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The Stock Investment Strategy at Company Acquisition

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Abstract: Recent studies in Accounting, Industrial Organizations and Finance often incorporate efficient market hypothesis in event studies. Event studies can be used to examine how changes in company environment affect corporate finance. However, using short-term stock prices to examine mean reversion may face a problem. Specifically, there is no evidence that changes in market values are unbiased estimates of changes in fundamentals. This study adopts program trading to test the mean reversion of an acquisition event (SPIL and ASE Group) between 2015 and 2016 in Taiwan. The results show that investors can use RSI spread and stock price deviation to make abnormal returns. In other words, investors can make profits based on technical analyses. Therefore, the evidence suggests that between 2015 and 2016, the security market in Taiwan did not fully meet the condition of a semi-strong form efficient market.

Keywords: Mean reversion, Program trading, Granger Casualty Test, Efficient market, Acquisition

1. Introduction

In recent years, activist shareholders play an important role in company mergers and acquisitions (M&A). According to Thomson Reuters' report, activist shareholders have direct impacts on over half of the top 10 M&A deals in 2015, with transactions over US$26 billion. Activist shareholders usually buy in companies with slow growth and large amount of cash and companies that they have held around 7%-8% of shareholdings. Activist shareholders will try to gain a board seat to affect company strategies and seek for outside takeover targets. Past studies typically show that companies being intervened by activist shareholders have better stock price performance.

In Taiwan, the ASE Group is the global top number one company in IC packaging and testing. The Group announced on 21 August 2015 to publicly acquire 24.99% shareholdings of SPIL, the global top number three company in the same industry, at a premium price of $45 per share between 24 August 2015 and 30 September 2015. The ASE Group stressed that it would not get involved in SPIL's business operations or in its board of directors. The acquisition would be purely for financial investment purposes. The acquisition announcement was a shock to the semiconductor industry. SPIL deemed that the ASE Group was faking its investment purpose and believed that the final aim of ASE Group was to take over the control of SPIL. SPIL refused to negotiate with ASE Group and planned to use private placement with Hon Hai. However, the proposal was rejected at the interim meeting of shareholders. SPIL later also attempted to seek investment by Tsinghua Unigroup but due to the political issues between Taiwan and China, the cooperation between SPIL and Tsinghua Unigroup failed.

On 14 December 2015, ASE Group filed for the acquisition of SPIL's stocks for the second time and aimed to increase its shareholdings from 24.99% to 49.71%. ASE Group had announced that this time it was a hostile takeover. Acquisitions for the same company twice were rarely seen in Taiwan's securities market. The market estimated that the acquisition would cost ASE Group $7.8 billion. Such a large amount was also rare in Taiwan market.

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According to FSC's report, foreign institutional investors had increased their investments in Taiwan. In contrast, up till the end of March 2015, individual investors in the market had dropped to around 50% compared to the high of 60%-70% in the past. Credit trading also reduced by $37.2 billion compared to the same period data last year. The report showed that individual investors were running away from the market due to information asymmetry. Individual investors had high stock turnover rate. The aim of this study is therefore to use behavioral finance to help individual investors make correct investment strategies so that stock prices can reflect accurately. Hopefully, the Taiwan securities market can turn into a stable mature market away from the current thin market.

This study examines this issue from the industry development and stock investment perspectives and proposes investment strategies in the conclusion. The organization of this paper is as follows. The literature review is provided in Section 2. In Section 3, we discuss the methods used, including event study, Granger causality model and program trading. Descriptions of the data and the results are provided in Section 4 and 5, respectively. A conclusion is provided in Section 6.

2. Literature review

Since the 1980s, more and more empirical studies have found market anomalies due to investors' cognitive bias. Some typical investment behaviour includes availability bias, representative bias, anchoring effect bias and framing dependence bias. In addition, investors are characterized by over-confidence, loss aversion, and regret avoidance and disposition effect. As a result, investors often conduct trades by following noises in the market or adopt positive feedback trading. Positive feedback trading is caused by herd trading behaviour, extrapolation expectation and technical analysis. Murphy (1986) suggests that technical analysis is a typical example of positive feedback trading strategy.

Early studies such as Shleifer (1979) and LeRoy and Porter (1981) find excessive price movements of speculative assets. That is, the market over-reacts. This phenomenon contradicts with the efficient market hypothesis. De Bondt and Thaler (1985, 1987) find that stocks do not always win or always lose. Based on a sample of NYSE listed stocks between 1926 and 1982, they find evidence of investor overreaction. Fama and French (1988) also report that overreacted price will return to its long-term trend. Porterba and Summer (1988) use variance ratio test to examine the market return in the US between 1871 and 1986 and in other 17 countries between 1957 and 1985. Their results all show positive autocorrelation in short-term market returns and negative autocorrelation in the long-term. De Long, Shleifer, Summers and Waldmann (1990) suggest that noise traders will cause overreaction. When the price goes too high or too low, it will make correction in the opposite direction. Therefore, the long-term returns will have negative autocorrelation. Cutler, Poterba and Summers (1991) find that short-term stock returns of less than one year have positive autocorrelation. This shows that price does not reflect all the information initially until later. Daniel, Hirsheifer and Subrahmanyam (1998) (i.e., DHS model) develop a model for investor behaviour from the information perspective. Uninformed investors suffer from judgement bias while informed investors suffer from over-confidence and excessive self-preference. Therefore, as investors react to public information, we will see continuity in short-term returns and long-term reversion. Barberis, Shleifer and Vishny (1998) argue that because investors do not realize that the real returns of risky assets follow random walk, investors often over react or react insufficiently.

Thaler (1992) proposes a way of testing the size of losers' short-term price reversion and risk volatility. If the price of one stock rise or fall by 10%, it is unlikely that the objective risk will have such a large volatility. Therefore, mean reversion can be observed in a very short-term period. It is less likely to be caused by size or objective risk. Bremer and Sweeney (1988) examine the short-term price changes and find that the pattern of returns in one day is very similar to the finding reported by Brown and Van Harlow (1988) on long-term winners and losers.

Event studies can be used to analyses how changes in company environment affect finance. The focus is on the changes in stock prices before and after the news is announced. Thaler (1992) believes that changes in market value are caused by changes in fundamentals. For example, when company A purchases company B, the market increases by 10%. To test if this estimate is unbiased, we can test if the price is correct five years later. Prices have large variations, and there is no one correct method for testing this hypothesis. Hence, this study proposes a new testing method. Using a quantitative model and optimized program trading, we incorporate efficient market hypothesis in the event study method and use a two-stage test to look for a stable investment strategy. This study tests if investors can enhance its

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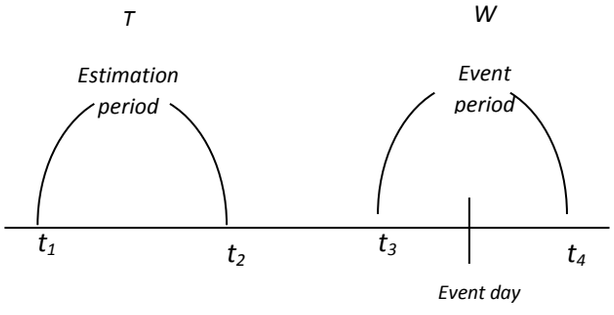
investment efficiency based on the mean reversion feature in stock prices. In other words, when the technical analysis shows a diversion in stock price and index and investors use the positive feedback trading model to enhance their profits, we can prove that stock prices are characterized by mean reversion.

3. Research Methods

3.1 Event Study

Following the paper of Binder (1998), which introduced the development history of event study methodology, this study uses the classic event study to examine how M&A announcement affects stock prices. We use the announcement date provided in Taiwan Economic Journal (TEJ) database and use GARCH to conduct abnormal returns test. The following defines the timing for event study:



t：time　T：Estimation period　W：Event period

Estimated returns of the market model is as follows:

$$R_t = \alpha + \beta R_{mt} + \varepsilon_t$$

where R_t: Stock returns at time t; R_{mt}: Market return on day t

$$\hat{\varepsilon}_t \left| \Omega_{t-1} \right. \sim N(0, h_t)$$

Expected value of the error term, ε_t, is zero. The conditional variance in the GARCH (1,1) case is,

$$h_t = d_0 + d_1 \varepsilon_{t-1}^2 + d_2 h_{t-1}$$

with $d_0>0$, $d_1>0$, $d_2>0$, and $d_1+d_2<1$. Abnormal returns (ARs) during the event period is as follows:

$$AR_t = R_t - \hat{R}_t$$

where $R_t = \log(P_t / P_{t-1})$; P is the stock price.

Cumulative abnormal returns (CARs) is calculated as follows：

$$CAR = \sum_{t=t_3}^{t_4} AR_t$$

As the acquisition example in this study has a trading restriction after the announcement, we use the 30 day before and after the acquisition announcement date (21 August 2015) as the event period. That is, a total of 61 days. This study examines if AR and CAR are significantly different from zero. The 200 trading days for the estimation period which covers September 11, 2014 to July 10, 2015.uses the Taiwan Stock Exchange Capitalization Weighted Stock Index (hereafter TAIEX) as the baseline.

3.2 Vector Auto regression (VAR) Model

Adopting the model of Sims (1980), this model can be used to ensure that all variables in the model have causal relationship and can avoid the recognition problem when estimating traditional simultaneous structural equations. The variables in the vector auto regression model in econometrics are lagged variables of itself and other variables. Besides,

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single variable auto regression can be extended as multi-variable vector auto regression. All variables are endogenous. Therefore, they can be used to predict a relevant time series system and the dynamic impact on this system by random noises. In this study, the three variables (the stock prices of SPIL and ASE Group and their price spread) in the model are y_{1t}, y_{2t}, y_{3t}. Variable in time t is formed by the variable in the prior time k and error term. Therefore, the following shows VAR (1) (i.e., k = 1) as an example:

$$\begin{aligned} y_{1t} &= m_1 + a_{11}y_{1,t-1} + a_{12}y_{2,t-1} + a_{13}y_{3,t-1} + \varepsilon_{1t} \\ y_{2t} &= m_2 + a_{21}y_{1,t-1} + a_{22}y_{2,t-1} + a_{23}y_{3,t-1} + \varepsilon_{2t} \\ y_{3t} &= m_3 + a_{31}y_{1,t-1} + a_{32}y_{2,t-1} + a_{33}y_{3,t-1} + \varepsilon_{3t} \end{aligned} \quad (1)$$

where $E(\varepsilon_t) = 0, \forall t, E(\varepsilon_t \varepsilon_s^{'}) = \begin{cases} \Omega, s = t \\ 0, s \neq t \end{cases}, \Omega = E(\varepsilon_t \varepsilon_t^{'})$, the error term ε_t is white noise; m is the constant, a is the coefficient and Ω is the positive definite variable and covariance matrix. That is, the error terms ε_t can be correlated at the same period but cannot be correlated to its lagged period or the variables at the right-hand side of the equation.

3.3 Granger Causality Model

To analyse how variables are related and whether an endogenous variable can be treated as an exogenous variable, Granger (1969, 1988) proposes a causality test and the two variables model contains only the stock price of SPIL and the price spread of SPIL and ASR Group are used in this study. This model tests if the coefficients of current y series (the stock price of SPIL) and the past values of x series (the price spread of SPIL and ASR Group) have causal relationship. In other words, whether the past values of x can explain the present values of y. By adding a lagged value of x we test if it can increase the degree of explanation, or the correlation coefficient of x and y are statistically significant. If it is the case, then we can conclude that y (the stock price of SPIL) is Granger caused by x (the price spread of SPIL and ASR Group).

If the series do not have the property of unit root, the causality relationship can be tested using the following model:

$$\begin{aligned} Y_{t1} &= \delta_0 + \sum_{i=1}^{m} \delta_i Y_{t1-i} + \sum_{i=1}^{m} \gamma_i Y_{t2-i} + \varepsilon_t \\ Y_{t2} &= \lambda_0 + \sum_{i=1}^{n} \lambda_i Y_{t2-i} + \sum_{i=1}^{n} \omega_i Y_{t1-i} + \nu_t \end{aligned} \quad (2)$$

where ε_t and ν_t in Equation (2) are white noise error terms. m and n are the optimal lag periods based on SC's minimum value. The null hypothesis is $\gamma = 0, \omega = 0$. If $\gamma \neq 0, \omega = 0$, we can conclude that Y_2 (the price spread of SPIL and ASR Group) has a Granger lead on Y_1 (the stock price of SPIL) and that it can be treated as an exogenous variable. The alternative hypothesis is that Y_1 has a Granger lead on Y_2. If both γ and ω are not equal to 0, this means that there is bidirectional causality relationship and the stock price of SPIL and the price spread of SPIL and ASR Group are endogenous of each other.

3.4. Experimental Design and Estimation Method

The experiment used in this study incorporates two models. Model one has only one set of data (data1), which includes the original estimated acquiring firm price at higher end. Model two is based on Williams' (1999) program trading design. To increase the trading performance, apart from data1, another set of data (i.e., the price spread of acquiring and acquired firm) is used as a filter. To ensure the fairness in evaluation, the models are estimated based on the following trading strategies. That is, apart from data1 (i.e., the higher price-end of acquiring firm price) and data2 (i.e., the price spread of SPIL and ASE Group is used as an index. The technical analysis of diversion trading strategy[2] in program trading design is as follows:

1. The index uses RSI oscillators. Data1 is the price of acquired firm, SPIL.
2. Calculate the price spread of Two M&A Companies as the index. That is, the stock price of data2 minus the stock price of data3 times 100.

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3. When up to nine K bars goes above 70 (or below 30) and the values of RSI are twice above 70 (or below 30), this can be included. In addition, when the price touches the low (or high) point of the K bar, the strategy is to sell (or buy).

This study uses MultiCharts program trading to conduct back-testing of the first stage (2015.01.01~2015.08.03). The optimal coefficient that occurs when we have up to nine K bars and RSI that is above 70 (or below 30) is brought into stage two (2015.01.01~2016.02.03) to estimate the Taiwan stock market. Therefore, we can see if technical analysis can enhance trading profits by incorporating the price spread of M&A companies.

4. Data

This study tests if including the price spread of SPIL and ASE Group can enhance the trading profit. The intraday data used include SPIL and ASE Group 60-min trading price obtained from XQ database. To ensure that the baseline of the model can be more accurate, the data is divided into two groups. One has a shorter learning period (7 months); the other has a longer learning period (9 months). Both starts from the date 1 January 2015; that is, six months before ASE Group announced to acquire SPIL. To carry out the experiment, the first stage includes 1240 sample points and starts from 1 January 2015 to 3 August 2015. Note that the second group ends in October. The second stage includes 2580 sample points and starts from 1 January 2015 to 3 February 2016. We apply the optimized simulated parameters from the first stage in the second stage. The above data are all calculated at level except for those original data that is I (1). These need to be differentiated and represented by D. In addition, all models assume a transaction cost of 1% of the stock price.

5. Results

5.1 Abnormal Returns after the takeover announcement

5.1.1 SPIL's price reaction to takeover announcement

Figure 1 and 2 shows the AR and CAR based on GARCH model. The results show that after the takeover announcement (21 August) the average AR reaches 13.08% and 22 days after the announcement, the average CAR is still positive (0.5366%). In contrast, 29 days before the announcement date, there is a negative AR of -14.2192%. This might show that the market does not reflect the information in advance. After the spin-off announcement, the AR is positive, suggesting that the market believes that the spin-off is good for the company and affirm the ASE Group's acquisition strategies. After ASE Group makes the takeover announcement, SPIL's stock price rises from $33.5 to $36.85 (representing a 10% rise). Up till 14 December, SPIL's stock price remains at $45.55. The Figure shows that SPIL's stock price has positive excess abnormal returns.

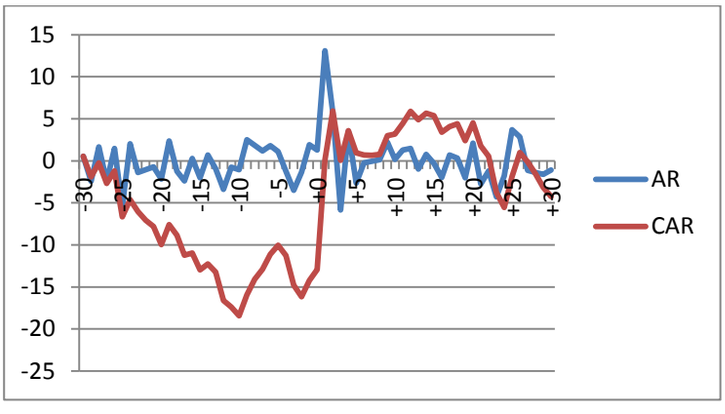

Figure 1: AR and CAR of SPIL around takeover announcement

5.1.2 ASE Group's price reaction to takeover announcement

In contrast, when ASE Group releases the takeover announcement, the stock price rises from $30 to $31.8 (showing a 6% increase). However, on the next day, the average AR is only moderate at 11.07%. The third day after the takeover announcement, the average CAR becomes negative at -5.6435%. Up till 14 December, the price of ASE Group remains at $33.4. Figure 2 show that the stock price of ASE Group has weaker positive excess abnormal return.

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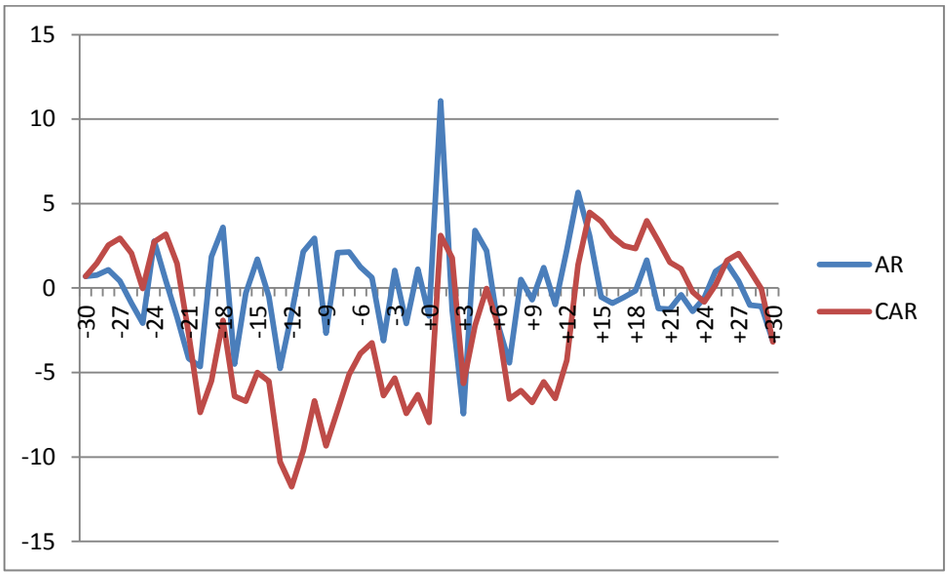

Figure 2: AR and CAR of ASE Group around takeover announcement

5.2. Unit Root Test of Sample Data

To ensure the validity of empirical results, we need to ensure that the series are stationary when testing the causality relationships. Only when the time series level of two variables are the same (that is, I(D)), there exists a counteraction relationship. Hence, we use ADF unit root test to ensure that the 60-min data of SPIL, ASE Group and price spread are stationary. The results are presented in Table 1 as follows:

Table 1: Unit root test of Granger model variables

Variables / Model	Constant (C)	Trend (T) and Constant (C)	No time trend (T) and constant (C)
N2325	-2.6087(0)*	-2.3314(0)	0.0956(0)
D(N2325)	-51.3756(0)***	-51.3972(0)***	-51.3823(0)***
N2311	-2.1435(0)	-2.1634(0)	-0.5520(0)
D(N2311)	-55.2526(0)***	-55.2536(0)***	-53.2489(0)***
N2511	-2.0663(0)	-2.0888(0)	-0.3253(0)
D(N2511)	-54.2230(0)***	-54.2241(0)***	-54.2257(0)***

Note: According to Mackinnon (1991), *, **, and ** shows significance at 1%, 5% and 10% level, respectively. C, T, and L represent the constant, time trend and lagged period. D2325, D2311 and D2511 represent the 60-min data of SPIL, ASE Group and price spread, respectively. D denotes differentiated data and N denotes the original level data.

The original level data includes the 60-min SPIL, ASE Group and price spread. Based on the test of lagged period with minimum SIC, most cannot reject the null hypothesis. The results suggest that the variables are not stationary as most financial data have fat tails and the time series data are characterized by autocorrelation. Hence, after taking the first difference, the series are stationary and satisfy the condition of counteraction. Therefore, we can then proceed with Granger causality test.

5.3. Estimation Results of VAR Model

This section examines the causality relationship between SPIL's 60-min stock price and price spread. The causality relationship of VAR model shows that only the price spread leads SPIL's 60-min price data for one period.

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Table 2: VAR estimation results of SPIL's stock price and price spread

	D2325	D2511
D2325(-1)	-0.020090	-1.129807
	(0.02601)	(2.58212)
	[-0.77230]	[-0.43755]
D2511(-1)	-0.000430	-0.058459
	(0.00026)	(0.02600)
	[-1.64096]	[-2.24872]
C	0.006612	0.401635
	(0.00784)	(0.77855)
	[0.84306]	[0.51588]
Determinant reside covariance (dof adj.)		142.0773
Determinant reside covariance		141.7468
Log likelihood		-13701.81
Akaike information criterion		10.63445
Schwarz criterion		10.64808

Table 3: Granger causality relationship between the price spread and SPIL's stock price

Dependent variable: D2325			
Excluded	Chi-sq	df	Prob.
D2511	2.692739	1	0.1008
All	2.692739	1	0.1008
Dependent variable: D2511			
Excluded	Chi-sq	df	Prob.
D2325	0.191450	1	0.6617
All	0.191450	1	0.6617

5.4. Granger Causality Test of SPIL's stock price and price spread

This section examines the Granger causality relationship between the 60-min price spread (D2511) and SPIL's 60-min stock price (D2325). The results show that when lagging one period, the two variables have one direction Granger causality relationship as shown in Table 3. In other words, the price spared is the Granger cause of SPIL. Therefore, in the next section, we will include these two variables in the model and use program trading to conduct back-testing to see their effects on trading performance.

5.5. Evaluating the effect of SPIL's stock price and adding price spread information on trading performance

This section first examines Model 1 where investors have SPIL's stock market price and trades only based on RSI's price volume diversion technical analysis. For the shorter training period (7 months, between 2015.1.1~2015.8.3~2016.2.3), we find that applying the optimal simulated parameter to the second stage does not increase trading period. The profit is $15 for both stages. For the longer training period (9 months,

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2015.1.1~2015.10.3~2016.2.3), the simulated result shows that the profit has increased slightly to $15.95 (around 5%). In other words, past information may not be used to make profits. Therefore, an efficient market exists.

Table 4: Total trading analysis of Model 1 at first and second stage

Period	2015.1.1~2015.8.3~2016.2.3		2015.1.1~2015.10.3~2016.2.3	
Stage	Stage I	Stage II	Stage I	Stage II
Winning probability (No. of trade/ successful trades)	66%(3/2)	66%(3/2)	44%(9/4)	45%(11/6)
Net profit	15	15	15.2	15.95

The results from Model 2 where the price spread of acquiring and acquired firms is included shows that for the shorter learning period net profit at the second stage greatly increases. The net profit doubles and increases from $9.2 to $18.7. For the longer learning period, the simulated result also shows that the profit increases from $26.65 at the first stage to $31.9 at the second stage. There is a 20% increase. Therefore, the evidence suggests that including the price spread information and using the characteristic of mean reversion, investors can make profits based on past information and technical analysis. An efficient market thus does not exist.

Table 5: Total trading analysis of Model 2 at first and second stage

Period	2015.1.1~2015.8.3~2016.2.3		2015.1.1~2015.10.3~2016.2.3	
Stage	Stage I	Stage II	Stage I	Stage II
Winning probability (No. of trade/ successful trades)	50%(2/1)	66%(3/2)	80%(5/4)	50%(10/5)
Net profit	9.2	18.7	26.65	31.9

6. Conclusion

Tests of efficient market hypothesis often adopt the event study methodology especially in the areas of Accounting, Industrial Organizations and Finance. Event studies can be used to examine how changes in the company environment affect corporate finance. However, there may be a problem when using short-term stock prices to test the mean reversion. That is, there is no evidence that changes in market value are unbiased estimates of changes in fundamentals. This study adopts to use program trading simulation to examine the mean reversion feature of price spread between acquiring and acquired firms. The evidence shows that an efficient market does not exist. Investors can use RSI price spread and stock price deviation to make excess abnormal returns. Furthermore, the result of this research is consistent with the issue of overconfidence, such as: the Daniel et al. (1998) model (DHS model) which explains reversal using overconfidence and the Barberis et al. (1998) model (BSV model) which accounts for both momentum and reversal and is based on the anchoring and representativeness heuristics and is worth consulting the trading tactic.

Specifically, using 1240 (or 1280) trading samples (i.e., 60-min intraday data) between 1 January 2015 and 3 August 2015 (or 3 October 2015) as the first stage data and using 2580 trading sample between 1 January 2015 and 3 February 2016 as the second stage data, this study analyses whether incorporating the price of SPIL and price spread between acquiring and acquired firms in the program trading can lead to trading profits. The results show that incorporating the price spread information in the shorter learning period (2015.1.1~2015.8.3~2016.2.3) model, the simulated profits increase dramatically from $9.2 in the first stage to $18.7 in the second stage. Results from the longer learning period (2015.1.1~2015.10.3~2016.2.3) model also show a dramatic increase in trading profits from $26.65 to $31.9 (i.e., a

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20% increase). Overall, the evidence suggests that trading strategies based on technical analyses with price spread information and the mean reversion feature can lead to profits. The results show that between 2015 and 2016, the security market in Taiwan did not meet the condition of a weak-form efficient market. Due to the space and time limit, future research could use other M&A cases in Taiwan to conduct optimal back-testing and run the simulation.

Notes

- Commercial Times (2015/12/24): "ASE Group acquires SPIL for the second time: Foreign institutional investors believe that there are four main advantages."
- When the price makes a new high (or a new low) but the index does not.

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