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EVIDENCE ON THE SPEED OF CONVERGENCE TO MARKET EFFICIENCY: EVIDENCE FROM STOCK SPIN-OFFS

Han-Ching Huang, Chung Yuan Christian University
Yong-Chern Su, National Taiwan University
Chun-E Shih, National Taiwan University

ABSTRACT

We use order imbalance to investigate dynamic relations among intraday return, volatility and order imbalance of stock spinoffs. A GARCH model is employed to examine whether the larger order imbalance is associated with larger stock price volatility. We do not find a significant positive relation between them, which implies that market makers do a successful job of mitigating volatility on spinoffs. Moreover, we develop imbalance-based trading strategies and find they can beat open-to-close returns only in the 5-minutes time interval.

JEL: G14, G34

KEYWORDS: Spin-off, Order Imbalance, Market Efficiency, Volatility

INTRODUCTION

In recent decades, many diversified firms have gone back to basics by focusing on their core business. A spinoff, defined as a pro-rata distribution of a share of the subsidiary to the original parent's stockholders, is a common way to sharpen focus. The majority of studies document significant positive abnormal stock returns around spinoff announcements (See Cusatis et al. 1993; Krishnaswami and Subramaniam, 1999; Mulherin and Boone, 2000; Huson and MacKinnon, 2003; Maxwell and Rao, 2003; and Son and Crabtree, 2011). Many papers also present evidence that spinoffs increase long-run shareholder value (e.g. Burch and Nanda, 2003; Ahn and Denis, 2004; Kim et al., 2008; Lin and Yung, 2013; Jordan et al., 2014). The above studies use daily data to explore the abnormal returns. To our knowledge, no existing study that explores the behavior of market microstructure on the announcement day of a spinoff. In this study, we use intraday transactions to examine convergence in spin-off market efficiency. We explore whether lagged stock order imbalances could be used to predict stock returns. According to Charoenwong et al. (2008), prior to the spinoff announcement, trading could be mainly initiated by insiders. Nonetheless, trading on the announcement day could be mainly initiated by uninformed traders, who could only trade the stocks after hearing the announcement day news.

We employ a time-varying GARCH model to examine whether larger stock price volatility is positively associated with larger order imbalance. We develop an imbalance-based trading strategy, which is to buy the stock at the ask price just when the positive imbalance appears, and to sell the stock once the negative imbalance appears.

This paper makes several contributions. First, on the announcement day of the spin-off, market makers can mitigate volatility from discretionary trades through inventory adjustments. Second, we investigate the relationship between order imbalances and returns as we explore the intraday dynamics that are essential in

the convergence process of the spin-off announcement. The remainder of the paper is organized as follows. In the next section, we present a literature review. The following section provide a discussion of the data and methodology used. Next, we present the study results and close with some concluding comments.

LITERATURE REVIEW

The literature presents several explanations of the value gains to spinoffs (short-run stock abnormal return or long-run shareholder value). First, parent firms divest unrelated divisions to sharpen their core business competence (Daley et al. 1997; Desai and Jain, 1999). Second, the management team of the parent enjoys increasing managerial efficiency, reducing potential misallocation of investment, improving operating performance, and eliminating negative synergies to mitigate the information asymmetry between managers and investors by allowing more accurate estimation of firm value (Schipper and Smith, 1983; Ahn and Denis, 2004). Third, the wealth gains associated with spinoffs result from the correction of a prior mistake, which was an unprofitable earlier acquisition. A spinoff represents the undoing of that unwise takeover (Allen et al., 1995). In addition, transfer of wealth from bondholders to shareholders (Veld and Veld-Merkoulova, 2004; Veld and Veld-Merkoulova, 2008), relaxing tax and regulatory burdens (Schipper and Smith, 1983), facilitation of a merger or takeover (Cusatis et al., 1993) and sending positive signals to the stock market (Kunz and Rosa-Majhensek, 2008) also explain gains to parent firms following spinoffs.

If someone is capable of earning profit in spinoff, it implies that the spinoff market is not efficient enough to respond the arrival of relevant new information. Nonetheless, as all investors engage in diversified investment behavior, the market will converge toward efficiency gradually. How does the market converge to efficiency? Chordia et al. (2005) interpret convergence based on individual actions. First, order imbalances arise from traders who demand immediacy for liquidity or informational needs. These order imbalances are positively auto-correlated, suggesting that traders are either herding or spreading their orders over time, or both. Second, NYSE specialists react to initial order imbalances by altering quotes away from fundamental value in an effort to control inventory. Finally, outside arbitragers intervene to add market-making capacity by performing countervailing trades in the opposite direction. This arbitrage activity takes at least a few minutes since arbitragers must ascertain whether or not there is new relevant information regarding values.

Chordia et al. (2005) indicate that efficiency does not happen immediately since order imbalances can predict future returns over very short intervals. They find it takes more than five minutes but less than sixty minutes for the market to achieve weak-form efficiency. Visaltanachoti and Yang (2010) also find that, on average, it takes 30-60 minutes for a foreign stock listed on the NYSE to achieve market efficiency. For a comparable US stock, it takes only 10-15 minutes. Moreover, Chordia et al. (2005) report that there is little evidence of unconditional serial dependence on returns since no t-statistic exceeds 2.0 in absolute value and thirteen of the fifteen t-statistics are less than 1.0 in absolute value. This suggests that these stocks conform well to weak-form efficiency; that is to say, using only the past history of returns, there is little, if any, predictability of future returns even over intervals as short as five minutes.

DATA AND METHODOLOGY

We identify spinoffs from Securities Data Corporation (SDC). We use Trades and Automated Quotations (TAQ) to obtain intraday transactions that include bid and ask prices and trading prices as well as trading size in consolidate trades database from 9:30 AM to 4:00 PM on announcement dates of spinoffs. We remove the beginning of day observations that include lagged terms from the previous trading day to avoid generating spurious results. Samples range from January 1, 1994 through December 31, 2005 because NYSE TAQ initiated intraday dataset in 1994. We collect stock prices and outstanding shares in announcement years from the Center for Research in Security Prices (CRSP). Seventy-three firms are included in our sample.

We apply Lee and Ready's (1991) algorithm on each transaction in 5-minute, 10-minute and 15-minute time intervals. The unreported results show that the mean return is -0.21%, with a median of 0% and standard deviation is 3.44%. The skewness of daily returns is 0.1654 and the kurtosis is 7.4787. These figures imply that the distribution is positively skewed and leptokurtic. Average market capitalization of the sample is 23.6350 billion and the median is 5.4059 billion. We examine the regression of return-order imbalance relation as follow:

$$R_t = \alpha + \varepsilon_t \qquad \varepsilon_t \,|\Omega_{t-1} \sim N(0, h_t) \qquad h_t = A_1 + B_1 h_{t-1} + C_1 \varepsilon_{t-1}^2 + D_1 OI_t \qquad (1)$$

where R_t is the return in period t, defined as $(P_t - P_{t-1})/P_{t-1,}$ OI_t is the explanatory variable, order imbalance, ε_t equals the residual of the stock return in period t, h_t is the conditional variance in the period t, and Ω_{t-1} is the information set in period t-1.

Chordia and Subrahmanyam (2004) document a positive relation between current return and current order imbalances and a negative relation between current return and lagged order imbalance after controlling for the current imbalance because of "information over-weighting" from market makers. We expect a positively predictive power between return and lagged order imbalances in spinoffs. After controlling for the current imbalance, we expect that a positive sign of contemporaneous imbalances and the positive relation between lagged imbalance and returns disappears.

To examine dynamic volatility-order imbalance in convergence, we employ a time-varying GARCH model as follows:

$$R_t = \alpha + \varepsilon_t \qquad \varepsilon_t \,|\Omega_{t-1} \sim N(0, h_t) \qquad h_t = A_1 + B_1 h_{t-1} + C_1 \varepsilon_{t-1}^2 + D_1 OI_t \qquad (2)$$

where R_t is the return in period t, defined as $(P_t - P_{t-1})/P_{t-1,}$ OI_t is the explanatory variable, order imbalance, ε_t equals the residual of the stock return in period t, h_t is the conditional variance in the period t, and Ω_{t-1} is the information set in period t-1.

Dynamic volatility-order imbalance relation is another focus in our study. Intuitively, the higher volatility is positively associated with the higher order imbalance. A spinoff is not an exception.

RESULTS AND DISCUSSION

Table 1 shows the positive and significant coefficients on lag one order imbalance under time intervals of 5-minute, 10-minute and 15-minute. At the 5% significance level, the positively and significant percentages for lagged-one imbalances are 4.11%, 5.48%, and 6.85%, respectively. This finding implies an efficient spinoff market on convergence. Previous studies argue a positive abnormal return for parent firms at spinoff announcements (Schipper and Smith, 1983).

When firms announce spinoffs, information spreads out during convergence. Discretionary traders actively split their large orders at announcement. To accommodate large imbalances from discretionary investors, market makers raise inventory levels to mitigate volatility at the announcement. Market makers successfully use sufficient inventory to conduct countervailing transaction against informed traders at spinoff announcements.

In Table 2, we find 9.59%, 8.22%, and 10.96% of lagged-one imbalance are negatively significant under different time interval of 5 minutes, 10 minutes and 15 minutes at 5% significance level and the average lag-one coefficients are positive. We argue that market makers, inheriting a responsibility to mitigate volatility at a spinoff announcement, gradually increase imperceptible bid and ask prices with large positive

order imbalance pressure within a 5 and 10 minutes period since discretionary traders keep placing large orders. Nonetheless, perceiving decay of large imbalances from discretionary traders, market makers start to lower bid-ask spreads. The result shows a negative return-lagged one order imbalance relation within a 15-minute time interval. Thus, the 15-minute interval is the best interval for market makers to mitigate volatility.

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}	3.1358	58.90%	4.11%	6.85%
OI_{t-2}	-3.3657	43.84%	6.85%	8.22%
OI_{t-3}	3.4476	57.53%	9.59%	6.85%
OI_{t-4}	-0.8808	46.58%	2.74%	1.37%
OI_{t-5}	1.0839	45.21%	1.37%	6.85%
Panel B: 10-minute Interval				
OI_{t-1}	-2.3254	36.99%	5.48%	6.85%
OI_{t-2}	5.4016	50.68%	8.22%	1.37%
OI_{t-3}	-6.5821	28.77%	4.11%	5.48%
OI_{t-4}	-4.3265	38.36%	5.48%	2.74%
OI_{t-5}	0.6592	36.99%	1.37%	8.22%
Panel C: 15-minute Interval				
OI_{t-1}	4.6263	50.68%	6.85%	1.37%
OI_{t-2}	-6.1272	36.99%	2.74%	9.59%
OI_{t-3}	-2.7114	39.73%	1.37%	2.74%
OI_{t-4}	-1.6110	39.73%	1.37%	2.74%
OI_{t-5}	-3.7464	46.58%	1.37%	1.37%

*This table shows 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.*

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	13.4858	94.52%	67.12%	0.00%
OI_{t-1}	1.2657	53.42%	4.11%	9.59%
OI_{t-2}	-3.1376	38.36%	6.85%	10.96%
OI_{t-3}	3.5498	54.79%	6.85%	5.48%
OI_{t-4}	-1.1139	42.47%	5.48%	2.74%
Panel B: 10-minute Interval				
OI_t	16.7854	95.89%	45.21%	0.00%
OI_{t-1}	1.3831	46.58%	4.11%	8.22%
OI_{t-2}	3.9911	53.42%	8.22%	0.00%
OI_{t-3}	-3.8365	35.62%	1.37%	8.22%
OI_{t-4}	-2.2692	43.84%	8.22%	1.37%
Panel C: 15-minute Interval				
OI_t	14.6301	90.41%	39.73%	0.00%
OI_{t-1}	-3.7516	38.36%	9.59%	10.96%
OI_{t-2}	-5.0414	34.25%	1.37%	6.85%
OI_{t-3}	-2.4110	41.10%	0.00%	5.48%
OI_{t-4}	0.2419	47.95%	1.37%	1.37%

*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. *, **,*** indicate significance at the 10, 5 and 1 percent levels respectively. "Significant" denotes significance at the 5% level.*

Table 3 exhibits a dynamic volatility-order imbalance relation from a time-varying GARCH model. We observe that either the percentage of significantly positive or negative coefficients is less than 5% for all significance levels in three different time intervals. The empirical results reject a significantly positive relationship between volatility and order imbalance on convergence. Apparently, market makers have done a successful job in mitigating volatility from large imbalances. Market makers are reluctant to adjust bid-ask spreads to accommodate discretionary orders. We find that market makers have good power to stabilize the market at spinoffs.

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

	Average Coefficient	Percent Positive and Significant	Percent Negative and Significant
5-min interval	-67.8	4.11%	0.00%
10-min interval	-0.73	1.37%	0.00%
15-min interval	65.7	2.74%	1.37%

This table shows regression estimates of the equation: $R_t = \alpha + \varepsilon_t$ *,* $\varepsilon_t \square \Omega_{t-1} \sim N(0, h_t)$, $h_t = A + Bh_{t-1} + C\varepsilon_{t-1}^2 + \gamma * OI_t$ *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. All coefficients are multiplied by* 10^4.

Based on previous empirical results, we develop an intraday imbalance-based trading strategy to beat the market. We trim 90% of small order imbalances in each day under three time intervals because larger imbalances have a more substantial impact on returns. For each stock, we buy the share at the ask price just when the positive imbalance appears, and sell the share once the negative imbalance appears. The trading strategies are built on quote price or trade price. In Panel A of Table 4, we find that returns of imbalance-based trading strategy for 5-, 10- and 15-minute time intervals are -0.74%, -1.04%, and -0.87%, respectively. The returns of imbalance-based trading strategy on quote price are significantly negative at the 1 % significant level. We use paired t-tests to examine whether the return from a trading strategy is higher than the open-to-close return on the announcement day of spinoff. Panel B shows the return of trading strategies for the 10-minute interval is significantly lower than an open-to-close return. Panel C shows that there is no significant difference among three different time intervals at the 10 % significant level.

Table 4: Returns of Imbalance-Based Trading Strategy Based on Quote Price

Panel A: Returns Compared with Zero			
			P-value
5-min return strategy			0.0013
10-min return strategy			0.0001
15-min return strategy			0.0001
Panel B: Returns Compared with Returns of Buy-and-hold Strategy			
	Mean Original	**Open-to-close Return**	**P-value**
5-min return strategy	-0.0074	-0.0021	0.0530
10-min return strategy	-0.0104	-0.0021	0.0093
15-min return strategy	-0.0087	-0.0021	0.2602
Panel C: Differences in Returns among the Three Intervals			
P-value	**5-min Return**	**10-min Return**	**15-min Return**
10-min return	0.1508		
15-min return	0.5932	0.1897	

This table shows trading profits under the quoted price. For each stock, we buy the share at the ask price just when the positive imbalance appears, and sell the share once the negative imbalance appears. Panel A presents the p-values to be used to examine whether the return of imbalance-based trading strategy is positive. Panel B shows the p-values to be used to explore whether the return of imbalance-based trading strategy is higher than open-to-close return on spinoffs. Panel C exhibits the p-values to be used to examine whether there is no difference in return of the strategy among three different time intervals.

Table 5 shows the returns of an imbalance-based trading strategy on the basis of trade price. Panel A shows the return for 5-minute intervals is 0.76%, which is significantly positive and higher than the return on a

buy-and-hold strategy at the 1 % significant level. However, returns for 10- and 15-minute intervals are not significant at the 10 % significant level. Panel B, shows the return of imbalance-based trading strategy for 5-minute intervals successfully beat the market at the 1 % significant level. Panel C shows there are significant differences between 5 and 10 minutes as well as 5 and 15 minutes at the 1 % significant level.

CONCLUDING COMMENTS

Previous studies argue that information asymmetry problems between managers and investors is alleviated or exacerbated after the spinoff. They examine whether the spinoff event provides any information to lead traders to earn abnormal excess return around the announcement periods. However, if someone can earn profit at spinoff, it implies the spinoff market is not efficient enough to respond to the arrival of new information. Therefore, we use order imbalance as an indicator of insiders trading information in this study. We examine dynamic relationships between order imbalance, volatility and return of spinoffs on the announcement date. We also develop an imbalance-based trading strategy to test convergence to market efficiency of spinoffs.

We examine the unconditional return-order imbalance regression relation based on Chordia and Subrahmanyam (2004). Our empirical results provide an insignificant positive relation between current stock returns and lagged order imbalances, which is inconsistent with Chordia and Subrahmanyam (2004). We investigate conditional contemporaneous return-order imbalance relation. We document a positive contemporaneous return-order imbalance relation for three different time intervals, which is consistent with Chordia and Subrahmanyam (2004). Further, we use a time-varying GARCH model to examine whether the larger order imbalance is positively associated with greater stock price volatility. Our empirical study indicates no strong positive relationship between them. We believe that market makers have good power to stabilize the market through inventory adjustments. Finally, we develop an imbalance-based trading strategy on the basis of quote and trading prices. Only returns on trades priced in the 5-minute interval could beat open-to-close returns. Thus, the spinoff market is not efficient in the 5-minute interval.

This paper focuses on the impact of stock order imbalances on stock returns of spinoffs. Because the investors also trade options of underlying stocks, future research should examine the influence of option order imbalances on stock returns of spinoffs.

Table 5: The Returns of Imbalance-Based Trading Strategy Based on Trade Price

Panel A: Returns Compared with Zero				
			P-value	
5-min Return of strategy		0.0027		
10-min Return of strategy		0.3053		
15-min Return of strategy		0.4930		
Panel B: Returns Compared with Returns of buy-and-hold Strategy				
	Mean	**Original**	**open-to-close Return**	**P-value**
5-min return strategy		0.0076	-0.0021	0.0006
10-min return strategy		0.0007	-0.0021	0.1990
15-min return strategy		0.0002	-0.0021	0.2602
Panel C: Differences in Returns among the Three Intervals				
P-value	**5-min Return**		**10-min Return**	**15-min Return**
10-min return	0.0013			
15-min return	0.0013		0.4799	

This table shows trading profits under the trade price. For each stock, we buy the share at the ask price just when a positive imbalance appears, and sell it once a negative imbalance appears. Panel A presents p-values to examine whether the return of imbalance-based trading strategy is positive. Panel B shows the p-values to explore whether the return of imbalance-based trading strategy is higher than open-to-close return on spinoffs. Panel C exhibits the p-values to examine whether there is no difference in return of the strategy among three different time intervals.

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BIOGRAPHY

Han-Ching Huang is Associate Professor of Finance and Director of International Master of Business Administration at the Chung Yuan Christian University. His research appears in journals such as Journal of Banking and Finance, Pacific Basin Finance Journal, Investment Analysts Journal, and Applied Economics. He can be reached at Chung Yuan Christian University, 200, Chung Pei Road, Chung Li District, Taoyuan City, Taiwan, 32023, samprass@cycu.edu.tw.

Yong-Chern Su is Professor of Finance at National Taiwan University. His research appears in journals such as Journal of Banking and Finance, Pacific Basin Finance Journal, Investment Analysts Journal, and Applied Economics. He can be reached at National Taiwan University, 50 Lane 144 Sec. 4, Keelung Road, Taipei, Taiwan, ycsu@ntu.edu.tw.

Chun-E Shih is Master of Finance at National Taiwan University. She can be reached at National Taiwan University, 50 Lane 144 Sec. 4, Keelung Road, Taipei, Taiwan, r96723052@ntu.edu.tw.