Order Aggressiveness of Institutional and Individual Investors

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Abstract

This paper investigates the factors determining the order aggressiveness of institutional and individual investors on the Australian Stock Exchange (ASX). The study also examines the changes in institutional and individual investors' order aggressiveness following the removal of broker IDs on the 28th of November 2005. While investigating the order submission strategies of stocks sampled from large, medium and small capitalization groups, we document that the institutional and individual investors' order aggressiveness responds similarly to the market depth and the bid-ask spread, but differently to the time left-to-trade (end of the day) and the order size. This difference in the order submission strategies employed by institutional and retail investors is more strongly pronounced in the post-transparent (anonymous) market. In addition, both groups of investors become less aggressive after the move to anonymity, with stronger results observed for individual investors.

JEL classification: C35, G15, G25 and G29

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1. Introduction

This study investigates the factors determining the order aggressiveness of institutional and individual investors on the Australian Stock Exchange (ASX). In addition, the study also examines the effect of the removal of broker IDs on the ASX on institutional and individual investors' order aggressiveness. In so doing, we address three research questions. What are the factors affecting the order aggressiveness of institutional and individual investors? Do these factors influence institutional and individual investors' order aggressiveness in a similar way? How do institutional and individual investors respond to the change in market transparency; in particular, are institutional and individual investors more or less aggressive following the removal of broker IDs on the ASX?[1]

Consistent with Biais et al. (1995), we classify orders into different aggressiveness levels on the basis of the comparison of the order price and order size to the price and market depth of the best quote. The investigation of investors' order aggressiveness is important for various reasons. First, according to Harris (1998), understanding the factors that affect order submission strategies will enable traders to decide what type of orders to submit, how to determine the order prices and how and when to revise or cancel their orders, if necessary. Therefore, evidence regarding the order aggressiveness of institutional and individual investors will facilitate traders to optimize their trading strategies, which, in turn, will result in lower transaction costs and higher portfolio returns.

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[1] From 28 November 2005, brokers can no longer observe the identification (IDs) of other brokers submitting orders in the ASX. Prior to this change, brokers have been able to identify, in real-time the broker number associated with every order (the Broker IDs) in the central limit order book for each security traded on the ASX. The main reason for the ASX to stop disclosing broker IDs is that exposing broker IDs fosters front-running activities. These activities suppress liquidity and impose extra costs on investors, which in turn, result in investors seeking execution outside the central market (the limit order book), which in turn, impairs the overall market liquidity (ASX, 2005).

Second, unlike the quote-driven market where market makers are obliged to provide liquidity, in an order driven market such as the ASX, liquidity provision relies solely on the submission of orders (Bloomfield et al., 2005). The submission of limit orders is viewed as the provision (supply) of liquidity while market orders consume (demand) liquidity. Therefore, for the market as a whole, analyzing traders' order submission strategies will help to understand better the market conditions under which traders are willing to supply (submission of limit orders) and demand (placement of market orders) liquidity. This will improve our understanding of the price formation process (Ellul et al., 2007) and the fundamental issues of how order-driven markets function (Bloomfield et al., 2005).

Furthermore, examining the changing behaviour of institutional and individual investors in different market transparency regimes will provide better understanding of investors' demand and supply of liquidity in response to a reduction in market transparency. These findings will be helpful to market regulators in designing the market mechanism that will enhance the overall market liquidity. The increasingly important role of limit order market as the form of security market organization[2] provides further motivation for the research on the order submission strategies of institutional and individual traders in the limit order market.

The current investigation is also relevant for specialist and dealer markets such as NYSE and NASDAQ since the limit order book is an important part of these markets' trading. For the NYSE, limit order traders play an important role in the market-making process with 74.9% of the quotes have at least one side originated

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[2] Glosten (1994) provides the theoretical background for the importance of order driven market. In the investigation of 51 stock exchanges around the world, Jain (2003) also documents that at the end of 1999, 51% of the 51 stock markets are organized as a pure limit order book, while another 29% are hybrid with the limit order book as a core engine. Many prominent stock exchanges such as the Tokyo Stock Exchange, the Stock Exchange of Hong Kong, the ASX and virtually all of the market centers in Europe are organized as limit order markets (Handa et al., 2003).

from limit-order traders (Chung et al., 1999). The limit order book (the SuperDot system) also accounts for 53 percent of the participations in all transactions in the NYSE (Harris and Hasbrouck, 1996) and as much as 45% of the volume on NASDAQ are traded on the electronic communication networks (ECNs), which are organized as electronic order book markets (Bloomfield et al., 2005).

The study contributes to the current literature in the following dimensions. First, while there are extensive empirical studies on the order choice or order aggressiveness of investors[3], few studies have made a distinction between institutional and individual investors' orders in their investigation of order aggressiveness. Differentiating between institutional and individual orders, while examining investors order aggressiveness, is important since these two classes of investors potentially differ in their possession of private information, which leads to the better performance for institutional limit orders.[4]. Moreover, according to D'Aloisio the CEO of the ASX, individual investors are also an important investment group, where about 55% of the adult Australian population own shares. In terms of market value, individual investors possess at least 22% of the Australian equity market and their trading activities are accounted for about 51% of the market turnover as it is measured by the number of transactions (D'Aloisio, 2005).

To the best of our knowledge, Aitken et al. (2007) is the only study that distinguishes between institutional and individual investors' orders while analysing order aggressiveness. However, the main focus of their study is to highlight which

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[3] See for example Biais et al. (1995), Griffiths et al. (2000), Bae et al. (2003), Ranaldo (2004), Cao et al. (2004), Verhoeven et al. (2004), Beber and Caglio (2005), Hall and Hautsch (2006), Ellul et al. (2007) and Aitken et al. (2007).
[4] Szewczyk et al. (1992), Alangar et al. (1999) and Dennis and Weston (2001) find evidence that institutional investors are better informed than individual investors. Chakravarty (2001) documents that institutional medium-size orders have a significantly greater cumulative stock price impact than individual orders. Moreover, Anand, Chakravarty and Martell (2005) also show that institutional limit orders outperform retail limit orders

class of investors is more aggressive in their order submission. We contribute to the current literature by investigating the determinants of order aggressiveness for institutional investors and individual investors. We also differentiate from Aitken et al. (2007) by not only analyzing the factors affecting investors' order aggressiveness but also highlighting whether these factors affect institutional and individual investors' order aggressiveness in a similar fashion. The results of our study will enhance the understanding of the similarities as well as the differences in the supply and demand of liquidity of institutional and individual investors in order driven markets.

Second, we analyze the effect of the change in the degree of market transparency on institutional and individual investors' order aggressiveness. In contrast to the common belief that increasing market transparency will improve market quality, as specified in Madhavan (1992), Pagano and Roell (1996) and Glosten (1999), and the current trend of moving towards a more transparent market[5], from 28 November 2005, the ASX decided to reduce the market transparency by removing the identification (IDs) of brokers submitting orders in the market. Foucault, Moinas and Theissen (2007) provide a theoretical model suggesting that the move to anonymity will increase (decrease) uninformed investors' aggressiveness if the participation rate of the informed traders in the trading process is low (high).

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[5] For example, on April 12, 1990, the Toronto Stock Exchange (TSE) began to disseminate information regarding the depth and quotes for the current inside market as well as the depth and limit orders prices for up to four levels above and below the current market. The NYSE also introduced the OpenBook service on January 24, 2002 for all securities, which provides the aggregate limit order volume available in the NYSE Display Book system at each price point. See Madhavan et al. (2005), Boehmer et al. (2005) and Baruch (2005) for a discussion of the effect of the increase in market transparency on market quality in the TSE and the NYSE.

Empirical evidence regarding the effect of the removal of broker IDs is relatively sparse, and often focuses almost exclusively on the effect on the bid-ask spread.[6]

Comerton-Forde and Tang (2007) is the only study that analyzes the effect of removing broker IDs on investors' order aggressiveness. The study documents a reduction in investors' order aggressiveness following the move to anonymity. Our study differs from that of Comerton-Forde and Tang (2007) by differentiating between institutional and individual orders when investigating the impact of reducing market transparency on investors' order aggressiveness. Specifically, we examine whether institutional and individual investors become more or less aggressive following the move to anonymity and whether these two groups of investors react in a similar or different fashion to this change in the market transparency. Moreover, we also incorporate the effect of market depth beyond the best quotes, rather than considering only the market depth at the best quote as in Comerton-Forde and Tang (2007), in our investigation of order aggressiveness.

In addition, our study also differentiates from prior studies on anonymity by investigating the effect of the move to anonymity on investors' order aggressiveness based on a natural experiment, where we examine the same market in two different periods where the only difference is the anonymity of liquidity suppliers. This differentiates us from prior studies on anonymity, which rely on the comparison between different markets (Garfinkel and Nimalendran, 2003 and Heidle and Huang, 2002) or different trading venues within the same markets (Grammig et al., 2001; Theissen, 2002; Simaan et al., 2003 and Reiss and Werner, 2004).

We examine the order aggressiveness of institutional and individual investors for 30 large capitalization (cap), 30 mid cap and 30 small cap stocks traded on the

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[6] See for example, Comerton-Forde et al. (2005), Haig et al. (2006), Foucault et al. (2007), Comerton-Forde and Tang (2007) and Securities and Derivatives Industry Association – SDIA (2007).

ASX, over 171 trading days between 1 August 2005 and 31 March 2006. This sample period is chosen to minimize the effect of information events unrelated to the removal of broker IDs on investors' order aggressiveness and also because of the computationally intensive nature of our investigation. Consistent with prior literature, we find the order aggressiveness of institutional and individual investors to be positively (negatively) related to the same-side (opposite-side) market depth. In addition, we also document a negative relation between order aggressiveness and the bid-ask spread, except in the small cap stocks for individual investors. However, we do not observe conclusive evidence regarding the effect of volatility on order aggressiveness, with different results obtained for both institutional and individual investors in the three groups of stocks.

Consistent with Bloomfield et al. (2005) and Anand et al. (2005), we also highlight differences in the order aggressiveness patterns of institutional and individual investors over the course of the trading day. Specifically, institutional investors are more aggressive during the first trading hour while individual investors are less aggressive early on in the day and tend to increase their order aggressiveness as the market close approaches. In addition, individual investors are less aggressive when submitting large orders while institutional investors tend to increase their aggressiveness when submitting large orders, except in small cap stocks. We also observe that these differences in the order submission pattern and the response to the changes in the order size between institutional and individual investors are stronger in the anonymous market. Moreover, institutional and individual investors are more aggressive in their selling activities than in their buying activities, but only in mid cap and small cap stocks. We also document different responses of individual buyers and sellers to changes in spread and volatility in mid cap stocks.

Finally, we find both institutional and individual investors to be less aggressive in their order submission following the removal of broker IDs on the ASX. The reduction in order aggressiveness is, however, much stronger for the individual investors than for the institutional investors. This finding suggests that following the move to anonymity, both institutional and individual investors are more willing to display or supply liquidity to the central limit order book than demand liquidity. This result is also consistent with the observation of an increase in liquidity following the removal of broker IDs, as demonstrated in Comerton-Forde et al. (2005), Haig et al. (2006), Foucault et al. (2007) and Comerton-Forde and Tang (2007). Overall, our evidence supports the decision by the ASX to remove broker IDs in order to enhance the overall market liquidity.

The rest of the paper is organized as follows. Section 2 provides a review of the current literature and develops the hypotheses to be examined in the current study. Section 3 describes the data to be used in the study and Section 4 explains the research methods. Section 5 discusses the results and implications while Section 6 concludes the paper.

2. Literature Review and Hypotheses

2.1 The determinants of order aggressiveness

When making trading decisions, traders can choose to submit limit orders and supply liquidity to the market, or post market orders and consume liquidity. The choice of limit or market orders reflects the trade-off between the costs and benefits of one particular type of order over the other. The advantage of using market orders is the immediacy of the order execution, but it comes with the cost of potentially paying higher execution prices. In contrast, limit orders provide price improvement over

market orders, but are associated with the risk of non-execution. Moreover, since the limit price is fixed overtime and monitoring might be costly, limit orders can become mispriced, and thus be executed at unfavourable price. This is often referred in the literature as the risk of being "picked-off". The trade-off among execution probability, price improvement and the risk of being "picked-off" plays a key role in deciding the traders' order choice.[7]

Parlour (1998) develops a dynamic model of a limit order book market without asymmetric information to explain the traders' choice of limit and market orders. According to Parlour (1998), the reduction of the market depth on the sell (buy) side will enhance the execution probability of a limit order at the ask (bid), which in turn will increase the pay-off to limit orders. Therefore, an incoming seller (buyer) is more likely to submit a sell (buy) limit order instead of a sell (buy) market order. In contrast, an increase in the market depth on the sell (buy) side reduces the execution probability of the incoming sell (buy) limit order. Furthermore, buyers also rationally anticipate the crowding out of limit orders on the sell side and so limit buy orders become more attractive than market buy orders. Thus, when the market depth on the sell side increases, an incoming seller (buyer) is more likely to submit a market sell order (limit buy order). Consistent with Parlour (1998), Handa et al. (2003) also show that the larger the excess market depth of the buy (sell) side relative to the market depth of the sell (buy) side, the higher the execution risk to buyers (sellers). Therefore, the larger (smaller) the imbalance between the buy side relative to the sell side, the more likely buyers (sellers) are to use market orders rather than limit orders.

Foucault (1999) develops a game theoretic model of price formation and order placement decisions in a dynamic limit order market where investors differ in

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[7] See Handa and Schwartz (1996), Harris and Hasbrouck (1996), Wald and Horrigan (2005) and Hollifield et al. (2006) for a discussion of the profitability of limit order trading.

their valuations but not in their private information. Foucault (1999) suggests that higher volatility implies greater risk of being "picked-off" for limit order submitters. Thus, limit order traders will demand a larger compensation for the risk of being "picked-off" in a more volatile market. This in turn results in a larger spread and a higher cost of trading with market orders. Hence, more traders find it optimal to carry out their trades with limit orders rather than market orders. Drawing on this intuition, the model predicts that the proportion of limit orders in the order flow is positively related to the price volatility and the bid-ask spread in limit order markets. The prediction of a positive relation between limit order submissions and the bid-ask spread is also consistent with the theoretical model of Cohen et al. (1981), in which limit orders become more attractive as the bid-ask spread increases.

Empirical analysis of investors' order submission strategies generally provides support for theoretical predictions of the effect of spread and market depth on the order aggressiveness of investors. This support is consistent and robust for different markets and over different sample periods (see for example Biais et al., 1995; Griffiths et al., 2000; Ranaldo, 2004; Verhoeven et al., 2004; Cao et al., 2004; Beber and Caglio, 2005; Hall and Hautsch, 2006; Ellul et al., 2007 and Aitken et al., 2007).

The effect of volatility on order aggressiveness is less conclusive. Bae et al. (2003), Ranaldo (2004) and Beber and Caglio (2005) document a positive relation between the placement of limit orders and volatility, as predicted by Foucault (1999). In contrast, in their investigation of the orders submitted in Island ECN for the 300 largest NASDAQ National Market stocks during the forth quarter of 1999, Hasbrouck and Saar (2002) find that higher volatility is generally associated with a lower proportion of limit orders in the incoming order flow. Similarly, in their examination of investors' order aggressiveness for a sample of 38 stocks traded on the ASX during

2001, Aitken et al. (2007) also document that investors are actually more aggressive when volatility increases.

The different empirical evidence regarding the effect of volatility on order aggressiveness can be attributed to the assumption of risk-neutral investors in the Foucault (1999) model. According to Hasbrouck and Saar (2002), the prediction of this model might not be applicable to risk-averse investors.[8] Moreover, higher volatility might also imply greater costs of order monitoring and management, which in turn reduces the use of limit order strategies. Based on the previous theoretical models and empirical results, we formulate the following hypotheses regarding the effect of market depth, bid-ask spread and volatility on order aggressiveness:

H_1: *Order aggressiveness is positively (negatively) related to the same-side (opposite-side) market depth.*

H_2: *Order aggressiveness is negatively related to the bid-ask spread.*

H_3: *Order aggressiveness is negatively related to the price volatility.*

Harris (1998) derives a model for optimal dynamic order submission strategies, which encompasses three types of traders: uninformed liquidity traders, informed traders and value-motivated traders. In this model, both liquidity and informed traders become more aggressive as the trading progresses. While liquidity traders are focusing to achieve their daily targets towards the end of the trading session, the informed traders are also trying to transact rapidly in order to take advantage of their 'information' before it is revealed to the market.

This argument by Harris (1998) is supported by Beber and Caglio (2005), who document the increasing aggressiveness of orders throughout the day in their analysis

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[8] Wald and Horrigan (2005) observe that for a risk-averse investor, higher volatility increases the execution probability of limit orders, but it is also associated with larger adverse selection costs. The authors show that the higher adverse selection costs associated with increased volatility can outweigh the benefits of higher fill rates for limit orders. Thus, a rise in volatility would result in a decline in the use of limit orders relative to market orders.

of 10 stocks traded on the NYSE during the period from November 1990 to January 1991.

Bloomfield et al. (2005) provide experimental evidence that informed traders are more aggressive and trade mostly with market orders early in the trading day. However, in contrast to Harris (1998), they document that towards the end of the trading day, rather than becoming more aggressive, informed traders, on average, trade more with limit orders than market orders. Uninformed investors behave in the opposite fashion. They are less aggressive early on in the trading day and become more aggressive as the trading expiration approaches. Anand et al. (2005) and Ellul et al. (2007) offer empirical support for the experimental evidence of Bloomfield et al. (2005). Drawing on the findings in prior literature that institutional traders are informed and individual traders are uninformed, Anand et al. (2005) show that institutional (informed) investors are more aggressive and use more market orders in the first half of the trading day than in the second half. In addition, Ellul et al. (2007) also observe a positive (negative) relation between elapsed trading time and the probability of limit orders (market sell orders) for 148 stocks traded on the NYSE during the week between April 30 and May 4, 2001.

Based on the evidence presented in Bloomfield et al. (2005), Anand et al. (2005) and Ellul et al. (2007), and on the findings in prior studies that institutional investors are better informed,[9] we formulate the following hypothesis regarding the pattern of investors' order aggressiveness over the course of the trading day:

H_4: Institutional (individual) investors are more (less) aggressive early on in the trading day than at the end of the trading day.

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[9] See for example, Szewczyk et al. (1992), Alangar et al. (1999), Dennis and Weston (2001) and Chakravarty (2001).

2.2 Order aggressiveness and the removal of broker IDs

The literature on the informativeness of broker identification is relatively sparse and often focuses on the effect of withdrawing (or disclosing) broker IDs on bid-ask spread.[10] Foucault et al. (2007) develop a theoretical model for a limit order market to explain the changing aggressiveness of informed and uninformed traders after the removal of brokers IDs. In a transparent market, uninformed investors infer information about future price movements from observing the quotation behaviour of informed traders. They will try to front-run the informed traders to benefit from the information by setting more competitive quotes than those posted by the informed traders. The informed traders respond by sometimes engaging in bluffing strategies, posting non-aggressive orders and setting wider spreads than appropriate. In an anonymous trading system, uninformed traders cannot distinguish informed traders' orders from those of uninformed traders. They submit orders based on the belief about the identity of the traders with the orders in the limit order book. In this case, if the participation rate of informed traders is small (large), uninformed traders will be more (less) aggressive, and improve on the already posted orders more (less) often.[11]

Comerton-Forde and Tang (2007) examines the effect of removing the broker IDs on market quality. They document a reduction in bid-ask spreads, adverse selection risk, trade execution costs and order exposure risk after the removal of

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[10] Comerton-Forde et al. (2005), Foucault et al. (2007) and Comerton-Forde and Tang (2007) observe a reduction in the bid-ask spread following the move to anonymity in the Euronext Paris, the Tokyo Stock Exchange and the ASX. On the other hand, Comerton-Forde et al. (2005) document a larger spread after the Korea Stock Exchange started disclosing broker IDs information.
[11] Alternatively, Simaan et al. (2003) propose the collusion hypothesis which argues that a non-anonymous trading system facilitates collusion among liquidity suppliers. Therefore, traders' aggressiveness is lower under the non-anonymous trading system compared to the anonymous system. In support of this hypothesis, Simaan et al. (2003) document evidence that dealers post more aggressive quotes in an anonymous market (the ECNs) than in a transparent market where dealers' IDs are displayed (the NASDAQ). Since the ASX is a limit order market, we will formulate our hypothesis regarding the effect of the removal broker IDs in the ASX on investors' order aggressiveness based on Foucault et al. (2007) model.

broker IDs on the ASX. They also observe a reduction in order aggressiveness following the move to anonymity.

Drawing on the insights of Foucault et al. (2007), we argue that if institutional investors are better informed than individual investors, in the non-anonymous trading system they will submit aggressive orders to minimize the risk of being front-run by other traders. Since the risk of front-running activities is reduced in an anonymous trading system, institutional investors will be less aggressive and submit limit orders more often after the removal of broker IDs on the ASX. For individual investors, in the non-anonymous trading system, they observe the order submissions by institutional investors and try to front-run these orders by submitting more aggressive orders. After the removal of broker IDs, individual investors cannot differentiate orders submitted by institutional investors from those submitted by other individual investors. This reduces their ability to engage in front-running activities, and thus individual investors will also be less aggressive in their order submission following the move to anonymity. Based on the above discussion, we formulate the following hypothesis regarding the effect of the move to anonymity on investors' order aggressiveness:

H_5: *A move to anonymity decreases institutional and individual investors' order aggressiveness.*

3. Data

We investigate the determinants of order aggressiveness for the 30 large cap, 30 mid cap and 30 small cap stocks traded on the ASX between August 2005 and March 2006. The selection criteria for the stocks under investigation include both the stocks' market capitalization and trading activity. First, we consider only common stocks so

all the unit trusts and preference shares are excluded. We also include only seasoned stocks with at least 3 years of trading history. Second, we require that all the stocks under investigation must be included in the S&P 200 index on 29 July 2005 (the day before our sample period), 25 November 2005 (the day before the removal of broker IDs) and 31 Mar 2006 (the end of sample period). The choice of S&P 200 index ensure the representation of large cap, mid cap and small cap stocks as well as the institutional trading interest and the liquidity of the stocks under investigation. The large cap stocks are defined as the stocks included in the S&P 50 index while the mid cap and small cap stocks are the stocks included in the S&P 100 index but not in the S&P 50 index, and the stocks included in S&P 200 index but not in the S&P 100 index, respectively.

Third, we rank all large cap, mid cap and small cap stocks based on the daily average number of trades for the 3-month period before our sample (May to July 2005). The 30 large cap stocks and small cap stocks chosen are the 30 most traded large cap stocks and the 30 least traded small cap stocks based on the daily average number of trades for the period between May and July 2005, respectively. The 30 mid cap stocks chosen are the 15 stocks above and the 15 stocks below the stocks with median daily average number of trades for the period between May and July 2005.

We obtain two different datasets from the Securities Industry Research Centre of Asia-Pacific (SIRCA) for the investigation of the order aggressiveness of institutional and individual investors. The first dataset is the unique Order book dataset which records each order, including the order type (order submission, order revision, order cancellation), the date and time to the nearest hundredth of a second, stock code, order price, order volume and order direction (buy or sell order). Each new order is assigned a unique identification number (ID) so that we can track the

order from its submission through to any revision, cancellation or execution. A unique feature of this dataset is the provision of the confidential dummy variable indicating whether the order is submitted by an institutional or an individual investor.[12] In this study, only the orders submitted in the continuous trading session (from 10:10 am to 4:00 pm) are included. In addition, we only analyze standard orders, so that crossing orders, All or Nothing orders and Fill and Kill orders are excluded.

The second dataset is the Market depth data, also provided by SIRCA, which contains information on the market depth of a particular stock. Specifically, it details the 10 best limit prices on the bid and ask side, in association with the total volume (number of shares) and the total number of orders at each price level. This dataset is updated whenever there is a change to the price and/or volume to any of these 10 best limit prices. We remove all the observations in the Market depth dataset whenever the bid price is greater than the ask price at any of the 10 limit price levels. We also exclude all observations where the bid (ask) prices are not in strict descending (ascending) order from the first to the tenth best prices.

For our purpose of investigating the order aggressiveness of institutional and individual investors, we match the Order book dataset to the Market depth dataset. Thus, we arrive at a final dataset that contains detailed information on every institutional or individual order submitted, revised or cancelled together with the market depth information at the time of order submission, revision or cancellation.

4. Research Methodology

Consistent with Biais et al. (1995), we classify orders into six levels of order aggressiveness. Category 1, the most aggressive orders, are buy (sell) orders with the

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[12] This confidential dataset is released by the Australian Stock Exchange (ASX) and provided to us via SIRCA.

prices greater (less) than the best ask (bid) quotes and the size of the orders exceeds the market depth at the best ask (bid) quote. These orders will be executed against the volume at the ask (bid) and in part against the market depth available higher (lower) in the book up to the order price. The unfilled portion of the order will enter as limit orders in the order book. Category 2 orders are buy (sell) orders with prices equal to the best ask (bid) quotes and demand more volume than the market depth at the best ask (bid) quote. These orders will be executed immediately and the unfilled portion will become limit orders at that price in the limit order book. Category 3 orders are orders with price equal to the opposite best quote and demand less volume than the market depth at the best opposite quote. These orders will be executed immediately and in full. Category 4 and 5 orders are limit orders within and at the prevailing quotes, respectively. Category 6 orders are the least aggressive, in the sense that they are buy (sell) orders with prices less (greater) than the best bid (ask) quotes. Based on this classification, Category 1, 2 and 3 can be classified as market orders, since they result in immediate execution, while Category 4, 5 and 6 orders are limit orders, as these orders are not executed immediately. These orders stand in the limit orders book, waiting for execution.

The determinants of institutional and individual investors' order aggressiveness will be investigated based on the ordered probit model. The ordered probit model consists of two parts. The first part relates the observable action types (R_i) to the latent linking variable (Z_i) as follows:

$$R_i = \begin{cases} 1 & \text{if } Z_i \in (-\infty, \mu_1] \\ 2 & \text{if } Z_i \in (\mu_1, \mu_2] \\ 3 & \text{if } Z_i \in (\mu_2, \mu_3] \\ 4 & \text{if } Z_i \in (\mu_3, \mu_4] \\ 5 & \text{if } Z_i \in (\mu_4, \mu_5] \\ 6 & \text{if } Z_i \in (\mu_5, \infty) \end{cases}$$

R_i is the order aggressiveness, classified as suggested by Biais et al. (1995). μ_k is the intercept parameter to be estimated. In the second part of the model, the latent variable Z_i is in turn modelled as follows:

$$Z_i = \beta_1\, Depth_{same,i} + \beta_2\, Depth_{opposite,i} + \beta_3\, Spread_i + \beta_4\, Vola_i + \beta_5\, FirstInt_i + \beta_6\, Size_i$$

$$+ \beta_7\, Direction_i + \beta_8\, Anonymous_i + \varepsilon_i, \tag{1}$$

where $Depth_{same,i}$ ($Depth_{opposite,i}$) is the natural logarithm of the same-side (opposite-side) market depth, in term of number of shares, at the time of order submission. $Spread_i$ is the relative bid-ask spread, measured as the percentage of the bid-ask spread over the bid-ask midpoint, at the time of the order submission. Following Ranaldo (2004), $Vola_i$ is defined as the standard deviation of the 20 most recent mid quote returns multiplied by 100. $FirstInt_i$ is a dummy variable that equals one for orders submitted between 10:10 am and 11:00 am and zero otherwise. $Direction_i$ is a dummy variable that equals one for sell orders and zero otherwise. $Size_i$ is the natural logarithm of the number of shares in a particular order. $Anonymous_i$ is a dummy variable that takes the value of one for orders submitted from 28 November 2005 onwards (in the anonymous trading system) and zero otherwise.

Besides spread, market depth and volatility, we include a dummy variable for the first trading hour to examine the potential differences in the order aggressiveness of institutional and individual investors in the early part of the trading day, as suggested by Bloomfield et al. (2005) and Anand et al. (2005). The dummy variable $Direction_i$ is included to control for the potential asymmetry between buy and sell

orders, as documented in Keim and Madhavan (1995) and Ranaldo (2004). $Size_i$ is also incorporated in the order probit regression to examine the relation between order size and its aggressiveness. Finally, $Anonymous_i$ is incorporated into the ordered probit model to investigate the effect of the removal of broker IDs on investors' order aggressiveness. If investors are more (less) aggressive following the move to anonymity, we should expect β_8 to be negative (positive) and significant. In order to highlight the potentially different impact an explanatory variable might have on the order aggressiveness of institutional and individual investors, the ordered probit model as given with equation (1) is estimated separately for institutional orders and individual orders.

We also perform the analysis of the institutional and individual investors' order aggressiveness for the buy orders and sell orders separately to highlight the potential differences in the determinants of the order aggressiveness of buyers and sellers as documented in Ranaldo (2004). We estimate the following ordered probit model for institutional and individual investors' buy and sell orders:

$$Z_i = \beta_1\,Depth_{same,i} + \beta_2\,Depth_{opposite,i} + \beta_3\,Spread_i + \beta_4\,Vola_i + \beta_5\,FirstInt_i + \beta_6\,Size_i$$
$$+ \beta_7\,Anonymous_i + \varepsilon_i \tag{2}$$

In addition to incorporating the dummy variable for orders submitted in anonymous market as in equation (1) and (2), we also examine the effect of the move to anonymity on investors' order aggressiveness by analyzing the determinants of institutional and individual investors' order aggressiveness separately for the transparent market and for the anonymous market. The model is specified as follows:

$$Z_i = \beta_1\,Depth_{same,i} + \beta_2\,Depth_{opposite,i} + \beta_3\,Spread_i + \beta_4\,Vola_i + \beta_5\,FirstInt_i + \beta_6\,Size_i$$
$$+ \beta_7\,Direction_i + \varepsilon_i \tag{3}$$

Besides relying on the coefficient estimates of the ordered probit regressions, we also examine the marginal effects induced by an incremental variation in the regressors. Specifically, if the latent order aggressiveness $Z = x^{'}\beta + \varepsilon$, the marginal effects of changes in the regressors are calculated as follows:

$$\frac{\delta \Pr[R = 1]}{\delta x} = -\phi(\mu_1 - x^{'}\beta)\beta \tag{4}$$

$$\frac{\delta \Pr[R = m]}{\delta x} = [\phi(\mu_{m-1} - x^{'}\beta) - \phi(\mu_m - x^{'}\beta)]\beta \qquad \text{for m} = 2,3,4,5 \tag{5}$$

$$\frac{\delta \Pr[R = 6]}{\delta x} = \phi(\mu_5 - x^{'}\beta)\beta \tag{6}$$

where $\phi(.)$ is the density normal distribution, β (s) are the coefficient estimates from equation (3). $\mu_1, \mu_2, \mu_3, \mu_4, \mu_5$ are the intercept parameters (limit points) estimated in equation (3). In the current study, we utilize the individual observations of the regressors rather than the regressors' mean value for estimating the marginal effects. In other words, based on equation (4), (5) and (6), we calculate the value of $x^{'}\beta$ based on each individual value of the explanatory variables rather than the mean value of the regressors. The reported marginal probabilities for will be the average of all the estimated marginal probabilities calculated based on the individual observations of the explanatory variables.

5. Results and Discussion

5.1 Statistics of order submissions

Table 1 provides summary statistics for the orders submitted for the 90 stocks under investigation. In total, we investigate 16,438,201 orders, including 7,207,314 orders submitted by institutional investors and 9,230,887 orders submitted by individual investors. Similar to Aitken et al. (2007), Category 5 orders are the most common

order type for institutional investors while the most common order type for individual investors is Category 6 orders. In addition, consistent with Parlour (1998) and Handa et al. (2003), both institutional and individual investors tend to submit aggressive (market) orders when the same-side market depth is higher than the opposite-side market depth. For both institutional and individual investors, the relative bid-ask spread is also higher at the time of limit order submission than at the time of market order submission. These observations present early support for the effect of spread and market depth on order aggressiveness, as specified in Hypothesis 1 and 2.

[INSERT TABLE 1 HERE]

5.2 The distribution of order aggressiveness levels

Table 2 provides information regarding the distribution of order aggressiveness levels over the course of the trading day. In the current study, we partition the trading day into six intervals: 10:10 am-11:00 am, 11:00 am-12:00 pm, 12:00 pm-1:00 pm, 1:00 pm-2:00pm, 2:00 pm-3:00pm and 3:00pm-4:00 pm.

[INSERT TABLE 2 HERE]

From Table 2, we observe that the order aggressiveness of institutional investors has a U-shaped pattern. Institutional investors are more aggressive and demand more liquidity (place more market orders) early on in the trading day than in other intervals. As the trading day progresses, institutional investors become less aggressive and submit fewer market orders and more limit orders. Towards the end of the trading day, institutional investors increase their order aggressiveness. However, the order aggressiveness of institutional investors at the end of the trading day is not as high as it is at the beginning of the trading day. Individual investors behave in an

opposite fashion; they are less aggressive early on in the day and become more aggressive as the trading deadline approaches. This is reflected by the increase (decrease) in the use of market (limit) orders towards the end of the trading day.

We also investigate the effect of the removal of broker IDs on the distribution of investors' order aggressiveness. The results presented in Table 3 suggest that institutional and individual investors appear to be less aggressive and reduce their use of market orders following the move to anonymity. In contrast, both groups of investors tend to increase their use of limit orders in the anonymous market, with the largest increases observed for Category 5 orders for institutional investors and Category 6 orders for individual investors

[INSERT TABLE 3 HERE]

5.3 The order aggressiveness of institutional and individual investors

Table 4 presents the results of investigating the determinants of order aggressiveness for institutional and individual investors, based on the ordered probit model specified in equation (1). Since the aggressiveness levels are ranked from 1 (the most aggressive) to 6 (the least aggressive), a negative coefficient indicates a positive relation between the explanatory variable and investors' order aggressiveness.

[INSERT TABLE 4 HERE]

From Table 4, we observe positive (negative) and significant relation between the same-side (opposite-side) market depth and order aggressiveness for all stocks under investigation. These results are consistent for both institutional and individual investors' orders and provide support for Hypothesis 1. Consistent with prior literature,[13] these findings suggest that the market depth can be viewed as a proxy for the execution probability and thus will affect investors' order aggressiveness. Both

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[13] See for example, Biais et al. (1995), Parlour (1998), Griffiths et al. (2000), Ranaldo (2004), Cao et al. (2004), Beber and Caglio (2005), Hall and Hautsch (2006), Ellul et al. (2007) and Aitken et al. (2007).

institutional and individual investors tend to submit more aggressive orders when the same-side market depth increases or when the opposite-side market depth decreases. In contrast, investors tend to submit less aggressive orders when the same-side market depth decreases or when the opposite-side increases.

We also find the majority of the coefficients for the bid-ask spread to be positive and significant for institutional investors' orders. This finding supports Hypothesis 2, which suggests a negative relation between the order aggressiveness of institutional investors and the bid-ask spread. The order aggressiveness of individual investors is also negatively related to the bid-ask spread but only in the large cap and mid cap stocks. In small cap stocks, individual investors tend to submit more aggressive orders when the spread widens.

The finding for the effect of volatility on investors' order aggressiveness is less conclusive. For large cap stocks, we observe a positive relation between the order aggressiveness of institutional investors and volatility. In contrast, a negative relation between institutional investors' order aggressiveness and volatility is documented in mid cap stocks while this relation is insignificant for the majority of small cap stocks. For individual investors, their order aggressiveness is negatively related to volatility in mid cap stocks but positively related to volatility in small cap stocks. In contrast, there is no clear-cut evidence regarding the direction or the significance of the relation between volatility and individual investors' order aggressiveness for large cap stocks.

Our finding regarding the effect of volatility on order aggressiveness is similar to the mixed empirical evidence in prior literature. Higher volatility is associated with the higher risk of being "picked-off" by better-informed investors. Therefore, if institutional investors are better-informed and monitor the order book more closely, they will try to "pick-off" mispriced limit orders more in the high volatile period.

Since the limit order book is thicker for large cap stocks than for mid and small cap stocks, the execution costs are relatively lower for institutional investors to adopt this trading strategy in large cap stocks than in mid and small cap stocks. Thus, we observe a positive relation between volatility and order aggressiveness for institutional investors in large cap stocks but not in mid cap and small cap stocks.

On the other hand, because the prices of small cap stocks are also relatively smaller compared to large cap and mid cap stocks, a similar change in price will result in a larger absolute return in small cap stocks compared to large cap and mid cap stocks. Therefore, investors in small cap stocks are potentially more risk-averse than in large and mid cap stocks. Hasbrouck and Saar (2002) and Wald and Horrigan (2005) suggest that for risk-averse investors, a rise in volatility results in the increase in the submission of market orders. Thus, our finding of a positive relation between order aggressiveness and volatility for individual investors in small cap stocks might reflect a higher risk-aversion of individual investors in those stocks in comparison to large cap and mid cap stocks.

We also document that institutional and individual investors adopt different order submission strategies over the course of the trading day. For institutional investors, negative and significant coefficient estimates for the *FirstInt* variable are observed for the majority of large cap, mid cap and small cap stocks under investigation. This implies that institutional investors are more aggressive in the first hour of the trading day. In contrast, for individual orders, the majority of the coefficient estimates for the *FirstInt* variables are positive and significant. This result indicates that individual investors are less aggressive and use more limit orders during the first trading hour.

Overall, the results in Table 2 and the results regarding the *FirstInt* variable presented in Table 4 support our fourth hypothesis. Institutional investors and individual investors in our studies tend to behave similarly to the informed and uninformed investors, as documented in Bloomfield et al. (2005) and Anand et al. (2005). Institutional investors are potentially the better-informed investors[14], they submit more aggressive orders early on in the trading when information asymmetry is high and prices have not converged to their true value. As trading progresses and information is incorporated into prices, institutional investors switch to using limit orders and provide liquidity to the market. Individual investors behave in the opposite direction; they are less aggressive early on in the trading day and more aggressive as trading expiration approaches to achieve their trading targets.[15]

With regard to the relation between order size and order aggressiveness, the results in Panel A of Table 4 indicate that in large and mid cap stocks, the larger the institutional investors' orders, the more aggressive they are. In contrast, in small cap stocks, institutional investors are often less aggressive when they submit a large order. For individual investors, if they submit a large order, this order is often non-aggressive as well. This contrasting behaviour of institutional and individual investors suggests that for institutional investors, the non-execution risk is more important than the "picked-off" risk when submitting large orders. In contrast, the "picked-off" risk appears to be more important for individual investors when placing large orders.[16]

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[14] See for example, Szewczyk et al. (1992), Alangar et al. (1999), Dennis and Weston (2001), Chakravarty (2001) and Anand et al. (2005).

[15] We also incorporate the remaining time (in hours) until market closing time (*TTC*) into the ordered probit regression. Negative (positive) and significant coefficient estimates for the *TTC* variable are observed for institutional (individual) investors in the majority of large cap, mid cap and small cap stocks. This evidence indicates that institutional investors are more aggressive early on in the trading day while individual investors are more aggressive in their order submission towards the end of the trading day. These results are consistent with those presented in Table 4 and are available upon request from the authors.

[16] Our result regarding the relation between order size and order aggressiveness of institutional and retail investors might also provide explanation for the finding in Aitken et al. (2007) that order

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Finally, we document mixed results regarding the relation between order direction and order aggressiveness. The results in Table 4 show that institutional investors' sell orders are more aggressive than their buy orders, especially in mid cap and small cap stocks. In contrast, individual investors' sell orders are more (less) aggressive than buy orders in small cap and mid cap stocks (large cap stocks). This finding implies that institutional and individual investors consider a higher opportunity cost of non-execution for sell orders in mid and small cap stocks while individual investors are more patient in their selling activities in large cap stocks.

5.4 The order aggressiveness of buy and sell orders

We investigate the order aggressiveness of institutional investors' buy and sell orders in Table 5. We observe consistent results regarding the same-side market depth, the opposite-side market depth, the bid-ask spread, volatility and order size for both buy and sell orders. In addition, the majority of the coefficient estimates for the *FirstInt* variable in Panel A of Table 5 are negative and significant, which indicates that institutional investors tend to be more aggressive early on in the trading day for buy orders. In contrast, we observe a similar pattern in institutional sell orders only in large cap and mid cap stocks. For small cap stocks, the majority of the coefficient estimates for the *FirstInt* variable in Panel B of Table 5 are insignificant. This finding suggests that in small cap stocks, there is no tendency for institutional investors to be more aggressive in their selling activities early on in the day. This difference in results for buy and sell orders suggests that if the behaviour of institutional investors

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aggressive is positively related to order size for heavily traded stocks and negatively related to order size for lightly traded stocks. The overall positive relation between order size and order aggressiveness in heavily traded stocks is driven by the positive relation between order size and the order aggressiveness of institutional investors. In contrast, we will observe a negative relation between order size and order aggressiveness in lightly traded stocks since both institutional and individual investors' order aggressiveness are negatively related to the order size for small caps stocks.

throughout the day can be explained by their information advantage over individual investors, institutional investors tend to exploit their information advantage using buy orders. This is also consistent with the finding of Griffiths et al. (2000) that aggressive buy orders are more likely to be motivated by information than sell orders.

[INSERT TABLE 5 HERE]

The results of investigating the order aggressiveness of individual investors' buy and sell orders are given in Table 6. For individual investors, the buy and sell order aggressiveness is positively related to the same-side market depth and negatively related to the opposite-side market depth and the order size. In addition, the majority of the coefficient estimates for the *FirstInt* variable are positive and significant. This finding suggests that individual investors are less aggressive in both their buying and selling activities early on in the trading day. The most significant difference in the effect of spread and volatility on individual buy and sell orders are observed in mid cap stocks. In mid cap stocks, when the spread increases, individual investors tend to submit less aggressive buy orders but more aggressive sell orders. Similarly, a rise in volatility will result in the submission of less aggressive buy orders but more aggressive sell orders.

[INSERT TABLE 6 HERE]

5.5 Anonymity and investors' order aggressiveness

We investigate the effect of the removal of broker IDs on investors' order aggressiveness by comparing the proportion of market and limit orders submitted by institutional and individual investors before and after the move to anonymity Results of this investigation appear in Table 3. In addition, we also incorporate a dummy variable indicating orders submitted in the anonymous trading system (orders

submitted from 28 November 2005 onwards) to the ordered probit model in equations (1) and (2).

In addition to the results in Table 3, from Tables 4, 5 and 6, we also obtain a positive and significant coefficient estimate for the *Anonymous* variable for the majority of the stocks analyzed in this study. This evidence is consistent for all three groups of stocks, for both buy and sell orders and for both institutional and individual investors, with stronger results obtained for individual investors. This finding is also consistent with the observation of the reduction in the use of market orders for both institutional and individual investors in Table 3. Overall, the results in Tables 3, 4, 5 and 6 provide support for Hypothesis 5. Our findings indicate that both institutional and individual investors are less aggressive in their order submission and tend to supply liquidity rather than demand liquidity following the move to anonymity. This result is also consistent with the evidence documented in prior studies[17] and provides support for the decision to cease displaying the broker IDs in order to enhance the overall market liquidity by the ASX.

In order to examine the effect of the move to anonymity on the investors' order aggressiveness further, we investigate the determinants of institutional and individual investors' order aggressiveness in the transparent market (before 28 November 2005) and in the anonymous market (from 28 November 2005 onwards), as specified in equation (3). The results of this investigation are presented in Tables 7 and 8.

[INSERT TABLES 7 and 8 HERE]

Table 7 provides consistent results regarding the effect of market depth, spread, volatility, order size and the order direction (except in large cap stocks) in

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[17] See for example, Comerton-Forde et al. (2005), Haig et al. (2006), Foucault et al. (2007) and Comerton-Forde and Tang (2007).

both the transparent and anonymous market. The results regarding the *FirstInt* variable suggest that institutional investors are more aggressive in the first hour of the trading day, with stronger results observed in the anonymous market, especially for small cap stocks. This finding is consistent with the suggestion of Foucault et al. (2007) that risk of front-running activities in the transparent market might result in the informed traders sometimes engaging in bluffing strategies and posting less aggressive orders than would be appropriate. In an anonymous market with smaller risk of front-running activities, institutional investors will increase their submission of aggressive orders when their information advantage is arguably largest.

For individual investors, the most significant differences when examining the two market regimes are observed for the effect of order size and the first trading hour on order aggressiveness. In the transparent market, individual investors are more aggressive when submitting large orders while they tend to be less aggressive when placing large orders in the anonymous market. This pattern in order submission is consistent with that of the institutional investors in large cap and mid cap stocks. In addition, individual investors are also less aggressive in the first trading hour, especially in the small cap stocks and in the anonymous market. Overall, these findings suggest that in an anonymous market where uninformed investors cannot identify the order submission of informed investors, they tend to submit less aggressive orders when the information asymmetry is potentially higher (in the first hour of the trading day) and when risk of being "picked-off" is higher (when their order size is larger).

In addition to the coefficient estimates, we also analyze the marginal effects induced by an incremental variation in one of the explanatory variables based on

equations (4), (5) and (6). The results of this investigation are given in Tables 9, 10 and 11.

[INSERT TABLES 9, 10, AND 11 HERE]

The marginal effects analysis in Tables 9, 10 and 11 shows that a change in the same-side (opposite-side) market depth is associated with a positive (negative) marginal reaction for market order traders and a negative (positive) marginal reaction for limit order traders. A change in the bid-ask spread is also associated with a negative reaction for market order traders and a positive reaction for limit order traders. The switching normally occurs between traders who place limit orders within the quotes (Category 4 orders) and the traders who submit orders at the quote (Category 5 orders). Consistent with the results in Table 7 and 8, we observe inconclusive evidence regarding the marginal effects for the *Volatility* and *Direction* variable. Institutional investors generally increase the probability of submitting aggressive orders during the first trading hour while individual investors tend to decrease the probability of submitting aggressive orders in the same period. Finally, institutional and individual investors also differ in their marginal reaction to a change in the order size in large and mid cap stocks in the anonymous market regime and in small cap stocks in the transparent market regime.

6. Conclusion

This study investigates the factors affecting the order aggressiveness of institutional and individual investors and examines the effect of the removal of broker IDs on the ASX on the order aggressiveness of these two classes of investors. Investigating the order submissions during the period between 1 August 2005 and 31 March 2006, we document strong support for the role of market depth and the bid-ask spread in

affecting both institutional and individual investors' order aggressiveness in all three groups of stocks. The effect of volatility is less conclusive. Both institutional and individual investors are more likely to place less aggressive orders when volatility increases, but only in mid cap stocks.

In addition, institutional investors are more aggressive early on in the trading day and become less aggressive as the trading day progresses while individual investors behave in an opposite manner. Institutional investors are also more likely to increase their aggressiveness when placing large orders in large and mid cap stocks while large orders submitted by individual investors are more likely to be non-aggressive. These differences in the behaviour of institutional and individual investors over the course of the trading day and in response to changes in the order size are stronger in the anonymous market than in the transparent market. We also find individual buyers and sellers to react differently to changes in spread and volatility in mid cap stocks. Finally, we document that both groups of investors become less aggressive in their order submission after the removal of broker IDs on the ASX, with stronger evidence documented for individual investors. This finding suggests an enhancement to market liquidity where both institutional and individual investors tend to increase their supply of liquidity, following the move to anonymity.

Our results regarding the order aggressiveness of institutional and individual investors in an order driven market provide important implication for the quote driven and hybrid market as well. Glosten (1994) develop a theoretical model suggesting that the limit order book will be the inevitable form of stock market organization. Even in hybrid market such as NYSE, Chung et al. (1999) also document that

Harris and Hasbrouck (1996) document that the NYSE SuperDOT system accounts for 53% of the participants in all transactions, but only 30% of the buy and sell volume

References

Aitken, M., Brown, P., Wee, M., 2007. Institutional versus retail traders: a comparison of their order placement strategies. Working paper, University of Western Australia.

Alangar, S., Bathala, C., Rao, R., 1999. The effect of institutional interest on the information content of dividend-change announcements. Journal of Financial Research 22, 429-448.

Anand, A., Chakravarty, C., Martell, T., 2005. Empirical evidence on the evolution of liquidity: choice of market versus limit orders by informed and uninformed investors. Journal of Financial Markets 8, 265-287.

Australian Stock Exchange, 2005. Enhancing the liquidity of the Australian equity market. Decisions on reform paper, the Australian Stock Exchange.

Bae, K-H., Jang, H., Park, K.S., 2003. Traders' choice between limit and market orders: evidence from NYSE stocks. Journal of Financial Markets 6, 517-538.

Baruch, S., 2005. Who benefits from an open limit order book? Journal of Business 78, 1267-1306.

Beber, A., Caglio, C., 2005. Order submission strategies and information: empirical evidence from the NYSE. Working paper, University of Pennsylvania.

Biais, B., Hillion, P., Spatt, C., 1995. An empirical analysis of the limit order book and the order flow in the Paris Bourse. Journal of Finance 50, 1655-1689.

Bloomfield, R., O'Hara, M., Saar, G., 2005. The "make or take" decision in an electronic market: evidence on the evolution of liquidity. Journal of Financial Economics 75, 165-200.

Boehmer, E., Saar, G., Yu, L., 2005. Lifting the veil: an analysis of pre-trade transparency at the NYSE. Journal of Finance 60, 783-815.

Cao, C., Hansch, O., Wang, X., 2004. The informational content of an open limit order book. Working paper, Penn State University.

Chakravarty, S., 2001. Stealth trading: which traders' trades move stock prices? Journal of Financial Economics 61, 289-307.

Chung, K.H., Van Ness, B.F., Van Ness, R.A., 1999. Limit orders and the bid-ask spread. Journal of Financial Economics 53, 255-287.

Cohen, K., Maier, S., Schwartz, R., Whitcomb, D., 1981. Transaction costs, order placement strategy and the existence of bid-ask spread. Journal of Political Economy 89, 287-305.

Comerton-Forde, C., Frino, A., Mollica, V., 2005. The impact of limit order anonymity on liquidity: evidence from Paris, Tokyo and Korea. Journal of Economics and Business 57, 528-540.

Comerton-Forde, C., Tang, K.M., 2007. Pre-trade anonymity, liquidity and fragmentation. Working paper, University of Sydney.

D'Aloisio, T., 2005. "ASX: an Important Part of Australia's Capital Markets". Speech by Tony D'Aloisio, Chief Executive Officer & Managing Director, ASX Australian Shareholders' Association Conference, Australian Stock Exchange.

Dennis, P., Weston, J., 2001. Who's informed: an analysis of information and ownership structure. Working paper, Rice University.

Ellul, A., Holden, C.W., Jain, P., Jennings, R., 2007. Order dynamics: recent evidence from the NYSE. Journal of Empirical Finance, forthcoming.

Foucault, T., 1999. Price formation in a dynamic limit order market. Journal of Financial Markets 2, 99-134.

Foucault, T., Moinas, S., Theissen, E., 2007. Does anonymity matter in electronic limit order markets? Review of Financial Studies, forthcoming.

Garfinkel, J.A., Nimalendran, M., 2003. Market structure and trader anonymity: an analysis of insider trading. Journal of Financial and Quantitative Analysis 38, 591-610.

Glosten, L.R., 1994. Is an electronic open limit order book inevitable? Journal of Finance 49, 1127-1161.

Glosten, L.R., 1999. Introductory comments: Bloomfield and O'Hara, and Flood, Huisman, Koedijk and Mahieu. Review of Financial Studies 12, 1-3.

Grammig, J., Schiereck, D., Theissen, E., 2001. Knowing me, knowing you: trader anonymity and informed trading in parallel markets. Journal of Financial Markets 4, 385-412.

Griffiths, M.D., Smith, B., Turnbull, D.A.S., White, R.W., 2000. The costs and determinants of order aggressiveness. Journal of Financial Economics 56, 65-88.

Haig, A., Hilan, M., Williams, C., 2006. Impact of broker anonymity. Working paper, UBS investment research.

Hall, A.D., Hautsch, N., 2006. Order aggressiveness and order book dynamics. Empirical Economics 30, 973-1005.

Handa, P., Schwartz, R.A., 1996. Limit order trading. Journal of Finance 51, 1835-1861.

Handa, P., Schwartz, R.A., Tiwari, A., 2003. Quote setting and price formation in an order driven market. Journal of Financial Markets 6, 461-489.

Harris, L., 1998. Optimal dynamic order submission strategies in some stylized trading problems. Financial Markets, Institutions and Instruments 7, 1-75.

Harris, L., Hasbrouck, J., 1996. Market vs. limit orders: the SuperDOT evidence on order submission strategy. Journal of Financial and Quantitative Analysis 31, 213-231.

Hasbrouck, J., Saar, G., 2002. Limit orders and volatility in a hybrid market: the Island ECN. Working paper, Stern Business School, New York University.

Heidle, H.G., Huang, R.D., 2002. Information-based trading in dealer and auction market: an analysis of exchange listings. Journal of Financial and Quantitative Analysis 37, 394-424.

Hollifield, B., Miller, R.A., Sandas, P., Slive, J., 2006. Estimating the gains from trade in limit-order markets. Journal of Finance 61, 2753-2804.

Jain, P., 2003. Institutional design and liquidity at stock exchanges around the world. Working paper, University of Memphis.

Jones, C.M., Lipson, M.L., 2003. Are retail orders different? Working paper, Columbia University.

Keim, D.B., Madhavan, M., 1995. Anatomy of the trading process: empirical evidence on the behavior of institutional traders. Journal of Financial Economics 37, 371-398.

Madhavan. A., 1992. Securities prices and market transparency. Journal of Financial Intermediation 5, 255-283.

Madhavan. A., Porter, D., Weaver, D., 2005. Should securities markets be transparent? Journal of Financial Markets 8, 266-288.

Pagano, M., Roell, A., 1996. Transparency and liquidity: a comparison of auction and dealer markets with informed trading. Journal of Finance 51, 579-611.

Parlour, C., 1998. Price dynamics in limit order markets. Review of Financial Studies 11, 789-816.

Ranaldo, A., 2004. Order aggressiveness in limit order book markets. Journal of Financial Markets 7, 53-74.

Reiss, P.C., Werner, I.M., 2004. Anonymity, adverse selection and the sorting of interdealer trades. Review of Financial Studies 18, 599-636.

Securities and Derivatives Industry Association, 2007. Attitudes towards disclosure of broker ID in trades conducted on the ASX. Working paper, Australian Research Group.

Simaan, Y., Weaver, D.G., Whitcomb, D.K., 2003. Market maker quotation behavior and pretrade transparency. Journal of Finance 58, 1247-1267.

Szewczyk, S., Tsetsekos, G., Varma, R., 1992. Institutional ownership and the liquidity of common stock offerings. The Financial Review 27, 211-225.

Theissen, E., 2002. Floor versus screen trading: evidence from the German stock market. Journal of Institutional and Theoretical Economics 158, 32-54.

Verhoeven, P., Ching, S., Ng, H.G., 2004. Determinants of the decision to submit market or limit orders on the ASX. Pacific-Basin Finance Journal 12, 1-18.

Wald, J.K., Horrigan, H.T., 2005. Optimal limit order choice. Journal of Business 78, 597-619.

Appendix: Order aggressiveness classification

This appendix provides details on the order aggressiveness classification scheme applied in the current study. Consistent with Biais et al. (1995), we classify orders into six aggressiveness levels. Category 1 orders are buy (sell) orders with the prices greater (less) than the best ask (bid) quotes and the size of the orders exceeds the market depth at the best ask (bid) quote. Category 2 orders are buy (sell) orders with prices equal to the best ask (bid) quotes and demand more volume than the market depth at the best ask (bid) quote. Category 3 orders are orders with price equal to the opposite best quote and demand less volume than the market depth at the best opposite quote. Category 4 and 5 orders are limit orders within and at the prevailing quotes, respectively. Category 6 orders are buy (sell) orders with prices less (greater) than the best bid (ask) quotes. For example, consider stock AAA, which has the best bid (ask) quote at time t of B_1 (A_1) and the market depth available at this quote is V_{B1} (V_{A1}). We determine the order aggressiveness level ($OA_{i,t}$) of the incoming order i at time t with price P_i and size V_i as follows:

For buy orders: $OA_{i,t} = \begin{cases} 1 \text{ if } P_i > A_1 \ \& V_i > V_{A1} \\ 2 \text{ if } P_i = A_1 \ \& V_i > V_{A1} \\ 3 \text{ if } P_i = A_1 \ \& V_i \leq V_{A1} \\ 4 \text{ if } A_1 > P_i > B_1 \\ 5 \text{ if } P_i = B_1 \\ 6 \text{ if } P_i < B_1 \end{cases}$

For sell orders: $OA_{i,t} = \begin{cases} 1 \text{ if } P_i < B_1 \ \& V_i > V_{B1} \\ 2 \text{ if } P_i = B_1 \ \& V_i > V_{B1} \\ 3 \text{ if } P_i = B_1 \ \& V_i \leq V_{B1} \\ 4 \text{ if } A_1 > P_i > B_1 \\ 5 \text{ if } P_i = A_1 \\ 6 \text{ if } P_i > A_1 \end{cases}$

Table 1: Descriptive statistics of order submissions

This table presents summary statistics of the order submissions for the institutional and individual orders in this study. The sample period is between 1 August 2005 and 31 March 2006, totalling 171 trading days. Following Biais et al. (1995), orders are classified into six aggressiveness levels. Category 1 orders are buy (sell) orders with the prices greater (less) than the best ask (bid) quotes and the order size exceeds the market depth at the best ask (bid) quote. Category 2 orders are buy (sell) orders with prices equal to the best ask (bid) quotes and demand more volume than the market depth at the best ask (bid) quote. Category 3 orders are orders with price equal to the opposite best quote and demand less volume than the market depth at the best opposite quote. Category 4 and 5 orders are limit orders within and at the prevailing quotes, respectively. Category 6 orders are buy (sell) orders with prices less (greater) than the best bid (ask) quotes. "Frequency" is the number of orders submitted at a particular aggressiveness level. "% of all orders" is the percentage of the number of orders in a particular order aggressiveness level over all orders. "Order size" is the average number of shares submitted in an order. "Depth at best same (opposite)" is the average number of shares at the best same-side (opposite-site) quote at the time of order submission. "Depth at same (opposite)" is the average number of shares at the 10 best same-side (opposite-side) quote at the time of order submission. "Relative spread" is the average relative spread, which is calculated as the bid ask spread over the bid-ask midpoint, at the time of the order submission. "Volatility" is the average volatility, which is calculated as the standard deviation of the most recent 20 mid-quote returns at the time of order submission multiplied by 100.

Panel A: Institutional orders

Aggressiveness Level	Frequency	% of all orders	Order Size	Depth at best same	Depth at best opposite	Depth at same	Depth at opposite	Relative Spread	Volatility
1	109,097	1.51%	6,913	7,492	1,647	67,648	62,783	0.1974	0.0187
2	531,215	7.37%	16,232	26,536	7,256	192,121	183,360	0.1154	0.0343
3	1,691,793	23.47%	4,150	52,741	42,792	387,009	378,632	0.1725	0.0309
4	741,463	10.29%	2,708	9,508	9,053	77,498	77,738	0.2907	0.0414
5	2,827,552	39.23%	4,577	36,230	45,792	352,889	354,237	0.1562	0.0338
6	1,306,194	18.12%	5,501	16,768	22,653	183,594	189,667	0.1676	0.0258

Panel B: Individual orders

Aggressiveness Level	Frequency	% of all orders	Order Size	Depth at best same	Depth at best opposite	Depth at same	Depth at opposite	Relative Spread	Volatility
1	159,935	1.73%	6,533	9,458	1,708	88,605	80,792	0.2031	0.0248
2	524,809	5.69%	11,649	26,167	5,294	198,326	181,578	0.1353	0.0396
3	2,198,717	23.82%	4,009	97,022	80,293	739,030	712,801	0.1691	0.0295
4	713,470	7.73%	3,103	11,813	10,401	91,927	90,202	0.3495	0.0475
5	2,525,904	27.36%	5,382	62,758	76,078	587,172	592,409	0.2082	0.0395
6	3,108,052	33.67%	8,935	52,632	59,792	511,331	509,305	0.2023	0.0351

Table 2: The distribution of order aggressiveness levels over the trading day

This table presents the distribution of order aggressiveness level over the trading day. Following Biais et al. (1995), order are classified into six aggressiveness levels. Category 1 orders are buy (sell) orders with the prices greater (less) than the best ask (bid) quotes and the order size exceeds the market depth at the best ask (bid) quote. Category 2 orders are buy (sell) orders with prices equal to the best ask (bid) quotes and demand more volume than the market depth at the best ask (bid) quote. Category 3 orders are orders with price equal to the opposite best quote and demand less volume than the market depth at the best opposite quote. Category 4 and 5 orders are limit orders within and at the prevailing quotes, respectively. Category 6 orders are buy (sell) orders with prices less (greater) than the best bid (ask) quotes. Orders with aggressiveness levels from 1 to 3 are market orders and orders with aggressiveness levels from 4 to 6 are limit orders. The trading day is divided into six intervals: 10:10 am-11:00 am, 11:00 am-12:00 pm, 12:00 pm-1:00 pm, 1:00 pm-2:00pm, 2:00 pm-3:00pm and 3:00pm-4:00 pm. "MO" ("LO") refers to the total number of market (limit) orders in a particular interval. "Total" is the total number of orders submitted in a particular interval. "% MO" ("% LO") is the percentage of market (limit) orders out of all orders submitted in a particular interval.

Panel A: Institutional orders

Interval	Levels of order aggressiveness						MO	LO	Total	% MO	% LO
	1	2	3	4	5	6					
10.10 am-11:00 am	21,943	113,479	314,930	170,333	468,445	206,327	450,352	845,105	1,295,457	34.76%	65.24%
11:00 am-12:00 pm	29,904	88,591	294,694	140,510	429,819	251,380	413,189	821,709	1,234,898	33.46%	66.54%
12:00 pm-1:00 pm	12,031	56,689	197,752	83,601	351,399	188,706	266,472	623,706	890,178	29.93%	70.07%
1:00 pm-2:00pm	6,661	35,564	152,441	60,981	310,315	147,939	194,666	519,235	713,901	27.27%	72.73%
2:00 pm-3:00pm	17,067	93,636	284,888	121,778	556,481	227,619	395,591	905,878	1,301,469	30.40%	69.60%
3:00pm-4:00 pm	21,491	143,256	447,088	164,260	711,093	284,223	611,835	1159,576	1,771,411	34.54%	65.46%

Panel B: Individual orders

Interval	Levels of order aggressiveness						MO	LO	Total	% MO	% LO
	1	2	3	4	5	6					
10.10 am-11:00 am	37,639	114,474	429,256	174,945	511,381	728,550	581,369	1,414,876	1,996,245	29.12%	70.88%
11:00 am-12:00 pm	39,242	88,731	399,647	131,958	417,144	629,005	527,620	1,178,107	1,705,727	30.93%	69.07%
12:00 pm-1:00 pm	20,453	62,788	295,059	90,382	342,058	433,258	378,300	865,698	1,243,998	30.41%	69.59%
1:00 pm-2:00pm	14,277	42,032	220,244	62,354	260,894	314,822	276,553	638,070	914,623	30.24%	69.76%
2:00 pm-3:00pm	20,109	85,691	351,401	104,574	417,444	450,128	457,201	972,146	1,429,347	31.99%	68.01%
3:00pm-4:00 pm	28,215	131,093	503,110	149,257	576,983	552,289	662,418	1,278,529	1,940,947	34.13%	65.87%

Table 3: Anonymity and the distribution of order aggressiveness

This table presents the distribution of institutional and individual order aggressiveness for two periods: Pre-Anonymity (before 28 November 2005) and Post-Anonymity (from 28 November 2005 onwards). Following Biais et al. (1995), order are classified into six aggressiveness levels. Category 1 orders are buy (sell) orders with the prices greater (less) than the best ask (bid) quotes and the order size exceeds the market depth at the best ask (bid) quote. Category 2 orders are buy (sell) orders with prices equal to the best ask (bid) quotes and demand more volume than the market depth at the best ask (bid) quote. Category 3 orders are orders with price equal to the opposite best quote and demand less volume than the market depth at the best opposite quote. Category 4 and 5 orders are limit orders within and at the prevailing quotes, respectively. Category 6 orders are buy (sell) orders with prices less (greater) than the best bid (ask) quotes. "% Inst. orders" and "% Indi. orders" refers to the percentage out of all institutional and individual orders, respectively.

Panel A: Institutional orders

Aggressiveness Level	Large Cap Stocks				Mid Cap Stocks				Small Cap Stocks			
	Pre-Anonymity		Post-Anonymity		Pre-Anonymity		Post-Anonymity		Pre-Anonymity		Post-Anonymity	
	Frequency	% Inst. orders	Frequency	% Inst. orders	Frequency	% Inst. orders	Frequency	% Inst. orders	Frequency	% Inst. orders	Frequency	% Inst. orders
1	21,145	1.06%	32,641	1.23%	17,274	2.14%	18,674	1.65%	8,618	3.17%	10,745	3.07%
2	183,110	9.15%	212,325	8.03%	47,162	5.85%	58,258	5.14%	13,543	4.99%	16,817	4.80%
3	439,600	21.96%	548,787	20.75%	205,405	25.49%	285,590	25.19%	88,938	32.74%	123,473	35.25%
4	205,911	10.29%	241,968	9.15%	98,173	12.18%	115,737	10.21%	38,816	14.29%	40,858	11.67%
5	816,715	40.80%	1,128,554	42.68%	291,641	36.20%	420,792	37.12%	69,423	25.56%	100,427	28.67%
6	335,372	16.75%	479,876	18.15%	146,080	18.13%	234,619	20.70%	52,317	19.26%	57,930	16.54%

Panel B: Individual orders

Aggressiveness Level	Large Cap Stocks				Mid Cap Stocks				Small Cap Stocks			
	Pre-Anonymity		Post-Anonymity		Pre-Anonymity		Post-Anonymity		Pre-Anonymity		Post-Anonymity	
	Frequency	% Indi. orders	Frequency	% Indi. orders	Frequency	% Indi. orders	Frequency	% Indi. orders	Frequency	% Indi. orders	Frequency	% Indi. orders
1	37,473	1.42%	44,767	1.45%	24,250	2.36%	22,774	1.64%	14,663	3.17%	16,008	2.51%
2	172,831	6.55%	180,721	5.87%	54,831	5.33%	65,051	4.70%	23,731	5.13%	27,644	4.34%
3	740,285	28.04%	776,187	25.22%	221,499	21.53%	263,803	19.05%	91,833	19.85%	105,110	16.51%
4	210,613	7.98%	200,577	6.52%	100,698	9.79%	95,328	6.88%	54,681	11.82%	51,573	8.10%
5	672,830	25.48%	819,425	26.63%	334,911	32.56%	395,509	28.56%	142,831	30.87%	160,398	25.20%
6	806,235	30.54%	1,055,936	34.31%	292,475	28.43%	542,566	39.17%	134,955	29.17%	275,885	43.34%

Table 4: The determinants of institutional & individual order aggressiveness

This table presents results of investigating the determinants of institutional and individual investors' order aggressiveness. We estimate the following ordered probit model for institutional and individual orders: $Z_i = \beta_1 \text{Depth}_{same,i} + \beta_2 \text{Depth}_{opposite,i} + \beta_3 \text{Spread}_i + \beta_4 \text{Volatility}_i + \beta_5 \text{FirstInt}_i + \beta_6 \text{Size}_i + \beta_7 \text{Direction}_i + \beta_8 \text{Anonymous}_i + \varepsilon_i$, where Z_i is the latent order aggressiveness, $\text{Depth}_{same,i}$ ($\text{Depth}_{opposite,i}$) is the natural logarithm of the same-side (opposite-side) market depth, in term of number of shares, at the time of order submission. Spread_i is the relative bid-ask spread at the time of the order submission. Volatility_i is defined as the standard deviation of the 20 most recent mid-quote returns multiplied by 100. FirstInt_i is the dummy variable for the first trading hour of the trading day. Direction_i and Anonymous_i is the dummy variable for sell orders and for orders submitted from 28 November 2005 onwards, respectively. Size_i is the natural logarithm of the number of shares in the particular order. "Coeff" refers to the average of the estimated coefficients. % t-stat > 1.96 (% t-stat < -1.96) refers to the percentage of coefficients that is positive (negative) and significant at the 5% level.

Panel A: Institutional orders

	Large Cap Stocks			Mid Cap Stocks			Small Cap Stocks		
	Coeff	% t-stat > 1.96	% t-stat < -1.96	Coeff	% t-stat > 1.96	% t-stat < -1.96	Coeff	% t-stat > 1.96	% t-stat < -1.96
Depth_{same}	-0.0823	0%	100.00%	-0.0686	13.33%	80.00%	-0.0687	20.00%	66.67%
$\text{Depth}_{opposite}$	0.1002	96.67%	0%	0.1138	90.00%	6.67%	0.0412	43.33%	13.33%
Spread	0.5522	86.67%	6.67%	0.1654	70.00%	3.33%	0.1394	86.67%	3.33%
Volatility	-0.3840	33.33%	66.67%	0.1141	50.00%	26.67%	-0.0408	13.33%	26.67%
FirstInt	-0.1081	0%	100.00%	-0.0699	6.67%	90.00%	-0.0275	10.00%	46.67%
Size	-0.1197	3.33%	96.67%	-0.0411	10.00%	90.00%	0.0385	66.67%	30.00%
Direction	-0.0038	36.67%	40.00%	-0.0066	26.67%	50.00%	-0.0309	30.00%	46.67%
Anonymous	0.0341	63.33%	20.00%	0.0338	50.00%	26.67%	0.0160	56.67%	20.00%

Panel B: Individual orders

	Large Cap Stocks			Mid Cap Stocks			Small Cap Stocks		
	Coeff	% t-stat > 1.96	% t-stat < -1.96	Coeff	% t-stat > 1.96	% t-stat < -1.96	Coeff	% t-stat > 1.96	% t-stat < -1.96
Depth_{same}	-0.0856	0%	96.67%	-0.0632	0%	76.67%	-0.1123	3.33%	83.33%
$\text{Depth}_{opposite}$	0.0599	86.67%	6.67%	0.0431	76.67%	10.00%	0.0718	50.00%	10.00%
Spread	1.0103	93.33%	3.33%	0.0420	46.67%	33.33%	-0.0425	20.00%	50.00%
Volatility	-0.9454	33.33%	36.67%	0.0024	40.00%	16.67%	-0.1152	6.67%	50.00%
FirstInt	0.0544	93.33%	0%	0.0189	63.33%	6.67%	0.0483	73.33%	3.33%
Size	0.0260	60.00%	30.00%	0.0349	73.33%	16.67%	0.0402	73.33%	13.33%
Direction	0.0032	50.00%	26.67%	0.0003	40.00%	43.33%	-0.0474	20.00%	53.33%
Anonymous	0.0937	90.00%	3.33%	0.1555	96.67%	3.33%	0.2789	93.33%	6.67%

Table 5: The determinants of institutional buy and sell order aggressiveness

This table presents results of investigating the determinants of institutional investors' buy and sell order aggressiveness. We estimate the following ordered probit model for institutional investors' buy and sell orders: $Z_i = \beta_1 \text{Depth}_{same,i} + \beta_2 \text{Depth}_{opposite,i} + \beta_3 \text{Spread}_i + \beta_4 \text{Volatility}_i + \beta_5 \text{FirstInt}_i + \beta_6 \text{Size}_i + \beta_7 \text{Anonymous}_i + \varepsilon_i$, where Z_i is the latent order aggressiveness, $\text{Depth}_{same,i}$ ($\text{Depth}_{opposite,i}$) is the natural logarithm of the same-side (opposite-side) market depth, in term of number of shares, at the time of order submission. Spread_i is the relative bid-ask spread at the time of the order submission. Volatility_i is defined as the standard deviation of the 20 most recent mid-quote returns multiplied by 100. FirstInt_i is the dummy variable for the first hour of the trading day. Size_i is the natural logarithm of the number of shares in the particular order. Anonymous_i is the dummy variable for orders submitted from 28 November 2005 onwards. "Coeff" refers to the average of the estimated coefficients. % t-stat > 1.96 (% t-stat < -1.96) refers to the percentage of coefficients that is positive (negative) and significant at the 5% level.

Panel A: Institutional buy orders

	Large Cap Stocks			Mid Cap Stocks			Small Cap Stocks		
	Coeff	% t-stat > 1.96	% t-stat < -1.96	Coeff	% t-stat > 1.96	% t-stat < -1.96	Coeff	% t-stat > 1.96	% t-stat < -1.96
Depth$_{same}$	-0.0767	0%	90.00%	-0.0673	20.00%	63.33%	-0.0413	16.67%	56.67%
Depth$_{opposite}$	0.1016	100.00%	0%	0.1350	70.00%	3.33%	0.0794	66.67%	10.00%
Spread	0.6356	80.00%	6.67%	0.1979	66.67%	13.33%	0.1500	83.33%	10.00%
Volatility	-0.2759	26.67%	53.33%	0.2095	60.00%	26.67%	-0.0371	33.33%	33.33%
FirstInt	-0.1108	3.33%	96.67%	-0.0668	6.67%	80.00%	-0.0519	10.00%	56.67%
Size	-0.1109	3.33%	96.67%	-0.0317	10.00%	90.00%	0.0498	70.00%	16.67%
Anonymous	0.0273	46.67%	33.33%	0.0330	50.00%	30.00%	0.0454	53.33%	20.00%

Panel B: Institutional sell orders

	Large Cap Stocks			Mid Cap Stocks			Small Cap Stocks		
	Coeff	% t-stat > 1.96	% t-stat < -1.96	Coeff	% t-stat > 1.96	% t-stat < -1.96	Coeff	% t-stat > 1.96	% t-stat < -1.96
Depth$_{same}$	-0.0897	0%	96.67%	-0.0846	0%	70.00%	-0.1290	16.67 %	70.00%
Depth$_{opposite}$	0.1024	100.00%	0%	0.0976	73.33%	20.00%	0.0161	36.67 %	36.67%
Spread	0.4833	76.67%	6.67%	0.1333	63.33%	13.33%	0.1348	76.67 %	3.33%
Volatility	-0.5032	33.33%	60.00%	-0.0104	50.00%	30.00%	-0.0396	23.33 %	23.33%
FirstInt	-0.1043	3.33%	96.67%	-0.0716	6.67%	76.67%	-0.0035	26.67 %	26.67%
Size	-0.1290	3.33%	96.67%	-0.0524	6.67%	86.67%	0.0234	46.67 %	36.67%
Anonymous	0.0413	66.67%	16.67%	0.0415	56.67%	26.67%	-0.0006	43.33 %	26.67%

Table 6: The determinants of individual buy and sell order aggressiveness

This table presents results of investigating the determinants of individual investors' buy and sell order aggressiveness. We estimate the following ordered probit model for individual investors' buy and sell orders: $Z_i = \beta_1 \text{Depth}_{same,i} + \beta_2 \text{Depth}_{opposite,i} + \beta_3 \text{Spread}_i + \beta_4 \text{Volatility}_i + \beta_5 \text{FirstInt}_i + \beta_6 \text{Size}_i + \beta_7 \text{Anonymous}_i + \varepsilon_i$, where Z_i is the latent order aggressiveness, $\text{Depth}_{same,i}$ ($\text{Depth}_{opposite,i}$) is the natural logarithm of the same-side (opposite-side) market depth, in term of number of shares, at the time of order submission. Spread_i is the relative bid-ask spread at the time of the order submission. Volatility_i is defined as the standard deviation of the 20 most recent mid-quote returns multiplied by 100. FirstInt_i is the dummy variable for the first hour of the trading day. Size_i is the natural logarithm of the number of shares in the particular order. Anonymous_i is the dummy variable for orders submitted from 28 November 2005 onwards. "Coeff" refers to the average of the estimated coefficients. % t-stat > 1.96 (% t-stat < -1.96) refers to the percentage of coefficients that is positive (negative) and significant at the 5% level.

Panel A: Individual buy orders

	Large Cap Stocks			Mid Cap Stocks			Small Cap Stocks		
	Coeff	% t-stat > 1.96	% t-stat < -1.96	Coeff	% t-stat > 1.96	% t-stat < -1.96	Coeff	% t-stat > 1.96	% t-stat < -1.96
Depth_{same}	-0.0875	0%	90.00%	-0.1078	13.33%	66.67%	-0.1064	10.00%	70.00%
$\text{Depth}_{opposite}$	0.0670	80.00%	10.00%	0.0547	63.33%	20.00%	0.0920	60.00%	10.00%
Spread	1.1959	90.00%	3.33%	0.1150	60.00%	33.33%	-0.0295	23.33%	43.33%
Volatility	-0.8287	33.33%	30.00%	-0.0079	53.33%	30.00%	-0.0415	20.00%	36.67%
FirstInt	0.0412	80.00%	3.33%	0.0329	53.33%	10.00%	0.0568	60.00%	10.00%
Size	0.0211	63.33%	36.67%	0.0430	76.67%	10.00%	0.0418	80.00%	13.33%
Anonymous	0.0993	86.67%	13.33%	0.2585	96.67%	0%	0.2979	90.00%	3.33%

Panel B: Individual sell orders

	Large Cap Stocks			Mid Cap Stocks			Small Cap Stocks		
	Coeff	% t-stat > 1.96	% t-stat < -1.96	Coeff	% t-stat > 1.96	% t-stat < -1.96	Coeff	% t-stat > 1.96	% t-stat < -1.96
Depth_{same}	-0.0904	6.67%	83.33%	-0.0860	10.00%	80.00%	-0.1377	6.67%	70.00%
$\text{Depth}_{opposite}$	0.0564	83.33%	6.67%	0.0696	73.33%	16.67%	0.0672	53.33%	16.67%
Spread	0.8008	90.00%	0%	-0.0178	26.67%	36.67%	-0.0497	26.67%	43.33%
Volatility	-1.0234	33.33%	36.67%	-0.0387	33.33%	40.00%	-0.2086	13.33%	53.333%
FirstInt	0.0669	90.00%	0%	0.0230	53.33%	16.67%	0.0399	60.00%	13.33%
Size	0.0308	63.33%	26.67%	0.0555	80.00%	13.33%	0.0409	70.00%	20.00%
Anonymous	0.0930	86.67%	10.00%	0.1865	96.67%	0%	0.2605	93.33%	6.67%

Table 7: The determinants of institutional order aggressiveness in transparent and anonymous market

This table presents results of investigating the determinants of institutional investors' order aggressiveness in transparent and anonymous market. We estimate the following ordered probit model for institutional investors' orders: $Z_i = \beta_1 \text{Depth}_{same,i} + \beta_2 \text{Depth}_{opposite,i} + \beta_3 \text{Spread}_i + \beta_4 \text{Volatility}_i + \beta_5 \text{FirstInt}_i + \beta_6 \text{Size}_i + \beta_7 \text{Direction}_i + \varepsilon_i$, where Z_i is the latent order aggressiveness, $\text{Depth}_{same,i}$ ($\text{Depth}_{opposite,i}$) is the natural logarithm of the same-side (opposite-side) market depth, in term of number of shares, at the time of order submission. Spread_i is the relative bid-ask spread at the time of the order submission. Volatility_i is defined as the standard deviation of the 20 most recent mid-quote returns multiplied by 100. FirstInt_i is the dummy variable for the first hour of the trading day. Size_i is the natural logarithm of the number of shares in the particular order. Direction_i is the dummy variable for sell orders. "Coeff" refers to the average of the estimated coefficients. % t-stat > 1.96 (% t-stat < -1.96) refers to the percentage of coefficients that is positive (negative) and significant at the 5% level.

Panel A: Transparent market

	Large Cap Stocks			Mid Cap Stocks			Small Cap Stocks		
	Coeff	% t-stat > 1.96	% t-stat < -1.96	Coeff	% t-stat > 1.96	% t-stat < -1.96	Coeff	% t-stat > 1.96	% t-stat < -1.96
Depth_{same}	-0.0481	10.00%	66.67%	-0.0373	26.67%	46.67%	-0.1090	13.33%	56.67%
$\text{Depth}_{opposite}$	0.1002	96.67%	0%	0.0995	66.67%	3.33%	0.0782	63.33%	3.33%
Spread	0.6383	83.33%	6.67%	0.1615	60.00%	20.00%	0.1203	80.00%	10.00%
Volatility	-0.6394	23.33%	70.00%	0.0065	40.00%	23.33%	-0.0881	10.00%	26.67%
FirstInt	-0.1046	0%	90.00%	-0.0429	13.33%	66.67%	0.0173	23.33%	13.33%
Size	-0.1301	0%	100.00%	-0.0509	6.67%	90.00%	0.0282	53.33%	26.67%
Direction	-0.0113	26.67%	60.00%	-0.0129	33.33%	50.00%	-0.0083	23.33%	43.33%

Panel B: Anonymous market

	Large Cap Stocks			Mid Cap Stocks			Small Cap Stocks		
	Coeff	% t-stat > 1.96	% t-stat < -1.96	Coeff	% t-stat > 1.96	% t-stat < -1.96	Coeff	% t-stat > 1.96	% t-stat < -1.96
Depth_{same}	-0.1141	0%	100.00%	-0.1022	6.67%	83.33%	-0.0621	16.67%	56.67%
$\text{Depth}_{opposite}$	0.1036	96.67%	0%	0.1261	76.67%	10.00%	0.0257	46.67%	20.00%
Spread	0.5243	83.33%	3.33%	0.1881	83.33%	3.33%	0.1815	83.33%	0%
Volatility	-0.1521	33.33%	56.67%	0.2163	46.67%	16.67%	0.0369	30.00%	23.33%
FirstInt	-0.1117	3.33%	96.67%	-0.0938	0%	93.33%	-0.0735	6.67%	63.33%
Size	-0.1118	3.33%	96.67%	-0.0334	10.00%	86.67%	0.0468	73.33%	20.00%
Direction	0.0033	40.00%	36.67%	-0.0029	33.33%	50.00%	-0.0361	30.00%	46.67%

Table 8: The determinants of individual order aggressiveness in transparent and anonymous market

This table presents results of investigating the determinants of individual investors' order aggressiveness in transparent and anonymous market. We estimate the following ordered probit model for institutional investors' orders: $Z_i = \beta_1 \text{Depth}_{same,i} + \beta_2 \text{Depth}_{opposite,i} + \beta_3 \text{Spread}_i + \beta_4 \text{Volatility}_i + \beta_5 \text{FirstInt}_i + \beta_6 \text{Size}_i + \beta_7 \text{Direction}_i + \varepsilon_i$, where Z_i is the latent order aggressiveness, $\text{Depth}_{same,i}$ ($\text{Depth}_{opposite,i}$) is the natural logarithm of the same-side (opposite-side) market depth, in term of number of shares, at the time of order submission. Spread_i is the relative bid-ask spread at the time of the order submission. Volatility_i is defined as the standard deviation of the 20 most recent mid-quote returns multiplied by 100. FirstInt_i is the dummy variable for the first hour of the trading day. Size_i is the natural logarithm of the number of shares in the particular order. Direction_i is the dummy variable for sell orders. "Coeff" refers to the average of the estimated coefficients. % t-stat > 1.96 (% t-stat < -1.96) refers to the percentage of coefficients that is positive (negative) and significant at the 5% level.

Panel A: Transparent market

	Large Cap Stocks			Mid Cap Stocks			Small Cap Stocks		
	Coeff	% t-stat > 1.96	% t-stat < -1.96	Coeff	% t-stat > 1.96	% t-stat < -1.96	Coeff	% t-stat > 1.96	% t-stat < -1.96
Depth$_{same}$	-0.0788	0%	93.33%	-0.0766	10.00%	76.67%	-0.1340	6.67%	73.33%
Depth$_{opposite}$	0.0614	86.67%	6.67%	0.0550	60.00%	6.67%	0.1147	66.67%	10.00%
Spread	0.9082	90.00%	6.67%	-0.0003	10.00%	40.00%	0.0061	40.00%	33.33%
Volatility	-0.9172	20.00%	36.67%	0.0805	46.67%	16.67%	-0.0562	16.67%	30.00%
FirstInt	0.0387	60.00%	0%	0.0073	36.67%	33.33%	0.0218	33.33%	6.67%
Size	-0.0373	16.67%	80.00%	-0.0469	13.33%	76.67%	-0.0205	26.67%	60.00%
Direction	0.0118	50.00%	30.00%	0.0339	93.33%	30.00%	-0.0286	33.33%	53.33%

Panel B: Anonymous market

	Large Cap Stocks			Mid Cap Stocks			Small Cap Stocks		
	Coeff	% t-stat > 1.96	% t-stat < -1.96	Coeff	% t-stat > 1.96	% t-stat < -1.96	Coeff	% t-stat > 1.96	% t-stat < -1.96
Depth$_{same}$	-0.0959	3.33%	93.33%	-0.1105	3.33%	86.67%	-0.1128	10.00%	76.67%
Depth$_{opposite}$	0.0588	86.67%	6.67%	0.0639	66.67%	6.67%	0.0555	40.00%	36.67%
Spread	1.0783	93.33%	6.67%	0.0895	50.00%	26.67%	-0.0954	10.00%	76.67%
Volatility	-0.9364	40.00%	36.67%	-0.1279	30.00%	33.33%	-0.1467	6.67%	36.67%
FirstInt	0.0608	86.67%	3.33%	0.0459	76.67%	6.67%	0.0642	76.67%	0%
Size	0.0685	83.33%	16.67%	0.1111	100.00%	0%	0.0877	100.00%	0%
Direction	-0.0066	40.00%	33.33%	-0.0256	33.33%	53.33%	-0.0527	16.67%	53.33%

Table 9: Marginal probabilities for large cap stocks

This table presents results of the marginal probabilities based on the investigation of institutional and individual investors' order aggressiveness in large cap stocks in transparent and anonymous market. We estimate following ordered probit model: $Z_i = \beta_1 \text{Depth}_{same,i} + \beta_2 \text{Depth}_{opposite,i} + \beta_3 \text{Spread}_i + \beta_4 \text{Volatility}_i + \beta_5 \text{FirstInt}_i + \beta_6 \text{Size}_i + \beta_7 \text{Direction}_i + \varepsilon_i$. The marginal probabilities are calculated as follows: $\delta \Pr[R=1]/\delta x = -\phi(\mu_1 - x'\beta)\beta$, $\delta \Pr[R=m]/\delta x = [\phi(\mu_{m-1} - x'\beta) - \phi(\mu_m - x'\beta)]\beta$ for m = 2,3,4,5 and $\delta \Pr[R=6]/\delta x = \phi(\mu_5 - x'\beta)\beta$, where $\phi(.)$ is the density normal distribution, β (s) are the coefficient estimates and $\mu_1, \mu_2, \mu_3, \mu_4, \mu_5$ are the intercept parameters (limit points) estimated in the ordered probit equation.

Panel A: Institutional orders

| | Transparent market | | | | | | Anonymous market | | | | | |
| | Levels of Order Aggressiveness | | | | | | Levels of Order Aggressiveness | | | | | |
	1	2	3	4	5	6	1	2	3	4	5	6
Depth$_{same}$	0.0012	0.0065	0.0089	0.0016	-0.0067	-0.0115	0.0024	0.0133	0.0230	0.0032	-0.0147	-0.0272
Depth$_{opposite}$	-0.0022	-0.0138	-0.0186	-0.0029	0.0143	0.0232	-0.0022	-0.0124	-0.0207	-0.0029	0.0138	0.0244
Spread	-0.0163	-0.0999	-0.1027	-0.0199	0.0819	0.1569	-0.0142	-0.0733	-0.0883	-0.0179	0.0580	0.1357
Volatility	0.0237	0.1118	0.0792	0.0289	-0.0614	-0.1822	0.0288	0.0450	-0.0462	0.0334	0.0670	-0.1280
FirstInt	0.0024	0.0146	0.0189	0.0032	-0.0146	-0.0245	0.0029	0.0141	0.0209	0.0036	-0.0152	-0.0263
Size	0.0029	0.0182	0.0237	0.0038	-0.0185	-0.0301	0.0029	0.0146	0.0202	0.0039	-0.0152	-0.0264
Direction	1.61×10^{-5}	0.0016	0.0023	7.91×10^{-5}	-0.0021	-0.0018	-0.0002	-0.0013	0.0002	-0.0001	0.0008	0.0006

Panel B: Individual orders

| | Transparent market | | | | | | Anonymous market | | | | | |
| | Levels of Order Aggressiveness | | | | | | Levels of Order Aggressiveness | | | | | |
	1	2	3	4	5	6	1	2	3	4	5	6
Depth$_{same}$	0.0025	0.0082	0.0179	0.0017	-0.0038	-0.0265	0.0026	0.0085	0.0215	0.0016	-0.0007	-0.0335
Depth$_{opposite}$	-0.0024	-0.0068	-0.0135	-0.0012	0.0033	0.0206	-0.0020	-0.0057	-0.0129	-0.0011	0.0018	0.0199
Spread	-0.0344	-0.1099	-0.1949	-0.0126	0.0445	0.3073	-0.0439	-0.1183	-0.2199	-0.0219	0.0384	0.3656
Volatility	0.0242	0.1073	0.1898	0.0222	0.0033	-0.3468	0.0196	0.0781	0.1431	0.0282	0.0786	-0.3476
FirstInt	-0.0009	-0.0037	-0.0096	-0.0006	0.0013	0.0135	-0.0021	-0.0060	-0.0133	-0.0013	0.0017	0.0210
Size	0.0019	0.0051	0.0067	0.0009	-0.0020	-0.0126	-0.0016	-0.0055	-0.0155	-0.0013	-0.0005	0.0244
Direction	-0.0011	-0.0024	-0.0006	-0.0007	0.0004	0.0044	-0.0002	-0.0003	0.0022	0.0001	0.0006	-0.0024

Table 10: Marginal probabilities for mid cap stocks

This table presents results of the marginal probabilities based on the investigation of institutional and individual investors' order aggressiveness in mid cap stocks in transparent and anonymous market. We estimate following ordered probit model: $Z_i = \beta_1 \text{Depth}_{same,i} + \beta_2 \text{Depth}_{opposite,i} + \beta_3 \text{Spread}_i + \beta_4 \text{Volatility}_i + \beta_5 \text{FirstInt}_i + \beta_6 \text{Size}_i + \beta_7 \text{Direction}_i + \varepsilon_i$. The marginal probabilities are calculated as follows: $\delta \Pr[R=1]/\delta x = -\phi(\mu_1 - x'\beta)\beta$, $\delta \Pr[R=m]/\delta x = [\phi(\mu_{m-1} - x'\beta) - \phi(\mu_m - x'\beta)]\beta$ for m = 2,3,4,5 and $\delta \Pr[R=6]/\delta x = \phi(\mu_5 - x'\beta)\beta$, where $\phi(.)$ is the density normal distribution, β (s) are the coefficient estimates and $\mu_1, \mu_2, \mu_3, \mu_4, \mu_5$ are the intercept parameters (limit points) estimated in the ordered probit equation.

Panel A: Institutional orders

| | Transparent market | | | | | | Anonymous market | | | | | |
| | Levels of Order Aggressiveness | | | | | | Levels of Order Aggressiveness | | | | | |
	1	2	3	4	5	6	1	2	3	4	5	6
Depth$_{same}$	0.0023	0.0036	0.0077	0.0007	-0.0059	-0.0084	0.0035	0.0087	0.0238	0.0023	-0.0144	-0.0239
Depth$_{opposite}$	-0.0055	-0.0091	-0.0206	-0.0025	0.0137	0.0240	-0.0049	-0.0114	-0.0284	-0.0036	0.0164	0.0319
Spread	-0.0081	-0.0169	-0.0341	-0.0039	0.0239	0.0391	-0.0073	-0.0177	-0.0423	-0.0049	0.0292	0.0430
Volatility	0.0078	0.0009	-0.0280	0.0096	0.0457	-0.0360	-0.0014	-0.0216	-0.0851	0.0037	0.1025	0.0019
FirstInt	0.0023	0.0046	0.0091	0.0011	-0.0072	-0.0099	0.0030	0.0088	0.0222	0.0021	-0.0155	-0.0206
Size	0.0027	0.0056	0.0116	0.0009	-0.0103	-0.0105	0.0018	0.0047	0.0090	0.0010	-0.0099	-0.0066
Direction	-0.0003	0.0012	0.0028	0.0007	-0.0008	-0.0036	4.97×10^{-6}	0.0010	-0.0008	0.0002	0.0003	-0.0007

Panel B: Individual orders

| | Transparent market | | | | | | Anonymous market | | | | | |
| | Levels of Order Aggressiveness | | | | | | Levels of Order Aggressiveness | | | | | |
	1	2	3	4	5	6	1	2	3	4	5	6
Depth$_{same}$	0.0039	0.0069	0.0152	0.0029	-0.0047	-0.0242	0.0046	0.0077	0.0197	0.0045	0.0044	-0.0409
Depth$_{opposite}$	-0.0030	-0.0043	-0.0102	-0.0027	0.0024	0.0178	-0.0025	-0.0050	-0.0118	-0.0022	-0.0023	0.0238
Spread	0.0002	-0.0035	-0.0009	0.0019	0.0018	0.0005	-0.0047	-0.0099	-0.0178	-0.0018	-1.70×10^{-5}	0.0342
Volatility	-0.0062	-0.0064	-0.0204	-0.0009	0.0150	0.0189	0.0004	0.0072	0.0203	0.0033	0.0176	-0.0488
FirstInt	0.0002	-0.0008	-0.0020	0.0002	-0.0001	0.0025	-0.0023	-0.0042	-0.0081	-0.0020	-0.0006	0.0172
Size	0.0030	0.0048	0.0083	0.0020	-0.0034	-0.0147	-0.0040	-0.0081	-0.0205	-0.0038	-0.0048	0.0412
Direction	-0.0024	-0.0025	-0.0060	-0.0012	0.0005	0.0116	0.0009	0.0024	0.0041	0.0011	0.0013	-0.0098

Table 11: Marginal probabilities for small cap stocks

This table presents results of the marginal probabilities based on the investigation of institutional and individual investors' order aggressiveness in small cap stocks in transparent and anonymous market. We estimate following ordered probit model: $Z_i = \beta_1 \text{Depth}_{same,i} + \beta_2 \text{Depth}_{opposite,i} + \beta_3 \text{Spread}_i + \beta_4 \text{Volatility}_i + \beta_5 \text{FirstInt}_i + \beta_6 \text{Size}_i + \beta_7 \text{Direction}_i + \varepsilon_i$. The marginal probabilities are calculated as follows: $\delta \Pr[R=1]/\delta x = -\phi(\mu_1 - x'\beta)\beta$, $\delta \Pr[R=m]/\delta x = [\phi(\mu_{m-1} - x'\beta) - \phi(\mu_m - x'\beta)]\beta$ for m = 2,3,4,5 and $\delta \Pr[R=6]/\delta x = \phi(\mu_5 - x'\beta)\beta$, where $\phi(.)$ is the density normal distribution, β (s) are the coefficient estimates and $\mu_1, \mu_2, \mu_3, \mu_4, \mu_5$ are the intercept parameters (limit points) estimated in the ordered probit equation.

Panel A: Institutional orders

| | Transparent market | | | | | | Anonymous market | | | | | |
| | Levels of Order Aggressiveness | | | | | | Levels of Order Aggressiveness | | | | | |
	1	2	3	4	5	6	1	2	3	4	5	6
Depth$_{same}$	0.0067	0.0081	0.0236	0.0005	-0.0130	-0.0259	-0.0006	0.0045	0.0208	0.0011	-0.0101	-0.0157
Depth$_{opposite}$	-0.0057	-0.0062	-0.0177	0.0006	0.0111	0.0179	0.0002	-0.0025	-0.0093	-0.0005	0.0051	0.0070
Spread	-0.0082	-0.0108	-0.0286	0.0011	0.0221	0.0244	-0.0124	-0.0137	-0.0427	0.0007	0.0285	0.0396
Volatility	0.0012	0.0081	0.0177	0.0017	-0.0085	-0.0202	-0.0095	-0.0028	-0.0038	0.0024	0.0179	-0.0042
FirstInt	-0.0005	-0.0013	-0.0041	6.36×10^{-5}	0.0021	0.0038	0.0032	0.0059	0.0198	7.95×10^{-5}	-0.0131	-0.0158
Size	-0.0007	-0.0016	-0.0065	5.30×10^{-5}	0.0023	0.0065	-0.0015	-0.0032	-0.0125	9.75×10^{-5}	0.0075	0.0097
Direction	0.0013	0.0019	0.0041	-0.0008	-0.0071	0.0006	-0.0006	0.0034	0.0124	-8.50×10^{-5}	-0.0098	-0.0054

Panel B: Individual orders

| | Transparent market | | | | | | Anonymous market | | | | | |
| | Levels of Order Aggressiveness | | | | | | Levels of Order Aggressiveness | | | | | |
	1	2	3	4	5	6	1	2	3	4	5	6
Depth$_{same}$	0.0097	0.0105	0.0238	0.0051	-0.0045	-0.0446	0.0074	0.0073	0.0185	0.0050	0.0051	-0.0433
Depth$_{opposite}$	-0.0095	-0.0090	-0.0205	-0.0045	0.0051	0.0384	-0.0039	-0.0029	-0.0092	-0.0024	-0.0029	0.0213
Spread	-0.0012	-0.0019	-0.0013	0.0012	0.0023	0.0009	0.0054	0.0059	0.0161	0.0043	0.0051	-0.0368
Volatility	0.0022	0.0046	0.0094	0.0017	0.0034	-0.0213	0.0052	0.0107	0.0252	0.0042	0.0112	-0.0565
FirstInt	-0.0017	-0.0013	-0.0037	-0.0009	-0.0005	0.0081	-0.0042	-0.0043	-0.0104	-0.0033	-0.0024	0.0246
Size	0.0017	0.0015	0.0034	0.0013	-0.0017	-0.0062	-0.0054	-0.0062	-0.0146	-0.0039	-0.0036	0.0337
Direction	0.0016	0.0025	0.0051	0.0016	-0.0010	-0.0098	0.0028	0.0041	0.0088	0.0024	0.0021	-0.0202