MARKET EFFICIENCY AROUND THE ANNOUNCEMENT DAY OF SELF-TENDER OFFERS

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ABTRACT

We examine the dynamic relationship between self-tender returns, volatility and order imbalances. Since market makers care more about volatilities than inventory risk, they tend to lower the bid-ask spread to mitigate volatility. This result is different from the previous argument whereby market makers tend to raise the bid-ask spread to control inventory risk. A time-varying GARCH model also confirms the results that an order imbalance does not affect volatility during self-tender market convergency. We develop an imbalance-based trading strategy which is to buy (sell) according to whether order imbalances are positive (negative). The empirical findings support self-tender market efficiency.

JEL: G12, G14

KEYWORDS: Self Tender, Order Imbalance, Information Asymmetry, Volatility

INTRODUCTION

An extensive body of literature has developed on stock buyback programs, which mainly take the form of open-market repurchases or self-tender offers (See Comment and Jarrell, 1991; Peyer and Vermaelen, 2009; Wang et al., 2009; Liang et al., 2013; and Chen et al., 2014). Nonetheless, few studies focus on the empirical patterns of the market microstructure. For example, Coke et al. (1995) investigate the bid-ask spread surrounding open-market repurchases. Ahn et al. (2001) examine the spread around self-tender offers. Therefore, we use intraday data for self-tender offer stocks on the announcement day to explore the market efficiency.

Compared with open-market repurchases, self-tender offers have the following characteristics. First, the timing, quality, and prices of shares acquired for self-tender offers are known because they are announced in company press releases. Besides, these offers occur over a relatively short period, typically 30 days, whereas open-market repurchases can span several years. Therefore, a shorter period can avoid more confounding informational events (See Nayar et al., 2008). Second, although self-tender offers occur less frequently than open-market repurchases, self-tender offers have a greater impact on the market since they involve a substantial offer volume and premium. Therefore, more risk arbitrageurs will be attracted to become involved in the trading activities during the self-tender offer period since they have strong incentives to buy stocks and tender them back to the firm to generate profits due to the large gaps between the pre-expiration market and offer prices (See Lakonishok and Vermaelen, 1990; Covrig and Melvin, 2005). In this study, we are particularly interested in the dynamic relationships between order imbalances, volatility and returns during the process of convergence to market efficiency. Admati and Pfleiderer (1988) point out that a concentrated-trading pattern arises endogenously as a result of the strategic behavior of liquidity traders and informed traders. Their results provide a partial explanation for some of the recent empirical findings concerning the patterns of volume and price variability in intraday transaction data. In order to perform a market efficiency test, we develop an order imbalance-based trading strategy to examine whether the strategy could earn a positive return and even beat the buy and hold return for different intervals during the convergence process.

We have several marginal contributions. First of all, in the self-tender offer literature on market efficiency, the time horizons are always long-term. We use the intraday data to explore the short-term speed of convergence to market efficiency on the announcement day for self-tender offer stocks to fill this gap in the literature. Secondly, on the announcement day of the self-tender, market maker behavior plays a very

important role in mitigating volatility from discretionary trades through inventory adjustments. The remainder of our study is organized as follows. In data and methodology section, we describe the data and methods. In results section, we present the empirical results, and we provide our conclusions in section concluding comments.

LITERATURE REVIEW AND RESEARCH DEVELOPMENT

In the self-tender offer literature on market efficiency, the time horizons that are used are always long-term. For example, Lakonishok, and Vermaelen (1990) find that the market underreacts to the announcement of self-tender offers. They use a trading rule to generate a 6.18% abnormal return, which implies that the market is inefficient. Fama (1998) documents that even if the anomalies existed in the past, once the anomalies are detected and made public, they will disappear since investors will try to take advantage of them. Nonetheless, using recent data, Peyer and Vermaelen (2009) find that the arbitrage opportunity still persists. The reasons that the event is rare and that there are no professional self-tender offer arbitrageurs might explain why this anomaly has persisted during three decades. Among all the studies, to the best of our knowledge, there is no paper studying the efficiency of self-tender offers over the intraday horizon. To fill this gap in the literature, we explore the speed of convergence to market efficiency on the announcement day for self-tender offer stocks.

Althought market efficiency has been discussed for decades, we all know that in the real world prices are not efficient enough to incorporate all information. On the other hand, informed traders have a better chance to trade inside information. We use order imbalances as an indicator of the price movements since Chordia *et al.* (2002) document that the market order imbalance is highly predictable from day-to-day while returns are independent. They find that price pressures caused by autocorrelated imbalances give rise to a positive relationship between lagged imbalances and returns. Chordia *et al.* (2005) argue that order imbalances are highly positively dependent over both short and long intervals, and imbalances predict future returns only over very short intervals. They find that it takes more than five minutes but less than sixty minutes for the market to achieve weak-form efficiency. Moreover, order imbalances in the first instance arise from traders who demand immediacy for liquidity or informational needs while specialists react to initial order imbalances by shifting quotes away from fundamental value in an effort to control inventory. Finally, outside arbitrageurs intervene to add market-making capacity by conducting countervailing trades in the oppostie direction to the initial order imbalances. This arbitrage activity takes at least a few minutes since arbitrageurs have to make sure whether there is new relevant information regarding values. They indicate that efficiency does not occur immediately.

A self-tender offer is frequently viewed as a complicated signaling event. It signals a positive shock that a company perceives an undervalued stock and wants to buy back shares because they are confident they will appreciate in the future. A self-tender announcement as defined by the SDC refers to all deals for which a company announces a self-tender offer, recapitalization, or exchange offer. Comment and Jarrell (1991) document that corporate self-tender offers are associated with statistically and economically significant announcement-period excess stock returns. Dann *et al.* (1991) and Hertzel and Jain (1991) report that earnings improve following self-tender offers and that the earnings improvement is correlated with the announcement period excess stock returns, and Lie and McConnell (1998) find improvements in both earnings and earnings forecasts when firms announce repurchases. They conclude that self-tender offers signal undervaluation or improved future earnings. According to Bae and Simet (1998), stocks of leveraged recapitalization firms, on average, exhibit significant positive abnormal returns during the announcement period. Masulis (1980) reports that exchange offers that result in increases in leverage are associated with positive abnormal common stock returns. Cornett and Travlos (1989) suggest that the debt-for-stock exchange transactions lead to abnormal stock price increases, while the stock-for-debt transactions lead to abnormal stock price decreases. All of the above support the view that a self-tender signals significant good news to the market. Extant studies focus on how the market interprets the purpose of initial offer announcements but have largely ignored actual share repurchases. Wang et al. (2009) find that the market reacts positively to the events, indicating that these announcements provide additional information to that contained in the initial repurchase intention announcements.

DATA AND METHODOLOGY

We collect self-tender samples in Security Data Corporation (SDC) from January 1, 2000 to December 31, 2007. We halt the sample at 2007 to prevent the results from being contaminated by the financial crisis in 2008. In order to access intraday data, we use Trade and Automated Quotations (TAQ) to get the intra-day trade prices and volumes, bid and ask quotes, for stock on that date self-tender is announced. To be in our sample, a self-tender firm must be existed in both SDC and TAQ. We use Lee and Ready (1991) trade assignment algorithm. Any quote less than five seconds prior to the trade is ignored and the first one at least five seconds prior to the trade is retained. Since we are interested in convergence process in self-tender event, we chose three time intervals: 5 minutes, 10 minutes, and 15 minutes. We include 112 self-tender firms in our sample. The unreported results show that the average return is 1.4134%, with a median of 0.4845%. The standard deviation of return is 3.5324%, with a maximum of 14.0600% and a minimum of -5.1150%. The distribution of our sample open-to-close return is graphed in Panel A of

Figure 1: There Is 37.5% of the Return Limited Below 0%

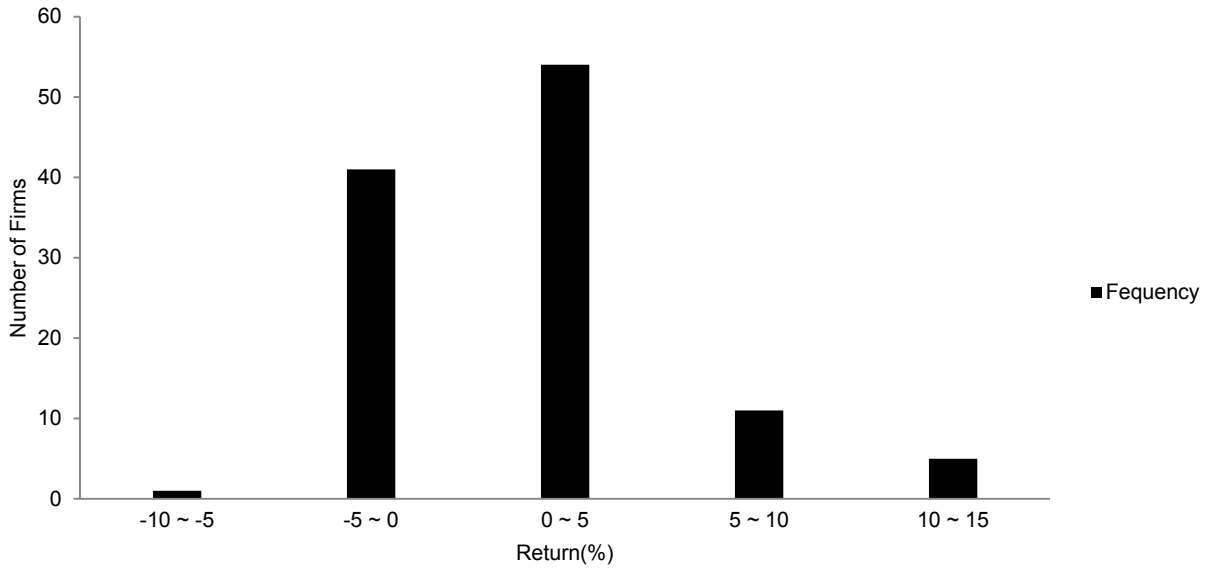

Figure 1: Distribution of Open-to-close Return This figure presents the distribution of open-to-close return. According to Chordia and Subahmanyam (2004) and Su et al. (2012), lagged imbalances are positively related to price changes. For the three different time intervals (5 minutes, 10 minutes, and 15 minutes), including five lags of imbalances, we run linear regressions on the daily returns for each self-tender stock. Specifically, we run the following regression,

$$R_t = \alpha_0 + \alpha_1 OI_{t-1} + \alpha_2 OI_{t-2} + \alpha_3 OI_{t-3} + \alpha_4 OI_{t-4} + \alpha_5 OI_{t-5} + \varepsilon_t \quad (1)$$

where R_t is the current stock return of the individual stock, OI_t are lagged order imbalance at time t of each individual stock, and ε_t is the residual of the current stock return. By using the coefficients of lagged OI and the t-statistics, we expect to find a significant positive relation between returns and lagged OI. If the explanatory power of lagged OI is significant, we should be able to employ an order imbalance based trading strategy to earn excess return. We also examine convergence process on 5-minute, 10-minute, and 15-minute intervals. We also include the contemporaneous order imbalance and four lags of order imbalance, for three different time intervals to examine conditional return-order imbalance relation.

In order to examine whether a large order imbalance has an impact on volatility, we employ a time

varying GARCH model.

$$R_t = \alpha + \varepsilon_t, \varepsilon_t \left| \Omega_{t-1} \sim N(0, h_t), h_t = A + Bh_{t-1} + C\varepsilon_{t-1}^{\ 2} + \gamma OI_t \right. \quad (2)$$

where γ is the impact of order imbalance on volatility, Ω_{t-1} is the information set in period t-1.

EMPIRICAL RESULTS

We use a multi-regression model to examine the unconditional lagged return-order imbalance OLS relation in Table 1. Chordia and Subrahmanyam (2004) argue that lagged order imbalances are positively related to returns. Since liquidity demands are autocorrelated, and imbalance in time 1 will bring a following imbalance in time 2, which leads to a positive predictive relation between imbalance and future price movements. The positive and significant percent of lagged-one imbalance at the 5% significant level are 6.3%, 1.8%, and 0.9% for 5-, 10-, and 15-min intervals respectively. The results of our empirical study show much lower prediction power than Chordia and Subrahmanyam (2004). It implies an efficient self-tender market. The total significant numbers of lagged-one present an expected decreasing pattern, which is consistent with Chordia and Subrahmanyam (2004). The positive significant numbers of lagged-one include an interlude in 10- and 15-min intervals but still show a decreasing pattern, too. However, the average coefficients of lagged-one of all intervals are negative, which is out of our expectation.

Table 1: Unconditional Lagged Return-Order Imbalance Ols Relation

	Average Coefficient	Positive	Positive And Significant	Negative And Significant
Panel A: 5-minute interval				
OI_{t-1}	-57.0**	39.33%	6.30%	6.30%
OI_{t-2}	-54.2**	39.33%	1.80%	6.30%
OI_{t-3}	-16.2	39.33%	2.70%	1.80%
OI_{t-4}	-25.2**	38.40%	0.90%	5.40%
OI_{t-5}	-28.4	43.87%	0.90%	5.40%
Panel B: 10-minute interval				
OI_{t-1}	-76.6**	41.13%	1.80%	5.40%
OI_{t-2}	-43.2*	40.20%	1.80%	1.80%
OI_{t-3}	-0.79	49.13%	3.60%	1.80%
OI_{t-4}	-6.48***	46.67%	0.90%	5.40%
OI_{t-5}	-4.19**	46.00%	0.90%	3.60%
Panel C: 15-minute interval				
OI_{t-1}	-94.2**	37.57%	0.90%	0.90%
OI_{t-2}	-40.4	47.37%	1.70%	0.90%
OI_{t-3}	-52.9*	38.47%	1.70%	1.80%
OI_{t-4}	-97.1***	42.90%	0.00%	0.00%
OI_{t-5}	-10.3	43.83%	1.70%	1.80%

This table shows the regression estimates of the equation. $R_t = \alpha_0 + \alpha_1 OI_{t-1} + \alpha_2 OI_{t-2} + \alpha_3 OI_{t-3} + \alpha_4 OI_{t-4} + \alpha_5 OI_{t-5} + \varepsilon_t$ *where R_t is the current stock return of the individual stock, and OI_t is lagged order imbalance at time t for each individual stock. Panels A, B and C present the results in 5, 10 and 15 minute interval respectively. The average coefficients are multiplied by 10^9. *, **,*** indicate significance at the 10, 5 and 1 percent levels respectively. "Significant" denotes significance at the 5% level.*

The possible explanation is as follows. Once a company announced self-tender, there must be some good news revealed to public. Before the spread of good news, discretionary investors spread their orders out over time, which causes a huge positive order imbalance. Under the heavy imbalance pressure, uninformed risk-aversed market makers, inherited by obligation, concern more about increasing price volatility than inventory risk. Instead of raising bid-ask, market makers lower it to reduce price volatility. Perotti and Rindi (2010) also find that the activity of designated market maker as information providers reduces spread and price volatility. There is likelihood that market makers have enough inventories to accommodate imbalances. According to our empirical result, market makers do a successful job in all the three intervals. A multi-regression with contemporaneous and four lagged order imbalances is performed and the results are exhibited in Table 2. For all significant levels and time intervals, contemporaneous

order imbalances are significantly positive, while most of the coefficients of lagged imbalances turn to be significantly negative, which is consistent with information overweighting theory (Chordia and Subrahmanyam, 2004). In contrast of the previous section, the positive relation between lagged imbalance and returns disappears after controlling for the contemporaneous imbalance. Because total current imbalances overweigh the impact of current trades that are autocorrelated with past trades, the price pressure induced by the lagged imbalances reverses. From 5-min to 15-min interval, the significantly positive coefficients of contemporaneous imbalance have been decreasing from 63.4 to 28.6%, respectively at the 5% significance level. We observe a self-tender market convergence to efficiency.

Table 2: Conditional Contemporaneous Return-Order Imbalance Ols Relation

	Average Coefficient	Positive	Positive And Significant	Negative And Significant
Panel A: 5-minute interval				
OI_t	411***	88.43%	63.40%	0.00%
OI_{t-1}	-65.6***	33.90%	2.70%	8.00%
OI_{t-2}	-29.3	43.87%	3.60%	8.00%
OI_{t-3}	-17.7	39.33%	0.90%	2.70%
OI_{t-4}	-0.45	45.55%	0.90%	4.50%
Panel B: 10-minute interval				
OI_t	321***	87.50%	37.50%	1.80%
OI_{t-1}	-78.6***	40.27%	2.70%	6.30%
OI_{t-2}	-18.9	50.00%	3.60%	5.40%
OI_{t-3}	7.44	48.20%	5.40%	2.70%
OI_{t-4}	-45.0	36.67%	0.90%	4.50%
Panel C: 15-minute interval				
OI_t	357***	84.80%	26.80%	1.80%
OI_{t-1}	-114***	36.67%	0.90%	6.30%
OI_{t-2}	-15.4	44.67%	2.70%	3.60%
OI_{t-3}	-9.80	43.87%	1.80%	4.50%
OI_{t-4}	-80.7*	52.73%	0.00%	1.80%

This table shows the regression estimates of the equation. $R_t = \alpha_0 + \alpha_1 OI_t + \alpha_2 OI_{t-1} + \alpha_3 OI_{t-2} + \alpha_4 OI_{t-3} + \alpha_5 OI_{t-4} + \varepsilon_t$ *where R_t is the current stock return of the individual stock, and OI_t is lagged order imbalance at time t for each individual stock. Panels A, B and C present the results in 5, 10 and 15 minute interval respectively. The average coefficients are multiplied by 10^9. ***, ** and * indicate significance at the 1, 5 and 10 percent levels respectively. "Significant" denotes significance at the 5% level.*

We examine the time varying GARCH relation between volatility and order imbalance in Table 3. The intuition is that the larger the order imbalance is, the higher is the volatility. However, the imbalance impact on volatility is not as strong as we have expected. At the 5% significant level, the pattern degenerates, only 9%, 0%, and 2% of order imbalances for 5-, 10-, and 15-min interval respectively.

Table 3: Dynamic Volatility-Order Imbalance GARCH(1,1) Relation

	Average Coefficient	Percent Positive and Significant	Percent Negative and Significant
5-min interval	0.140***	9.00%	0.00%
10-min interval	0.130***	0.00%	0.00%
15-min interval	0.140***	2.00%	0.00%

This table shows the regression estimates of the equation. $R_t = \alpha + \varepsilon_t, \varepsilon_t | \Omega_{t-1} \sim N(0, h_t), h_t = A + Bh_{t-1} + C\varepsilon_{t-1}^2 + \gamma OI_t$ *where R_t is the return in period t, and is defined as $\ln(P_t/P_{t-1})$, OI_t is the explanatory variable, order imbalance, γ is the coefficient describing the impact of order imbalance on stock volatility, ε_t is the residual value of the stock return in period t, Ω_{t-1} is the information set in period t-1. ***, ** and * indicate significance at the 1, 5 and 10 percent levels respectively. "Significant" denotes significant at the 5% level.*

An insignificant relation between order imbalance and volatility implies that market makers mitigate self-tender volatility. They have sufficient inventories on hand to stabilize market. Even trading on self-tender announcement, discretionary investors are incapable of affecting stock prices dramatically. Within a short time interval of 15 minutes, imbalances fade away. Market makers gain control the stability of self-tender market. We develop an imbalance based trading strategy to test self-tender market. Given the significantly positive relation between the contemporaneous order imbalance and returns, we form an intra-day trading strategy based on the sign of order imbalance. We utilize only 10% of the largest imbalance for the three different time intervals on the assumption that larger imbalances tend to correlate on positive returns. For each stock, we long a share at ask when a positive imbalance appears,

and sell a share when negative. There are chances that no trade happens in samples. We trade on basis of trade price in Panel A of Table 4. We earn a daily return of 1.32%, 0.90%, and 1.20% respectively for 5-, 10-, and 15-min intervals. The p-value from Z test is reported in Panel A of Table 4. We find that imbalance strategy on trade price earns significantly positive return at all significant levels.

Table 4: Trading Profit under the Imbalance Based Trading Strategy

Panel A: Returns Compared With Zero		
	Mean	P-value
5-min return strategy	0.0132***	0.0001
10-min return strategy	0.0090***	0.0069
15-min return strategy	0.0120***	0.0025
Panel B: Returns Compared With Returns of Buy-and-Hold Strategy		
	Mean	P-value
5-min return strategy	0.0132	0.4416
10-min return strategy	0.0090*	0.0821
15-min return strategy	0.0120	0.1936

Panel C: Differences in returns among the three intervals			
P-value	5-min return	10-min return	15-min return
5-min return			
10-min return	0.0218		
15-min return	0.1381	0.2638	

*This table presents the hypothesis test of trading profit under the imbalance based trading strategy. Panel A shows whether the profits under the 5-, 10-, and 15-min intervals are positive. Panel B exhibits whether the strategies under the 5-, 10-, and 15-min intervals can beat the buy-and-hold strategies (i.e., the original open-to-close return). Panel C investigates the differences of returns among the three intervals. ***, ** and * indicate significance at the 1, 5 and 10 percent levels respectively.*

We take a further step to perform a paired t-test to examine whether imbalance strategy on trade price is able to beat open-to-close. The p-values in Panel B show 0.4416, 0.0821, and 0.1936 respectively for 5-, 10-, and 15-min intervals. It implies that imbalance strategy is not capable of beating the original open-to-close return, either. The last question is which interval earns most. The p-values of the paired t-test in Panel C exhibit 0.1381, 0.0218, and 0.2638 respectively. It indicates that there exists a significant difference between 5-min and 10-min interval. In summary, only imbalance strategy on trade price shows a significant positive return. The reason is that a trade price is always between bid price and ask price, causing less bid-ask spread corroding. However, imbalance profit fades away during the convergence process.

CONCLUDING COMMENTS

In this study, we explore dynamic relation between order imbalance, volatility and return of self-tender market during convergence process. We use self-tender firm instead of open-market repurchase because self-tender offer is usually associated with large price and a shorter period that offer occurs can avoid more confounding informational events. Therefore, more risk arbitrageurs will involve in the trading since they have strong incentives to buy stocks and tender them back to the firm to generate profits due to the large gaps between the pre-expiration market and offer prices. In the self-tender offer literature on market efficiency, the time horizons that are used are always long-term. We use the intraday data to explore the short-term speed of convergence to market efficiency on the announcement day for self-tender offer stocks to fill this gap in the literature. We collect self-tender samples in SDC database from January 1, 2000 to December 31, 2007. 112 self-tender firms are included in our sample. From the conditional lagged return-order imbalance OLS model, we find that the relation between returns and lagged-one imbalances are negative at all the intervals, indicating that market makers mitigate volatility in market making. A positive relation between contemporaneous order imbalance and return in our study is consistent with Chordia and Subrahmanyam (2004). Among the intervals, we observe an apparent declining pattern as the interval increases during the convergency. We develop an imbalance trading strategy. The strategy earns a positive return, while trading strategy based on trade prices doesn't reject the null hypothesis for excess return. The above findings have important implications for market regulators. Since there exists the strategy which could earn a positive return on the announcement day of self-tender offers, investors who got inside information illegally might be involved. Therefore, the efforts

that regulators expend on monitoring security market in self-tender seem important. Lakonishok and Vermaelen (1990) find that the market underreacts to the announcements of self-tender offers. A trading rule they implement involves buying shares 6 days prior to the expiration of the offer and selling 12 days after the expiration date at the then prevailing market price. In the 25-year sample period, this rule generated a 6.18% abnormal return. Peyer and Vermaelen (2009) consider no good reasons to explain the anomaly except the event is rare and no professional repurchase tender offer arbitrageurs exist. How the anomaly exists around the expiration and on the announcement day in self-tender offers seems to be a worthwhile area for further research.

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