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Price Behavior of the Taiwan Depositary Receipt

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Abstract

This is a case study to discuss the Taiwan Depositary Receipt's (TDR) market performance. Attention is focused on the event study, market risk analysis and the trading strategy for TDRs. Tests of abnormal returns for underlying stocks during the event period were conducted. Regression analysis via the market model, comparing the risk level between the TDR and the underlying stocks was investigated. Furthermore, causality tests are applied to explore the relationships between the price of underlying stocks and the corresponding TDR. Finally, utilizing the cointegration structure, suitable strategies for trading TDRs are proposed. The empirical results indicate that the underlying stocks have declaration effects, at the TDR's initial announcement date. TDR's issued after 2009 have higher risks and higher returns. The out-sampled empirical results show that there are no immediate arbitrage opportunities, however, the proposed waiting trading strategy could increase profits.

Key words: Cointegration; Event study; Market risk; Taiwan depositary receipts; Trading strategy

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INTRODUCTION

In order to satisfy transnational capital demand, more and more firms have chosen to enter international capital market financing. As long as capital markets are not completely integrated, it is interesting to investigate the price behavior of international listings. Once a stock is listed at a foreign capital market, foreign investors can trade the stock in their own currency; and, save the transaction costs associated with dealing in a foreign currency, as well as effectively circumvent existing foreign exchange regulations. Thus, the international cross-listings may result in structural changes in the equilibrium asset pricing relationship.

The depositary receipt organized by the American Morgan Bank since 1972, is a negotiable certificate that usually represented a firm's publicly traded equity or debt; which is created when a broker purchased the firm's shares on the home stock market and traded then in the overseas stock market to raise capital. It was one kind of financial commodity, the possessor's rights and duties are the same as common share shareholder. According to the listing area, depositary receipts are divided into, the American Depositary Receipt (ADR), listing in the American stock market; the European Depositary Receipt (EDR), listing in London, Luxembourg and the German stock market, and the Global Depositary Receipt (GDR), listing all over the world.

Much of the existing depository receipts research literature is focused on the abnormal returns, or risks, to the original stock, after overseas listing of the ADR or GDR. An empirical study of stock returns surrounding the international listings was examined by Alexander et al. (1988). The sample including thirty-four non-US listed firms was divided into two groups, Canadian firms, supposed to covariate more highly with the US stock market, and non-Canadian firms. The empirical results

indicated that an insignificant decline in expected returns, much smaller than that of the non-Canadian firms, was obtained for Canadian firms.

The hypothesis, that a decrease in the cost of firms from depositary receipt offerings, was examined by Errunza and Miller (2000). A sample of 126 firms, from 32 countries outside the US, including developed and emerging markets, announced their first DR programs over the period 1985 to 1994 were used to investigate the conjecture. The empirical results indicated that financial market liberalization has significant economic benefits, about 42% decline in capital cost. Foerster and Karolyi (1999) investigated 153 non-US firms, from 11 countries, cross-listing their shares for the first time in the United Stated as ADRs from 1976 to 1992. The empirical results showed that there were significant abnormal returns during the year before listing; a minor 1.2 percent abnormal return during the listing week; but, a loss of 14 percent returns during the year following listing.

In order to investigate firm's benefits, improvements in capital access following an ADR listing, a sample of ADR listings on the NYSE and Nasdaq, over the period, 1986 to 1996, were examined by Lins, Strickland, and Zenner (2005). The empirical results indicated that a significant decline in the investment to cash flow sensitivity following the US market listing for firms from emerging markets was found; on the contrary, it was non-significant for firms from developed markets. These findings suggested that firms from emerging markets benefit from a US listing through an enhanced access to external capital markets.

Bailey, Karolyi, and Salva (2006) discussed the volatility and volume reactions to foreign firms' earnings announcements before and after the US listing. A sample consisting of 387 firms over 40 emerging and developed markets around the world that cross-listed on US markets over the period from 1989 to 2001 was analyzed. The empirical results indicated that the abnormal return volatility and trading volume around earnings announcements by non-US firms are significantly larger once they list on US markets.

Instead of discussing US listings, Lok and Kalev (2006) analyzed the daily price behavior of cross-listed stocks that traded on both the NZX and the ASX, during the period from May 2000 to December 2002. The daily data included 38 Australian and 25 NZ stocks trading on both markets. The empirical results suggested that both markets contribute to price discovery, but the home market is generally dominant. Arbitrage opportunities are not generally available in the trading of cross-listed stocks available on two markets. Tolmunen and Torstila (2005) analyzed 547 European firms listed shares in the US stock market, from 1996 to 2000, to examine whether European firms chose to list shares in the US market to facilitate capital acquisitions. The empirical evidence showed that once the firm was cross-listed in the US market, it could initiate larger transactions.

Foreign enterprises listing depository receipts on the Taiwan stock market, is called the Taiwan Depository Receipt, hereafter referred to as TDR. The new Taiwan dollar is taken as the unit of charge. The value declaration, the trading hours, perhaps the fluctuation units and magnitude, and so on, are all according to Taiwan stock market regulations. As well as the bid-ask patterns for trading TDRs are according to Taiwan stock market regulations. The TDR listing has some advantages: To the publisher, it may increase the fund raising sources and improve the investment environment, and promote overseas service, the product and firm's international popularity. To the investor, it may increase investment tools, share foreign enterprise's profit growth, reduce the risk from directly investing in foreign markets, and limit the foreign exchange losses. Moreover, the TDR listing can expand Taiwan stock market's scale, advance internationalization and substantially increase government's tax revenue.

TDR holders may earn price margins in the domestic stock market, and may short or exchange the TDR from the depository organization. To short a TDR means that the depository organization sells the underlying stock of the TDR, and transfers the selling price into new Taiwan dollars. As the TDR has exchanged to the original stock, all the remaining transactions should be finalized at the original stock market. The investor must take the risk and cost expenditures from shorting, and the depository organization does not guarantee that the original stock will be transacted.

Recently relationships across the Taiwan Straits have improved. Moreover the policy that foreign enterprises can come to Taiwan to list their stock in the Taiwan stock market was promoted beginning July 31, 2008. In this paper, investigations are focused on the TDR that the foreign enterprise's stock has already listed on the domestic stock market, then applies the TDR listing on the Taiwan market to solicit capital. On April 28, 2009, the first TDR listing was the Want Want China Firm, successfully attracting much attention from investors. After that many foreign enterprises relying on this pattern, distributed TDRs in Taiwan. There were a total of ten enterprises during the year 2009.

The firm issues identical stock on two different stock markets, the stock prices theoretically should be consistent. Once stock prices deviate, investors may pursue arbitraging opportunities; afterward, arbitrage may lead stock prices to return to equilibrium. The price relationship between the TDR and the original stock on each of the two stock markets were investigated: Firstly, examination of the ten listed TDRs, about whether abnormal returns existed from the original stock, and the TDR investment risk was higher than that of the original stock, are performed. Also the causality relationships between the original stock price and the TDR price are analyzed. The long-term cointegrated tendency between

the depositary receipt and the original stock, are organized to sketch suitable TDR transaction strategies. This paper will synthesize the mentioned research scopes to interpret the TDR market; hopefully, the empirical results provide references for investors.

The rest of the paper is organized as follows: The research framework for analyzing the original stock prices and the TDR prices are introduced in Section 1. In Section 2, empirical analysis on the ten TDRs listed in 2009 is analyzed. Finally, conclusion is offered.

1. RESEARCH METHODS

The price relationships between the original stock and the TDR are analyzed in this section. Firstly, discussions are focused on investor responses to the original stock around the TDR primary announcement date or the listing date. After the TDR listing of Want Want China in 2009, the Ju Teng TDR followed immediately; no matter whether during the purchasing period or the listings honeymoon period, these listings all did the TDR market an enormous favor as well as driving the original stock's prices up on the Hong Kong stock market. Using the event study methodology, whether the original stock prices were affected by the TDR listing, the first ten initial listings TDR in 2009, will be investigated.

The Taiwan stock market belongs to a shallow-dish type market, once external influences invade, the margin of fluctuation or risk will often be higher than that in a mature market. The market model, via regression analysis, will be carried out to understand the degree of fluctuation between the two stock markets. Moreover, when rational investors trade the TDR, they should refer to the stock price in the original market; in other words, the stock price in the original market should affect the TDR price. Therefore, the causality testing technique may be utilized to examine the relationships between the two market prices; if the stock price in the original market does affect the TDR price, then investors may using the original stock price to forecast the TDR's future price tendency.

Theoretically the identical firm's security listing on two different stock markets, should tend to be consistent prices in equilibrium; whenever the stock prices deviate, investors might find arbitrage chances. Then operating arbitraging strategies, the stock prices should again return to equilibrium. Using the cointegration structure between the TDR price and the original stock price, some TDR transaction strategies could be set up to carry out the arbitrage. Investment profits or losses of the suggested strategies are evaluated. The research contents discussed above will be conducted via research methods discussed in the following subsection.

1.1 Return, Risk and Causality Analysis

The study methodology is mainly used to investigate whether the securities prices will change, and if abnormal returns exist, after the occurrence of some specific event. The following regression model is applied to combine the data from the estimation period and the event period together:

$$R_t = \alpha + \beta R_{mt} + \sum_{j=0} r_j D_{jt} + \varepsilon_t,\ t = -T_1, \cdots, T. \tag{1}$$

Here R_{mt} , is the stock return and the domestic market index return respectively at time t; α is the intercept term, β is the regression coefficient, r_j is the abnormal return and ε_t is the error term; D_{jt} is a dummy variable, taking value 1, as $j = t$ and 0, otherwise.

For each firm, the described regression model (1) is fitted separately. Two kinds of event dates are discussed in this paper: One is the primary announcement date and the other is the listing date. The estimation period starts from the 204th day to the fifth day before the event day, 200 days in total; while the event period starts from the fourth day before the event day to the fourth day right after the event day, a total of 9 days. The CAPM is used to investigate the market risks, as usual the stock market index return is one of the important explanatory variables in the model. Since the analyzed stocks belong to the Asian market, for simplicity, the S&P Asian 50 replaces the corresponding domestic stock market index. The volatility index (VIX) is also used as another explanatory variable.

The VIX is the weighted average of the option's implied volatility, reflecting the cost that investors must undertake in facing future risks. When the VIX is over 40, it indicates that market fluctuations are high, and the investor presents pessimistic panicked views toward future market tendencies; when the VIX is under 15, it indicates that the market tends toward future stability. Generally speaking, the VIX usually presents a negative relation with the stock market index, therefore is popularly called "the panic index" by investors

A respective regression model is established for the TDR return, or the original stock return as follows:

$$R_t = \alpha + \beta R_{S\&P\_Asian\_50,t} + \gamma R_{VIX,t} + \varepsilon_t \tag{2}$$

where $R_{S\&P\_Asian\_50,t}$ and $R_{VIX,t}$ are returns of the S&P Asia 50 and VIX respectively; $\varepsilon_t = \lambda_1\varepsilon_{t-1} + \lambda_2\varepsilon_{t-2} + \cdots + \lambda_p\varepsilon_{t-p} + u_t$, here λ's are the coefficients of the autoregression model, satisfying the stationary condition. In order to catch the volatility clustering phenomenon, the error terms $\{u_t\}$ are assumed to satisfy a GARCH(1,1) model:

$$u_t \sim N(0,\delta_t^2) \text{ with } \delta_t^2 = \varnothing_0 + \varnothing_1 u_{t-1}^2 + \varnothing_2 \delta_{t-1}^2$$

Granger's causality is used to examine the price relationships between the TDR and the original stock via the following models:

$$X_t = \sum_{j=1}^{p} \varphi_j X_{t-j} + \sum_{j=1}^{p} \psi_j Y_{t-j} + w_t \quad \text{and} \quad Y_t = \sum_{j=1}^{q} \varphi_j^* Y_{t-j} + \sum_{j=1}^{q} \psi_j^* X_{t-j} + v_t$$

Here X_t and Y_t respectively represent the daily TDR price and the adjusted daily stock price in new Taiwan dollars on the domestic market, that is:

Adjusted original stock price=The stock price at the domestic market × transfer × unit current exchange rate. (3)

Here $\{w_t\}$ and $\{v_t\}$ are two independent white noises. Moreover, the optimal lagged periods P and q are respectively determined by the respective AIC value.

1.2 Trading Strategies

Engle and Granger (1987) suggested that a vector time series, despite all components being stationary after taking the first difference, may have stationary linear combinations. This caused the study of financial cointegrated time series models which is a common approach to eliminate illogical correlations and still keep the long-term equilibrium between the time series data. Before performing a cointegration test, a unit root test should be done. In this paper, the ADF test proposed by Dickey and Fuller (1979) is used to examine that both the prices of the TDR and the original stock have a unit root of the same order. Then the Johansen's maximum eigenvalue test (1988) is used to examine the existence of cointegration structures between the two stock prices.

If a cointegration relationship between the two stock prices does exist, theoretically, price deviations may induce transaction opportunities for trading the TDR. However, under continuing operations, the price deviations should be eliminated and the two prices will eventually tend towards equilibrium. Thus the cointegration structure could be applied to create trading strategies to detect TDR prices which may be over or under valued.

Once the cointegration relation is confirmed, the cointegration model is set as:

$$\ln(Y_t) = \eta + \theta \ln(X_t) + \varepsilon_t \tag{4}$$

Here Y_t denotes the TDR daily price and X_t is the adjusted original daily stock price. Since there is a 7% daily price constraint on the Taiwan stock market, this will limit stock price fluctuation during the trading day. Suitable TDR trading strategies applying model (4), are described in the following subsections.

1.2.1 Daily Trading Strategy

Suppose the most recent TDR transaction is for a short position, short selling at time ν, with delivery price Y_ν. Let
$\hat{\eta}_i$ and $\hat{\theta}_i$ denote the respective least squared estimate in model (4) with respect to η_i and θ_i ; suppose, the current TDR price, Y_t and the original stock price, X_t satisfy the following inequality, say:

$$(1-\delta_1)Y_t > \exp\{\hat{\eta} + \hat{\theta} \ln(X_t)\} \tag{5}$$

And if the position trading at time ν, has not been closed, and the current TDR price is higher than the previous trading price, that is $Y_t > Y_\nu$, then a TDR short selling strategy is executed. However, if the previous position has been closed during the time period (ν,t), then once inequality (5) is present, the TDR short selling strategy is executed again at price Y_t. ε_1 includes all the related transaction costs: Each handling charge, either long or short, is 0.1425%, the TDR transaction tax is 0.1%, and the short selling handling charge is 0.08%, for a conservative, $\delta_1 = 2 \times 0.1425\% + 0.1\% + 0.08\% = 0.465\%$.

On the other hand, suppose the most recent TDR transaction is at the long position, margin buying at time ν with the delivery price Y_ν As well as, the following inequality follows:

$$(1-\delta_1)Y_t < \exp\{\hat{\eta} + \hat{\theta} \ln(X_t)\} \tag{6}$$

Again, if the position trading at time ν has not been closed and the current TDR price Y_t is lower than the previous trading price, that is $Y_t < Y_\nu$, then the TDR margin buying strategy is executed; however, if it has been closed during time period (ν,t), then once inequality (6) is present, the TDR margin buying strategy is executed again at price Y_t. No matter whether short selling or margin buying, if the closing signal appears on the same day, then the opposite position is executed. On the contrary, if there is no closing opportunity, then the position is forced to close at the last transaction of the same day. This is called the daily trading strategy in this paper. The detailed closing procedure is described as follows:

Case A: Suppose at time t the TDR is sold by short selling at some relatively high price Y_t. Later, if we plan to close the position by margin buying with an expected return rate of at least, $\rho \times 100\%$, then the anticipated closing price Y_u must satisfy the following condition:

$$\frac{(1-\tau_1)Y_t - (1+\tau_2)Y_u}{(1+\tau_2)Y_u} \geq \rho$$

Therefore, a suitable closing time s, would be chosen as follows:

$$s = \min\left\{u : u > t \quad \& \quad Y_u \leq \frac{(1-\tau_1)}{(1+\rho)(1+\tau_2)} Y_t\right\} \tag{7}$$

Then at least $\rho \times 100\%$ return rate is guaranteed. Here, τ_1 includes the handling charge for TDR selling 0.1425%, the security transaction tax 0.1% and the short selling handling charge 0.08%, in total 0.3225%; τ_2 denotes the handling charge for the TDR buying 0.1425%.

Case B: Suppose at time t the TDR margin is bought at some relatively low price Y_t. Later, if we plan to close the position by short selling with an expected return rate of at least, $\rho \times 100\%$, then the closing price Y_u must satisfy the following condition:

$$\frac{(1-\tau_1)Y_u - (1+\tau_2)Y_t}{(1+\tau_2)Y_t} \geq \rho$$

Therefore, a suitable closing time s, would be chosen as follows:

$$s = \min\left\{u : u > t \quad \& \quad Y_u \geq \frac{(1+\tau_2)(1+\rho)}{(1-\tau_1)} Y_t\right\}$$

1.2.2 Waiting Trading Strategy

In this subsection, the carrying period is extended from one day to at most one month, called the waiting trading strategy. The process for the waiting trading strategy is the same as the daily trading strategy. If the investor is short selling the TDR, the position is closed by margin buying. However, it is complicated to evaluate the transaction costs of margin buying, which possibly has to be kept up to one month. Thus spot buying and then spot selling are used. Detailed descriptions are given as follows:

Suppose the TDR transaction occurred recently, at time v, with the spot buying price Y_v. As well as, the current TDR price Y_t and the original stock price X_t satisfying the following inequality:

$$(1+\delta_2)Y_t < \exp\left\{\hat{\eta} + \hat{\theta}\ln(X_t)\right\} \tag{8}$$

If the position trading at time has not been closed, and the current TDR price Y_t is lower than the previous trading price, that is $Y_t < Y_v$, then the TDR spot buying strategy is executed. However, if the previous position has been closed during the time period (v,t),then once inequality (8) is present, the TDR spot buying strategy is executed again. Here ε_2 denotes the related transaction costs. For each trade, the handling charge is 0.1425%, and the TDR transaction tax is 0.1%. A conservative ε_2 value is set as, $\varepsilon_2 = 2 \times 0.1425\% + 0.1\% = 0.385\%$.

The closing decision is similar to that of the daily trading strategy. The performance of Case A is exactly the same; while in Case B, the optimal closing time s, is replaced by

$$s = \min\left\{u : u > t \quad \& \quad Y_u \geq \frac{(1+\tau_2)(1+\rho)}{(1-\tau_3)} Y_t\right\}$$

Here, τ_3 is the handling charge of spot selling, $\tau_3 = 0.1425\% + 0.1\% = 0.2425\%$. If there is no opportunity to close the position during the designated waiting period, the TDR trading will be forced to be carried out at the last transaction during the investment period. Since the investment period is stipulated as at most only one month, for convenience, interest involving pot buying costs are omitted in this discussed waiting trading strategy.

Referring to both strategies, no matter whether it is establishing or closing the position, once the transaction signal appears, the TDR trading will be carried out in the next minute's transaction.

1.2.3 Profits Evaluation

For both strategies, the return rate for each transaction is defined as:

$$\text{Return Rate} = \frac{(1-\tau_1^*) \times Y_{short} - (1+\tau_2) \times Y_{long}}{(1+\tau_2) \times Y_{long}} \times 100\%$$

The value of τ_1^* will be adjusted according to the operation, whether the trade is short selling or spot selling. If it is short selling, then τ_1^* contains the short handling charges 0.1425%, transaction tax 0.1%, and the short selling handling charge 0.08%, in total 0.3225%. On the other hand, if it is spot selling, then τ_1^* contains the short handling charges 0.1425%, and transaction tax 0.1%, in total 0.2425%. On the other hand, no matter if it is margin buying or spot buying, τ_2 only contains the long handling charges, 0.1425%.

Based on the trading strategy, the daily trading strategy or the waiting trading strategy, the overall return rates during the investment period are summarized as follows:

$$\text{Overall Return Rate} = \frac{\sum\left[(1-\tau_1^*) \times Y_{short} - (1+\tau_2) \times Y_{long}\right]}{\sum\left[(1+\tau_2) \times Y_{long}\right]} \times 100\% \tag{9}$$

The overall return rate results help to evaluate arbitrage performances between the TDR market and the original stock market. In particular, whether the cointegration structure could be used to establish trading strategies to earn profits; as well as, for each TDR transaction, from opening a position to closing this position, the average duration time for keeping a position is computed. These results could provide references to investors planning a TDR trading strategy.

2. EMPIRICAL ANALYSIS

In this paper, the discussion sample consists of ten firms which initially listed on the TDR at the Taiwan market in 2009. For each firm, the in-sampled daily data period is from the listing date to April, 30, 2010; while the out-sampled minutely data period is from April 1, 2010 to April 31, 2010. The former daily data provide information for events studying, market risk analysis and investigating price relationships between the TDR and the original stock. Applying the price cointegration structure between the TDR and the original stock, the latter minutely data are used to evaluate the performance of the proposed TDR trading strategy.

The analyzed data include the TDR prices, the original stock prices and the related stock market index, the Taiwan weighted stock index (TAIEX), the Hong Kong Hang Seng index (HIS), the Singapore Straits Times index (SSTI), the S & P Asia 50, etc., along with the VIX and the exchange rate. The TAIEX and the TDR data are coded from the Taiwan Economy Journal; HIS, SSTI, VIX and the original stock data are coded from Yahoo Finance; S & P Asia 50 data is coded from the Standard & Poor's; and, the exchange rate data is coded from the Taiwan Central Bank. Most of the discussed original stocks

are listing at the Hong Kong stock market, except the Oceanus Group Limited, which is listing on the Singapore stock market. The TDR data period is from its first listing date to March 31, 2010. The original stock price will be adjusted according to formula (3). For simplicity, the original stock of A firm is referred to as the A stock; while the A TDR denotes the TDR of firm A, in the following discussion.

2.1 Preliminary Descriptive Statistics Analysis

The highest averaged return was achieved by the Oceanus TDR, up to 0.526%; while the lowest averaged return was the Oceanus stock, at -0.401%. As well, when comparing to the related market returns, the lowest return ratio also was the Oceanus stock, which is relatively lower than that of the SSTI, by about 64%; while the Oceanus TDR's return is higher than the TAIEX return of 10%. The Oceanus Group lists on two international stock markets, the Singapore stock market and the Taiwan stock market. However, each has entirely different appraisals. Taiwan's investors give a higher appraisal to the global abalone industry leader, Oceanus, than investors in the Singapore domestic stock market. Since Chinese people are used to regarding abalone as a high-quality ingredient and have deep confidence in its earnings, the Oceanus TDR performs sharply better in the Taiwan stock market. From a financial management viewpoint, if overseas investor's appraisals are higher than those of domestic investors, then the overseas fund raising will reduce fund cost and achieve the goal of financial control.

Besides, the highest relative return ratio on TDRs is Solargiga Energy's TDR, 16.302; Oceanus's TDR is second, 10.011; and Sandmartin's TDR third, 8.619. Solargiga Energy Industry is the leading enterprise in the solar energy industry, and a crystal-bar and chip manufacturer in China. As environmental protection becomes more and more important, Solargiga Energy has quite high potential to be a producer of energy alternatives. This may be the main reason that Solargiga Energy's TDR return surmounted the TAIEX return. Among the ten TDRs, there are eight TDRs giving returns higher than the TAIEX. On the other hand, only four out of the ten original stock returns are higher than the corresponding domestic market index returns. For investors, it seems the TDR is more attractive than the original stock.

Table 1
Descriptive Statistics for Returns

Code	Return of TDR			Return of Original Stock			Premium Ratio(%)
WW	09/04/28[1]	0.157[3]	0.046[5]	08/06/18[1]	0.167[3]	0.023[6]	17.399[3]
	232[2]	2.607[4]		449[2]	2.131[4]		16.199[4]
JT	09/05/25	0.303	2.984	08/07/17	0.196	0.938	38.141
	214	3.484		428	3.269		23.083
YO	09/10/08	0.065	0.417	08/12/01	-0.176	-16.396	47.774
	118	3.016		334	2.327		20.431
NFA	09/10/12	0.101	1.807	08/11/20	-0.037	-14.249	17.523
	116	2.750		341	1.136		12.969
VM	09/12/03	-0.118	-4.010	09/02/05	0.369	5.735	0.061
	78	2.703		293	3.746		9.260
SE	09/12/11	0.388	16.302	09/02/11	-0.376	-7.685	55.183
	72	3.362		289	2.640		11.602
TIN	09/12/16	-0.233	-8.364	09/02/16	-0.078	-2.036	9.593
	69	2.326		286	2.282		7.813
SAN	09/12/18	0.310	8.619	09/02/19	-0.019	-5.185	10.012
	67	3.711		283	3.341		11.007
NN	09/12/22	0.045	2.518	09/02/20	0.061	4.635	17.688
	65	2.840		282	3.028		12.414
OC	09/12/31	0.526	10.011	09/02/26	-0.401	-64.154	68.904
	58	3.967		278	2.972		26.591

Premium Ratio=100% (TDR price-Adjusted original stock price)/Adjusted original stock price;
1. Data starting date;
2. Number of in-sampled daily data;
3. Average;
4. Standard deviation;
5. Relative Return Ratio for the TDR=(TDR return-Taiwan market index return)/Taiwan market index return;
6. Relative Return Ratio for the original stock=(Stock return- Local market index return)/Local market index return;
WW: Want Want China Holdings Limited; JT: Ju Teng International Holdings Limited;
YO: Yorkey Optical International (Cayman) Limited; NFA: New Focus Auto Tech Holdings Limited; VM: Vietnam Manufacturing and Export Processing (Holdings) Limited;
SE: Solargiga Energy Holdings Limited; TIN: Tingyi (Cayman Islands) Holding Corporation;
SAN: Sandmartin International Holdings Limited; NN: Neo-Neon Holdings Limited;
OC: Oceanus Group Limited.

Since all TDRs are listed at a premium, the TDR listing price is higher than the original stock price, thus the premium ratios are all positive. The highest premium ratio is for the Oceanus TDR, the TDR listing price is 68% over the original stock price; and the lowest is for the Vietnam Manufacturing TDR, only 0.061% above the

stock price. The above discussed results are exhibited in Table 1.

2.2 Return and Risk Analysis

2.2.1 Event Study Approach

The existence of abnormal returns during the event period, four days before or after the event date is examined by model (1). First taking the TDR primary announcement date as the event date, the analysis results discovered that three of the original stocks, the New Focus Auto Tech stock, the Want Want stock and the Ju Teng stock, had abnormal positive returns at the TDR announcement date; in particular, the New Focus Auto Tech reached 1% significance. While only the Sandmartin stock had abnormal positive returns before the event date, and had abnormal negative returns right after the event date, this infers that the Sandmartin TDR announcement was helpful to the domestic stock price. Afterwards the price became lower than original price levels.

Next taking the TDR listing date as the event date: The results indicate that the three original stocks, Ju Teng, Tingyi and Oceanus stock, had abnormal positive returns at the TDR listing date. For the Tingyi stock, there was a significantly, at the 1% level, abnormal negative return at the listing date. The TDR listing response for the Tingyi may occur ahead of time, thus stock prices did not rise, instead falling on the listing day. The above discussed results showing significant abnormal returns are exhibited in Table 2.

Overall, the TDR announcing event seems more attractive to investors than the TDR listing event. The abnormal returns are more remarkable for those announced in early 2009; as time went on, the event response to the original stock at the domestic market gradually disappeared.

2.2.2 Market Model

The returns of the TDR and the original stock, both connected to the same firm, are respectively investigated by applying the market model (2), with the explanatory variables including the S&P Asia 50 return and the VIX. The coefficient is the TDR (or the original stock) risk coefficient to the S&P Asia 50 return. If value is greater than 1, that means the fluctuation of the TDR (or the original stock) return is greater than the Taiwan stock market index (or domestic stock market index) return.

Table 2
Abnormal Returns for the Original Stock

E	TDR Announcement Date[1]			TDR Listing Date[2]			
	WW	JT	NFA	SAN	JT	TIN	OC
-4	3.138	-1.068	1.455	-0.079	-3.184	0.178	-0.138
	(0.247)	(0.824)	(0.751)	(0.975)	(0.515)	(0.926)	(0.974)
-3	0.293	-4.393	1.530	6.020**	3.715	0.661	3.883
	(0.914)	(0.361)	(0.739)	(0.018)	(0.447)	(0.730)	(0.357)
-2	-0.090	2.016	-0.059	2.295	3.071	-0.554	8.408**
	(0.973)	(0.675)	(0.990)	(0.366)	(0.529)	(0.772)	(0.047)
-1	-0.090	3.339	0.414	1.728	11.004**	-0.083	1.520
	(0.973)	(0.487)	(0.928)	(0.496)	(0.025)	(0.966)	(0.718)
0	5.733**	11.884**	18.727***	3.193	2.127	-5.707***	-5.543
	(0.036)	(0.014)	(0.000)	(0.209)	(0.663)	(0.003)	(0.189)
1	0.025	-1.031	-6.822	-5.795**	-0.150	-1.972	-2.272
	(0.993)	(0.830)	(0.139)	(0.023)	(0.975)	(0.304)	(0.590)
2	2.205	-0.924	-1.762	-1.670	-7.105	-3.461*	-3.865
	(0.415)	(0.847)	(0.701)	(0.511)	(0.149)	(0.072)	(0.359)
3	0.143	-3.142	2.032	1.291	-10.267**	0.753	-0.680
	(0.958)	(0.514)	(0.658)	(0.611)	(0.038)	(0.694)	(0.872)
4	-0.615	3.777	-3.714	3.248	-0.034	1.040	-1.632
	(0.820)	(0.432)	(0.419)	(0.201)	(0.994)	(0.587)	(0.699)

1. The TDR primary announcement date as the event date;
2. The TDR listing date as the event date; Regression Model: $R_t = \alpha + \beta R_{mt} + \sum_{j=0}^{T} r_j D_{jt} + \varepsilon_t$ **; $H_0 : H_j=0$ vs $H_a : r_j \neq 0$; The number in parentheses denotes the p-value for testing H_0 vs H_a ; *** attained 1% significance level; **attained 5% significance level; *attained 10% significance level.**

Usually, investors buy riskier assets during bull markets, expecting higher profits. On the contrary, when β value is less than 1, investors would buy defensive assets in a bear market to protect assets. Using the TDR return as the response variable in model (2), all the estimated β coefficients are significantly positive. In particular, the β estimate of the Vietnam Manufacturing TDR is 1.029, which is the only TDR return significantly over the TAIEX return. The remaining β estimates, though less than 1, are significantly positive, with a p-value less than 3%.

The implied volatility VIX reflects the cost that investors must undertake for facing future risks. Higher VIX values indicate that the investor holds a pessimistic panicked view of the future; while lower VIX values mean that the market is viewed as tend to be stable in the

future. The VIX panic index usually presents a negative relation with the stock market index. The tendencies of the two explanatory variables are plotted, with negative relationships, from 2006 to 2010, in figure 1. Most of the coefficients in the TDR model are non-significant, except the Solargiga Energy TDR shows a slightly positive relationship with the VIX, at 10% significance level. Thus even though the stock market quotation is not optimistic, investors still favor this industry's potential. Among the ten discussed firms, six of them show higher estimates in the TDR model than that in the original stock model. This indicates a TDR investment risk higher than the original stock risk, thus the return is also relatively high. TDRs have gradually gained Taiwanese investor's favor.

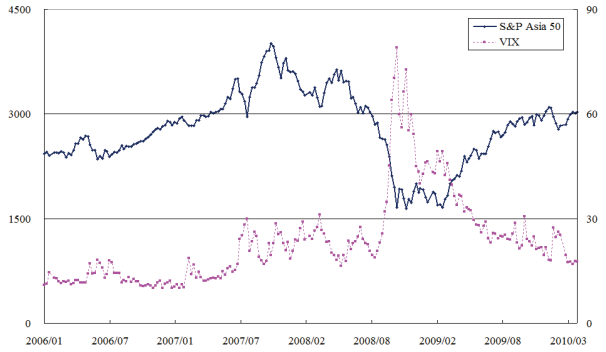

Figure 1
Tendency Plotting of S&P Asia 50 and VIX

Next, regression analysis of the original stock returns on the S&P Asia 50 and VIX are investigated. With the exception of Vietnam Manufacturing's stock, the remaining β estimates are significantly positive, presenting a positive relationship between the original stock return and the S&P Asia 50 return. The β estimates of the Neo-Neon stock and the Oceanus stock are respectively 1.145 and 1.070, greater than 1, with significance levels both reaching 1%. This indicates that the volatilities of the two stocks exceed the volatility of the S&P Asia 50 index. Referring to the estimate of the γ coefficient of the VIX variable, the returns on Tingyi, Sandmartin and Neo-Neon stock show positive relations with the implied volatility and the remaining stocks are non-significant. A stock return positively related with the VIX, may indicate the stock has growth potential.

In September 2008, the international financial crisis erupted, then the global stock market index dropped sharply; and, on October 24, 2008, the VIX reached historic high at 89.53. Until the end of April 2009, the VIX dropped below 40 (referred to Figure 1). Recently the whole world advocating energy conservation and carbon reduction, in addition, unemployment creates a dwelling economical fever, these factors cause certain industries to vigorously emerge. Firms like Solargiga Energy producing solar energy, Sandmartin design and media manufacturing, Neo-Neon Holdings, the biggest global decorative lighting supplier, as well as, Tingyi, a pioneer in the instant noodles market in China, though all suffered from the financial crisis, however, their industry specializations give investors optimism. These may induce a positive, instead of a negative, relationship between the VIX and the TDR return, or the original stock return. The above discussed results are given in Table 3.

Table 3
Market Risk Analysis

Code	Response: Returns of TDR			Response: Returns of Original Stock		
	α	β	γ	α	β	γ
WW	0.043	0.627 ***	-0.012	0.082	0.449 ***	-0.019
	(0.790)	(0.000)	(0.689)	(0.542)	(0.000)	(0.444)
JT	0.197	0.581***	0.021	0.100	0.763 ***	-0.019
	(0.498)	(0.001)	(0.610)	(0.639)	(0.000)	(0.633)
YO	-0.013	0.579 ***	0.005	-0.207	0.441 **	-0.027
	(0.971)	(0.009)	(0.893)	(0.218)	(0.016)	(0.431)
NFA	-0.005	0.547 ***	-0.052	-0.046	0.158 *	-0.005
	(0.987)	(0.008)	(0.168)	(0.664)	(0.089)	(0.761)
VM	-0.126	1.029 ***	0.011	0.340	0.551	-0.074
	(0.660)	(0.000)	(0.827)	(0.423)	(0.177)	(0.320)
SE	0.312	0.882 ***	0.093*	-0.407	0.999 ***	-0.028
	(0.668)	(0.002)	(0.062)	(0.155)	(0.000)	(0.566)
TIN	-0.249	0.909 ***	0.070	-0.089	0.829***	0.076*
	(0.339)	(0.000)	(0.112)	(0.729)	(0.001)	(0.083)
SAN	0.252	0.906 **	-0.011	-0.018	0.665*	0.127 *
	(0.572)	(0.028)	(0.889)	(0.964)	(0.072)	(0.066)
NN	-0.006	0.896 ***	0.009	0.013	1.145***	0.108 *
	(0.986)	(0.004)	(0.879)	(0.971)	(0.001)	(0.071)
OC	0.554	0.925 **	0.118	-0.395	1.070 ***	0.006
	(0.463)	(0.030)	(0.142)	(0.280)	(0.001)	(0.917)

Regression Model: $R_t = \alpha + \beta R_{S\&P\ Asia\ 50,t} + R_{VIX,t} + \varepsilon_t$, $\varepsilon_t = \lambda \varepsilon_{t-1} + u_t$, $\varepsilon_t \sim N(0,\delta_t^2)$, $\delta_t^2 = \varnothing_0 + \varnothing_1 u_{t-1}^2 + \varnothing_2 \delta_{t-1}^2$ **THE NUMBER IN PARENTHESES DENOTES THE P-VALUE FOR TESTING THE SIGNIFICANCE OF THE CORRESPONDING PARAMETER; *** ATTAINED 1% SIGNIFICANCE LEVEL; **ATTAINED 5% SIGNIFICANCE LEVEL; * ATTAINED 10% SIGNIFICANCE LEVEL.**

2.3 Causality and Cointegration Tests

In this section, the relationship between the TDR and the original stock, as well as its primary direction of movement, will be examined by the Granger causality test. The empirical results show that 6 firms experienced a mono-directional impact from the TDR release. The original stock price does affect the TDR price, for example, Yorkey Optical and Solargiga Energy attained a 1% significance level, New Focus Auto Tech and the Neo-Neon attained a 5% significance level, Tingyi and Oceanus attained a 10% significance level. On the other hand, none of the original stock price was influenced by the corresponding TDR price. In other words, for the remaining 4 firms, Want Want, Ju Teng, Vietnam Manufacturing and Sandmartin, the TDR market and the domestic market were independent and did not mutually affect each other. A bi-directional causal relationship did not exist. Moreover, the influences of the original stock prices are remarkably significant, in particular, for those TDRs listed after October, 2009. Therefore, in order to forecast future TDR price trends, investors may refer to the original stock price tendency.

Applying the ADF unit root test, results confirm that all the TDR price series and the original stock prices belong to the I(1) process; then using the Johansen (1988) cointegration test algorithm, the existence of the cointegration structure between the TDR price and the original stock price was examined. The testing results show that four firms represent the cointegration phenomenon; Want Want and Oceanus both showed strong evidence attained a 1% significance level, next was Yorkey Optical and Solargiga Energy attained a 5% significance level. To these four firms, listing in two different international stock markets, the existence of cointegration indicates that the TDR price and the original stock price may have some long-term equilibrium tendencies.

The aforementioned four firms, three are listed on the Hong Kong stock market, Want Want, Yorkey Optical and Solargiga Energy. As the connection between the two sides across the Taiwan Strait continually warms, Hong Kong and Taiwan stock markets interact gradually closely and actively. Therefore, in this paper, high frequency (per minute) trading strategies were only focused on the TDR with the original stock listing on Hong Kong stock market. Firstly, the Engle-Granger cointegration model was established, by using the in-sampled daily data to estimate the related parameters. The resultant was:

$$\ln(Y_t) = \hat{\eta} + \hat{\theta} \ln(X_t) \tag{10}$$

Here Y_t , X_t are daily price data for the TDR and the original stock respectively; again, the stock price has been adjusted by formula (3). The estimated values, and are presented in Table 4. Formula (10) will be used to construct trading strategies in the following subsection.

Table 4
Engle-Granger Cointegration Analysis

Code	$\hat{\eta}$	$\hat{\theta}$	F-statistic	t-Statistic
WW	2.949***	0.061*	2.945*	-5.751***
	(0.000)	(0.088)	(0.087)	(0.000)
YO	0.077	1.158***	29.493***	-2.469**
	(0.850)	(0.000)	(0.000)	(0.014)
SE	1.274***	0.587***	34.912***	-3.543***
	(0.000)	(0.000)	(0.000)	(0.001)

Regression model: $\ln(Y_t) = \eta + \theta \ln(X_t) + \varepsilon_t$; the t-Statistic is the ADF test with H_0: with unit root vs H_1: without unit root; while the F-Statistic is testing H_0: $\eta = \theta = 0$ VS H_1: $\eta \neq 0$ or $\theta \neq 0$; * attained 1% significance level; ** attained 5% significance level; * attained 10% significance level.**

2.4 Trading Strategies

The out-sampled minutely transaction data of the TDR and the original stock are suitably combined via formula (10) to examine the performance of the suggested trading strategies. The sources of minutely data are coded from, the TDR price on the cnYES website, the original stock price from the Hong Kong Exchanges and the exchange rate from Taiwan Bank. The minutely data, from April 1, 2010 to April 31, 2010, are over a total of 21 trading days. The TDR data is from 9:00am to 1:30pm, the Hong Kong stock data is from 10:00am to 12:30pm and 2:30pm to 4:00pm, and the exchange rate data is from 9:00am to 4:00pm. Since the trading times are inconsistent, the trading period is based on the TDR. The original stock price from 9:00am to 10:00am is extrapolated by the closing price of the preceding day; while the price from 12:30pm to 1:30pm is interpolated by the delivery price at 12:30pm. Following the designed procedure, the re-organized data have 5,691 minutely price data for the TDR and the original stock respectively.

After the opening position has been established, the opposite position is carried out according to the signal, either applying the daily trading strategy or the waiting trading strategy. Then total profits are estimated via formula (9) and the average waiting time for each of the three firms, Want Want, Yorkey Optical and Solargiga Energy. From the analyzed overall return rate results, the waiting trading strategy seems significantly better performing than the daily trading strategy. Most cases of the latter are forced to close the established position, thus having failed to achieve the prescribed profit goal.

The TDR market seems not profitable under the daily trading strategy; however, the TDR investor can make profits under the waiting trading, in particular, for those TDRs with the market risk coefficient β close to 1 and a higher premium return ratio. The overall return rate is achievable and close to the prescribed profit goal. Since the Taiwan stock market has rising and declining daily limits, this may lead the stock price to not be deep enough. Therefore, investors adopting the waiting trading strategy, extending the investment period, instead of the daily trading strategy, will achieve the anticipated profit goal.

By inspecting respective TDR performances, no matter whether daily trades or waiting trades are adopted, Solargiga Energy TDR always made money. Also, the average waiting time was shorter compared to the other two TDRs, Want Want TDR and Yorkey Optical TDR. This signifies that Solargiga's stock had big fluctuations, more risk, more potential profits and a reduction in the risks associated with having to hold the stock for a long time.

Due to the fact that price volatility in Want Want TDR and Yorkey Optical TDR was not deep enough, there was no arbitrage opportunity. Whenever a position opened, it was hard to find a profitable chance to close the position, on the same day. Afterward, the position was forced to close and a loss is logged. Also, as average waiting times increase, the risk of holding the stock increases too. Moreover, though the Want Want and Yorkey Optical TDRs were profitable under the waiting trading strategy, due to the fact that TDR price fluctuations are not deep enough, the actual return rates were still lower than the pre-designed profit rates.

TDR prices with high relative premium ratios means they lead the Taiwan stock market index, thus investment will probably achieve the anticipated earning. The premium ratio for the Solargiga Energy TDR was high at 16.302, which is a profitable equity. The waiting trading strategy achieves or exceeds the hypothesized return rate, and the average waiting period was from two to four calendar days. For the Want Want and Yorkey Optical TDRs, while their premium rates were rather low, 0.046 and 0.417 respectively, both strategies were unable to achieve the hypothesized profit goal. The discussed results are shown in Table 5.

Table 5
Profit and Loss of Trading Strategy

TDR	Premium Ratio	β	ρ	Daily Trading		Waiting Trading	
				Return Rate	Average Waiting(min)	Return Rate	Average Waiting(day)
WW	0.046	0.627	0.4%	-0.4172%	194	0.1763%	2.24
			0.8%	-0.3840%	220	0.4050%	2.94
			1.0%	-0.4607%	225	0.3690%	3.45
			2.0%	-0.4522%	229	0.6214%	5.83
			3.0%	-0.4522%	229	0.5075%	8.87
YO	0.417	0.579	0.4%	-0.2801%	89	0.4011%	0.97
			0.8%	-0.3130%	119	0.4913%	1.33
			1.0%	-0.2652%	129	0.6544%	1.49
			2.0%	-0.2710%	141	0.7213%	2.28
			3.0%	-0.2872%	168	0.7411%	2.16
SE	16.302	0.882	0.4%	0.1169%	57	0.6126%	1.23
			0.8%	0.5308%	75	1.0325%	1.50
			1.0%	0.6901%	85	1.4945%	1.61
			2.0%	1.0643%	130	2.4029%	2.67
			3.0%	1.0760%	164	2.9865%	3.99

β coefficient is coded from Table 3; Premium ratio is coded from Table 1;

Overall Return Rate $= \dfrac{\sum\left[(1-\tau_1^*)\times Y_{short} - (1+\tau_2)\times Y_{long}\right]}{\sum\left[(1+\tau_2)\times Y_{long}\right]} \times$ **100%;**

For the daily trading: $\tau_1^* = 0.3225\%$ **and** $\tau_2 = 0.1425\%$**; For the waiting trading:** $\tau_1^* = 0.2425\%$ **and** $\tau_2 = 0.1425\%$ **; The average waiting is evaluated on basis of minute for the daily trading, while for the waiting trading is based on day.**

CONCLUSIONS

Recently, the rapidly rising economic system in China has made it become a global economic powerhouse. The capital market's transactions in Greater China could make the TDR market's scale increase, and helpful to the Taiwan stock market. In this paper, the TDR empirical investigations are focused on event studies, market risk analysis, causal relationships, cointegration analysis and trading strategies. The empirical results show that the original stocks have abnormal returns at the primary announcement date, and the announcement effect is more significant than that of the listing effect. The more significant abnormal returns at the announcement date are similar to that pointed out by Alexander et al (1988).

The cointegration structure between the TDR price data and the original stock was respectively established for the three screened firms, Want Want, Solargiga Energy and Yorkey Optical. This relationship was applied to construct some simply trading strategies. Empirical results indicate that due to the fluctuation limits on the Taiwan stock market, it is hard to make profits with a daily trading strategy, especially, utilizing the immediate arbitrage. However, TDR investments can realize profits with the waiting trading strategy; in particular, as the TDR market's risk coefficient comes closer to 1 and the TDR return leads the TAIEX return.

Since the TDR and original stock are related to the same asset but listed on two different international markets, it is interesting to detect arbitrage opportunities. Inspecting the average waiting time for a complete

transaction, the duration from opening a position to closing the position, immediate arbitrage chances were almost impossible; however, a waiting trading strategy may be successful. Hopefully, the discussed empirical evidence will result in understanding the TDR market more thoroughly and providing information for TDR investment.

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