Evidence on the Speed of Convergence to Market Efficiency in the Canadian Market

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ABSTRACT

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The process by which prices converge to achieve market efficiency is still unresolved in the Canadian market. By analyzing the pattern of serial dependence between returns and order imbalances for various lag lengths, we investigate the speed at which such serial dependence disappears in the Canadian market. Our major findings are that negative serial dependence gradually disappears and positive serial dependence gets weaker after each of the two minimum-quotation-increment-reductions. However, serial dependence between returns and order imbalances is still significant for elapsed times of up to sixty minutes.

Keywords: market efficiency, serial dependence, order imbalances.

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1. INTRODUCTION

Market efficiency is a topic that continues to be intensely studied in the financial literature. However, much of the literature examines this topic by examining if markets react quickly to various information events or whether momentum in various series (such as returns) can be used profitably in various investment strategies. Under the conditions that frictions can be the obstacles for information to be fully and rapidly incorporated into securities prices and investors may be semi-rational, it is reasonable to view market efficiency as a process and to argue that it takes at least some time for price discovery to be fully complete. This paper probes into this price-discovery process by examining several cross-sectional horizons, which are defined by the length of time elapsed after an order imbalance, and by analyzing the future return predictability of the order imbalances and returns for these horizons.

This paper provides more empirical evidence on the price discovery process behind market efficiency at the intraday level for the Canadian market. By examining the autocorrelations of returns and the correlation between subsequent returns and preceding order imbalance metrics, we conduct a weak-form or predictability test of market efficiency in the Canadian market.[1] By conducting these tests for different horizons from five minutes to one day, we investigate the speed of marker convergence to efficiency in the Canadian market. Finally, by comparing the results for years preceding and following two minimum-quotation-increment-

[1] Fama (1970, 1991) switched from the term weak-form efficiency to predictability tests.

reduction (MQIR) events in 1996 and 2002, we provide some initial evidence on the effect of these events on the price discovery process in the Canadian market.[2]

In order to accommodate a greater intensity of thin-trading problems in the Canadian market and to maximize the number of observations, we employ an alternative method for defining intraday horizons, which differs from that used by Chordia et al. (2005) in the US market. Instead of defining the horizons by specific time points within a day, we adopt a reverse procedure where we define a horizon as preceding from every point in time of trades as one observation.

Our major finding is that there is some predictability of future returns by returns and/or order imbalances for intraday and daily horizons in 1994 and 1999. This predictability remains at the intraday horizons but not at the daily horizon in 2002, which suggests that price discovery has become quicker with time. Comparisons of the significance of this predictability between years preceding and following the two MQIRs indicate that the predictability efficiency of Canadian market has improved after the MQIRs.

The remainder of the thesis is organized as follow. The relevant literature is briefly reviewed in the next section. The sample and data are described in section three. The hypotheses are formulated in section four. The results for univariate regressions between returns and lagged returns or one of the lagged order imbalance metrics are presented and discussed in section five. The results for multivariate regressions between one of the various types of returns and its lagged value and one of the order imbalance metrics are presented and analyzed in section six. Section seven concludes the thesis.

2. LITERATURE REVIEW

[2] Various studies have examined other aspects for the Canadian MQIR in 1996 (e.g., Ahn *et al.*, 1998; Chung *et al.*, 1996; Kryzanowski and Lazrak, 2011; Kryzanowski and Rubalcava, 2005; Kryzanowski and Zhang, 2002; Mittoo, 2003).

One definition of efficient capital markets is the case where security prices fully reflect all available information. In his first review article, Fama (1970) defined three types of informational efficiency that could be statistically tested depending on the broadness of the information incorporated in security prices. Weak form tests are concerned with the information contained in historical prices and volumes. Semi-strong form tests are concerned with all publicly available information. Finally, strong form tests include all information, irrespective of whether it is public or private.

In his second review article, Fama (1991) clarified the first two efficiency tests as being tests of return predictability and event studies, respectively. Most of the current efficient markets literature concentrates on return predictability and on event studies dealing with various macro or firm-specific announcements.[3] Given the need to protect the secrecy of their trading by insiders and specialists, strong form tests mostly focus on supposedly informed traders such as mutual funds managers.

A "fair game" concept serves as the criterion to judge market efficiency. It examines whether some investors can persistently earn a return above normal based on the available information. Tests of return predictability are tests of the random walk model, which is a restricted version of the fair game model. Therefore, evidence rejecting return predictability provides evidence supporting market efficiency with regard to historical prices (Elton *et al.,* 2007). Most of the literature analyzes return predictability at a daily or lower frequency. Far fewer studies examine such predictability at an intraday frequency, probably because it is a computationally intensive task to deal with millions and millions of data points. This paper considers market efficiency at the intraday level.

Obviously, market efficiency does not happen instantaneously. The models established in the papers by Grossman (1976), Grossman and Stiglitz (1980) and Cornell and Roll (1981), amongst others, suggest that transaction costs are not zero in the real world, so that a more

[3] This literature is too extensive to review in this thesis.

realistic definition of market efficiency would be that price reflects information until the marginal costs of obtaining information and trading no longer exceed the marginal benefit of doing such.

Moreover, what the three types of tests refer to is a rational economy with "informational efficiency". It requires that a sufficient number of the investors in the market are completely rational. However, investors may instead be semi-rational, acting rationally most of the time but irrationally from time to time. DeBondt and Thaler (1985, 1987) argue that investors overreact to the losers and winners in the market, and that the most extreme losers outperform and the most extreme winners underperform in subsequent periods. Furthermore, voluminous experimental results also demonstrate semi-rationality of investors. Haruvy *et al.* (2007) find that most traders do not expect market downturns in the first experience of an experiment and overestimate the remaining time left for downturns to occur in the following repeated sessions. Lei *et al.* (2001) find that bubbles and crashes still exist even if speculation is forbidden in the experiments. It seems that investors need time to evaluate information precisely or even to react to it. Therefore, the importance of interpreting market efficiency as a price-discovery process is reinforced.

In contrast, research on the association between market returns and volumes dates back to the 1970s and earlier. Karpoff (1987) reviews the empirical results about and the theoretical explanations for relationships between volumes and the absolute values of price changes and between volumes and the price changes per se. Gallant *et al.* (1992) find that large price movements are followed by higher subsequent volumes. Hiemstra and Jones (1994) document significant bidirectional nonlinear causality between returns and volumes. More recently, Lo and Wang (2000) explain the volume implications of popular asset pricing models, such as the CAPM and ICAPM.

However, we believe that order imbalance, computed as the number of buyer-initiated trades minus the number of seller-initiated trades, is likely to be a better measure of trading activities than volume. As argued by Chordia *et al.* (2002), order imbalances may "signal private information". Moreover, order imbalances may exert pressure on the inventory of market makers

if they fail to predict this kind of imbalance, which in turn will affect market quotes. The inventory models of Stoll (1978), Ho and Stoll (1983) and Spiegel and Subrahmanyam (1995), for example, all account for such inventory concerns.

Chordia *et al.* (2005) report the evidence on the speed of convergence to market efficiency in the US markets and find that this process lasts more than five minutes but less than sixty minutes. Also, the time needed for the market to reach efficiency has shortened as the US market underwent MQIR events in 1997 and 2001. Similar Canadian MQIRs occurred in 1996 and 2001. However, as argued by Smith *et al.* (2000), Canadian and US markets differ in many ways, including network externalities, market quality and trading activity. Therefore, by investigating the relationship between returns and order imbalances at the intraday level in the Canadian market, we will provide out-of-sample evidence dealing with the return predictability hypothesis.

3. SAMPLE AND DATA

In this thesis, only stocks that are likely to be more frequently traded are considered due to the difficulty of measuring serial dependence between subsequent returns and order imbalances for highly infrequently traded (such as many small) stocks. Thus, our initial sample is the largest 100 stocks as proxied by TSX100 membership on the Toronto Stock Exchange (TSX) for the three representative years of 1994, 1999 and 2002. These years are chosen because they bracket two Canadian MQIR events. On April 15, 1996, the TSX reduced the MQI from C$1/8 to C$0.05 for stocks priced above C$5. For stocks priced between C$3 and C$5, the MQIR was reduced from C$0.05 to C$0.01. The TSX further reduced the MQI to one cent for all stocks priced above fifty cents in January, 2001. We expect the pattern of intraday and/or daily dependence of returns and between returns and order imbalances changed from years preceding to years following these events.

All of the stocks chosen in these three years are ordinary equities. Based on the composite lists of TSX100 shares at the beginning and the end of each year[4], stocks are further excluded if they (1) were not continually listed throughout the year; or (2) were not traded at least once on at least ten trading days that year; or (3) split or paid a stock dividend during the year. This reduced the sample to 87 stocks in 1994, 83 stocks in 1999 and 86 stocks in 2002.

Trade and quote (TAQ) data for each stock in the final sample is drawn from the TSX TAQ database. For the trade data, we delete (1) transactions labeled "Odd Lot", "Sales Delayed", "Delayed Delivery", "Certificate", "Not Net", "Cancellation", "Cancelled", "Special Terms" or "Corrections"; (2) transactions before the opening at 9:30 or after the closing at 16:00; (3) any days for a stock where the average price for that day falls below C$2 to avoid any contaminating influence of the MQIR for this breakpoint; and (4) transactions with non-positive trade prices, or non-positive number of traded shares, or trade-by-trade return larger than 50%. For the quote data, we exclude quotes if they (1) are labeled as "Pre-open" or "Halted"; (2) result in bid-ask spreads less than zero or more than 30% of the mid-spread; (3) are non-positive bid or ask prices, or (4) are associated with a zero bid or ask size. Only the prevailing BBO (best bid and offer) are chosen for each point in time.

3.1 Intraday and daily intervals

In order to assess how long within the day pressure from order imbalances continue to move prices, we consider five intraday post-order-imbalance intervals (five, ten, fifteen, thirty and sixty minutes) and a daily interval. We initially attempted to define intervals by specific time points (e.g. 9:30-10:00 for one thirty-minutes interval), but more than 50% of the intervals failed to get matched for a lag of five minutes after we discarded returns where the closest price to either end of the interval is more than two and a half minutes away.

[4] TSX 60 membership is used to replace TSX 100 membership at the end of 2002 because TSX 100 membership no long existed at the time.

To circumvent this thin-trading problem and to maximize the number of observations, we adopt a reverse procedure where we begin with trades at every point in time as one observation. One of the two ends for each of the intraday intervals is fixed as the time point of trades. Time points 5, 10, 15, 30 and 60 minutes prior to that time are then calculated and serve as the other end of the corresponding interval. Then trade prices closest to the other end and quotes closest to the two ends of each interval are matched and used to calculate the corresponding return for each of the five intervals for every trade. A return for that interval is not used if the matched trade price or quote is more than or equal to half-interval away. At the same time, the order imbalance for each interval is calculated based on the trades that occurred within the interval. For the daily interval, the last trade price and the last quote of the day are used to calculate daily returns and the trades within the day are used to calculate the order imbalance for that day. Lagged values of returns are calculated based on trade prices and quotes at time points for the prior interval and lagged values of order imbalances are calculated based on trades within the prior interval.

Each trade is designated as either buyer or seller-initiated using the Lee and Ready (1991) algorithm. Each trade is matched with the prevailing quote that is the closest but at least one second prior, as in Henker and Wang (2006) and Kryzanowski, Lazrak and Rakita (2010) for stocks listed on the TSX[5]. The trade is then defined as buyer-initiated (seller-initiated) if the trade price is closer to the ask (bid) of the matched quote. If the trade price is exactly at the midpoint of the quoted spread, a "tick test" is used whereby the trade is classified as buyer- (seller-) initiated if the last price change (tick) prior to the trade is positive (negative). For robustness and to facilitate comparability with the results reported in Chordia *et al.* (2005) using the five-second signing rule of Lee and Ready (1991) for the 150 largest stocks listed on the NYSE in 1996, we also conduct the matching by using a five-second rule.

[5] Although Bessembinder (2003) reports that an allowance for trade reporting lags is no longer optimal for stocks listed on NASDAQ and NYSE when signing trades, no evidence exists that this is also optimal for stocks listed on the TSX.

In our sample, the data resulting from matching based on one- and five-second signing rule are exactly the same for 1994 and 1999. It may be caused by the mechanism used to record trade and quote data by the exchange. The minimum time elapsed between the trades records and quotes records are both six seconds for 1994 and 1999 and it shrinks to one second for 2002. Therefore, we report our results mainly based on the one-second signing rule, but for robustness also report the results based on the five-second rule for 2002.

3.2 Order imbalance (OIB) Metrics

We compute and use three order imbalance metrics in our subsequent tests. OIBNUM is order imbalance measured as the number of buyer-initiated trades minus the number of seller-initiated trades within a time interval (from five minutes to one day in this thesis). OIBSH is order imbalance measured as the number of buyer-initiated shares purchased minus the number of seller-initiated shares sold over the interval. OIBDOL is order imbalance measured as the dollar amount (trade price multiplied by the number of shares traded) of buyer-initiated trades minus the dollar amount of seller-initiated trades within the interval.

3.3 Returns

Three types of returns are computed. Trade returns are based on trade prices, while quote returns are based on quote mid-spreads. Trade and quote returns maximize the number of observations by using trade prices if available and mid-spreads whenever trade prices are not available. All the results based on trade and quote returns are quite similar to those results based on trade returns, probably due to the priority of trade returns in constructing the metric. While we report results based on this return metric in an appendix, we only discuss these results when they differ notably from those for the trade returns.

3.4 Descriptive Statistics for Returns and OIBs

In this section, we report summary statistics for the distribution of returns and order imbalance metrics for each of 1994, 1999 and 2002 in tables 1, 2 and 3, respectively. Specifically, we report the mean, median, minimum, maximum, standard deviation and skewness for the distributions of each of the three return metrics (trade, quote, and trade and quote returns) and the three order-imbalance metrics (OIBNUM, OIBSH and OIBDOL) based on both the five- and one-second signing rules for each of the three years examined herein. As explained above, the results for 1994 and 1999 are based on the same data matched by either trade-signing rule. Therefore, we label them as 5(1)s.

As reported for 1994 in Table 1, statistics of both types of returns are similar. Although means of returns are negative at daily and hourly horizons and positive at the other four horizons, they range from -0.01% to 0.005%, which are close to zero. Moreover, the medians of both types of returns are zero for all intervals. Skewnesses are generally small. Standard deviations of trade returns are consistently larger than those for the quote returns. Also, the means of OIBNUM at all horizons are close to zero and all its medians are zero. At the same time, skewnesses are also modest. On the other hand, OIBSH and OIBDOL have negative means at all horizons, while their medians are negative for intervals from 30 minutes to one day. For intervals from 5 minutes to 15 minutes, OIBSH has a median of zero and OIBDOL has a median of 25. Unlike OIBNUM which is mildly positively (right) skewed, both OIBSH and OIBDOL are negatively (left) skewed, with skewness values of less than -9 and -11, respectively, for all six horizons. Except for OIBNUM at the daily horizon, the absolute value of all the order imbalance metrics gets smaller as the length of the horizon decreases.

As reported for 1999 in Table 2, all the mean returns are positive. Medians of all three types of returns are zero except for quote returns at a daily horizon. Skewness remains close to zero. The means of the OIB metrics, except for OIBSH and OIBDOL for the daily interval, are positive and reduce as the length of the interval gets shorter. Medians of OIBNUM are close to zero, while those of OIBSH are 100 for all the intraday horizons. OIBNUM is slightly skewed to

the right and OIBSH is more right skewed. Medians of OIBDOL are positive for all the intraday intervals, ranging from C$1850 to C$3010. OIBDOL is skewed to the left at horizons of five and ten minutes, but skewed to the right at horizons from 30 minutes to a day.

As reported for 2002 in Table 3, trade, quote and trade and quote returns have zero medians for all the intraday intervals. All the means are negative, with values ranging from -0.001% to -0.034%, which are close to zero. Return skewnesses are again close to zero. The standard deviation of the quote returns is now larger than that for the trade returns at the thirty-minute horizon in addition to the daily and sixty-minute horizons. Comparing the statistics for OIB metrics matched by the five- and one-second rule, we find that the differences are modest. All the statistics for OIB metrics matched using the one-second rule are slightly larger than those matched using the five-second rule. It is not surprising that investors are more purchase-inclined when the quote price is falling and vice versa. All three metrics are skewed to the right for a daily interval. While OIBSH continues to be right-skewed, OIBNUM and OIBDOL become left-skewed for all the intraday intervals.

Note that statistics based on trade and quote returns are quite similar to those for trade returns, especially for the longer horizons (e.g. one day). In fact, trade and quote returns are almost the same as trade returns at the daily horizon. Therefore, we report correlations based on trade returns and quote returns only in the following section.

3.5 Correlations

We report the autocorrelations of returns and the product-moment correlations between trade / quote returns and contemporaneous and lagged values of the three OIB metrics at a daily horizon for each of the three years in Table 4. Trade returns and quote returns exhibit positive autocorrelations in all three years that are significant except for the autocorrelations of trade returns in 2002, as indicated by the p-value of 0.38 in the parenthesis. This differs from the findings by Chordia *et al.* (2005) for daily trade returns with insignificantly positive

autocorrelations in 1996 and significantly negative autocorrelations in 2002. Compared with those in 1994, there is little change in autocorrelations of trade returns and quote returns in 1999. However, compared to 1999, autocorrelations of both returns in 2002 drop noticeably from 0.066 to 0.006 for trade returns and from 0.095 to 0.019 for quote returns. Furthermore, the autocorrelations of trade returns become insignificant.

On the other hand, both types of returns are significantly correlated with all three contemporaneous OIB metrics based on the one-second signing rule for the daily horizon for each of the three years, with all p-values being less than 0.001. Moreover, these correlations increase as the year studied moves from 1994 to 1999 and from 1999 to 2002. The correlations for the lagged OIB metrics with contemporaneous returns increase mildly in 1999 compared to 1994. The growth in the correlation coefficients is 0.017 with trade returns and 0.004 with quote returns for lagged OIBNUM; and is 0.01 with trade returns and 0.008 with quote returns for lagged OIBSH; and is 0.009 with trade returns and 0.006 with quote returns for lagged OIBDOL. In 2002, there is little change in the product-moment correlation between any type of returns and lagged OIBSH. However, for lagged OIBNUM and lagged OIBDOL, the decreases in the correlation coefficients are more noticeable. They drop from 0.04 to 0.013, with a decrease of 0.027 for correlations between trade returns and lagged OIBNUM; and from 0.045 to 0.015, with a decrease of 0.03 for correlations between quote returns and lagged OIBNUM. Significance of the correlations also falls from the 1% to the 10% confidence level with trade returns and from the 1% to the 5% with quote returns. For lagged OIBDOL, the correlation coefficients with trade returns reduce by 0.012 to 0.006, and the ones with quote returns reduce by 0.015 to 0.007. Neither of these correlation coefficients is significant at the 10% level in 2002.

The correlations between lagged OIBSH and lagged OIBDOL and the correlation coefficients between returns and contemporaneous / lagged OIB metrics based on the five-second signing rule are larger than the ones based on the one-second signing rule. However, the differences are modest.

With regard to the daily serial dependence of order imbalances, Table 5 reports the autocorrelation coefficients for the order imbalance metrics (i.e. OIBNUM, OIBSH and OIBDOL) and the product-moment correlations between any two of them, contemporary or lagged. All the correlations are significant with p-values that are less than 0.001. The autocorrelations for OIBNUM remain in the tight range of 0.43-0.44 through all three years. The autocorrelations for OIBSH mildly increase from 0.032 in 1994 to 0.058 in 1999, before increasing to 0.23 in 2002. The autocorrelations for OIBDOL share the same pattern of change as for OIBSH, increasing from 0.041 in 1994 to 0.069 in 1999 and further decreasing to 0.01 in 2002.

While the correlation between OIBSH and OIBDOL is high at 0.90 in 1994 and 1999, it drops to 0.66 in 2002. Correlation coefficients for OIBNUM with OIBSH or with OIBDOL increase for all three years. While similarly correlated with the other two metrics in 1994 and 1999, OIBSH becomes more correlated with OIBNUM and less correlated with OIBDOL in 2002, with coefficients of 0.60 versus 0.31. Since OIBSH and OIBDOL seem to be highly correlated across all three years, we report the results of regressions based on OIBNUM and OIBDOL only[6].

4. HYPOTHESES

Given a sudden and unexpected preponderance of orders on the same side of the market, we expect that astute investors will require some time to discern what is happening to the order flow and if the order flow contains any relevant information about values. Any return autocorrelations and the correlations between returns and lagged order imbalances should

[6] Based on untabulated results, the relationships between returns and lagged OIBSH are similar to those between returns and lagged OIBNUM or between returns and lagged OIBDOL. The only difference is in 2002, where the t-statistics clustered by date for regressions based on OIBSH are less significant than the other t-statistics, but generally lead to the same inferences and the same conclusions as for OIBNUM and OIBDOL. Therefore, in the interests of brevity, the results based on OIBSH are untabulated but available on request.

dissipate as prices adjust to their new equilibrium levels. We believe that through a non-instantaneous price discovery process the market converges to efficiency. Therefore, the market should evolve gradually from inefficiency to efficiency as the post-OIB horizon gets longer. Stated differently, there should be serial dependence between returns and lagged order imbalances for intervals that are short enough, which would eventually disappear as the horizon lengthens. Thus, our first and second hypotheses in their alternate forms are:

H_A^1: (Trade / Quote / Trade and Quote) returns autocorrelations are insignificant after some post-OIB horizon.

H_A^2: Correlations between (Trade / Quote / Trade and Quote) returns and lagged order imbalances (OIBNUM / OIBSH / OIBDOL) are eliminated after some post-OIB horizon.

If the rate of convergence is affected by frictions such as the MQI, then we would expect the rate of convergence to differ around the two MQIRs. As stated earlier, the MQI on the TSX was reduced from C$1/8 to C$0.05 and from C$0.05 to C$0.01 on April 15, 1996 for stocks priced above $5 and for stocks priced between C$3 and C$5, respectively. The MQI moved from C$0.05 to C$0.01 for stocks priced above C$5 in January 2001. However, note that we have already deleted those firm-days whose average prices for those days are less than or equal to C$2 to avoid any contaminating influence of the MQI. The trade records with prices between C$2 and C$3 in our sample for 1999 account for merely 16,816 out of 5,608,666 (0.3%) trades. This involved 44 out of the 20,872 (0.21%) firm days and 2 out of 83 companies. For 2002, a price screen eliminated 942,653 out of 11,714,745 (8.05%) trade records, and affected 311 out of 21,671(1.44%) firm-days and 3 out of 86 companies with average daily prices between C$2 and C$5. These percentages are very small. Moreover, no companies stayed in those price ranges for the whole year. In addition, there are different companies included in the sample of each year. Therefore, we consider the efficiency of the whole market without exclusion of any of the records

mentioned above and state our third and fourth hypotheses in their alternate forms as the following:

H_A^3: (Trade / Quote / Trade and Quote) return autocorrelations and correlations between (trade / quote / trade and quote) returns and lagged order imbalances (OIBNUM / OIBSH / OIBDOL) are eliminated over a shorter post-OIB horizon after the 1996 MQIR.

H_A^4: (Trade / Quote / Trade and Quote) return autocorrelations and correlations between (trade / quote / trade and quote) returns and lagged order imbalances (OIBNUM / OIBSH / OIBDOL) are eliminated over a shorter post-OIB horizon after the 2001 MQIR.

5. UNIVARIATE REGRESSION RESULTS

5.1 Predictive Univariate Regressions for Returns

5.1.1 Initial results using the one-second trade signing rule

We run univariate panel regressions for each of five intraday post-OIB horizons (five, ten, fifteen, thirty and sixty minutes) and a daily horizon. The dependent variable is (trade / quote / trade and quote) returns and the single independent variable is lagged corresponding (trade / quote / trade and quote) returns or lagged OIBNUM, or lagged OIBDOL. Since trades of different companies happen at different points in time, these panel regressions are unbalanced. As suggested by Petersen (2009), standard errors estimated by OLS can be biased downward and t-statistics can be biased upward, especially when there is "time-series dependence" and / or "cross-sectional dependence". Therefore, in addition to the standard OLS t-statistics (t_0) and the t-statistics adjusted for heteroscedasticity (t_1), we also report the t-statistics clustered by firm (t_{21}), by date (t_{22}) and by firm and date (t_3). The estimated coefficient for this panel regression is presented as $b_{0\text{-}3}$. Next, we run two more panel regressions controlling for fixed firm effects and fixed date effects respectively, and present their coefficient estimates and t-statistics as b_{41}, t_{41} and

b_{42}, t_{42}. In our results, the sizes of the clustered t-statistics (i.e. by firm, by date or by both) are much smaller than those of the other t-statistics. Therefore, we base our analysis mainly on the significance levels of these statistics. As mentioned, results based on trade and quote returns are reported in an Appendix and they are similar to those based on trade returns. The specific regressions run are:

$$trade\ return_t = b_0 + b_1 trade\ return_{t-1}$$

$$trade\ return_t = b_0 + b_1 OIBNUM_{t-1}$$

$$trade\ return_t = b_0 + b_1 OIBDOL_{t-1}$$

$$quote\ return_t = b_0 + b_1 quote\ return_{t-1}$$

$$quote\ return_t = b_0 + b_1 OIBNUM_{t-1}$$

$$quote\ return_t = b_0 + b_1 OIBDOL_{t-1}$$

$$trade\ and\ quote\ return_t = b_0 + b_1 trade\ and\ quote\ return_{t-1}$$

$$trade\ and\ quote\ return_t = b_0 + b_1 OIBNUM_{t-1}$$

$$trade\ and\ quote\ return_t = b_0 + b_1 OIBDOL_{t-1}$$

As reported for 1994 in Table 6, autocorrelations for trade returns for the intraday post-OIB horizons from five to sixty minutes are negative and significant at the 1% confidence level. However, the autocorrelation for the daily post-OIB horizon becomes positive and significant at the 1% level. As the length of the post-OIB horizon grows, the values of the coefficient estimates and the adjusted R-square values decrease from -0.21 and 4.27% to 0.058 and 0.34%, respectively. The estimated coefficients of lagged OIBNUM are also significantly negative for the short horizons of up to fifteen minutes but become insignificant for the thirty- and sixty-minute horizons. Its estimated coefficient for the daily horizon is larger in size than that for the sixty-minute horizon and is now significant at the 5% confidence level[7]. Similar to the autocorrelations of trade returns, the negative correlations between trade returns and lagged OIBNUM get weaker as the post-OIB horizon lengthens and they gradually change from negative

[7] All the coefficients of OIBNUM in the tables are multiplied by one thousand.

and significant values to positive and significant values. No pattern exists as the length of the post-OIB horizon increases for the correlations between trade returns and lagged OIBDOL. They are negative and significant for the horizons from five minutes to thirty minutes, and the estimated coefficients increase from -8.63 for the five-minute horizon to -5.54 for the ten-minute horizon before decreasing to -7.12 for the fifteen-minute horizon[8]. Also, the level of significance decreases from 1% for the five-minute horizon to 10% for the ten-minute horizon, before increasing to 5% for the fifteen-minute horizon. The correlations are insignificant for the thirty-minute, sixty-minute and daily horizons. Lagged OIBDOL has hardly any predictability power for trade returns as the adjusted R-square values are close to zero. The adjusted R-square values for the regressions on lagged trade returns are much larger than those for the regressions on lagged order imbalances, indicating that lagged trade returns better explain the deviations of contemporaneous trade returns in 1994.

Results of the regressions predicting quote returns for 1994 are reported in Table 7. Compared to those for the autocorrelations of trade returns, the magnitudes of the coefficient estimates and the adjusted R-square values for the autocorrelations of quote returns are smaller. None of the coefficients for any horizon exceeds 0.1 in absolute value and the adjusted R-square values range from 0.01% to 0.57%. The estimated coefficients for the quote returns autocorrelations turn from significantly negative at the 1% confidence level for the five- and ten-minute horizons, to insignificant for the horizons from fifteen minutes to sixty minutes, and to significantly positive at the 1% level for the daily horizon. Contrary to those results for the regressions predicting trade returns, the correlations between quote returns and lagged OIBNUM are positive and significant for all post-OIB horizons at the 1% level. After a drop from 2.93 to 1.90, coefficients slightly change within the range between 1.75 and 1.90. Few of the various statistics are significant at the 1% level for lagged OIBDOL, and similar to the last table the adjusted R-square values are close to zero.

[8] All the coefficients of OIBDOL in the tables are multiplied by one billion.

Results of the regressions predicting trade returns and quote returns for 1999 are reported in Tables 8 and 9, respectively. The estimated coefficients and adjusted R-square values for any independent variable predicting quote returns are generally larger and more significant than those predicting trade returns in this year. For the five-minute horizon, trade returns are insignificantly autocorrelated, while quote returns are positively autocorrelated with clustered t-statistics that are significant at the 5% level. Their autocorrelations are weakest for the ten- and fifteen-minute horizons and strongest for the sixty-minute and daily horizons (significant at the 1% level for both types of returns). None of the estimated coefficients for the autocorrelations of both types of returns is larger than 0.1. The estimated coefficients and adjusted R-square values for quote returns, which range from 0.047 to 0.095 and from 0.22% to 0.89%, are larger than those for trade returns, which range from 0.0054 to 0.066 and from 0.00% to 0.43%, respectively. The adjusted R-square values of the regressions for lagged trade returns noticeably decrease compared to those in 1994. Also, unlike in 1994, the correlation coefficients between trade (quote) returns and lagged OIBNUM are positive and significant for all horizons. Their significances are weaker for the sixty-minute horizon than for the other horizons (10% for trade returns and 5% for quote returns). As the post-OIB intraday horizon lengthens, the estimated coefficients and the adjusted R-square values predicting either type of return are lower, but increase slightly for the daily horizon. Correlations between quote returns and lagged OIBNUM yield coefficients and adjusted R-square values larger in size than those yielded by correlations between trade returns and lagged OIBNUM. None of the clustered t-statistics for correlations between trade returns and lagged OIBDOL are significant at the 10% level for post-OIB horizons from five to fifteen minutes. For longer horizons, the estimated coefficients are larger and become significant at the 5% level. Correlations between quote returns and lagged OIBDOL yield coefficient estimates that decease as the horizon lengthens from five to fifteen minutes, and then increase as the horizon lengthens to a day. The smallest t-values occur for the ten- and fifteen-minute horizons. Adjusted R-square values for regressions predicting either type of returns never exceed 0.04%.

Results of the regressions predicting trade returns and quote returns for 2002 are reported in Tables 10 and 11, respectively. All of the coefficient estimates in the table are positive for 2002. Coefficient estimates and adjusted R-square values for any independent variable predicting quote returns are larger and more significant than those predicting trade returns. Changes in coefficients and adjusted R-square values of lagged returns, lagged OIBNUM and lagged OIBDOL share the same pattern, generally increasing as the horizon grows from five to thirty minutes, and falling with longer horizons. Trade returns autocorrelations and correlations between trade returns and lagged OIBNUM are not significant for the five-minute horizon, while their counterparts for quote returns are significant for all the intraday horizons. While there are more estimated coefficients of lagged OIBDOL with clustered t-statistics significant at the 1% level for quote returns than for trade returns, all estimated coefficients of lagged OIBDOL are significant for all the intraday horizons. However, none of the adjusted R-square values exceed 0.05%. Compared to the results in 1999, return autocorrelations are slightly stronger for the intraday horizons, while autocorrelations of both types of returns and correlations between either type of returns and lagged order imbalances become insignificant for the daily horizon in 2002. Moreover, the correlations between returns and lagged OIBNUM for all the intraday horizons decrease from the range of 0.71-1.69 in 1999 to the range of 0.28-0.70 in 2002 for trade returns and from the range of 0.84-2.63 in 1999 to the range of 0.45-0.74 in 2002 for quote returns.

In summary, the autocorrelations for both types of returns and the correlations between trade returns and lagged OIBNUM change gradually from being significantly negative to significantly positive as the length of the horizon grows in 1994. In contrast, the correlations between quote returns and order imbalances are positive for all horizons in 1994. No negative coefficient estimates are significant in 1999. Returns autocorrelations are insignificant for the ten- and fifteen-minute horizons in 1999. The correlations between either type of returns and lagged OIBNUM gradually decrease in size and become less significant as the horizon grows to sixty minutes, before slightly increasing for the daily horizon in 1999. No returns autocorrelations or

correlations between either type of returns and lagged order imbalances are significant for the daily horizon, but remain significant at the 1% level for the intraday horizons in 2002. All coefficient estimates increase until the horizon lengthens to thirty minutes and then decrease thereafter in 2002. Compared to their counterparts in 1999, the magnitudes of the estimated coefficients of lagged OIBNUM are smaller in size in 2002. The estimated coefficients for lagged OIBDOL are much less significant compared to those for lagged trade returns and lagged OIBNUM and change without any pattern as the horizon lengthens for all three years.

5.1.2 Tests of robustness using the five-second trade signing rule

Results of the regressions predicting trade returns and quote returns for 2002 by lagged order imbalances based on the five-second trade signing rule are reported in Tables 12 and 13, respectively. Correlations between trade (quote) returns and lagged OIBNUM (OIBDOL) have little change when trades and quotes are matched using the five-second instead of the one-second trade signing rule. After being multiplied by one thousand, the differences in the estimated coefficients of lagged OIBNUM never exceed 0.07. The only noticeable change in the estimated coefficients of lagged OIBDOL is that the significance level for the sixty-minute horizon reduces from 5% to 10% when the five-second signing rule is used instead of the one-second signing rule. However, it does not change any conclusions resulting from the univariate regressions using either order imbalance metric.

5.2 Predictive Univariate Regressions for Order Imbalances

5.2.1 Initial results using the one-second trade signing rule

Univariate regressions predicting contemporaneous order imbalances using their corresponding lagged values are run to examine the autocorrelation of order imbalances. In these regressions, the dependent variable is OIBNUM or OIBDOL and the independent variable is lagged OIBNUM or lagged OIBDOL, respectively. Three panel regressions are run for each of

the six horizons (five, ten, fifteen, thirty and sixty minutes and one day). Coefficients, t-statistics unadjusted and adjusted for heteroscedasticity, clustered by firm, by date, and by firm and date are reported for the first regressions. Also, corresponding coefficients and t-statistics are reported for the second and the third regressions controlling for fixed firm effects and fixed date effects, respectively. The equations are given by:

$$OIBNUM_t = b_0 + b_1 OIBNUM_{t-1}$$

$$OIBDOL_t = b_0 + b_1 OIBDOL_{t-1}$$

As reported for 1994 in Table 14, autocorrelations of OIBNUM are significant for horizons from five minutes to one day at the 1% confidence level. The size of the estimated coefficients and the adjusted R-square values increase as the length of the post-OIB interval grows from 0.17 to 0.43 and from 2.24% to 18.46%, respectively. For the autocorrelations of OIBDOL, the significances of their coefficients are not as stable and the changes in the size of their coefficients do not follow a discernible trend as was the case for the autocorrelations of OIBNUM. Clustered t-statistics are insignificant for horizons of ten and sixty minutes, significant at the 5% level for horizons of thirty minutes and a day, and significant at the 1% level for horizons of five and fifteen minutes. Compared to OIBNUM, the estimated coefficients and the adjusted R-square values for the OIBDOL autocorrelations are much smaller in size, ranging from 0.019 to 0.041 and from 0.04% to 0.20%, respectively.

As reported for 1999 in Table 15, once again the autocorrelations of OIBNUM are significant at the 1% level for all six horizons. As the length of the horizon increases, the magnitudes of the estimated coefficients and the adjusted R-square values still increase but within a narrower range compared to their counterparts in 1994 (from 0.30 to 0.43 and from 8.06% to 18.45%, respectively). The autocorrelations of OIBDOL for 1999 are insignificant for the horizons of five and thirty minutes, which are one interval shorter than in 1994. Moreover, these autocorrelations are significant at the 10% level for the ten-minute horizon, significant at the 5% level for the daily horizon and significant at the 1% level for the fifteen- and sixty-minute

horizons. The smallest coefficient is 0.0078 for the horizon of thirty minutes compared to 0.019 for the same horizon in 1994. Furthermore, none of the adjusted R-square values exceeds 0.12%.

As reported for 2002 in Table 16, the autocorrelations of OIBNUM are similar to those in 1999, with coefficient estimates ranging from 0.30 to 0.45 that are significant at the 1% level for all horizons. However, instead of increasing gradually and reaching their largest values at the daily horizon, the coefficients and adjusted R-square values of OIBNUM are largest for the horizon of thirty minutes (0.45 and 23.41% respectively). In contrast to their counterparts in 1994 and 1999, the autocorrelations of OIBDOL are significant for all horizons from five minutes to one day. The magnitudes of the estimated coefficients and adjusted R-square values increase as the horizon increases within the day. They reach 0.12 and 1.08% for the sixty-minute horizon, respectively. However, OIBDOL is much less autocorrelated than OIBNUM, based on the magnitudes of the estimated coefficients and adjusted R-square values.

5.2.2 Tests of robustness using the five-second trade signing rule

Results based on the five-second trade signing rule for 2002 are reported in Table 17. The differences from those results based on the one-second rule are modest. They never exceed 0.05 for the coefficient estimates of lagged OIBNUM and never exceed 0.01 for the coefficient estimates of lagged OIBDOL. Once again, no conclusion would be modified if the five-second signing rule is used instead of the one-second signing rule.

5.2.3 Cross-autocorrelation coefficients between buying and selling

We observe that the autocorrelations of OIBNUM change marginally and the autocorrelations of OIBDOL increase in the magnitudes of their estimated coefficients across the years. In this section, we investigate the cross-autocorrelations between initial and future orders on the other side of the market. As reported in Table 18, not only the coefficients between buy sides and next sell sides but also the coefficients between sell sides and next buy sides, measured

either by trade number or by dollar amount, increase as the interval lengthens. Exceptions are the changes of the coefficients between buy orders and next sell orders for the thirty- and sixty-minute horizons in 1999 and 2002. More importantly, they increase across the years for all the corresponding horizons, especially from 1994 to 1999.

We interpret the increase of the cross-autocorrelation coefficients between buying and selling as suggesting that countervailing arbitrages are growing in the market as the horizon lengthens within each year and that their magnitudes for the same horizon are also growing over the years. For the equation

$$Cov\ OIB_t, OIB_{t-1} = Cov\ B_t - S_t, B_{t-1} - S_{t-1}$$
$$= Cov\ B_t, B_{t-1} + Cov\ S_t, S_{t-1} - Cov\ B_t, S_{t-1} - Cov\ S_t, B_{t-1},$$

we observe that its left-hand side changes marginally for OIBNUM and increases for OIBDOL over time and that the last two terms on the right-hand side increase in absolute values over time. This suggests that $Cov\ B_t, B_{t-1}$ and $Cov\ S_t, S_{t-1}$ are growing at a faster pace than the increase of the countervailing arbitrages [$Cov\ B_t, S_{t-1}$ and $Cov\ S_t, B_{t-1}$]. In turn, this fails to completely offset the OIB persistence [$Cov\ OIB_t, OIB_{t-1}$]. Therefore, in order to reduce the correlations between returns and order imbalances under the condition that OIB persistence remains or even increases, limit orders and specialist actions may have contributed to the improvement of informational efficiency in the Canadian market.

6. MULTIVARIATE REGRESSION RESULTS

6.1 Predictive Multivariate Regressions for Returns

To examine their influences and to help control for endogeneity, we set both lagged returns and lagged order imbalances (OIBNUM, OIBSH and OIBDOL) as the independent

variables in the panel regressions to predict contemporaneous returns for each of the six post-OIB horizons of five minutes to one day. The following are reported for these panel regressions: the coefficients ($b_{0\text{-}3}$), OLS t-statistics (t_0), t-statistics adjusted for heteroscedasticity (t_1), and t-statistics clustered by firm (t_{21}), by date (t_{22}) and by firm and date (t_3). Panel regressions controlling for fixed firm and fixed date effects are also run and their respective coefficients (b_{41} and b_{42}) and t-statistics (t_{41} and t_{42}) are reported. We base our interpretations mainly on the stricter clustered t-statistics in the first panel regression. As mentioned, results based on trade and quote returns are reported in the Appendix and they are similar to those based on trade returns. The specific panel regressions run are:

$$trade\ return_t = b_0 + b_1 trade\ return_{t-1} + b_2 OIBNUM_{t-1}$$

$$trade\ return_t = b_0 + b_1 trade\ return_{t-1} + b_2 OIBDOL_{t-1}$$

$$quote\ return_t = b_0 + b_1 quote\ return_{t-1} + b_2 OIBNUM_{t-1}$$

$$quote\ return_t = b_0 + b_1 quote\ return_{t-1} + b_2 OIBDOL_{t-1}$$

$$trade\ and\ quote\ return_t = b_0 + b_1 trade\ and\ quote\ return_{t-1} + b_2 OIBNUM_{t-1}$$

$$trade\ and\ quote\ return_t = b_0 + b_1 trade\ and\ quote\ return_{t-1} + b_2 OIBDOL_{t-1}$$

Results of the multiple regressions predicting contemporaneous trade returns for 1994 are reported in Table 19. When contemporaneous trade returns are regressed on both lagged trade returns and lagged order imbalances, the coefficients of lagged returns exhibit little change compared to those reported earlier for the univariate regressions in Table 6. This is supported by the observation that the adjusted R-square values are much larger for lagged trade returns than for lagged OIBNUM/OIBDOL in Table 6.With the use of lagged OIBNUM or lagged OIBDOL as the other independent variable, the coefficients of lagged trade returns for all horizons are still significant at the 1% confidence level, with negative coefficient estimates decreasing in size for all the intraday horizons up to sixty minutes and a positive estimate for the daily horizon. In contrast, when lagged trade returns is the other independent variable, the coefficient estimates of lagged OIBNUM for the fifteen-minute and daily horizons change from being significant to being

insignificant. Meanwhile, the estimate for the sixty-minute horizon changes from being insignificant to being significant at the 5% level. Compared to the univariate regression results, significant and negative coefficients of lagged OIBDOL are smaller in size for the horizons of up to thirty minutes.

Results of the multiple regressions predicting contemporaneous quote returns for 1994 are reported in Table 20. Consistent with the results for the univariate regressions, the coefficients of the lagged quote returns gradually change from being significantly negative to being significantly positive as the length of the horizon grows from five minutes to one day when either lagged OIBNUM or lagged OIBDOL is included in the regressions. The magnitudes and the significances of their coefficient estimates are similar to those reported in Table 7. When the other independent variable is lagged quote returns, the coefficient estimates for lagged OIBNUM are still significantly positive for all the horizons from five minutes to one day, and larger in size except for the sixty-minute and daily horizons. The estimate for the daily horizon is now significant only at the 5% level versus being significant at the 1% level in the univariate regression. The estimated coefficients of lagged OIBNUM decrease from 3.47 to 1.02 as the horizon lengthens from five minutes to one day. Those for lagged OIBDOL continue to be insignificant for most horizons except for the thirty- and sixty-minute horizons where they are significant at the 5% level.

Results of the multiple regressions predicting contemporaneous trade returns for 1999 are reported in Table 21. Given the larger adjusted R-square values for lagged OIBNUM in the univariate regressions, it is not surprising that the incorporation of lagged OIBNUM and lagged trade returns in the regressions has more of an impact on the estimated coefficients of the lagged returns. Estimated coefficients of lagged trade returns with the presence of lagged OIBNUM differ from those in the univariate regressions in that the significance of the positive coefficient disappears for the thirty-minute horizon and becomes weaker (at the 5% level versus the 1% level) for the sixty-minute horizon. The estimated coefficients of lagged OIBNUM with the

presence of lagged trade returns as the other independent variable differ from those for the univariate regressions by becoming insignificant from being significant for the sixty-minute horizon and by becoming less significant for the thirty-minute horizon (5% versus 1%) and for the daily horizon (10% versus 1%). The coefficient estimates decrease in size gradually as the horizon lengthens, become insignificant for the sixty-minute horizon, and remain significant but only at the 10% level for the daily horizon. Also, the estimated coefficients of lagged OIBDOL become significant at the 10% level for the five-minute horizon and insignificant for the daily horizon, when compared to their counterparts in the univariate regressions. The adjusted R-square values are larger for the combination of lagged trade returns and lagged OIBNUM than the combination of lagged trade returns and lagged OIBDOL, especially for horizons less than thirty minutes where the coefficients of lagged OIBDOL are significant only at the 10% level or are insignificant.

The estimated coefficients of trade returns in 1994 for all the intraday horizons are significantly negative whenever the other predictor is lagged OIBNUM or lagged OIBDOL. In contrast, those in 1999 are insignificant for horizons of five to thirty minutes for lagged OIBNUM and for horizons of five to fifteen minutes for lagged OIBDOL. They are significantly positive for the sixty-minute horizon when the other predictor is lagged OIBNUM and for the thirty- and sixty-minute horizons when the other predictor is lagged OIBDOL. Z-tests of the coefficient differences indicate that the differences for all intraday horizons are significant.[9] Similarly, the differences in the estimated coefficients of lagged OIBNUM and OIBDOL are significant for horizons of five to fifteen minutes, basically driven by the significantly positive estimates in 1999 and the significantly negative estimates in 1994. The exception is the estimate for lagged OIBNUM for the fifteen-minute horizon.

[9] In order to test whether the differences in the estimated coefficients between the two size subsamples and between contiguous years are significant, z-statistics are calculated based on the three types of clustered standard errors. The differences and their significance levels based on the corresponding z-values are tabulated and reported in the Appendix. Inferences are made when all three z-statistics are significant at least at the 10% level.

Results of the multiple regressions predicting contemporaneous quote returns for 1999 are reported in Table 22. While the coefficient estimates for lagged quote returns are insignificant for the ten- and fifteen-minute horizons in the univariate regressions, they become significant at least at the 5% level in the multivariate regressions whenever lagged OIBNUM or lagged OIBDOL is added into the regressions as the other predictor. The estimated coefficients of lagged OIBNUM become smaller in size for all horizons and less significant for horizons of thirty minutes to one day compared to those in the univariate regressions. When combined with lagged quote returns as the independent variables, lagged OIBDOL has less significant estimated coefficients for all horizons.

Compared to the significantly negative (positive) estimated coefficients of lagged quote returns for the horizons of five to thirty minutes (for the sixty-minute horizon) in 1994, the estimates in 1999 are significantly positive for all horizons. Meanwhile, the differences in the estimates between the two years are positive and significant for all the intraday horizons. Furthermore, while their counterparts are significantly positive for all horizons in 1994, the estimated coefficients of lagged OIBNUM begin with a significant and positive value for the five-minute horizon, decrease in magnitude as the length of the horizon grows, and finally become insignificant for the sixty-minute and daily horizons. They are significantly smaller in magnitude than their counterparts in 1994 for all the intraday horizons. The estimates for lagged OIBDOL are significant at the 5% level for the five-and sixty-minute horizons, at the 10% level for the thirty-minute and daily horizons, and insignificant for the ten- and fifteen-minute horizons in1999. However, they do not differ significantly from their counterparts in 1994.

Results of the multiple regressions predicting contemporaneous trade returns for 2002 are reported in Table 23. The estimated coefficients of lagged trade returns remain the same as in the univariate regressions when lagged OIBDOL is added to the regressions, and become smaller in magnitude than in the univariate regressions when lagged OIBNUM is instead added. The estimated coefficient of lagged trade returns for the ten-minute horizon changes from being

significant at the 10% level to being insignificant with the addition of lagged OIBNUM. In contrast, the estimated coefficients remain insignificant for the five-minute and daily horizons, and positive and significant for the fifteen-, thirty- and sixty-minute horizons with the addition of either lagged order imbalance metric (i.e. OIBNUM or OIBDOL) as the other independent variable. When the other predictor is lagged trade returns, the estimated coefficients of lagged OIBNUM are smaller in size compared to those in the univariate regressions. As the horizon lengthens, the estimates are insignificant for the five-minute horizon, significant (0.51) at the 1% level for the thirty-minute horizon, and insignificant for the sixty-minute and daily horizons. The estimated coefficients of lagged OIBDOL are insignificant for horizons of fifteen, thirty and sixty minutes in the multiple regressions, while they are significant for these horizons in the univariate regressions.

Differing from those in 1999, the estimated coefficients of lagged trade returns are positive and significant for the fifteen- and thirty-minute horizons in 2002. Based on the z-tests, the estimates in 2002 are significantly larger in magnitude than their counterparts in 1999 for these horizons and also for the sixty-minute horizon when the other predictor is lagged OIBDOL. In contrast, the estimates for the daily horizon become insignificant in 2002 and they are significantly smaller in magnitude than their counterparts in 1999. Compared to their counterparts in 1999, the estimated coefficients of lagged OIBNUM are significantly smaller in magnitude for horizons of five to fifteen minutes. No significant differences exist for the other horizons. Compared with the results in 1999, the coefficient estimates of lagged OIBDOL in 2002 are more significant for shorter horizons (five and ten minutes) and less significant for longer horizons (thirty and sixty minutes). However, they do not differ significantly from their counterparts in 1999. No coefficient estimates are significant for the daily horizon, and the adjusted R-square value for either set of multiple regressions is reduced to zero.

Results of the multiple regressions predicting contemporaneous quote returns for 2002 are reported in Table 24. When contemporaneous quote returns are regressed on both lagged

quote returns and lagged OIBNUMs, the estimated coefficients for both independent variables are smaller than their counterparts in the unvariate regressions. The estimated coefficients of lagged quote returns remain significant at the 1% level for all the intraday horizons and insignificant for the daily horizon. In contrast, the estimated coefficients of lagged OIBNUM become insignificant for short (five- and ten-minute) horizons and the sixty-minute horizon. They become less significant at the10% level for the ten-minute horizon and at the 5% level for the fifteen-minute horizon (versus the 1% level for the univariate regressions). The estimated coefficients of lagged OIBDOL become insignificant for all horizons, and the estimated coefficients of lagged quote returns are little changed when both lagged OIBDOL and lagged quote returns are included in the regressions.

Compared to the multiple regression results in 1999 for the intraday horizons, the estimated coefficients of the lagged quote returns are significantly larger in magnitude for the thirty-minute horizon, but are significantly smaller in magnitude for the daily horizon whenever the other predictor is lagged OIBNUM or lagged OIBDOL. The estimated coefficients of lagged OIBNUM for the five- and ten-minute horizons become insignificant in 2002 and they are significantly smaller in magnitude than their significant and positive counterparts in 1999. Again, the estimated coefficients of lagged OIBDOL do not differ significantly from their counterparts in 1999. Furthermore, none of the coefficient estimates are significant for the daily horizon, and the adjusted R-square values become close to zero.

In summary, compared to the results for the univariate regressions, the estimated coefficients of lagged order imbalances (OIBNUM or OIBDOL) are generally less significant, especially for the longer horizons. In contrast, the estimated coefficients of lagged returns are the same or even more significant compared to their counterparts in the univariate regressions. As a result, the patterns which appeared in the univariate regressions become more obvious. The significances of the estimated coefficients of lagged returns and lagged OIBNUM last up to a day in 1994 and 1999. With time, the negative (positive) estimated coefficients of both lagged returns

and lagged order imbalances gradually disappear for the short (longer) horizons. However, more than sixty minutes is still required to eliminate the conditional return autocorrelations and more than 30 minutes is required to eliminate the conditional correlation between returns and lagged OIBNUM in 2002.

6.2 Predictive Multivariate Regressions for Returns Stratified by Firm Size

We rerun all multiple regressions for two subsamples for each of three years, where the subsamples are based on the market capitalizations of the sample period at the beginning of each year. This is done in order to check whether size-based differences exist in the results for the multiple regressions. The half of the original sample with the highest (lowest) market capitalizations is categorized as the large- (small-) size sample. Since large-size companies tend to be more frequently traded, the large-size sample accounts for 73% to 75% of the trade-time-point observations in the original sample. Therefore, results of the regressions for the large-size subsample are closer to those for the original sample.

Results of the multiple regressions predicting contemporaneous trade returns for the large and small subsamples for 1994 are reported in Tables 25 and 26. The estimated coefficients of lagged trade returns for both subsamples (whenever lagged OIBNUM or lagged OIBDOL is the other predictor) are negative and significant for the intraday horizons and positive for the daily horizon. The coefficient estimates for the large-size companies become smaller faster than those for the small-size companies. They reduce by 67% from -0.18 for the five-minute horizon to -0.06 for the sixty-minute horizon versus by 22% from -0.25 to -0.17 for the small-size companies. This leads to less significant coefficients for the large-size companies (5% and 10% level) versus their highly significant counterparts for the small-size companies (1% level) for the thirty- and sixty-minute horizons. Results from the z-tests for the coefficient differences agree with this observation. They indicate that the estimates for the small-size companies are significantly larger in absolute magnitudes than those for the large-size companies for the thirty- and sixty-minute

horizons. Similarly significant differences are present for the estimated coefficients of lagged OIBNUM. The estimates for large-size companies begin with a negative and significant value for the five-minute horizon, and reduce both in magnitude and significance as the length of the horizon grows. They become insignificant for the fifteen- and thirty-minute horizons. The estimated coefficients for the small-size companies become insignificant fifteen minutes later at the thirty-minute horizon. The estimated coefficients of lagged OIBDOL for both subsamples are significant for the horizons of five to fifteen minutes and insignificant for the horizons of thirty minutes to a day. However, there are no significant differences in the estimates between two size-groups. The adjusted R-square values for the small-size companies are larger for the intraday horizons and smaller for the daily horizon than those for the large-size companies.

Results of the multiple regressions predicting contemporaneous quote returns for the groups of large and small firms for 1994, which are reported in Tables 27 and 28, are similar to those discussed above. The predictability of either lagged quote returns, lagged OIBNUM or lagged OIBDOL are stronger for the small-size companies than for the large-size companies. While large-size companies have insignificant coefficients for lagged quote returns for all the intraday horizons when lagged OIBNUM is the other predictor, small-size companies have negative and significant (1% level) estimated coefficients for lagged quote returns for these horizons. Based on the z-tests, their differences are all significant. The positive estimated coefficients of lagged OIBNUM are significantly smaller in magnitude for the large-size companies than for the small-size companies for all the intraday horizons, and the significances of the estimates are also smaller for the large-size companies than for the small-size companies for the sixty-minute (5% level versus 1% level) and daily horizons (insignificant versus 5% level). While the coefficients of lagged OIBDOL are not significant for all horizons for the large-size companies, those for small-size companies are significant at least at the 10% level for all intraday horizons. Those for the large-size companies are significantly smaller in magnitude than those for the small-size companies for horizons of five to thirty minutes. Both of the subsamples

have insignificant coefficients of lagged OIBDOL for the daily horizon. Once again, the adjusted R-square values for small-size companies are larger in magnitude for the intraday horizons and smaller for the daily horizon than those for large-size companies.

Results of the multiple regressions predicting contemporaneous trade returns for large and small companies for 1999 are reported in Tables 29 and 30. The negative conditional correlation between contemporaneous trade returns and lagged trade returns / lagged OIBDOL for both subsamples (especially for the small-firm-size group) diminish in 1999 compared to 1994. This explains the smaller adjusted R-square values for both groups compared to 1994 and the smaller adjusted R-square values for the small-size companies compared to those for the large-size companies in 1999. While the estimated coefficients of lagged trade returns for the large-size companies are positive and significant for the horizons of thirty minutes to a day, those for the small-size companies are insignificant for the same horizons when lagged OIBNUM is the other predictor They are significant at the 5% level for the daily horizon when lagged OIBDOL is the other predictor. They are insignificant for both size groups for horizons of five to fifteen minutes (except for the five-minute horizon when lagged OIBNUM is the other predictor and for the fifteen-minute horizon when lagged OIBDOL is the other predictor for the large-size companies). However, no significant differences in these estimated coefficients exist between the two subsamples. Unlike the results in 1994, the estimated coefficients of lagged OIBNUM are positive for all horizons for both subsamples, and decrease in both size and significance as the horizon lengthens. Starting from positive and significant values for the five-minute horizon, the estimates of lagged OIBNUM become insignificant for horizons of sixty minutes and a day for the large-size companies. In contrast, those for the small-size companies are insignificant for horizons of thirty and sixty minutes and significant for the daily horizon. Based on the z-tests, the positive estimates for the large-size companies are significantly smaller in magnitude than those for the small-size companies for the ten-minute, fifteen-minute and daily horizons. Unlike those estimates in 1994 that are negative and significant, the estimated coefficients of lagged OIBDOL

in 1999 are insignificant for most of the horizons for both groups, with the exception of the five-minute horizon for the large-firm-size group and the thirty-minute horizon for the small-firm-size group. No significant differences exist for these estimated coefficients.

Results of the multiple regressions predicting contemporaneous quote returns for large and small firms for 1999 are reported in Tables 31 and 32. Unlike the results in 1994, the estimated coefficients of lagged returns for both subsamples are all positive for 1999. Contemporaneous quote returns are better predicted by lagged quote returns for the large-size companies and by lagged OIBNUM for the small-size companies. The estimated coefficients of lagged quote returns for the large-size companies are positive and highly significant (1% level) for all six horizons, while those for the small-size companies are insignificant for horizons from five to thirty minutes and weakly significant (10% level) for the sixty-minute horizon. Their differences are significant for the ten- and fifteen-minute horizons when the other predictor is lagged OIBNUM. On the other hand, while the estimated coefficients of lagged OIBNUM for the small-size companies are all positive and significant except for the sixty-minute horizon, those for the large-size companies are significant only for the five-minute horizon. Based on z-tests, their differences are significant for the ten- and fifteen-minute horizons, the same horizons as for the significant differences in the estimated coefficients of lagged trade returns. The estimated coefficients of lagged OIBDOL for both subsamples are not significant for all horizons with the exceptions of the five- and sixty-minute horizons for the large-size companies and the thirty-minute horizon for the small-size companies, wherein the coefficient difference between the two subsamples for the thirty-minute horizon is significant. Unlike the results in 1994, the estimated coefficients of lagged OIBDOL for small-size companies are insignificant for most of the intraday horizons.

Results of the multiple regressions predicting contemporaneous trade returns for the large and small firm groupings for 2002 are reported in Tables 33 and 34. Compared to the results in 1999, the estimated coefficients for lagged trade returns for the large-size companies become

significant for the fifteen-minute horizon, while those for the small-size companies remain insignificant for the fifteen-minute horizon and become significant at the 10% level for the thirty-minute horizon and at the 5% level for the sixty-minute horizon when lagged OIBNUM is the other predictor. They become positive and significant at horizons of fifteen, thirty and sixty minutes for both size-groups and are more significant for the large- versus small-size companies. Based on the z-tests, the estimated coefficients of lagged trade returns for the large-size companies are significantly larger in magnitude than those for the small-size companies for the thirty-minute horizon when the other predictor is lagged OIBNUM and for the thirty- and sixty-minute horizons when the other predictor is lagged OIBDOL. The significance of the estimated coefficients of lagged trade returns for the daily horizon disappears for both groups. The estimated coefficients of lagged OIBNUM for the large-size companies are significantly smaller in magnitude than those for the small-size companies for horizons of five, ten and thirty minutes. The estimates for the large-size companies are not significant for the five-minute horizon, significant at the 5% level for the ten- and thirty-minute horizons and significant at the 1% level for the fifteen-minute horizon. In contrast, those for the small-size companies are significant at the 1% level for the five-, ten- and thirty-minute horizons and insignificant for the fifteen-minute horizon. They are insignificant for both subsamples for the sixty-minute and daily horizons. As a result, regressions for large-size companies have larger adjusted R-square values with the exceptions of the five- and ten-minute horizons. The estimated coefficients of lagged OIBDOL for the small-size companies are not significant for all horizons, and those for the large-size companies are significant for the five- and ten-minute horizons only at the 10% level. Differences in these estimated coefficients are not significant for all horizons.

Finally, the results of the multiple regressions predicting contemporaneous quote returns for the large- and small-firm-size groups for 2002 are reported in Tables 35 and 36. Once again, the high significances of the estimated coefficients of lagged quote returns for the daily horizon in 1999 disappear, while they remain at the 1% level for all the intraday horizons for both firm-size-

groups. Differing from the z-test results for 1994 and 1999, the estimate for the ten-minute horizon when the other predictor is lagged OIBDOL is significantly smaller in magnitude for the large- versus small-size companies in 2002. For the large-size companies, the estimates for lagged OIBNUM are significant only at the 10% level for the ten-minute horizon and at the 5% level for the fifteen- and thirty-minute horizons. Their high significance for the five-minute horizon in 1999 vanishes, and the estimate for the daily horizon also becomes insignificant. Compared to 1999, the estimated coefficients of lagged OIBNUM for the small-size companies in 2002 also become insignificant for two more horizons of fifteen minutes and one day. However, the estimated coefficients of both lagged OIBNUM (1% level versus 5% level) and lagged OIBDOL (insignificant versus 5% level) for the small-size companies become more significant for the five-minute horizon compared to those in 1999. The estimates of lagged OIBDOL for the other horizons are insignificant for the small-size companies in 2002 (versus significant only for the thirty-minute horizon at the 5% level in 1999), while those for the large-size companies are significant only for the ten-minute horizon at the 10% level in 2002 (versus significant only for the ten-minute horizon at the 10% level in 1999). As a result, the estimated coefficients of lagged OIBNUM (lagged OIBDOL) are significantly smaller in magnitude for the five-, ten- and thirty-minute horizons (for the five-minute horizon) for the large- versus small-size companies.

In summary, the negative estimated coefficients of lagged trade / quote returns in the multiple regressions are less significant and smaller in magnitude for large- versus small-size companies in 1994. The positive coefficients of trade / quote return autocorrelations are more significant and larger in magnitude for the large- versus small-size companies in 1999. The estimated coefficients of the correlations between returns and lagged OIBNUM (lagged OIBDOL) are less significant and smaller in absolute magnitude for large- versus small-size companies whether the estimates are negative or positive across years. Negative coefficients gradually disappear and the estimated coefficients of lagged OIBNUM become insignificant at more horizons for both firm-size groups with time. While the first insignificant estimated

coefficient of lagged OIBNUM appears for the five-minute horizon for the large-size companies in 2002, it first appears for the fifteen-minute horizon for the small-size companies in 2002. The estimated coefficients of lagged trade / quote returns for the daily horizon are significant in 1994 and 1999 and become insignificant in 2002 for both firm-size groups.

7. CONCLUSION

By analyzing the autocorrelations of returns and the correlations between returns and order imbalance, both unconditionally and conditionally, we observe that these serial dependences (i.e. autocorrelations of trade / quote returns and the correlations between trade returns and lagged OIBNUM / lagged OIBDOL) can be negative at short horizons dating back to 1994. They could be indicators of overreactions by investors who fail to properly interpret the information contained in past price changes and order imbalances over shorter horizons. However, these measures of negative serial dependences in 1994 have gradually disappeared in 1999. The positive correlations between quote returns and lagged OIBNUM become significantly smaller in magnitude in 1999 compared to 1994 and continue to decrease in magnitude in 2002. The correlations between trade returns and lagged OIBNUM also decrease in magnitude in 2002. The positive autocorrelations of trade / quote returns significantly increase for the intraday horizons but significantly decrease for the daily horizon in 2002. With the passage of time, these measures of positive serial dependences gradually become insignificant for the daily horizon. All these are consistent with an improvement in market informational efficiency.

However, we do observe that positive serial dependences can disappear over some horizon and return with significance as the horizon lengthens. This may explain why efficiency at the daily level coexists with long-term anomalies and emphasizes the importance of treating market efficiency as a price-discovery process that is not instantaneous.

In conclusion, this thesis provides some empirical evidence that weak-form market efficiency in the Canadian market has improved over time, probably due to the reduction of

friction costs by the two MQIRs. Comparing the results in this paper with those in the paper of Chordia et al. (2005), we conclude that Canadian markets are less efficient than the US markets in the last year examined herein due to their slower speed of convergence to market efficiency. Future investigations could extend to more recent years and to small and mid-cap firms in the Canadian market, to foreign exchanges other than those in the US. Also, future studies could examine if the relationships of returns itself or between returns and order imbalances at the intraday level are non-linear and could control for other factors in the regressions such as returns and liquidities of the market portfolio.

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Tables

Table 1. Descriptive statistics for 1994

This table presents the descriptive statistics for six variables measured for different intervals (from 5 minutes to a day). Mean, median, minimum, maximum, standard deviation and skewness of the distribution of each variable for each interval are reported. All returns are presented in %. OIBNUM is order imbalance measured as the number of buyer-initiated trades minus the number of seller-initiated trades within a time interval (from five minutes to one day in this thesis). OIBSH is order imbalance measured as the number of buyer-initiated shares purchased minus the number of seller-initiated shares sold over the interval. OIBDOL is order imbalance measured as the dollar amount (trade price multiplied by the number of shares traded) of buyer-initiated trades minus the dollar amount of seller-initiated trades within the interval.

					5(1)s		
		Trade Return	Quote Return	T & Q Return	OIBNUM	OIBSH	OIBDOL
Daily	Mean	- 0.007	-0.010	-0.008	-0.19	-13601.02	-231453.23
	Median	0	0	0	0	-902.50	-19224.38
	Minimum	-30.90	-31.19	-30.90	-512	-9988662	-225658233
	Maximum	14.18	13.50	14.18	572	2509072	48365396.88
	Std. Dev.	1.76	1.68	1.76	36.80	197655.50	3868633.43
	Skewness	-0.09	-0.10	-0.09	0.49	-9.86	-11.76
1h	Mean	-0.003	-0.001	-0.004	0.39	-3576.53	-61143.11
	Median	0	0	0	0	-100	-1925
	Minimum	-19.69	-14.64	-19.69	-212	-10605762	-226550811
	Maximum	23.53	16.67	23.53	253	4350000	99393250
	Std. Dev.	0.92	0.86	0.92	18.12	122729.69	2557082.26
	Skewness	-0.19	-0.18	-0.21	0.46	-20.00	-29.63
30 mins	Mean	0.002	0.003	0.001	0.20	-2275.35	-37728.46
	Median	0	0	0	0	-50	-536.25
	Minimum	-19.05	-11.51	-19.05	-153	-10595862	-223318961
	Maximum	23.53	16.67	23.53	199	4332700	99110525
	Std. Dev.	0.75	0.69	0.75	12.81	94657.17	2009245.54
	Skewness	-0.10	-0.06	-0.12	0.40	-25.11	-41.63
15 mins	Mean	0.003	0.005	0.003	0.11	-1411.72	-22852.46
	Median	0	0	0	0	0	25
	Minimum	-19.05	-14.11	-19.05	-137	-10581062	-223042449
	Maximum	24.51	15.50	24.51	182	4333600	99131100
	Std. Dev.	0.63	0.56	0.62	9.34	70631.55	1490792.36
	Skewness	0.23	0.17	0.24	0.49	-25.73	-48.53
10 mins	Mean	0.003	0.005	0.002	0.076	-1093.40	-17712.22
	Median	0	0	0	0	0	25
	Minimum	-19.69	-14.11	-19.69	-132	-10581062	-223043011
	Maximum	23.53	14.17	23.53	183	4331000	99071625
	Std. Dev.	0.58	0.50	0.57	7.89	61139.67	1252394.08
	Skewness	-0.07	0.26	-0.008	0.61	-27.83	-47.52
5 mins	Mean	0.003	0.003	0.002	0.033	-744.84	-11977.86
	Median	0	0	0	0	0	25
	Minimum	-19.05	-36.22	-19.05	-128	-10571262	-222972561
	Maximum	5.84	14.91	13.33	183	4319600	98810850
	Std. Dev.	0.50	0.43	0.49	6.10	47416.77	946310.05
	Skewness	-0.20	-1.61	-0.07	0.70	-24.88	-37.15

Table 2. Descriptive statistics for 1999

This table presents the descriptive statistics for six variables measured for different intervals (from 5 minutes to a day). Mean, median, minimum, maximum, standard deviation and skewness of the distribution of each variable for each interval are reported. All returns are presented in %. OIBNUM is order imbalance measured as the number of buyer-initiated trades minus the number of seller-initiated trades within a time interval (from five minutes to one day in this thesis). OIBSH is order imbalance measured as the number of buyer-initiated shares purchased minus the number of seller-initiated shares sold over the interval. OIBDOL is order imbalance measured as the dollar amount (trade price multiplied by the number of shares traded) of buyer-initiated trades minus the dollar amount of seller-initiated trades within the interval.

					5(1)s		
		Trade Return	Quote Return	T & Q Return	OIBNUM	OIBSH	OIBDOL
Daily	Mean	0.025	0.020	0.020	8.51	-10717.61	-226940.66
	Median	0	-0.11	0	-1	-3400	-75264.35
	Minimum	-37.32	-38.05	-37.32	-1742.00	-7855310	-226135858
	Maximum	31.77	41.60	41.60	2810.00	11666016	306962253
	Std. Dev.	2.64	2.73	2.76	100.32	269181.10	6902763.22
	Skewness	0.23	0.53	0.52	4.72	5.48	3.92
1h	Mean	0.005	0.003	0.003	7.41	585.37	27802.41
	Median	0	0	0	1	100	3010
	Minimum	-35.55	-43.01	-42.79	-735	-8968200	-258738500
	Maximum	35.93	41.06	35.93	1061	11898630	309819750
	Std. Dev.	1.28	1.31	1.32	56.38	142694.78	3670985.14
	Skewness	0.41	-1.60	-1.40	2.18	6.29	1.98
30 mins	Mean	0.007	0.007	0.005	4.08	430.27	17751.59
	Median	0	0	0	1	100	2777.50
	Minimum	-33.32	-37.50	-37.26	-523	-8937000	-257828485
	Maximum	30.89	43.54	30.89	649	11898630	309973180
	Std. Dev.	0.96	0.96	0.97	36.11	105998.69	2724413.54
	Skewness	0.26	-0.68	-1.03	1.88	9.72	2.66
15 mins	Mean	0.003	0.004	0.002	2.16	232.84	9858.24
	Median	0	0	0	1	100	2285
	Minimum	-31.50	-30.18	-31.50	-594	-8967200	-258703215
	Maximum	29.52	34.11	31.12	640	11894030	309845675
	Std. Dev.	0.72	0.69	0.72	23.24	77658.78	2009260.89
	Skewness	0.18	-0.003	-0.11	1.58	10.53	2.34
10 mins	Mean	0.002	0.003	0.001	1.48	110.36	5751.48
	Median	0	0	0	1	100	2060
	Minimum	-29.65	-30.80	-30.18	-469	-8963700	-258601420
	Maximum	32.72	42.03	42.86	454	11894030	309919515
	Std. Dev.	0.60	0.57	0.61	17.98	66579.93	1713197.12
	Skewness	0.02	0.77	0.73	1.25	24.43	-0.96
5 mins	Mean	0.001	0.001	-0.000	0.77	6.86	1787.74
	Median	0	0	0	0	100	1850
	Minimum	-27.41	-23.86	-27.41	-433	-8979800	-259067330
	Maximum	30.43	36.72	37.50	414	11894030	309910605
	Std. Dev.	0.46	0.43	0.46	11.79	52231.92	1363397.23
	Skewness	-0.07	0.066	0.12	0.90	13.88	-0.44

Table 3. Descriptive statistics for 2002

This table presents the descriptive statistics for six variables measured for different intervals (from 5 minutes to a day). Mean, median, minimum, maximum, standard deviation and skewness of the distribution of each variable for each interval are reported. All returns are presented in %. OIBNUM is order imbalance measured as the number of buyer-initiated trades minus the number of seller-initiated trades within a time interval (from five minutes to one day in this thesis). OIBSH is order imbalance measured as the number of buyer-initiated shares purchased minus the number of seller-initiated shares sold over the interval. OIBDOL is order imbalance measured as the dollar amount (trade price multiplied by the number of shares traded) of buyer-initiated trades minus the dollar amount of seller-initiated trades within the interval.

					5s			1s		
		Trade Return	Quote Return	T & Q Return	OIBNUM	OIBSH	OIBDOL	OIBNUM	OIBSH	OIBDOL
Daily	Mean	-0.034	-0.033	-0.032	19.19	23712.77	582314.55	22.58	26530.55	617470.93
	Median	-0.032	-0.045	-0.032	5	3100	85825	6	3500	100878
	Minimum	-43.69	-43.25	-43.69	-5450	-7488900	-115828800	-5816	-7603100	-112320196
	Maximum	31.02	31.45	31.02	4776	16880800	122325219	5314	15474200	119113301
	Std. Dev.	2.67	2.69	2.73	173.09	416474.03	7096203.85	186.77	432769.16	7097210.27
	Skewness	0.022	0.094	0.087	3.42	9.21	0.96	4.54	10.00	1.00
1h	Mean	-0.033	-0.028	-0.032	11.15	25571.46	264855.83	15.30	28983.93	288328.94
	Median	0	0	0	3	2200	57430	4	2400	63802
	Minimum	-27.57	-27.68	-27.57	-3002	-8457100	-118528468	-3360	-8408300	-117835712
	Maximum	17.62	33.18	26.32	1916	10697600	80485632	2016	11083100	80475076
	Std. Dev.	1.40	1.43	1.42	147.88	392847.79	3626574.12	154.81	407976.71	3639878.53
	Skewness	-0.55	-0.032	-0.24	-1.91	3.26	-0.84	-1.35	3.94	-0.91
30 mins	Mean	-0.014	-0.010	-0.013	6.17	14960.71	156980.30	8.47	16785.59	169332.46
	Median	0	0	0	2	1200	32625	3	1400	35760.50
	Minimum	-19.67	-20.94	-19.79	-1956	-8469800	-118710669	-1967	-8434000	-118204149
	Maximum	16.17	33.44	23.79	1280	7312200	78355918	1390	7345100	78345362
	Std. Dev.	1.03	1.05	1.06	94.74	276361.37	2676265.26	97.78	284945.76	2679825.03
	Skewness	-0.33	0.28	0.18	-2.11	2.35	-1.52	-1.40	3.14	-1.70
15 mins	Mean	-0.006	-0.004	-0.006	3.27	8236.43	89085.66	4.49	9214.74	95312.97
	Median	0	0	0	1	700	17785	2	700	19343
	Minimum	-16.36	-20.29	-20.83	-1346	-8436600	-118236010	-1429	-8405800	-117800660
	Maximum	15.31	31.72	31.18	938	6787300	77453529	998	7081400	77453529
	Std. Dev.	0.77	0.76	0.77	60.96	190511.77	1930199.67	61.94	195115.84	1934865.06
	Skewness	-0.12	-0.005	-0.008	-3.33	2.42	-1.46	-2.66	3.88	-1.79
10 mins	Mean	-0.004	-0.002	-0.004	2.25	5682.81	62846.20	3.09	6367.29	67294.45
	Median	0	0	0	1	500	12266	1	500	13440
	Minimum	-16.36	-17.12	-16.36	-1220	-8353200	-117051478	-1312	-8330600	-116732288
	Maximum	13.93	14.55	14.37	801	6861400	75839616	879	6894500	7584338
	Std. Dev.	0.65	0.63	0.65	47.46	154076.52	1589534.41	47.80	155948.86	1590024.72
	Skewness	-0.12	-0.11	-0.12	-4.36	2.41	-1.18	-3.81	4.36	-1.45
5 mins	Mean	-0.003	-0.001	-0.003	1.17	2901.26	33898.82	1.61	3301.99	36383.83
	Median	0	0	0	1	300	6919	1	300	7437
	Minimum	-14.37	-14.15	-14.37	-1157	-8313900	-116490084	-1161	-8300900	-116307694
	Maximum	12.61	12.37	12.61	652	6740100	73384945	676	6746900	73384945
	Std. Dev.	0.49	0.46	-0.49	30.88	107560.62	1160935.28	30.67	106998.58	1160525.71
	Skewness	-0.20	-0.19	-0.22	-7.08	1.45	-3.47	-6.75	3.40	-3.64

Table 4. Correlations between returns and contemporaneous (lagged) order imbalance metrics

This table presents the autocorrelations of (trade / quote) returns and product-moment correlation coefficients between (trade/quote) returns and order imbalances (i.e. OIBNUM, OIBSH and OIBDOL), contemporaneous or lagged, with p-values for significance in parentheses. The findings are the same for the 5s and 1s signing rule for 1994 and 1999 where s refers to seconds.

		5s		1s	
		Trade Return$_t$	Quote Return$_t$	Trade Return$_t$	Quote Return$_t$
1994	T/QReturn$_{t-1}$			0.05869	0.09834
				(<0.0001)	(<0.0001)
	OIBNUM$_t$			0.19112	0.18211
				(<0.0001)	(<0.0001)
	OIBNUM$_{t-1}$			0.02320	0.04051
				(0.0006)	(<0.0001)
	OIBSH$_t$			0.07245	0.06338
				(<0.0001)	(<0.0001)
	OIBSH$_{t-1}$			0.00565	0.01184
				(0.4062)	(0.0811)
	OIBDOL$_t$			0.08175	0.07592
				(<0.0001)	(<0.0001)
	OIBDOL$_{t-1}$			0.00938	0.01456
				(0.1678)	(0.0320)
1999	T/QReturn$_{t-1}$			0.06620	0.09457
				(<0.0001)	(<0.0001)
	OIBNUM$_t$			0.29569	0.29544
				(<0.0001)	(<0.0001)
	OIBNUM$_{t-1}$			0.03981	0.04469
				(<0.0001)	(<0.0001)
	OIBSH$_t$			0.15745	0.15751
				(<0.0001)	(<0.0001)
	OIBSH$_{t-1}$			0.01597	0.01988
				(0.0220)	(0.0042)
	OIBDOL$_t$			0.13496	0.13424
				(<0.0001)	(<0.0001)
	OIBDOL$_{t-1}$			0.01800	0.02141
				(0.0099)	(0.0021)
2002	T/QReturn$_{t-1}$			0.00597	0.01924
				(0.3821)	(0.0048)
	OIBNUM$_t$	0.38546	0.38670	0.33779	0.33946
		(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)
	OIBNUM$_{t-1}$	0.01571	0.01859	0.01278	0.01503
		(0.0212)	(0.0064)	(0.0609)	(0.0275)
	OIBSH$_t$	0.19418	0.20100	0.18143	0.18837
		(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)
	OIBSH$_{t-1}$	0.01788	0.01644	0.02103	0.01976
		(0.0087)	(0.0159)	(0.0020)	(0.0038)
	OIBDOL$_t$	0.18334	0.18523	0.17938	0.18148
		(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)
	OIBDOL$_{t-1}$	0.00515	0.00679	0.00578	0.00717
		(0.4503)	(0.3193)	(0.3964)	(0.2929)

Table 5. Correlations between contemporaneous and contemporaneous (lagged) order imbalance metrics

This table presents the autocorrelation coefficients of order imbalances (i.e. OIBNUM, OIBSH and OIBDOL) and product-moment correlations between any two of them, contemporary or lagged, with p-values for significance in parentheses.

		5s			1s		
		$OIBNUM_t$	$OIBSH_t$	$OIBDOL_t$	$OIBNUM_t$	$OIBSH_t$	$OIBDOL_t$
1994	$OIBNUM_{t-1}$				0.42965		
					(<0.0001)		
	$OIBSH_t$				0.17368		
					(<0.0001)		
	$OIBSH_{t-1}$				0.02414	0.03215	
					(0.0004)	(<0.0001)	
	$OIBDOL_t$				0.18373	0.89943	
					(<0.0001)	(<0.0001)	
	$OIBDOL_{t-1}$				0.02638	0.03452	0.04148
					(0.0001)	(<0.0001)	(<0.0001)
1999	$OIBNUM_{t-1}$				0.42963		
					(<0.0001)		
	$OIBSH_t$				0.21920		
					(<0.0001)		
	$OIBSH_{t-1}$				0.04214	0.05784	
					(<0.0001)	(<0.0001)	
	$OIBDOL_t$				0.20936	0.89278	
					(<0.0001)	(<0.0001)	
	$OIBDOL_{t-1}$				0.03878	0.05349	0.06865
					(<0.0001)	(<0.0001)	(<0.0001)
2002	$OIBNUM_{t-1}$	0.39272			0.44344		
		(<0.0001)			(<0.0001)		
	$OIBSH_t$	0.58366			0.60313		
		(<0.0001)			(<0.0001)		
	$OIBSH_{t-1}$	0.25324	0.21088		0.28244	0.22960	
		(<0.0001)	(<0.0001)		(<0.0001)	(<0.0001)	
	$OIBDOL_t$	0.31962	0.65759		0.31493	0.64304	
		(<0.0001)	(<0.0001)		(<0.0001)	(<0.0001)	
	$OIBDOL_{t-1}$	0.10173	0.08094	0.10460	0.11010	0.08167	0.10183
		(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)

Table 6. Serial regressions for trade returns and univariate regressions of trade returns on lagged order imbalance (OIBNUM / OIBDOL) for 1994 (based on 1-second signing rule)

Dependent variable is trade returns and the single independent variable is lagged trade returns, lagged OIBNUM or lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

Number of Time Slots (5, 10, 15, 30, 60 mins)		895345		Number of Days			21837
		$TReturn_t$					
		5 mins	10 mins	15 mins	30 mins	60 mins	Daily
$TReturn_{t-1}$	$b_{0\text{-}3}$	-0.21	-0.20	-0.18	-0.14	-0.097	0.058
	t_0	-115.69*	-132.76*	-135.63*	-107.63*	-73.32*	8.62*
	t_1	-65.13*	-49.27*	-34.93*	-48.73*	-42.64*	6.23*
	t_{21}	-4.69*	-5.50*	-4.54*	-4.20*	-3.38*	4.56*
	t_{22}	-20.70*	-19.94*	-13.48*	-14.39*	-9.02*	3.92*
	t_3	-4.68*	-5.47*	-4.52*	-4.18*	-3.32*	3.38*
	b_{41}	-0.21	-0.20	-0.19	-0.14	-0.099	0.056
	t_{41}	-116.36*	-133.42*	-136.41*	-108.57*	-74.33*	8.23*
	b_{42}	-0.21	-0.20	-0.20	-0.16	-0.12	0.020
	t_{42}	-119.07*	-138.62*	-143.97*	-121.14*	-94.50*	2.97*
	Adjusted- R^2 (%)	4.27	3.77	3.38	1.91	0.95	0.34
	# of Observations	299793	449746	525880	595041	559643	21521
$OIBNUM_{t-1}$	$b_{0\text{-}3}$ (10^3)	-5.37	-4.03	-2.87	-0.80	0.26	1.11
	t_0	-42.84*	-39.78*	-31.84*	-10.75*	4.11*	3.41*
	t_1	-33.45*	-32.35*	-26.94*	-9.45*	3.61*	3.23*
	t_{21}	-8.03*	-6.66*	-5.68*	-1.70^	0.26	2.80*
	t_{22}	-13.08*	-8.29*	-5.71*	-1.67^	0.26	2.20#
	t_3	-7.76*	-5.95*	-4.89*	-1.57	0.47	2.05#
	b_{41}(10^3)	-5.23	-3.87	-2.71	-0.56	0.57	1.52
	t_{41}	-41.44*	-37.80*	-29.64*	-7.39*	8.60*	4.33*
	b_{42} (10^3)	-5.75	-4.57	-3.49	-1.60	-0.65	0.042
	t_{42}	-45.58*	-44.69*	-38.25*	-21.23*	-10.07*	0.13
	Adjusted- R^2 (%)	0.49	0.31	0.17	0.02	0.00	0.05
$OIBDOL_{t-1}$	$b_{0\text{-}3}$ (10^9)	-8.63	-5.54	-7.12	-2.01	0.59	4.25
	t_0	-12.37*	-11.53*	-14.00*	-4.05*	1.25	1.38
	t_1	-7.29*	-6.65*	-6.56*	-3.08*	1.39	1.36
	t_{21}	-3.69*	-1.85^	-2.31#	-1.38	0.36	1.48
	t_{22}	-3.73*	-1.84^	-2.36#	-1.06	0.27	1.21
	t_3	-3.65*	-1.84^	-2.29#	-1.40	0.39	1.29
	b_{41} (10^9)	-8.56	-5.53	-7.10	-2.03	0.54	3.90
	t_{41}	-12.28*	-11.49*	-13.95*	-4.08*	1.15	1.26
	b_{42} (10^9)	-8.95	-5.95	-7.53	-2.81	-0.25	2.28
	t_{42}	-12.83*	-12.36*	-14.81*	-5.69*	-0.54	0.79
	Adjusted- R^2 (%)	0.04	0.03	0.03	0.00	0.00	0.00
	# of Observations	373578	510530	581635	652547	636059	21644

Table 7. Serial regressions for quote returns and univariate regressions of quote returns on lagged order imbalance (OIBNUM / OIBDOL) for 1994 (based on 1-second signing rule)

Dependent variable is quote returns and the single independent variable is lagged quote returns, lagged OIBNUM or lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

Number of Time Slots (5, 10, 15, 30, 60 mins)		895345		Number of Days			21837
		$QReturn_t$					
		5 mins	10 mins	15 mins	30 mins	60 mins	Daily
$QReturn_{t-1}$	$b_{0\text{-}3}$	-0.085	-0.058	-0.037	-0.009	0.0078	0.098
	t_0	-51.92*	-40.64*	-27.11*	-6.64*	5.83*	14.54*
	t_1	-17.05*	-14.56*	-10.96*	-3.32*	3.08*	10.00*
	t_{21}	-3.11*	-2.82*	-1.51	-0.45	0.49	8.46*
	t_{22}	-9.23*	-6.22*	-3.64*	-0.91	0.72	6.18*
	t_3	-3.10*	-2.82*	-1.49	-0.45	0.46	5.75*
	b_{41}	-0.086	-0.059	-0.038	-0.010	0.006	0.095
	t_{41}	-52.57*	-41.41*	-27.90*	-7.59*	4.68*	14.12*
	b_{42}	-0.092	-0.067	-0.050	-0.028	-0.022	0.054
	t_{42}	-56.17*	-47.53*	-36.67*	-21.45*	-16.25*	8.00*
	Adjusted-R^2 (%)	0.57	0.28	0.11	0.01	0.01	0.96
	# of Observations	469667	595624	645679	665178	591829	21657
$OIBNUM_{t-1}$	$b_{0\text{-}3}$ (10^3)	2.93	1.90	1.76	1.97	1.75	1.85
	t_0	28.31*	22.29*	22.66*	29.68*	29.71*	5.97*
	t_1	19.48*	17.28*	18.56*	25.45*	25.84*	5.60*
	t_{21}	6.51*	5.10*	3.62*	3.85*	3.36*	3.97*
	t_{22}	6.30*	4.24*	4.01*	4.59*	3.08*	3.69*
	t_3	6.27*	4.13*	3.23*	3.69*	3.18*	3.09*
	b_{41}(10^3)	3.13	2.15	2.03	2.31	2.16	2.38
	t_{41}	30.12*	24.98*	25.82*	34.14*	35.54*	7.11*
	b_{42} (10^3)	2.64	1.47	1.24	1.29	0.90	0.69
	t_{42}	25.33*	17.08*	15.90*	19.29*	15.21*	2.29#
	Adjusted- R^2 (%)	0.19	0.09	0.08	0.13	0.14	0.16
$OIBDOL_{t-1}$	$b_{0\text{-}3}$ (10^9)	3.92	0.91	0.32	3.36	4.65	6.32
	t_0	6.85*	2.23#	0.74	7.61*	10.80*	2.14#
	t_1	2.90*	1.31	0.43	6.73*	10.64*	1.93^
	t_{21}	1.49	0.56	0.19	2.67*	2.63#	2.33#
	t_{22}	1.52	0.66	0.21	2.10#	2.05#	1.76^
	t_3	1.48	0.56	0.19	2.61*	2.82*	2.06#
	b_{41} (10^9)	3.93	0.94	0.33	3.31	4.60	6.00
	t_{41}	6.86*	2.30#	0.75	7.51*	10.69*	2.03#
	b_{42} (10^9)	3.61	0.52	-0.083	2.63	3.79	4.33
	t_{42}	6.31*	1.36	-0.19	6.01*	8.93*	1.56
	Adjusted- R^2 (%)	0.01	0.00	-0.00	0.01	0.02	0.02
	# of Observations	482959	548306	613497	672349	645188	21691

Table 8. Serial regressions for trade returns and univariate regressions of trade returns on lagged order imbalance (OIBNUM / OIBDOL) for 1999 (based on 1-second signing rule)

Dependent variable is trade returns and the single independent variable is lagged trade returns, lagged OIBNUM or lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

Number of Time Slots (5, 10, 15, 30, 60 mins)		2710586			Number of Days		20916
		$TReturn_t$					
		5 mins	10 mins	15 mins	30 mins	60 mins	Daily
$TReturn_{t-1}$	$b_{0\text{-}3}$	-0.023	0.0054	0.0083	0.030	0.039	0.066
	t_0	-31.48*	8.03*	12.75*	46.09*	58.05*	9.49*
	t_1	-5.80*	1.40	2.41#	11.02*	18.66*	4.98*
	t_{21}	-0.81	0.25	0.73	3.05*	4.83*	6.26*
	t_{22}	-2.26#	0.40	0.47	2.60#	2.86*	3.69*
	t_3	-0.81	0.24	0.68	2.85*	5.01*	4.12*
	b_{41}	-0.024	0.0038	0.0065	0.026	0.033	0.061
	t_{41}	-32.99*	5.61*	9.94*	40.59*	48.54*	8.69*
	b_{42}	-0.027	$9.06*10^{-4}$	$1.51*10^{-5}$	0.016	0.019	0.054
	t_{42}	-37.03*	-1.34	0.02	25.20*	27.92*	7.75*
	Adjusted- R^2 (%)	0.05	0.00	0.01	0.10	0.18	0.43
	# of Observations	1887928	2199297	2279739	2221286	1918651	20451
$OIBNUM_{t-1}$	$b_{0\text{-}3}$ (10^3)	1.69	1.32	1.02	0.91	0.71	1.04
	t_0	65.11*	60.98*	51.84*	54.09*	48.17*	5.71*
	t_1	30.09*	28.09*	25.25*	29.53*	28.78*	4.01*
	t_{21}	7.20*	5.81*	5.21*	2.87*	1.87^	2.71*
	t_{22}	8.70*	5.86*	3.76*	3.29*	1.98#	3.51*
	t_3	7.18*	5.86*	5.52*	2.81*	1.86^	2.54#
	b_{41}(10^3)	1.76	1.40	1.10	1.02	0.82	1.43
	t_{41}	67.21*	64.23*	55.60*	59.57*	54.23*	7.19*
	b_{42} (10^3)	1.55	1.13	0.78	0.62	0.35	0.84
	t_{42}	59.38*	51.67*	39.39*	36.51*	23.19*	4.72*
	Adjusted- R^2 (%)	0.21	0.16	0.11	0.13	0.11	0.15
$OIBDOL_{t-1}$	$b_{0\text{-}3}$ (10^9)	2.95	3.69	2.33	3.76	5.54	6.86
	t_0	10.74*	15.38*	10.07*	16.78*	23.00*	2.58*
	t_1	5.84*	8.78*	7.56*	13.99*	20.54*	2.75*
	t_{21}	1.64	1.33	1.23	3.72*	2.78*	2.45#
	t_{22}	2.06#	1.91^	1.49	2.27#	2.41#	2.66*
	t_3	1.62	1.34	1.27	3.23*	2.61*	2.39#
	b_{41} (10^9)	2.90	3.63	2.25	3.61	5.20	6.70
	t_{41}	10.57*	15.13*	9.72*	16.09*	21.65*	2.50#
	b_{42} (10^9)	2.51	3.00	1.45	2.30	3.19	4.79
	t_{42}	9.16*	12.51*	6.29*	10.28*	13.37*	1.87^
	Adjusted- R^2 (%)	0.01	0.01	0.00	0.01	0.02	0.03
	# of Observations	2000428	2276090	2355704	2335786	2124865	20551

Table 9. Serial regressions for quote returns and univariate regressions of quote returns on lagged order imbalance (OIBNUM / OIBDOL) for 1999 (based on 1-second signing rule)

Dependent variable is quote returns and the single independent variable is lagged quote returns, lagged OIBNUM or lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

Number of Time Slots (5, 10, 15, 30, 60 mins)		2710586			Number of Days		20916
		$QReturn_t$					
		5 mins	10 mins	15 mins	30 mins	60 mins	Daily
$QReturn_{t-1}$	$b_{0\text{-}3}$	0.050	0.047	0.047	0.045	0.051	0.095
	t_0	72.67*	72.71*	74.56*	73.54*	79.09*	13.68*
	t_1	6.63*	4.70*	5.96*	6.69*	15.35*	5.74*
	t_{21}	2.08#	1.09	1.92^	1.88^	3.15*	4.51*
	t_{22}	2.93*	1.13	1.64	1.74^	2.63*	4.74*
	t_3	2.07#	1.08	1.90^	1.85^	3.17*	3.97*
	b_{41}	0.049	0.045	0.045	0.042	0.045	0.090
	t_{41}	71.37*	70.55*	71.89*	68.16*	70.24*	12.97*
	b_{42}	0.046	0.041	0.039	0.033	0.032	0.083
	t_{42}	66.88*	63.36*	62.23*	53.43*	50.52*	11.91*
	Adjusted- R^2 (%)	0.23	0.22	0.23	0.24	0.32	0.89
	# of Observations	2243178	2401033	2407301	2267334	1931429	20737
$OIBNUM_{t-1}$	$b_{0\text{-}3}$ (10^3)	2.63	1.86	1.39	1.13	0.84	1.16
	t_0	111.97*	92.63*	75.03*	69.36*	58.02*	6.42*
	t_1	46.81*	39.82*	34.54*	36.68*	34.03*	4.44*
	t_{21}	7.32*	6.31*	5.82*	3.55*	2.21#	2.84*
	t_{22}	13.09*	8.02*	4.97*	4.07*	2.35#	3.91*
	t_3	7.32*	6.37*	6.02*	3.48*	2.20#	2.68*
	b_{41}(10^3)	2.70	1.95	1.49	1.24	0.96	1.57
	t_{41}	114.63*	96.28*	79.31*	75.29*	64.50*	7.97*
	b_{42} (10^3)	2.50	1.68	1.16	0.84	0.48	0.93
	t_{42}	105.99*	82.86*	62.12*	51.42*	32.69*	5.23*
	Adjusted- R^2 (%)	0.59	0.37	0.23	0.20	0.16	0.19
$OIBDOL_{t-1}$	$b_{0\text{-}3}$ (10^9)	6.23	5.62	3.92	4.78	6.48	8.11
	t_0	25.11*	25.13*	17.89*	22.13*	27.45*	3.07*
	t_1	9.62*	11.51*	11.53*	16.62*	23.52*	3.27*
	t_{21}	2.81*	1.78^	1.81^	3.77*	3.13*	2.77*
	t_{22}	3.80*	2.78*	2.35#	2.66*	2.80*	3.13*
	t_3	2.79*	1.81^	1.87^	3.42*	2.96*	2.69*
	b_{41} (10^9)	6.19	4.56	3.85	4.63	6.14	8.00
	t_{41}	24.97*	24.89*	17.58*	21.45*	26.12*	3.01*
	b_{42} (10^9)	5.80	4.92	3.04	3.33	4.10	5.69
	t_{42}	23.41*	22.06*	13.90*	15.47*	17.55*	2.23#
	Adjusted- R^2 (%)	0.03	0.03	0.01	0.02	0.04	0.04
	# of Observations	2100313	2337620	2394532	2350511	2128424	20582

Table 10. Serial regressions for trade returns and univariate regressions of trade returns on lagged order imbalance (OIBNUM / OIBDOL) for 2002 (based on 1-second signing rule)

Dependent variable is trade returns and the single independent variable is lagged trade returns, lagged OIBNUM or lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

Number of Time Slots (5, 10, 15, 30, 60 mins)		6519684			Number of Days		21672
		$TReturn_t$					
		5 mins	10 mins	15 mins	30 mins	60 mins	Daily
$TReturn_{t-1}$	$b_{0\text{-}3}$	0.013	0.020	0.049	0.080	0.072	0.0060
	t_0	29.27*	48.70*	116.16*	185.99*	158.40*	0.87
	t_1	10.48*	19.12*	47.07*	79.54*	79.36*	0.45
	t_{21}	0.88	1.98^	4.36*	8.15*	4.99*	0.52
	t_{22}	1.56	2.17#	5.15*	7.34*	5.22*	0.23
	t_3	0.87	1.90^	4.27*	7.68*	4.77*	0.24
	b_{41}	0.012	0.020	0.047	0.078	0.068	0.0022
	t_{41}	27.95*	46.63*	113.20*	180.94*	150.69*	0.33
	b_{42}	0.0072	0.011	0.036	0.058	0.036	-0.0019
	t_{42}	16.48*	26.55*	85.34*	135.80*	79.20*	-0.27
	Adjusted- R^2 (%)	0.02	0.04	0.23	0.64	0.55	0.00
	# of Observations	5500965	5835844	5809236	5402056	4577029	21418
$OIBNUM_{t-1}$	$b_{0\text{-}3}$ (10^3)	0.28	0.39	0.50	0.70	0.53	0.19
	t_0	43.36*	69.97*	99.66*	159.63*	137.13*	1.87^
	t_1	16.98*	31.51*	47.90*	85.46*	79.50*	0.71
	t_{21}	1.65	3.30*	5.80*	7.98*	7.92*	1.81^
	t_{22}	1.76^	2.37#	3.23*	4.12*	3.06*	0.61
	t_3	1.66^	3.33*	5.72*	8.08*	8.53*	1.01
	b_{41}(10^3)	0.29	0.40	0.53	0.75	0.61	0.33
	t_{41}	44.46*	71.98*	103.43*	168.03*	153.83*	3.16*
	b_{42} (10^3)	0.19	0.27	0.36	0.52	0.28	0.10
	t_{42}	29.25*	47.37*	70.16*	114.24*	69.42*	1.10
	Adjusted- R^2 (%)	0.03	0.08	0.17	0.44	0.37	0.01
$OIBDOL_{t-1}$	$b_{0\text{-}3}$ (10^9)	3.19	3.97	5.23	8.37	7.56	2.17
	t_0	17.72*	23.90*	31.91*	49.57*	44.33*	0.85
	t_1	17.87*	23.55*	29.02*	48.69*	44.92*	0.92
	t_{21}	2.91*	1.99^	1.74^	2.31#	2.05#	0.87
	t_{22}	2.45#	2.30#	2.37#	3.31*	2.36#	0.73
	t_3	2.85*	1.92^	1.70^	2.30#	2.03#	0.70
	b_{41} (10^9)	3.17	3.97	5.28	8.50	7.99	2.72
	t_{41}	17.62*	23.91*	32.20*	50.31*	46.86*	1.04
	b_{42} (10^9)	2.33	2.68	3.43	5.01	1.95	-0.95
	t_{42}	12.96*	16.20*	21.03*	29.93*	11.60*	-0.39
	Adjusted- R^2 (%)	0.01	0.01	0.02	0.04	0.04	0.00
	# of Observations	5647022	5966470	5975139	5715129	5092452	21507

Table 11. Serial regressions for quote returns and univariate regressions of quote returns on lagged order imbalance (OIBNUM / OIBDOL) for 2002 (based on 1-second signing rule)

Dependent variable is quote returns and the single independent variable is lagged quote returns, lagged OIBNUM or lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion..

Number of Time Slots (5, 10, 15, 30, 60 mins)		6519684			Number of Days		21672
		$QReturn_t$					
		5 mins	10 mins	15 mins	30 mins	60 mins	Daily
$QReturn_{t-1}$	$b_{0\text{-}3}$	0.080	0.077	0.091	0.10	0.086	0.019
	t_0	188.51*	186.03*	223.08*	248.42*	195.87*	2.82*
	t_1	57.64*	58.22*	82.01*	102.98*	97.07*	1.37
	t_{21}	4.25*	4.62*	7.27*	11.21*	5.63*	1.60
	t_{22}	9.03*	5.92*	8.64*	9.38*	6.26*	0.71
	t_3	4.21*	4.51*	7.11*	10.78*	5.69*	0.74
	b_{41}	0.079	0.075	0.090	0.10	0.083	0.016
	t_{41}	186.88*	183.20*	219.52*	242.82*	187.81*	2.34#
	b_{42}	0.074	0.067	0.078	0.083	0.053	0.010
	t_{42}	175.14*	163.49*	192.31*	199.17*	119.37*	1.45
	Adjusted- R^2 (%)	0.58	0.57	0.83	1.12	0.83	0.03
	# of Observations	6129497	6088804	5941000	5439788	4589178	21500
$OIBNUM_{t-1}$	$b_{0\text{-}3}$ (10^3)	0.45	0.48	0.57	0.74	0.56	0.21
	t_0	73.18*	90.18*	115.33*	171.82*	144.65*	2.20#
	t_1	27.26*	39.45*	54.17*	90.91*	83.14*	0.84
	t_{21}	1.99#	3.50*	5.41*	7.48*	7.62*	1.81^
	t_{22}	2.78*	2.97*	3.67*	4.39*	3.21*	0.71
	t_3	2.00#	3.30*	5.36*	7.57*	8.14*	1.05
	b_{41}(10^3)	0.46	0.49	0.59	0.79	0.63	0.37
	t_{41}	74.51*	92.48*	119.40*	180.58*	161.71*	3.66*
	b_{42} (10^3)	0.36	0.36	0.42	0.56	0.30	0.12
	t_{42}	58.57*	66.89*	85.01*	125.85*	76.44*	1.32
	Adjusted- R^2 (%)	0.09	0.13	0.22	0.51	0.41	0.02
$OIBDOL_{t-1}$	$b_{0\text{-}3}$ (10^9)	5.65	5.66	6.57	9.29	8.27	2.66
	t_0	33.38*	35.47*	41.23*	55.95*	48.98*	1.05
	t_1	31.10*	32.73*	35.69*	54.04*	48.85*	1.14
	t_{21}	4.30*	2.70*	2.13#	2.50#	2.17#	1.07
	t_{22}	4.12*	3.18*	2.91*	3.63*	2.57#	0.91
	t_3	4.11*	2.60*	2.08#	2.48#	2.15#	0.87
	b_{41} (10^9)	5.63	5.67	6.62	9.41	8.70	3.30
	t_{41}	33.29*	35.49*	41.54*	56.69*	51.51*	1.28
	b_{42} (10^9)	4.80	4.37	4.76	5.92	2.64	-0.73
	t_{42}	28.41*	27.45*	30.03*	35.99*	15.89*	-0.31
	Adjusted- R^2 (%)	0.02	0.02	0.03	0.05	0.05	0.00
	# of Observations	5828556	6044621	6015871	5725557	5094283	21511

Table 12. Serial regressions for trade returns and univariate regressions of trade returns on lagged order imbalance for 2002 (based on 5-second signing rule)

Dependent variable is trade returns and the single independent variable is lagged OIBNUM or lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

Number of Time Slots (5, 10, 15, 30, 60 mins)		6519684			Number of Days		21672
		$TReturn_t$					
		5 mins	10 mins	15 mins	30 mins	60 mins	Daily
$OIBNUM_{t-1}$	$b_{0\text{-}3}$ (10^3)	0.26	0.37	0.49	0.71	0.57	0.25
	t_0	40.42*	65.43*	95.81*	155.81*	138.62*	2.30#
	t_1	15.67*	28.91*	45.69*	82.99*	79.21*	0.88
	t_{21}	1.52	2.75*	5.18*	10.10*	7.58*	2.10#
	t_{22}	1.68^	2.22#	3.14*	4.05*	3.19*	0.74
	t_3	1.53	2.76*	5.07*	10.00*	7.71*	1.15
	b_{41}(10^3)	0.26	0.37	0.50	0.74	0.62	0.36
	t_{41}	40.82*	66.31*	97.79*	160.75*	149.50*	3.24*
	b_{42} (10^3)	0.17	0.24	0.34	0.50	0.28	0.15
	t_{42}	25.76*	41.75*	64.67*	107.41*	66.72*	1.50
	Adjusted- R^2 (%)	0.03	0.07	0.15	0.42	0.38	0.02
$OIBDOL_{t-1}$	$b_{0\text{-}3}$ (10^9)	2.98	3.87	5.00	8.35	5.39	1.94
	t_0	16.52*	23.17*	30.51*	49.35*	31.63*	0.75
	t_1	16.53*	23.49*	28.27*	49.15*	33.52*	0.84
	t_{21}	2.62#	2.31#	1.72^	1.99#	1.79^	0.76
	t_{22}	2.30#	2.47#	2.60*	3.55*	1.73^	0.65
	t_3	2.51#	2.23#	1.69^	1.99#	1.77^	0.62
	b_{41} (10^9)	2.95	3.83	5.00	8.38	5.63	2.29
	t_{41}	16.33*	22.97*	30.50*	49.49*	32.97*	0.88
	b_{42} (10^9)	2.10	2.52	3.15	4.91	-2.01	-1.60
	t_{42}	11.62*	15.13*	19.27*	29.27*	-1.20	-0.67
	Adjusted- R^2 (%)	0.00	0.01	0.02	0.04	0.02	0.00
	# of Observations	5828313	6044369	6015616	5725239	5094015	21511

Table 13. Serial regressions for quote returns and univariate regressions of quote returns on lagged order imbalance for 2002 (based on 5-second signing rule)

Dependent variable is quote returns and the single independent variable is lagged OIBNUM or lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

Number of Time Slots (5, 10, 15, 30, 60 mins)		6519684			Number of Days		21672
		$QReturn_t$					
		5 mins	10 mins	15 mins	30 mins	60 mins	Daily
$OIBNUM_{t-1}$	$b_{0\text{-}3}$ (10^3)	0.43	0.46	0.56	0.75	0.59	0.28
	t_0	70.55*	85.97*	111.77*	168.38*	146.57*	2.73*
	t_1	26.02*	36.88*	52.05*	88.60*	83.01*	1.05
	t_{21}	1.93^	3.17*	5.17*	9.34*	7.25*	2.07#
	t_{22}	2.75*	2.83*	3.59*	4.33*	3.35*	0.86
	t_3	1.94^	3.18*	5.08*	9.28*	7.38*	1.22
	b_{41}(10^3)	0.43	0.47	0.57	0.78	0.64	0.41
	t_{41}	71.04*	86.97*	113.89*	173.50*	157.66*	3.80*
	b_{42} (10^3)	0.34	0.33	0.40	0.55	0.31	0.18
	t_{42}	55.36*	61.57*	79.79*	119.34*	74.12*	1.79^
	Adjusted- R^2 (%)	0.09	0.12	0.21	0.49	0.42	0.03
$OIBDOL_{t-1}$	$b_{0\text{-}3}$ (10^9)	5.48	5.61	6.36	9.28	6.13	2.52
	t_0	32.27*	34.94*	39.88*	55.77*	36.32*	1.00
	t_1	30.01*	33.24*	35.19*	54.60*	37.89*	1.10
	t_{21}	4.07*	3.12*	2.14#	2.16#	1.95^	0.98
	t_{22}	4.03*	3.44*	3.21*	3.90*	1.95^	0.86
	t_3	3.85*	2.99*	2.10#	2.16#	1.93^	0.42
	b_{41} (10^9)	5.45	5.58	6.36	9.30	6.36	2.96
	t_{41}	32.08*	34.76*	39.87*	55.90*	37.66*	1.15
	b_{42} (10^9)	4.60	4.25	4.49	5.83	5.18	-1.27
	t_{42}	27.15*	26.57*	28.28*	35.36*	3.12*	-0.53
	Adjusted- R^2 (%)	0.02	0.02	0.03	0.05	0.03	0.00
	# of Observations	5828313	6044369	6015616	5725239	5094015	21511

Table 14. Serial regressions for OIBNUM and OIBDOL for 1994 (based on 1-second signing rule)

Dependent variable is OIBNUM (OIBDOL) and the single independent variable is lagged OIBNUM (lagged OIBDOL). $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level.

Number of Time Slots (5, 10, 15, 30, 60 mins)		895345		Number of Days			21837
		$OIBNUM_t/OIBDOL_t$					
		5 mins	10 mins	15 mins	30 mins	60 mins	Daily
$OIBNUM_{t-1}$	$b_{0\text{-}3}$	0.17	0.20	0.22	0.28	0.34	0.43
	t_0	102.82*	136.48*	159.38*	211.42*	264.10*	69.99*
	t_1	42.20*	73.75*	82.70*	99.30*	105.76*	27.76*
	t_{21}	17.91*	17.24*	14.68*	10.43*	8.76*	10.11*
	t_{22}	13.67*	18.63*	14.96*	16.39*	11.95*	20.12*
	t_3	16.25*	15.83*	13.77*	10.23*	8.43*	9.55*
	b_{41}	0.15	0.18	0.20	0.24	0.28	0.33
	t_{41}	94.44*	122.03*	139.94*	180.90*	218.02*	52.07*
	b_{42}	0.15	0.18	0.20	0.24	0.30	0.43
	t_{42}	92.02*	120.87*	140.14*	185.17*	229.86*	69.60*
	Adjusted- R^2 (%)	2.24	3.09	3.81	6.12	9.69	18.46
$OIBDOL_{t-1}$	$b_{0\text{-}3}$	0.037	0.018	0.041	0.019	0.024	0.041
	t_0	28.28*	18.13*	35.61*	16.38*	20.75*	6.11*
	t_1	1.65^	6.02*	3.40*	8.87*	9.23*	2.81*
	t_{21}	4.38*	1.52	5.57*	2.99*	1.38	2.26#
	t_{22}	3.63*	1.54	5.53*	2.40#	1.25	2.82*
	t_3	4.40*	1.51	5.59*	3.09*	1.37	2.26#
	b_{41}	0.036	0.017	0.040	0.017	0.022	0.032
	t_{41}	27.68*	17.48*	34.49*	15.12*	18.90*	4.69*
	b_{42}	0.035	0.016	0.038	0.015	0.018	0.039
	t_{42}	26.75*	15.91*	32.44*	12.85*	15.35*	5.77*
	Adjusted- R^2 (%)	0.17	0.06	0.20	0.04	0.07	0.17
	# of Oberservations	461928	585084	641010	686182	650073	21638

Table 15. Serial regressions for OIBNUM and OIBDOL for 1999 (based on 1-second signing rule)

Dependent variable is OIBNUM (OIBDOL) and the single independent variable is lagged OIBNUM (lagged OIBDOL). $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level.

Number of Time Slots (5, 10, 15, 30, 60 mins)		2710586			Number of Days		20916
		$OIBNUM_t/OIBDOL_t$					
		5 mins	10 mins	15 mins	30 mins	60 mins	Daily
$OIBNUM_{t-1}$	$b_{0\text{-}3}$	0.30	0.33	0.34	0.39	0.43	0.43
	t_0	435.57*	515.10*	544.01*	627.03*	637.75*	68.18*
	t_1	104.56*	128.20*	131.19*	163.29*	165.58*	15.95*
	t_{21}	22.12*	21.14*	24.37*	14.38*	9.78*	5.20*
	t_{22}	24.84*	20.30*	19.21*	14.09*	11.63*	15.63*
	t_3	22.97*	22.19*	26.64*	14.16*	9.74*	5.19*
	b_{41}	0.29	0.32	0.32	0.36	0.39	0.32
	t_{41}	421.17*	491.31*	512.91*	579.34*	569.68*	48.57*
	b_{42}	0.29	0.32	0.32	0.37	0.40	0.44
	t_{42}	417.99	489.82*	513.03*	585.36*	585.96*	69.21*
	Adjusted- R^2 (%)	8.06	10.07	10.93	14.31	16.04	18.45
$OIBDOL_{t-1}$	$b_{0\text{-}3}$	0.016	0.020	0.020	0.0078	0.039	0.069
	t_0	19.45*	29.51*	29.65*	11.46*	19.98*	9.86*
	t_1	5.22*	9.32*	5.96*	1.78^	14.80*	3.92*
	t_{21}	1.28	1.85^	2.88*	0.32	2.74*	2.61#
	t_{22}	1.09	1.76^	2.35*	0.29	2.96*	3.86*
	t_3	1.24	1.79^	2.74*	0.33	2.80*	2.59#
	b_{41}	0.015	0.019	0.019	0.0058	0.035	0.050
	t_{41}	18.65*	28.21*	27.80*	8.52*	44.98*	7.13*
	b_{42}	0.014	0.018	0.017	0.0019	0.028	0.067
	t_{42}	17.47*	26.01*	24.91*	2.75*	36.03*	9.61*
	Adjusted- R^2 (%)	0.02	0.04	0.04	0.01	0.12	0.47
	# of Oberservations	2164586	2368472	2411202	2354964	2129203	20538

Table 16. Serial regressions for OIBNUM and OIBDOL for 2002 (based on 1-second signing rule)

Dependent variable is OIBNUM (OIBDOL) and the single independent variable is lagged OIBNUM (lagged OIBDOL). $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level.

Number of Time Slots (5, 10, 15, 30, 60 mins)		6519684			Number of Days		21672
		$OIBNUM_t/OIBDOL_t$					
		5 mins	10 mins	15 mins	30 mins	60 mins	Daily
$OIBNUM_{t-1}$	$b_{0\text{-}3}$	0.30	0.35	0.39	0.45	0.45	0.44
	t_0	858.15*	1018.61*	1143.12*	1323.14*	1198.91*	72.55*
	t_1	147.35*	193.25*	231.39*	275.28*	262.39*	6.97*
	t_{21}	43.63*	29.37*	31.44*	35.55*	104.63*	8.22*
	t_{22}	13.71*	10.59*	10.62*	9.60*	8.80*	6.71*
	t_3	35.77*	26.16*	27.10*	29.04*	43.54*	7.81*
	b_{41}	0.29	0.34	0.37	0.44	0.43	0.38
	t_{41}	844.55*	994.75*	1112.73*	1281.84*	1141.08*	60.40*
	b_{42}	0.28	0.32	0.36	0.42	0.40	0.45
	t_{42}	808.83*	946.09*	1054.12*	1203.11*	1052.50*	74.36*
	Adjusted- R^2 (%)	11.16	14.63	17.83	23.41	22.01	19.66
$OIBDOL_{t-1}$	$b_{0\text{-}3}$	0.039	0.052	0.059	0.087	0.12	0.10
	t_0	87.90*	122.07*	136.40*	185.87*	236.08*	15.01*
	t_1	29.54*	44.83*	52.35*	78.68*	102.47*	6.44*
	t_{21}	4.26*	4.83*	3.92*	3.74*	4.84*	5.63*
	t_{22}	6.39*	7.61*	6.65*	6.68*	7.57*	6.25*
	t_3	4.06*	4.24*	3.75*	3.63*	4.81*	5.50*
	b_{41}	0.039	0.051	0.057	0.083	0.11	0.071
	t_{41}	86.17*	118.71*	131.65*	178.41*	224.34*	10.48*
	b_{42}	0.036	0.047	0.053	0.076	0.10	0.099
	t_{42}	81.45*	110.87*	121.10*	163.83*	202.30*	14.55*
	Adjusted- R^2 (%)	0.13	0.25	0.31	0.60	1.08	1.03
	# of Oberservations	5862322	6055104	6020127	5726444	5094326	21507

Table 17. Serial regressions for OIBNUM and OIBDOL for 2002 (based on 5-second signing rule)

Dependent variable is OIBNUM (OIBDOL) and the single independent variable is lagged OIBNUM (lagged OIBDOL). $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level.

Number of Time Slots (5, 10, 15, 30, 60 mins)		6519684			Number of Days		21672
		$OIBNUM_t/OIBDOL_t$					
		5 mins	10 mins	15 mins	30 mins	60 mins	Daily
$OIBNUM_{t-1}$	$b_{0\text{-}3}$	0.27	0.31	0.34	0.41	0.41	0.39
	t_0	743.31*	877.85*	991.13*	1163.23*	1062.25*	62.62*
	t_1	137.33*	181.91*	216.02*	249.19*	233.71*	6.53*
	t_{21}	40.09*	21.86*	23.11*	21.89*	77.72*	8.24*
	t_{22}	13.77*	10.44*	10.41*	8.77*	7.58*	6.32*
	t_3	34.45*	20.61*	21.46*	21.08*	39.33*	7.84*
	b_{41}	0.26	0.30	0.34	0.40	0.40	0.35
	t_{41}	737.44*	866.79*	976.56*	1142.79*	1030.74*	54.24*
	b_{42}	0.25	0.29	0.32	0.38	0.36	0.40
	t_{42}	700.36*	813.10*	910.25*	1050.98*	921.42*	64.21*
	Adjusted- R^2 (%)	8.61	11.29	14.03	19.11	18.13	15.42
$OIBDOL_{t-1}$	$b_{0\text{-}3}$	0.043	0.051	0.060	0.082	0.11	0.10
	t_0	95.61*	119.03*	137.46*	174.38*	232.41*	15.42*
	t_1	31.45*	43.87*	52.39*	73.80*	103.12*	6.49*
	t_{21}	6.56*	5.39*	4.31*	3.89*	4.79*	5.49*
	t_{22}	6.70*	6.95*	6.90*	6.59*	7.82*	6.26*
	t_3	5.83*	4.96*	4.07*	3.75*	4.75*	5.35*
	b_{41}	0.042	0.050	0.058	0.079	0.11	0.074
	t_{41}	94.00*	115.96*	133.16*	167.45*	221.63*	10.93*
	b_{42}	0.040	0.047	0.054	0.072	0.099	0.10
	t_{42}	89.48*	108.26*	122.75*	152.84*	199.26*	14.96*
	Adjusted- R^2 (%)	0.16	0.23	0.31	0.53	1.05	1.09
	# of Oberservations	5862079	6054852	6019872	5726126	5094058	21507

Table 18. Cross-autocorrelation coefficients between buying and selling over intraday horizons

The top number in each cell is the correlation coefficient and the below number in each cell is the p-value for a test of the significance of the correlation coefficient.

	Initial order type	5 mins	10 mins	15 mins	30 mins	60 mins
OIBNUM						
1994	Buy	0.112 <0.0001	0.191 <0.0001	0.249 <0.0001	0.342 <0.0001	0.413 <0.0001
	Sell	0.100 <0.0001	0.184 <0.0001	0.243 <0.0001	0.328 <0.0001	0.394 <0.0001
1999	Buy	0.511 <0.0001	0.623 <0.0001	0.669 <0.0001	0.706 <0.0001	0.702 <0.0001
	Sell	0.498 <0.0001	0.610 <0.0001	0.658 <0.0001	0.713 <0.0001	0.720 <0.0001
2002(1s)	Buy	0.560 <0.0001	0.645 <0.0001	0.680 <0.0001	0.696 <0.0001	0.679 <0.0001
	Sell	0.595 <0.0001	0.679 <0.0001	0.709 <0.0001	0.733 <0.0001	0.735 <0.0001
2002(5s)	Buy	0.567 <0.0001	0.656 <0.0001	0.693 <0.0001	0.709 <0.0001	0.691 <0.0001
	Sell	0.602 <0.0001	0.688 <0.0001	0.719 <0.0001	0.745 <0.0001	0.747 <0.0001
OIBDOL						
1994	Buy	0.095 <0.0001	0.117 <0.0001	0.124 <0.0001	0.179 <0.0001	0.252 <0.0001
	Sell	0.064 <0.0001	0.071 <0.0001	0.103 <0.0001	0.153 <0.0001	0.201 <0.0001
1999	Buy	0.128 <0.0001	0.202 <0.0001	0.261 <0.0001	0.331 <0.0001	0.378 <0.0001
	Sell	0.138 <0.0001	0.221 <0.0001	0.260 <0.0001	0.347 <0.0001	0.395 <0.0001
2002(1s)	Buy	0.235 <0.0001	0.353 <0.0001	0.412 <0.0001	0.491 <0.0001	0.526 <0.0001
	Sell	0.242 <0.0001	0.339 <0.0001	0.403 <0.0001	0.488 <0.0001	0.521 <0.0001
2002(5s)	Buy	0.233 <0.0001	0.352 <0.0001	0.411 <0.0001	0.493 <0.0001	0.521 <0.0001
	Sell	0.243 <0.0001	0.340 <0.0001	0.402 <0.0001	0.486 <0.0001	0.524 <0.0001

Table 19. Multiple regressions of trade returns on lagged trade returns and lagged order imbalances (OIBNUM / OIBDOL) for 1994 (based on 1-second signing rule)

Dependent variable is trade returns and the two independent variables are lagged trade returns and lagged OIBNUM or lagged trade returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				895345				Number of Days		21837	
		$TReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$TReturn_{t-1}$	$b_{0\text{-}3}$	-0.20	-0.20	-0.19	-0.19	-0.18	-0.18	-0.14	-0.14	-0.10	-0.096	0.056	0.058
	t_0	102.63*	-104.46*	-122.61*	-125.07*	-128.59*	-130.19*	-105.18*	-105.05*	-73.39*	-72.16*	8.17*	8.55*
	t_1	-57.29*	-58.29*	-44.44*	-45.61*	-32.30*	-32.94*	-47.17*	-47.23*	-42.79*	-41.96*	5.99*	6.18*
	t_{21}	-4.27*	-4.35*	-5.20*	-5.25*	-4.42*	-4.37*	-4.23*	-4.10*	-3.54*	-3.33*	4.37*	4.55*
	t_{22}	-18.17*	-18.56*	-17.93*	-18.49*	-12.56*	-12.75*	-14.13*	-13.95*	-9.15*	-8.93*	3.92*	3.90*
	t_3	-4.26*	-4.34*	-5.17*	-5.22*	-4.40*	-4.35*	-4.21*	-4.08*	-3.47*	-3.27*	3.34*	3.37*
	b_{41}	-0.20	-0.20	-0.19	-0.19	-0.18	-0.18	-0.14	-0.14	-0.10	-0.098	0.052	0.056
	t_{41}	-103.36*	-105.11*	-123.48*	125.77*	-129.71*	-131.00*	-106.76*	-106.02*	-75.75*	73.17*	7.53*	8.17*
	b_{42}	-0.20	-0.20	-0.20	-0.20	-0.19	-0.19	-0.15	-0.16	-0.12	-0.12	0.021	0.020
	t_{42}	-106.05*	-107.97*	-128.01*	-130.89*	-136.20*	-138.51*	-117.33*	-118.58*	-98.81*	-93.29*	3.03*	2.95*
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	-2.37		-1.61		-0.50		0.63		1.06		0.54	
	t_0	-17.66*		-15.40*		-5.45*		8.31*		16.33*		1.63	
	t_1	-13.86*		-12.64*		-4.33*		7.45*		14.82*		1.58	
	t_{21}	-5.38*		-3.25*		-0.98		1.86^		2.88*		1.68^	
	t_{22}	-5.97*		-3.14*		-1.01		1.45		2.12#		1.19	
	t_3	-5.08*		-2.80*		-0.87		1.56		2.42#		1.23	
	$b_{41}(10^3)$	-2.17		-1.39		-2.29		0.97		1.44		0.88	
	t_{41}	-16.02*		-13.15*		-2.46#		12.59*		21.49*		2.47#	
	$b_{42}(10^3)$	-2.78		-2.15		-1.09		-0.072		2.81		-0.15	
	t_{42}	-20.52*		-20.34*		-11.77*		-0.95		4.32*		-0.48	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		-5.57		-4.04		-6.67		-0.38		2.08		2.03
	t_0		-7.44*		-8.11*		-10.72*		-0.71		4.08*		0.66
	t_1		-7.26*		-5.82*		-5.26*		-0.60		4.02*		0.68
	t_{21}		-4.02*		-1.92^		-2.18#		-0.30		0.98		0.76
	t_{22}		-4.18*		-1.99#		-2.41#		-0.21		0.80		0.61
	t_3		-4.00*		-1.92^		-2.16#		-0.30		1.03		0.66
	$b_{41}(10^9)$		-5.48		-4.04		6.62		-0.40		2.07		1.78
	t_{41}		-7.31*		-8.10*		-10.64*		-0.66		4.06*		0.57
	$b_{42}(10^9)$		-5.97		-4.48		-7.28		-1.03		1.27		1.44
	t_{42}		-7.98*		-8.97*		-11.77*		-1.95^		2.54#		0.50
	AR^2(%)	4.00	3.91	3.66	3.62	3.30	3.32	1.89	1.88	0.98	0.94	0.35	0.34
	# of Obs.	270496		419116		498797		577662		551310		21514	

Table 20. Multiple regressions of quote returns on lagged quote returns and lagged order imbalances (OIBNUM / OIBDOL) for 1994 (based on 1-second signing rule)

Dependent variable is quote returns and the two independent variables are lagged quote returns and lagged OIBNUM or lagged quote returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				895345			Number of Days			21837	
		$QReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$QReturn_{t-1}$	$b_{0\text{-}3}$	-0.078	-0.070	-0.052	-0.045	-0.038	-0.031	-0.012	-0.0041	0.0028	0.0095	0.094	0.098
	t_0	-44.13*	-39.85*	-34.90*	-30.88*	-26.76*	-21.83*	-8.77*	-3.11*	2.06#	7.10*	13.77*	14.48*
	t_1	-14.47*	-13.11*	-12.77*	-11.38*	-10.90*	-8.93*	-4.52*	-1.59	1.10	3.79*	9.64*	9.96*
	t_{21}	-2.81*	-2.58#	-2.45#	-2.21#	-1.55	-1.24	-0.62	-0.22	0.18	0.60	8.14*	8.48*
	t_{22}	-7.68*	-7.02*	-5.04*	-4.59*	-3.56*	-2.92*	-1.19	-0.42	0.25	0.87	6.17*	6.19*
	t_3	-2.79*	-2.57#	-2.45#	-2.21#	-1.54	-1.23	-0.61	-0.21	0.17	0.57	5.72*	5.78*
	b_{41}	-0.079	-0.070	-0.054	-0.046	-0.040	-0.035	-0.015	-0.0054	-0.0081	0.0080	0.090	0.095
	t_{41}	-45.01*	-40.37*	-36.33*	-31.73*	-28.42*	-22.70*	-10.98*	-4.11*	-0.60	5.97*	13.04*	14.06*
	b_{42}	-0.085	-0.077	-0.060	-0.055	-0.050	-0.044	-0.029	-0.024	-0.023	-0.020	0.054	0.054
	t_{42}	-47.98*	-44.21*	-40.98*	-37.82*	-35.22*	-31.45*	-21.92*	-18.06*	-17.36*	-14.90*	7.84*	7.96*
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	3.47		2.41		2.43		2.17		1.66		1.02	
	t_0	32.29*		27.49*		30.68*		32.19*		27.87*		3.25*	
	t_1	20.97*		21.14*		24.90*		28.24*		24.39*		3.13*	
	t_{21}	5.55*		4.51*		4.26*		4.62*		4.08*		3.02*	
	t_{22}	7.10*		4.91*		5.55*		5.53*		3.38*		2.26#	
	t_3	5.46*		4.06*		4.04*		4.36*		3.67*		2.22#	
	$b_{41}(10^3)$	3.71		2.70		2.76		2.57		2.07		1.44	
	t_{41}	34.25*		30.50*		34.35*		37.19*		33.49*		4.22*	
	$b_{42}(10^3)$	3.22		2.03		2.01		1.66		1.02		0.35	
	t_{42}	29.77*		23.02*		25.27*		24.49*		17.01*		1.15	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		-3.76		0.79		1.59		3.76		4.99		3.03
	t_0		6.53*		1.96#		3.10*		8.03*		10.80*		1.03
	t_1		2.76*		1.13		1.58		6.31*		9.76*		1.01
	t_{21}		1.40		0.46		0.63		2.65*		2.55#		1.34
	t_{22}		1.45		0.56		0.69		2.06#		2.00#		0.94
	t_3		1.39		0.47		0.62		2.55#		2.75*		1.17
	$b_{41}(10^9)$		3.78		0.81		1.61		3.75		4.98		2.80
	t_{41}		6.57*		2.02#		3.14*		8.02*		10.78*		0.95
	$b_{42}(10^9)$		3.49		0.51		1.10		3.31		4.41		2.67
	t_{42}		6.07*		1.26		2.16#		7.14*		9.72*		0.96
	AR^2(%)	0.72	0.45	0.34	0.19	0.25	0.08	0.17	0.01	0.15	0.03	1.02	0.97
	# of Obs.	360143		501789		569053		621441		573310		21603	

Table 21. Multiple regressions of trade returns on lagged trade returns and lagged order imbalances (OIBNUM / OIBDOL) for 1999 (based on 1-second signing rule)

Dependent variable is trade returns and the two independent variables are lagged trade returns and lagged OIBNUM or lagged trade returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				2710586				Number of Days		20916	
		$TReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$TReturn_{t-1}$	$b_{0\text{-}3}$	-0.045	-0.020	-0.012	0.0065	-0.0079	0.0087	0.015	0.029	0.028	0.037	0.060	0.065
	t_0	-55.49*	-26.71*	-15.87*	9.50*	-10.77*	13.11*	21.05*	44.79*	38.16*	54.58*	8.16*	9.25*
	t_1	-9.73*	-4.87*	-2.63*	1.64	-1.95^	2.47#	4.92*	10.67*	12.36*	17.52*	4.26*	4.86*
	t_{21}	-1.40	-0.70	-0.48	0.30	-0.69	0.77	1.58	2.97*	2.73*	4.64*	5.19*	6.15*
	t_{22}	-3.86*	-1.92^	-0.80	0.48	-0.39	0.48	1.12	2.50#	2.00#	2.71*	3.23*	3.62*
	t_3	-1.40	-0.70	-0.47	0.29	-0.61	0.72	1.36	2.76*	2.64*	4.84*	3.58*	4.07*
	b_{41}	-0.048	-0.021	-0.015	0.0048	-0.012	0.0068	0.0085	0.026	0.018	0.031	0.049	0.060
	t_{41}	-58.35*	-28.20*	-20.51*	7.03*	-16.24*	10.29*	11.72*	39.28*	24.49*	45.15*	6.69*	8.46*
	b_{42}	-0.048	-0.024	-0.016	0.00024	-0.014	0.00046	0.0046	0.016	0.012	0.017	0.049	0.054
	t_{42}	-59.09*	-32.19*	-21.77*	0.35	-18.86*	0.69	6.43*	24.52*	15.84*	25.64*	6.75*	7.63*
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	2.32		1.45		1.17		0.87		0.55		0.60	
	t_0	81.97*		61.40*		54.78*		21.05*		35.11*		3.13*	
	t_1	29.89*		21.15*		20.29*		22.58*		20.19*		2.22#	
	t_{21}	6.45*		4.84*		5.31*		2.70*		1.27		1.74^	
	t_{22}	10.79*		5.93*		3.62*		2.81*		1.51		2.06#	
	t_3	6.50*		4.99*		5.18*		2.53#		1.24		1.65^	
	$b_{41}(10^3)$	2.43		1.58		1.30		1.03		0.71		0.98	
	t_{41}	85.11*		66.10*		60.30*		55.93*		44.09*		4.65*	
	$b_{42}(10^3)$	2.22		1.31		1.01		0.70		0.36		0.53	
	t_{42}	77.99*		55.19*		46.86*		38.67*		22.73*		2.87*	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		3.66		3.62		2.43		3.24		4.32		3.39
	t_0		13.13*		15.06*		10.52*		14.87*		18.34*		1.27
	t_1		6.47*		8.28*		7.33*		12.47*		17.02*		1.39
	t_{21}		1.87^		1.37		1.38		3.23*		2.44#		1.47
	t_{22}		2.40#		1.98#		1.53		2.02#		2.23#		1.42
	t_3		1.85^		1.39		1.43		2.78*		2.41#		1.50
	$b_{41}(10^9)$		3.64		3.61		2.40		3.20		4.27		3.51
	t_{41}		13.07*		15.01*		10.42*		14.70*		18.18*		1.30
	$b_{42}(10^9)$		3.35		3.12		1.80		2.31		2.99		2.45
	t_{42}		12.03*		13.02*		7.84*		10.66*		12.82*		0.96
	AR^2(%)	0.41	0.05	0.18	0.02	0.14	0.01	0.20	0.11	0.24	0.19	0.48	0.44
	# of Obs.	1808752		2147814		2245073		2207166		1914797		20442	

Table 22. Multiple regressions of quote returns on lagged quote returns and lagged order imbalances (OIBNUM / OIBDOL) for 1999 (based on 1-second signing rule)

Dependent variable is quote returns and the two independent variables are lagged quote returns and lagged OIBNUM or lagged quote returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				2710586				Number of Days		20916	
		$QReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$QReturn_{t-1}$	$b_{0\text{-}3}$	0.046	0.071	0.073	0.084	0.058	0.068	0.044	0.056	0.050	0.058	0.072	0.077
	t_0	58.11*	97.34*	100.40*	128.28*	80.20*	104.68*	63.42*	89.23*	71.44*	87.99*	9.86*	11.00*
	t_1	8.63*	15.09*	13.71*	18.50*	11.08*	15.39*	11.97*	17.33*	21.56*	26.28*	4.57*	5.13*
	t_{21}	1.97^	3.69*	4.01*	5.27*	4.16*	5.49*	2.38#	3.16*	4.61*	5.62*	5.06*	6.03*
	t_{22}	3.49*	6.51*	4.21*	5.59*	2.48#	3.35*	1.95^	2.79*	3.28*	3.79*	3.66*	4.06*
	t_3	1.97#	3.70*	3.89*	5.11*	3.96*	5.32*	2.27#	3.07*	4.49*	5.77*	3.89*	4.46*
	b_{41}	0.044	0.070	0.070	0.083	0.054	0.066	0.038	0.053	0.041	0.052	0.061	0.071
	t_{41}	54.94*	95.89*	95.89*	126.03*	74.76*	101.96*	54.11*	83.81*	58.47*	79.16*	8.33*	10.17*
	b_{42}	0.043	0.066	0.069	0.078	0.052	0.059	0.034	0.044	0.035	0.039	0.060	0.064
	t_{42}	54.23*	91.43*	94.39*	118.75*	72.31*	92.03*	49.44*	69.26*	50.36*	60.37*	8.22*	9.12*
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	1.94		0.82		0.66		0.74		0.48		0.60	
	t_0	75.18*		37.47*		32.36*		42.73*		31.61*		3.18*	
	t_1	21.95*		10.68*		9.38*		16.89*		17.44*		2.21#	
	t_{21}	4.56*		2.96*		2.65*		2.19#		1.13		1.67^	
	t_{22}	6.99*		2.76*		1.84^		2.14#		1.33		2.03#	
	t_3	4.57*		2.97*		2.59#		2.07#		1.11		1.59	
	$b_{41}(10^3)$	2.04		0.93		0.77		0.89		0.62		0.99	
	t_{41}	78.51*		41.62*		37.42*		49.96*		39.87*		4.75*	
	$b_{42}(10^3)$	1.85		0.69		0.49		0.57		0.27		0.53	
	t_{42}	71.48*		31.21*		24.10*		32.29*		17.90*		2.87*	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		3.75		2.78		1.75		3.10		4.03		4.05
	t_0		14.94*		12.55*		8.10*		14.83*		17.50*		1.53
	t_1		7.02*		7.11*		5.52*		11.88*		16.15*		1.67^
	t_{21}		2.39#		1.31		1.20		2.91*		2.26#		1.69^
	t_{22}		2.86*		1.71		1.14		1.88^		2.09#		1.67^
	t_3		2.37#		1.34		1.26		2.55#		2.25#		1.69^
	$b_{41}(10^9)$		3.74		2.77		1.74		3.05		3.97		4.22
	t_{41}		14.91*		12.50*		8.02*		14.64*		17.33*		1.58
	$b_{42}(10^9)$		3.48		2.34		1.19		2.21		2.72		2.87
	t_{42}		13.89*		10.58*		5.51*		10.63*		11.92*		1.12
	AR^2(%)	0.76	0.50	0.80	0.75	0.53	0.48	0.46	0.38	0.49	0.45	0.66	0.62
	# of Obs.	2017018		2273924		2326526		2237384		1922986		20497	

Table 23. Multiple regressions of trade returns on lagged trade returns and lagged order imbalances (OIBNUM / OIBDOL) for 2002 (based on 1-second signing rule)

Dependent variable is trade returns and the two independent variables are lagged trade returns and lagged OIBNUM or lagged trade returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				6519684				Number of Days		21672	
		$TReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$TReturn_{t-1}$	$b_{0\text{-}3}$	0.0068	0.013	0.0076	0.020	0.033	0.048	0.059	0.078	0.060	0.072	0.0027	0.0052
	t_0	14.27*	28.88*	16.48*	46.10*	72.39*	112.42*	125.27*	179.85*	120.45*	155.19*	0.37	0.75
	t_1	5.28*	10.36*	6.64*	18.13*	29.63*	45.65*	53.45*	77.01*	60.25*	77.91*	0.19	0.38
	t_{21}	0.46	0.87	0.70	1.90^	3.13*	4.49*	5.97*	8.34*	2.96*	4.90*	0.21	0.45
	t_{22}	0.90	1.57	0.85	2.08#	3.42*	5.08*	5.43*	7.24*	3.80*	5.29*	0.10	0.20
	t_3	0.46	0.86	0.68	1.82^	3.12*	4.39*	5.80*	7.82*	2.89*	4.70*	0.11	0.21
	b_{41}	0.0058	0.012	0.0058	0.019	0.030	0.046	0.054	0.076	0.051	0.068	-0.0059	0.0010
	t_{41}	12.26*	27.53*	12.59*	43.99*	66.14*	109.33*	112.96*	174.49*	101.64*	146.78*	-0.80	0.15
	b_{42}	0.0031	0.0073	0.0012	0.011	0.024	0.035	0.043	0.058	0.031	0.037	-0.0038	-0.0013
	t_{42}	6.53*	16.56*	2.62*	24.84*	52.39*	82.96*	91.08*	132.35*	61.76*	80.33*	-0.53	-0.19
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	0.27		0.44		0.48		0.51		0.25		0.14	
	t_0	37.49*		71.26*		84.07*		105.95*		57.27*		1.34	
	t_1	15.75*		34.51*		42.17*		55.65*		32.50*		0.51	
	t_{21}	2.40#		6.10*		9.85*		10.11*		3.94*		1.16	
	t_{22}	1.51		2.81*		2.98*		2.81*		1.24		0.49	
	t_3	2.41#		6.49*		11.04*		15.22*		4.21*		0.98	
	$b_{41}(10^3)$	0.29		0.47		0.52		0.59		0.35		0.34	
	t_{41}	39.24*		75.23*		90.81*		119.51*		79.73*		3.04*	
	$b_{42}(10^3)$	0.20		0.35		0.37		0.39		0.11		0.088	
	t_{42}	26.72*		55.28*		64.32*		79.43*		25.77*		0.89	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		2.54		3.16		3.01		2.84		-0.13		1.61
	t_0		14.11*		19.15*		18.62*		17.33*		-0.76		0.62
	t_1		14.45*		19.04*		17.53*		17.53*		-0.80		0.68
	t_{21}		2.80*		1.88^		1.39		1.71^		-0.06		0.65
	t_{22}		2.18#		2.06#		1.55		1.45		-0.05		0.66
	t_3		2.73*		1.81^		1.36		1.74^		-0.06		0.63
	$b_{41}(10^9)$		2.56		3.22		3.16		3.15		0.51		2.51
	t_{41}		14.23*		19.54*		19.52*		19.19*		3.04*		0.95
	$b_{42}(10^9)$		1.98		2.36		2.00		1.27		-2.25		-1.19
	t_{42}		11.01*		14.34*		12.43*		7.82*		-13.66*		-0.49
	AR^2 (%)	0.04	0.02	0.13	0.05	0.36	0.24	0.84	0.64	0.62	0.55	0.00	0.00
	# of Obs.	5377825		5777778		5777195		5392458		4575021		21418	

Table 24. Multiple regressions of quote returns on lagged quote returns and lagged order imbalances (OIBNUM / OIBDOL) for 2002 (based on 1-second signing rule)

Dependent variable is quote returns and the two independent variables are lagged quote returns and lagged OIBNUM or lagged quote returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				6519684				Number of Days		21672	
		$QReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$QReturn_{t-1}$	$b_{0\text{-}3}$	0.078	0.078	0.058	0.065	0.076	0.086	0.087	0.10	0.076	0.087	0.013	0.016
	t_0	164.30*	177.79*	125.75*	154.56*	167.28*	205.71*	189.20*	243.21*	158.46*	192.44*	1.84^	2.28#
	t_1	52.18*	55.63*	45.45*	55.00*	63.79*	78.05*	78.93*	101.10*	78.92*	95.48*	0.91	1.14
	t_{21}	4.25*	4.12*	4.10*	5.00*	5.96*	7.30*	8.10*	11.37*	3.64*	5.56*	1.02	1.32
	t_{22}	9.42*	8.71*	6.20*	6.74*	7.33*	8.68*	7.75*	9.43*	4.76*	6.33*	0.52	0.61
	t_3	4.22*	4.08*	4.05*	4.88*	5.97*	7.16*	7.76*	10.93*	3.47*	5.33*	0.54	0.64
	b_{41}	0.077	0.077	0.056	0.064	0.073	0.085	0.081	0.10	0.068	0.083	0.0045	0.012
	t_{41}	162.13*	176.33*	121.47*	152.16*	160.48*	202.17*	176.25*	237.29*	139.52*	183.76*	0.62	1.67
	b_{42}	0.074	0.072	0.051	0.056	0.067	0.074	0.071	0.083	0.049	0.054	0.0045	0.0071
	t_{42}	156.10*	164.77*	111.40*	132.49*	147.02*	175.81*	155.77*	196.64*	102.31*	120.12*	0.63	1.03
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	0.021		0.26		0.32		0.44		0.22		0.13	
	t_0	3.01*		44.15*		58.41*		93.13*		51.12*		1.29	
	t_1	1.17		20.31*		28.40*		48.14*		28.74*		0.49	
	t_{21}	0.19		3.34*		5.72*		7.94*		3.27*		1.05	
	t_{22}	0.11		1.63		1.96^		2.36#		1.07		0.47	
	t_3	0.20		3.52*		6.36*		8.27*		2.70*		0.84	
	$b_{41}(10^3)$	0.032		0.29		0.36		0.51		0.32		0.33	
	t_{41}	4.63*		48.07*		65.06*		106.55*		73.22*		3.07*	
	$b_{42}(10^3)$	-0.052		0.17		0.22		0.32		0.074		0.085	
	t_{42}	-7.53*		28.27*		38.61*		65.66*		17.29*		0.89	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		1.41		2.35		2.09		2.29		-0.16		1.44
	t_0		8.39*		14.88*		13.30*		14.23*		-0.99		0.56
	t_1		8.32*		14.61*		12.45*		14.28*		-1.03		0.61
	t_{21}		2.87*		1.79^		1.11		1.50		-0.09		0.58
	t_{22}		1.28		1.57		1.08		1.16		-0.07		0.61
	t_3		2.97*		1.70^		1.08		1.53		-0.08		0.57
	$b_{41}(10^9)$		1.43		2.42		2.24		2.60		0.45		2.38
	t_{41}		8.49*		15.32*		14.27*		16.14*		2.71*		0.91
	$b_{42}(10^9)$		0.93		1.61		1.13		0.64		-2.50		-1.38
	t_{42}		5.53*		10.24*		7.22*		4.04*		-15.44*		-0.57
	AR^2(%)	0.56	0.57	0.45	0.42	0.81	0.75	1.29	1.14	0.89	0.83	0.03	0.02
	# of Obs.	5751231		5942781		5866521		5420510		4584880		21425	

Table 25. Multiple regressions of trade returns on lagged trade returns and lagged order imbalances (OIBNUM / OIBDOL) for 1994 and for large-size companies (based on 1-second signing rule)

Dependent variable is trade returns and the two independent variables are lagged trade returns and lagged OIBNUM or lagged trade returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				653876				Number of Days		11044	
		$TReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$TReturn_{t-1}$	$b_{0\text{-}3}$	-0.18	-0.18	-0.17	-0.17	-0.16	-0.16	-0.11	-0.11	-0.065	-0.061	0.065	0.067
	t_0	-88.04*	-89.81*	-100.02*	-102.14*	-102.42*	-103.61*	-72.79*	-72.31*	-42.07*	-39.99*	6.72*	7.06*
	t_1	-49.02*	-49.98*	-30.99*	-31.88	-20.87*	-21.30*	-27.49*	-27.45*	-21.68*	-20.71*	4.46*	4.60*
	t_{21}	-3.07*	-3.13*	-3.59*	-3.63*	-2.96*	-2.92*	-2.55#	-2.46#	-1.85^	-1.70^	3.27*	3.47*
	t_{22}	-14.53*	-14.87*	-13.13*	-13.59*	-8.25*	-8.40*	-8.52*	-8.42*	-4.90*	-4.76*	3.45*	3.49*
	t_3	-3.07*	-3.13*	-3.58*	-3.62*	-2.95*	-2.91*	-2.54#	-2.45#	-1.84^	-1.69^	2.81*	2.91*
	b_{41}	-0.18	-0.18	-0.17	-0.17	-0.16	-0.16	-0.11	-0.11	-0.068	-0.062	0.061	0.065
	t_{41}	-88.44*	-90.11*	-100.47*	-102.39*	-103.11*	-103.95*	-74.00*	-72.83*	-43.71*	-10.61*	6.29*	6.84*
	b_{42}	-0.19	-0.19	-0.18	-0.18	-0.17	-0.17	-0.13	-0.13	-0.095	-0.093	0.038	0.038
	t_{42}	-91.70*	-93.58*	-106.03*	-108.64*	-110.90*	-112.85*	-86.16*	-87.15*	-61.66*	-61.75*	3.93*	3.93*
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	-2.08		-1.19		-0.25		0.64		1.02		0.45	
	t_0	-15.84*		-11.64*		-2.80*		8.63*		15.99*		1.29	
	t_1	-12.07*		-9.32*		-2.06#		7.43*		14.06*		1.27	
	t_{21}	-4.75*		-2.64#		-0.50		2.13#		2.95*		1.51	
	t_{22}	-5.08*		-2.24#		-0.48		1.41		1.95^		1.00	
	t_3	-4.48*		-2.21#		-0.44		1.70^		2.38#		1.11	
	$b_{41}(10^3)$	-1.88		0.97		0.015		0.97		1.39		0.73	
	t_{41}	-14.20*		-9.38*		0.16		12.74*		20.90*		1.92^	
	$b_{42}(10^3)$	-2.43		-1.69		-0.78		0.0052		0.33		0.023	
	t_{42}	-18.41*		-16.45*		-8.62*		0.07		5.11*		0.07	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		-5.21		-3.67		-6.16		-0.16		2.44		0.96
	t_0		-7.32*		-7.79*		-10.28*		-0.32		4.89*		0.29
	t_1		-7.36*		-5.44*		-4.64*		-0.25		4.56*		0.29
	t_{21}		-3.88*		-1.81^		-1.90^		-0.13		1.12		0.35
	t_{22}		-4.13*		-1.89^		-2.14#		-0.09		0.89		0.26
	t_3		-3.81*		-1.79^		-1.88^		-0.13		1.17		0.30
	$b_{41}(10^9)$		-5.22		-3.71		-6.16		-0.18		2.46		0.55
	t_{41}		-7.33*		-7.86*		-10.28*		-0.35		4.92*		0.17
	$b_{42}(10^9)$		-5.58		-4.08		-6.79		-0.85		1.51		1.09
	t_{42}		-7.85*		-8.66*		-11.42*		-1.65^		3.09*		0.35
	AR^2 (%)	3.36	3.28	2.84	2.82	2.49	2.52	1.13	1.11	0.44	0.38	0.46	0.44
	# of Obs.	239841		362566		422365		464775		421449		10927	

Table 26. Multiple regressions of trade returns on lagged trade returns and lagged order imbalances (OIBNUM / OIBDOL) for 1994 and for small-size companies (based on 1-second signing rule)

Dependent variable is trade returns and the two independent variables are lagged trade returns and lagged OIBNUM or lagged trade returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				241469				Number of Days		10793	
		$TReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$TReturn_{t-1}$	$b_{0\text{-}3}$	-0.25	-0.25	-0.25	-0.26	-0.24	-0.25	-0.21	-0.21	-0.17	-0.17	0.048	0.049
	t_0	-44.56*	-45.17*	-61.52*	-62.75*	-69.58*	-70.89*	-71.88*	-72.73*	-62.05*	-62.71*	4.81*	5.10*
	t_1	-30.21*	-30.60*	-42.84*	-43.76*	-50.45*	-51.35*	-54.64*	-54.98*	-48.42*	-48.79*	3.91*	4.12*
	t_{21}	-7.01*	-7.16*	-9.28*	-9.26*	-9.42*	-9.49*	-8.56*	-8.64*	-7.71*	-7.58*	3.09*	3.14*
	t_{22}	-15.38*	-15.57*	-21.87*	-22.38*	-23.24*	-23.36*	-25.47*	-25.05*	-16.22*	-15.39*	3.00*	3.01*
	t_3	-7.03*	-7.19*	-9.28*	-9.25*	-9.43*	-9.50*	-8.60*	-8.66*	-7.51*	-7.33*	2.57#	2.55#
	b_{41}	-0.25	-0.25	-0.25	-0.26	-0.24	-0.25	-0.21	-0.21	-0.17	-0.17	0.043	0.046
	t_{41}	-44.91*	-45.52*	-61.99*	-63.24*	-70.13*	-71.43*	-72.49*	-73.27*	-62.72*	-63.26*	4.33*	4.77*
	b_{42}	-0.26	-0.26	-0.26	-0.27	-0.25	-0.26	-0.23	-0.23	-0.20	-0.20	0.0033	0.0018
	t_{42}	46.69*	-47.27*	-63.89*	-65.13*	-72.84*	-74.31*	-77.25*	-78.57*	-72.00*	-73.53*	0.34	0.19
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	-5.83		-7.03		-4.24		-1.13		-0.11		0.86	
	t_0	-9.10*		-14.62*		-10.60*		-3.62*		-0.42		0.96	
	t_1	-7.55*		-11.19*		-8.71*		-2.90*		-0.34		0.80	
	t_{21}	-4.63*		-5.48*		-5.14*		-1.07		-0.09		0.64	
	t_{22}	-4.10*		-5.13*		-3.75*		-1.00		-0.08		0.73	
	t_3	-4.70*		-5.70*		-4.97*		-0.99		-0.09		0.60	
	$b_{41}(10^3)$	-5.74		-6.94		-4.08		-0.91		0.16		1.45	
	t_{41}	-8.94*		-14.39*		-10.17*		-2.90*		0.62		1.58	
	$b_{42}(10^3)$	-7.02		-8.57		-5.87		-2.94		-1.84		-0.45	
	t_{42}	-10.78*		-17.58*		-14.52*		-9.32*		-7.17*		-0.52	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		-13.84		-15.51		-17.79		-7.76		-6.66		5.86
	t_0		-2.72*		-3.85*		-5.15*		-2.94*		-2.98*		0.80
	t_1		-2.41*		-3.70*		-4.53*		-2.99*		-2.92*		0.86
	t_{21}		-2.60#		-2.28#		-1.88^		-1.23		-1.05		0.76
	t_{22}		-1.68^		-2.04#		-1.91^		-1.45		-0.92		0.86
	t_3		-2.77*		-2.15#		-1.89^		-1.31		-1.05		0.77
	$b_{41}(10^9)$		-11.94		-14.61		-17.36		-7.35		-6.72		6.22
	t_{41}		-2.35#		-3.63*		-5.03*		-2.78*		-3.00*		0.85
	$b_{42}(10^9)$		-12.02		-17.38		-17.13		-7.16		-4.41		5.45
	t_{42}		-2.35#		-4.31*		-4.97*		-2.73*		-1.99#		0.79
	AR^2(%)	6.51	6.28	6.91	6.58	6.32	6.22	4.49	4.49	2.95	2.96	0.24	0.24
	# of Obs.	30655		56550		76432		112887		129861		10587	

Table 27. Multiple regressions of quote returns on lagged quote returns and lagged order imbalances (OIBNUM / OIBDOL) for 1994 and for large-size companies (based on 1-second signing rule)

Dependent variable is quote returns and the two independent variables are lagged quote returns and lagged OIBNUM or lagged quote returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				653876		Number of Days				11044	
		$QReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$QReturn_{t-1}$	$b_{0\text{-}3}$	-0.040	-0.032	-0.019	-0.013	-0.0032	0.0032	0.012	0.019	0.027	0.034	0.11	0.11
	t_0	-21.24*	-17.24*	-11.86*	-8.46*	-2.04#	2.12#	7.67*	12.66*	17.57*	22.03*	11.05*	11.56*
	t_1	-6.85*	-5.58*	-5.27*	-3.78*	-0.95	1.00	3.65*	6.01*	9.58*	12.06*	7.01*	7.19*
	t_{21}	-1.28	-1.07	-0.83	-0.61	-0.12	0.12	0.52	0.83	1.61	1.92^	6.53*	6.87*
	t_{22}	-3.57*	-2.96*	-1.62	-1.20	-0.25	0.27	0.90	1.49	2.03#	2.71*	5.59*	5.63*
	t_3	-1.28	-1.08	-0.84	-0.61	-0.12	0.12	0.51	0.82	1.57	1.90^	5.34*	5.48*
	b_{41}	-0.042	-0.033	-0.021	-0.014	-0.0049	0.0027	0.0089	0.018	0.024	0.032	0.10	0.11
	t_{41}	-21.96*	-17.58*	-12.82*	-8.83*	-3.18*	1.75^	5.90*	12.10*	15.34*	21.30*	10.56*	11.32*
	b_{42}	-0.049	-0.041	-0.030	-0.025	-0.018	-0.013	-0.010	-0.0050	-0.0041	-0.0010	0.077	0.078
	t_{42}	-25.63*	-22.10*	-18.63*	-16.11*	-11.41*	-8.39*	-6.59*	-3.40*	-2.68*	-0.67	7.99*	8.08*
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	2.79		1.72		1.72		1.67		1.32		0.67	
	t_0	27.33*		20.46*		22.40*		25.03*		22.26*		2.03#	
	t_1	16.84*		15.54*		17.71*		21.16*		18.95*		1.97#	
	t_{21}	4.63*		3.93*		3.93*		4.23*		3.50*		2.29#	
	t_{22}	5.58*		3.41*		3.78*		3.93*		2.49#		1.54	
	t_3	4.53*		3.41*		3.61*		3.87*		3.02*		1.68^	
	$b_{41}(10^3)$	3.01		1.99		2.02		2.03		1.69		0.99	
	t_{41}	29.27*		23.36*		25.87*		29.72*		27.41*		2.72*	
	$b_{42}(10^3)$	2.59		1.37		1.36		1.20		0.74		0.25	
	t_{42}	25.26*		16.22*		17.51*		17.83*		12.43*		0.79	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		2.38		0.052		0.56		2.55		4.08		1.57
	t_0		4.49*		0.14		1.16		5.60*		8.98*		0.49
	t_1		2.08#		0.08		0.54		4.26*		8.05*		0.48
	t_{21}		1.07		0.04		0.22		2.20#		2.20#		0.67
	t_{22}		1.11		0.05		0.24		1.39		1.58		0.43
	t_3		1.07		0.04		0.22		2.14#		2.38#		0.55
	$b_{41}(10^9)$		2.37		0.054		0.56		2.50		4.09		1.19
	t_{41}		4.47*		0.14		1.15		5.50*		8.99*		0.37
	$b_{42}(10^9)$		2.13		-0.17		0.071		2.07		3.46		1.90
	t_{42}		4.03*		-0.47		0.15		4.61*		7.76*		0.63
	AR^2(%)	0.33	0.10	0.11	0.02	0.11	0.00	0.16	0.04	0.23	0.14	1.24	1.21
	# of Obs.	313737		424348		469245		487455		430570		10946	

Table 28. Multiple regressions of quote returns on lagged quote returns and lagged order imbalances (OIBNUM / OIBDOL) for 1994 and for small-size companies (based on 1-second signing rule)

Dependent variable is quote returns and the two independent variables are lagged quote returns and lagged OIBNUM or lagged quote returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				241469			Number of Days			10793	
		$QReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$QReturn_{t-1}$	$b_{0\text{-}3}$	-0.17	-0.16	-0.13	-0.12	-0.13	-0.11	-0.070	-0.059	-0.057	-0.046	0.080	0.087
	t_0	-35.03*	-33.28*	-35.50*	-33.28	-37.03*	-34.01*	-24.01*	-20.47*	-20.13*	-16.78*	8.16*	8.99*
	t_1	-15.20*	-14.40*	-13.63*	-12.82*	-15.48*	-14.19*	-15.28*	12.92*	-10.99*	-9.12*	6.27*	6.87*
	t_{21}	-8.12*	-7.57*	-5.83*	-5.52*	-5.01*	-4.80*	-4.39*	-3.90*	-3.90*	-3.27*	5.38*	5.64*
	t_{22}	-10.39*	-9.68*	-8.42*	-7.90*	-9.37*	-8.39*	-7.09*	-5.85*	-4.44*	-3.42*	4.60*	4.82*
	t_3	-7.93*	-7.40*	-5.72*	-5.41*	-5.06*	-4.83*	-4.37*	-3.87*	-3.66*	-2.99*	4.21*	4.33*
	b_{41}	-0.17	-0.16	-0.14	-0.13	-0.13	-0.12	-0.072	-0.060	-0.059	-0.048	0.075	0.083
	t_{41}	-35.28*	-33.49*	-36.08*	-33.78*	-37.76*	-34.61*	-24.74*	-21.02*	-21.06*	-17.42*	7.62*	8.64*
	b_{42}	-0.18	-0.17	-0.14	-0.14	-0.14	0.13	-0.088	-0.080	-0.084	-0.078	0.029	0.031
	t_{42}	-36.84*	-35.45*	-38.13*	-36.37*	-40.76	-38.42*	-30.42*	-27.94*	-30.06*	-28.32*	2.90*	3.14*
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	8.36		7.70		7.75		6.30		4.37		2.85	
	t_0	16.13*		19.39*		22.92*		23.51*		19.02*		3.36*	
	t_1	12.31*		14.56*		18.13*		18.87*		14.75*		2.84*	
	t_{21}	5.62*		5.44*		6.35*		8.47*		2.83*		2.24#	
	t_{22}	5.58*		6.38*		7.31*		6.95*		3.39*		2.51#	
	t_3	5.64*		5.38*		6.20*		8.09*		2.77*		2.07#	
	$b_{41}(10^3)$	8.54		7.88		8.00		6.56		4.68		3.49	
	t_{41}	16.45*		19.79*		23.58*		24.39*		20.28*		4.03*	
	$b_{42}(10^3)$	7.56		6.76		6.75		5.13		3.06		1.50	
	t_{42}	14.42*		16.87*		19.79*		19.01*		13.32*		1.82^	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		34.31		25.35		16.53		18.56		12.91		8.36
	t_0		7.92*		7.58*		5.79*		8.39*		6.54*		1.21
	t_1		5.01*		6.75*		5.17*		8.27*		6.32*		1.29
	t_{21}		3.71*		2.51#		1.99^		2.96*		1.80^		1.36
	t_{22}		4.69*		3.27*		1.99#		3.78*		1.84^		1.33
	t_3		3.79*		2.43#		1.93^		3.10*		1.82^		1.41
	$b_{41}(10^9)$		35.18		26.06		16.83		18.98		12.97		8.70
	t_{41}		8.12*		7.79*		5.90*		8.58*		6.56*		1.25
	$b_{42}(10^9)$		35.20		23.79		16.77		19.55		15.39		8.48
	t_{42}		8.11*		7.12*		5.89*		8.91*		8.06*		1.29
	AR^2 (%)	2.83	2.42	1.86	1.46	1.65	1.17	0.71	0.36	0.44	0.22	0.85	0.76
	# of Obs.	46406		77441		99808		133986		142740		10657	

Table 29. Multiple regressions of trade returns on lagged trade returns and lagged order imbalances (OIBNUM / OIBDOL) for 1999 and for large-size companies (based on 1-second signing rule)

Dependent variable is trade returns and the two independent variables are lagged trade returns and lagged OIBNUM or lagged trade returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				1999140				Number of Days		10584	
		$TReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$TReturn_{t-1}$	$b_{0\text{-}3}$	-0.052	-0.018	0.0079	0.027	0.021	0.036	0.028	0.045	0.030	0.045	0.082	0.087
	t_0	-56.33*	-21.80*	9.00*	35.22*	24.57*	48.30*	32.05*	60.54*	34.06*	57.30*	7.83*	8.74*
	t_1	-26.50*	-9.13*	3.89*	13.68*	9.63*	17.37*	11.68*	20.51*	13.92*	21.90*	5.45*	5.99*
	t_{21}	-2.25#	-0.76	0.42	1.53	1.22	2.38#	1.83^	2.95*	2.43#	4.04*	5.80*	6.42*
	t_{22}	-6.94*	-2.44#	0.64	2.28#	1.60	2.65*	2.26#	3.87*	2.02#	2.05#	4.29*	4.68*
	t_3	-2.22#	-0.75	0.42	1.50	1.16	2.25#	1.72^	2.80*	2.39#	4.10*	4.46*	4.87*
	b_{41}	-0.054	-0.019	0.0056	0.026	0.018	0.035	0.024	0.044	0.025	0.043	0.073	0.084
	t_{41}	-58.24*	-22.51*	6.33*	34.37*	21.24*	47.23*	27.28*	59.00*	27.82*	54.38*	6.88*	8.42*
	b_{42}	-0.056	-0.024	0.0024	0.019	0.014	0.025	0.015	0.028	0.0090	0.018	0.077	0.081
	t_{42}	-60.40*	-28.35*	2.77*	24.49*	16.39*	33.81*	17.16*	37.21*	10.21*	23.29*	7.37*	8.09*
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	2.21		1.06		0.72		0.73		0.62		0.33	
	t_0	85.77*		48.53*		36.29*		42.29*		41.16*		1.68*	
	t_1	38.44*		22.68*		17.77*		23.65*		24.25*		1.16	
	t_{21}	8.53*		5.38*		3.70*		2.04#		1.36		0.94	
	t_{22}	12.03*		5.06*		2.82*		2.39#		1.65^		1.10	
	t_3	8.55*		5.53*		3.79*		1.99#		1.34		0.91	
	$b_{41}(10^3)$	2.29		1.14		0.81		0.83		0.71		0.61	
	t_{41}	88.01*		51.55*		39.89*		46.82*		45.17*		2.80*	
	$b_{42}(10^3)$	2.12		0.92		0.55		0.54		0.40		0.30	
	t_{42}	81.48*		41.60*		27.08*		30.78*		25.78*		1.58	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		5.13		4.47		2.27		2.12		4.10		2.01
	t_0		20.72*		21.18*		11.20*		10.84*		18.75*		0.74
	t_1		7.90*		9.51*		7.64*		9.76*		16.50*		0.79
	t_{21}		2.51#		1.59		1.38		2.44#		2.26#		0.87
	t_{22}		3.64*		2.44#		1.51		1.44		1.20		0.77
	t_3		2.50#		1.60		1.41		2.02#		2.17#		0.84
	$b_{41}(10^9)$		5.08		4.42		2.21		1.98		3.78		1.96
	t_{41}		20.53*		20.94*		10.90*		10.10*		17.30*		0.71
	$b_{42}(10^9)$		4.81		4.00		1.73		1.29		2.86		1.57
	t_{42}		19.45*		19.02*		8.56*		6.63*		13.24*		0.60
	AR^2(%)	0.51	0.05	0.22	0.11	0.22	0.15	0.34	0.24	0.39	0.29	0.78	0.76
	# of Obs.	1517332		1720431		1748835		1660957		1417631		10389	

Table 30. Multiple regressions of trade returns on lagged trade returns and lagged order imbalances (OIBNUM / OIBDOL) for 1999 and for small-size companies (based on 1-second signing rule)

Dependent variable is trade returns and the two independent variables are lagged trade returns and lagged OIBNUM or lagged trade returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				711446			Number of Days			10332	
		$TReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$TReturn_{t-1}$	$b_{0\text{-}3}$	-0.041	-0.023	-0.039	-0.020	-0.043	-0.026	0.00	0.0075	0.029	0.026	0.040	0.049
	t_0	-21.35*	-12.42*	-23.97*	-13.20*	-28.76*	-18.73*	0.03	5.70*	20.33*	19.26*	3.83*	4.89*
	t_1	-4.12*	-2.42#	-4.23*	-2.34#	-5.48*	-3.58*	0.01	1.35	6.68*	6.18*	1.86^	2.36#
	t_{21}	-0.66	-0.37	-0.77	-0.41	-2.51#	-1.41	0.00	0.55	1.25	1.84^	2.59#	3.40*
	t_{22}	-1.76^	-1.00	-1.50	-0.81	-1.16	-0.74	0.00	0.33	1.18	1.04	1.59	2.04#
	t_3	-0.66	-0.38	-0.77	-0.41	-2.46#	-1.40	0.0021	0.52	1.23	1.80^	1.98#	2.61*
	b_{41}	-0.044	-0.025	-0.043	-0.023	-0.048	-0.030	-0.0098	0.00	0.012	0.013	0.030	0.041
	t_{41}	-22.79*	-13.35*	-26.69*	-15.09*	-32.02*	-20.96*	-6.99*	0.44	8.41*	9.91*	2.85*	4.15*
	b_{42}	-0.048	-0.030	-0.049	-0.031	-0.055	-0.038	-0.018	-0.0098	0.0051	0.0023	0.024	0.034
	t_{42}	-24.78*	-16.22*	-29.85*	-19.98*	-36.55*	-27.32*	-12.59*	-7.48*	3.58*	1.74^	2.30#	3.34*
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	4.36		3.66		3.04		1.33		-0.36		1.71	
	t_0	30.00*		33.32*		32.26*		17.73*		-5.68*		3.27*	
	t_1	14.85*		14.96*		15.61*		10.12*		-3.82*		2.63*	
	t_{21}	2.46#		3.78*		2.81*		1.84^		-0.24		3.31*	
	t_{22}	4.12*		3.80*		3.34*		1.63		-0.35		2.53#	
	t_3	2.46#		3.77*		2.78*		1.84^		-0.24		3.13*	
	$b_{41}(10^3)$	4.61		3.95		3.36		1.77		0.25		2.14	
	t_{41}	31.50*		35.67*		35.20*		23.17*		3.79*		3.95*	
	$b_{42}(10^3)$	4.32		3.56		2.98		1.35		-0.39		1.90	
	t_{42}	28.92*		31.39*		30.58*		17.32*		-5.82*		3.72*	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		-9.81		-13.07		-6.79		11.97		2.95		6.33
	t_0		-7.05*		-10.26*		-5.34*		10.53*		2.78*		0.92
	t_1		-3.15*		-5.93*		-3.21*		7.56*		3.10*		0.92
	t_{21}		-1.24		-1.12		-0.61		1.84^		0.60		0.88
	t_{22}		-1.03		-1.20		-0.71		2.04#		0.53		0.91
	t_3		-1.23		-1.12		-0.61		1.79^		0.58		0.87
	$b_{41}(10^9)$		-9.89		-13.22		-6.92		12.22		3.91		6.55
	t_{41}		-7.10*		-10.38*		-5.45*		10.77*		3.73*		0.96
	$b_{42}(10^9)$		-10.39		-13.87		-8.76		9.48		-0.066		5.90
	t_{42}		-7.47*		-10.91*		-6.92*		8.38*		-0.06		0.89
	AR^2(%)	0.36	0.07	0.30	0.07	0.28	0.08	0.06	0.03	0.08	0.08	0.34	0.24
	# of Obs.	291420		427383		496238		546209		497166		10053	

Table 31. Multiple regressions of quote returns on lagged quote returns and lagged order imbalances (OIBNUM / OIBDOL) for 1999 and for large-size companies (based on 1-second signing rule)

Dependent variable is quote returns and the two independent variables are lagged quote returns and lagged OIBNUM or lagged quote returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				1999140				Number of Days		10584	
		$QReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$QReturn_{t-1}$	$b_{0\text{-}3}$	0.070	0.096	0.10	0.11	0.095	0.097	0.069	0.081	0.055	0.067	0.061	0.068
	t_0	74.53*	116.93*	117.09*	143.23*	107.35*	129.39*	78.58*	107.10*	61.45*	85.32*	5.82*	6.85*
	t_1	28.28*	40.37*	44.64*	49.23*	36.51*	40.99*	25.55*	32.81*	24.08*	31.22*	3.85*	4.50*
	t_{21}	5.44*	8.48*	6.81*	7.34*	5.00*	6.15*	4.12*	4.63*	4.34*	5.63*	2.75*	3.37*
	t_{22}	9.18*	14.23*	8.48*	9.03*	6.98*	6.80*	5.02*	6.19*	3.63*	4.33*	3.09*	3.59*
	t_3	5.28*	8.37*	6.76*	7.25*	4.85*	5.84*	3.94*	4.45*	4.36*	5.81*	2.43#	2.93*
	b_{41}	0.068	0.095	0.10	0.11	0.092	0.096	0.066	0.080	0.050	0.065	0.052	0.065
	t_{41}	72.27*	116.20*	114.24*	142.34*	103.93*	128.30*	73.74*	105.54*	55.14*	82.53*	4.87*	6.56*
	b_{42}	0.066	0.090	0.099	0.10	0.087	0.086	0.056	0.063	0.034	0.040	0.051	0.057
	t_{42}	70.12*	109.73*	11.59*	131.70*	99.07*	114.22*	63.69*	83.22*	34.63*	51.01*	4.92*	5.71*
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	1.37		0.27		0.12		0.45		0.51		0.54	
	t_0	58.09*		12.96*		6.18*		26.43*		33.88*		2.71*	
	t_1	23.87*		5.73*		2.77*		14.03*		19.60*		1.84^	
	t_{21}	5.34*		1.91^		0.58		1.28		1.10		1.29	
	t_{22}	7.40*		1.26		0.45		1.43		1.33		1.77^	
	t_3	5.28*		1.99#		0.62		1.25		1.08		1.27	
	$b_{41}(10^3)$	1.44		0.33		0.18		0.53		0.59		0.86	
	t_{41}	60.42*		15.61*		9.35*		30.43*		37.69*		3.94*	
	$b_{42}(10^3)$	1.29		0.13		-0.058		0.26		0.28		0.48	
	t_{42}	54.14*		6.15*		-2.98*		14.83*		18.55*		2.50#	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		3.96		3.15		1.33		1.58		3.74		4.00
	t_0		17.97*		16.16*		6.94*		8.34*		17.43*		1.46
	t_1		7.56*		8.18*		4.97*		7.85*		15.60*		1.59
	t_{21}		2.54#		1.39		0.98		1.82^		2.02^		1.49
	t_{22}		3.39*		1.88^		0.92		1.12		1.90^		1.60
	t_3		2.54#		1.42		1.01		1.53		1.95^		1.49
	$b_{41}(10^9)$		3.92		3.11		1.28		1.43		3.43		3.99
	t_{41}		17.81*		15.93*		6.66*		7.56*		15.96*		1.44
	$b_{42}(10^9)$		3.71		2.76		0.85		0.81		2.56		3.24
	t_{42}		16.86*		14.19*		4.46*		4.30*		12.07*		1.23
	AR^2(%)	0.88	0.88	1.20	1.20	0.96	0.96	0.76	0.72	0.65	0.59	0.54	0.50
	# of Obs.	1650361		1780761		1780692		1669106		1418674		10439	

Table 32. Multiple regressions of quote returns on lagged quote returns and lagged order imbalances (OIBNUM / OIBDOL) for 1999 and for small-size companies (based on 1-second signing rule)

Dependent variable is quote returns and the two independent variables are lagged quote returns and lagged OIBNUM or lagged quote returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				711446				Number of Days		10332	
		$QReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$QReturn_{t-1}$	$b_{0\text{-}3}$	0.014	0.041	0.039	0.057	0.019	0.034	0.019	0.028	0.047	0.046	0.076	0.084
	t_0	8.23*	24.69*	26.93*	41.48*	13.38*	25.90*	14.93*	23.16*	37.66*	37.71*	7.36*	8.46*
	t_1	1.43	4.30*	4.07*	6.29*	1.95^	3.85*	2.96*	4.59*	11.85*	11.61*	3.08*	3.51*
	t_{21}	0.30	0.92	1.21	1.76^	1.66	2.95*	0.66	0.95	2.31#	2.76*	4.26*	5.15*
	t_{22}	0.56	1.83^	1.46	2.24#	0.47	0.90	0.52	0.76	1.84^	1.74^	2.69*	3.09*
	t_3	0.30	0.92	1.21	1.76^	1.67^	3.01*	0.65	0.93	2.26#	2.71*	3.38*	4.05*
	b_{41}	0.012	0.040	0.036	0.054	0.014	0.031	0.010	0.022	0.034	0.035	0.065	0.076
	t_{41}	6.65*	23.79*	24.44*	39.82*	10.23*	23.78*	8.02*	18.07*	27.27*	29.29*	6.27*	7.65*
	b_{42}	0.0080	0.035	0.031	0.048	0.0092	0.023	0.0051	0.013	0.030	0.027	0.060	0.068
	t_{42}	4.53*	20.83*	21.31*	34.99*	6.59*	17.74*	3.97*	11.17*	23.39*	22.54*	5.70*	6.77*
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	5.49		3.34		2.63		1.65		-0.14		1.44	
	t_0	43.47*		34.16*		30.10*		23.36*		-2.35#		2.80*	
	t_1	16.43*		13.03*		11.63*		11.68*		-1.54		2.03#	
	t_{21}	2.10#		2.89*		2.11#		2.75*		-0.10		2.52#	
	t_{22}	4.06*		3.38*		2.76*		2.44#		-0.14		1.96^	
	t_3	2.10#		2.88*		2.10#		2.75*		-0.10		2.40#	
	$b_{41}(10^3)$	5.74		3.57		2.89		2.05		0.36		1.91	
	t_{41}	45.15*		36.23*		32.73*		28.53*		5.83*		3.60*	
	$b_{42}(10^3)$	5.54		3.22		2.40		1.50		-0.34		1.66	
	t_{42}	42.83*		32.09*		26.70*		20.32*		-5.46*		3.28*	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		-3.95		-9.74		-3.96		13.74		2.77		5.92
	t_0		-3.27*		-8.63*		-3.62*		13.02*		2.73*		0.88
	t_1		-1.62		-4.69*		-2.14#		7.37*		2.74*		0.88
	t_{21}		-0.57		-0.91		-0.36		2.56#		0.63		0.86
	t_{22}		-0.47		-0.97		-0.40		2.70*		0.55		0.87
	t_3		-0.56		-0.91		-0.36		2.47#		0.62		0.86
	$b_{41}(10^9)$		-3.97		-9.81		-4.03		14.06		4.08		6.34
	t_{41}		-3.28*		-8.69*		-3.69*		13.37*		4.06*		0.94
	$b_{42}(10^9)$		-4.48		-10.43		-5.26		11.94		0.77		5.59
	t_{42}		-3.70*		-9.26*		-4.82*		11.38*		0.77		0.85
	AR^2(%)	0.68	0.17	0.58	0.36	0.29	0.12	0.20	0.15	0.29	0.29	0.79	0.72
	# of Obs.	366657		493163		545834		568278		504312		10058	

Table 33. Multiple regressions of trade returns on lagged trade returns and lagged order imbalances (OIBNUM / OIBDOL) for 2002 and for large-size companies (based on 1-second signing rule)

Dependent variable is trade returns and the two independent variables are lagged trade returns and lagged OIBNUM or lagged trade returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				4917594				Number of Days		10836	
		$TReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$TReturn_{t-1}$	$b_{0\text{-}3}$	0.0096	0.014	0.0068	0.020	0.038	0.055	0.065	0.087	0.068	0.081	0.015	0.018
	t_0	18.14*	29.26*	13.06*	42.02*	73.18*	114.00*	119.37*	175.81*	117.17*	152.97*	1.45	1.80^
	t_1	6.87*	10.70*	5.16*	16.22*	29.40*	45.71*	49.72*	73.82*	57.37*	75.51*	0.80	0.97
	t_{21}	0.58	0.91	0.52	1.67	2.84*	4.30*	4.79*	7.82*	2.40#	4.01*	0.96	1.30
	t_{22}	1.39	1.83^	0.61	1.75^	3.17*	4.80*	4.76*	6.69*	3.44*	4.84*	0.56	0.65
	t_3	0.58	0.91	0.51	1.62	2.85*	4.24*	4.59*	7.28*	2.36#	3.88*	0.60	0.72
	b_{41}	0.0087	0.014	0.0050	0.019	0.036	0.053	0.059	0.085	0.058	0.077	0.0042	0.013
	t_{41}	16.38*	28.11*	9.49*	40.15*	67.46*	111.32*	107.80*	170.96*	99.25*	145.24*	0.40	1.34
	b_{42}	0.0057	0.0082	-0.00	0.0097	0.028	0.040	0.046	0.063	0.032	0.038	0.014	0.018
	t_{42}	10.73*	16.68*	-0.22	20.22*	63.54*	83.49*	85.48*	126.25*	55.85*	72.47*	1.40	1.80^
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	0.19		0.41		0.45		0.49		0.23		0.094	
	t_0	25.49*		65.56*		78.68*		97.96*		51.06*		0.83	
	t_1	10.66*		31.42*		38.92*		51.25*		29.16*		0.32	
	t_{21}	2.12#		6.81*		11.14*		9.24*		2.63#		0.76	
	t_{22}	1.02		2.55#		2.75*		2.59#		1.12		0.31	
	t_3	2.21#		7.43*		14.11*		11.57*		2.81*		0.67	
	$b_{41}(10^3)$	0.20		0.44		0.49		0.56		0.33		0.29	
	t_{41}	27.05*		69.17*		84.66*		109.92*		71.29*		2.40#	
	$b_{42}(10^3)$	0.10		0.31		0.34		0.36		0.082		0.047	
	t_{42}	14.02*		48.31*		57.53*		69.24*		17.95*		0.44	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		1.99		3.22		3.52		2.58		-0.36		0.63
	t_0		11.01*		19.25*		21.25*		15.11*		-2.05#		0.21
	t_1		11.38*		19.02*		20.61*		15.56*		-2.17#		0.24
	t_{21}		2.02^		1.84^		1.63		1.52		-0.17		0.22
	t_{22}		1.72^		2.11#		1.81^		1.28		-0.15		0.23
	t_3		2.04#		1.80^		1.61		1.56		-0.17		0.22
	$b_{41}(10^9)$		2.01		3.27		3.63		2.78		0.13		1.39
	t_{41}		11.13*		19.54*		21.86*		16.26*		0.71		0.47
	$b_{42}(10^9)$		1.44		2.41		2.53		1.05		-2.44		-2.84
	t_{42}		7.97*		14.45*		15.31*		6.21*		-14.09*		-1.04
	AR^2(%)	0.04	0.02	0.14	0.05	0.46	0.33	1.04	0.81	0.78	0.71	0.02	0.01
	# of Obs.	4378135		4516180		4441462		4079660		3435000		10671	

Table 34. Multiple regressions of trade returns on lagged trade returns and lagged order imbalances (OIBNUM / OIBDOL) for 2002 and for small-size companies (based on 1-second signing rule)

Dependent variable is trade returns and the two independent variables are lagged trade returns and lagged OIBNUM or lagged trade returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				1602090				Number of Days		10836	
		$TReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$TReturn_{t-1}$	$b_{0\text{-}3}$	-0.040	0.0063	-0.014	0.018	0.0095	0.024	0.025	0.046	0.026	0.035	-0.015	-0.0091
	t_0	-34.66*	6.07*	-13.20*	18.95*	9.16*	26.68*	24.68*	49.64*	24.65*	36.78*	-1.42	-0.93
	t_1	-13.29*	2.10#	-6.26*	8.00*	4.52*	11.59*	11.74*	23.44*	13.84*	20.40*	-0.71	1.12
	t_{21}	-1.43	0.16	-0.77	0.85	0.59	1.75^	1.96^	3.46*	2.38#	4.28*	-0.73	-0.47
	t_{22}	-3.81*	0.27	-1.35	1.59	1.01	2.48#	1.87^	3.20*	2.30#	2.99*	-0.53	-0.32
	t_3	-1.42	0.16	-0.75	0.84	0.58	1.73^	1.87^	3.31*	2.42#	4.42*	-0.54	-0.32
	b_{41}	-0.040	0.0058	-0.014	0.017	0.0094	0.023	0.025	0.045	0.026	0.034	-0.019	-0.012
	t_{41}	-34.79*	5.63*	-13.20*	18.43*	9.11*	25.93*	24.40*	48.92*	24.13*	36.04*	-1.70^	-1.26
	b_{42}	-0.044	-0.0016	-0.019	0.0055	0.0027	0.0087	0.014	0.026	0.0095	0.0092	-0.023	-0.020
	t_{42}	-37.79*	-1.54	-18.20*	5.99*	2.67*	9.64*	13.67*	28.87*	9.10*	9.80*	-2.13#	-2.03#
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	5.64		3.24		1.31		2.06		0.72		0.65	
	t_0	90.24*		61.61*		25.96*		43.12*		16.47*		1.53	
	t_1	35.61*		26.56*		11.49*		30.18*		12.38*		1.19	
	t_{21}	8.72*		5.42*		1.47		3.90*		1.01		1.27	
	t_{22}	3.62*		6.19*		1.26		3.74*		1.12		1.19	
	t_3	8.42*		5.45*		1.45		3.87*		1.00		1.27	
	$b_{41}(10^3)$	5.60		3.19		1.24		2.00		0.69		0.65	
	t_{41}	89.48*		60.39*		24.48*		41.79*		15.67*		1.47	
	$b_{42}(10^3)$	5.18		2.56		0.41		1.26		-0.10		0.36	
	t_{42}	82.15*		48.15*		8.16*		26.40*		-2.27#		0.88	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		1.38		2.47		-8.65		2.67		-0.78		5.90
	t_0		15.00		3.25*		-12.53*		4.13*		-1.21		0.95
	t_1		10.54*		2.68*		-9.57*		3.53*		-1.37		1.12
	t_{21}		1.61		0.79		-1.18		0.59		-0.14		1.32
	t_{22}		1.81^		0.38		-0.89		0.53		-0.15		1.08
	t_3		1.60		0.73		-1.14		0.58		-0.13		1.26
	$b_{41}(10^9)$		13.20		1.89		-9.22		2.12		-1.38		5.45
	t_{41}		14.37*		2.48#		-13.34*		3.27*		-2.13#		0.87
	$b_{42}(10^9)$		10.58		-1.07		-12.35		-0.85		-3.93		4.46
	t_{42}		11.54*		-1.41		-17.99*		-1.33		-6.16*		0.75
	AR^2 (%)	0.81	0.03	0.33	0.03	0.10	0.06	0.33	0.19	0.14	0.12	0.01	0.00
	# of Obs.	999690		1261598		1335733		1312798		1140021		10747	

Table 35. Multiple regressions of quote returns on lagged quote returns and lagged order imbalances (OIBNUM / OIBDOL) for 2002 and for large-size companies (based on 1-second signing rule)

Dependent variable is quote returns and the two independent variables are lagged quote returns and lagged OIBNUM or lagged quote returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				4917594				Number of Days		10836	
		$QReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$QReturn_{t-1}$	$b_{0\text{-}3}$	0.070	0.069	0.047	0.056	0.074	0.086	0.085	0.10	0.080	0.092	0.022	0.025
	t_0	132.59*	142.69*	89.70*	118.37*	142.53*	181.76*	161.86*	217.74*	143.47*	178.58*	2.13#	2.52#
	t_1	43.65*	46.06*	31.99*	41.74*	54.03*	69.06*	66.55*	89.45*	70.20*	87.31*	1.16	1.35
	t_{21}	3.27*	3.35*	2.83*	3.75*	4.63*	5.97*	6.13*	9.24*	2.86*	4.46*	1.41	1.83^
	t_{22}	8.87*	7.78*	3.99*	4.73*	5.87*	7.28*	6.21*	8.02*	4.04*	5.50*	0.83	0.91
	t_3	3.26*	3.33*	2.81*	3.69*	4.67*	5.90*	5.83*	8.94*	2.75*	4.31*	0.91	1.02
	b_{41}	0.069	0.069	0.045	0.055	0.071	0.085	0.079	0.10	0.071	0.088	0.011	0.020
	t_{41}	130.65*	141.41*	85.78*	116.23*	136.33*	178.64*	149.67*	212.29*	125.55*	170.60*	1.05	2.06#
	b_{42}	0.066	0.063	0.040	0.046	0.064	0.072	0.068	0.082	0.048	0.053	0.020	0.024
	t_{42}	124.80*	129.44*	76.13*	96.02*	122.92*	151.22*	129.36*	169.95*	86.29*	102.23*	1.95^	2.40#
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	-0.012		0.29		0.33		0.45		0.21		0.085	
	t_0	-1.81^		46.86*		59.48*		91.25*		48.26*		0.77	
	t_1	-0.70		21.48*		28.69*		47.45*		27.50*		0.30	
	t_{21}	-0.10		3.56*		5.90*		7.98*		2.52#		0.68	
	t_{22}	-0.07		1.74^		2.01#		2.34#		1.03		0.29	
	t_3	-0.10		3.79*		7.01*		7.73*		2.20#		0.56	
	$b_{41}(10^3)$	-0.0019		0.31		0.37		0.51		0.31		0.29	
	t_{41}	-0.27		50.46*		65.38*		103.18*		68.13*		2.42#	
	$b_{42}(10^3)$	-0.093		0.18		0.22		0.31		0.053		0.045	
	t_{42}	-13.22*		29.52*		37.98*		60.99*		11.61*		0.44	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		1.17		2.74		2.85		2.47		-0.13		0.41
	t_0		6.85*		16.85*		17.57*		14.65*		-0.74		0.14
	t_1		6.88*		16.51*		16.83*		14.93*		-0.77		0.16
	t_{21}		1.97^		1.90^		1.49		1.54		-0.06		0.15
	t_{22}		1.04		1.83^		1.46		1.21		-0.05		0.15
	t_3		2.08#		1.86^		1.48		1.59		-0.06		0.14
	$b_{41}(10^9)$		1.19		2.80		2.96		2.68		0.33		1.21
	t_{41}		6.97*		17.18*		18.22*		15.87*		1.91^		0.41
	$b_{42}(10^9)$		0.68		1.97		1.87		0.78		-2.58		-3.12
	t_{42}		4.01*		12.16*		11.58*		4.69*		-15.06*		-1.15
	AR^2(%)	0.46	0.46	0.37	0.33	0.86	0.79	1.42	1.22	1.03	0.96	0.05	0.04
	# of Obs.	4555003		4573169		4467965		4087688		3438946		10676	

Table 36. Multiple regressions of quote returns on lagged quote returns and lagged order imbalances (OIBNUM / OIBDOL) for 2002 and for small-size companies (based on 1-second signing rule)

Dependent variable is quote returns and the two independent variables are lagged quote returns and lagged OIBNUM or lagged quote returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				1602090				Number of Days		10836	
		$QReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$QReturn_{t-1}$	$b_{0\text{-}3}$	0.063	0.11	0.075	0.098	0.082	0.087	0.081	0.096	0.057	0.063	-0.0033	0.0049
	t_0	54.79*	108.87*	69.61*	106.89*	76.38*	96.16*	78.23*	105.58*	54.37*	67.70*	-0.30	0.51
	t_1	16.47*	31.03*	29.66*	39.87*	35.33*	36.91*	35.60*	47.40*	30.76*	37.56*	-0.15	0.24
	t_{21}	4.36*	5.49*	6.70*	10.22*	6.83*	5.53*	9.30*	11.57*	5.72*	7.93*	-0.15	0.24
	t_{22}	4.88*	4.79*	6.62*	11.00*	7.68*	6.25*	5.41*	6.27*	4.82*	5.28*	-0.11	0.17
	t_3	4.17*	5.43*	6.00*	9.28*	6.47*	5.44*	8.45*	10.57*	5.65*	7.85*	-0.11	0.17
	b_{41}	0.063	0.11	0.075	0.098	0.082	0.087	0.081	0.096	0.057	0.062	-0.0068	0.0016
	t_{41}	54.76*	108.42*	69.70*	106.32*	76.50*	95.38*	78.11*	104.89*	53.95*	66.96*	-0.62	0.17
	b_{42}	0.059	0.10	0.069	0.086	0.074	0.071	0.068	0.076	0.039	0.036	-0.013	-0.0089
	t_{42}	51.74*	101.18*	64.45*	98.28*	69.78*	78.18*	66.68*	83.94*	37.57*	39.29*	-1.22	-0.90
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	4.51		2.00		0.35		1.45		0.46		0.82	
	t_0	79.58*		40.14*		7.23*		31.22*		10.61*		1.94^	
	t_1	28.84*		16.08*		2.94*		21.02*		7.87*		1.50	
	t_{21}	7.10*		3.38*		0.38		2.76*		0.60		1.85^	
	t_{22}	3.60*		3.14*		0.30		2.59#		0.71		1.60	
	t_3	6.82*		3.31*		0.38		2.73*		0.60		2.05#	
	$b_{41}(10^3)$	4.46		1.94		0.27		1.37		0.41		0.83	
	t_{41}	78.59*		38.72*		5.43*		29.45*		9.45*		1.90^	
	$b_{42}(10^3)$	4.15		1.41		-0.47		0.71		-0.31		0.47	
	t_{42}	72.63*		28.05*		-9.51*		15.28*		-7.28*		1.16	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		1.16		1.33		-8.85		1.07		-1.12		6.73
	t_0		14.86*		1.94^		-13.71*		1.72^		-1.76^		1.10
	t_1		10.06*		1.52		-10.32*		1.57		-1.97#		1.27
	t_{21}		2.12#		0.26		-1.01		0.22		-0.18		1.41
	t_{22}		2.16#		0.17		-0.86		0.21		-0.22		1.25
	t_3		2.09#		0.25		-0.99		0.21		-0.18		1.38
	$b_{41}(10^9)$		11.11		0.83		-9.39		0.48		-1.75		6.31
	t_{41}		14.20*		1.21		-14.55*		0.77		-2.76*		1.03
	$b_{42}(10^9)$		9.42		-1.37		-11.89		-2.00		-3.91		4.59
	t_{42}		12.07*		-2.01#		-18.54*		-3.26*		-6.30*		0.79
	AR^2(%)	1.55	1.05	0.96	0.85	0.65	0.66	0.92	0.84	0.41	0.40	0.02	0.00
	# of Obs.	1196228		1369612		1398556		1332822		1145934		10749	

Appendix

Table A1. Serial regressions for trade and quote returns and univariate regressions of trade and quote returns on lagged order imbalance (OIBNUM / OIBDOL) for 1994 (based on 1-second signing rule)

Dependent variable is trade and quote returns and the single independent variable is lagged trade and quote returns, lagged OIBNUM or lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

Number of Time Slots (5, 10, 15, 30, 60 mins)		895345				
		$TQReturn_t$				
		5 mins	10 mins	15 mins	30 mins	60 mins
$TQReturn_{t-1}$	$b_{0\text{-}3}$	-0.23	-0.21	-0.19	-0.14	-0.10
	t_0	-157.99*	-159.49*	-153.64*	-114.49*	-76.80*
	t_1	-81.05*	-61.88*	-41.85*	-52.71*	-44.81*
	t_{21}	-6.13*	-6.35*	-5.15*	-4.47*	-3.58*
	t_{22}	-29.62*	-24.29*	-15.86*	-15.64*	-9.50*
	t_3	-6.12*	-6.32*	-5.13*	-4.45*	-3.51*
	b_{41}	-0.23	-0.21	-0.19	-0.14	-0.10
	t_{41}	-158.36*	-160.01*	-154.22*	-115.31*	-77.76*
	b_{42}	-0.24	-0.22	-0.20	-0.16	-0.13
	t_{42}	-161.60*	-165.56*	-162.16*	-128.06*	-98.20*
	Adjusted- R^2 (%)	4.88	4.01	3.48	1.92	0.98
	# of Observations	486363	608149	655490	670767	594081
$OIBNUM_{t-1}$	$b_{0\text{-}3}$ (10^3)	-4.67	-3.72	-2.73	-0.78	0.27
	t_0	-38.69*	-37.60*	-30.70*	-10.55*	4.27*
	t_1	-30.28*	-30.40*	-25.81*	-9.22*	3.75*
	t_{21}	-8.27*	-6.84*	-5.62*	-1.66	0.52
	t_{22}	-11.82*	-7.82*	-5.49*	-1.64	0.46
	t_3	-7.89*	-5.98*	-4.79*	-1.54	0.49
	b_{41}(10^3)	-4.61	-3.61	-2.59	-0.55	0.58
	t_{41}	-37.99*	-36.11*	-28.80*	-7.31*	8.76*
	b_{42} (10^3)	-5.09	-4.27	-3.36	-1.58	-0.65
	t_{42}	-41.93*	-42.82*	-37.49*	-21.06*	-10.01*
	Adjusted- R^2 (%)	0.35	0.25	0.15	0.02	0.00
$OIBDOL_{t-1}$	$b_{0\text{-}3}$ (10^9)	-7.94	-5.24	-6.94	-1.98	0.62
	t_0	-12.01*	-11.13*	-13.86*	-4.03*	1.33
	t_1	-7.90*	-6.64*	-6.53*	-3.07*	1.47
	t_{21}	-4.11*	-1.88^	-2.30#	-1.34	0.38
	t_{22}	-4.14*	-1.86^	-2.37#	-1.05	0.28
	t_3	-4.07*	-1.86^	-2.28#	-1.36	0.41
	b_{41} (10^9)	-7.90	-5.24	-6.94	-2.00	0.58
	t_{41}	-11.94*	-11.11*	-13.84*	-4.06*	1.24
	b_{42} (10^9)	-8.25	-5.63	-7.34	-2.75	-0.21
	t_{42}	-12.48*	-11.94*	-14.69*	-5.62	-0.45
	Adjusted- R^2 (%)	0.03	0.02	0.03	0.00	0.00
	# of Observations	423133	555822	619256	675489	646415

Table A2. Serial regressions for trade and quote returns and univariate regressions of trade and quote returns on lagged order imbalance (OIBNUM / OIBDOL) for 1999 (based on 1-second signing rule)

Dependent variable is trade returns and the single independent variable is lagged trade returns, lagged OIBNUM or lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

Number of Time Slots (5, 10, 15, 30, 60 mins)		2710586				
		$TQReturn_t$				
		5 mins	10 mins	15 mins	30 mins	60 mins
$TQReturn_{t-1}$	$b_{0\text{-}3}$	-0.047	-0.024	0.0055	0.026	0.034
	t_0	-69.64*	-37.82*	8.79*	43.00*	51.96*
	t_1	-9.07*	-3.03*	1.06*	8.47*	16.00*
	t_{21}	-1.72^	-0.73	0.53	3.11*	3.70*
	t_{22}	-4.69*	-0.90	0.35	2.57#	2.51#
	t_3	-1.72^	-0.72	0.49	2.89*	3.74*
	b_{41}	-0.047	-0.025	0.0039	0.023	0.028
	t_{41}	-70.82*	-39.90*	6.17*	37.64*	42.70*
	b_{42}	-0.050	-0.030	-0.0020	0.014	0.015
	t_{42}	-74.99*	-46.65*	-3.17*	22.94*	23.07*
	Adjusted- R^2 (%)	0.21	0.06	0.00	0.08	0.14
	# of Observations	2254462	2409760	2411240	2271436	1934367
$OIBNUM_{t-1}$	$b_{0\text{-}3}$ (10^3)	1.72	1.33	1.02	0.91	0.71
	t_0	66.90*	61.88*	52.28*	54.26*	48.18*
	t_1	30.64*	28.34*	25.37*	29.56*	28.79*
	t_{21}	7.25*	5.83*	5.22*	2.88*	1.87^
	t_{22}	8.85*	5.91*	3.77*	3.30*	1.98#
	t_3	7.23*	5.87*	5.53*	2.82*	1.86^
	b_{41}(10^3)	1.78	1.41	1.10	1.02	0.82
	t_{41}	68.79*	64.97*	55.93*	59.69*	54.20*
	b_{42} (10^3)	1.58	1.14	0.78	0.62	0.35
	t_{42}	61.02*	52.55*	39.84*	36.72*	23.22*
	Adjusted- R^2 (%)	0.21	0.16	0.11	0.13	0.11
$OIBDOL_{t-1}$	$b_{0\text{-}3}$ (10^9)	3.00	3.74	2.34	3.76	5.55
	t_0	11.10*	15.70*	10.17*	16.84*	23.01*
	t_1	5.97*	8.88*	7.60*	14.03*	20.55*
	t_{21}	1.68^	1.34	1.24	3.74*	2.78*
	t_{22}	2.11#	1.94^	1.50	2.27#	2.41#
	t_3	1.66^	1.36	1.28	3.25*	2.61*
	b_{41} (10^9)	2.95	3.68	2.26	3.61	5.20
	t_{41}	10.92*	15.44*	9.81*	16.15*	21.66*
	b_{42} (10^9)	2.56	3.05	1.47	2.31	3.20
	t_{42}	9.50*	12.82*	6.39*	10.37*	13.39*
	Adjusted- R^2 (%)	0.01	0.01	0.00	0.01	0.02
	# of Observations	2106346	2340628	2396345	2351150	2128590

Table A3. Serial regressions for trade and quote returns and univariate regressions of trade and quote returns on lagged order imbalance (OIBNUM / OIBDOL) for 2002 (based on 1-second signing rule)

Dependent variable is trade returns and the single independent variable is lagged trade returns, lagged OIBNUM or lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

Number of Time Slots (5, 10, 15, 30, 60 mins)		6519684				
		$TQReturn_t$				
		5 mins	10 mins	15 mins	30 mins	60 mins
$TQReturn_{t-1}$	$b_{0\text{-}3}$	0.0090	0.027	0.051	0.079	0.071
	t_0	21.57*	67.60*	126.04*	189.07*	159.96*
	t_1	7.44*	23.30*	50.69*	81.50*	80.56*
	t_{21}	0.64	2.22#	4.61*	8.09*	5.03*
	t_{22}	1.13	2.31#	5.15*	7.34*	5.29*
	t_3	0.64	2.12#	4.49*	7.71*	4.79*
	b_{41}	0.0083	0.026	0.050	0.077	0.068
	t_{41}	20.08*	65.02*	122.71*	183.68*	152.06*
	b_{42}	0.0038	0.019	0.039	0.059	0.037
	t_{42}	9.05	46.04*	96.33*	140.24*	82.68*
	Adjusted- R^2 (%)	0.01	0.07	0.27	0.65	0.55
	# of Observations	6134056	6090101	5941468	5439868	4589193
$OIBNUM_{t-1}$	$b_{0\text{-}3}$ (10^3)	0.28	0.39	0.50	0.70	0.53
	t_0	44.14*	70.36*	99.92*	159.75*	137.15*
	t_1	17.12*	31.56*	47.91*	85.46*	79.50*
	t_{21}	1.65	3.30*	5.80*	7.97*	7.92*
	t_{22}	1.77^	2.37#	3.23*	4.12*	3.06*
	t_3	1.66^	3.33*	5.71*	8.08*	8.53*
	b_{41}(10^3)	0.29	0.40	0.53	0.75	0.61
	t_{41}	45.21*	72.35*	103.67*	168.14*	153.85*
	b_{42} (10^3)	0.20	0.27	0.36	0.51	0.28
	t_{42}	30.14*	47.79*	70.43*	114.36*	69.44*
	Adjusted- R^2 (%)	0.03	0.08	0.17	0.44	0.37
$OIBDOL_{t-1}$	$b_{0\text{-}3}$ (10^9)	3.22	3.97	5.23	8.37	7.56
	t_0	18.14*	24.04*	31.98*	49.62*	44.33*
	t_1	18.14*	23.60*	29.03*	48.71*	44.92*
	t_{21}	2.95*	1.99#	1.74^	2.32#	2.05#
	t_{22}	2.49#	2.30#	2.37#	3.31*	2.36#
	t_3	2.88*	1.92^	1.70^	2.30#	2.03#
	b_{41} (10^9)	3.20	3.97	5.28	8.50	7.99
	t_{41}	18.04*	24.04*	32.27*	50.34*	46.86*
	b_{42} (10^9)	2.38	2.69	3.44	5.02	1.95
	t_{42}	13.40*	16.35*	21.12*	29.98*	11.60*
	Adjusted- R^2 (%)	0.01	0.01	0.02	0.04	0.04
	# of Observations	5830742	6045201	6016076	5725595	5094283

Table A4. Serial regressions for trade and quote returns and univariate regressions of trade and quote returns on lagged order imbalance for 2002 (based on 5-second signing rule)

Dependent variable is trade returns and the single independent variable is lagged trade returns, lagged OIBNUM or lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level.

Number of Time Slots (5, 10, 15, 30, 60 mins)		6519684				
		$TQReturn_t$				
		5 mins	10 mins	15 mins	30 mins	60 mins
$OIBNUM_{t-1}$	$b_{0\text{-}3}$ (10^3)	0.26	0.37	0.49	0.71	0.57
	t_0	41.17*	65.80*	96.05*	155.92*	138.63*
	t_1	15.81*	28.95*	45.70*	83.00*	79.21*
	t_{21}	1.52	2.75*	5.18*	10.10*	7.58*
	t_{22}	1.70^	2.22#	3.14*	4.05*	3.19*
	t_3	1.53	2.76*	5.07*	10.00*	7.71*
	b_{41}(10^3)	0.27	0.37	0.50	0.74	0.62
	t_{41}	41.55*	66.66*	98.02*	160.85*	149.51*
	b_{42} (10^3)	0.17	0.24	0.34	0.50	0.28
	t_{42}	26.63*	42.15*	64.93*	107.52*	66.74*
	Adjusted- R^2 (%)	0.03	0.07	0.15	0.42	0.38
$OIBDOL_{t-1}$	$b_{0\text{-}3}$ (10^9)	3.02	3.87	5.00	8.36	5.39
	t_0	16.90*	23.31*	30.58*	49.40*	31.63*
	t_1	16.77*	23.55*	28.27*	49.16*	33.52*
	t_{21}	2.65*	2.32#	1.72^	1.99#	1.79^
	t_{22}	2.34#	2.48#	2.60*	3.55*	1.73^
	t_3	2.54#	2.24#	1.69^	1.99#	1.77^
	b_{41} (10^9)	2.98	3.84	5.00	8.38	5.63
	t_{41}	16.71*	23.11*	30.56*	49.52*	32.97*
	b_{42} (10^9)	2.14	2.53	3.15	4.92	-2.00
	t_{42}	12.01*	15.28*	19.25*	29.32*	-1.19
	Adjusted- R^2 (%)	0.00	0.01	0.02	0.04	0.02
	# of Observations	5830499	6044949	6015821	5725277	5094015

Table A5. Multiple regressions of trade and quote returns on lagged trade and quote returns and lagged order imbalances (OIBNUM / OIBDOL) for 1994 (based on 1-second signing rule)

Dependent variable is trade and quote returns and the two independent variables are lagged trade and quote returns and lagged OIBNUM or lagged trade and quote returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				895345			Number of Days			21837	
		$TQReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$TQReturn_{t-1}$	$b_{0\text{-}3}$	-0.22	-0.22	-0.20	-0.20	-0.18	-0.19	-0.14	-0.14	-0.10	-0.098	0.055	0.057
	t_0	-131.01*	-132.92*	-140.46*	-142.96*	-139.15*	-140.85*	-109.44*	-109.29*	-76.66*	-74.93*	8.03*	8.41*
	t_1	66.71*	-67.55*	-52.87*	-54.11*	-36.45*	-37.14*	-49.71*	-49.71*	-44.51*	-43.64*	5.89*	6.07*
	t_{21}	-5.24*	-5.31*	-5.77*	-5.82*	-4.77*	-4.72*	-4.40*	-4.26*	-3.72*	-3.49*	4.30*	4.48*
	t_{22}	-23.79*	-24.21*	-20.36*	-21.01*	-13.95*	-14.16*	-14.98*	-14.76*	-9.53*	-9.32*	3.85*	3.84*
	t_3	-5.23*	-5.31*	-5.74*	-5.79*	-4.74*	-4.70*	-4.38*	-4.24*	-3.65*	-3.43*	3.29*	3.32*
	b_{41}	-0.22	-0.22	-0.20	-0.20	-0.19	-0.19	-0.14	-0.14	-0.10	-0.099	0.051	0.055
	t_{41}	-131.45*	-133.34*	-141.19*	-143.59*	-140.11*	-141.58*	-110.91*	-110.18*	-78.59*	-75.92*	7.40*	8.03*
	b_{42}	-0.22	-0.22	-0.20	-0.21	-0.19	-0.20	-0.16	-0.16	-0.13	-0.13	0.019	0.019
	t_{42}	-134.48*	-136.54*	-145.95*	-148.89*	-146.82*	-149.26*	-121.67*	-122.86*	-95.86*	-96.24*	2.83*	2.75*
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	-2.29		-1.68		-0.61		0.63		1.12		0.54	
	t_0	-18.91*		-16.87*		-6.86*		8.45*		17.34*		1.65^	
	t_1	-14.29*		-13.52*		-5.44*		7.54*		15.52*		1.61	
	t_{21}	-4.54*		-3.33*		-1.20		1.77^		2.90*		1.71^	
	t_{22}	-5.43*		-3.18*		-1.21		1.45		2.16#		1.21	
	t_3	-4.31*		-2.80*		-1.05		1.52		2.48#		1.25	
	$b_{41}(10^3)$	-2.20		-1.51		-0.38		0.97		1.51		0.89	
	t_{41}	-18.10*		-15.03*		-4.20*		12.68*		22.55*		2.50#	
	$b_{42}(10^3)$	-2.74		-2.23		-1.23		-0.069		0.33		-0.14	
	t_{42}	-22.52*		-22.29*		-13.65*		-0.91		5.11*		-0.44	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		-5.38		-3.91		-6.09		-0.50		2.31		2.08
	t_0		-8.34*		-8.55*		-10.54*		-0.96		4.60*		0.67
	t_1		-8.37*		-6.54*		-5.13*		-0.81		4.53*		0.69
	t_{21}		-4.23*		-2.06#		-2.03#		-0.42		1.05		0.78
	t_{22}		-4.68*		-2.14#		-2.24#		-0.28		0.88		0.62
	t_3		-4.18*		-2.05#		-2.00#		-0.40		1.03		0.68
	$b_{41}(10^9)$		-5.34		-3.91		-6.07		-0.48		1.11		1.82
	t_{41}		-8.28*		-8.55*		-10.52*		-0.92		4.59*		0.59
	$b_{42}(10^9)$		-5.75		-4.30		-6.66		-1.12		1.56		1.53
	t_{42}		-8.92*		-9.40*		-11.59*		-2.16#		3.16*		0.53
	AR^2 (%)	4.63	4.56	3.90	3.86	3.35	3.36	1.89	1.88	1.02	0.97	0.34	0.33
	# of Obs.	372004		510936		576369		625790		575075		21605	

Table A6. Multiple regressions of trade and quote returns on lagged trade and quote returns and lagged order imbalances (OIBNUM / OIBDOL) for 1999 (based on 1-second signing rule)

Dependent variable is trade and quote returns and the two independent variables are lagged trade and quote returns and lagged OIBNUM or lagged trade and quote returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)			2710586				Number of Days		20916	
		$TQReturn_t$										
		5 mins	5 mins	10 mins	10 mins	15 mins	15 mins	30 mins	30 mins	60 mins	60 mins	Daily	Daily
$TQReturn_{t-1}$	$b_{0\text{-}3}$	-0.059	-0.034	-0.016	0.0015	-0.013	0.0030	-0.0014	0.014	0.022	0.031	0.067	0.072
	t_0	-77.93*	-48.13*	-22.82*	2.33#	-18.83*	4.65*	-1.97#	22.60*	31.20*	47.29*	9.25*	10.28*
	t_1	-13.16*	-8.35*	-3.70*	0.39	-3.22*	0.83	-0.42	4.93*	9.64*	14.52*	4.47*	4.99*
	t_{21}	-1.91^	-1.21	-0.69	0.07	-1.09	0.25	-0.09	1.01	1.97^	3.19*	5.58*	6.55*
	t_{22}	-5.19*	-3.36*	-1.13	0.11	-0.68	0.17	-0.08	0.90	1.58	2.23#	3.56*	3.92*
	t_3	-1.91^	-1.21	-0.67	0.070	-0.99	0.23	-0.09	0.97	1.90^	3.23*	4.05*	4.56*
	b_{41}	-0.061	-0.035	-0.019	0.000082	-0.017	0.0013	-0.0077	0.011	0.013	0.025	0.057	0.066
	t_{41}	-80.48*	-49.44*	-26.98*	0.13	-23.92*	1.99#	-10.99*	17.23*	17.94*	38.05*	7.76*	9.46*
	b_{42}	-0.062	-0.038	-0.020	-0.0043	-0.019	-0.0048	-0.011	0.0018	0.0069	0.013	0.058	0.062
	t_{42}	-81.49*	-53.57*	-28.65*	-6.64*	-26.59*	-7.46*	-16.11*	2.82*	9.68*	19.37*	8.01*	8.83*
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	2.52		1.51		1.20		1.03		0.60		0.52	
	t_0	91.51*		64.94*		56.81*		57.47*		38.80*		2.71*	
	t_1	32.18*		22.43*		20.36*		25.48*		21.83*		1.92^	
	t_{21}	6.74*		5.19*		5.40*		3.13*		1.40		1.55	
	t_{22}	10.55*		6.12*		3.78*		3.24*		1.68^		1.77^	
	t_3	6.76*		5.36*		5.32*		2.95*		1.37		1.46	
	$b_{41}(10^3)$	2.62		1.62		1.33		1.19		0.76		0.89	
	t_{41}	94.38*		69.23*		61.97*		64.95*		47.48*		4.23*	
	$b_{42}(10^3)$	2.42		1.37		1.03		0.85		0.40		0.45	
	t_{42}	87.33*		58.59*		48.53*		47.12*		25.52*		2.43#	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		4.03		3.72		2.42		3.74		4.62		3.03
	t_0		14.84*		15.65*		10.58*		17.22*		19.58*		1.13
	t_1		7.06*		8.46*		7.31*		13.49*		17.81*		1.24
	t_{21}		2.06#		1.40		1.36		3.21*		2.51#		1.32
	t_{22}		2.76*		2.07#		1.53		2.19#		2.35#		1.25
	t_3		2.05#		1.42		1.40		2.83*		2.48#		1.33
	$b_{41}(10^9)$		4.00		3.70		2.38		3.69		4.55		3.17
	t_{41}		14.75*		15.56*		10.44*		17.00*		19.39*		1.17
	$b_{42}(10^9)$		3.70		3.21		1.79		2.79		3.26		2.03
	t_{42}		13.66*		13.54*		7.88*		12.90*		13.96*		0.79
	AR^2(%)	0.52	0.12	0.19	0.01	0.14	0.01	0.17	0.04	0.21	0.15	0.56	0.53
	# of Obs.	2025406		2280871		2329676		2241141		1925826		20497	

Table A7. Multiple regressions of trade and quote returns on lagged trade and quote returns and lagged order imbalances (OIBNUM / OIBDOL) for 2002 (based on 1-second signing rule)

Dependent variable is trade and quote returns and the two independent variables are lagged trade and quote returns and lagged OIBNUM or lagged trade and quote returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				6519684				Number of Days		21672	
		$TQReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$TQReturn_{t-1}$	$b_{0\text{-}3}$	0.0029	0.0089	0.0065	0.019	0.034	0.048	0.060	0.078	0.059	0.071	0.0032	0.0054
	t_0	6.21*	20.70*	14.32*	44.29*	76.97*	116.33*	130.04*	183.75*	121.48*	156.04*	0.44	0.78
	t_1	2.24#	7.29*	5.73*	17.31*	31.17*	46.95*	56.34*	79.47*	61.33*	78.76*	0.22	0.40
	t_{21}	0.20	0.62	0.61	1.83^	3.22*	4.61*	6.19*	8.39*	3.02*	4.94*	0.25	0.46
	t_{22}	0.39	1.12	0.75	2.01#	3.48*	5.07*	5.69*	7.34*	3.79*	5.34*	0.12	0.21
	t_3	0.20	0.62	0.59	1.76^	3.23*	4.49*	6.08*	7.95*	2.90*	4.72*	0.13	0.22
	b_{41}	0.0019	0.0083	0.0047	0.018	0.032	0.047	0.054	0.076	0.051	0.067	-0.0055	0.0013
	t_{41}	4.24*	19.34*	10.38*	42.10*	70.51*	112.99*	117.51*	178.05*	102.69*	147.51*	-0.75	0.19
	b_{42}	-0.00	0.0037	0.00	0.0097	0.026	0.036	0.044	0.059	0.031	0.038	-0.0035	-0.00
	t_{42}	-1.63	8.51*	0.39	23.15*	57.12*	87.37*	96.65*	137.54*	64.34*	82.93*	-0.48	-0.13
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	0.29		0.46		0.47		0.52		0.25		0.13	
	t_0	40.01*		74.00*		84.10*		107.69*		59.34*		1.24	
	t_1	16.46*		35.52*		41.80*		56.90*		33.78*		0.48	
	t_{21}	2.29#		5.85*		8.77*		9.87*		4.48*		1.04	
	t_{22}	1.60		2.91*		2.95*		2.87*		1.27		0.45	
	t_3	2.31#		6.19*		10.42*		14.53*		4.20*		0.81	
	$b_{41}(10^3)$	0.30		0.48		0.52		0.60		0.36		0.33	
	t_{41}	41.64*		77.96*		90.86*		121.24*		81.73*		3.01*	
	$b_{42}(10^3)$	0.21		0.36		0.37		0.40		0.12		0.089	
	t_{42}	29.49*		58.11*		64.36*		80.51*		26.67*		0.92	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		2.69		3.31		3.04		3.00		0.19		1.60
	t_0		15.23*		20.22*		18.85*		18.32*		1.15		0.61
	t_1		15.30*		19.89*		17.64*		18.56*		1.21		0.68
	t_{21}		3.02*		1.95^		1.37		1.76^		0.10		0.65
	t_{22}		2.31#		2.12#		1.53		1.50		0.08		0.65
	t_3		2.95*		1.88^		1.34		1.78^		0.10		0.63
	$b_{41}(10^9)$		2.71		3.38		3.20		3.32		0.83		2.54
	t_{41}		15.32*		20.63*		19.81*		20.24*		4.94*		0.96
	$b_{42}(10^9)$		2.14		2.51		2.00		1.32		-2.10		-1.18
	t_{42}		12.12*		15.35*		12.50*		8.12*		-12.76*		-0.48
	AR^2 (%)	0.04	0.01	0.13	0.04	0.37	0.25	0.87	0.67	0.63	0.55	0.00	0.00
	# of Obs.	5754615		4943787		5866895		5420578		4584892		21425	

Table A8. Multiple regressions of trade and quote returns on lagged trade and quote returns and lagged order imbalances (OIBNUM / OIBDOL) for 1994 and for large-size companies (based on 1-second signing rule)

Dependent variable is trade and quote returns and the two independent variables are lagged trade and quote returns and lagged OIBNUM or lagged trade and quote returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				653876			Number of Days			11044	
		$TQReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$TQReturn_{t-1}$	$b_{0\text{-}3}$	-0.19	-0.20	-0.17	-0.18	-0.16	-0.16	-0.11	-0.11	-0.066	-0.062	0.065	0.067
	t_0	-109.02*	-110.91*	-112.13*	-114.37*	-108.01*	-109.34*	-73.96*	-73.44*	-43.15*	-40.98*	6.72*	7.06*
	t_1	-54.05*	-54.83*	-35.50*	-36.46*	-22.43*	-22.90*	-28.06*	-27.98*	-22.30*	-21.29*	4.46*	4.60*
	t_{21}	-3.55*	-3.61*	-3.83*	-3.87*	-3.05*	-3.03*	-2.58#	-2.48#	-1.92^	-1.76^	3.27*	3.47*
	t_{22}	-18.07*	-18.44*	-14.44*	-14.98*	-8.73*	-8.90*	-8.79*	-8.67*	-5.02*	-4.90*	3.45*	3.49*
	t_3	-3.55*	-3.61*	-3.82*	-3.86*	-3.04*	-3.01*	-2.57#	-2.48#	-1.90^	-1.75^	2.80*	2.91*
	b_{41}	-0.19	-0.20	-0.17	-0.18	-0.16	-0.16	-0.11	-0.11	-0.069	-0.063	0.061	0.065
	t_{41}	-109.22*	-111.11*	-112.48*	-114.57*	-108.57*	-109.61*	-75.13*	-73.94*	-44.80*	-41.58*	6.29*	6.84*
	b_{42}	-0.20	-0.20	-0.18	-0.18	-0.17	-0.17	-0.13	-0.13	-0.095	-0.094	0.038	0.038
	t_{42}	-112.77*	-114.83*	-118.14*	120.88*	-116.52*	-118.62*	-87.33*	-88.25*	-62.91*	-62.89*	3.91*	3.91*
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	-2.03		-1.27		-0.36		0.65		1.07		0.45	
	t_0	-17.36*		-13.18*		-4.11*		8.85*		16.81*		1.29	
	t_1	-12.58*		-10.20*		-3.00*		7.58*		14.55*		1.28	
	t_{21}	-3.98*		-2.73*		-0.71		2.04#		2.93*		1.51	
	t_{22}	-4.69*		-2.34#		-0.67		1.42		1.96^		1.00	
	t_3	-3.80*		-2.25#		-0.63		1.67^		2.41#		1.11	
	$b_{41}(10^3)$	-1.95		-1.10		-0.13		0.98		1.44		0.73	
	t_{41}	-16.57*		-11.28*		-1.45		12.97*		21.79*		1.92^	
	$b_{42}(10^3)$	-2.43		-1.78		-0.90		0.016		0.37		0.029	
	t_{42}	-20.70*		-18.36*		-10.23*		0.22		5.79*		0.09	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		-5.22		-3.55		-5.69		-0.16		2.54		0.96
	t_0		-8.63*		-8.28*		-10.29*		-0.32		5.16*		0.29
	t_1		-8.42*		-6.10*		-4.59*		-0.25		4.83*		0.29
	t_{21}		-4.06*		-1.96^		-1.80^		-0.14		1.14		0.35
	t_{22}		-4.65*		-2.06#		-2.01#		-0.09		0.92		0.26
	t_3		-3.98*		-1.94^		-1.78^		-0.13		1.20		0.30
	$b_{41}(10^9)$		-5.24		-3.57		-5.70		-0.18		2.55		0.56
	t_{41}		-8.65*		-8.32*		-10.31*		-0.36		5.19*		0.17
	$b_{42}(10^9)$		-5.58		-3.90		-6.27		-0.81		1.65		1.10
	t_{42}		-9.23*		-9.10*		-11.41*		-1.63		3.42*		0.35
	AR^2 (%)	3.77	3.70	2.99	2.97	2.48	2.50	1.11	1.09	0.45	0.39	0.46	0.44
	# of Obs.	322555		430195		473357		489489		431197		10946	

Table A9. Multiple regressions of trade and quote returns on lagged trade and quote returns and lagged order imbalances (OIBNUM / OIBDOL) for 1994 and for small-size companies (based on 1-second signing rule)

Dependent variable is trade and quote returns and the two independent variables are lagged trade and quote returns and lagged OIBNUM or lagged trade and quote returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				241469				Number of Days		10793	
		$TQReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$TQReturn_{t-1}$	$b_{0\text{-}3}$	-0.27	-0.28	-0.26	-0.26	-0.24	-0.25	-0.21	-0.21	-0.17	-0.17	0.046	0.047
	t_0	-61.50*	-65.15*	-74.29*	-75.46*	-79.39*	-80.71*	-77.19*	-78.05*	-65.08*	-65.68*	4.62*	4.92*
	t_1	-41.88*	-42.29*	-51.24*	-52.10*	-56.71*	-57.60*	-57.77*	-58.05*	-49.62*	-49.96*	3.75*	3.96*
	t_{21}	-9.15*	-9.27*	-9.92*	-9.89*	-9.81*	-9.88*	-8.77*	-8.86*	-8.15*	-8.01*	3.01*	3.08*
	t_{22}	-21.86*	-22.11*	-25.28*	-25.78*	-26.87*	-27.01*	-26.03*	-25.61*	-16.75*	-15.85*	2.87*	2.89*
	t_3	-9.14*	-9.25*	-9.90*	-9.88*	-9.83*	-9.90*	-8.78*	-8.86*	-7.91*	-7.71*	2.50#	2.49#
	b_{41}	-0.27	-0.28	-0.26	-0.26	-0.25	-0.25	-0.21	-0.21	-0.17	-0.17	0.041	0.044
	t_{41}	-61.68*	-62.33*	-74.66*	-75.86*	-79.81*	-81.14*	-77.72*	-78.53*	-65.73*	-66.21*	4.14*	4.59*
	b_{42}	-0.28	-0.28	-0.27	-0.27	-0.25	-0.26	-0.22	-0.23	-0.20	-0.20	0.00	-0.00
	t_{42}	-63.13*	-63.79*	-76.73*	-77.95*	-82.83*	-84.34*	-82.79*	-84.12*	-75.02*	-76.51*	0.07	-0.08
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	-5.38		-6.72		-4.33		-1.21		0.043		0.89	
	t_0	-9.77*		-15.45*		-11.62*		-4.04*		0.17		0.99	
	t_1	-7.89*		-11.69*		-9.45*		-3.18*		0.14		0.83	
	t_{21}	-5.06*		-5.23*		-5.19*		-1.13		0.04		0.66	
	t_{22}	-4.13*		-5.33*		-4.03*		-1.09		0.03		0.76	
	t_3	-5.23*		-5.35*		-5.05*		-1.06		0.03		0.62	
	$b_{41}(10^3)$	-5.35		-6.71		-4.21		-1.04		0.29		1.49	
	t_{41}	-9.70*		-15.39*		-11.27*		-3.44*		1.14		1.62	
	$b_{42}(10^3)$	-6.76		-8.24		-5.94		-2.97		-1.69		-0.40	
	t_{42}	-12.12-		-18.79*		-15.84*		-9.85*		-6.72*		-0.46	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		-10.05		-15.17		-14.72		-9.45		-4.73		5.99
	t_0		-2.29#		-4.30*		-4.80*		-3.85*		-2.18#		0.82
	t_1		-2.09#		-4.11*		-4.33*		-3.87*		-2.11#		0.88
	t_{21}		-2.34#		-2.10^		-1.79^		-1.55		-0.67		0.78
	t_{22}		-1.40		-2.19^		-1.86^		1.90^		-0.63		0.88
	t_3		-2.39#		-1.94^		-1.81^		1.65		-0.67		0.79
	$b_{41}(10^9)$		-9.20		-14.74		-14.51		-8.96		-4.65		6.34
	t_{41}		-2.10#		-4.17*		-4.73*		-3.65*		-2.14#		0.87
	$b_{42}(10^9)$		-10.09		-16.70		-14.08		-8.73		-2.54		5.84
	t_{42}		-2.30#		-4.73*		-4.60*		-3.58*		-1.18		0.85
	AR^2(%)	7.43	7.26	6.90	6.64	6.09	5.98	4.30	4.29	2.92	2.92	0.22	0.22
	Obs	49449		80741		103012		136301		143878		10659	

Table A10. Multiple regressions of trade and quote returns on lagged trade and quote returns and lagged order imbalances (OIBNUM / OIBDOL) for 1999 and for large-size companies (based on 1-second signing rule)

Dependent variable is trade and quote returns and the two independent variables are lagged trade and quote returns and lagged OIBNUM or lagged trade and quote returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				1999140				Number of Days		10584	
		$TQReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$TQReturn_{t-1}$	$b_{0\text{-}3}$	-0.058	-0.025	0.0047	0.024	0.020	0.035	0.025	0.043	0.029	0.044	0.082	0.086
	t_0	-65.77*	-30.91*	5.48*	31.96*	23.41*	46.73*	28.89*	56.92*	33.29*	56.65*	7.85*	8.75*
	t_1	-30.25*	-12.79*	2.29#	12.14*	9.15*	16.81*	10.51*	19.27*	13.61*	21.66*	5.47*	6.01*
	t_{21}	-2.52#	-1.02	0.25	1.35	1.15	2.29#	1.79^	2.93*	2.37#	3.99*	5.90*	6.53*
	t_{22}	-7.81*	-3.37*	0.39	2.04#	1.51	2.55#	1.99#	3.55*	1.96^	2.86*	4.32*	4.71*
	t_3	-2.49#	-1.02	0.25	1.33	1.09	2.16#	1.65^	2.76*	2.31#	4.02*	4.52*	4.94*
	b_{41}	-0.060	-0.025	0.0025	0.024	0.017	0.034	0.021	0.041	0.024	0.042	0.073	0.084
	t_{41}	-67.53*	-31.51*	2.87*	31.15*	20.18*	45.67*	24.29*	55.39*	27.10*	53.74*	6.93*	8.45*
	b_{42}	-0.062	-0.030	-0.00	0.016	0.013	0.024	0.012	0.025	0.0084	0.018	0.077	0.081
	t_{42}	-69.74*	-37.36*	-0.78	21.27*	15.27*	32.34*	14.12*	33.61*	9.47*	22.67*	7.45*	8.16*
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	2.26		1.09		0.72		0.74		0.63		0.33	
	t_0	90.23*		50.74*		36.37*		42.75*		41.78*		1.68^	
	t_1	39.38*		23.30*		17.66*		23.82*		24.60*		1.15	
	t_{21}	8.99*		5.52*		3.49*		2.05#		1.36		0.94	
	t_{22}	12.20*		5.21*		2.77*		2.39#		1.68^		1.10	
	t_3	8.96*		5.67*		3.59*		2.00#		1.34		0.91	
	$b_{41}(10^3)$	2.33		1.17		0.80		0.83		0.72		0.61	
	t_{41}	92.39*		53.74*		39.84*		47.02*		45.70*		2.80*	
	$b_{42}(10^3)$	2.16		0.95		0.54		0.54		0.40		0.29	
	t_{42}	85.80*		43.78*		27.14*		30.94*		26.36*		1.55	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		5.19		4.56		2.34		2.25		4.19		2.05
	t_0		21.56*		21.81*		11.62*		11.47*		19.16*		0.75
	t_1		8.13*		9.66*		7.86*		10.21*		16.80*		0.81
	t_{21}		2.56#		1.60		1.42		2.58#		2.24#		0.89
	t_{22}		3.72*		2.49#		1.56		1.49		2.08#		0.79
	t_3		2.56#		1.62		1.44		2.12#		2.15#		0.86
	$b_{41}(10^9)$		5.14		4.51		2.28		2.10		3.87		2.00
	t_{41}		21.36*		21.57*		11.30*		10.71*		17.69*		0.73
	$b_{42}(10^9)$		4.87		4.09		1.80		1.40		2.94		1.60
	t_{42}		20.27*		19.61*		8.96*		7.18*		13.62*		0.62
	AR^2 (%)	0.54	0.08	0.21	0.09	0.21	0.14	0.32	0.22	0.38	0.29	0.78	0.76
	# of Obs.	1654748		1784617		1781945		1671584		1420746		10439	

Table A11. Multiple regressions of trade and quote returns on lagged trade and quote returns and lagged order imbalances (OIBNUM / OIBDOL) for 1999 and for small-size companies (based on 1-second signing rule)

Dependent variable is trade and quote returns and the two independent variables are lagged trade and quote returns and lagged OIBNUM or lagged trade and quote returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				711446				Number of Days		10332	
		$TQReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$TQReturn_{t-1}$	$b_{0\text{-}3}$	-0.066	-0.046	-0.041	-0.024	-0.049	-0.034	-0.028	-0.019	0.017	0.015	0.054	0.062
	t_0	-38.77*	-28.34*	-28.17*	-17.57*	-35.50*	-25.91*	-22.01	-15.74*	12.80*	11.93*	5.21*	6.16*
	t_1	-7.13*	-5.21*	-4.92*	-3.06*	-6.35*	-4.69*	-4.95*	-3.51*	4.09*	3.75*	2.32#	2.71*
	t_{21}	-1.11	-0.79	-0.93	-0.54	-2.79*	-1.71^	-1.09	-0.73	0.70	0.83	2.94*	3.73*
	t_{22}	-2.92*	-2.16#	-1.79^	-1.07	-1.46	-1.03	-0.98	-0.65	0.73	0.63	2.03#	2.39#
	t_3	-1.11	-0.79	-0.93	-0.54	-2.75*	-1.70^	-1.06	-0.72	0.69	0.82	2.42#	3.01*
	b_{41}	-0.068	-0.048	-0.044	-0.026	-0.053	-0.037	-0.037	-0.026	0.0024	0.0038	0.043	0.054
	t_{41}	-40.12*	-29.22*	-30.57*	-19.26*	-38.50*	-28.00*	-28.73*	-20.82*	1.85^	3.04*	4.16*	5.37*
	b_{42}	-0.072	-0.052	-0.048	-0.033	-0.058	-0.044	-0.043	-0.034	-0.0031	-0.0052	0.040	0.048
	t_{42}	-42.15*	-32.06*	-33.63*	-23.87*	-42.10*	-33.72*	-33.40*	-27.96*	-2.38#	-4.19*	3.83*	4.77*
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	5.14		3.68		2.95		1.83		-0.21		1.38	
	t_0	38.40*		35.45*		32.34*		24.86*		-3.32*		2.61*	
	t_1	16.89*		15.53*		14.69*		13.72*		-2.21#		2.00#	
	t_{21}	2.31#		3.21*		2.66#		2.92*		-0.15		2.43#	
	t_{22}	4.04*		3.92*		3.36*		2.75*		-0.21		1.95^	
	t_3	2.31#		3.20*		2.64*		2.92*		-0.14		2.35#	
	$b_{41}(10^3)$	5.35		3.93		3.22		2.24		0.34		1.85	
	t_{41}	39.79*		37.58*		34.98*		30.05*		5.36*		3.38*	
	$b_{42}(10^3)$	5.11		3.55		2.75		1.74		-0.33		1.57	
	t_{42}	37.37*		33.35*		29.29*		22.74*		-5.09*		3.05*	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		-8.03		-13.09		-8.10		12.56		3.40		5.28
	t_0		-6.27*		-10.84*		-7.03*		11.35*		3.24*		0.76
	t_1		-2.93*		-5.98*		-4.24*		7.09*		3.30*		0.77
	t_{21}		-1.18		-1.15		-0.74		2.12#		0.70		0.73
	t_{22}		-0.95		-1.22		-0.83		2.48#		0.66		0.76
	t_3		-1.17		-1.15		-0.74		2.06#		0.68		0.72
	$b_{41}(10^9)$		-8.10		-13.22		-8.22		12.84		4.56		5.68
	t_{41}		-6.33*		-10.95*		-7.15*		11.65*		4.39*		0.82
	$b_{42}(10^9)$		-8.69		-13.82		-9.46		10.53		0.89		4.71
	t_{42}		-6.79*		-11.47*		-8.24*		9.58*		0.86		0.70
	AR^2(%)	0.62	0.23	0.32	0.09	0.32	0.14	0.15	0.06	0.03	0.03	0.44	0.38
	# of Obs.	370658		496254		547731		569557		505080		10058	

Table A12. Multiple regressions of trade and quote returns on lagged trade and quote returns and lagged order imbalances (OIBNUM / OIBDOL) for 2002 and for large-size companies (based on 1-second signing rule)

Dependent variable is trade and quote returns and the two independent variables are lagged trade and quote returns and lagged OIBNUM or lagged trade and quote returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				4917594				Number of Days		10836	
		$TQReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$TQReturn_{t-1}$	$b_{0\text{-}3}$	0.0084	0.013	0.0072	0.020	0.041	0.056	0.066	0.088	0.068	0.081	0.016	0.018
	t_0	16.29*	26.81*	13.89*	42.97*	79.58*	119.41*	125.58*	180.92*	118.86*	154.42*	1.53	1.84^
	t_1	5.99*	9.58*	5.44*	16.49*	31.62*	47.58*	53.18*	76.77*	58.72*	76.55*	0.84	1.00
	t_{21}	0.53	0.84	0.55	1.71^	3.00*	4.49*	5.05*	7.98*	2.46#	4.07*	1.00	1.32
	t_{22}	1.22	1.66^	0.66	1.80^	3.33*	4.90*	5.05*	6.83*	3.44*	4.91*	0.59	0.66
	t_3	0.53	0.83	0.54	1.66^	3.04*	4.43*	4.85*	7.52*	2.39#	3.92*	0.63	0.74
	b_{41}	0.0075	0.012	0.0053	0.019	0.038	0.055	0.061	0.085	0.058	0.077	0.0049	0.014
	t_{41}	14.54*	25.62*	10.26*	41.01*	73.63*	116.44*	113.74*	175.66*	100.94*	146.53*	0.47	1.40
	b_{42}	0.0046	0.0069	0.00	0.010	0.031	0.042	0.049	0.064	0.034	0.040	0.015	0.019
	t_{42}	8.80*	14.30*	0.57	21.33*	60.15*	89.52*	92.77*	133.03*	59.77*	76.32*	1.45	1.87^
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	0.18		0.42		0.44		0.49		0.23		0.080	
	t_0	25.09*		66.82*		77.68*		98.96*		52.88*		0.72	
	t_1	10.29*		31.82*		38.15*		52.24*		30.31*		0.28	
	t_{21}	2.11#		6.74*		9.37*		9.81*		2.97*		0.64	
	t_{22}	0.99		2.60*		2.69*		2.63*		1.15		0.27	
	t_3	2.20#		7.44*		13.12*		12.75*		2.87*		0.51	
	$b_{41}(10^3)$	0.19		0.44		0.48		0.56		0.33		0.28	
	t_{41}	26.59*		70.39*		83.67*		110.90*		73.00*		2.36#	
	$b_{42}(10^3)$	0.10		0.32		0.33		0.36		0.083		0.049	
	t_{42}	13.76*		49.53*		56.45*		69.30*		18.09*		0.48	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		2.00		3.31		3.51		2.75		-0.010		0.61
	t_0		11.22*		19.78*		21.18*		16.09*		-0.06		0.21
	t_1		11.42*		19.43*		20.47*		16.65*		-0.06		0.23
	t_{21}		2.12#		1.87^		1.59		1.60		-0.00		0.22
	t_{22}		1.73^		2.13#		1.75^		1.34		-0.00		0.23
	t_3		2.15#		1.83^		1.57		1.63		-0.0048		0.21
	$b_{41}(10^9)$		2.02		3.36		3.62		2.96		0.47		1.42
	t_{41}		11.33*		20.08*		21.85*		17.32*		2.68*		0.47
	$b_{42}(10^9)$		1.45		2.49		2.48		1.07		-2.32		-2.82
	t_{42}		8.18*		14.93*		15.02*		6.34*		13.42*		-1.03
	AR^2(%)	0.03	0.02	0.14	0.06	0.48	0.36	1.09	0.86	0.80	0.72	0.02	0.02
	# of Obs.	4556227		4573447		4468053		4087704		3438946		10676	

Table A13. Multiple regressions of trade and quote returns on lagged trade and quote returns and lagged order imbalances (OIBNUM / OIBDOL) for 2002 and for small-size companies (based on 1-second signing rule)

Dependent variable is trade and quote returns and the two independent variables are lagged trade and quote returns and lagged OIBNUM or lagged trade and quote returns and lagged OIBDOL. $b_{0\text{-}3}$ is the regression coefficient of the first panel regression, t_0 is t-value calculated by OLS standard error, t_1 is heteroscedasticity consistent t-statistic, t_{21} is the t-value calculated by firm-clustered error, t_{22} is the t-value calculated by date-clustered error and t_3 is the t-value calculated by firm and date-clustered error. b_{41} is the regression coefficient of the second panel regression controlling for fixed firm effect; t_{41} is the t-statistic after adjusting for the fixed firm effect; b_{42} is the regression coefficient of the third panel regression controlling for fixed date effect; t_{42} is the t-statistic after adjusting for the fixed date effect. * represents significance at the 1% confidence level or better; # represents significance between 1% and 5% confidence level; ^ represents significance between 5% and 10% confidence level. All the coefficients of OIBNUM in the tables are multiplied by one thousand. All the coefficients of OIBDOL in the tables are multiplied by one billion.

		Number of Time Slots (5, 10, 15, 30, 60 mins)				1602090				Number of Days		10836	
		$TQReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
$TQReturn_{t-1}$	$b_{0\text{-}3}$	-0.051	-0.0054	-0.019	0.012	0.0067	0.022	0.023	0.043	0.025	0.033	-0.015	-0.0091
	t_0	-48.03*	-5.58*	-19.08*	13.60*	6.70*	24.61*	23.53*	47.96*	23.54*	35.63*	-1.42	-0.94
	t_1	-18.07*	-1.90^	-8.96*	5.68*	3.28*	10.66*	11.43*	22.98*	13.40*	19.96*	-0.71	-0.46
	t_{21}	-1.80^	-0.14	-1.07	0.58	0.42	1.57	1.84^	3.26*	2.29#	4.18*	-0.73	-0.32
	t_{22}	-5.13*	-0.25	-1.90^	1.11	0.73	2.29	1.83^	3.15*	2.24#	2.94*	-0.53	-0.54
	t_3	-1.79^	-0.14	-1.04	0.57	0.42	1.55	1.77^	3.15*	2.34#	4.35*	-0.54	-0.32
	b_{41}	-0.051	-0.0058	-0.019	0.012	0.0068	0.021	0.023	0.042	0.024	0.032	-0.019	-0.012
	t_{41}	-48.08*	-6.00*	-19.05*	13.07*	6.71*	23.86*	23.27*	47.28*	23.06*	34.94*	-1.71^	-1.26
	b_{42}	-0.054	-0.012	-0.024	0.00	0.00	0.0068	0.012	0.024	0.0077	0.0077	-0.023	-0.020
	t_{42}	-51.12*	-12.76*	-24.14*	0.92	0.10	7.73*	12.19*	27.16*	7.47*	8.33*	-2.13#	-2.03#
$OIBNUM_{t-1}$	$b_{0\text{-}3}(10^3)$	5.86		3.34		1.38		2.07		0.75		0.65	
	t_0	99.98*		65.28*		27.85*		43.78*		17.11*		1.53	
	t_1	37.72*		27.64*		12.20*		30.81*		12.93*		1.19	
	t_{21}	9.28*		5.46*		1.55		3.90*		1.04		1.27	
	t_{22}	3.85*		6.24*		1.35		3.76*		1.17		1.19	
	t_3	8.95*		5.48*		1.54		3.87*		1.03		1.27	
	$b_{41}(10^3)$	5.82		3.28		1.30		2.01		0.72		0.65	
	t_{41}	99.02*		63.96*		26.23*		42.36*		16.29*		1.47	
	$b_{42}(10^3)$	5.46		2.69		0.51		1.28		-0.069		0.36	
	t_{42}	92.31*		52.18*		10.29*		27.08*		-1.58		0.88	
$OIBDOL_{t-1}$	$b_{0\text{-}3}(10^9)$		13.87		3.15		-8.17		2.46		-0.78		5.89
	t_0		16.47*		4.34*		-12.08*		3.83*		-1.21		0.95
	t_1		11.51*		3.55*		-9.12*		3.25*		-1.37		1.12
	t_{21}		1.71^		1.11		-1.15		0.56		-0.14		1.08
	t_{22}		1.95^		0.51		-0.86		0.50		-0.15		1.27
	t_3		1.69^		1.01		-1.11		0.55		-0.13		1.26
	$b_{41}(10^9)$		13.31		2.60		-8.74		1.89		-1.39		5.44
	t_{41}		15.80*		3.57*		-12.91*		2.94*		-2.14#		0.87
	$b_{42}(10^9)$		11.18		-0.069		-11.68		-1.00		-3.94		4.43
	t_{42}		13.29*		-0.10		-17.37*		-1.57		-6.19*		0.75
	AR^2 (%)	0.83	0.02	0.32	0.02	0.09	0.05	0.32	0.18	0.14	0.11	0.01	0.00
	# of Obs.	1198388		1370340		1398842		1332874		1145946		10749	

Table A14 Z-test for the coefficient differences between large-size companies and small-size companies based on trade returns

$z = (b_{\text{large}} - b_{\text{small}}) / \sqrt{(SE^2_{\text{large}} + SE^2_{\text{small}})}$. b_{large}-b_{small} represents the difference in the estimated coefficient between the large-size companies and the small-size companies. $Sig._{firm}$ represents the significance level of the z-statistic when SE is the firm-clustered error of the coefficient. $Sig._{date}$ represents the significance level of the z-statistic when SE is the date-clustered error of the coefficient. $Sig._{firm\&date}$ represents the significance level of the z-statistic when SE is the firm & date-clustered error of the coefficient. Numbers in shadow are the significant differences where all three z-statistics are significant at least at the 10% level.

		$TReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
						1994							
$TReturn_{t-1}$	b_{large}-b_{small}	0.067	0.068	0.084	0.087	0.085	0.088	0.10	0.11	0.11	0.11	0.017	0.018
	$Sig._{firm}$							5%	5%	5%	1%		
	$Sig._{date}$	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%		
	$Sig._{firm\&date}$							5%	5%	5%	1%		
$OIBNUM_{t-1}$	b_{large}-$b_{small}(10^3)$	3.75		5.84		3.99		1.77		1.13		-0.41	
	$Sig._{firm}$	1%		1%		1%		10%					
	$Sig._{date}$	5%		1%		1%							
	$Sig._{firm\&date}$	1%		1%		1%							
$OIBDOL_{t-1}$	b_{large}-$b_{small}(10^9)$		-4.89		9.10		7.59		11.63		11.83		8.63
	$Sig._{firm}$										10%		
	$Sig._{date}$												
	$Sig._{firm\&date}$												10%
						1999							
$TReturn_{t-1}$	b_{large}-b_{small}	-0.011	0.0049	0.047	0.047	0.064	0.063	0.028	0.038	0.0012	0.019	0.042	0.038
	$Sig._{firm}$					1%	1%		10%			5%	10%
	$Sig._{date}$				10%								
	$Sig._{firm\&date}$					5%	5%						
$OIBNUM_{t-1}$	b_{large}-$b_{small}(10^3)$	-2.15		-2.60		-2.32		-0.60		0.98		-1.38	
	$Sig._{firm}$			1%		5%						1%	
	$Sig._{date}$	5%		1%		5%						20%	
	$Sig._{firm\&date}$			5%		5%						5%	
$OIBDOL_{t-1}$	b_{large}-$b_{small}(10^9)$		14.95		17.55		9.06		-9.85		1.15		-4.32
	$Sig._{firm}$		10%										
	$Sig._{date}$												
	$Sig._{firm\&date}$		10%										
						2002							
$TReturn_{t-1}$	b_{large}-b_{small}	0.050	0.0080	0.021	0.0026	0.029	0.031	0.039	0.042	0.042	0.047	0.031	0.027
	$Sig._{firm}$							5%	5%		5%		
	$Sig._{date}$	1%				10%		5%	5%	10%	5%		
	$Sig._{firm\&date}$							5%	5%		5%		
$OIBNUM_{t-1}$	b_{large}-$b_{small}(10^3)$	-5.45		-2.83		-0.86		-1.57		-0.49		-0.56	
	$Sig._{firm}$	1%		1%				1%					
	$Sig._{date}$	1%		1%				1%					
	$Sig._{firm\&date}$	1%		1%				1%					
$OIBDOL_{t-1}$	b_{large}-$b_{small}(10^9)$		-11.78		0.76		12.18		-0.091		0.42		-5.26
	$Sig._{firm}$						10%						
	$Sig._{date}$												
	$Sig._{firm\&date}$												

Table A15 Z-test for the coefficient differences between large-size companies and small-size companies based on quote returns

$z = (b_{\text{large}} - b_{\text{small}}) / \sqrt{(SE^2_{\text{large}} + SE^2_{\text{small}})}$. b_{large}-b_{small} represents the difference in the estimated coefficient between the large-size companies and the small-size companies. $Sig._{firm}$ represents the significance level of the z-statistic when SE is the firm-clustered error of the coefficient. $Sig._{date}$ represents the significance level of the z-statistic when SE is the date-clustered error of the coefficient. $Sig._{firm\&date}$ represents the significance level of the z-statistic when SE is the firm & date-clustered error of the coefficient. Numbers in shadow are the significant differences where all three z-statistics are significant at least at the 10% level.

		$QReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
1994													
$QReturn_{t-1}$	b_{large}-b_{small}	0.13	0.13	0.11	0.11	0.12	0.12	0.081	0.077	0.084	0.080	0.026	0.023
	$Sig._{firm}$	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%		
	$Sig._{date}$	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%		
	$Sig._{firm\&date}$	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%		
$OIBNUM_{t-1}$	b_{large}-$b_{small}(10^3)$	-5.57		-5.98		-6.03		-4.63		-3.05		-2.18	
	$Sig._{firm}$	1%		1%		1%		1%		5%		10%	
	$Sig._{date}$	1%		1%		1%		1%		5%		10%	
	$Sig._{firm\&date}$	1%		1%		1%		1%		10%			
$OIBDOL_{t-1}$	b_{large}-$b_{small}(10^9)$		-3.19		-2.53		-1.60		-1.60		-8.84		-6.78
	$Sig._{firm}$		1%		5%		10%		5%				
	$Sig._{date}$		1%		1%		10%		1%				
	$Sig._{firm\&date}$		1%		5%		10%		5%				
1999													
$QReturn_{t-1}$	b_{large}-b_{small}	0.055	0.055	0.066	0.053	0.076	0.063	0.050	0.053	0.0077	0.021	-0.016	-0.016
	$Sig._{firm}$			10%		1%	1%						
	$Sig._{date}$		5%	5%	10%	10%							
	$Sig._{firm\&date}$			10%		1%	1%						
$OIBNUM_{t-1}$	b_{large}-$b_{small}(10^3)$	-4.12		-3.07		-2.51		-1.20		0.65		-0.90	
	$Sig._{firm}$			1%		5%							
	$Sig._{date}$	1%		1%		5%							
	$Sig._{firm\&date}$			1%		5%		10%					
$OIBDOL_{t-1}$	b_{large}-$b_{small}(10^9)$		7.92		12.89		5.29		-12.15		0.97		-1.92
	$Sig._{firm}$								5%				
	$Sig._{date}$								5%				
	$Sig._{firm\&date}$								5%				
2002													
$QReturn_{t-1}$	b_{large}-b_{small}	0.0074	-0.039	-0.028	-0.042	-0.0077	-0.0013	0.0043	0.0086	0.023	0.029	0.025	0.020
	$Sig._{firm}$				5%								
	$Sig._{date}$			10%	1%								
	$Sig._{firm\&date}$				5%								
$OIBNUM_{t-1}$	b_{large}-$b_{small}(10^3)$	-4.52		-1.71		-0.018		-1.00		-0.24		-0.73	
	$Sig._{firm}$	1%		1%				10%					
	$Sig._{date}$	1%		1%				10%					
	$Sig._{firm\&date}$	1%		1%				10%				10%	
$OIBDOL_{t-1}$	b_{large}-$b_{small}(10^9)$		-10.45		1.41		11.70		1.40		0.99		-6.32
	$Sig._{firm}$		10%										
	$Sig._{date}$		10%										
	$Sig._{firm\&date}$		10%										

Table A16 Z-test for the coefficient differences between 1999 and 1994 and between 2002 and 1999 based on trade returns

$z_{1999-1994} = (b_{1999} - b_{1994})/\ \overline{(SE_{1999}^2 + SE_{1994}^2)}$ and $z_{2002-1999} = (b_{2002} - b_{1999})/\ \overline{(SE_{2002}^2 + SE_{1999}^2)}$. b_{1999}-b_{1994} and b_{2002}-b_{1999} represent the difference in the estimated coefficient between 1999 and 1994 and between 2002 and 1999. $Sig._{firm}$ represents the significance level of the z-statistic when SE is the firm-clustered error of the coefficient. $Sig._{date}$ represents the significance level of the z-statistic when SE is the date-clustered error of the coefficient. $Sig._{firm\&date}$ represents the significance level of the z-statistic when SE is the firm & date-clustered error of the coefficient. Numbers in shadow are the significant differences where all three z-statistics are significant at least at the 10% level.

		$TReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
1999-1994													
$TReturn_{t-1}$	b_{1999}-b_{1994}	0.15	0.18	0.18	0.20	0.17	0.19	0.15	0.17	0.13	0.13	0.0031	0.0069
	$Sig._{firm}$	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%		
	$Sig._{date}$	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%		
	$Sig._{firm\&date}$	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%		
$OIBNUM_{t-1}$	b_{1999}-b_{1994}(10^3)	4.69		3.06		1.67		0.24		-0.51		0.61	
	$Sig._{firm}$	1%		1%		1%							
	$Sig._{date}$	1%		1%		1%							
	$Sig._{firm\&date}$	1%		1%		1%							
$OIBDOL_{t-1}$	b_{1999}-b_{1994}(10^9)		9.23		7.67		9.09		3.61		2.24		1.36
	$Sig._{firm}$		1%		5%		5%		5%				
	$Sig._{date}$		1%		1%		1%						
	$Sig._{firm\&date}$		1%		5%		1%		5%				
2002-1999													
$TReturn_{t-1}$	b_{2002}-b_{1999}	0.052	0.033	0.020	0.013	0.041	0.039	0.044	0.049	0.032	0.035	-0.057	-0.060
	$Sig._{firm}$					1%	5%	1%	1%		5%	1%	1%
	$Sig._{date}$					10%	1%	5%	1%		1%	10%	10%
	$Sig._{firm\&date}$					5%	5%	1%	1%		5%	10%	5%
$OIBNUM_{t-1}$	b_{2002}-b_{1999}(10^3)	-2.05		-1.01		-0.69		-0.36		-0.30		-0.45	
	$Sig._{firm}$	1%		1%		1%							
	$Sig._{date}$	1%		1%		10%							
	$Sig._{firm\&date}$	1%		1%		1%							
$OIBDOL_{t-1}$	b_{2002}-b_{1999}(10^9)		-1.12		-0.47		0.59		-0.39		-4.45		-1.78
	$Sig._{firm}$										1%		
	$Sig._{date}$												
	$Sig._{firm\&date}$										1%		

Table A17 Z-test for the coefficient differences between 1999 and 1994 and between 2002 and 1999 based on quote returns

$z_{1999-1994} = (b_{1999} - b_{1994})/\ \overline{(SE_{1999}^2 + SE_{1994}^2)}$ and $z_{2002-1999} = (b_{2002} - b_{1999})/\ \overline{(SE_{2002}^2 + SE_{1999}^2)}$. b_{1999}-b_{1994} and b_{2002}-b_{1999} represent the difference in the estimated coefficient between 1999 and 1994 and between 2002 and 1999. $Sig._{firm}$ represents the significance level of the z-statistic when SE is the firm-clustered error of the coefficient. $Sig._{date}$ represents the significance level of the z-statistic when SE is the date-clustered error of the coefficient. $Sig._{firm\&date}$ represents the significance level of the z-statistic when SE is the firm & date-clustered error of the coefficient. Numbers in shadow are the significant differences where all three z-statistics are significant at least at the 10% level.

		$QReturn_t$											
		5 mins		10 mins		15 mins		30 mins		60 mins		Daily	
1999-1994													
$QReturn_{t-1}$	b_{1999}-b_{1994}	0.12	0.14	0.12	0.13	0.10	0.10	0.056	0.060	0.048	0.048	-0.023	-0.021
	$Sig._{firm}$	1%	1%	1%	1%	1%	1%	5%	5%	5%	5%		
	$Sig._{date}$	1%	1%	1%	1%	1%	1%	5%	1%	5%	5%		
	$Sig._{firm\&date}$	1%	1%	1%	1%	1%	1%	5%	5%	5%	5%		
$OIBNUM_{t-1}$	b_{1999}-$b_{1994}(10^3)$	-1.53		-1.59		-1.77		-1.43		-1.18		-0.42	
	$Sig._{firm}$	5%		1%		1%		5%		5%			
	$Sig._{date}$	1%		1%		1%		1%		10%			
	$Sig._{firm\&date}$	5%		5%		1%		5%		10%			
$OIBDOL_{t-1}$	b_{1999}-$b_{1994}(10^9)$		-0.0072		1.99		0.17		-0.66		-0.96		1.02
	$Sig._{firm}$												
	$Sig._{date}$												
	$Sig._{firm\&date}$												
2002-1999													
$QReturn_{t-1}$	b_{2002}-b_{1999}	0.031	0.0070	-0.015	-0.019	0.018	0.019	0.043	0.047	0.026	0.029	-0.058	-0.061
	$Sig._{firm}$							5%	5%			1%	1%
	$Sig._{date}$	5%						1%	5%			10%	10%
	$Sig._{firm\&date}$							1%	5%			10%	5%
$OIBNUM_{t-1}$	b_{2002}-$b_{1999}(10^3)$	-1.92		-0.56		-0.34		-0.30		-0.26		-0.47	
	$Sig._{firm}$	1%		10%									
	$Sig._{date}$	1%		10%									
	$Sig._{firm\&date}$	1%		10%									
$OIBDOL_{t-1}$	b_{2002}-$b_{1999}(10^9)$		-2.61		-4.19		-0.81		0.33		-0.43		-2.34
	$Sig._{firm}$												
	$Sig._{date}$												
	$Sig._{firm\&date}$												