can be executed.

Next, the sizes of quoted spreads are compared in Table 5.1. The period under observation is the six months from January to June 2001. The figures are obtained by first

calculating daily intraday averages of quoted spreads, which is then averaged for each month per issue. As tick size influences spread, these averages are normalized by tick size, and the analyses on spread in the sections below are conducted in ticks.[18] Table 5.1 shows the results of averages for all issues, OD issues, and MM issues.

Average quoted spread adjusted for tick size is 20.4 ticks for OD issues, and 13.2 ticks of MM issues. Quoted spreads for MM issues are relatively tighter than for OD issues (about two-thirds). The average standard deviation of by-issue quoted spread is 11.4 ticks for OD issues, whereas that for market-maker stocks is 5.0 ticks, showing constantly tighter spreads for MM issues.

It is widely accepted that spreads of stocks vary depending on market capitalization.[19] Average market capitalization of OD issues is 10.6 billion yen, while that for MM issues is 6.4 billion yen. OD issues include stocks with large capitalization, and as seen in Section 3, given the differences in the distribution by market capitalization for OD and MM issues, it would be useful to compare quoted spreads by market capitalization.

There are nine companies traded as OD issues with market capitalization exceeding 100 billion yen, yielding 49 data points. The average quoted spread for these stocks is 5.4 ticks. There are 59 companies traded as OD issues with market capitalization over 50 billion and under 100 billion yen yielding 311 data points, with average quoted spread of 8.3 ticks. For the 15 companies traded as MM issues in the comparable capitalization range, the average of 87 data points is smaller at 5.2 ticks. Statistical tests regarding the similarity of the average quoted spreads for the two groups are inconclusive for stocks with larger market capitalization, but for mid-caps to small-caps the difference is statistically significant. The exception was in the 20 billion to 50 billion yen capitalization range where the average quoted spread for OD issues is slightly narrower than that for MM issues. This result, however, is not statistically significant, and so the average quoted spreads for the two groups of stocks in this range can be considered to have no statistically significant differences. There is a possibility that this could be influenced by the difference in the smallest quote or tick size applicable at particular price levels, which will be studied in more detail in Section 5.4.

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[18] See footnote 9.

[19] Ashida (2002).

Table 5.1 Quoted Spreads of OD and MM Issues (averages)

	[OD issues]						[MM issues]						
	Observations	Market capitalization	Time spread was observed	Average spread	Average S.D.	S.D. of average spread	Observations	Market capitalization	Time spread was observed	Average spread	Average S.D.	S.D. of average spread	Z-score
Total	3510	106.0	81.5	20.35	11.38	19.3	1377	63.7	234.7	13.17	4.97	8.8	17.8
[Market Capitalization]													
100 billion yen and over	49	1885.1	244.1	5.42	2.62	3.7							
50 bill. to under 100 bill.	311	407.4	181.1	8.34	5.17	10.9	87	360.8	249.4	5.18	1.94	3.1	4.5
20 bill. to under 50 bill.	340	144.3	132.8	9.79	5.48	10.8	124	125.8	242.3	8.78	3.83	9.5	1.0
10 bill. to under 20 bill.	756	70.8	92.2	22.56	12.58	24.0	244	71.2	236.5	12.40	4.46	8.1	10.0
5 bill. to under 10 bill.	709	38.3	59.6	24.59	14.13	19.9	322	39.7	234.5	14.74	6.09	11.3	10.1
2 billion yen and over	525	24.8	55.5	26.55	14.84	19.3	235	24.8	230.6	16.07	5.66	6.9	11.0
under 2 billion yen	820	12.5	38.5	20.65	11.14	15.5	365	13.2	230.1	13.82	4.98	6.8	10.5

Note: Market capitalization as of end-December 2001 is shown in units of 100 million yen. The Quoted spread = (Ask – Bid) / Ticks. The observation period is the six months from January to June 2001. The number of monthly average observations for each market capitalization category is recorded in the observations column. Monthly averages were derived from averaging daily averages of quoted spreads for each issue. Standard deviation is the standard deviation from the monthly average. Tick is the smallest unit of change in stock prices, set according to the stock price. For example, the tick for stocks in the 1 to 1,000 yen price range is 1 yen, and for those in the 1,000 to 10,000 yen range, 10 yen. See Footnote 9 for more on tick rules. The Z-score shows the result of statistical tests based on the hypothesis that averages for OD and MM issues are different. If the Z-score is greater than ±1.96, then the two groups of data are different at a 95 percent confidence level.

5.3 Quoted Spreads at Trade Execution

Analyses in the previous sections have used data on average quoted spreads based on all data available from the trading sessions. As aforementioned, quoted spreads may not exist or be wider for OD issues. It needs to be considered whether this means that trading cost is higher for OD issues than for MM issues. The only information disclosed for an MM issue relating to price is the level of quotes by market makers. For OD issues, however, market participants may place limit orders to hit existing limit orders in the market. If market participants act as such, the spreads for OD issues could become tighter immediately before orders are executed. From this viewpoint, the size of the quoted spread just before an order is executed will be analyzed in the following paragraphs.

In estimating quotes just before trade execution for MM issues, the following information was taken into account. If a trade was executed outside the JASDAQ system, the trade information is subsequently entered manually, resulting in tick data that may not always be sequential. However, not all information on trades outside the JASDAQ system is manually entered. Computer-matched trades are input automatically. Therefore, the order of data is corrected when the time stamps for trade execution and the indication

updates are recorded in reverse order. Where such reversal of data needed to be corrected for a point in time where several trades are recorded, the revised data entry was entered as the last trade at the same time. Where this may bias the results of analysis, note was made, as in the notes under Table 6.2 for the analysis in Section 6.[20]

Table 5.2 Quoted Spreads of OD and MM Issues
(Average at trade execution)

[Order-Driven Stocks (OD)]

	Observations	Market capitalization	Quoted Spread	S.D.	Effective spread	S.D.
OD issues	3288	110.5	11.45	11.40	10.54	10.49
[Market Capitalization]						
100 billion yen and over	49	1885.1	3.69	2.25	3.64	2.16
50 bil to under 100 bil	311	407.4	5.68	8.25	5.23	7.25
20 bil to under 50 bil	326	144.1	5.99	5.79	5.68	5.52
10 bil to under 20 bil	710	70.7	12.61	13.21	11.35	11.48
5 bil to under 10 bil	667	38.4	14.22	12.79	13.34	12.49
2 bil to under 5 bil	492	24.8	14.68	11.69	13.38	10.65
under 2 billion yen	733	12.5	11.09	9.15	10.23	8.57

[Market-Maker Stocks (MM)]

	Observations	Market capitalization	Quoted Spread	S.D.	Z-score	Effective spread	S.D.	Z-score
MM issues	1377	63.7	13.65	9.45	-6.8	9.56	7.13	3.7
[Market Capitalization]								
100 billion yen and over								
50 bil to under 100 bil	87	360.8	5.17	3.36	0.9	3.54	2.04	3.6
20 bil to under 50 bil	124	125.8	8.89	10.69	-2.9	6.15	5.84	-0.8
10 bil to under 20 bil	244	71.2	12.76	8.75	-0.2	9.01	6.15	4.0
5 bil to under 10 bil	322	39.7	14.92	11.47	-0.9	10.72	10.06	3.5
2 bil to under 5 bil	235	24.8	16.84	7.30	-3.0	11.93	5.51	2.4
under 2 billion yen	365	13.2	14.71	7.78	-6.8	9.96	5.27	0.6

Note: Market capitalization as of end-December 2001 is shown in units of 100 million yen. The Quoted spread = (Ask – Bid) / Ticks, and the Effective spread = (Execution price – Mid-market price) / Mid-market price x 2. The observation period is the six months from January to June 2001. The number of monthly average observations for each market capitalization category is recorded in the observations column. Monthly averages were derived from averaging daily averages of quoted (effective) spreads for each issue. Standard deviation is the standard deviation from the monthly average. Tick is the smallest unit of change in stock prices, set according to the stock price. For example, the tick for stocks in the 1 to 1,000 yen price range is 1 yen, and for those in the 1,000 to 10,000 yen range is 10 yen. See Footnote 9 for more on tick rules. The Z-score shows the result of statistical tests based on the hypothesis that averages for OD and MM issues are different. If the Z-score is greater than ±1.96, then the two groups of data are different at a 95 percent confidence level.

The average quoted spread before trade execution for OD issues is 11.5 ticks, as shown in Table 5.2, about half of the levels shown in Table 5.1. Meanwhile, that for MM issues is

[20] See note 2 to Table 6.2.

13.7 ticks, which is about the same as those in Table 5.1. Comparing the spreads of OD and MM issues for each market capitalization category, the spreads for the former are tighter, except in the 500 to 1,000 billion yen class. This observation is consistent with the hypothesis that market participants would narrow the market spread to enhance the chances of execution by placing limit orders within the then existing wider spread. Grouping data by months, there were statistically significant differences in the averages of OD and MM issues for four groups.

5.4 Effective Spreads

The next step is to compare effective spreads. Effective spreads indicate the relationship between quotes just before trade execution and actual execution prices, and can be translated as the execution cost paid by those placing orders.[21]

The average effective spread for OD issues is 10.5 ticks. This is about 10 percent smaller than the quoted spread immediately before trade execution. Compared to this, the average effective spread for MM issues is 9.6 ticks, which is 30 percent smaller than the quoted spread immediately before trade execution. As a result, effective spread is smaller for MM issues than for OD issues.

Effective spread is calculated by doubling the difference between the mid-market price from the quotes immediately before trade execution and the actual execution price. This means that if all orders are executed at the best bid or the best ask quotes, the average quoted spread should be equal to the average effective spread. A smaller effective spread implies that trades are executed within the quoted spreads, and the frequency of such trades is reflected in the effective to quoted spread ratio. Details on this point will follow in Section 6, analyzing the distribution of spread and the execution price.

[21] When calculating effective spreads from the trade execution price and the mid-market price immediately before trade execution, it becomes difficult to distinguish the order of data if there are same time stamps for trade execution and the update of quotes. This is explained in more detail in Note 2 of Table 6.2.

Table 5.3 Quoted Spread Ratio of OD and MM Issues (At execution)

	[OD issues]					
	Observations	Market capitalization	Quoted spread	S.D.	Effective spread	S.D.
	3,288	110.5	3.21	2.7	2.97	2.5
[Market Capitalization]						
100 billion yen and over	49	1885.1	0.66	0.3	0.65	0.3
50 bil to under 100 bil	311	407.4	1.53	1.5	1.43	1.3
20 bil to under 50 bil	326	144.1	2.07	1.4	1.97	1.4
10 bil to under 20 bil	710	70.7	2.62	1.8	2.38	1.6
5 bil to under 10 bil	667	38.4	3.26	2.2	3.06	2.1
2 bil to under 5 bil	492	24.8	3.71	2.7	3.38	2.5
under 2 billion yen	733	12.5	4.83	3.6	4.48	3.4

	[MM issues]							
	Observations	Market capitalization	Quoted spread	S.D.	Z-score	Effective spread	S.D.	Z-score
	1,377	63.7	3.56	2.1	-4.7	2.50	1.6	7.9
[Market Capitalization]								
100 billion yen and over								
50 bil to under 100 bil	87	360.8	1.78	1.2	-1.6	1.24	0.8	1.7
20 bil to under 50 bil	124	125.8	2.27	1.1	-1.5	1.63	0.7	3.5
10 bil to under 20 bil	244	71.2	2.74	1.3	-1.1	1.94	0.9	5.2
5 bil to under 10 bil	322	39.7	3.26	2.1	0.0	2.34	1.9	5.4
2 bil to under 5 bil	235	24.8	4.03	1.9	-1.8	2.87	1.5	3.5
under 2 billion yen	365	13.2	4.93	2.1	-0.6	3.35	1.5	7.6

Note: Market capitalization as of end-December 2001 is shown in units of 100 million yen. The Quoted spread = (Ask – Bid) / Ticks, and the Effective spread = (Execution price – Mid-market price) / Mid-market price x 2. The observation period is the six months from January to June 2001. The number of monthly averages observations for each market capitalization category are recorded in the observations column. Monthly averages were derived from averaging daily averages of quoted (effective) spreads for each issue. Standard deviation is the standard deviation from the monthly average. Tick is the smallest unit of change in stock prices, set according to the stock price. For example, the tick for stocks in the 1 to 1,000 yen price range is 1 yen, and for those in the 1,000 to 10,000 yen-range is 10 yen. See Footnote 9 for more on tick rules. The Z-score shows the result of statistical tests based on the hypothesis that averages for OD and MM issues are different. If the Z-score is greater than ±1.96, then the two groups of data are different at a 95 percent confidence level.

5.5 Stock Price Levels and Spreads

In this section, the focus will be on the size of spreads relative to stock price levels, rather than the quoted (efective) spreads in terms of the number of ticks as seen in the preceding sections.

The average quoted spread ratio for OD issues at trade execution is 3.2 percent, as shown in Table 5.3. For MM issues, the same is 3.6 percent. Considering that the average for all issues might not escape the influences of the over-100 billion yen group, comprised of OD issues only, it is necessary to examine by market capitalization categories. In absolute value terms, the quoted spread ratio for each market capitalization category is smaller for

OD issues than MM issues, but such differences are not statistically significant. In short, taking into account the levels of stock prices, the quoted spread ratio for OD and MM issues just before trade execution is not different at statistically significant levels.

Meanwhile, Table 5.3 shows the effective spread ratio. For all stocks with market capitalization of less than 50 billion yen, the effective spread ratio is smaller, at statistically significant levels, for MM issues than OD issues. For these stocks, the effective spread ratio is smaller for MM issues, even when the difference in stock price levels and tick sizes are considered. In the group with market capitalization of 50 billion to 100 billion yen, however, the Z-score was 1.7, indicating that there was no statistically significant difference at the customary 5 percent level. This seems to imply that large-cap issues are not significantly influenced by the existence of market makers.

6. Market Makers and Quotes

6.1 Distribution of Spreads

Section 5 compared the average spreads of OD and MM issues. It was observed that for MM issues the execution prices tend to be better than the best quotes before trade execution. The distribution of spreads for each issue is examined in this section to show the relationship between the quotes by market makers and execution prices.

Table 6.1 shows the spread distribution of OD and MM issues. This frequency table shows the frequency with which spread is 1 to 10 ticks for each tick level. Frequency of spreads larger than 10 ticks is recorded as one category. According to this table, for OD issues falling under the three largest market capitalization groups, more than 50 percent of observed spreads are 1 tick. The frequency of 1-tick spread is also high (between 45 percent and 49 percent) for the next three groupings by market capitalization. This falls significantly to 27 percent for the group with market capitalization of 2 billion yen and below.

For MM issues, the incidence of 1-tick spread is about 38 percent. The incidence of 1-tick spreads decreases significantly for stocks with smaller market capitalization. For stocks

with market capitalization of less than 10 billion yen, it is 10 percent, and for those in the less than 5 billion yen category it is less than 1 percent. There seem to be a smaller incidence of 1-tick spreads in the case of MM issues compared to OD issues.

Table 6.1 Distribution of Spreads

(A) OD issues	Market Capitalization							
Tick spread	over 100 bil	50 bil to under 100 bil	20 bil to under 50 bil	10 bil to under 20 bil	5 bil to under 10 bil	2 bil to under 5 bil	under 2 bil	Total
1	57.32	51.29	51.34	48.53	45.25	49.27	27.04	
2	14.47	19.29	15.75	16.14	11.81	11.05	12.68	
3	8.11	10.2	7.92	9.17	6.85	6.16	10.63	
4	6.98	7.28	6.33	7.55	6.39	6.45	11.81	
5	5.36	5.38	5.63	5.81	6.44	6.39	11.36	
6	0.87	0.93	1.25	1.24	1.12	1.12	2.07	
7	0.93	0.85	1.3	1.21	1.2	1.18	2.29	
8	1.07	0.94	1.56	1.41	1.68	1.57	2.53	
9	1.38	1.1	2.27	2.07	3.46	2.77	3.45	
10	2.34	1.45	2.78	2.57	5.08	4.13	4.67	
10-	1.17	1.29	3.86	4.29	10.71	9.9	11.47	
Observations	103,677	251,626	124,757	173,165	60,559	48,392	34,663	796,839
(B) MM issues								
Tick spread	over 100 bil	50 bil to under 100 bil	20 bil to under 50 bil	10 bil to under 20 bil	5 bil to under 10 bil	2 bil to under 5 bil	under 2 bil	Total
1	-	38.41	22.87	14.99	10.4	0.74	0.88	
2	-	22.64	19.17	18.77	15.04	1.58	1.51	
3	-	10.38	10.47	12.13	10.39	1.45	1.79	
4	-	5.15	6.59	7.38	5.78	1.74	2.61	
5	-	9.45	13.02	10.54	13.56	14.96	15.94	
6	-	1.31	1.98	1.96	1.51	0.44	1.22	
7	-	1.24	1.61	1.56	1.16	0.79	1.51	
8	-	1.05	1.19	1.31	0.89	0.98	1.66	
9	-	0.67	0.98	1.02	1.13	1.32	2.32	
10	-	6.26	9.7	9.72	14.13	24.85	23	
10-	-	3.45	12.42	20.62	26.01	51.14	47.57	
Observations	0	140,178	64,341	63,025	70,002	28,357	26,970	392,873

Note: Panel A shows the results for OD issues, Panel B for MM issues. The two panels show the distribution in percent and incidence of specific tick sizes according to the following formula: Tick or (quoted) spread = (Ask – Bid) / Tick size. All observations are grouped by market capitalization. The period observed is from January to June 2001.

6.2 Relationship between Execution Price and Best Bid or Ask

The relationship between the best bid or ask and the execution price is shown in Table 6.2. The score of -1 is recorded when the execution price is equal to the best bid, and +1 when it is equal to the best ask. Trades are executed out of the bid-ask spread are scored as -2 or 2. Trades executed within the bid-ask spread are scored 0.

Panel A in Table 6.2 shows the distribution of execution prices in relation to best quotes for OD issues. In 47.4 percent of the cases, trades were executed at the best bid and in 47.9

percent, at best ask. In 2.2 percent of the cases, trades were executed within the best bid-ask spread. Trades were executed out of the bid-ask spread for about 1 percent of the cases for both buy and sell orders. Looking at differences in execution price according to market capitalization, the smaller the capitalization, the higher the frequency of execution within the spread. This is probably related to the fact that spread is wider for small-cap stocks, and securities firms would thus tend to execute trades for smaller stocks by crossing buy and sell orders that they had accumulated.

Panel B looks at MM issues. Trades executed at the best bid accounted for 31.2 percent of trades, and those executed at best ask, 34.9 percent, both lower than the percentages for OD issues. The percentage of trades executed within the spread is 28.7 percent, which is higher compared to OD issues.[22] The percentage of trades executed at prices out of the bid-ask spread is also higher than OD issues, at 5.2 percent.

The relationship between execution prices and quotes are analyzed for trades with 1 tick spreads and with 2 ticks or larger spreads. Panels C and D show the distribution of execution prices when spreads are 1 tick. When the spread is 1 tick, even for MM issues, there is a higher probability that trades are executed at the best bid or ask, acounting for 43.0 percent and 49.3 percent of trades, respectively. The percentage of trades executed out of the bid-ask spread is also higher.

Panels E and F look at the relationship of execution prices to quotes when spreads are more than 2 ticks. The percentage of trades executed inside the spread for OD issues is 4.3 percent. That for MM issues is 36.7 percent, which is even higher than the percentage of trades at the best quotes. Considering that, for each market capitalization grouping, the bid-ask spreads for OD issues are more likely to be 1 tick compared to MM issues, there is a higher probability that trades for MM issues are executed within the spread. This shows

[22] The tick data in Panel B may not be in the order of actual trades and quotes for market-maker stocks. Specifically, in Panels B, E, and F, out of order trades are deemed to be the last trade with a time stamp when there are other trades with the same time stamp. Through such a data adjustment process, tests were conducted on whether there are cases where "execution prices match the best bid or ask but are not correctly identified as such". Panels B, E, and F show the percentage of trades that were not executed at best bid or ask just before the trade was executed. For panel B, this amounts to 33.9 percent (1 – 0.312 – 0.349) of trades. However, when matches against "other best bid or ask with the same time stamp" are considered, the proportion of non-matching trades decreases to 27.1 percent. The 6.8 percentage difference between the two figures should not be regarded as reflecting errors in the original calculation, as there is a possibility of over-compensation. It is important to note that the percentage of trades executed outside of the bid-ask spread just before execution is not small, even if errors in the calculation are considered.

that market makers take into account the quotes of other market makers and maintain a certain spread when they themselves make quotes. This translates into a tendency for price improvement when customer trades are executed.[23] In overseas markets, it is reported that there are cases where market makers would, instead of competing on prices quoted to the market, attempt to attract orders by promising rebates or execution at better prices. The patterns of spreads would reflect such practices.[24] Similar factors may be at work in the behavior of Japanese market makers.

[23] Rhodes-Kropf (2001) highlights two cases. One is where adverse selection for orders does not exist and another is where the bargaining power of customers is substantial. Rhodes-Kropf points out that it is important to distinguish these differences in the analysis of price improvement.

[24] In the United States, there are practices such as preferencing and internalization, whose relations to best excution are extensively examined. For a list of literature, see Hansch-Naik-Viswanathan (1999).

Table 6.2 Distribution of Trades by Execution Prices

Panel A [OD issues]

	Execution Price					
Market Capitalization	**-2**	**-1**	**0**	**1**	**2**	**Total**
100 billion yen and over	1.0	46.2	1.2	50.5	1.0	
50 bil to under 100 bil	1.1	47.1	1.6	48.8	1.4	
20 bil to under 50 bil	1.1	46.1	2.2	49.1	1.4	
10 bil to under 20 bil	1.1	47.9	2.3	47.1	1.5	
5 bil to under 10 bil	0.9	48.4	3.3	45.9	1.6	
2 bil to under 5 bil	1.1	48.6	3.4	45.3	1.6	
under 2 billion yen	1.3	51.2	4.3	41.3	1.9	
Total	1.1%	47.4%	2.2%	47.9%	1.4%	100.0%
Observations	8,694	378,901	17,361	383,508	11,447	799,911

Panel B [MM issues]

	Execution Price					
Market Capitalization	**-2**	**-1**	**0**	**1**	**2**	**Total**
50 bil to under 100 bil	2.8	33.2	23.0	38.2	2.8	
20 bil to under 50 bil	2.9	32.3	27.5	34.7	2.6	
10 bil to under 20 bil	2.7	30.0	31.6	33.3	2.5	
5 bil to under 10 bil	2.6	28.9	32.6	33.3	2.7	
2 bil to under 5 bil	1.7	29.2	35.7	31.5	1.9	
under 2 billion yen	1.6	28.9	37.2	30.6	1.8	
Total	2.6%	31.2%	28.7%	34.9%	2.6%	100.0%
Observations	10,248	122,520	112,888	137,339	10,080	393,075

Panel C [OD issues: Spread = 1 tick]

	Execution Price					
Market Capitalization	**-2**	**-1**	**0**	**1**	**2**	**Total**
100 billion yen and over	0.8	46.5	0.0	52.0	0.7	
50 bil to under 100 bil	1.0	48.1	0.0	49.9	1.0	
20 bil to under 50 bil	1.1	46.5	0.0	51.3	1.1	
10 bil to under 20 bil	1.0	49.5	0.0	48.8	0.8	
5 bil to under 10 bil	0.6	50.2	0.0	48.7	0.7	
2 bil to under 5 bil	0.8	49.9	0.0	48.6	0.7	
under 2 billion yen	0.9	53.5	0.0	44.8	0.8	
Total	0.9%	48.3%	0.0%	49.9%	0.9%	100.0%
Observations	3,735	191,691	0	198,285	3,493	397,204

Panel D [MM issues: Spread = 1 tick]

	Execution Price					
Market Capitalization	**-2**	**-1**	**0**	**1**	**2**	**Total**
50 bil to under 100 bil	3.2	43.2	0.0	50.2	3.4	
20 bil to under 50 bil	4.1	43.9	0.0	48.1	4.0	
10 bil to under 20 bil	5.0	41.3	0.0	48.7	5.0	
5 bil to under 10 bil	5.8	41.0	0.0	46.8	6.4	
2 bil to under 5 bil	7.1	44.1	0.0	47.4	1.4	
under 2 billion yen	5.5	45.2	0.0	46.4	3.0	
Total	3.8%	43.0%	0.0%	49.3%	3.9%	100.0%
Observations	3,247	36,824	0	42,299	3,361	85,731

Panel E [OD issues: Spread = 2 ticks]

	Execution Price					
Market Capitalization	**-2**	**-1**	**0**	**1**	**2**	**Total**
100 billion yen and over	1.3	45.9	2.8	48.5	1.5	
50 bil to under 100 bil	1.1	46.0	3.3	47.7	1.9	
20 bil to under 50 bil	1.2	45.7	4.6	46.9	1.6	
10 bil to under 20 bil	1.3	46.5	4.5	45.4	2.2	
5 bil to under 10 bil	1.1	46.9	6.0	43.6	2.3	
2 bil to under 5 bil	1.3	47.2	6.7	42.2	2.6	
under 2 billion yen	1.4	50.4	5.9	40.0	2.3	
Total	1.2%	46.5%	4.3%	46.0%	2.0%	100.0%
Observations	4,959	187,210	17,361	185,223	7,954	402,707

Panel F [MM issues: Spread = 2 ticks]

	Execution Price					
Market Capitalization	**-2**	**-1**	**0**	**1**	**2**	**Total**
50 bil to under 100 bil	2.6	26.9	37.4	30.7	2.5	
20 bil to under 50 bil	2.6	28.9	35.6	30.7	2.3	
10 bil to under 20 bil	2.3	27.9	37.1	30.6	2.0	
5 bil to under 10 bil	2.2	27.4	36.4	31.7	2.3	
2 bil to under 5 bil	1.7	29.1	36.0	31.4	1.9	
under 2 billion yen	1.6	28.8	37.5	30.4	1.8	
Total	2.3%	27.9%	36.7%	30.9%	2.2%	100.0%
Observations	7,001	85,696	112,888	95,040	6,719	307,344

Notes 1: Execution prices are shown here according to the following rule. When the execution price equals the best bid just before the trade, then the score is -1, and when it equals the best ask the score is 1. Similarly, cheaper than the best bid scores -2, and more expensive than the best ask scores 2. When execution price is within the bid-ask spread, it is represented by a score of 0.

2: Tick data for MM issues in Panel B are realigned in the correct time order when tick data are not recorded in the right time order. In such cases, the misplaced data is deemed the last in sequence when there are several trades with the same time stamp. In addition, cases where "execution prices match the best bid or ask but are not correctly identified as such" were taken into account. Panel B shows the percentage of trades that were not executed at best bid or ask just before the trade was executed, 33.9 percent (1 – 0.312 – 0.349) of trades. However, when matches against "other best bid or ask with the same time stamp" are considered, the proportion of non-matching trades decreases to 27.1 percent. The 6.8 percentage point difference between the two figures should not be regarded as reflecting errors in the original calculation, as there is a possibility of over-compensation. It is important to note that the percentage of trades executed outside of the bid-ask spread just before execution is not small, even if errors in the calculation are considered.

6.3 Trading Volume and Volatility

The results of analyses in the previous sections reveal that the effective spread which represents the effective trading cost is smaller for MM issues than OD issues, and these results proved to be statistically significant. This section examines whether this translates into differences in trading volume and volatility. It was observed that the quoted spread is stable for MM issues, which indicates that the volatility of daily changes in stock prices and the standard deviation from the average may be smaller. As seen in Table 6.3, volatility for OD issues is 8.0 percent, and that for MM issues is smaller at 6.3 percent. The distribution of volatility (measured by standard deviation of volatility figures) is also less dispersed for MM issues than OD issues, at 8.3 and 11.5 percent, respectively. Grouped by market capitalization, the level of volatility is 70 to 80 percent of that for OD issues for all groupings except for those in the 20 billion to 50 billion yen group.

On the other hand, the difference in turnover is not as obvious. The daily average for all stocks is 23,730,000 yen for OD issues versus 24,170,00 yen for MM issues. The two averages are almost identical. There are some groups by market capitalization where the averages for MM issues greatly exceed that of OD issues, as in the 50 billion to 100 billion yen group (2.0 times), and in the 5 to 10 billion yen group (3.1 times). Considering that market turnover of MM issues is said to be approximately 1.6 times the turnover of OD issues for the same underlying trade flows, turnover seems to be more substantial for MM issues in the 5 to 10 billion yen and 50 to 100 billion yen capitalization groups, but less in the under 2 billion yen category.

Table 6.3 Turnover and Volatility

	OD issues				
	Observations	Volatility (A)	Standard deviation	Daily turnover (C)	Standard deviation
OD issues	572	0.080	0.115	23,727,759	96,884,933
[Market Capitalization]					
100 billion yen and over	8	0.040	0.008	531,214,095	539,356,565
50 bil to under 100 bil	49	0.061	0.092	89,382,308	114,317,325
20 bil to under 50 bil	54	0.059	0.057	31,803,598	51,007,816
10 bil to under 20 bil	122	0.069	0.085	16,894,394	31,498,699
5 bil to under 10 bil	115	0.076	0.118	4,542,346	7,372,150
2 bil to under 5 bil	87	0.083	0.136	3,890,645	8,391,064
under 2 billion yen	137	0.107	0.143	2,215,080	6,205,210

	MM issues						
	Observations	Volatility (B)	Standard deviation	(B)/(A)	Daily turnover (D)	Standard deviation	(D)/(C)
MM issues	220	0.063	0.083		24,171,432	68,340,274	
[Market Capitalization]							
100 billion yen and over							
50 bil to under 100 bil	13	0.045	0.019	0.7	178,938,829	180,944,781	2.0
20 bil to under 50 bil	20	0.063	0.051	1.1	46,645,754	88,675,767	1.5
10 bil to under 20 bil	38	0.049	0.038	0.7	25,657,094	43,129,682	1.5
5 bil to under 10 bil	53	0.052	0.079	0.7	14,279,841	28,083,856	3.1
2 bil to under 5 bil	38	0.067	0.054	0.8	5,178,218	7,135,474	1.3
under 2 billion yen	58	0.082	0.128	0.8	2,241,757	2,765,587	1.0

Note: Volatility is measured as the standard deviation of daily stock price movements. Daily turnover is estimated by trading volume multiplied by the closing price. Units of yen. The period under observation is the six months from January to June 2001. The MM/OD ratio is calculated using the formula (volatility of execution prices (turnover) for MM issues / volatility of execution prices (turnover) for OD issues).

7. The Influence of Switch in Trading Systems on Spreads

In the January to June 2001 period observed in our analysis, 45 issues switched trading systems from order-driven to market-maker. Changes in the opposite direction numbered eleven. In this section, the changes in spreads before and after such switches in trading system will be analyzed. By studying the patterns in quotes and execution prices for the same stock before and after a switch, it might be possible to identify the influences of the trading system from specific features of the stock. For such analysis, there is a tradeoff in the choice of observation periods. That is, in order to secure enough data samples to make the tests statistically robust, the period should be sufficiently long. On the other hand, to minimize the influence of changes in market conditions and stock prices of the stock, the observation period should not be too long.

As such, the analysis on the switch in trading systems in this paper will be conducted in the

following order. To eliminate as much as possible any influences of trades in preparation for market-making and unwinding of positions, data from five trading days before and after the switch were excluded. Samples for 40 trading days before and after this blackout period were used. Stocks for which there were fewer than nine trades during the observation period are considered to be ineligible. Applying these criteria, excluding stocks with insufficient data before and after the trading system switch and also those with too few trades, it was possible to conduct analyses on fifteen stocks that became MM issues and five stocks that became OD issues.

Table 7.1 shows the patterns of spreads, distinguishing between instances when the spread is 1 tick, and when the spread is more than 2 ticks. 1-tick spreads are observed when buy and sell orders are balanced, and there is no room to tighten the spread further in such cases. Spreads of 2 ticks and larger means there are several prices at which orders to buy or sell can be matched within the spread.

Trade execution or observed trade data increased 7.4-fold on average (2.4-fold if weighted) for stocks that were switched from order-driven to market-maker. Trade execution seems to have been facilitated for these stocks, as trade execution for ten of the fifteen such stocks increased more than 160 percent.[25]

Looking at spreads just before trade execution, the share of 1 tick spreads was 15.3 percent before the switch, and fell to 7.2 percent after the switch. This indicates that the quoted spread before trade execution widened with the switch. The share of trades executed within the spread, meanwhile, increased 5.8-fold from 6.8 percent to 39.5 percent. These results are in line with the results of analyses in Section 6.

Turning to the five stocks that were first traded as MM issues and later switched to OD issues, it was observed that the trades for these stocks decreased, on average, to about 40 percent after they became OD issues. Meanwhile, the share of 1 tick spreads increased from 4.1 percent to 30.2 percent with the switch. The percentage of trade execution within the bid-ask spread decreased from 42.1 percent to 16.3 percent.

Table 7.2 shows execution prices as seen through effective spreads. The effective spread

[25] Trading volume may double in the cases of MM issues, compared to order-driven trade matching. This happens when market makers fill sell orders by buying on their own account and fill buy orders from their inventories, both cases counting as separate trades. Typically, market makers execute 60 percent of trades against their own positions and 40 percent of trades by matching customers' orders.

could be regarded as the trading cost that investors pay to market makers, and this will be compared with patterns for OD issues.

The effective spread ratio for the 15 stocks for which trading was switched from order-driven to market-maker became smaller from 1.49 percent to 1.03 percent. There were eleven stocks for which effective spreads decreased after the switch. Of these, seven were statistically significant. The increase in trades executed within the spread can explain the decline in effective spread for MM issues. On the other hand, effective spreads for stocks which changed from being market-maker to order-driven decreased for all but one stock. Of these, changes that were statistically significant in three stocks. Much of this change can be accounted for by the decline of spreads to 1 tick.

For stocks where trading systems were switched within the observation period, spread distribution patterns were similar to those noted in Sections 6.1 and 6.2. Market makers tend to quote larger spreads, and attract orders by executing trades within the spread with price improvement. It follows the observations seen in literature on NASDAQ markets in the United States that competition between market makers does not lead to competition by narrowing spreads. Price improvement is noted for MM issues even though spread is wider, which might indicate that the routing of order flows could influence price discovery.

Table 7.1 Patterns of Spreads

Stock issue (Codes)	Observations before switch (A)	Observations 1 tick	Share 1 tick	Observations 2 or more ticks	Share Inside-the-spread	Observations after switch (B)	(B)/(A)	Observations 1 tick	Share 1 tick	Observations 2 or more ticks	Share Inside-the-spread
[Switch from OD to MM issues]											
1793	25	2	8.0%	23	4.4%	134	5.4	10	7.5%	124	44.4%
1799	17	0	0.0%	17	0.0%	117	6.9	3	2.6%	114	29.0%
1986	757	159	21.0%	598	4.5%	2,100	2.8	2	0.1%	2,098	19.8%
2673	560	59	10.5%	501	7.0%	322	0.6	1	0.3%	321	38.3%
3891	60	16	26.7%	44	6.8%	234	3.9	45	19.2%	189	55.6%
4548	699	325	46.5%	374	4.3%	1,299	1.9	206	15.9%	1,093	48.9%
4561	184	50	27.2%	134	12.7%	126	0.7	14	11.1%	112	32.1%
6867	266	51	19.2%	215	7.9%	412	1.5	1	0.2%	411	41.4%
6930	585	217	37.1%	368	4.9%	1,481	2.5	412	27.8%	1,069	40.0%
7298	15	1	6.7%	14	0.0%	821	54.7	2	0.3%	819	22.1%
7467	22	0	0.0%	22	9.1%	90	4.1	0	0.0%	90	56.7%
7521	37	6	16.2%	31	16.1%	496	13.4	108	21.8%	388	49.2%
7612	62	2	3.2%	60	15.0%	99	1.6	1	1.0%	98	41.8%
7623	13	1	7.7%	12	0.0%	50	3.8	0	0.0%	50	44.0%
9908	22	0	0.0%	22	9.1%	158	7.2	0	0.0%	158	29.8%
Average	222	59	15.3%	162	6.8%	529	7.4	54	7.2%	476	39.5%
[Switch from MM to OD issues]											
1770	224	0	0.0%	224	42.9%	211	0.9	27	12.8%	184	6.0%
8215	62	0	0.0%	62	41.9%	29	0.5	4	13.8%	25	8.0%
8880	698	83	11.9%	615	26.3%	223	0.3	154	69.1%	69	8.7%
9056	116	10	8.6%	106	47.2%	22	0.2	11	50.0%	11	36.4%
9651	67	0	0.0%	67	52.2%	19	0.3	1	5.3%	18	22.2%
Average	233	19	4.1%	215	42.1%	101	0.4	39	30.2%	61	16.3%

Note: The execution price position shows the relationship between execution price and spread. When a trade is executed below the best bid, it is denoted as -2, when it is executed at the best bid, -1, within the bid-ask spread 0, at the best ask 1, and higher than the best ask 2. See Section 7 for more details on data and period observed in this analysis.

Table 7.2 Switch in Trading Systems and Spreads: Comparison of OD and MM Issues

(A) Quoted Spread

Stock issue (Codes)	Observations before switch (A)	Quoted spread (B)	Standard deviation	Midprice	Observations after switch (C)	(C)/(A)	Quoted spread (D)	Standard deviation	Midprice	Quoted spread (D)/(B)	Quoted spread Z-score
[Switch from OD to MM issues]											
1793	25	2.85	9.04	605	134	5.4	2.69	3.85	528	0.95	0.2
1799	17	3.46	7.36	223	117	6.9	4.22	6.58	234	1.22	-1.1
1986	757	1.39	2.36	361	2,100	2.8	1.55	0.70	502	1.12	-2.8
2673	560	1.81	2.63	706	322	0.6	2.82	2.47	542	1.56	-9.1
3891	60	3.03	9.87	1,329	234	3.9	2.78	14.15	1,096	0.92	0.5
4548	699	1.31	0.78	1,075	1,299	1.9	2.41	1.50	1,135	1.83	-23.0
4561	184	1.92	3.32	2,002	126	0.7	2.21	1.82	1,652	1.15	-1.6
6867	266	2.77	12.89	1,014	412	1.5	3.65	4.38	941	1.32	-3.6
6930	585	1.75	2.29	1,459	1,481	2.5	1.49	1.20	1,673	0.85	3.7
7298	15	2.16	3.67	382	821	54.7	2.44	2.66	524	1.13	-0.6
7467	22	3.76	10.90	538	90	4.1	6.03	9.33	535	1.60	-2.9
7521	37	4.29	23.98	1,026	496	13.4	2.22	2.19	1,248	0.52	2.6
7612	62	6.84	39.32	412	99	1.6	3.78	4.80	377	0.55	3.7
7623	13	6.12	34.74	386	50	3.8	3.96	6.45	388	0.65	1.3
9908	22	3.54	3.91	535	158	7.2	2.76	2.49	615	0.78	1.8
Average		3.13					3.00			1.08	
[Switch from MM to OD issues]											
1770	224	3.08	1.87	433	211	0.9	1.37	1.35	497	0.44	14.1
8215	62	7.24	7.35	198	29	0.5	5.03	30.00	196	0.69	2.1
8880	698	1.98	0.86	1,489	223	0.3	0.95	0.22	1,512	0.48	21.9
9056	116	4.37	19.58	1,341	22	0.2	2.53	8.29	1,230	0.58	2.5
9651	67	4.49	3.30	554	19	0.3	4.12	17.52	642	0.92	0.4
Average		4.23					2.80			0.62	

(B) Effective Spread

Stock issue (Codes)	Observations before switch (A)	Effective spread (B)	Standard deviation	Midprice	Observations after switch (C)	(C)/(A)	Effective spread (D)	Standard deviation	Midprice	Quoted spread (D)/(B)	Quoted spread Z-score
[Switch from OD to MM issues]											
1793	25	1.42	2.25	605	134	5.4	0.99	0.66	528	0.70	1.4
1799	17	1.73	1.84	223	117	6.9	1.50	1.51	234	0.87	0.7
1986	757	0.68	0.58	361	2,100	2.8	0.59	0.17	502	0.87	3.0
2673	560	0.85	0.50	706	322	0.6	1.01	0.56	542	1.19	-3.1
3891	60	1.49	2.77	1,329	234	3.9	0.90	3.28	1,096	0.61	2.4
4548	699	0.64	0.20	1,075	1,299	1.9	0.82	0.38	1,135	1.27	-7.2
4561	184	0.87	0.67	2,002	126	0.7	0.88	0.39	1,652	1.01	-0.2
6867	266	1.39	2.89	1,014	412	1.5	1.20	0.78	941	0.87	1.7
6930	585	0.86	0.51	1,459	1,481	2.5	0.53	0.18	1,673	0.62	10.4
7298	15	1.08	0.92	382	821	54.7	1.02	0.65	524	0.95	0.2
7467	22	1.58	0.81	538	90	4.1	1.80	2.17	535	1.14	-0.9
7521	37	1.86	5.84	1,026	496	13.4	0.75	0.52	1,248	0.41	2.8
7612	62	3.03	9.23	412	99	1.6	1.17	0.78	377	0.39	4.7
7623	13	3.16	9.98	386	50	3.8	1.23	0.60	388	0.39	2.2
9908	22	1.64	0.72	535	158	7.2	1.05	0.43	615	0.64	3.1
Average		1.49					1.03			0.79	
[Switch from MM to OD issues]											
1770	224	0.95	0.50	433	211	0.9	0.65	0.31	497	0.68	5.0
8215	62	2.44	1.82	198	29	0.5	2.42	7.59	196	0.99	0.0
8880	698	0.80	0.24	1,489	223	0.3	0.46	0.06	1,512	0.57	13.9
9056	116	1.58	2.78	1,341	22	0.2	1.01	1.01	1,230	0.64	2.2
9651	67	1.34	0.84	554	19	0.3	1.35	2.09	642	1.00	0.0
Average		1.42					1.18			0.78	

Note: Stocks that were changed from one trading system to the other from January to June 2001 with enough data before and after the switch were selected for analysis. See Section 7 for details.

8. Summary

This paper examined the influences of different trading systems on spreads and trading costs of stocks listed on JASDAQ using intraday data for the six-month period between January and June 2001. Since the introduction of the market-making system, the number of MM issues has increased significantly, to account for one-third of all listed stocks on JASDAQ. The proportion of MM issues to OD issues is relatively stable across market capitalization, except for the largest and smallest cap issues, where there are fewer MM issues.

Comparing the price formation of MM issues and OD issues, it was found that, for MM issues, a) observed spreads were stable and two-way prices existed for 90 percent of trading hours; b) effective spreads were about 30 percent narrower than the observed spreads immediately before trades were consummated; and c) the narrowing of the effective spread, or the lowering of the tradings cost, was the result of about 30 percent of trades being executed within the observed spreads that existed immediately before trades. Such characteristics of MM issues were evident in both cross-sectional analyses for a single period, and in time-series analyses of stocks that switched from OD to MM issues (and vice versa) during the sample period. It was also observed that not only spreads were more stable for MM issues, but the price volatility of these stocks was also lower.

Looking at the distribution of spreads, 1-tick spreads in MM issues were observed for just over 20 percent of the time, whereas OD issues saw 1-tick spreads 50 percent of the time. For OD issues, two-way prices became sporadic for issues with smaller market capitalization. Spreads just before trades are consummated, however, tightened to levels matching or even narrower than those for MM issues. This reflected the behavior of market participants to place limit orders in a way that would increase the likelihood of trade execution. In other words, market spreads of OD issues were influenced by individual market participants placing limit orders. The behavior of market makers – quoting somewhat wide but stable spreads regardless of actual order flows, while often executing trades at prices better than quoted spreads – should reflect their avoiding risk of hitting small orders coming in through the small-lot order automatic matching system. Similar behavior on the part of market makers is also observed in the United States. The fact that trades for market-maker stocks are often executed at better prices than quoted prices is not

necessarily consistent with the role of markets in providing access to a level playing field for all investors, and warrants further examination.

In evaluating such behavior of market makers, it is necessary to take into account macroeconomic welfare effects. From the perspective of investors, one must compare a) the cost of maintaining relationships with certain market makers and b) market liquidity cost, or the cost of having to trade under wide spreads. Theoretically, if the former is larger than the latter, investors should prefer order-driven markets, and, if the opposite is true, prefer market-maker markets.

Establishing a market-making system as a complementary or alternative system to the order-driven system, should be a desirable development from the general viewpoint of enhancing investor choice of trade execution. Moreover, it could be encouraged for the marcroeconomic welfare effects, in that it could lead to enhancement of market liquidity through the active role of market makers. From this perspective, it is important to establish and maintain sufficient levels of market transparency so that changes in the market liquidity of individual issues and competition between market makers can be observed and analyzed in detail.

Annex

Analyses on volatility, trading frequency, and trading volume were conducted in a similar manner as the analyses in Section 3. The observation period is October to December 2000.

Volatility

Figure 3.8 shows the distribution of daily volatility for the prices of MM and OD issues. Volatility was below 3 percent for 59 percent of the MM issues. Volatility was somewhat higher for order-driven stocks, with the highest concentration, 24 percent, being observed for the 3 to 4 percent volatility level.

Figure 3.8 Stock Price Changes: Distribution of S.D.

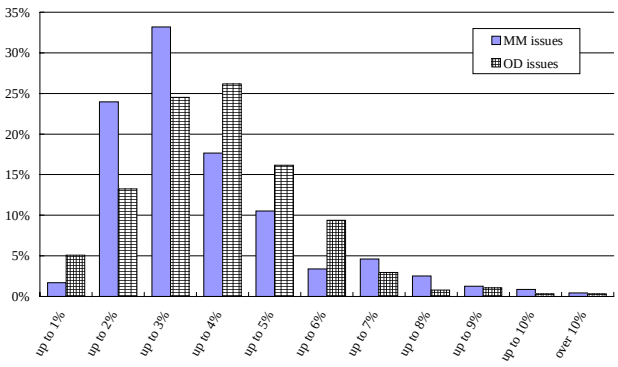
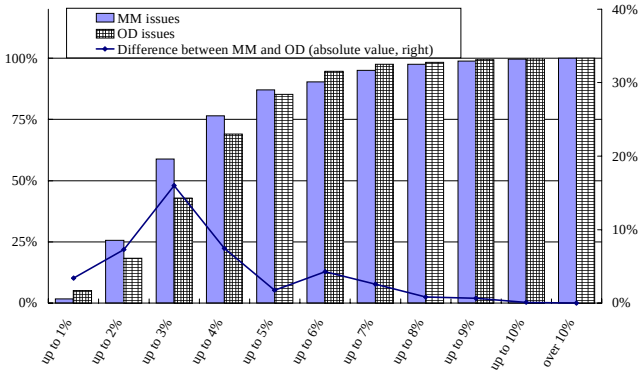


Figure 3.9 Stock Price Changes: Cumulative Distribution of S.D.



Trading Frequency

Figure 3.10 shows the proportion of trading days when trades were observed. For MM issues, trades were observed on each day of the observation period for more than a third of all issues. Meanwhile, the same is less than one-fourth of all OD issues.

Figure 3.10 Trading Frequency

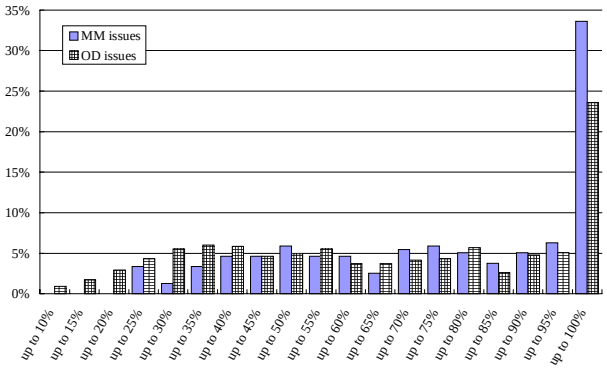
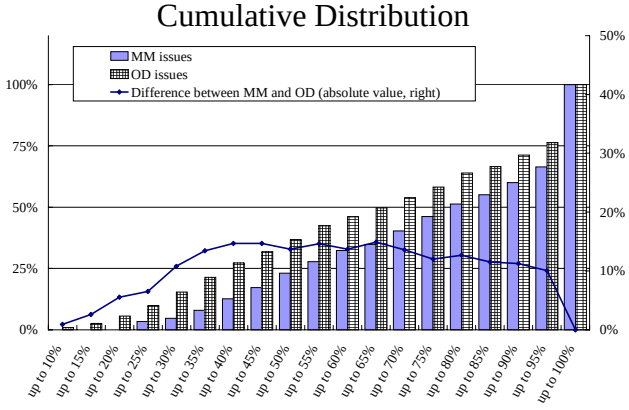


Figure 3.11 Trading Frequency: Cumulative Distribution



Trading Volume (daily, in trading units)

Figure 3.12 shows the distribution of trading volume divided by trading units of the respective stocks. Less than 1 unit of many of the OD issues are traded for each day, while the highest concentration of MM issues is observed in the 10 to 49 units range. It is important to note here that there may be cases where trading of MM issues is recorded twice. Interviews with major market makers reveal that market-maker stock trading tends to be recorded at 1.6 times that for order-driven stocks.* Data adjusted for this are plotted in Figure 3.14. After adjustment, differences in the two groups of stocks become negligible.

Figure 3.12 Distribution of Trading Volume (MM unadjusted)

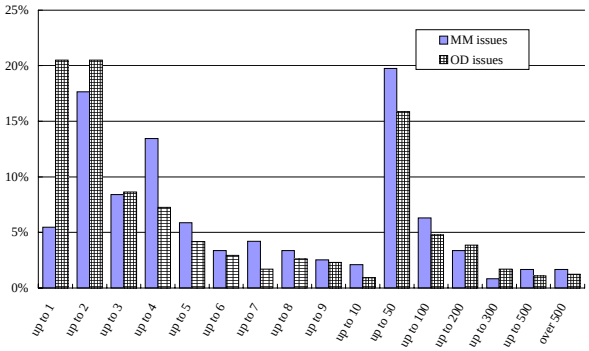
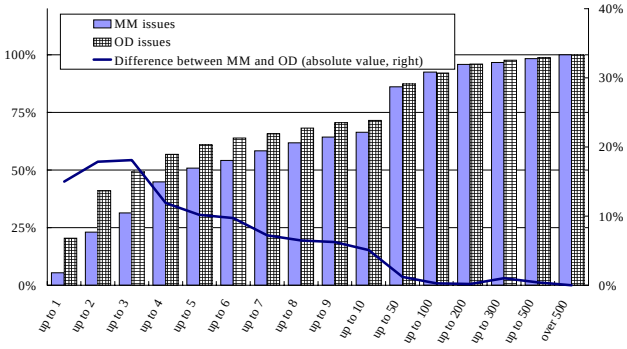


Figure 3.13 Cumulative Distribution of Trading Volume (MM unadjusted)



* See footnote 25. First, trading volume for market-maker stocks is divided by 1.6. Next, stocks for the two types of trading systems are compared.

Figure 3.14 Trading Volume (MM / 1.6)

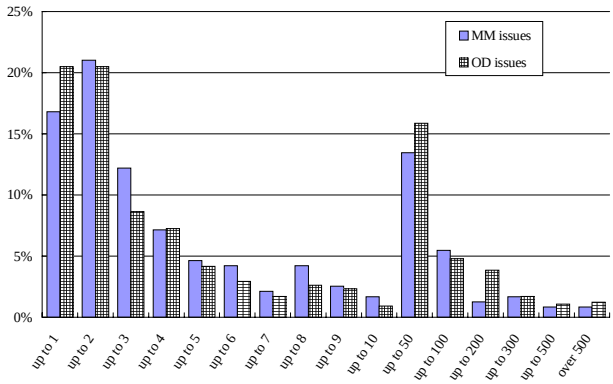
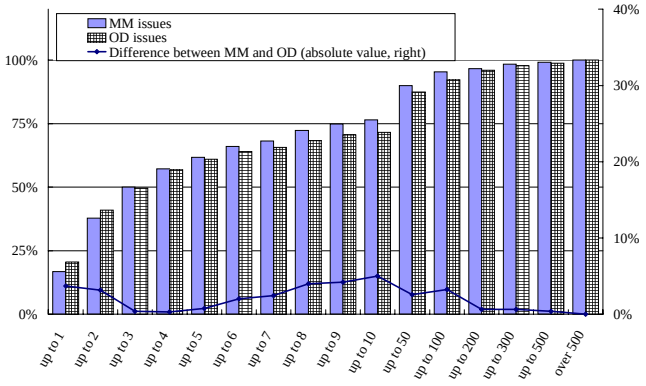


Figure 3.15 Trading Volume (MM / 1.6)



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