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Market Efficiency and QFIIs in Emerging Countries: A Case Study of Taiwan

Yu-Wei Lan
Associate Professor
Department of Banking and Finance,
Takming University of Science and Technology
ywlan@takming.edu.tw

Dan Lin
Assistant Professor
Department of Banking and Finance, Takming University of Science and Technology
mcylin@takming.edu.tw

Lu Lin
Assistant Professor
Department of Public Finance and Taxation,
Takming University of Science and Technology
suzannelin@takming.edu.tw

Abstract: *This study first examines the impact on the stock price of Asia Plastic Recycle using an event study method. Based on the event that happened on 24 April 2014 where Qualified Foreign Institutional Investors (QFIIs) lowered the rating for Asia Plastic Recycle. The result shows significant variations in cumulative abnormal returns before and after the event date, suggesting that the Taiwan stock market is not consistent with semi-strong-form market efficiency. Secondly, this study simulates the investment behavior of QFIIs using a program trading model, which is developed based on the Granger (1986) causality test. The result shows that with the incorporation of security lending data, the QFIIs can still profit if extending the optimal investment coefficient from the 30-month period between 3 January 2011 and 27 July 2013 to 27 June 2013. Again, the result supports the hypothesis that Taiwan futures market does not have strong-form market efficiency. Further, we conduct the Granger causality model by using the QFII's spot net trading value. The results show that when the security lending information is replaced with the spot net trading data of Merrill Lynch, Merrill Lynch (60144), which has the highest market share, is incorporated as an endogenous variable in the optimal investment strategy by almost half of the QFIIs. The result thus supports hypothesis 3 that QFIIs in Taiwan exhibits positive feedback investment behaviour.*

Keywords: *Event Study, Granger Causality Test, Market Efficiency, Positive Feedback Trading, Program Trading, Security Lending*

1. INTRODUCTION

Financial liberalization, which began in the 1970s, became popular in the 1990s and led to short-term capital flow between countries. In order to encourage investments by insititutaionl investors, to increase capital supply and to enlarge the market size, the Taiwan government opened up for Qualified Foreign Institutional Investors (QFIIs) to invest in domestic market. QFIIs currently invest as high as NT$9 trillion in Taiwan stock market, representing 37% of the total value. The statistics provided by the Reserve Bank of Taiwan reported that from 2011 to the first quarter of 2014, the outflow from the financial account totaled to NT$3.69 trillion (or US$ 120 trillion). This suggests that Tawain is a net capital outflow country with current account surplus and foregin reserve of US$423.6 trillion. As Tawian market suffers from drawbacks such as few investment tools, low efficiency and low returns, capital often flows out of the country to seek for higher returns. Consequencly, due to the relatively small market size, the Taiwan stock market can be easily influenced by foreign capital flow. This worsens the domestic investment environment.

On 24 April 2014, the US short-selling firm, Glaucus Research Group, accused Asia Plastic Recycle (represented by its stock ticker F-Recycle, thereafter) of providing false accounting reports and lowered its target price to zero dollar. This announcment caused the stock price of F-Recycle to fall by 30%. Therefore, the Financial Supervisory Commission (FSC) of Taiwan wanted to stop QFIIs as vultures and investigated whether Glaucus intentionally made false

announcement or provided false information to affect the stock prices.[1] On 31 July, the FSC announced that security brokers in Taiwan should not allow their reports to be quoted by the media without permission. If reports were purposely disseminated, the security brokers may be asked to stop business or withdrawn license.

While the Taiwan capital market has abundant foreign reserve, why does financial liberalization cause Taiwan market to become more fragile than before? One possible explanation is that Taiwan has a relatively loose regulation on QFIIs and has a thin market for investment. The development of the futures market in Taiwan can be divided into two stages. At the first stage, Taiwan allowed foreign futures trading in 1993. At the second stage, the domestic market for futures was set up and established the Taiwan Futures Exchange. In face of the intense competition due to globalization of international financial markets and to attract overseas Chinese to invest in Taiwan market, the Taiwan government set up a system for security lending in June 2003.[2] In July 2007, the center of security lending was established. Security brokers and security finance companies could handle security lending matters and QFIIs were allowed to engage in security lending.[3] In July 2011, the QFIIs contributed to about 1/3 of the total market value and the number of security lending stocks had reached 4.3 million with a total value of $239 trillion. QFIIs became the largest player in Taiwan's stock market.

However, while QFIIs possess a large number of stocks, without a time limit on short covering, it is very easy for QFIIs to short sell using security lending and to use spot securities to lower stock prices. As a result, the Taiwan Stock Exchange Weighted Index (TAIEX) fell by 57.5% in August 2008 during the subprime crisis. The fall in Taiwan stock market was even greater than that in the US stock market, which was the starting country of the financial crisis. In July 2011, the Euro crisis again caused another fall (about 22%) in TAIEX, causing great losses to investors. The issue of security lending for short sell by QFIIs was again put on the table. So long as the short selling is prevelent in the international market, the arbigrate strategy by QFIIs could lead to a crash in Taiwan stock market at any time.

Accordingly, this study examines whether the capital inflow by QFIIs is benefitial to Taiwan economic growth. In addition, by assuming no collusions between markets, we investigate why QFIIs are able to make consistent profits through seucrity lending from the behavioral finance perspective. The organization of this paper is as follows. The literature review is provided in Section 2. In Section 3, we discuss the methods used in this paper, including event study, vector autoregression (VAR), Granger causality test, and program trading. Descriptions of the data and the results are provided in Section 4 and 5, respectively. A conclusion and a discussion on investment strategies are provided in Section 6.

2. LITERATURE REVIEW

Stock market efficiency was first under investigation by Bachelier (1900) who proposed the random walk theory. Bachelier (1900) suggested that stock market movement was similar to the brownian motion in Physics. Later, the economist, Samulson (1965), argued that stock prices could not be predicted and followed a random walk if including the expectations of all market participants and all information. Fama (1970) then integrated past literature and formally proposed the efficient market hypothesis (EMH). According to Fama (1965, 1970), there were three different levels of market efficiency. The first level was weak-form market efficiency. If the information incorporated in historical prices were completely reflected in current prices, then investors would not be able to make abnormal returns based on historical price information. The

[1] The Economic Daily News report that the stock price of F-Recycle reached a high of $91.80 on 21 April 2014 and fell to $89.30 on 23 April and $86.40 on the next day. Over 13 days, the stock price fell to a low of $59.30, representing an overall decline of 35.4%. According to the Securities and Exchange Act, stock broker cannot intentionally affect the stock trading price by spreading rumors or providing false information.
http://udn.com/NEWS/FINANCE/FIN1/8654279.shtml#104#ixzz30om7NHCf

[2] The United Evening News on 31 August 2007 reported that Taiwan Stock Exchange opened up for security lending which can benefit not only security brokers and domestic investors but also QFIIs. This act was complimented by the FTSE Group. http://www.twskype.com/news/9206/920616.htm

[3] Please refer to
http://www.epochtimes.com/b5/7/6/27/n1755971.htm

second level was semi-strong-form market efficiency, which suggested that stock prices have reflected all public information about the company's future prospects. Investors would not be able to make abnormal returns based on historical price information or by analyzing current public information. The third level was strong-form market efficiency, which suggested that stock prices had reflected all company-related information, including insider information. Investors would not be able to make abnormal returns even with insider information.

With the proposals of rational expectations theory (Lucas, 1972) and the intertemporal CAPM (Merton, 1973), neoclassical economics became a distinguished school. However, in the following twenty years or so, empirical evidence found market anomalies such as calendar effect, size effect, IPO underpricing puzzle, equity premium puzzle and excessive volatility puzzle. Behavioral finance also discussed four important ways in which humans deviated from the standard economic model, including bounded rationality, bounded self-interest, bounded self-control, and bounded market. These could lead to market inefficiency. Black (1986) proposed the concept of irrational trading or noise trading, which was not predictable and occurred randomly. This increased the risk in asset pricing. Shleifer (1997) argued that due to the limits of arbitrage, rational trading might not be able to push the price back to its base value. Therefore, it was possible that stock prices might deviate from their base values. In addition, there existed a group of irrational traders who followed positive feedback. This group of traders could be classified as noise traders as their trading strategy was solely based on short-term performance of stock prices; that is, they bought the stocks when stock prices went up and sold when stock prices fell. De Long, Shleifer, Summers and Waldmann (1990b) proved that when positive feedback trading strategy was adopted by some market traders, rational investors might also follow this strategy, causing further instability in short-term stock prices. In other words, rational traders, to some extent, might reinforce the strength of positive feedback. The DSSW model (De Long, Shleifer, Summers and Waldmann, 1990a) was then developed.

The trading strategy based on positive feedback included herd behavior, extrapolative expectations and technical analysis. Herd behavior was prevalent in the financial market. When there was information uncertainty, investors might followed other's trading strategies without independent thinking. However, the herd behavior might be rational under high information uncertainty. Extrapolative expectations suggested that the trend in economic indicators in the last period was used to predict the trend for the next period. According to Murphy (1986), technical analysis meant that investors traded by following past trends. This was the typical positive feedback trading strategy. However, the financial markets differed from traditional economic theories in terms of insufficient information, uncertainty markets, and costs in information gathering and processing. Institutional investors had better knowledge of the industrial conditions and had greater ability in information processing and predicting than individual investors. Therefore, institutional investors were more likely to have herd trading behavior. Froot, Scharfstein and Stein (1992) found evidence supporting this argument. Institutional investors often used the same market information such as fundamental and technical indicators, the same models, investment portfolio and hedging strategies. Therefore, their investment behavior became very similar and gave similar investment recommendations. Trueman (1994) proved that there existed herd behavior among investment analysts. Grinblatt et al. (1995) also found evidence of herd behavior among fund investments. Kim and Wei (1999) showed that the investment behavior by QFIIs in Korea followed positive feedback, causing greater volatility in the market. Further, Shiller (2002) argued that when investors were being misled and caused investment bubble, this was also one kind of herd behavior.

Therefore, this study develops the following hypotheses and uses quantitative models and optimal program trading to test the above arguments. The aim is to find safe and sound investment strategies.

H1: The Taiwan stock market does not possess market efficiency.

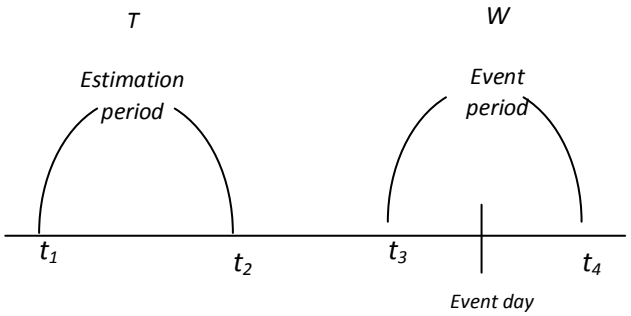
H2: The Taiwan futures market does not possess market efficiency.

H3: The trading strategy of QFIIs follows positive feedback.

3. RESEARCH METHODS

3.1 Event Study

This study uses an event study to examine the effect on stock prices and investment returns after the announcement of the research report by QFIIs. We will use GARCH to conduct abnormal returns test. The following defines the timing for event study:



t：time　T：Estimation period　W：Event period

Estimated return based on the market model is as follows:

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

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

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

Expected value of the error term, ε_t, is zero.

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

Abnormal return (AR) during the event period is calculated as follows:

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

where $R_t = \ln P_t - \ln P_{t-1}$; P is the stock price.

Cumulative abnormal return (CAR) is calculated as follows：

$$CAR = \sum_{t=t_3}^{t_4} AR_t \quad (2)$$

Then, we use the data from Taiwan Economic Journal (TEJ) database to proceed with GARCH model testing. Due to the restriction on trading F-Recycle after the announcement day, we use 30 days before and after the event date (24 April 2014) as the event period. Therefore, we use a 60-day period to test if AR and CAR are significantly different from zero. Normally, the estimation period is 200 days. However, as the event under study happened in April 2014, the estimation period is shortened to 70 days.

Therefore, based on where the AR/CAR lines break in GARCH model, we are able to determine if there are significant abnormal returns before the announcement of research report by QFIIs. If there are, this suggests that the market reflects the information before the event actually occurs. If the abnormal returns are significantly negative after the announcement day, this will be a reflection of the event on stock prices, thereby, providing a test for the market efficiency.

Average abnormal return (AAR) is calculated as follows:

$$AAR = \frac{1}{N} \sum_{t=t_3}^{t_4} AR_t \quad (3)$$

Cumulated average abnormal return (CAAR) is calculated as follows:

$$CAAR = \sum_{t=t_3}^{t_4} AAR_t \quad (4)$$

3.2 Quantitative Models and Estimation Methods

3.2.1 Vector Autoregression (VAR) Model

To ensure that all variables in the model have the causal relationship and to avoid the recognition problem when estimating traditional simultaneous structural equations, Sims (1980) apply the vector autoregression model in econometrics. All variables in the model are lagged variables of itself and other variables. Sims (1980) extends the single variable autoregression to multi-variable vector autoregression. As all variables are endogenous variables, 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 in the model are y_{1t}, y_{2t}, y_{3t} (where y_{1t} is the return on Taiwan index futures; y_{2t} is the spot net trading value of Merrill Lynch (Q60144); and y_{3t} is the increment/decrement value in security lending). 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:

$$\begin{aligned} y_{1t} &= m_1 + a_{11}y_{1,t-1} + a_{12}y_{2,t-1} + a_{13}y_{3,t-1} + \varepsilon_{1t} \\ y_{2t} &= m_2 + a_{21}y_{1,t-1} + a_{22}y_{2,t-1} + a_{23}y_{3,t-1} + \varepsilon_{2t} \\ y_{3t} &= m_3 + a_{31}y_{1,t-1} + a_{32}y_{2,t-1} + a_{33}y_{3,t-1} + \varepsilon_{3t} \end{aligned} \tag{5}$$

where

$$E(\varepsilon_{it}) = 0, \forall i = 1,2,3; \text{Var}(\varepsilon_t) = E(\varepsilon_t \varepsilon_t') = \sum, \forall t, E(\varepsilon_{it}\varepsilon_{is}) = 0, \forall t \neq s, i = 1,2,3.$$

The error term ε_{it} is white noise. The causality test, which is used in this study, impulse response function and forecast error variance decomposition can then be developed based on this model.

3.2.2 Granger Causality Model

As the relationship between stock prices and security lending by QFIIs remains inconclusive, Granger (1969, 1988) causality test can be used to analyze how they are related and whether an endogenous variable can be treated as an exogenous variable. Testing if the coefficients of current y series and the past values of x series have causal relationship is similar to testing if the past values of x can explain the present values of y. That is, if adding a lagged value of x can increase the degree of explanation, or similarly the correlation coefficient of x and y are statistically significant, then we can conclude that y is Granger caused by x.

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

$$\begin{aligned} Y_{t1} &= \delta_0 + \sum_{i=1}^{m} \delta_i Y_{t1-i} + \sum_{i=1}^{m} \gamma_i Y_{t2-i} + \varepsilon_t \\ Y_{t2} &= \lambda_0 + \sum_{i=1}^{n} \lambda_i Y_{t2-i} + \sum_{i=1}^{n} \omega_i Y_{t1-i} + \nu_t \end{aligned} \tag{6}$$

where ε_t and ν_t in Equation (6) 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 Y2 has a Granger lead on Y1 and that it can be treated as an exogenous variable. The alternative hypothesis is that Y1 has a Granger lead on Y2. If both γ and ω do not equal to 0, this means that there is bidirectional causality relationship and the two variables are endogenous of each other.

3.3 Experimental Design and Estimation Method

Based on actual market trading data, this study uses two stages of testing to examine how QFIIs are able to make consistent profits in Taiwan financial market. First, we use program trading to obtain the optimal trading simulation. Secondly, we substitute the coefficients from the first stage of optimal transaction to Taiwan financial market data. If abnormal returns still exist, this suggests that Taiwan financial market is not efficient.

Based on the design concept of program trading (Williams, 1999), we include two more sets of data as filters in addition to the initially proposed Taiwan index futures data (Data1) to increase the trading performance. That is, we also include the spot net trading value of QFII's security brokers (Data2) and variation in security lending (Data3). Therefore, to ensure the fairness in

evaluation, the models are estimated based on the following trading strategies: when the following three conditions have been met, a buy strategy is adopted; (1) when the closing price of Data2 is greater than the 20-day moving average price; (2) when the closing price of Data3 is greater than the 5-day moving average price; (3) when the 14-day RSI closing price of Data1 is greater than 60. Conversely, when the following three conditions have been met, a sell strategy is adopted: (1) when the closing price of Data2 is smaller than the 20-day moving average price; (2) when the closing price of Data3 is smaller than the 5-day moving average price; (3) when the 14-day RSI closing prices of Data1 is smaller than 25. The transaction fees are assumed to be NT$1000 without considering slippage and other transaction costs. The position should be closed out if the profit is greater than 350 points or the loss is greater than 100 points.

Apart from the above basic settings, this study also uses the optimal MultiCharts[4] program trading to conduct back-testing. By comparing the trading performance in the optimal condition, we can see if including the QFII's security lending data as a variable can increase the trading profits in the futures market using technical analysis.

4. DATA

This study examines the investment strategy of QFIIs after financial liberalization. The empirical research includes two parts. In the first part, we use event study to investigate F-Recycle. The event day (24 April 2014) is used as the cut-off date and the risk-adjusted GARCH is adopted. We use the weighted index of Taiwan listed companies as the control group data.

In the second part, we investigate the efficiency of Taiwan futures market and how QFIIs are able to make consistent profits through security lending. The tests are conducted in two stages. At the first stage, the data covers from 2011.1.3~2013.6.27, while at the second stage, the data covers from 2011.1.3~2014.6.27. The later stage involves investment simulation using program trading and data from TEJ, including (1) Taiwan index futures returns rate (ln(Pt+1/Pt),TXA1), (2) spot net trading value of QFII's security brokers, (3) spot net trading value of the eight largest government owned banks and security brokers, and (4) variation in security lending (LOAN)[5].

The QFII's security brokers include Morgan Stanley (Q60147, 3.2%), Daiwa-Cathay (Q30135, 0.4%), Banque de l'Indochine (Q30138, 5.5%), CIMB Group (Q60166, 0.3%), Primasia (Q60601, -1%), Barclays (Q60891, 3.7%), Citibank (Q60159, 20.2%), Societe Generale (Q30157, 10.8%), Nomura (Q30156, 11.1%), BNP Paribas (Q30890, -4.7%), HSBC (Q30896, 3.6%), Royal Bank of Scotland Group (Q30140, -1.2%), CLSA (Q30138, -7.5%), Macquarie (Q30136, -3.1%), Merrill Lynch (Q60144, 28.4%), Deutsche Bank (Q30153, 1.8%), Goldman Sachs (Q30148, 8.6%), UBS (Q30165, 7.1%), and Credit Suisse (Q30152, 11.9%). The data of eight largest government owned banks and security brokers are combined together as one variable (GOV) in this study. This is because even though the Taiwan Cooperative Bank has the highest spot net trading value, its value is even less than half of the net trading value of Morgan Stanley (Q60147) over the period 2011.1.3~2014.6.27. All variables including the intercept and intercept & trend are I(0) stationary series. Therefore, further tests can be conducted.

5. RESULTS

5.1 Event Study of F-Recycle

The purpose of event study is to use statistical methods to test abnormal returns and to investigate whether the event has any impact on company stock prices. On 24 April 2014, Glaucus Research Group announced its investment research report; therefore, this date is set to be the event day. Due to panic selling on the part of investors, the stock price of F-Recycle continued to fall for six days from NT$90 to NT$59.10 until the FSC intervened. The CAR showed a dramatic declining trend. This event suggests that QFII's report can have a significant impact on the stock prices of a thin market such as Taiwan. Investors could still make a profit by short selling after the report was

[4] Please refer to http://www.multicharts.com. The trading strategy of Data4 in Group (B) of Table 6 (cont.) is the same as Data3 in this model.

[5] Due to the restrictions in data processing in MultiCharts, we use the security lending data at time t-1 to reflect informed trading. We also use security lending data at time t to conduct another test. We found that one third of the samples have losses, suggesting a weak-form market efficiency.

announced. This suggests that Taiwan stock market is not semi-strong-form efficient. The AR and CAR are presented in Figure 1.

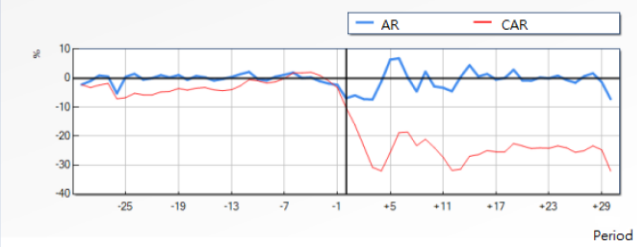


Figure1. *Effect on stock price of F-Recycle after the report announcement on 2014.4.24*

5.2 Unit Root Test of VAR Model Variables

To ensure the validity of empirical results, we need to ensure that the series are stationary. According to the VAR testing, we need to choose AIC with the minimum value. Thus, we use Merrill Lynch (Q60144), which has the highest market share, as an example and find the following results. Based on the daily net trading value, both the intercept (-24.4022(0)) and trend & intercept (-24.5094(0)) reject the null hypothesis. That is, the variables are stationary and do not have the fat-tail, which is common in financial data, or autocorrelation; i.e., I(0) stationary series. Therefore, we can proceed with VAR testing.

TABLE I. *Unit root test of VAR model variables*

Variables / Model	Intercept	Trend & intercept	Variables / Model	Intercept	Trend & intercept
LOAN	-28.3088(0)*	-28.2927(0)*	Q30156	-24.6147(0)*	-24.6600(0)*
GOV	-7.8565(4)*	-7.9079(4)*	Q30890	-13.4306(2)	-24.7158(0)*
ZTXA1	-27.9271(0)*	-27.9747(0)*	Q30136	-25.5833(0) *	-25.5724(0) *
QFII	-16.9704(0)*	-17.3381(0)*	Q60144	-24.4022(0)*	-24.5094(0)*
Q30157	-17.6228(1)*	-17.6459(1)*	Q30153	-22.7226(0)*	-22.8424(0)*
Q60147	-12.5416(2)*	-12.7484(2)*	Q30148	-23.8527(0) *	-24.0556(0) *
Q60159	-23.0798(0) *	-23.0752(0) *	Q30165	-22.6554(0)*	-227517(0)*
Q30896	-24.3394(0) *	-24.4436(0) *	Q30152	-11.6393(2)*	-11.7656(2)*
QFII	-16.9704(0)*	-17.3381(0)*	S18	-11.3358(2)*	-17.8487(2)*
TOP2	-22.0324(0)*	-22.1035(0)*	S17	-11.1777(2)*	-11.5396(2)*
TOP5	-18.3964(0)*	-18.5074(0)*	S14	-18.4501(0) *	-18.9527(0) *
TOP7	-18.2930(0) *	-18.5144(0)*	S12	-14.3431(1) *	-14.7928(1) *

Note: According to Mackinnon (1991), * shows significance at 1% level. (0) means that when the lag period is zero, the AIC is at the minimum. QFII is the total of 19 QFII's security brokers. TOP2 is the total for the top two QFII's security brokers. TOP5 is the total for the top five QFII's security brokers. TOP7 is the total for the top seven QFII's security brokers. S18 means to deduct the previous one QFII's security broker. S14 means to deduct the previous two QFII's security broker. S12 means to deduct the previous seven QFII's security broker. Other variables are as defined in section 4.

5.3 Causality Test of VAR Model

To proceed with VAR testing, the first step is to examine the lagging period. Similarly, we use Merrill Lynch (Q60144) as an example. The result shows that AIC, HQ and FPE are at minimum when they are lagged one period. Therefore, this study includes another three variables (ZTXA1, Q60144, LOAN) in the model. The results from VAR show that when lagging one period, the spot net trading value of Merrill Lynch and the returns on Taiwan index futures have bidirectional causal relationship (as shown in Table 3). That is, the two variables are endogenous of each other and the model is valid.

TABLE II. *Lagged model of VAR estimation based on Merrill Lynch (Q60144) data*

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-30302.90	NA	1.72e+27	71.22421	71.24095*	71.23062
1	-30275.06	55.42088	1.64e+27*	71.17993*	71.24686	71.20557*
2	-30266.38	17.21882*	1.64e+27	71.18068	71.29781	71.22555

TABLE III. *VAR estimation results of Merrill Lynch (Q60144)*

	ZTXA1	Q60144	LOAN
ZTXA1(-1)	0.053632	11379452	-1.51E+10
	(0.04041)	(3683914)	(1.7E+10)
	[1.32719]	[3.08896]	[-0.86583]
Q60144(-1)	8.01E-10	0.146595	50.54515
	(3.8E-10)	(0.03426)	(162.219)
	[2.13218]	[4.27946]	[0.31159]
LOAN(-1)	-1.05E-13	7.73E-06	0.049342
	(9.3E-14)	(8.5E-06)	(0.04010)
	[-1.12555]	[0.91286]	[1.23036]
C	-0.000109	172280.8	2.18E+08
	(0.00037)	(34016.5)	(1.6E+08)
	[-0.29274]	[5.06462]	[1.35581]
Determinant resid covariance (dof adj.)		1.60E+27	
Akaike information criterion		71.16814	
Schwarz criterion		71.23463	

Note: ( ) shows the standard deviation. [ ] shows t-statistics. Sample codes are as explained in Table 1.

5.4 Granger Causality Test

In this section, we examine the Granger causality relationship between the spot net trading value of QFII (60144), the QFII's security lending value as provided by the stock exchange and the returns on Taiwan index futures. The results show that when we lag one period, the spot net trading value of QFII (60144) has a bidirectional relationship with the returns on Taiwan index futures (as shown in Table 4). The QFII's security lending value as provided by the stock exchange and the spot net trading value of QFII (60144) has a unidirectional Granger causality relationship. In other words, the spot net trading value of QFII (60144) and the returns on Taiwan index futures are Granger cause of each other. The QFII's security lending value as provided by the stock exchange is also a Granger cause of the spot net trading value of QFII (60144).[6] Therefore, in the next section, we will include these three variables (i.e., Data1 which is the Taiwan index futures; Data2 which is the spot data of individual QFII's security brokers; and Data3 which is the QFII's security lending data) in the model and conduct back-testing based on optimal program trading to study the market efficiency of the Taiwan futures market and the investment behaviour of QFII's security brokers.

Table IV. *The Granger causality relationship between ZTXA1, Q60144 and LOAN*

Null Hypothesis:	Obs	F-Statistic	Prob.
Q60144 does not Granger Cause ZTXA1	858	4.29945	0.0384
ZTXA1 does not Granger Cause Q60144		16.8712	4.E-05
LOAN does not Granger Cause ZTXA1	858	1.01723	0.3135
ZTXA1 does not Granger Cause LOAN		0.68365	0.4086
LOAN does not Granger Cause Q60144	859	8.09532	0.0045
Q60144 does not Granger Cause LOAN		0.03317	0.8555

Similarly, VAR can be used to derive a clear vector relationship which is not known beforehand from the economic theory. We can assume that vectors are related to each other and use the vector values at the current period to run a regression with the vector values at lagging periods. This assumes a dynamic relationship between all vectors. To examine the investment behavior of QFII's security brokers based on the available security lending data, this study includes the returns on Taiwan index futures, data on government owned security brokers and data on the 19 QFII's security brokers in the VAR model and conducts Granger causality test. The results show that when lagging one period, Merrill Lynch (Q60144), which has the largest market share, has the highest number of times being the Granger cause of other QFII's security brokers. The spot net trading value of Merrill Lynch is endogenous of the investment behavior of the other 11 QFII's security brokers. In other words, five of the QFII's security brokers exclude the

[6]Due to the space limit, we do not report the Granger causality relationship of the other 11 QFII's security brokers.

information of Merrill Lynch in their optimal investment strategy. Therefore, the information of Merrill Lynch is the Granger cause of spot net trading value of other QFII's security brokers. The result also suggests herd behavior among QFII's security brokers. If we use program trading based on technical analysis, we can then see the trading performance. That is, we need to use the optimal coefficient from the first stage to do the simulation at the second stage. The empirical result also suggests positive feedback trading behavior among QFII's security brokers. This helps smaller security brokers to make consistent profits in the volatile futures market.

Table V. *Granger causality test of QFII's investment behavior*

Dependent variable: ZTXA1				**Dependent variable: LOAN**				**Dependent variable: GOV**				**Dependent variable: Q60147**				**Dependent variable: Q60159**			
Excluded	**Chi-sq**	**df**	**Prob.**	**Excluded**	**Chi-sq**	**df**	**Prob.**	**Excluded**	**Chi-sq**	**df**	**Prob.**	**Excluded**	**Chi-sq**	**df**	**Prob.**	**Excluded**	**Chi-sq**	**df**	**Prob.**
LOAN	**1.195**	**1**	**0.274**	**ZTXA1**	**0.590**	**1**	**0.443**	**ZTXA1**	**6.102**	**1**	**0.014**	**ZTXA1**	**1.433**	**1**	**0.231**	**ZTXA1**	**3.799**	**1**	**0.051**
GOV	**2.582**	**1**	**0.108**	**GOV**	**3.529**	**1**	**0.060**	**LOAN**	**1.499**	**1**	**0.221**	**LOAN**	**1.556**	**1**	**0.212**	**LOAN**	**1.295**	**1**	**0.255**
Q60147	**2.053**	**1**	**0.152**	**Q60147**	**3.521**	**1**	**0.061**	**Q60147**	**0.000**	**1**	**0.998**	**GOV**	**0.101**	**1**	**0.751**	**GOV**	**0.009**	**1**	**0.926**
Q60159	**1.186**	**1**	**0.276**	**Q60159**	**0.222**	**1**	**0.638**	**Q60159**	**0.708**	**1**	**0.400**	**Q60159**	**0.008**	**1**	**0.930**	**Q60147**	**1.170**	**1**	**0.279**
Q30157	**1.095**	**1**	**0.295**	**Q30157**	**16.997**	**1**	**0.000**	**Q30157**	**0.369**	**1**	**0.543**	**Q30157**	**0.354**	**1**	**0.552**	**Q30157**	**0.038**	**1**	**0.846**
Q30156	**0.403**	**1**	**0.525**	**Q30156**	**7.718**	**1**	**0.006**	**Q30156**	**0.202**	**1**	**0.654**	**Q30156**	**1.412**	**1**	**0.235**	**Q30156**	**0.134**	**1**	**0.714**
Q30890	**1.130**	**1**	**0.288**	**Q30890**	**1.155**	**1**	**0.283**	**Q30890**	**0.644**	**1**	**0.422**	**Q30890**	**0.400**	**1**	**0.527**	**Q30890**	**0.010**	**1**	**0.921**
Q30136	**1.505**	**1**	**0.220**	**Q30136**	**2.363**	**1**	**0.124**	**Q30136**	**0.174**	**1**	**0.676**	**Q30136**	**1.904**	**1**	**0.168**	**Q30136**	**0.548**	**1**	**0.459**
Q60144	**3.996**	**1**	**0.046**	**Q60144**	**0.134**	**1**	**0.715**	**Q60144**	**2.494**	**1**	**0.114**	**Q60144**	**3.233**	**1**	**0.072**	**Q60144**	**1.977**	**1**	**0.160**
Q30153	**0.002**	**1**	**0.962**	**Q30153**	**0.008**	**1**	**0.930**	**Q30153**	**2.470**	**1**	**0.116**	**Q30153**	**0.377**	**1**	**0.539**	**Q30153**	**0.015**	**1**	**0.901**
Q30148	**0.453**	**1**	**0.501**	**Q30148**	**0.001**	**1**	**0.976**	**Q30148**	**2.887**	**1**	**0.089**	**Q30148**	**3.176**	**1**	**0.075**	**Q30148**	**4.211**	**1**	**0.040**
Q30165	**1.845**	**1**	**0.174**	**Q30165**	**2.346**	**1**	**0.126**	**Q30165**	**4.840**	**1**	**0.028**	**Q30165**	**14.115**	**1**	**0.000**	**Q30165**	**2.608**	**1**	**0.106**
Q30152	**0.658**	**1**	**0.417**	**Q30152**	**0.048**	**1**	**0.826**	**Q30152**	**1.373**	**1**	**0.241**	**Q30152**	**0.700**	**1**	**0.403**	**Q30152**	**1.438**	**1**	**0.230**
Q30896	**0.014**	**1**	**0.905**	**Q30896**	**0.932**	**1**	**0.334**	**Q30896**	**2.001**	**1**	**0.157**	**Q30896**	**1.532**	**1**	**0.216**	**Q30896**	**1.517**	**1**	**0.218**
All	**17.968**	**14**	**0.208**	**All**	**33.205**	**14**	**0.003**	**All**	**24.511**	**14**	**0.040**	**All**	**37.046**	**14**	**0.001**	**All**	**35.643**	**14**	**0.001**
Dependent variable: Q30157				**Dependent variable: Q30156**				**Dependent variable: Q30890**				**Dependent variable: Q30136**				**Dependent variable: Q60144**			
Excluded	**Chi-sq**	**df**	**Prob.**	**Excluded**	**Chi-sq**	**df**	**Prob.**	**Excluded**	**Chi-sq**	**df**	**Prob.**	**Excluded**	**Chi-sq**	**df**	**Prob.**	**Excluded**	**Chi-sq**	**df**	**Prob.**
ZTXA1	**1.386**	**1**	**0.239**	**ZTXA1**	**3.707**	**1**	**0.054**	**ZTXA1**	**1.937**	**1**	**0.164**	**ZTXA1**	**1.612**	**1**	**0.204**	**ZTXA1**	**3.353**	**1**	**0.067**
LOAN	**0.037**	**1**	**0.847**	**LOAN**	**0.961**	**1**	**0.327**	**LOAN**	**0.113**	**1**	**0.736**	**LOAN**	**2.062**	**1**	**0.151**	**LOAN**	**0.383**	**1**	**0.536**
GOV	**0.469**	**1**	**0.494**	**GOV**	**0.004**	**1**	**0.947**	**GOV**	**1.899**	**1**	**0.168**	**GOV**	**1.946**	**1**	**0.163**	**GOV**	**3.328**	**1**	**0.068**
Q60147	**1.509**	**1**	**0.219**	**Q60147**	**0.013**	**1**	**0.910**	**Q60147**	**3.810**	**1**	**0.051**	**Q60147**	**0.197**	**1**	**0.657**	**Q60147**	**0.342**	**1**	**0.559**
Q60159	**0.212**	**1**	**0.645**	**Q60159**	**1.369**	**1**	**0.242**	**Q60159**	**0.047**	**1**	**0.828**	**Q60159**	**0.354**	**1**	**0.552**	**Q60159**	**3.060**	**1**	**0.080**
Q30156	**0.781**	**1**	**0.377**	**Q30157**	**0.023**	**1**	**0.879**	**Q30157**	**0.743**	**1**	**0.389**	**Q30157**	**2.696**	**1**	**0.101**	**Q30157**	**1.181**	**1**	**0.277**
Q30890	**0.789**	**1**	**0.374**	**Q30890**	**0.009**	**1**	**0.924**	**Q30156**	**0.306**	**1**	**0.580**	**Q30156**	**0.170**	**1**	**0.680**	**Q30156**	**7.532**	**1**	**0.006**
Q30136	**2.488**	**1**	**0.115**	**Q30136**	**5.218**	**1**	**0.022**	**Q30136**	**0.314**	**1**	**0.575**	**Q30890**	**0.768**	**1**	**0.381**	**Q30890**	**2.121**	**1**	**0.145**
Q60144	**0.050**	**1**	**0.824**	**Q60144**	**1.908**	**1**	**0.167**	**Q60144**	**0.065**	**1**	**0.799**	**Q60144**	**5.189**	**1**	**0.023**	**Q30136**	**0.532**	**1**	**0.466**
Q30153	**0.395**	**1**	**0.530**	**Q30153**	**1.080**	**1**	**0.299**	**Q30153**	**0.335**	**1**	**0.563**	**Q30153**	**1.716**	**1**	**0.190**	**Q30153**	**2.164**	**1**	**0.141**
Q30148	**0.004**	**1**	**0.949**	**Q30148**	**2.842**	**1**	**0.092**	**Q30148**	**0.886**	**1**	**0.347**	**Q30148**	**0.576**	**1**	**0.448**	**Q30148**	**1.424**	**1**	**0.233**
Q30165	**0.135**	**1**	**0.714**	**Q30165**	**0.108**	**1**	**0.742**	**Q30165**	**0.007**	**1**	**0.933**	**Q30165**	**1.081**	**1**	**0.299**	**Q30165**	**4.631**	**1**	**0.031**
Q30152	**4.245**	**1**	**0.039**	**Q30152**	**0.172**	**1**	**0.678**	**Q30152**	**0.849**	**1**	**0.357**	**Q30152**	**0.000**	**1**	**0.992**	**Q30152**	**6.551**	**1**	**0.011**
Q30896	**0.240**	**1**	**0.624**	**Q30896**	**0.000**	**1**	**0.995**	**Q30896**	**0.077**	**1**	**0.782**	**Q30896**	**0.011**	**1**	**0.915**	**Q30896**	**0.044**	**1**	**0.834**
All	**14.216**	**14**	**0.434**	**All**	**20.208**	**14**	**0.124**	**All**	**15.837**	**14**	**0.324**	**All**	**25.804**	**14**	**0.027**	**All**	**52.064**	**14**	**0.000**
Dependent variable: Q30153				**Dependent variable: Q30148**				**Dependent variable: Q30165**				**Dependent variable: Q30152**				**Dependent variable: Q30896**			
Excluded	**Chi-sq**	**df**	**Prob.**	**Excluded**	**Chi-sq**	**df**	**Prob.**	**Excluded**	**Chi-sq**	**df**	**Prob.**	**Excluded**	**Chi-sq**	**df**	**Prob.**	**Excluded**	**Chi-sq**	**df**	**Prob.**
ZTXA1	**0.002**	**1**	**0.968**	**ZTXA1**	**0.724**	**1**	**0.395**	**ZTXA1**	**2.186**	**1**	**0.139**	**ZTXA1**	**0.025**	**1**	**0.874**	**ZTXA1**	**3.783**	**1**	**0.052**

LOAN	2.297	1	0.130	LOAN	3.903	1	0.048	LOAN	0.060	1	0.806	LOAN	15.593	1	0.000	LOAN	0.211	1	0.646
GOV	2.612	1	0.106	GOV	0.272	1	0.602	GOV	0.540	1	0.462	GOV	0.269	1	0.604	GOV	1.613	1	0.204
Q60147	1.470	1	0.225	Q60147	1.930	1	0.165	Q60147	0.750	1	0.386	Q60147	1.485	1	0.223	Q60147	0.099	1	0.753
Q60159	0.188	1	0.665	Q60159	0.218	1	0.640	Q60159	2.256	1	0.133	Q60159	1.374	1	0.241	Q60159	0.071	1	0.790
Q30157	0.154	1	0.695	Q30157	0.171	1	0.679	Q30157	0.386	1	0.534	Q30157	6.689	1	0.010	Q30157	1.152	1	0.283
Q30156	0.064	1	0.800	Q30156	0.013	1	0.908	Q30156	2.143	1	0.143	Q30156	3.544	1	0.060	Q30156	0.294	1	0.588
Q30890	0.160	1	0.689	Q30890	0.096	1	0.757	Q30890	0.368	1	0.544	Q30890	1.179	1	0.278	Q30890	2.245	1	0.134
Q30136	0.519	1	0.471	Q30136	0.246	1	0.620	Q30136	0.106	1	0.745	Q30136	0.096	1	0.756	Q30136	0.854	1	0.356
Q60144	0.138	1	0.710	Q60144	2.836	1	0.092	Q60144	0.102	1	0.749	Q60144	4.179	1	0.041	Q60144	0.001	1	0.976
Q30148	5.773	1	0.016	Q30153	0.184	1	0.668	Q30153	0.513	1	0.474	Q30153	5.731	1	0.017	Q30153	0.949	1	0.330
Q30165	0.190	1	0.663	Q30165	2.305	1	0.129	Q30148	0.488	1	0.485	Q30148	0.707	1	0.400	Q30148	0.712	1	0.399
Q30152	6.723	1	0.010	Q30152	3.053	1	0.081	Q30152	0.022	1	0.882	Q30165	3.342	1	0.068	Q30165	0.134	1	0.715
Q30896	2.073	1	0.150	Q30896	0.999	1	0.318	Q30896	0.001	1	0.971	Q30896	1.315	1	0.252	Q30152	0.140	1	0.708
All	32.469	14	0.003	All	19.541	14	0.145	All	19.910	14	0.133	All	51.503	14	0.000	All	17.285	14	0.241

Note: The codes are as explained in Table 1.

5.5 Empirical Results of QFII's Investment Behaviour

Based on the above model, we simulate the investment behaviour of QFIIs. Again using Merrill Lynch (Q60144) as an example, the result shows that during the 30-month period (2011.1.3~2013.6.27), the futures index falls from 9020 to 7713. Merrill Lynch trades for eight times and makes a profit of NT$290,000. We then simulate for the period 2011.1.3~2014.6.27 and find that the futures index rises to 9207 and the profit of Merrill Lynch increases to NT$320,000. The profit of HSBC (Q30896) increases from NT$190,000 at the first stage to NT$330,000 at the second stage, showing an increase of 73%. Citibank (Q60159) has the second highest market share and its profit increases from NT$280,000 at the first stage to NT$420,000 at the second stage, showing a rise of 50%. The profits of all QFIIs increase from NT$306,000 at the first stage to NT$426,000 at the second stage, showing an increase of 39.1%. Even after excluding the seven largest QFII's security brokers (S12), the profits increase by 39.1%, far exceeding the increase in futures index of 19.3%. In contrast, the simulated trading profits of the eight largest government owned security brokers fall from NT$140,000 at the first stage to NT$120,000, which is about 14.2%. The result suggests that the roles played from government owned security brokers and QFIIs are completely different. The information on security lending does not help improve trading performance of government owned security brokers. Therefore, despite the high volatility in futures market, as long as we can get hold of QFII's security lending information, we can profit through this program trading. In other words, the Taiwan futures market is not strong-form market efficient.

To conduct further tests, we replace Data3, the security lending data, with the spot data of Merrill Lynch (Q60144). That is, Data1 is the Taiwan index futures; Data2 is the spot trading data of individual QFII's security brokers; Data3 is the spot trading data of Merrill Lynch. Again, the results show that profits can be made (as shown in Group (A) of Table 6 (cont.)) and the total growth rate in profits is 23%, which is even higher than that of the previous model (16%). Overall, we provide evidence of positive feedback in QFII's investment behavior in Taiwan.

We then extend the above model to include Data4 as the filter. That is, Data1 is the Taiwan index futures; Data2 is the spot trading data of individual QFII's security brokers; Data3 is the QFII's security lending data; Data4 is the spot trading data of Merrill Lynch. We again find that profits can be made as shown in Group (B) of Table 6 (cont.) and the figure of Golden Sachs' detailed equity curve in the Appendix. The growth rate for the profit is 26.5%, which is higher than the previous two models. The winning probability is also higher. In other words, sometimes there is free money available to investors, but it is all up to the investors to use the right method to obtain the free money. This argument is consistent with Lo (2004)'s adaptive market hypothesis.

Table VI. *The total trading analysis of QFIIs based on program trading*

Unit: dollar, number of times, %

	2011.1.3~2013.6.27				2011.1.3~2014.6.27			
Broker	Net profit	Trading number	Winning prob	Average profit / average loss ratio	Net profit	Trading number	Winning prob	Average profit / average loss ratio
60144	290000	8	62.50	3.50	320000	11	54.55	3.50
60159	280000	4	100.00	n/a	420000	6	100.00	n/a
60152	310000	7	71.43	3.50	360000	9	66.67	3.50
60156	330000	6	83.33	3.50	380000	8	75.00	3.50
30157	310000	7	71.43	3.50	360000	9	66.67	3.50
30148	287200	4	100.00	n/a	247200	6	66.67	3.59
30165	287200	4	100.00	n/a	297200	8	62.50	3.57
60147	170000	5	60.00	3.50	220000	7	57.14	3.50
30896	190000	4	75.00	3.50	330000	6	83.33	3.50
30153	330000	6	83.33	3.50	380000	8	75.00	3.50
30136	280000	4	100.00	n/a	240000	6	66.67	3.50
30890	240000	6	66.67	3.50	270000	9	55.56	3.50
QFII	306600	7	71.43	3.23	426600	10	70.00	3.31
TOP2	310000	7	71.43	3.50	430000	10	70.00	3.50
TOP5	330000	6	83.33	3.50	360000	9	66.67	3.50
TOP7	317200	7	71.43	3.57	347200	10	60.00	3.56
S18	306600	7	71.43	3.23	426600	10	70.00	3.31
S17	306600	7	71.43	3.23	336600	10	60.00	3.36
S14	306600	7	71.43	3.23	426600	10	70.00	3.31
S12	306600	7	71.43	3.23	426600	10	70.00	3.31
GOV	140000	2	100.00	n/a	120000	3	66.67	3.50

Note: The codes are as explained in Table 1. The first stage covers the period 2011.1.3~2013.6.27 and the second stage covers the period 2011.1.3~2014.6.27.

Table VI (Cont.). *The total trading analysis of QFIIs based on program trading*

Unit: dollar, number of times, %

	2011.1.3~2013.6.27			2011.1.3~2014.6.27		
Broker	Net profit	Trading number	Winning prob	Net profit	Trading number	Winning prob
60144	0	0	0	0	0	0
60159	(A) 235600	6	66.6	265600	9	55.5
	(B) 280000	4	100	420000	6	100
60152	(A) 286800	8	62.5	371200	13	53.8
	(B) 330000	6	83.3	380000	8	75
60156	(A) 260000	5	80	364400	9	66.6
	(B) 210000	3	100	260000	5	80
30157	(A) 286800	8	62.5	391200	12	58.3
	(B) 330000	6	83.3	380000	8	75
30148	(A) 200000	8	50	116600	12	33
	(B) 260000	5	80	380000	8	75
30165	(A) 306800	7	71.4	391200	12	58.3
	(B) 280000	4	100	310000	7	71.4
60147	(A) 130000	9	42.8	210000	12	41.6
	(B) 190000	4	75	310000	7	71.4
30896	(A) 290000	8	62.5	227000	11	45.4
	(B) 190000	4	75	240000	6	66.6
30153	(A) 245600	10	50	350000	14	50
	(B) 330000	6	83.3	380000	8	75
30136	(A) 236800	6	66.6	316800	11	54.5
	(B) 280000	4	100	400000	7	85.7
30890	(A) 260000	5	80	364400	9	66.6
	(B) 260000	5	80	290000	8	62.5

Note: The codes are as explained in Table 1. The first stage covers the period 2011.1.3~2013.6.27 and the second stage covers the period 2011.1.3~2014.6.27.

6. CONCLUSION AND DISCUSSION ON INVESTMENT STRATEGIES

This empirical research includes two parts, the event study and the program trading simulation. In the first part, we use the event study method to test the effect of Glaucus' research report on F-Recycle's stock price on 24 April 2014. When report was announced, the CAR continued to fall and short-sellers were able to make abnormal returns. The results support hypothesis 1 that Taiwan stock market is not semi-strong-form efficient.

In the second part, we develop a program trading model based on Granger (1986) causality relationship to simulate the investment behavior of QFIIs. The results show that if we extend the optimal investment coefficient of QFIIs from the 30-month period between 3 January 2011 and 27 June 2013 to a longer period till 27 June 2014, most of the QFIIs can still profit. Therefore, the evidence supports hypothesis 2 that Taiwan futures market is not strong-form efficient.

Further, we use the Granger causality relationship model to find the leading player in herd behavior using the spot net trading value of QFIIs. We find that Merrill Lynch, which has the highest market share, is the leading player and is included as an endogenous variable by almost half of the QFII's security brokers' investment strategy in addition to the security lending information which can be used for risk control. Therefore, the results support hypothesis 3 that QFIIs in Taiwan market exhibit positive feedback investment behavior.

Since 1973 where the Bretton Woods system collapsed, the IMF and the World Bank proposed the Washington Consensus to help solve the debt crisis in Latin America in the 1980s. Since then, liberalization, privatization and marketization became global trends. The US dollar did not lose its leading position in the global currencies as a result. Since financial globalization, the recent statistics show that the US is able to profit from the international mint tax, which represents more than 5% of the GDP in the US on average each year. According to the institutional change theory of North (1982), it is a rational choice of choosing the international monetary non-system under current economic and political systems. However, the emerging markets are suffering great impact due to the large and quick flow of global capital. After the global financial crisis, the US Federal Reserve adopted the quantitative easing (QE) policy by releasing large amount of US dollars. Steil, who is a senior fellow and director of international economics at the Council on Foreign Relations, points out in his recent article in Foreign Affairs (2014) that the Fed will pay attention to the spillover effect. [7] If the Taiwan is eager to open the market by encouraging QFIIs, there is a fear of "too big to manage" by FSC.[8] Currently, the QFIIs own about 38% of the market share in Taiwan stock market. The Taiwan financial market has large capital inflows by QFIIs while large capital outflows by domestic investors, showing unconventional Gresham's Law (i.e., inferior currency is being squeeze out by better currency). Therefore, it is important for emerging markets to carefully examine their own conditions, set a suitable opening level and have tight law control when opening the markets. This is because large hedge funds may adopt unintentional strategy (through positive feedback trading by increasing asset price volatility) or intentional strategy (through requesting law and regulation changes) to realize speculative profits.

Due to the space and time limit, future research could study the security lending stocks in Taiwan financial markets or use a different optimal back-testing program to run the simulation.

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[7]Please refer to Commercial Times on 2014.8.8 for an article on "The chain effect of the Fed's monetary policy changes".

[8]Please refer to Economic Daily News on 2014.8.3 for an article on "A control relax on QFII's reports by FSC".

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Appendix

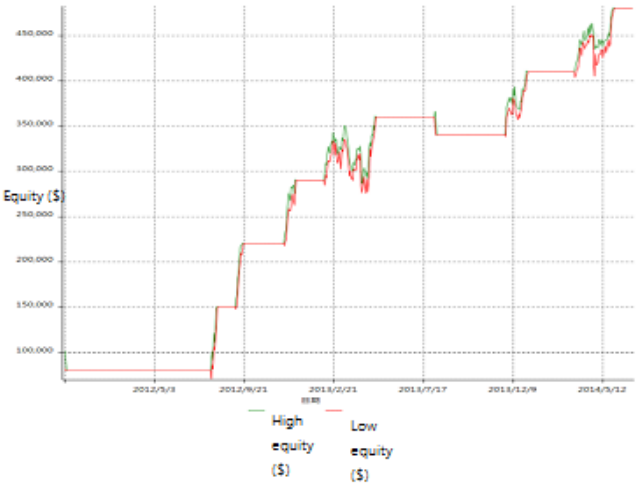

Figure2. *Detailed equity line curve of Goldman Sachs (Q30148)*