The Investment Strategy When Having a Breach of Tender Offer: A Case Study of Taiwan's Online Game Companies

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Abstract

Having robust investment in the financial market has been the objective of many investors. However, as the financial markets in developing countries are not well established, the first-ever settlement default in tender offer happened in Taiwan securities market in August 2016. The Japanese company, Bai Chi Gan Tou, failed to pay for the acquisition.

This study uses the contrary investment strategy suggested by Kestner (2003) to analyze 1150 daily trading data of XPEC Entertainment, a major online game company in Taiwan, during the period 1 January 2012 to 1 September 2016. Based on the program trading simulation of 100-day mean reversion trading performance after price diversion and fourteen online game companies as the investment portfolio, the trading profit is $86, showing an increase of 10.92%, and exceeds the stock market index by 4.85%.

This study further tests the Granger causality, chooses the bellwether stock, X-Legend Entertainment, and uses the technical analysis to examine the mean reversion after price diversion based on program trading. The optimal coefficient from the first stage is extended and used in the second stage to obtain trading profits of $905.59, an increase of 115.03%. The resulting performance is better than that based on Kestner's (2003) trading strategy. Therefore, the empirical evidence suggests that latter approach can help make stable profits in the versatile online game stock markets and that the Taiwan online game stock market does not fulfill an efficient market condition. In conclusion, this study finds evidence supporting our hypothesis that the information of bellwether stock and price mean reversion characteristic can be used to enhance trading performance in the stock market.

Keywords: *mean reversion; program trading; Granger casualty test; online game; efficient market*

1. Introduction

Bai Chi Gan Tou Digital Entertainment is an overseas foreign company registered in British Virgin Islands and allowed to establish in Taiwan on 29 September 2014 with a capital of $50 million. In 2015, Bai Chi Gan Tou purchased about 5.4% of XPEC Entertainment's stocks(Note 1). XPEC Entertainment intensively issued convertible bonds (of $2 billion) on the 1st and 2nd of March 2016. The convertible price was set at around $73.8~$75.1. Later, on 31 May 2016, Bai Chi Gan Tou announced to acquire 38000 stocks of XPEC Entertainment at $128 per share. The total acquisition amount was $4.864 billion. Bai Chi Gan Tou expected to acquire 25.71% of XPEC Entertainment's stocks.

The stock price of XPEC Entertainment was at $105 when the acquisition announcement was made. In other words, Bai Chi Gan Tou paid a premium of 22% in acquisition and attracted many investors. After the lock-up period, the trading volume soared to 14,816,000 shares on 1 June. After the acquisition was approved by the Investment Commission on 25 July, the trading volume rocketed to 15,355,000 shares, which was 5.6 times of the monthly average. The last day for selling stocks was on 19 August. However, Bai Chi Gan Tou made an announcement on 22 August that due to administration delay, the settlement payment of $4.864 billion would be delayed to 31 August. However, on the day (30 August) that XPEC Entertainment had an interim meeting of shareholders, Bai Chi Gan Tou announced that it would not complete the deal. This was the first tender offer with malice that resulted in a settlement

default. The stock price of XPEC Entertainment had failed consecutively for seven days since 8 September to a low of $37.5. Compared to the peak price, the stock price had fallen by 2/3 causing significant losses to stockholders.

During the acquisition period, the stock price of XPEC Entertainment had once reached as high as $115.5 on 25 July. However, the issue of convertible bonds and the tender offer by Bai Chi Gan Tou had been timed so precisely that the vulture was able to speculate the stock price higher based on the tender offer issue. Investors who had converted their bond holdings to stocks were able to sell their stocks at high prices and make huge profits. Suspiciously, the three convertible bonds issued by XPEC Entertainment were held by the few particular persons. Whether the holders of convertible bonds were related to the malice default settlements was still under investigation by the Financial Supervisory Commission (FSC). According to Taiwan's legislation on tender offers, the takeover conditions could be decided by the acquiring firm. Stockholders could also decide whether to sell their holdings. Once the tender offer exceeded the buying thresholds and the FSC had approved the acquisition, the takeover should succeed and there was no reason for Bai Chi Gan Tou to use rumors or price volatility as a reason to withdraw the acquisition.(Note 2)

In addition, during the tender offer of XPEC Entertainment, the company's stock had been short sold by many people. Prior to the lock-up period on 1 June and on 25 July, short-selling of XPEC Entertainment's stocks soared to 2,798,000 shares. The stock price also reached its peak. During late May and early August, the number of short-selling stocks was more than ten thousands shares. Stockholders sold their shares to the public investors and the latter's funds were tied-up when stock prices fell while short-sellers and holders of convertible bonds earned enormous profits of at least $2 billion. The correlation coefficient between the stock price of XPEC Entertainment and the stock index of online game companies is 0.73. It shows high correlation between the two. The trends of XPEC Entertainment's stock price and trading volume during the period between 27 January 2016 and 2 September 2016 are shown in the following chart.

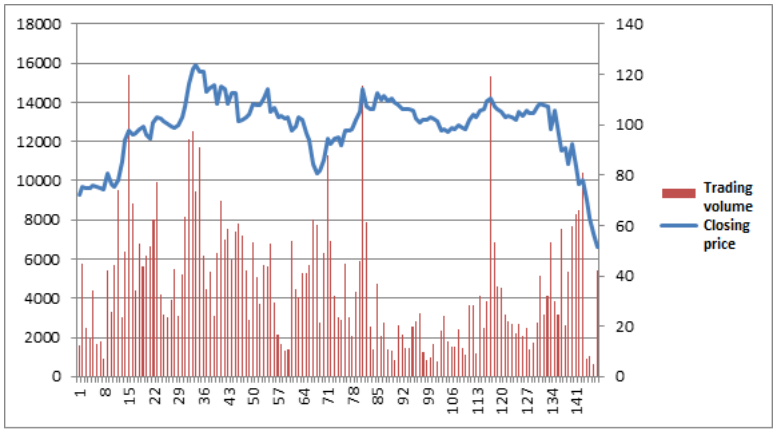

Figure 1. The Trends of XPEC Entertainment's Stock Price and Trading Volume

Based on the statistics reported by FSC, in August 2016, individual investors in the market had dropped to less than 50%. As individual investors faced higher information asymmetry and were likely to trace high and sell at low, they mostly made investment losses. Therefore, how to utilize behavior finance theory to help individual investors develop appropriate investment strategies are crucial. This study is motivated to propose profitable investment strategies based on the case study of tender offer failure of XPEC Entertainment and market investment point of view. The paper is structured as follows. The second section provides literature review. The third section discusses the Granger causality theory model and estimation method based on program trading. Section 4 then provides data source and Section 5 provides empirical results and analyses. Lastly, a conclusion is provided in Section 6.

2. Literature Review

How to predict the market direction has been a hot issue among the financial market. Fama (1965) suggests that the trend in stock market is random; that is, the market is efficient. Based on this theory, Bachelier (1990) proposes a random walk theory and suggests that stock price volatility is consistent with the Brownian motion in Physics. Later, from modern Economics, Samulson (1965) suggests that stock prices are unpredictable if the anticipations of all market participants and information are included. Fama (1970) then sums up the past relevant research and formally

proposes the efficient market hypothesis. The efficient market hypothesis (EMH) of Fama (1965, 1970) classifies the market into three categories. First, a weak form efficient market. It is where the current stock price has completely reflected past stock price information and investors cannot use past information to make abnormal profits. Secondly, a semi-strong form efficient market. It is where the stock price has reflected public information about company's future prospects and investors cannot make abnormal profits based on past stock price information or current public information. Thirdly, a strong form efficient market. It is where the stock price has reflected all information about the company including information possessed by insiders. Investors cannot make abnormal returns based on insider information. In other words, the efficient market hypothesis believes that all market participants are "rational". When making strategies, investors aim to be most efficient and make unbiased estimates and reactions based on market information. Influenced by this, the neoclassical economists, Lucas (1972) who proposes the rational expectation theory and Morton (1973) who proposes the asset pricing theory, have become the main school of thoughts.

However, due to investors' cognitive bias, Tversky and Kahneman (1973) find that people are not able to extract all relevant information from past memory and they tend to believe that events that can be easily remembered are events that happen very often. Also, when evaluating the probability of an event, people often over rely on the experience of similar events; that is, representativeness heuristics, anchoring effect bias, confirmation bias and context dependence. Due to investors' psychological characteristics, investors have some typical investment behavior. For example, Shefrin and Statman (1994) find that people are often over confident in themselves and think that they are correct, thereby resulting in overconfidence, ambiguity aversion, loss aversion, regret aversion, home bias, disposition effect and herd effect. Therefore, the behavior finance theory suggests that investors are "bounded rational". Since 1980, there are more and more evidence of market anomalies, such as fundamental data anomaly, equity premium puzzle, closed-end mutual fund puzzle, momentum effect, momentum effect, reversal effect, calendar effect, book-to-market effect, size effect, overreaction effect and underreaction effect. These anomalies all suggest that the market is inefficient.

Black (1986) formally proposes the concept of noise trading. Noise traders are random and unpredictable to the market and contribute risks to asset pricing. Sheifer (1997) argues that due to limits of arbitrage, rational trading is not able to push the stock price back to its basic value. Thus, the diversion of stock price from its basic value may persistently exist. In addition, there exists irrational traders following the positive feedback. The positive feedback leads to herd behavior in trading, extrapolation expectation and technical analysis. In particular, the herd behavior commonly exists in financial behavior. Due to information uncertainty, investors' behavior is often affected by other investors. Investors do not think independently but to mimic other's strategies. As herd behavior relates to many individual investors' behavior. It has great impact on the stability and efficiency of the market. Lakonishok et al. (1992) use 769 US stock funds during 1985-1989 and find that as small companies have less public information, fund managers often observe other mangers' trading behavior when trading small company's stocks. Froot et al. (1994) suggest that institutional investors are highly homogeneous as they adopt similar data source, economic model, investment portfolio and hedging strategies. Therefore, the strategies of financial analysts also have herd effect. In addition, Trueman (1994) and Grinblatt et al. (1995) find herd behavior among financial analysts and mutual fund investment. Werners (1999) examines the mutual funds between 1975 and 1994 and finds that stocks that have been commonly purchased by mutual funds have better same-period and lag-period returns than those that have been commonly sold by mutual funds. Therefore, Werners (1999) believes that the herd trading behavior of mutual funds is rational and helps speed up the reflection of information in stock prices, thereby stabilizing the market.

However, Kim and Wei (1999) show that QFIIs adopt positive feedback strategy in Korea's market, causing more volatility in emerging market. Shiller (2002) believes that due to financial fraud, investors may face with bubble effect. This is also a phenomenon of herd behavior. In sum, as humans are colonial animals, and the market is highly uncertain with incomplete information, mimicking other investors' strategies can reduce the information collection costs. Investors can also shirk the responsibility to others if they make investment loss.

In addition, there exist anomalies in the financial markets and possible improvements in raising efficiencies. Shiller (1979) reports that the prices of speculative assets are overly volatile and there is an overreaction effect. This evidence contradicts with the concept of market efficiency and allows rooms for trading profits from contrary investment strategy. Basu (1977) examines the relationship between P/E ratio and investment returns of NYSE listed companies between 1957 and 1971 and finds that firms in the high P/E ratio group have average yearly return of 9.3% while firms in the low P/E ratio group have average yearly return of 16.3%. The results show that contrary investment strategy can lead to trading profits. Following Fama's (1965) research method, French et al. (1986) analyze all listed companies in the U.S. between 1963 and 1982 and find that there is a low but significantly negative

correlation in daily stock prices.

Using data from NYSE listed companies between 1926 and 1982, DeBondt and Thaler (1985, 1987) show that overreactions do exist in the market. The return of "losing group" (which consists of 35 worst performing stocks in past three years) is 8% higher in yearly average than that of "winning group" (which consists of 35 best performing stocks in the past three years) and is 25% higher in three-year returns. Poterba and Summers (1988) employ variance ratio test to examine the market returns in the US market between 1871 and 1986 and seventeen other countries between 1957 and 1985. Their results show positive correlation in short-term stock returns and negative autocorrelation in long-term returns. Fama and French (1988) test the mean reversion effect by examining the stock price variation of NYSE listed companies between 1926 and 1985. They find that 3~5 year stock market returns are negatively autocorrelated. About 25% to 40% of the results can be predicted based on past profit predictions. The result suggests that price overreaction will recover in the long-run. The evidence suggests that overreacted price will return to its mean value especially for small sized companies. The prediction rate for small companies is 40% and 24% for large companies.

De Long et al. (1990) suggest that noise trading will cause overreactions. If the asset price rises too high or falls too low, an inverse correction is likely. As a result, there is a negative autocorrelation in long-run returns. Cutler, Poterba and Summers (1991) find negative autocorrelations in 3~5 year stock market returns. The evidence suggests that price under-reacts initially and corrects gradually. Bremer and Sweeney (1991) examine Fortune 500 companies between July 1962 and December 1986. Stocks whose prices vary by more than 7.5%, 10% and 15% are all included in the sample. After following these stocks for 20 days, they find that for losers, the returns are 2.84%, 3.95% and 6.18% five days later. On the other hand, there is no abnormal profit for winners. In other words, there is significant correction for losers while no correction for winners. The degree of correction increases with the initial price variation.

Lakonishok et al. (1994) further test the contrary investment strategy of NYSE and AMEX listed companies between 1968 and 1990. They find that the stock portfolio with low P/E ratio has higher returns than the portfolio with high P/E ratio. Also, the portfolio with high P/BV ratio has lower return than that of low P/BV ratio. The result suggests that low P/BV stocks have lower risks. Furthermore, the portfolio with high P/CF stocks has lower returns than low P/CF stocks. The former has average yearly return of 9.1% for five holding years while the latter's average yearly return is 20.1%. Hackel et al. (1996) also examine the relationship between P/CF and investment returns for NYSE listed companies between 1980 and 1994. After classifying the sample into five groups based on P/E ratio, they find that the average yearly return of S&P 500 is 4.1% and the return is 19.2% for the lowest P/E ratio group. Similarly, O'Shaughnessy (1996) reports that contrary investment strategy can be profitable. Based on a sample of 50 low P/S NYSE listed companies between 1951 and 1993, they find that the return of these stocks is 16.01% while the return of stocks whose market value is 1.5 times of a basket of stocks is 12.81%. Kestner (2003) uses stocks, interest rate, exchange rate, option, swap and futures to calculate the standard deviation between closing price and 100 moving average deviation. Based on the mean reversion feature, they find that investors can beat the overall market if they buy in when the 100-day static is lower than -2.5 and sell out when the 100-day static is higher than 2.5. One weakness in this paper is that the standard for choosing financial products is too subjective.

Therefore, in this study we propose a new testing method and trading strategy. First, we use Granger causality test to choose the target stock. Then, we use the mean reversion of two types of stock price deviation to examine the market efficiency hypothesis. In other words, we test if investors can pick bellwether stock to enhance investment efficiency based on mean reversion feature of stocks. Therefore, the hypothesis tested in this study is: *after using the information of bellwether stock, investors can enhance their trading performance based on the mean reversion characteristic.*

3. Methods

3.1 VAR and Granger Causality Model and Estimation Methods

This study follows the methods used in Lan et al. (2014 and 2015) and adopts Sims (1980) factor autoregression model. The variables in the model are a function of its lag estimates and lag estimates of other factors. They can be used to predict the time series and the dynamic impacts of random noises on the series. This study uses X-Legend Entertainment (stock ID 4994) as the base variable and UserJoy Technology (stock ID 3546) as the companion company. There is causality relationship between variables. Hence, in the following sections, X-Legend Entertainment is used as the base variable and the two variables in the model are P4994 (X-Legend Entertainment)

and P9446 (the price difference between X-Legend Entertainment and UserJoy Technology). The variables y_{1t}, y_{2t} at time t are composed of variables in the prior time k and error term. Using VAR(1) (i.e., k = 1) as an example, the model is follows:

$$P4994_t = \alpha_1 + a_{11}P4994_{t-1} + a_{12}P9446_{t-1} + \varepsilon_{1t}$$

$$P9446_t = \alpha_2 + a_{21}P4994_{t-1} + a_{22}P9446_{t-1} + \varepsilon_{2t}$$

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; α is the constant, a is the coefficient and Ω is the positive definite variable and covariance matrix. That is, the error term ε_t can be same period correlated but cannot be correlated with its lagged estimates or variables on the right-hand side of the function. From here, we develop the causality test.

In addition, as the economic theory does not yet have a final conclusion on the relationship between stock price and price difference, the causality test analysis developed by Granger (1969, 1988) can help examine the relation between the two. That is, we can examine whether a causal relationship exists between current period price difference (P9446) and past value of P4994 values (X-Legend Entertainment). That is, we want to examine the degree to which the past value of P4994 can be used to explain the spot value of P9446. That is, if adding the lagged value of P4994 can increase the explainability or the correlation coefficient of P4994 and P9446 is statistically significant, the result then suggests that P9446 is the Granger cause of P4994.

3.2 Experimental Design and Estimation Methods

Traditionally, there are two research methods in financial behaviour. One is the structural equation modelling (SEM). SEM aims to find a theoretical method based on the observing data. However, this method requires careful questionnaire design and a large scale of survey. This method can present the data in a scientific model, test various theories and conduct hypothesis testing. It is a comprehensive statistical analysis technique.

The other method is to use an experiment. Its advantage is low risk and cost. The method can save the cost of revising theory and policy. The data can be controlled and repeatedly tested. The experimental method has the most potential in the behavioural finance research field. To reduce the bias from experimental environmental design and the perception of the subject about the experiment, this study includes two models in the experiments. Model 1 includes only one set of data (data1), which is the stock price of the company. According to Kestner's (2003) contrary investment strategy, this study is based on the mean reversion feature of 100-day and 10-day moving average deviation. The optimal trading strategy in this study allows for 100-day and 10-day moving average to increase by 10% in the simulation zone to see if the returns can beat the overall market.

Model 2 is classified into Model 2A and Model 2B based on the program trading concept in Williams (1999). In addition to the original company stock price (data1), we add an additional dataset, the corresponding company's price difference as the filter. The model in this study is estimated based on the following trading strategies. In other words, Model 2A not only considers the base company data1 (X-Legend Entertainment) but also the price difference between data2 (X-Legend Entertainment) and its corresponding company (data3, an online game company). The diversion trading(Note 3) based on technical analysis in program trading is designed as follows:

Calculate the price difference between X-Legend and the online game company: Data2 (price of X-Legend Entertainment) minuses data3 (stock price of an online game company) and times 100 to obtain RSI (i.e., the oscillators) of this study.

1. When RSI is above 70 (or below 30) within nine K bars and it happens at least two times, it is then included. If the closing price reaches a new high (or low) within nine K bars but RSI does not, this value of K bar is noted down. In the future, if the stock price touches this low (or high) point of the K bar, the strategy is to sell (or buy).
2. Model 2B and Model 2A are basically the same except that the base company (data1) changes from X-Legend Entertainment to UserJoy Technology. Also, the price difference between data2 (UserJoy Technology) and its corresponding company (an online game company) is considered.

In addition, this study uses MultiCharts program trading to do backtesting in two stages. The trading performance in optimal conditions are compared. The optimal simulated coefficient (including up to nine K bars and RSI above 70 (or below 30)) from the program are then substituted into the second stage which involves estimating the Taiwan

stock market. By doing so, we can determine if trading performance can be enhanced by using the technical analysis and the price difference between two companies.

4. Data

As the price of XPEC Entertainment and online game stock index are highly correlated with correlation coefficient of 0.73. This study aims to find out if including the price difference of X-Legend Entertainment (as an example) and an online game company as one of the variable in the model can enhance the trading profit in the securities market. The daily price data used include X-Legend Entertainment and online game companies, which are obtained from TEJ database. Two models are developed for the experiments. Model 1 includes the online game stock index (A909) from the date that it first released (1 January 2012) to date (1 September 2016). To ensure equal distribution in the experimental design, this study uses data from 2012.1.1~2014.1.1 (i.e., 1150 sample points) as the first stage and data from 2012.1.1~2016.9.1. (i.e., 1150 sample points) as the second stage. The experimental method is to use the optimized simulated parameters obtained from the first stage in the second stage.

As for Model 2A and Model 2B, the data and method are the same as above except that Model 1 only considers one price variation (i.e., individual online game company) while Model 2 adds a price difference variable. All data mentioned above are calculated at level except for those original data that is I(1). These need to be differentiated and symbolized by D. Also, a transaction cost in the model is about 1% of the average price of online game companies over the entire period.

Based on the XQ database, this study uses fourteen online game companies, including Gametower (stock ID 3293), Softstar (stock ID 6111), Soft-world (stock ID 5478), UserJoy (stock ID 3546), XPEC Entertainment (stock ID 3662), X-Legend Entertainment (stock ID 4994), Macrowell (stock ID 3687), Chinesegamer (stock ID 3083), Astro Group (stock IP 3064), Wasabii (stock ID 4946), InterServ (stock ID 6169), Gamania Digital Entertainment (stock ID 6180), Yes168 (stock ID 3086), Foxconn (stock ID 2354).

5. Empirical Results

5.1 Returns from Kestner's Contrary Investment Strategy

Table 1. The Returns of Model 1's Contrary Investment Strategy

	2012.1.1-2014.1.1			2012.1.1-2016.9.1		
Stock ID	Net Profit	Trading No.	Winning Prob.	Net Profit	Trading No.	Winning Prob.
3293	0	0	0	-	-	-
6111	6.65	1	100	-	-	-
5478	9.78	1	100	-11.38	4	50
3546	20.61	2	100	21.66	7	57
3662	52.36	2	100	-	-	-
4994	67.38	1	100	162.75	11	63
3687	49.86	4	100	97.06	7	85
3083	17.13	1	100	35.14	3	100
3064	3.38	1	100	12.12	4	75
4946	2.38	1	100	-	-	-
6169	0	0	0	-	-	-
6180	0	0	0	-	-	-
3086	0	0	0	-	-	-
2354	4.48	1	100	2.66	2	50

Note: Company names for each stock ID is provided in Section 4.

Model 1 is based on Kestner's (2004) best performance of 100-day contrary investment strategy in his new ideal market investment portfolio. Using the mean reversion feature in daily closing price and 100-day moving average, this study attempts to obtain an optimal trading strategy than can beat the overall market. Model 1 allows the current day and 100-day moving average day numbers to increase by 10% of the simulation period. The results are shown in Table 1. Table 1 shows that the returns of five companies in the second stage have increased. If the investment portfolio includes 14 online game companies, the opening price is $787.2. The profit of the investment portfolio during the period 2014.1.1~2016.9.1 is $86, which has increased by 10.92% and is better than the overall market by 4.85%. The results suggest that this model is profitable and that the Taiwan online game market does not meet the condition of an efficient market.

5.2 Model Testing of Online Game Companies (Model 2)

5.2.1 Unit Root Test of VAR Model Variables of Online Game Companies

To ensure the validity of empirical results, we need to test the stability of all series. According to the VAR model testing, minimum value of AIC will be selected. Take Gametower (stock ID 3293) as an example, the results suggest that the net buy/sell value of daily data does not reject the null hypothesis, no matter whether the intercept (-1.2988 (0)), intercept and trend (-1.8722 (0) and no intercept and trend (-0.5393 (0)) are included. That is, the variables are not stationary and have fat-tail that is commonly observed in financial data. The series are also autocorrelated; that is, I(0) is not stationary. After taking a differentiation, the results all reject the null hypothesis (as shown in Table 2). That is, the variables are now stationary and we can then proceed with VAR and Granger causality test.

Table 2. Unit Root Tests of Model 2's Variables

Variables / Model	Intercept	Intercept & trend	No intercept & trend	Intercept	Intercept & trend	No intercept & trend
3293	-1.2988(0)	-1.8722(0)	-0.5393(0)	-33.5714(0)***	-33.6073(0)***	-33.5860(0)***
6111	-0.8300(1)	-2.6472(0)	-0.4403(0)	-33.8950(0)***	-33.8837(0)***	-33.8748(0)***
5478	-1.8934(0)	-1.8113(0)	-0.2764(0)	-33.4052(0)***	-33.4012(0)***	-33.4186(0)***
3546	-1.8531(1)	-2.0560(1)	-0.5273(1)	-30.6834(0)***	-30.6813(0)***	-30.6967(0)***
3662	-1.4884(0)	-1.0141(0)	-0.5157(0)	-32.6536(0)	-32.6814(0)***	-32.6679(0)***
4994	-1.4954(0)	-3.6078(1)**	-0.9804(0)	-26.6216(1)***	-26.6320(1)***	-26.6296(1)***
3687	-1.4596(0)	-2.1306(0)	-1.6416(0)	-33.1667(0)***	-33.1571(0)***	-33.7432(0)
3083	-1.7904(3)	-2.6505(3)	-1.0618(3)	-18.5044(2)***	-18.4967(2)***	-18.5017(2)***
3064	-2.4545(1)	-2.7930(1)	-0.5703(1)	-30.4869(0)***	-30.4736(0)***	-30.5002(0)***
4946	-1.4243(1)	-1.9805(1)	-0.8246(1)	-31.1859(0)***	-31.1875(0)***	-31.1958(0)***
6169	-2.6857(0)**	-2.6201(0)	-0.6180(0)	-25.9410(1)***	-25.9479(1)***	-25.9517(1)***
6180	-2.1291(0)	-2.3456(0)*	-0.3074(1)	-34.6063(0)***	-34.6002(0)***	-34.6212(0)***
3086	2.1096(1)	-2.4761(1)	-1.2387(0)	--31.1009(0)***	-31.2882(0)***	-31.2959(0)***
2354	-1.9352(0)	-2.0706(0)	-0.5003(0)	-35.0254(0)***	-35.01410)***	-35.0400(0)***
9446	-1.6529(0)	-3.7075(0)	-1.1695(0)	-27.0424(1)***	-27.0636(1)***	-27.0480(1)***

Note: According to Mackinnon (1991), *, **, and *** represent significance at 10%, 5% and 1% level, respectively. (0) is where the lagged period is 0 with minimal AIC. Stock ID is detailed in Section 4. D denotes differentiated data at level 1. 9446 is the price difference of X-Legend Entertainment and UserJoy Technology

5.2.2 Lagged Period Test of Online Game Companies' VAR Model

In order to proceed with VAR model estimation, we need to first examine the lagged period. Table 2 shows that the AIC, HQ, FPE and SC of online game companies are at the minimum when they are lagged one period. Therefore, one lagging period is adopted in the model for estimation.

Table 3. Estimation Results of Lagged Period Test of Online Game Companies' VAR Model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-59095.98	NA	5.05e+27	103.5201	103.5819	103.5434
1	-29990.97	57445.44	519753.2*	52.89137*	53.81826*	53.24137*
2	-29826.36	320.8623	549197.1	52.94634	54.73833	53.62302
3	-29697.70	247.6364	618150.4	53.06427	55.72136	54.06762
4	-29552.40	276.0834	676003.4	53.15307	56.67527	54.48309

5.2.3 Granger Causality Test of Online Game Companies

VAR model is useful when the relationship between variables cannot be determined based on theoretical economic models. In this case, we can assume that each factor in the system is related to other factors. Then, the spot values of all factors are regressed on past values of the factors to estimate the dynamic relationships between the factors. To examine the investment behavior of online game companies, this study includes the trading data of fourteen online game companies in the VAR model to proceed with the Granger causality test. The results shown in Table 4 suggest that when one lagging period is adopted, X-Legend Entertainment and UserJoy Technology, which have the second highest stock prices, are most frequently being the Granger cause of other online game companies. Among the other 12 online game companies, the spot stock trading of X-Legend Entertainment and UserJoy Technology are endogenous to eight companies' investment behavior. In other words, the optimal investment behavior of eight online game companies all reject to exclude the information of X-Legend Entertainment and UserJoy Technology. Therefore, X-Legend Entertainment and UserJoy Technology are the Granger cause of other online game companies' net trading value and have herding effect on other online game companies.

Table 4. Granger Causality Test of Online Game Companies

Dep Var: P2354			**Dep Var: P3064**			**Dep Var: P3083**			**Dep Var: P3086**			**Dep Var: P3293**		
Excluded	Chi-sq	Prob.	Excluded	Chi-sq	Prob.	Excluded	Chi-sq	Prob.	Excluded	Chi-sq	Prob.	Excluded	Chi-sq	Prob.
P3064	1.05	0.31	P2354	0.02	0.88	P2354	3.87	0.05	P2354	0.07	0.79	P2354	0.04	0.85
P3083	0.64	0.42	P3083	0.65	0.42	P3064	0.70	0.40	P3064	0.32	0.57	P3064	0.19	0.67
P3086	6.78	0.01	P3086	0.18	0.67	P3086	7.11	0.01	P3083	0.11	0.74	P3083	0.09	0.76
P3293	0.08	0.78	P3293	3.75	0.05	P3293	4.24	0.04	P3293	0.19	0.66	P3086	1.76	0.18
P3546	3.04	0.08	P3546	0.86	0.35	P3546	2.92	0.09	P3546	4.77	0.03	P3546	4.97	0.03
P3662	0.02	0.90	P3662	0.85	0.36	P3662	1.64	0.20	P3662	2.50	0.11	P3662	2.31	0.13
P3687	1.82	0.18	P3687	0.24	0.62	P3687	7.87	0.01	P3687	6.91	0.01	P3687	0.10	0.76
P4946	0.00	0.96	P4946	0.02	0.90	P4946	2.74	0.10	P4946	0.04	0.85	P4946	0.09	0.76
P4994	5.89	0.02	P4994	5.91	0.02	P4994	19.01	0.00	P4994	1.50	0.22	P4994	0.41	0.52
P5478	0.14	0.71	P5478	4.92	0.03	P5478	0.35	0.56	P5478	0.70	0.40	P5478	2.32	0.13
P6111	0.36	0.55	P6111	5.67	0.02	P6111	0.68	0.41	P6111	0.77	0.38	P6111	4.08	0.04
P6169	4.49	0.03	P6169	0.73	0.39	P6169	0.87	0.35	P6169	1.47	0.23	P6169	1.98	0.16
P6180	3.54	0.06	P6180	0.03	0.87	P6180	6.81	0.01	P6180	0.24	0.63	P6180	5.86	0.02
All	24.05	0.03	All	28.96	0.01	All	39.02	0.00	All	16.82	0.21	All	36.19	0.00

Dep Var: P3546			Dep Var: P3662			Dep Var: P3687			Dep Var: P4946			Dep Var: P4994		
Excluded	Chi-sq	Prob.	Excluded	Chi-sq	Prob.	Excluded	Chi-sq	Prob.	Excluded	Chi-sq	Prob.	Excluded	Chi-sq	Prob.
P2354	0.06	0.81	P2354	0.10	0.75	P2354	0.85	0.36	P2354	0.18	0.67	P2354	1.42	0.23
P3064	0.74	0.39	P3064	0.01	0.90	P3064	0.19	0.66	P3064	1.96	0.16	P3064	0.07	0.79
P3083	2.15	0.14	P3083	0.59	0.44	P3083	8.52	0.00	P3083	5.03	0.02	P3083	0.67	0.41
P3086	2.28	0.13	P3086	0.10	0.75	P3086	0.02	0.89	P3086	7.36	0.01	P3086	0.62	0.43
P3293	0.12	0.73	P3293	0.00	1.00	P3293	1.13	0.29	P3293	9.48	0.00	P3293	0.56	0.45
P3662	0.16	0.69	P3546	4.12	0.04	P3546	3.80	0.05	P3546	3.03	0.08	P3546	1.87	0.17
P3687	4.40	0.04	P3687	2.32	0.13	P3662	4.37	0.04	P3662	0.14	0.71	P3662	0.08	0.78
P4946	1.48	0.22	P4946	1.03	0.31	P4946	0.06	0.80	P3687	3.03	0.08	P3687	1.50	0.22
P4994	13.93	0.00	P4994	0.28	0.60	P4994	4.60	0.03	P4994	6.78	0.01	P4946	2.83	0.09
P5478	0.44	0.51	P5478	4.05	0.04	P5478	0.34	0.56	P5478	0.44	0.51	P5478	0.69	0.41
P6111	0.13	0.72	P6111	0.00	1.00	P6111	0.00	0.98	P6111	2.63	0.10	P6111	0.66	0.42
P6169	0.05	0.83	P6169	0.29	0.59	P6169	0.15	0.69	P6169	0.02	0.90	P6169	2.55	0.11
P6180	1.93	0.16	P6180	1.72	0.19	P6180	0.49	0.48	P6180	5.60	0.02	P6180	0.71	0.40
All	26.14	0.02	All	21.09	0.07	All	16.32	0.23	All	24.71	0.03	All	36.92	0.00

Dep Var: P5478			Dep Var: P6111			Dep Var: P6169			Dep Var: P6180		
Excluded	Chi-sq	Prob.	Excluded	Chi-sq	Prob.	Excluded	Chi-sq	Prob.	Excluded	Chi-sq	Prob.
P2354	0.75	0.39	P2354	0.02	0.89	P2354	7.28	0.01	P2354	1.18	0.28
P3064	0.08	0.77	P3064	0.04	0.84	P3064	0.78	0.38	P3064	0.08	0.78
P3083	0.01	0.91	P3083	2.24	0.13	P3083	0.01	0.92	P3083	0.56	0.46
P3086	0.04	0.83	P3086	0.00	0.95	P3086	0.80	0.37	P3086	1.91	0.17
P3293	2.51	0.11	P3293	0.26	0.61	P3293	1.35	0.25	P3293	4.56	0.03
P3546	0.13	0.71	P3546	0.03	0.87	P3546	4.15	0.04	P3546	0.19	0.66
P3662	0.13	0.72	P3662	0.44	0.51	P3662	2.83	0.09	P3662	0.00	0.97
P3687	2.99	0.08	P3687	0.37	0.54	P3687	0.88	0.35	P3687	0.00	0.97
P4946	6.73	0.01	P4946	0.13	0.72	P4946	0.81	0.37	P4946	0.01	0.90
P4994	5.81	0.02	P4994	1.81	0.18	P4994	7.36	0.01	P4994	3.34	0.07
P6111	4.78	0.03	P5478	2.94	0.09	P5478	0.53	0.47	P5478	0.15	0.70
P6169	0.05	0.83	P6169	0.00	0.97	P6111	0.04	0.83	P6111	4.69	0.03
P6180	3.75	0.05	P6180	5.92	0.01	P6180	0.40	0.53	P6169	0.47	0.49
All	24.71	0.03	All	18.26	0.15	All	22.04	0.05	All	19.90	0.10

Note: The sample code is same as described in Table 1.

5.3 Test of Model 2A: X-Legend Entertainment

5.3.1 Lagged Period Test of Model 2A's Variables

In order to conduct VAR model estimation, we need to first test the lagged period. The results show that AIC and FPE is minimal when the lagged period is 5. Therefore, this study will include these two variables (4994 and 9446) in the model.

Table 5. Lagged Period Test of Model 2A

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-10797.49	NA	561030.2	18.91328	18.92211	18.91662
1	-6058.379	9453.313	140.4533	10.62063	10.64711*	10.63063*
2	-6052.500	11.70761	139.9918	10.61734	10.66148	10.63400
3	-6044.519	15.86301*	139.0193	10.61037	10.67216	10.63370
4	-6040.837	7.307192	139.0966	10.61092	10.69037	10.64092
5	-6036.311	8.963342	138.9688*	10.61000*	10.70711	10.64667
6	-6032.391	7.752435	138.9882	10.61014	10.72490	10.65348
7	-6029.860	4.993755	139.3466	10.61272	10.74513	10.66272
8	-6029.545	0.621919	140.2488	10.61917	10.76924	10.67584

Note: The sample code is same as described in Table 1.

5.3.2 Granger Causality Test of Model 2A

This section proceeds with Granger causality model estimation. The results in Table 6 shows that when we lagged 5 periods, the price difference of X-Legend Entertainment and UserJoy Technology have bidirectional Granger causal relationship. The result suggests that the model is valid. Therefore, in the next section(Note 4), these two variables are included in Model 2A (where Data1 and Data2 are the spot market prices of X-Legend Entertainment and Data3 is the price difference of X-Legend Entertainment and UserJoy Technology) to conduct backtesting of optimal program trading in order to understand the market efficiency of Taiwan's online game companies and investment behavior.

Table 6. Granger Causality Test of Model 2A

Dependent variable: P4994			
Excluded	Chi-sq	df	Prob.
D9446	22.63079	5	0.0004
All	22.63079	5	0.0004
Dependent variable: D9446			
Excluded	Chi-sq	df	Prob.
P4994	17.61103	5	0.0035
All	17.61103	5	0.0035

Note: The sample code is same as described in Table 1.

5.4 Test of Model 2B: UserJoy Technology

5.4.1 Lagged Period Test of Model 2B's Variables

Before proceeding with VAR model estimation, we test the lagged periods. The results show that AIC and FPE are minimal when the lagged period is 5 (as shown in Table 7). Therefore, this study includes these two variables (3546 and 9446) in the model estimation.

Table 7. Lagged Period Test of Model 2B

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-10797.49	NA	561030.2	18.91328	18.92211	18.91662
1	-6058.379	9453.313	140.4533	10.62063	10.64711*	10.63063*
2	-6052.500	11.70761	139.9918	10.61734	10.66148	10.63400
3	-6044.519	15.86301*	139.0193	10.61037	10.67216	10.63370
4	-6040.837	7.307192	139.0966	10.61092	10.69037	10.64092
5	-6036.311	8.963342	138.9688*	10.61000*	10.70711	10.64667
6	-6032.391	7.752435	138.9882	10.61014	10.72490	10.65348
7	-6029.860	4.993755	139.3466	10.61272	10.74513	10.66272
8	-6029.545	0.621919	140.2488	10.61917	10.76924	10.67584

Note: The sample code is same as described in Table 1.

5.4.2 Granger Causality Test of Model 2B

This section conducts Granger causality test. The results are shown in Table 8. When we lag five periods, the spot data of UserJoy Technology and the price difference of X-Legend Entertainment and UserJoy Technology have unidirectional Granger causal relationship (as shown in Table 4). The results suggest that the model is valid. Therefore, in the next section(Note 5), these two variables are included in Model 2B (where Data1 and Data2 are the spot market prices of UserJoy Technology and Data3 is the price difference of X-Legend Entertainment and UserJoy Technology) to conduct backtesting of optimal program trading in order to understand the market efficiency of Taiwan's online game companies and investment behavior.

Table 8. Granger Causality Test of Model 2B

Dependent variable: P3546			
Excluded	Chi-sq	df	Prob.
D9446	3.761371	5	0.5843
All	3.761371	5	0.5843
Dependent variable: D9446			
Excluded	Chi-sq	df	Prob.
P3546	17.61103	5	0.0035
All	17.61103	5	0.0035

Note: The sample code is same as described in Table 1.

5.5 Empirical Results of Model 2's Program Trading

5.5.1 Results from Model 2A

Based on the model described above, we first simulate QFII's investment behavior using Model 2A. In Model 2A, Data1 is X-Legend Entertainment, Data2 is X-Legend Entertainment, Data3 is the price difference of X-Legend Entertainment and UserJoy Technology. Taking Softstar as an example, the results show that during the first period of 24 months (2012.1.1~2014.1.1), the TAIEX rises from 7073.48 to 8585.74. Softstar has three trading opportunities and the profit is $57.26. The optimal coefficient obtained is then applied in the expanded period in the second stage (2012.1.1~2016.9.1). During this period, the TAIEX rises to 9001.15 (that is, an increase of 4.85%). However, Softstar's profit is $129.85 (that is, an increase of 126%). The results are presented in Group A of Table 7.

As for Gametower (stock ID 3293), the results show that during the first stage, there are 3 trading opportunities and the profit is $25.12. When the optimal coefficient is applied in an expanded simulation period, the profit is $-18.35. This is because high priced stocks are more volatile. On the contrary, the profits of the other eleven companies, including Softstar (stock ID 6111), Soft-world (stock ID 5478), UserJoy (stock ID 3546), XPEC Entertainment (stock ID 3662), Macrowell (stock ID 3687), Chinesegamer (stock ID 3083), Astro Group (stock IP 3064), Wasabii (stock ID 4946), InterServ (stock ID 6169), Gamania Digital Entertainment (stock ID 6180), Yes168 (stock ID 3086), Foxconn (stock ID 2354), are growing. If these 14 online game companies form an investment portfolio, the profit during the period 2014.1.1~2016.9.1 is $905.59 (an increase of 115.03%) which is better than the overall market of 4.85%. The results suggest that as long as we can get hold of the price difference information, this program trading can be profitable. The results also imply that the Taiwan's online game market does not fulfil the condition of an efficient market.

5.5.2 Results from Model 2B

If the base variable of Model 2A is changed to UserJoy Technology, then Data1 of Model 2B is UserJoy Technology, Data2 is UserJoy Technology and Data3 is the price difference of X-Legend Entertainment and UserJoy Technology. The results also show trading profit (as shown in Group B of Table 7). Similarly, taking Softstar as an example, the results show that during the first period of 24 months (2012.1.1~2014.1.1), Softstar has six trading opportunities and the profit is $14.79. The optimal coefficient obtained is then applied in the expanded period in the second stage (2012.1.1~2016.9.1). During this period, Softstar can trade for 18 times and the profit increases to $18.61 (i.e., an increase of 25%).

As for Gametower (stock ID 3293), the results show that during the first stage, there are 5 trading opportunities and the profit is $36.1. When the optimal coefficient is applied in an expanded simulation period, the number of trading opportunities increases to 15 times but the profit declines to $17.79. Again, the result shows that high priced stocks

are more volatile to the market fluctuations. On the contrary, the profits of the other six companies, including Softstar (stock ID 6111), Chinesegamer (stock ID 3083), Astro Group (stock IP 3064), Gamania Digital Entertainment (stock ID 6180), Yes168 (stock ID 3086), Foxconn (stock ID 2354), are growing. The results suggest that as long as we can get hold of the price difference information, this program trading can be profitable. However, when the base variable changes to UserJoy Technology, the performance is worse than the case when X-Legend Entertainment is used as the base variable. If 14 online game companies form an investment portfolio, the profit during the period 2014.1.1~2016.9.1 is $51.13 (an increase of 4.01%) which is worse than the overall market of 4.85%. Therefore, the results suggest that the base variable should be carefully chosen and should have clear Granger causality relationship.

Table 7. Trading Analysis of Model 2's Program Trading Unit: $, times, %

Stock ID		2012.1.1~2014.1.1			2012.1.1~2016.9.1		
		Net Profit	No. of Trading	Winning Probabilities	Net Profit	No. of Trading	Winning Probabilities
3293	(A)	25.12	3	66	-18.35	10	50
	(B)	36.10	5	80	17.79	15	46
6111	(A)	57.26	3	66	129.85	5	80
	(B)	14.79	6	33	18.61	18	100
5478	(A)	0.12	3	66	21.93	7	156
	(B)	0.74	1	100	-8.68	3	-0.08
3546	(A)	34.12	3	100	162.75	11	63
3662	(A)	54.62	3	66	157.15	10	50
	(B)	16.22	3	66	-15.59	8	50
4994	(B)	4.02	3	66	-49.95	8	75
3687	(A)	52.2	1	100	121.33	6	50
	(B)	15.76	4	75	6.35	9	44
3083	(A)	56.41	2	100	88.22	5	80
	(B)	21.78	2	100	30.1	5	60
3064	(A)	23.12	3	33	62.75	11	36
	(B)	14.02	3	100	75.57	12	66
4946	(A)	53.62	3	33	255.44	8	50
	(B)	19.62	3	66	14.96	8	50
6169	(A)	36.20	1	100	67.93	7	42
	(B)	-16.83	1	100	-	-	-
6180	(A)	32.12	3	33	70.84	9	44
	(B)	15.92	3	66	65.85	12	58
3086	(A)	36.12	3	66	103.64	8	50
	(B)	6.72	3	100	36.73	11	63
2354	(A)	48.82	4	50	48.82	4	50
	(B)	19.75	9	33	27.60	23	54

Note: The sample code is same as described in Table 1. Stage 1: 2012.1.1~2014.1.1. Stage 2: 2012.1.1~201.9.1. In Model (A) Data1 is X-Legend Entertainment, Data2 is X-Legend Entertainment and Data3 is individual stock. In Model (B), Data1 is UserJoy Technology, Data2 is UserJoy Technology and Data3 is individual stock.

6. Conclusion and Discussion on Investment Strategies

Having robust investment in the financial market of developing countries has been the objective of many investors. However, as the markets in developing countries are not well developed, the Japanese company, Bai Chi Gan Tou, defaulted on its acquisition payment. Bai Chi Gan Tou, which was to be a financial investor, planned to acquire 1/4 of the XPEC Entertainment's shares in the open market at $128. As a consequence, XPEC Entertainment's price rocketed and many investors were attracted to the investment. However, on 31 August, the date which Bai Chi Gan Tou, supposedly to pay for the settlement, the company defaulted the payment. It was the first case happened in Taiwan. The stock price of XPEC Entertainment fell from $115.5 to $37.5 (i.e., a drop of 67%) causing at least $2.2 billion losses to 20,000 investors.

This study uses the contrary investment strategy proposed by Kestner (2003) to analyze 1150 daily trading data of a

major online game company in Taiwan for the period 2012.1.1~2016.9.1. Based on the program trading simulation of 100-day mean reversion trading performance after price diversion and fourteen online game companies as the investment portfolio, the trading profit is $86, showing an increase of 10.92%, and exceeds the stock index by 4.85%.

This study further tests the Granger causality, chooses the bellwether stock, X-Legend Entertainment, and uses the technical analysis to examine the mean reversion after price diversion based on program trading. The optimal coefficient from the first stage is extended and used in the second stage to obtain trading profits of $905.59, an increase of 115.03%. The resulting performance is better than that based on Kestner's (2003) trading strategy which is based only on underlying stock. Therefore, the empirical evidence suggests that the latter approach can help make stable profits in the versatile online game stock markets and that the Taiwan online game stock market does not meet an efficient market condition. Accordingly, this study finds evidence supporting the hypothesis: *the information of bellwether stock and price mean reversion feature can be used to enhance trading performance in the stock market*. Due to the space and time limit, future research could use data of all online game companies in Taiwan to conduct optimal backtesting and run the simulation.

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Notes

Note 1. XPEC Entertainment (stock ID: 3662) was established in August 2000 and became public a year later. It has $1.6 billion in capital. The revenue in 2015 was $2.2 billion, which consists of 45.16% of royalty revenue, 21.38% of artwork services, 18.49% of mobile games, 11.55% of food and beverage and 3.43% of game development revenue.

In 2016, the EPS in Q2 is $0.22 and the stock price is 15.8 on 13 October.

Note 2. Wealth Magazine (8 September 2016): ”Five suspicious points in XPEC’s absurb takeover event”. CAN News (4 September 2016): “Check out for XPEC’s takeover: Four clarifying points from FSC”. United Evening News (31 August 2016): “XPEC’s tender offer / Convertible bonds and tender offer: a stock speculation fraud?”.

Note 3. When the stock price reaches a new high (or low), the indicator does not.

Note 4. Due to page limit, the VAR model and Granger causality test results that include 12 foreign brokerages will end up with 24 groups and the results are not provided in this paper. Readers who are interested in this result can contact the corresponding author.

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