An Empirical Analysis of Undisclosed Limit Orders Submissions around Earnings Announcements on the Australian Securities Exchange

Ngoc Duc Duong, Huu Nhan Duong, and Charles Corrado

Ngoc Duc Duong, School of Accounting, Economics and Finance, Faculty of Business and Law, Deakin University, 221 Burwood Highway, Burwood, Victoria 3125, Australia. Telephone: (+613) 9244 3815; Email: nduong@deakin.edu.au.

Huu Nhan Duong, School of Accounting, Economics and Finance, Faculty of Business and Law, Deakin University, 221 Burwood Highway, Burwood, Victoria 3125, Australia. Telephone: (+613) 9244 6146; Email: huu.duong@deakin.edu.au.

Charles Corrado, School of Accounting, Economics and Finance, Faculty of Business and Law, Deakin University, 221 Burwood Highway, Burwood, Victoria 3125, Australia. Telephone: (+613) 9244 6214; Email: Charles.corrado@deakin.edu.au.

An Empirical Analysis of Undisclosed Limit Orders Submissions around Earnings Announcements on the Australian Securities Exchange

Abstract

This study investigates the information content of undisclosed limit orders before earning announcements for stocks traded on the Australian Securities Exchange (ASX). We also examine the impact of the removal of broker identities on the informativeness of undisclosed limit orders. We document permanent price impact following the submissions of undisclosed limit orders in both transparent and anonymous market. We find no evidence that informed traders use undisclosed limit orders more often than other types in pre-anonymity market. After the brokers' ID is removed, informed traders prefer to use undisclosed limit orders over disclosed limit orders.

Keywords: Undisclosed limit orders, disclosed limit orders, market orders, anonymity.

JEL Classification: G10, G20, G24

1. INTRODUCTION

This study investigates the submissions of Undisclosed Limit Orders (ULOs) before earnings announcement for stocks traded on the Australian Securities Exchange (ASX). In doing so, this study addresses two research questions. Firstly, are ULOs submitted by more informed traders prior to the release of earning announcements? Secondly, does the information content of ULOs increase or decrease after the ASX's switch to anonymous trading system on November 28, 2005?

When making trading decision, investors can choose to place market orders or limit orders. Corrado and Jordan (2005, p.153) define market order as "an order to buy or sell securities marked for immediate execution at current market price. In contrast, limit order is an order to buy or sell securities with a specified "limit" price. The order can be executed only at the limit price or better". On the ASX, traders can also choose to submit ULOs which allow them to partially reveal their limit orders' size. The purpose of ULOs submissions is that these orders allow traders to hide their full trading intentions (Aitken et al., 2001).

This study analyses the submissions of ULOs around earning announcements, the periods associated with high information asymmetry. This examination is important for various reasons. Firstly, hidden orders are important components of equity markets. Aitken et al. (1996) finds that a total of 6% of all submitted orders on the ASX were undisclosed, accounting for 28% of total volume. International evidences are reported in Degryse (1999) who document that hidden orders account for over 16% of the order book in the Brussels CATS system. Similarly, Bessembinder et al. (2009) find that hidden orders represent 44% of all order volume in their sample of 100 firms traded on the Euronext Paris. Anand and

Weaver (2004) also observe that hidden orders account for approximately 7% of submitted total volume on the Toronto Stock Exchange (TSX).

Secondly, the findings of the study will reveal whether ULOs are used by more informed traders and thus, highlight the way information is incorporated into prices. Thirdly, given there is a current trend of equity markets moving towards anonymous trading system and remove the identities of brokers[1], it is important to understand how traders react to this reduction in market transparency. More specifically, this study analyses ULOs submissions around the last earning announcement before the removal of broker IDs on 25 November 2005 and the first earning announcement after the switch to anonymous market.

Finally, the examination of ULOs submissions on the ASX is further motivated by unique features of ULOs on the ASX. In comparison to iceberg orders on other stock exchanges, the hidden portion of ULOs on the ASX has the same execution priority as the disclosed part. In contrast, hidden portions of iceberg orders are treated as new order submissions in the order book and thus, lose execution priority. As a result, hidden portions of iceberg orders face the risk of not being executed in the required time frame (Esser and Monch,2007).

This study contributes to the current literature in the following ways. Firstly, this study analyses the submissions of ULOs around earning announcements. This examination contributes to the current debate regarding whether informed traders use limit orders. Prior literature has been inconclusive regarding this issue. Glosten (1994) and Seppi (1997) argue that informed traders use only market orders. In contrast, more recent studies such as Chakravarty and Holden (1995), Bloomfield et al. (2005), Anand et al. (2005), Wald and

[1] Markets that have recently removed broker IDs and switched to anonymous trading system includes the Euronext Paris on April 23, 2001; the Tokyo Stock Exchange on June 30, 2003; and the Australian Securities Exchange on November 28, 2005.

Horrigan (2005), Kaniel and Liu (2006), Rosu (2009) and Goettler et al. (2009) find that limit orders are important components of the informed traders' order submission strategies. Given that ULOs allow traders to hide their trading intentions and earning announcements are periods associated with high information asymmetry, the analysis of the submissions of ULOs around earning announcements will provide insights into the use of limit orders by informed traders. Furthermore, this investigation can also reconcile differences in prior studies regarding the information content of ULOs such as Aitken et al. (2001), who show that ULOs are not used by informed traders and Chakrabarty and Shaw (2008) who observe increases in hidden order activity during earning announcements periods.

Secondly, w extend the current literature by examining the impact of the removal of broker IDs (the move to anonymity) on the information content of ULOs. Prior literature on broker anonymity tends to focus on the impact of the removal of broker IDs on liquidity (Comerton-Forde et al., 2005; Foucault et al., 2007; Comerton-Forde and Tang, 2009; Duong and Kalev, 2010a) or the information content of the limit order book (Foucault et al., 2007; Duong and Kalev, 2010b). One exception is Lepone and Mistry (2009), who document no significant changes in the information content of ULOs after the removal of broker IDs on the ASX. This study differs from prior literature by investigating the effect of the move to anonymity on the submissions of ULOs around earning announcements. Since earning announcements are associated with high information asymmetry, it will be more suitable to examine the impact of the removal of broker IDs on the information content of ULOs based on the period surrounding earning announcements. Given the importance of ULOs in the trading process of the ASX, and the fact that ULOs allow traders to hide their identity and their order size in anonymous market, the findings of this study will contribute to the understanding of the order exposure strategies of investors in transparent and anonymous market.

Investigating ULOs submissions during the period before earnings announcements, we document strong support for the permanent price impact of ULOs in both transparent and anonymous market. However, we do not observe significant difference in price reactions after the submission of disclosed and undisclosed limit orders in transparent market. After the move to anonymity, ULOs become more informative than DLOs, especially in sell orders. Overall, our results suggest that informed traders do incorporate ULOs in their order submission strategies, especially after the removal of broker IDs on the ASX.

The rest of the paper is organized as follows. Section 2 provides a review of existing literature. Section 3 describes the data and research methodology. Section 4 presents results and discussions. Section 5 concludes this paper.

2. LITERATURE REVIEW

2.1 The information content of undisclosed limit orders

The issue of the information content of undisclosed limit orders is related to the literature on the use of limit and market orders by informed traders. Early studies, such as Glosten (1994) and Seppi (1997) argue that informed traders only submit market orders, thus, limit orders contain no information regarding future price movements. In contrast, more recent studies provide both theoretical background and empirical evidence supporting the use of limit orders by informed traders. Chakravarty and Holden (1995) show that for a risk-neutral informed trader, it is more profitable for informed traders to combine market and limit orders instead of only placing market orders. Similarly, Wald and Horrigan (2005) suggest that rather than submitting market orders, it is optimal for informed traders to place slightly discounted limit orders, often inside the bid-ask spread, because the execution risk for these limit orders is minimal. Kaniel and Liu (2006) also support the use of limit orders by informed traders. The

authors highlight that when the expected time horizon for informed traders' private information is high, informed traders are more likely to submit limit orders instead of market orders. Moreover, when the probability that the information is long-lived is high enough, limit orders might be more informative than market orders. With the availability of limit order book data, various studies has documented the informativeness of limit orders for future volatility (see, among others, Ahn et al., 2001; Foucault et al., 2007; Pascual and Veredas, 2010; Duong and Kalev, 2010b); future trading volume (see, among others, Irvine et al., 2000; Kavajecz and Odders-White, 2004); and future returns (see, among others, Harris and Panchapagesan, 2005; Kalay and Wohl, 2009; Cao et al., 2009).

Regarding hidden orders, Harris (1996) argues that this type of order can help uninformed traders mitigate the option value of a standing limit order. In contrast, Monais (2006) develops a theoretical framework where an informed trader with long-lived private information on security value submits large limit orders with hidden depth. This order submission strategy allows the informed traders to protect their trading intention by mimicking the behaviour of uninformed liquidity traders.

Empirical evidence on the information content of ULOs on the ASX is provided by Aitken et al. (2001). These authors find that there is no difference in stock price reaction between disclosed and undisclosed limit orders. This finding implies that undisclosed limit orders are not used by informed traders. In the context of using hidden orders in the periods surrounding earning announcements, Chakrabarty & Shaw (2008) report that hidden order trade volume, the number of hidden order executed, hidden order trade size and the full size of hidden orders executed all increase. They also find that changes in hidden order activity at earning announcements are related to firm's pre-announcement information environment, the

information conveyed by the earnings announcement and changes in quoted liquidity. These findings provide support for the use of hidden orders by informed traders before earning announcements. Bessembinder et al. (2009) document that for stocks traded on the Euronext Paris, hidden orders are associated with lower implementation shortfall cost and smaller opportunity cost. These results imply that hidden orders are used primarily by traders without superior information on future security price movements.

2.2 The removal of broker identities and the information content of undisclosed limit orders

Foucault et al. (2007) provide a theoretical model on the impact of the removal of broker identities on the information content of the limit order book. The authors argue that if the participation rate of the informed traders is low, a move to anonymity will increase the order aggressiveness of uninformed investors, which in turn reduce the bid-ask spread and its correlation with future volatility.

Prior empirical studies on the effect of the removal of broker identities often focus on the impact of this change in market transparency on liquidity. The move to anonymous market is often found to enhance market liquidity, as reflected by the bid-ask spread, market depth or order aggressiveness (see, among others, Comerton-Forde et al., 2005; Foucault et al., 2007; Comerton-Forde and Tang, 2009; Duong and Kalev, 2010a). The effect of anonymity on the information content of the order book is documented in Foucault et al. (2007) and Duong and Kalev (2010b). Foucault et al. (2007) present evidence of a decline in the informativeness of the bid-ask spread, which reflects the information contained in the first step of the limit order book, after the move to anonymity on the Euronext Paris. Examining the limit orders at and beyond the first level of the limit order book, Duong and Kalev (2010b) document an

increase in the information content of limit orders after the removal of broker identities on the ASX. Regarding the effects of anonymity on ULOs submissions, Lepone and Mistry (2009) come to the conclusion that the removal of broker identities has no significant effect on the information content of ULOs on the ASX. It is important to note that this finding is based on "normal" trading period, without any analysis for the periods surrounding firm-specific announcements.

The current study investigates the effect of the move to anonymity of the ASX on the information content of ULOs during the periods before earning announcements. Since using ULOs in anonymous market allows informed traders to hide both their identities and their trading intention (order size), it is expected that the information content of ULOs will increase after the removal of broker identities on the ASX.

3. DATA AND METHODOLOGY

We investigate the submissions of ULOs around earning announcements based on limit order book data provided by the Securities Industry Research Centre of Asia Pacific. The limit order book data contain details on every order submitted to the ASX, 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), which allow for the tracking of every order from its initial submission through to any revision, cancellation or execution. This dataset also contains information regarding whether the order is partially revealed. We also collect intraday bid-ask quotes date from SIRCA. These data provide information on stock code, date, time to the nearest hundredth of a second, and the best bid

and ask quotes in the limit order book. We remove those all observation with negative bid quote or ask quote and all observations with higher bid quote than ask quote.

The date and time of the all earning announcements are collected from the Signal G database, also provided by SIRCA. In order to ensure sufficient trading interest and liquidity of the stocks under investigation, this study examines the constituent stocks of the S&P/ASX 50 index. For each stock, the sample period is based on four weeks before the last earning announcement in the transparent market (before the removal of broker IDs) and four weeks before the first earning announcement in the anonymous market (after the removal of broker IDs).

Following Aitken et al. (2001), we examine the use of ULOs by informed traders around earnings announcements by comparing the price impact of ULOs with other market orders (MOs) and disclosed limit orders (DLOs). For each ULO, a matching DLO and MO of the same stock are selected such that they are of order sizes within 10% of the ULO; in the same direction (buy/sell); within 30 days of each other; not within 30 minutes before or after the submission of each other and with a current bid-ask spread in terms of ticks, within two ticks of the bid-ask spread at the time of the ULO submission. To tackle the fact that each ULO can be matched with multiple MOs and DLOs, for each ULO, we use the average of the price impact of the "matched" MOs and DLOs.

To measure the information content of the different order types, we measure stock price reaction at 1, 5 and 30 minutes after order submission. For limit orders, the best opposite-side quote prevailing at the time of submission is taken as the reference price. For market orders, same-side quotes are used because the execution of a market order results in a change in the

opposite-side of the order book. The comparison of stock price reaction after ULOs, DLOs and MOs submissions will reveal whether ULOs have larger price impact and thus, contain more information than other DLOs and MOs.

4. RESULTS AND DISCUSSION

Table 1 shows the results of the information content of ULOs, DLOs and MOs during the four weeks prior to the last earning announcement in transparent market. Panel A and B presents the results of buy orders and sell orders, respectively. The t-statistic value is used in the hypothesis testing with the null hypothesis of no difference between mean returns of DLOs and ULOs.

In general, sell order submissions have negative impact on stock price regardless of the usage of MOs, DLOs or ULOs while buy orders appear to have positive impact on stock price. The price impacts are greatest for MOs for both buy and sell orders. All of the return for MOs and DLOs are significantly different from zero, implying permanent price impacts after the submissions of these orders. More importantly, the price impacts of ULOs are significantly different from zero for buy orders and for sell orders when considering 1 minute after the order submission. This finding is different from that of Aiken et al (2001) who find no significant price impact for ULOs. This result also highlights the importance of examining the information content of ULOs around earnings announcements period. Finally, the price reactions following ULOs submissions are not significantly different from those following DLOs submissions. This finding is consistent with Aiken et al (2001). We therefore conclude that in the transparent market, ULOs do not contain more information than DLOs.

[INSERT TABLE 1 HERE]

Table 2 presents the results of price reactions following ULOs, DLOs and MOs submissions during the four week prior to the first earning announcement after the removal of brokers' ID. Sell orders still have negative impacts on stock price regardless of submissions of DLOs, MOs or ULOs. After 1 minute, buy orders increase stock price by almost 0.07% while sell orders lower prices by 0.05%. Price reactions after submissions of buy orders remain significant and create long-term impact on stock price. However, there are different price reactions depending on types limit orders submitted. If sell DLOs are placed, they make no permanent impact on stock price. In contrast, we observe permanent price impact following ULOs submissions in sell orders and in buy orders when considering 1 minute or 5 minute interval after the order submission. We also document that for sell orders, the price reactions following ULOs submissions is significantly different from the price reactions following DLOs submissions. Overall, our findings indicate that informed traders prefer ULOs over DLOs in the anonymous market.

[INSERT TABLE 2 HERE]

Table 3 shows the comparison in price reactions following submissions of ULOs in transparent market (year 2005) and anonymous market (year 2006). Sell ULOs make negative impact on stock price and the removal of broker IDs does not result in any significant difference between the price reactions following ULOs submissions. In term of buy ULOs, we only observe significant differences in 30-minute return but not in 1-minute or 5-minute return. This finding shows that ULOs makes no difference impact on price at short-run but it creates permanent impact on long-run.

[INSERT TABLE 3 HERE]

5. CONCLUSION

This study investigates the submission of undisclosed limit orders around earning announcement in periods before and after the removal of broker IDs on the ASX. In both transparent and anonymous market, we show significant price reactions following the submission of ULOs. We also find no significant in price reactions after the submission of disclosed and undisclosed limit orders in transparent market. However, in anonymous market, ULOs are more informative than DLOs, especially in sell orders. In the final analysis, we compare the price impact of ULOs in the pre- and post- anonymity period. We only find significant difference between the information content of buy ULOs in two markets at 30 minute interval.

REFERENCES

Ahn, H-J., Bae, K-H., Chan, K., 2001. Limit orders, depth, and volatility: Evidence from the Stock Exchange of Hong Kong. Journal of Finance 56, 767-788.

Aitken, M. J., Garvey, G., Swan, P., 1996. How brokers facilitate trades for long-term clients on competitive securities markets. Journal of Business 68, 1-33.

Aitken, M.J., Berkman, H., Mak, D., 2001. The use of undisclosed limit orders on the Australian Stock Exchange. Journal of Banking and Finance 25, 1589–1603.

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.

Anand, A.,Weaver, D., 2004. Can order exposure be mandated? Journal of Financial Markets 7, 405–426.

Bessembinder, H., Panayides, M., Venkataraman, K., 2009. Hidden liquidity: An analysis of order exposure strategies in electronic stock markets. Journal of Financial Economics 94, 361–383.

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.

Cao, C., Hansch, O., Wang, X., 2009. The information content of an open limit order book. Journal of Futures Markets 29, 16-41.

Chakrabarty, B., Shaw, K.W., 2008. Hidden liquidity: Order exposure strategies around earnings announcements. Journal of Business Finance & Accounting 35, 1220–1244.

Chakravarty, S., Holden, C., 1995. An integrated model of market and limit orders. Journal of Financial Intermediation 4, 213 -241.

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., 2009. Anonymity, liquidity and fragmentation. Journal of Financial Markets 12, 337-367.

Corrado, C.J., Jordan, B.D., 2005. Fundamentals of Investments – Valuation and Management. 3rd edition. Mc Graw Hill/ Irwin. New York.

Degryse, H., 1999. The total cost of trading Belgian shares: Brussels versus London, Journal of Banking and Finance 23, 1331-1356.

Duong, H.N., Kalev, P.S., 2010a. Anonymity and liquidity provision. Working paper, Deakin University.

Duong, H.N., Kalev, P.S., 2010b. Order book slope and price volatility. Working paper, Deakin University.

Esser, A., Monch, B., 2007. The navigation of an iceberg: The optimal use of hidden orders. Finance Research Letters 4, 68–81.

Foucault, T., Moinas, S., Theissen, E., 2007. Does anonymity matter in electric limit order markets? Review of Financial Studies 20, 1707–1747.

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

Goettler, R.L., Parlour, C.A., Rajan, U., 2009. Informed traders and limit order markets. Journal of Financial Economics 93, 67-87.

Harris, L., 1996. Does a minimum price variation encourage order exposure? Working paper, University of Southern California.

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.

Harris, L., Panchapagesan, V., 2005. The information content of the limit order book: Evidence from NYSE specialist decisions. Journal of Financial Markets 8, 25-67.

Irvine, P., Benston, G., Kandel, E., 2000. Liquidity beyond the inside spread: Measuring and using information in the limit order book. Working paper, Emory University.

Kalay, A., Wohl, A., 2009. Detecting liquidity traders. Journal of Financial and Quantitative Analysis 44, 29-54.

Kaniel, R., Liu, H., 2006. So what orders do informed traders use? Journal of business 79, 1867-1914.

Kavajecz, K.A., Odders-White, E., 2004. Technical analysis and liquidity provision. Review of Financial Studies 17, 1043-1071.

Lepone, A., Mistry, M., 2009. Transparency and information content of undisclosed limit orders: evidence from the Australian market. Working paper, University of Sydney.

Monais, S., 2006. Hidden limit orders and liquidity in limit order markets. Working paper, Toulouse Business school.

Pascual, R., Veredas, D., 2010. Does the limit order book matter in explaining informational volatility. Journal of Financial Econometrics 8, 57-87.

Rosu, I., 2009. A dynamic model of the limit order book. Review of Financial Studies 22, 4601-4641.

Seppi, D., 1997. Liquidity provision with limit orders and a strategic specialist. Review of Financial Studies 10, 103-150.

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

Table 1: Stock price reaction at 1 minute, 5 minute and 30 minute after order submission for matched ULO-DLO-MO in transparent market

This table presents results of the investigation of stock price reaction at 1 minute, 5 minute and 30 minute after the submissions of undisclosed limit orders (ULOs), market orders (MOs) and disclosed limit orders (DLOs) during the four weeks prior to the last earnings announcements in transparent market. For ULOs and DLOs, stock price reaction at 1 minute, 5 minute and 30 minute for a buy (sell) order is measured as the difference between the natural logarithm of the best ask (bid) quote at 1 minute, 5 minute and 30 minute after the order submission and the natural logarithm of the best ask (bid) quote at the time of the order submission. For MOs, stock price reaction at 1 minute, 5 minute and 30 minute for a buy (sell) order is measured as the difference between the natural logarithm of the best bid (ask) quote at 1 minute, 5 minute and 30 minute after the order submission and the natural logarithm of the best bid (ask) quote at the time of the order submission. For each ULO, matching DLOs and MOs of the same stock are selected such that they are of order sizes within 10% of the ULO; in the same direction (buy/sell); within 30 days of each other; not within 30 minutes before or after the submission of each other and with a current bid-ask spread in terms of ticks, within two ticks of the bid-ask spread at the time of the ULO submission. The numbers within the parentheses are the test statistics for the null hypothesis that returns after 1 minute, 5 minutes and 30 minutes are equal to zero. “t-statistics” is the test statistic for the null hypothesis of equal mean returns for ULOs and DLOs.

	1 min	5 min	30 min
Panel A: Buy-orders			
MOs	0.0684	0.0738	0.0955
	(19.372)	(17.036)	(11.0504)
DLOs	0.007810	0.0145	0.0142
	(3.569)	(4.629)	(4.5605)
ULOs	0.0195	0.0159	0.0285
	(3.5527)	(2.1148)	(1.7566)
ULO - DLO	0.01169	0.00140	0.01430
t-statistic (DLO = ULO)	1.9757	0.175	0.862
Panel B: Sell-orders			
MOs	-0.0383	-0.0488	-0.0508
	(-12.48)	(-11.847)	(-7.8168)
DLOs	-0.0125	-0.0218	-0.0218
	(-4.425)	(-4.366)	(-4.3658)
ULOs	-0.013	-0.0120	-0.0213
	(-2.516)	(-1.161)	(-1.099)
ULO - DLO	-0.0005	0.0098	0.0005
t-statistic (DLO = ULO)	-0.095	0.8514	0.0225

Table 2: Stock price reaction at 1 minute, 5 minute and 30 minute after order submissions for matched ULO-DLO-MO after brokers' ID have been removed

This table presents results of the investigation of stock price reaction at 1 minute, 5 minute and 30 minute after the submissions of undisclosed limit orders (ULOs), market orders (MOs) and disclosed limit orders (DLOs) during the four weeks prior to the last earnings announcements in anonymous market. For ULOs and DLOs, stock price reaction at 1 minute, 5 minute and 30 minute for a buy (sell) order is measured as the difference between the natural logarithm of the best ask (bid) quote at 1 minute, 5 minute and 30 minute after the order submission and the natural logarithm of the best ask (bid) quote at the time of the order submission. For MOs, stock price reaction at 1 minute, 5 minute and 30 minute for a buy (sell) order is measured as the difference between the natural logarithm of the best bid (ask) quote at 1 minute, 5 minute and 30 minute after the order submission and the natural logarithm of the best bid (ask) quote at the time of the order submission. For each ULO, matching DLOs and MOs of the same stock are selected such that they are of order sizes within 10% of the ULO; in the same direction (buy/sell); within 30 days of each other; not within 30 minutes before or after the submission of each other and with a current bid-ask spread in terms of ticks, within two ticks of the bid-ask spread at the time of the ULO submission. The numbers within the parentheses are the test statistics for the null hypothesis that returns after 1 minute, 5 minutes and 30 minutes are equal to zero. "t-statistics" is the test statistic for the null hypothesis of equal mean returns for ULOs and DLOs.

	1 min	5 min	30 min
Panel A: Buy-orders			
MOs	0.0686	0.0775	0.0795
	(16.1424)	(15.3521)	(9.0821)
DLOs	0.00778	0.0158	0.0158
	(2.9004)	(3.3131)	(3.3131)
ULOs	0.0223	0.0302	-0.0304
	(4.2626)	(3.0784)	(-1.4969)
ULO - DLO	0.01452	0.01440	-0.04620
t-statistic	2.4709	1.319	-2.215
(DLO = ULO)			
Panel B: Sell-orders			
MOs	-0.0563	-0.0658	-0.0895
	(-12.976)	(-15.7801)	(-11.9157)
DLOs	0.00166	-0.00125	-0.00125
	(0.4624)	(-0.1894)	(-0.1894)
ULOs	-0.0182	-0.0258	-0.0386
	(-2.837)	(-2.4206)	(-1.9510)
ULO - DLO	-0.01986	-0.02455	-0.03735
t-statistic	-2.700462	-1.9593	-1.7913
(DLO = ULO)			

Table 3: Price reactions after submissions of ULOs in transparent market (year 2005) and anonymous market (year 2006)

This table presents results of the comparison of the stock price reactions following the submission of undisclosed limit orders (ULOs) in transparent and anonymous market. Stock price reaction at 1 minute, 5 minute and 30 minute for a buy (sell) order is measured as the difference between the natural logarithm of the best ask (bid) quote at 1 minute, 5 minute and 30 minute after the order submission and the natural logarithm of the best ask (bid) quote at the time of the order submission. "t-statistics" is the test statistic for the null hypothesis of equal mean returns for ULOs in transparent and anonymous market.

	1 min	5 min	30 min
Panel A: Buy-orders			
ULO (2005)	0.0195	0.0159	0.0285
ULO (2006)	0.0223	0.0302	-0.0304
ULO (2005) - ULO (2006)	-0.0028	-0.0143	0.0589
t-statistic	-0.3737	-1.1322	2.2174
(ULO 2005 = ULO 2006)			
Panel B: Sell-orders			
ULO (2005)	-0.013	-0.0120	-0.0213
ULO (2006)	-0.0182	-0.0258	-0.0386
ULO (2005) - ULO (2006)	0.0052	0.0138	0.0173
t-statistic	0.6044	0.9155	0.6150
(ULO 2005 = ULO 2006)			