

# **Transparency, Intraday Order Placement Strategy and Market Performance**

Tai Ma\*, Yaling Lin, Showguay Cheng  
Department of Finance, National Sun Yat-sen University

## **Abstract**

We examine the impact of increasing pre-trade transparency using data from the Taiwanese stock market which has experienced a gradual increase in transparency. Specifically, we analyze the influence of transparency on the order placement strategies of individual as well as institutional investors, and its effect on market performance.

We find that as the pre-trade transparency increases, the percent of the most aggressive orders decreases significantly while that of the other inside-quote orders increases. Furthermore, the percent of the most conservative orders declines mildly for the institutional investors as market transparency enhances, while the opposite is true for individual investors. Our results indicate greater pre-trade transparency intensifies the competition in order placement strategy especially for institutional investors, at the same time it reduces the extreme orders placement of institutional investors. All investors get smarter in placing orders and reduce unnecessary high-cost orders when the market is more transparent. Compared with institutional investors, the individual investors seem to be more patient as order flow information is disclosed, suggesting liquidity providers are mainly individuals. The result of the intraday analysis shows that the intraday pattern of each order category does not change much as transparency increases, the intraday pattern of the more aggressive orders is U-shaped while that of the least aggressive orders is inverse J-shaped.

Generally speaking, greater transparency increases price volatility, while it does not improve market liquidity or efficiency. Further cross-sectional analysis reveals that the gain in liquidity from increasing transparency is positively related with the number of individual investor's trades in the stock.

**Key words:** transparency, order strategy, market performance

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\*Corresponding author. Email: matai@finance.nsysu.edu.tw, Address: Department of Finance, National Sun Yat-sen University, Kaohsiung, Taiwan.

# 1. Introduction

Increasing pre-trade transparency in limit order book has been a trend in recent years in exchanges around the world. Intuitively, greater order flow transparency should reduce the information asymmetry of the uninformed, thereby enhances market liquidity and information efficiency. However, it is not what the literature has always found. In fact, neither theoretical nor empirical studies have congruent results on the effect of pre-trade transparency. It is not clear whether and how pre-trade transparency affects the investor's order placement strategy and the market performance. Will the informed investors be more or less aggressive when more order flow information is disclosed? What about the uninformed investors? Without knowing the reaction of different market participants to a more transparent trading environment, it is difficult to evaluate the intricate effect of transparency enhancement. The question is, will the popular policy of increasing transparency bear scrutiny?

The order flow disclosure in the Taiwan Stock Exchange has been gradually stepping up over the past few years, which provides us a unique opportunity to empirically explore the effect of increasing pre-trade transparency. This paper aims to analyze the influence of transparency on the order placement strategy of individual as well as institutional investors and the resulting impact on market performance. Related literature includes research on limit order book information and studies on transparency. Previous research on limit order book has evidenced that investors' order submission strategies depend on limit order book information (e.g., Harris and Hasbrouck (1996), Cao, Hansh and Wang (2003), Al-Suhaibani and Kryzanowski(2001)). Furthermore, order flow information can explain the aggressiveness of the trading strategy (e.g., Biais, Hillion, and Spatt(1995), Pascual and Veredas(2003), Ranaldo(2004)). However, none of these studies empirically differentiate the strategies between different types of investors,<sup>1</sup> for example, the individual investors and the institutional investors, who may have quite different submission strategies and patterns facing order exposure. Furthermore, most empirical studies on limit order book concentrate either on the relation between order book information and order aggressiveness(e.g., Ranaldo(2004), Griffiths, Smith, Turnbull and White(2000)), or on the information content of LOB(e.g., Cao, Hansh and Wang (2003), Harris and Panchapagesan(2003)), or on the relation between order book information and trade variables such as duration and quote revision(e.g., Irvine, Benston and Kandel(2000), Coppejans and Domowitz (2002), Harris and Panchapagesan(2003)); however, they do not deal with the issue of transparency enhancement.

On the other hand, the result of the theoretical research on the impact of transparency

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<sup>1</sup> Although there are theoretical studies about the determinants of market vs. limit orders for informed traders(Angel,1994), and on price formation and order placement decisions(e.g., Foucault,1999, Foucault, Kada, Kandel,2001, Handa, Schwartz, Tiwari, 2003, Ma and Tsai, 2004 )for informed and liquidity traders, empirical evidence on the order placement decisions for different types of investors is scant.

is far from conclusive. Bloomfield and O'Hara (1999) and Roell (1997) posit that transparency speeds price discovery. However, Flood, Huisman, Koedijk, and Mahieu (1999) find that increased pre-trade transparency slows price discovery in a multiple-dealer market. In addition, Madhavan (1996) demonstrates that market transparency can actually increase price volatility and lower market liquidity if the market is thin. Pagano and Roell (1996) compare the price formation process in several stylized trading systems with different degrees of transparency, and find that greater transparency generates lower trading costs for uninformed traders on average, although not necessarily for every size of trade. In the empirical research, Friedman (1993) evidences that showing the entire book (as opposed to only the best bid and offer) reduces the bid/ask spread in the market, but does not significantly vary the information efficiency of prices. Gerke, Arneth, Bosch, and Syha (1997) find lower volatility in the transparent setting but no difference in spreads. Madhavan, Porter and Weaver (2001) study the effect of an increase in pre-trade transparency for Toronto Stock Exchange and find that volatility and execution costs increase whereas liquidity decreases with increasing transparency.<sup>2</sup> However, Boehmer, Saar, and Yu (2004) study the impact of increased order book transparency in NYSE and their result is contrary to the Canadian market – they find greater order flow transparency leads to improvement in liquidity and a reduction in the execution costs of trades.<sup>3</sup>

Except for Boehmer, Saar and Yu (2004), the above studies on transparency focus mainly on the market performance, but they did not explore the influence of transparency on the investor's order strategy. Even in Boehmer, et al. (2004), only the changes in the average order size and cancellation rate are examined, we are still unclear about how and whether greater transparency affects the investors order placement strategies.

Our paper contributes to the literature by being the first to combine the issues of transparency, different investors' intraday order strategies and market performance, which should enhance our understanding to the dispute in transparency policy. To get a detailed picture of the effect of transparency on the market, in addition to examine the intraday order strategies for individual as well as institutional investors under different transparent conditions, we also run cross-sectional regressions to find out the determinants of market performance when transparency increases, which has not yet been done before.

Since July 1, 2002, Taiwan Stock Exchange has adopted a series of measures to enhance market transparency. First, the volume of the best bid/ask limit order is disclosed along with the price, whereas previously only the best price is disclosed. Beginning 2003, the price and volume of the best five unexecuted orders are also disclosed. These

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<sup>2</sup> On April 12, 1990, Toronto Stock Exchange (TSE) provided real-time public dissemination of the best bid and offer and associated depth (bid and ask size) as well as the depth and limit order prices for up to four levels away from the inside market in both directions.

<sup>3</sup> On January 24, 2002, NYSE enables traders off the exchange floor to observe depth in the limit order book in real time.

exogenous shocks provide us a unique opportunity to study the impact of increasing pre-trade transparency. In order to compare the impact of different degree of transparency, the study period is divided into three two-month periods - the least transparent period, the partially transparent and the most transparent period. For intraday analysis, each day is further divided into nine half-hour intervals. The order submission strategy is measured by the degree of order aggressiveness, which ranks from 1(the most aggressive) to 6 (the most conservative).

On investors order strategies we find that as the pre-trade transparency increases, the percent of the most aggressive orders decreases significantly while that of the other inside-quote orders increases for both individual investors and institutional investors, but more so for the institutional investors. Furthermore, the percent of the most conservative orders declines mildly for the institutional investors as market transparency enhances, while the opposite is true for individual investors. Our results indicate greater pre-trade transparency intensifies the competition in order placement strategy especially for institutional investors, at the same time it reduces the placement of extreme orders of institutional investors. All investors get smarter in placing orders and reduce unnecessary high-cost orders when the market is more transparent. Compared with institutional investors, the individual investors seem to be more patient with increasing transparency, suggesting liquidity providers are mainly individuals.

The impact of increasing transparency on order submissions differs in the opening interval and closing interval – at the opening interval the most placed orders are quite conservative (level 5) orders, regardless of the degree of transparency; however, at the closing interval, the order most favored switches from very aggressive (level 1) to fair (level 4) as transparency increases from stage one to stage three. Enhanced transparency has greater impact on order strategies near market close than market open, which suggests that investors submit more conservative orders at the beginning of the trading day to extract information from the market, as information is gradually revealed over the course of the day and as the LOB becomes more transparent in later stages, the need to submit a very aggressive and expensive order before the market close to ensure execution is largely reduced.

The intraday analysis of the order strategy shows that the intraday pattern of the more aggressive orders are U-shaped, while that of the conservative orders are inverse J-shaped. The intraday patterns of different order types do not seem to change much with the level of transparency, except for the institutional investors at the opening interval. Interestingly, we find that at the opening interval the institutional investor's most aggressive order increases when the volume of the best bid/ask is added for disclosure in period two, however, as the exposure of limit order book increases still further, the percent of the most aggressive order at the opening interval declines again. The intraday pattern of orders for the individual investors remains relatively unchanged. This result

reveals the complexity of the influence of order exposure on institutional order strategy and the relative sensitivity of institutional investors at the open interval.

With respect to the impact of transparency on market quality, we find greater transparency increases the market volatility and sometimes may reduce liquidity. This finding is consistent with Madhavan, Porter and Weaver's result on Toronto Stock Exchange, but different from Boehmer, Saar and Yu's finding on NYSE. The increase in volatility can be explained by the more aggressive order strategies of the institutional investors and the individual investors that we find as transparency increases. Our findings are partly consistent with Madhavan(1996) who proposes that transparency may result in higher volatility and lower liquidity, unless the market is very large, but we do not find efficiency improves with the level of transparency as suggested by Madhavan. Finally, we examine the cross sectional determinants of the market performance as the transparency level changes. The results indicate that the volatility of firms with lower P/E ratio, higher directors' ownership and higher market/book ratio increases as pre-trade transparency increases; liquidity is affected mainly by individual trader's activity - the change in liquidity is positively related with the number of trades of individual investors; finally, the change in efficiency is positively related with turnover ratios and negatively related with margin trading ratios, other things being equal.

## **2. Market Background and Data**

### **2.1 Market background**

Trading on Taiwan Stock Exchange Corporation (TSEC) starts at 9:00 a.m. and closes at 1:30 p.m. The orders can be entered half an hour before the trading session starts. The Fully Automated Securities Trading (FAST) system is a 'continuous' call system, where orders are accumulated and cleared every 45 seconds or so at a price that maximizes trading volume. The market opens and closes by call auction, and starting from July, 2002, the call period at the close extends to 5 minutes. When an order is placed by a customer or a dealer, the account number along with the volume, bid or offer price, and other required information are entered via a terminal into the main computer of the Exchange. The order is processed and executed by the trading system in a price and time priority principle. All traders can observe the transaction prices and volumes as well as the order flow information on a real time basis. There is a 7% daily price limit. The market is in general quite liquid, with relatively high turnover and the individual investors account for roughly 80% of trading, but institutional traders are usually the price leaders.

### **2.2 Sample and Data**

The sample consists of 50 stocks drawn from the listed companies in the Taiwan Stock Exchange from July 2002 and June 2003. In order to compare the influence of

different degree of transparency, the sample period covers three stages of increasing transparency, two months for each stage, including February, June, July and December of 2002, March and June of 2003. We define February and June of 2002 as the first stage, the least transparent stage when only the prices of the best bid and ask are disclosed; July and December of 2002 as the second stage, the partially transparent period when the price as well as the volume of the best bid/ask quotes are disclosed; and March and June of 2003 as the third stage, the most transparent period when the prices and volumes of the best five bid/ask orders are disclosed. Our intraday data set contains the complete order book and all trades executed from July 2002 to June 2003 during the continuous trading session. Each order and trade record includes information on the price, size, direction, investors type (institutional or individual), and time-stamped to the nearest one hundredth of a second. In the intraday analysis, the trading time is divided into nine half-hour intervals, the first interval is from 9:01am to 9:30am, and the 9th interval is half hour before the closing call.

The following is our sample selection procedure: First, only common stocks and non-financial firms listed in TAIEX are included. Firms that are not continuously traded during the sample period are also excluded. Second, we classify these stocks into deciles based on turnover ratios and randomly select 35 stocks from the 2nd, 5th, and 8th deciles, respectively, so that the sample would contain stocks with various trading intensity. Before July 1st, 2002, intra-day trading was subject to a two-tick rule where the execution price was limited to up or down two ticks from the last execution price. The disclosed best bid/ask price may be misleading if the best price is beyond the two-tick limit, in that case no quote or only one-side quote (ask or bid) is displayed on the screen. The order book information is less 'transparent' in such case as it does not reveal the hidden best quote for these stocks, in other words, these samples may subject to greater impact from the later increase in order exposure. Therefore, we investigate the order book of the sample stocks in the first stage and divide our samples into two groups, the highly disclosed (or the more 'transparent') stocks and the less correctly disclosed (or the less 'transparent') stocks, with 35 stocks in each group.<sup>4</sup> Finally, to control the effect of the intraday halt rule starting at the second period, we delete samples that have incurred frequent temporary intraday halts during the second and third sample period.<sup>5</sup> Finally, beginning 2003 TAIEX lengthens its closing call duration to five minutes, to control for the difference in the duration of the market close, all closing calls are excluded from the analysis. The resulting sample includes 50 stocks and are divided into two groups, the

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<sup>4</sup> To separate these firms, we calculate the percentage of two-sided quotation disclosure for each stock, as stocks with low percentage of two-sided quotation are often limited by the two-tick rule and their limit order disclosure is not revealing the true story. After dividing the 105 sample firms into three groups based on the frequency of two-sided disclosure, we choose 35 stocks from the highest and the lowest frequency group, respectively.

<sup>5</sup> Under this rule trading for stocks whose estimated execution price is 3.5% higher or lower than the last price will be temporarily halted for 2 to 3 minutes, after that trade will resume normally. Firms that were temporarily halted for more than 7 times during the study period are deleted from the sample.

high disclosure group and the low disclosure group as explained above.

### **3. Methodology**

#### **3.1 Order Aggressiveness**

Studies on order submission strategy usually refer to limit orders vs. market orders. We make more detailed distinction for order strategies and analyze the changes in each order type over the study period. The orders are classified by the aggressiveness of the limit price into six categories. Category 1 is the most aggressive, and category 6 is the most conservative. For instance, in the case of buy orders, the bid price that equals the daily maximum price limit is the most aggressive order. If the bid price is less than the maximum price limit and higher than the best ask, the order is in category 2. The bid price of category 3 orders is less than or equal to the best ask and higher than the best ask. If the bid price is less than or equal to the best bid and higher than the best bid minus two ticks, it is in category 4. If the bid price is less than or equal to the best bid minus two ticks and higher than the lowest price limit, it is in category 5. Category 6 is the most passive in that the bid price equals the minimum price limit. The category for the sell order is determined in a similar way. We compare the percentage of each order category in each intraday interval for the individual and the institutional traders in each period, in addition, we examine the intraday pattern for each order category and investor type.

#### **3.2 Market Performance**

To assess the effect of increasing transparency we examine the liquidity, volatility as well as efficiency of the sample stocks for each of the three periods. Furthermore, in addition to the overall performance we also examine whether there is any cross sectional difference in performance as level of transparency changes. The explanatory variables in the cross section analysis include firm characteristics variables (i.e., ownership structure and performance ratio) as well as trading activity variables (i.e., turnover ratios, margin trading, individual vs institutional trades).

The individual investors are the main market participants in the Taiwanese stock market, about 80% of trading is by individuals. The market is usually described as a shallow market in that the average trade size is relatively small. Furthermore, the behavior of individual investors is mostly of the momentum type. Increasing exposure of limit order book may reduce the temporary order-imbalance induced volatility on the one hand, but it may also stimulate the trend chasing behavior of the individual investors and aggravates volatility on the other hand. For the institutional investors, exposure of limit orders may lead to increasing competition for execution, or it may lead to information manipulation. Considering all of the above, we expect volatility to increase as pre-trade transparency increases. The standard deviation of individual stock return relative to the standard deviation of market return is used to measure the volatility.

A more transparent market should reduce the information asymmetry for uninformed investors and increase their incentive to trade, thereby increasing market liquidity. On the other hand, increasing transparency could have negative impact on the depth of the market in that investors may overreact to the disclosed order imbalance information, in this case the market may become less liquid. Informed traders may also be less willing to trade in a more transparent market. The actual effect on liquidity needs to be empirically examined. Schwartz (1991) defines liquidity as given the conditions of demand and supply, the ability to sell assets quickly with the reasonable price. Common measures for liquidity include the bid-ask spread and liquidity ratios. As there was a two-tick restriction in quoted price in the first period, it is not appropriate to measure liquidity by bid-ask spread in our study. We utilize Amivest Liquidity Ratio to measure liquidity. Amivest liquidity ratio measures the average trading volume relative to unit change in prices, which is similar to the inverse Kyle's measure of market depth, a higher ratio suggests higher liquidity. The Amivest ratio is estimated for each stock as follows:

$$L_i = \frac{\sum_{t=1}^n P_{i,t} V_{i,t}}{\sum_{t=1}^n |\% \Delta P_{i,t}|}, \quad \% \Delta P_{i,t} = \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}}$$

where  $L_i$  is the liquidity ratio for sample  $i$ ,  $P_{i,t}$  is the transaction price at time  $t$ , and  $V_{i,t}$  is the volume at time  $t$ .

As to the impact of increasing pre-trade transparency on pricing efficiency, it is generally believed that efficiency increases with transparency. We argue that in a market dominated by noise traders, the behavior of traders may also play a role. With increasing order book exposure, on the one hand traders may extract information more dynamically and therefore improve price efficiency, on the other hand, if they over-react to the order flow information and the order submission turn into a rat race, the price efficiency may be harmed rather than enhanced. So again this is an empirical question. We apply the market efficient coefficient (MEC) in Hasbrouck and Schwartz (1988) to measure the efficiency of each stock in each period. MEC is calculated as following:

$$MEC = \frac{V(R_T^*)}{2 \times V(r_t^*)}$$

where  $V(R_T^*)$  and  $V(r_t^*)$  are the variances of long term (10 minutes) returns and short term (5minutes) returns, respectively. Market is more efficient if MEC is close to 1.

#### 4. Analysis of Results

The distribution of order types and the intraday pattern of each order category under



various transparent stages are examined in details,<sup>6</sup> followed by performance analysis in the three stages.<sup>7</sup>

#### **4.1 Analysis of intraday order strategies**

The summary statistics of the distribution of order submission at each 30minute trade interval in the three stages for institutional and individual investors are exhibited in Table 1 and Table 2, respectively. Orders are classified into six categories based on the level of aggressiveness. The largest order type in a given interval is marked by #.

Table 1 shows the distribution of order types for institution investors. In the first stage, the types of orders most frequently placed are C3, C4, and C5, averaging about one fourth of total institutional orders. In the second stage, the largest order type concentrates on C3 and C4. Note that C3 becomes increasingly favored as the level of transparency increases in stage 2 and stage 3. That is, as the level of transparency increases, the institutional traders become increasingly aggressive in order submission during the continuous trading sessions.<sup>8</sup> At the closing interval, the top order choice for institutional traders is the most aggressive C1 order in stage one, but as transparency increases, the proportion of C1 at the closing interval declines significantly and C4 becomes the top order choice. On the other hand, at the beginning interval (interval 1), the top order type is C5 in all three stages. The result suggests that institutional traders would submit more conservative order near market open to extract information, and more aggressive order near market close. Although traders become more aggressive during the continuous trading sessions as pre-trade transparency increases, the most aggressive and costly C1 order declines sharply especially in the closing interval. Figure 1 gives a graphical presentation of the distribution of institutional order types at the opening, middle and closing intervals in three stages.

Table 2 shows the distribution of order types for individual investors. The pattern is somewhat different from Table1. Compared with institutional traders, the individual trader's top order choice is one-step less aggressive in all stages. The largest order type concentrates on C4, as opposed to institutional trader's C3. Similar to institutional traders, at the opening interval the orders are more conservative (except in the least transparent stage) while at the closing interval the orders are more aggressive. However, unlike the institutional investors who prefer C4 orders at the close, the individual trader's orders are

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<sup>6</sup> Our samples are divided into high and low disclosure firms based on the percentage of two-sided quotation disclosure for each stock. As the order distribution for the high disclosing samples and the low disclosing samples are similar, to save space only the results of the former are shown in the following. The summary statistics for low disclosure samples are available from the authors upon request.

<sup>7</sup> In the performance regression analysis, all 50 samples are included.

<sup>8</sup> The continuous trading sessions refer to periods after the market open session and before the market close session..

dichotomous at the close, both C1 and C4 orders are common. Compared with institutional traders, individual traders are more patient in general, but less patient at the closing interval. Figure 2 illustrates the distribution of individual orders at opening, middle and closing intervals.

We can see from Table 1, Table 2 and Figures 1& 2 that the impact of increasing transparency on order submissions differs in the opening interval and closing interval – at the opening interval the most placed orders are quite conservative (C5) orders, regardless of the degree of transparency; however, at the closing interval, the orders most favored change from very aggressive (C1) to fair (C4) as transparency increases from stage one to stage three. Enhanced transparency has greater impact on order strategies near market close than market open, which suggests that investors submit more conservative orders at the beginning of the trading day to gain information from the market, as more information is revealed during the course of the day and as the pre-trade transparency becomes more transparent, the need to submit a very aggressive and expensive order before the trading ends to ensure execution is largely reduced.

The results of nonparametric tests for the differences in the order aggressiveness between stages of various transparency levels are listed in Table 3 and Table 4. We find that as the pre-trade transparency increases, the percent of the most aggressive orders decreases significantly while that of the other inside-quote orders increases for both individual investors and institutional investors. Furthermore, the percent of the most conservative orders declines mildly for the institutional investors as market transparency enhances, while the opposite is true for individual investors. Our results indicate greater pre-trade transparency increases the competition in order placement strategy especially for institutional investors, at the same time it reduces the placement of extreme orders of institutional investors. All investors get smarter in placing orders and reduce unnecessary high-cost orders when the market is more transparent. Compared with institutional investors, the individual investors seem to be more patient with increasing transparency, suggesting liquidity providers are mainly individuals.

Table 5 shows the result of the difference in the order strategies between institutional and individual investors. Institutional investors place significantly more C3 orders relative to individual investors as pre-trade transparency increases, while the opposite is true for C5 orders. That is, institutional traders become more aggressive relative to individual traders as the exposure of order book increases. With respect to the most conservative order C6, in the first stage, institutional investors place less C6 relative to individual investors, the difference becomes insignificant in the later stages. As to the most aggressive C1 orders, individual traders tend to place more of C6 at the beginning and the ending interval relative to institutional traders.

To get a summary picture of the story, we aggregate the various order types into

three big categories and the result is shown in Table 6. "C1+C2+C3" is the aggregation of the three aggressive order types, and C5+C6 is the sum of the two conservative orders. For institutional investors, the proportion of aggregated aggressive orders (C1+C2+C3) increases as pre-trade transparency increases for intervals 2, 6, 7, 8 and 9. The proportion of 'ordinary' orders C4 increases with pre-trade transparency, but only in intervals 1, 7 and 9. Conversely, the proportion of aggregated conservative orders (C5+C6) decreases as pre-trade transparency increases. For individual investors, C1+C2+C3 and C4 exhibit similar trend as that of institutional investors (except for C1+C2+C3 at interval 9). As to C5+C6, there is no significant difference in individual's percent of conservative orders.

The analyses above focus on the distribution of order types given the time interval. Figure 3 to Figure 5 illustrate the intraday patterns given each order type in the three stages of transparency for institutional and investors. The intraday pattern of the more aggressive orders is U-shaped, while that of the conservative orders is inverse J-shaped, decreasing over the trading day. The intraday patterns of orders do not seem to change much with the level of transparency, except at the opening interval for the institutional.

#### 4.1 Performance analysis

Table 7 exhibits the average performance of the sample firms in the three stages. Volatility rises significantly with pre-trade transparency, especially in the third stage (the most transparent stage). Liquidity changes little with greater transparency, it is even lower from the first to the second stage. Efficiency is not significantly different either with greater transparency.

To examine whether there is any difference in the impact of transparency on stock performance among firms, the following cross sectional regressions are estimated:

$$CV = \beta_0 + \beta_1 High + \beta_2 Board + \beta_3 PER + \beta_4 PBR$$

where CV is the volatility increment (the difference between stage1 and stage3), "High" is the high disclosure dummy variable, "Board" is directors' shareholdings, "PER" is the P/E ratio and "PBR" is price/book ratio.

$$CL = \beta_0 + \beta_1 High + \beta_2 Uninf + \beta_3 Board + \beta_4 Equity + \beta_5 Turnover$$

Where CL is liquidity increment (the difference between stage1 and stage3) , "Uninf" is numbers of individual trades, "Equity" is growth rate of equity and "Turnover" is turnover ratio.

$$CE = \beta_0 + \beta_1 High + \beta_2 Margin + \beta_3 Turnover + \beta_4 Board$$

Where CE is market efficiency increment (the difference between stage1 and stage3) , "Margin" is margin trading ratio, and the other variables are the same as above.

Table 8 gives the result of the cross sectional regression on market performance. The dependent variables are the market performance measures, and the independent variables include the activity factors(i.e., numbers of individual trades, margin trading ratio, turnover ratio), the firm characteristics factors(i.e., directors' ownership, market to book ratio, and P/E ratio) . The result shows that change in volatility is positively related with directors' shareholdings and M/B ratio, but negatively related with P/E ratio. The change in liquidity is significantly positively related with the numbers of individual trades. Finally, the change in efficiency is positively related with the turnover ratio, but negatively related with the margin trading ratio.

## 5. Conclusion

The gradual increase in pre-trade transparency in the Taiwan Stock Exchange provides us a unique opportunity to explore the effect of transparency enhancement. We examine in details the changes in the intraday order placement strategies of individual and institutional investors as well as the market performance in the various stage of pre-trade transparency.

Our results indicate greater pre-trade transparency increases the intraday competition in more aggressive order placement for all investors, especially for institutional investors, at the same time it reduces the placement of extreme orders of institutional investors. All investors get smarter in placing orders and reduce unnecessary high-cost orders when the market is more transparent. Relative to institutional investors, the individual investors seem to be more patient with increasing transparency, suggesting liquidity providers are mainly individuals.

Enhanced transparency has greater impact on order strategies near market close than market open, as the LOB becomes more transparent, the need to submit a very aggressive and expensive order before the trading ends to ensure execution is largely reduced. The intraday analysis show that the intraday pattern of the more aggressive orders are U-shaped, while that of the conservative orders are inverse J-shaped. The intraday pattern of orders do not seem to change much with the level of transparency, except at the opening interval for the institutional traders. We find that the change in order aggressiveness in the opening interval is non linear in the level of transparency, indicating the complexity of the effect of increasing order exposure.

With respect to the impact of transparency on market quality, we find greater transparency increases volatility and in some case reduces liquidity. This finding is consistent with Madhavan, Porter and Weaver's result on Toronto Stock Exchange, but not consistent with Boehmer, Saar and Yu's finding on NYSE. We point out that the increase in volatility may be explained by the more aggressive order strategies found as transparency increases. Our result in increasing aggressiveness seems to suggest a rat race effect when more order book information is disclosed. Our findings are also partly consistent with Madhavan (1996) who argues that transparency leads to enhancement in liquidity only if the market is very large. Finally, cross sectional regressions show that the financial performance, the ownership structure and the trading activity of the firm can influence the relative impact of transparency enhancement.

We have demonstrated that changes in the level of pre-trade transparency will affect the order submission strategy of investors, and hence the market performance. Furthermore, the influence of transparency is different between institutional investors and individual investors, and between intraday intervals. Further analysis on intraday market performance will enable us to trace the interaction even closer.

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**Table 1      The distribution of order types for institutional investors**

This table illustrates the distribution of institutional order submission at each 30 minute trade interval in the three stages. Orders are classified into six categories based on the level of aggressiveness. For example, "interval 1" indicates the time interval between 9:00 am and 9:30am, and "C1" represents the category 1 orders, i.e. the most aggressive orders. The table gives the percentage of each order category at a given interval. The largest order type in a given interval is marked by #.

first stage						
	c1	c2	c3	c4	c5	c6
daily	20.31%	14.13%	19.76%	21.87% #	21.40%	2.53%
interval 1	18.07%	12.29%	18.74%	18.50%	28.40% #	4.01%
interval 2	19.94%	14.11%	16.97%	22.60%	23.46% #	2.91%
interval 3	17.23%	12.62%	20.22%	24.65% #	22.72%	2.56%
interval 4	18.86%	12.64%	21.63%	23.38% #	21.72%	1.77%
interval 5	18.47%	14.66%	21.49%	23.71% #	19.95%	1.73%
interval 6	18.98%	14.92%	24.20% #	23.46%	16.43%	2.00%
interval 7	18.06%	14.75%	24.68% #	20.45%	20.68%	1.37%
interval 8	20.77%	16.33%	20.54%	21.48% #	17.96%	2.93%
interval 9	27.51% #	13.77%	17.09%	20.07%	20.23%	1.32%
second stage						
	c1	c2	c3	c4	c5	c6
daily	15.41%	15.42%	23.34%	23.68% #	19.65%	2.51%
interval 1	14.29%	15.79%	20.04%	21.83%	24.70% #	3.36%
interval 2	13.14%	14.12%	22.97%	23.62% #	23.27%	2.87%
interval 3	14.02%	15.04%	24.59% #	24.27%	19.52%	2.55%
interval 4	14.42%	16.03%	24.29% #	23.83%	18.90%	2.53%
interval 5	13.05%	17.27%	26.66% #	23.80%	17.27%	1.95%
interval 6	14.08%	14.06%	25.42% #	25.27%	19.04%	2.12%
interval 7	15.40%	16.47%	23.34%	25.79% #	16.48%	2.50%
interval 8	14.82%	16.93%	25.53% #	22.91%	16.66%	3.14%
interval 9	19.96%	16.07%	19.86%	25.65% #	16.64%	1.82%
third stage						
	c1	c2	c3	c4	c5	c6
daily	14.30%	18.21%	24.31% #	24.02%	17.38%	1.78%
interval 1	14.35%	15.18%	20.30%	21.37%	25.46% #	3.34%
interval 2	13.40%	17.13%	24.28% #	23.48%	19.35%	2.37%
interval 3	13.25%	19.70%	24.26% #	23.00%	17.97%	1.82%
interval 4	12.11%	18.58%	26.54% #	26.14%	15.04%	1.59%
interval 5	13.20%	18.41%	26.62% #	25.44%	14.34%	1.99%
interval 6	12.99%	20.28%	26.74% #	22.45%	16.10%	1.45%
interval 7	14.53%	18.93%	29.41% #	22.78%	13.57%	0.79%
interval 8	14.78%	23.59%	25.64% #	22.13%	12.88%	0.98%
interval 9	18.80%	18.43%	20.32%	26.34% #	15.20%	0.92%



**Table 2      The distribution of order types for individual investors**

This table illustrates the distribution of individual order submission at each 30 minute trade interval in the three stages. Orders are classified into six categories based on the level of aggressiveness. For example, "interval 1" indicates the time interval between 9:00 am and 9:30am, and "C1" represents the category 1 orders, i.e. the most aggressive orders. The table gives the percentage of each order category at a given interval . The largest order type in a given interval is marked by #.

first stage						
	c1	c2	c3	c4	c5	c6
daily	21.67%	11.88%	17.02%	23.40% #	22.86%	3.17%
interval 1	22.01%	10.78%	14.58%	19.85%	28.53% #	4.25%
interval 2	19.29%	11.43%	16.78%	23.95%	24.93% #	3.62%
interval 3	18.91%	11.10%	18.64%	24.33% #	23.49%	3.53%
interval 4	18.65%	11.02%	17.86%	26.10% #	23.32%	3.05%
interval 5	19.30%	11.47%	18.02%	25.97% #	22.09%	3.15%
interval 6	18.99%	12.18%	18.58%	26.24% #	21.08%	2.93%
interval 7	19.92%	11.45%	18.81%	26.48% #	20.87%	2.47%
interval 8	21.02%	12.77%	18.60%	25.37% #	19.77%	2.47%
interval 9	30.10% #	14.24%	16.41%	20.89%	16.48%	1.87%
second stage						
	c1	c2	c3	c4	c5	c6
daily	16.50%	14.92%	19.37%	24.50% #	20.90%	3.82%
interval 1	16.52%	14.77%	17.46%	22.44%	24.33% #	4.48%
interval 2	14.09%	13.77%	19.55%	25.65% #	22.85%	4.09%
interval 3	13.79%	13.78%	20.12%	25.74% #	22.24%	4.33%
interval 4	13.85%	14.64%	20.50%	25.50% #	21.59%	3.92%
interval 5	13.99%	15.31%	21.44%	24.92% #	20.70%	3.65%
interval 6	14.24%	13.98%	21.29%	26.44% #	20.18%	3.88%
interval 7	14.36%	14.55%	21.13%	26.90% #	19.10%	3.97%
interval 8	15.59%	16.17%	20.98%	25.54% #	18.33%	3.40%
interval 9	21.63%	17.93%	18.31%	23.30% #	16.51%	2.32%
third stage						
	c1	c2	c3	c4	c5	c6
daily	16.37%	15.27%	19.48%	23.99% #	21.68%	3.22%
interval 1	15.77%	14.17%	16.86%	21.83%	27.44% #	3.93%
interval 2	15.11%	13.79%	19.38%	24.40% #	23.60%	3.71%
interval 3	14.91%	14.44%	20.38%	24.67% #	22.26%	3.34%
interval 4	14.38%	14.66%	20.82%	25.65% #	21.29%	3.19%
interval 5	15.50%	15.04%	20.92%	24.64% #	20.81%	3.09%
interval 6	14.51%	15.32%	21.13%	26.16% #	19.87%	3.01%
interval 7	15.11%	16.18%	21.70%	25.76% #	18.35%	2.89%
interval 8	15.42%	17.01%	22.00%	25.60% #	17.24%	2.72%
interval 9	21.76%	18.18%	18.59%	23.25% #	16.39%	1.83%

**Table 3     The difference in institutional investor's order aggressiveness between stages of various transparency level**

This table shows the difference in the order submission of institutional investors for given trade interval between various periods. Orders are classified into six categories based on the level of aggressiveness. For example, "interval 1" indicates the time interval between 9:00 am and 9:30am, and "C1" represents the category 1 orders, i.e. the most aggressive orders. The second column indicates the two periods under comparison, e.g., "1-2" means period 1 minus period 2. For example, at interval 1, the percent of C1 in the first stage minus the percent of C1 in the second stage is 3.78%, that is, C1 decreases from stage 1 to stage 2 for the first trade interval.

		<b>C 1</b>	<b>C 2</b>	<b>C 3</b>	<b>C 4</b>	<b>C 5</b>	<b>C 6</b>
interval 1	1-2	3.78% ***	-3.50% **	-1.30% *	-3.33% **	3.70% ***	0.65%
	1-3	3.72% **	-2.89% **	-1.57%	-2.87%	2.94% **	0.67%
	2-3	-0.06%	0.60%	-0.27%	0.46%	-0.76%	0.02%
interval 2	1-2	6.80% ***	-0.01%	-6.00% ***	-1.02%	0.19%	0.03%
	1-3	6.54% ***	-3.02% *	-7.30% ***	-0.87%	4.12% **	0.53%
	2-3	-0.26%	-3.00%	-1.30%	0.14%	3.92% **	0.50% *
interval 3	1-2	3.21% **	-2.42% *	-4.38% **	0.38%	3.20% *	0.01%
	1-3	3.98% ***	-7.08% **	-4.04%	1.65%	4.76% **	0.74% **
	2-3	0.77%	-4.66% *	0.33%	1.27%	1.55% *	0.73%
interval 4	1-2	4.44% **	-3.39% *	-2.66%	-0.45%	2.82%	-0.76%
	1-3	6.76% ***	-5.94% **	-4.91% **	-2.76%	6.68% **	0.18%
	2-3	2.32% **	-2.55%	-2.25%	-2.31%	3.86% *	0.94%
interval 5	1-2	5.42% ***	-2.61% *	-5.17% ***	-0.09%	2.67% **	-0.22%
	1-3	5.27% ***	-3.75%	-5.14% **	-1.73%	5.61% ***	-0.26%
	2-3	-0.15%	-1.15%	0.04%	-1.64%	2.93% *	-0.04%
interval 6	1-2	4.89% **	0.86%	-1.22%	-1.81%	-2.62%	-0.12%
	1-3	5.99% ***	-5.36% **	-2.53%	1.01%	0.33%	0.56%
	2-3	1.10%	-6.22% **	-1.32%	2.82% *	2.94% ***	0.68%
interval 7	1-2	2.66% *	-1.72% ***	1.34%	-5.34% *	4.20%	-1.14%
	1-3	3.53% **	-4.17% ***	-4.73%	-2.33% ***	7.12% ***	0.58%
	2-3	0.87%	-2.45%	-6.07%	3.01% ***	2.92% ***	1.72% ***
interval 8	1-2	5.94% ***	-0.60% **	-4.99% ***	-1.43%	1.30%	-0.22%
	1-3	5.99% ***	-7.26% *	-5.11% ***	-0.64%	5.08% ***	1.94%
	2-3	0.05%	-6.66%	-0.11%	0.79%	3.78% ***	2.16% ***
interval 9	1-2	7.55% ***	-2.29%	-2.77% *	-5.58% ***	3.59%	-0.50%
	1-3	8.71% ***	-4.65% ***	-3.22% *	-6.26% ***	5.03% **	0.40%
	2-3	1.16%	-2.36%	-0.46%	-0.68%	1.44%	0.91%

\* indicates significant at 10%, \*\* indicates significant at the 5%, and \*\*\* indicates significant at the 1%

**Table 4 The difference in individual investor's order aggressiveness between stages of various transparency level**

This table shows the difference in the order submission of individual investors for given trade interval between various periods. Orders are classified into six categories based on the level of aggressiveness. For example, "interval 1" indicates the time interval between 9:00 am and 9:30am, and "C1" represents the category 1 orders, i.e. the most aggressive orders. The second column indicates the two periods under comparison, e.g., "1-2" means period 1 minus period 2. For example, at interval 1, the percent of C1 in the first stage minus the percent of C1 in the second stage is 5.49%, that is, C1 decreases from stage 1 to stage 2 for the first trade interval.

		<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>	<b>C5</b>	<b>C6</b>
interval 1	1-2	5.49% ***	-3.99% ***	-2.88% ***	-2.59% **	4.20% ***	-0.23% *
	1-3	6.25% ***	-3.39% ***	-2.28% ***	-1.98% *	1.08%	0.33% ***
	2-3	0.76%	0.59%	0.60%	0.61%	-3.12% **	0.56%
interval 2	1-2	5.20% ***	-2.34% ***	-2.76% ***	-1.70%	2.08% **	-0.47% *
	1-3	4.18% ***	-2.36% ***	-2.59% ***	-0.45%	1.33%	-0.10% ***
	2-3	-1.02%	-0.02%	0.17%	1.25%	-0.75%	0.37% *
interval 3	1-2	5.11% ***	-2.68% ***	-1.48% **	-1.41%	1.24% **	-0.79% **
	1-3	4.00% ***	-3.34% ***	-1.74% **	-0.34%	1.22%	0.19% ***
	2-3	-1.12%	-0.66%	-0.26%	1.07%	-0.02%	0.99%
interval 4	1-2	4.80% ***	-3.62% ***	-2.64% ***	0.60%	1.73% *	-0.88% *
	1-3	4.27% ***	-3.64% ***	-2.96% ***	0.45%	2.03% **	-0.14% ***
	2-3	-0.54%	-0.02%	-0.33%	-0.15%	0.30%	0.73%
interval 5	1-2	5.32% ***	-3.84% ***	-3.42% ***	1.05%	1.39% *	-0.50% ***
	1-3	3.80% ***	-3.57% ***	-2.90% ***	1.33%	1.28%	0.07% ***
	2-3	-1.52%	0.27%	0.52%	0.28%	-0.11%	0.56%
interval 6	1-2	4.75% ***	-1.80% *	-2.71% ***	-0.20%	0.90%	-0.95% **
	1-3	4.48% ***	-3.14% **	-2.54% **	0.08%	1.21%	-0.08% ***
	2-3	-0.27%	-1.34%	0.16%	0.28%	0.31%	0.86%
interval 7	1-2	5.56% ***	-3.10% ***	-2.32% ***	-0.42%	1.77% **	-1.50%
	1-3	4.80% ***	-4.73% ***	-2.89% **	0.72%	2.52% **	-0.42% ***
	2-3	-0.76%	-1.63% *	-0.57%	1.14%	0.75%	1.08% ***
interval 8	1-2	5.43% ***	-3.40% **	-2.38% ***	-0.17%	1.45% **	-0.93% ***
	1-3	5.60% ***	-4.25% ***	-3.40% ***	-0.23%	2.53% **	-0.25% **
	2-3	0.17%	-0.85%	-1.02%	-0.07%	1.09% *	0.68%
interval 9	1-2	8.47% ***	-3.69% ***	-1.90% **	-2.41%	-0.03%	-0.44% **
	1-3	8.34% ***	-3.94% ***	-2.17% ***	-2.35%	0.09%	0.04% ***
	2-3	-0.13%	-0.25%	-0.28%	0.06%	0.12%	0.48%

\* indicates significant at 10%, \*\* indicates significant at the 5%, and \*\*\* indicates significant at the 1%

**Table 5 The comparison between the order strategies of the institutional and individual investors**

This table compares the order submission between institutional and individual investors for given interval in each stage. Orders are classified into six categories based on the level of aggressiveness. For example, "interval 1" indicates the time interval between 9:00 am and 9:30am, and "C1" represents the category 1 orders, i.e. the most aggressive orders. The percentage displayed is the difference between institutional and individual investors in a given order category. For example, given interval 1, the percent of institutional investor's C1 order minus that of individual investors is -3.94% in stage one, that is, individual investors place higher percentage in the most aggressive order than institutional investors do at the first trade interval.

		C1	C2	C3	C4	C5	C6
interval 1	first stage	-3.94% *	1.51%	4.16% *	-1.35%	-0.13%	-0.25% *
	second stage	-2.23%	1.02%	2.58% *	-0.61%	0.37%	-1.12%
	third stage	-1.42%	1.01%	3.44% *	-0.46%	-1.98%	-0.59%
interval 2	first stage	0.65%	2.68% **	0.19%	-1.35%	-1.46%	-0.71%
	second stage	-0.95%	0.35%	3.43%	-2.03%	0.42%	-1.21%
	third stage	-1.71%	3.34%	4.90% **	-0.93%	-4.25% **	-1.34%
interval 3	first stage	-1.68%	1.52%	1.58%	0.32%	-0.77% *	-0.97% **
	second stage	0.23%	1.26%	4.47% **	-1.46%	-2.73%	-1.77%
	third stage	-1.66%	5.26%	3.88% **	-1.67%	-4.30% ***	-1.51%
interval 4	first stage	0.21%	1.62%	3.77% *	-2.73%	-1.60%	-1.28% ***
	second stage	0.58%	1.39%	3.79% **	-1.67%	-2.69% **	-1.39%
	third stage	-2.28%	3.92%	5.72% ***	0.49%	-6.25% ***	-1.60%
interval 5	first stage	-0.83%	3.19%	3.47% **	-2.26%	-2.14% *	-1.42% ***
	second stage	-0.94%	1.96% *	5.22% ***	-1.12%	-3.43% ***	-1.70%
	third stage	-2.30%	3.37%	5.71% ***	0.80%	-6.47% ***	-1.10%
interval 6	first stage	-0.01%	2.75%	5.62% **	-2.78%	-4.65% ***	-0.92% ***
	second stage	-0.16%	0.08%	4.13%	-1.17%	-1.14% **	-1.75%
	third stage	-1.52%	4.97%	5.61% **	-3.71%	-3.77% ***	-1.57%
interval 7	first stage	-1.85%	3.30%	5.87% ***	-6.03%	-0.18% *	-1.10% ***
	second stage	1.05%	1.93%	2.22% *	-1.11%	-2.62% **	-1.47%
	third stage	-0.58%	2.75% ***	7.71%	-2.98%	-4.78% ***	-2.10%
interval 8	first stage	-0.25%	3.56%	1.93%	-3.89%	-1.81%	0.46% *
	second stage	-0.76%	0.77%	4.55% ***	-2.62%	-1.67%	-0.26%
	third stage	-0.64%	6.58%	3.64%	-3.48%	-4.36% ***	-1.74%
interval 9	first stage	-2.59%	-0.47%	0.68%	-0.82%	3.75%	-0.55% **
	second stage	-21.63%	-17.93% *	-18.31%	-23.30%	-16.51%	-2.32%
	third stage	-2.96% *	0.25%	1.73%	3.09%	-1.19%	-0.92%

\* indicates significant at 10%, \*\* indicates significant at the 5%, and \*\*\* indicates significant at the 1%

**Table 6      The aggregated order distribution of institutional and individual investors**

This table displays the order distribution of institutional and individual investors by summarizing order categories into three: more aggressive, the best price order, and the conservative. "C1+C2+C3" is the aggregation of the more aggressive orders, C4 includes the best quote orders, and 'C5+C6' are the more conservative orders. The percentage displayed is the difference between institutional and individual investors in a given summarizing order category and for a given interval between two periods.

		institutional			individual		
		C1+C2+C3	C4	C5+C6	C1+C2+C3	C4	C5+C6
daily	1-2	0.03%	-1.80%	1.78%	-0.20%	-1.10%	1.30% *
	1-3	-2.62%	-2.15%	4.77% ***	-0.54%	-0.59%	1.13%
	2-3	-2.65%	-0.35%	3.00% ***	-0.34%	0.51%	-0.17%
interval 1	1-2	-1.02%	-3.33% **	4.35% ***	-1.38% *	-2.59%	3.97% ***
	1-3	-0.74%	-2.87%	3.61% **	0.57%	-1.98% *	1.41%
	2-3	0.28%	0.46%	-0.74%	1.95% **	0.61%	-2.56%
interval 2	1-2	0.79%	-1.02%	0.22%	0.10%	-1.70%	1.60%
	1-3	-3.78% **	-0.87%	4.65% ***	-0.77%	-0.45%	1.23%
	2-3	-4.57% *	0.14%	4.43% **	-0.87%	1.25%	-0.38%
interval 3	1-2	-3.59%	0.38%	3.21%	0.96%	-1.41%	0.45% ***
	1-3	-7.14%	1.65%	5.49% **	-1.08%	-0.34%	1.42%
	2-3	-3.55%	1.27%	2.28% *	-2.03%	1.07%	0.97%
interval 4	1-2	-1.61%	-0.45%	2.07%	-1.46% ***	0.60%	0.85% **
	1-3	-4.10%	-2.76%	6.86% **	-2.34% ***	0.45%	1.88%
	2-3	-2.49%	-2.31%	4.80% **	-0.88% *	-0.15%	1.03%
interval 5	1-2	-2.36%	-0.09%	2.45% **	-1.94% ***	1.05%	0.89% ***
	1-3	-3.62%	-1.73%	5.35% ***	-2.67% **	1.33%	1.35%
	2-3	-1.26%	-1.64%	2.90% *	-0.73%	0.28%	0.45%
interval 6	1-2	4.54%	-1.81%	-2.73%	0.25% *	-0.20%	-0.05%
	1-3	-1.90%	1.01%	0.89% *	-1.20%	0.08%	1.12%
	2-3	-6.44% *	2.82%	3.62% ***	-1.45%	0.28%	1.17%
interval 7	1-2	2.27%	-5.34% **	3.07%	0.15% ***	-0.42%	0.27% *
	1-3	-5.37% **	-2.33%	7.70% ***	-2.82% **	0.72%	2.09% *
	2-3	-7.65% ***	3.01%	4.63% **	-2.97%	1.14%	1.83%
interval 8	1-2	0.35%	-1.43%	1.08%	-0.34% **	-0.17%	0.51%
	1-3	-6.38% **	-0.64%	7.02% ***	-2.04% ***	-0.23%	2.28% **
	2-3	-6.73% *	0.79%	5.94% ***	-1.70%	-0.07%	1.77%
interval 9	1-2	2.49% *	-5.58% ***	3.09%	2.88% ***	-2.41%	-0.47%
	1-3	0.83%	-6.26% ***	5.43% **	2.23% ***	-2.35% **	0.13%
	2-3	-1.66%	-0.68%	2.34% **	-0.66% **	0.06%	0.60%

\* indicates significant at 10%, \*\* indicates significant at the 5%, and \*\*\* indicates significant at the 1%

**Table 7      Comparisons of volatility, liquidity and efficiency among three stages**

This table exhibits the market performance measures (e.g., volatility, liquidity, and price efficiency), and shows the difference between different transparent stage for all measures. For example, the difference column (1-2) means the performance measure in stage1 minus that in stage2. The measure of volatility is variance of 5-minutes returns, t liquidity is the Amvist ratio and efficiency is measured by the absolute distance between MEC and 1. In order to take the change in the scale of the market return into consideration, the volatility and liquidity measures are estimated relative to that of market index.

Panel A: Performance measures in the different transparent stages			
	volatility	liquidity	efficiency
1st stage	6.2328	0.0000108	0.2403
2nd stage	6.1477	0.0000090	0.2420
3rd stage	6.6591	0.0000103	0.2568
Panel B: Differences in performance measures between the different transparent stages			
	volatility	liquidity	efficiency
1 - 2	0.085	1.814E-06	-0.002
1 - 3	-0.426 *	4.26E-07	-0.017
2 - 3	-0.511	-1.388E-06	-0.015

\* indicates significant at 10%, \*\* indicates significant at the 5%, and \*\*\* indicates significant at the 1%

**Table 8 Cross sectional regression results on market performance**

$$CV = \beta_0 + \beta_1 High + \beta_2 Board + \beta_3 PER + \beta_4 PBR$$

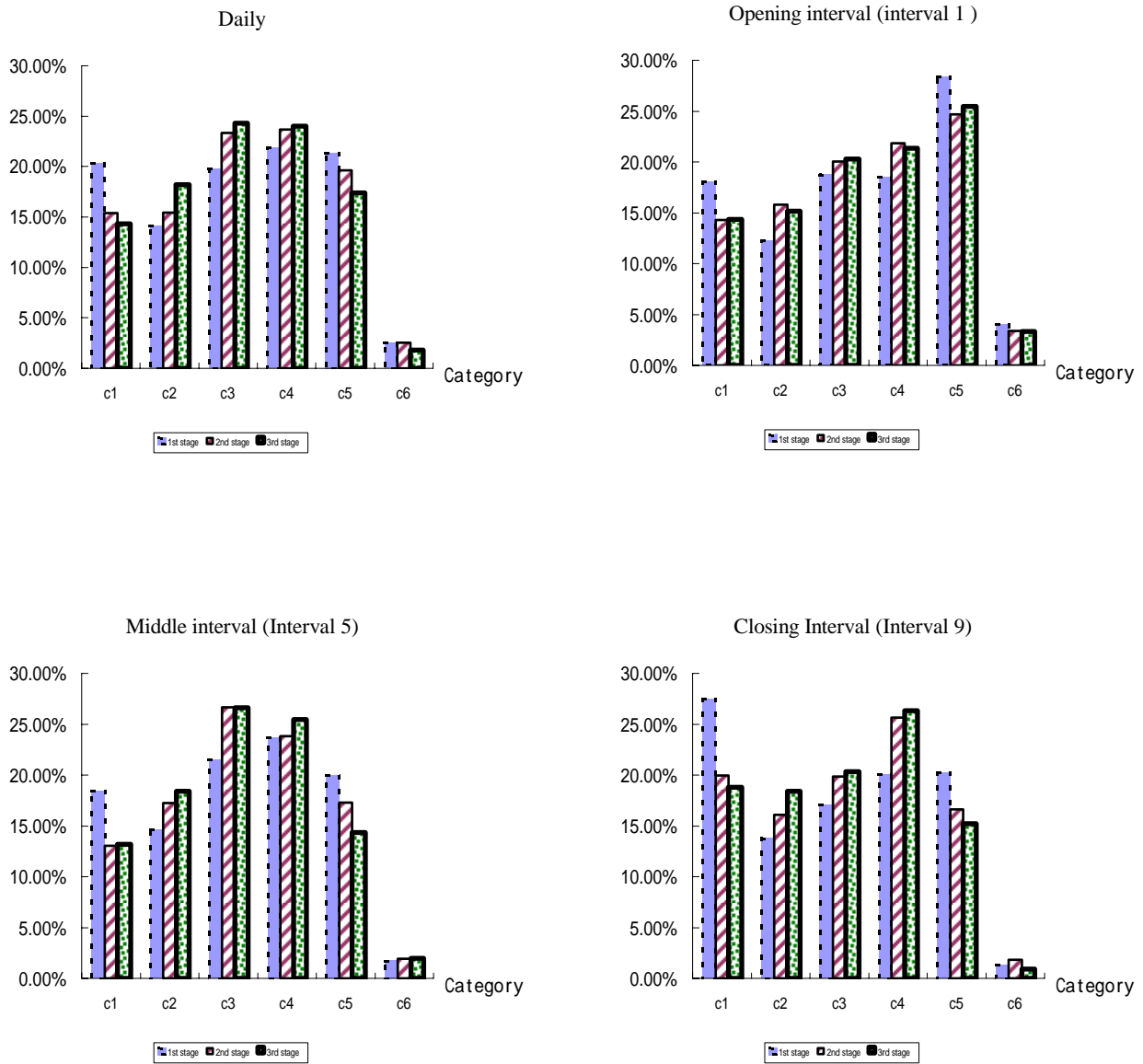
$$CL = \beta_0 + \beta_1 High + \beta_2 Uninf + \beta_3 Board + \beta_4 Equity + \beta_5 Turnover$$

$$CE = \beta_0 + \beta_1 High + \beta_2 Margin + \beta_3 Turnover + \beta_4 Board$$

CV : volatility increment (the difference between stage1 and stage3)  
 CL : liquidity increment (the difference between stage1 and stage3)  
 CE : market efficiency increment (the difference between stage1 and stage3)  
 High : the high disclosing rate dummy variable  
 Board : directors shareholding  
 PER : price/earning ratio  
 PBR: price/book ratio  
 Uninf : numbers of individual trades  
 Equity : growth rate of equity  
 Turnover : turnover ratio  
 Margin : margin ratio

CV		CL		CE	
coefficient	t	coefficient	t	coefficient	t
-4.2600	-2.8243 ***	-1.84E-05	-2.0176 *	3.25E-02	0.5554
0.9518	0.9303	1.34E-06	0.2069	1.88E-02	0.5682
0.0482	1.7162 *	2.16E-07	1.0793	-1.69E-03	-1.6141
-0.0055	-3.2565 ***				
1.2537	1.9558 *				
		1.21E-10	3.4493 ***		
		3.05E-08	0.5310		
		2.05E-07	1.3351	-2.82E-03	-3.2065 ***
				2.46E-01	2.1606 **

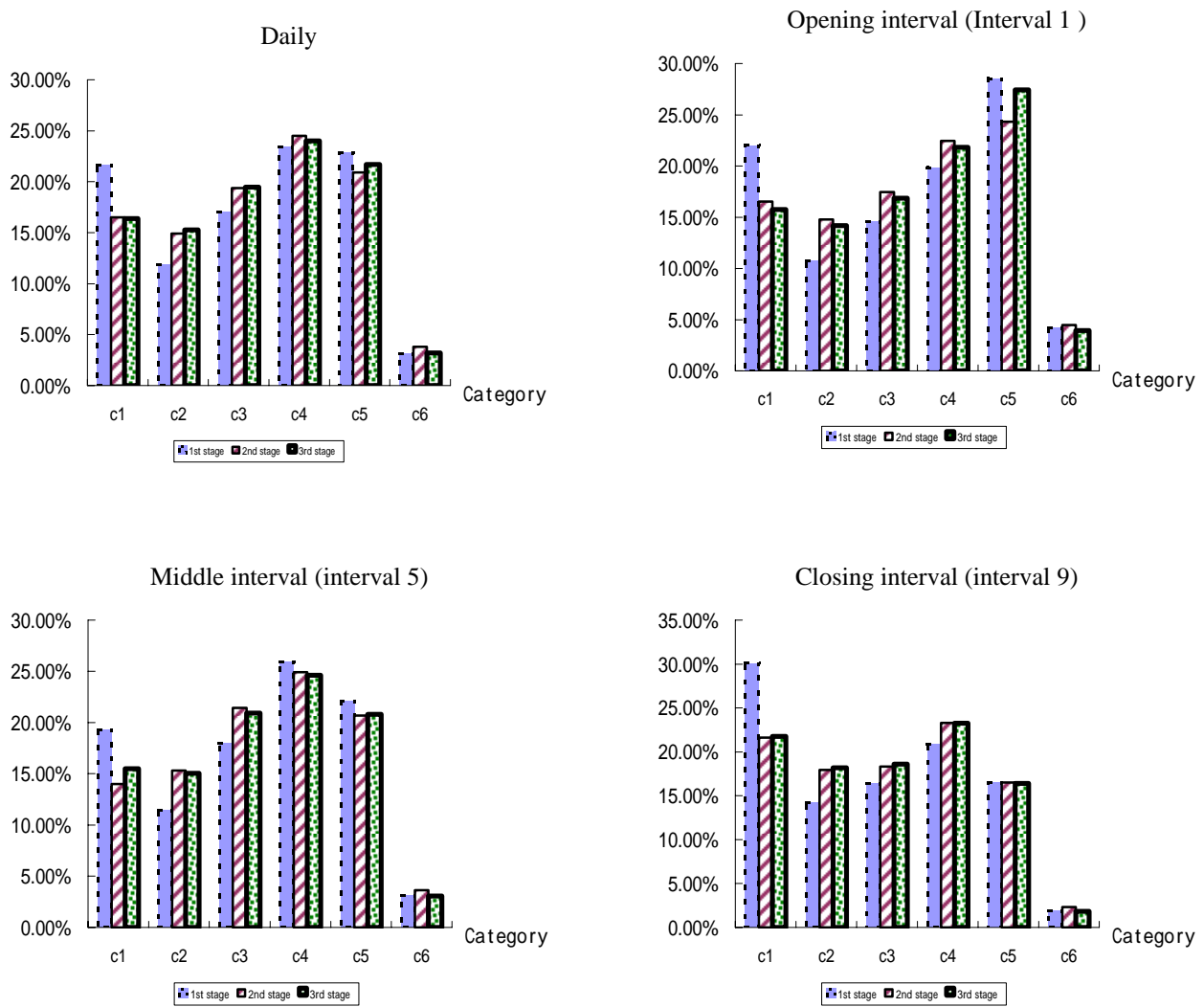
\* indicates significant at 10%, \*\* indicates significant at the 5%, and \*\*\* indicates significant at the 1%



**Figure 1** The distribution of order types for institutional investors at the opening, middle, and closing intervals.

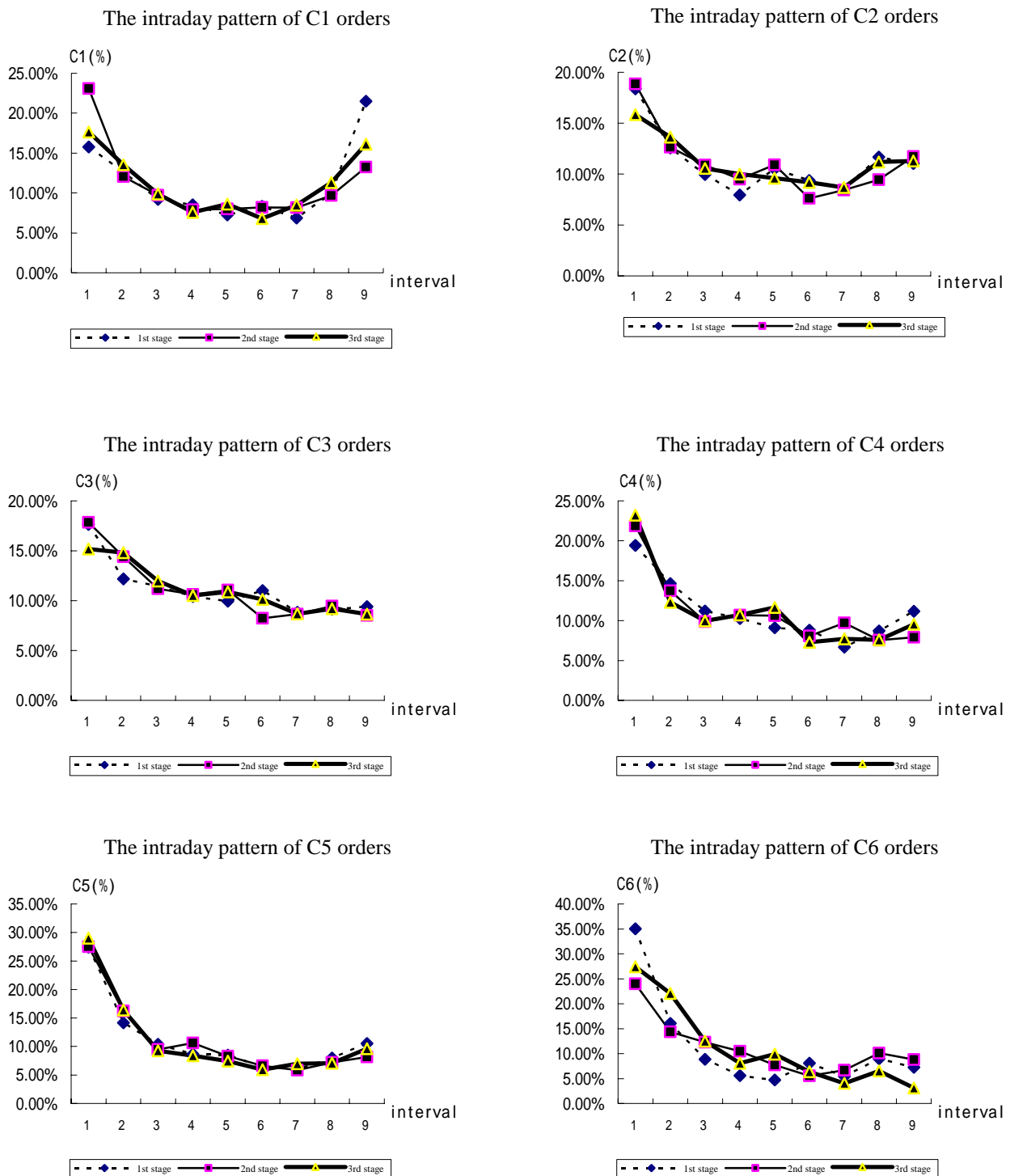
This figure illustrates the distribution of institutional order submission at the opening, middle, and closing intervals in the three stages. Interval 1 is the time interval between 9:01 am and 9:30 am, interval 5 is the time interval between 11:00 am and 11:30 am, and interval 9 is the time interval between 13:00 pm and 13:29 pm. The upper left figure illustrates the average daily distribution of order types. Orders are classified into six categories based on the level of aggressiveness. For example, "C1" represents the category 1 orders, i.e. the most aggressive orders. The vertical axis is the proportion of each order category at a given interval.





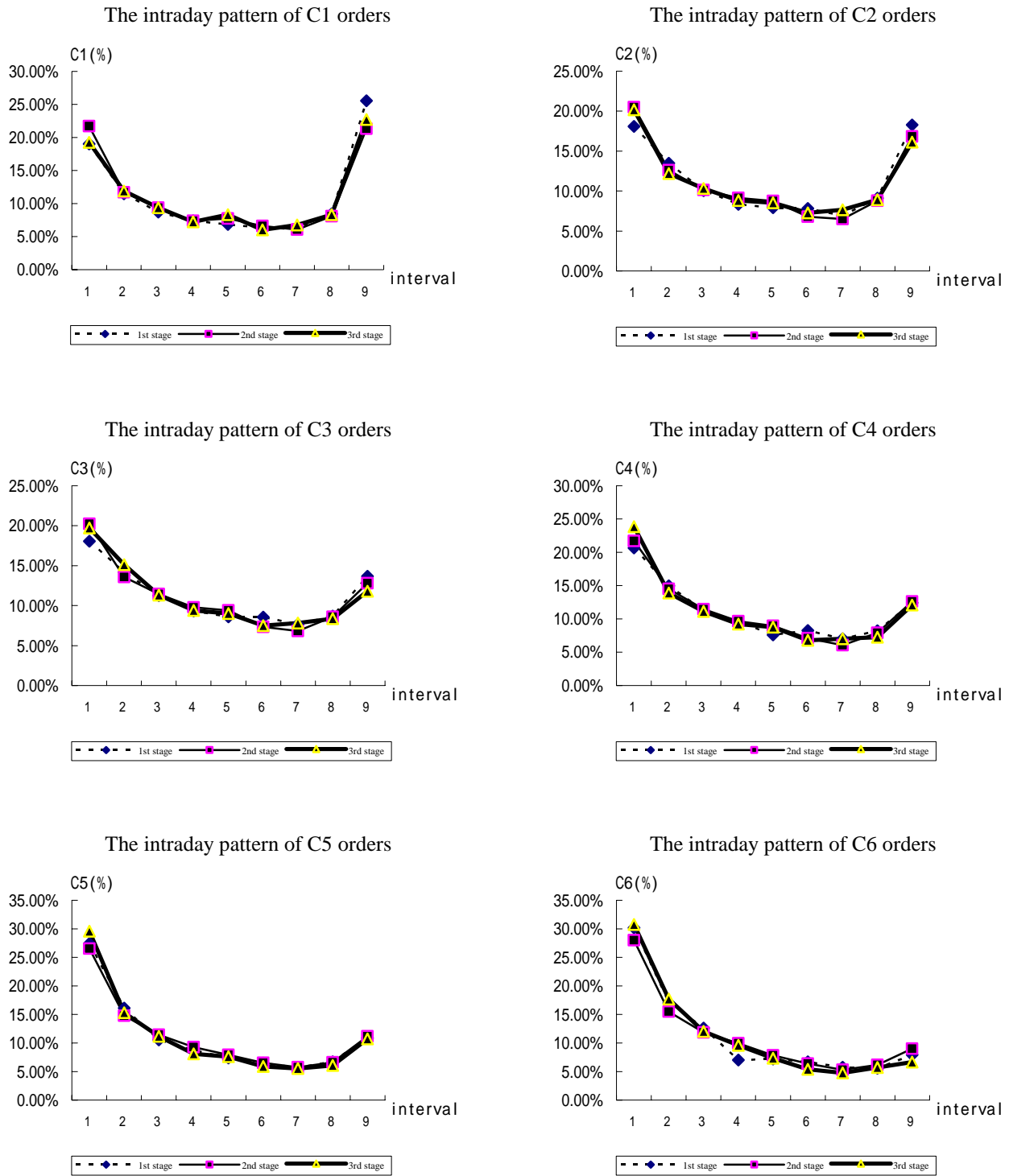
**Figure 2** The distribution of order types for individual investors at the opening, middle, and closing intervals.

This figure illustrates the distribution of individual order submission at the opening, middle, and closing intervals in the three stages. Interval 1 is the time interval between 9:01 am and 9:30 am, interval 5 is the time interval between 11:00 am and 11:30 am, and interval 9 is the time interval between 13:00 pm and 13:29 pm. The upper left figure illustrates the average daily distribution of order types. Orders are classified into six categories based on the level of aggressiveness. For example, "C1" represents the category 1 orders, i.e. the most aggressive orders. The vertical axis is the proportion of each order category at a given interval.



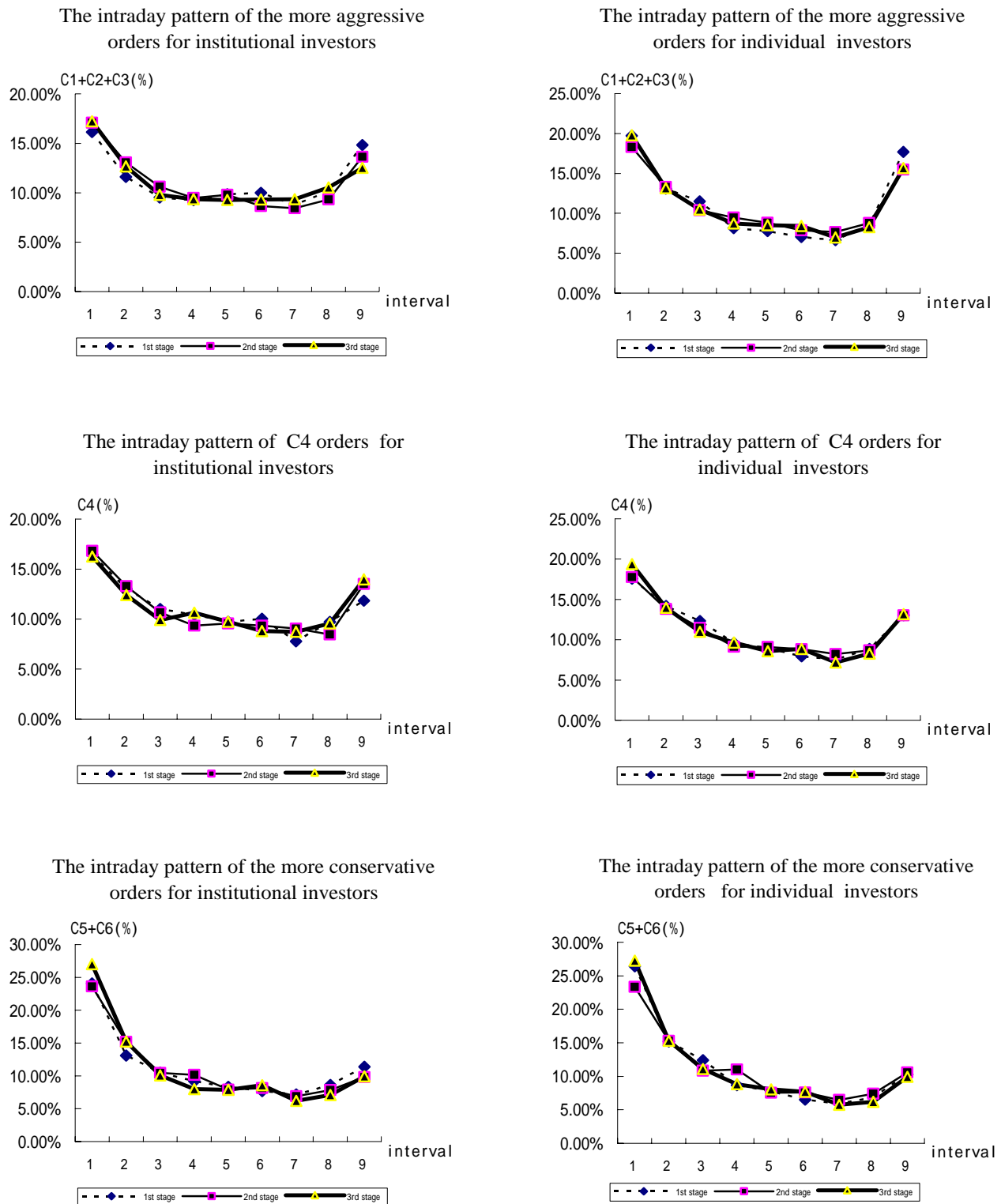
**Figure 3 The intraday patterns of each order type under various transparency level for institutional investors**

The figure illustrates the intraday patterns of each order type for institutional investors. Orders are classified into six categories based on the level of aggressiveness. The trading time is divided into nine 30-minute trade intervals. For example, "interval 1" indicates the time interval between 9:01 am and 9:30am, and "C1" represents the category 1 orders, i.e. the most aggressive orders. The vertical axis is the proportion of orders placed in each interval for a given order category.



**Figure 4 The intraday pattern of each order type under various transparency level for individual investors**

The figure illustrates the intraday patterns of each order type for individual investors. Orders are classified into six categories based on the level of aggressiveness. The trading time is divided into nine 30-minute trade intervals. For example, "interval 1" indicates the time interval between 9:01 am and 9:30am, and "C1" represents the category 1 orders, i.e. the most aggressive orders. The vertical axis is the proportion of orders placed in each interval for a given order category.



**Figure 5 The intraday pattern of aggregated order types for institutional and individual investors**

The figure illustrates the intraday patterns of order aggressiveness for institutional and individual investors by summarizing order categories into three: more aggressive, the best price order, and the conservative. "C1+C2+C3" is the aggregation of the more aggressive orders, C4 includes the best quote orders, and 'C5+C6' are the more conservative orders. "Interval" means the time interval that contains 30 minutes. For example, "interval 1" indicates the time interval between 9:00 am and 9:30am.