

An Empirical Study of Return and Causal Relationships of Taiwan Depository Receipts– Hong Kong-listed Companies

Yueh-Er Ji*, Ming-Chang Cheng**, Chien-Chi Lee***
and Po-Hsun Huang****

This paper studies the determinants of the effect of the price of underlying stock, the currency exchange rate, and the Taiwan Weighted Stock Index on the price and returns of Taiwan Depository Receipts (TDRs) issued by Hong Kong-listed companies. This study also determines the return and volatility transmission dynamic with the Impulse Response Model of Vector Autoregressive (VAR) and the causality relations of the Granger Causality Test. The result shows that TDR returns are affected by the underlying stock, exchange rate, and the Taiwan Stock Index. There is a two-way relationship between TDR returns and the underlying stock returns. There is also a two-way relationship between TDR returns and the Taiwan Weighted Stock Index. In addition, an arbitrage opportunity exists between TDR and Hong Kong underlying stock.

1. Introduction

Firms can raise funds across countries because of cooperation between stock exchanges worldwide. In 1996, the Taiwanese Government announced “Criteria Governing the Offering and Issuance of Securities by Foreign Issuers,” which allows foreign companies to issue securities in Taiwan. In March 15, 2010, the Taiwan Government allowed Chinese companies listed in Hong Kong to issue TDRs (Taiwan Depository Receipts) in Taiwan. These laws allowed both Taiwanese and foreign companies to raise funds in Taiwan’s capital market. Issuing TDRs will become one of the most popular methods firms can use to raise funds.

Businesses can raise funds for investments not only from domestic markets but also overseas markets. In general, the most common way to raise funds is to issue Depository Receipts or Convertible Bonds. Businesses, based upon their own characteristics, have to decide how they choose to raise funds. There are four major advantages of issuing DR. First, issuing Depository Receipts can raise funds for firms. Second, Depository Receipts can be issued at a price near the price of underlying stocks. Third, issuing Depository Receipts does not influence company ownership directly. Fourth, issuing DR can raise the company’s popularity in an overseas market. These advantages make issuing Depository Receipts increasingly popular to businesses.

*Yueh-Er Ji, Ph.D. Candidate, Guanghua School of Management, Peking University, China.

**Ming-Chang Cheng, Associate Professor, Department of Business Administration, National Chung Cheng University, Taiwan. Email: bmamcc@ccu.edu.tw

***Chien-Chi Lee, Ph.D. student, Department of Business Administration, National Chung Cheng University, Taiwan; Lecturer, Department of Hospitality Management, Taiwan Shoufu University.

****Po-Hsun Huang, Graduate student, Department of Business Administration, National Chung Cheng University, Taiwan.

Ji, Cheng, Lee & Huang

A Depositary Receipt (DR) is a type of negotiable (transferable) financial security traded on a local stock exchange, yet it represents a security, usually in the form of equity, which is issued by a foreign publicly listed company. The DR, which is a physical certificate, allows investors to hold shares in the equity of other countries. One of the most common types of DRs is the American depositary receipt (ADR). It uses the depositary receipt issued in America. Taiwan depositary receipts (TDRs) are those issued in Taiwan. Except in special cases, the right of DRs is the same as common stocks, allowing investors to become company shareholders.

Two kinds of DR exist. The first is sponsored DR, which means that the DR is issued in cooperation with the underlying foreign company whose equity shares underlie the DR shares. With the corporation's sponsorship, the DRs created in the issue usually afford their owners the same rights given to stockholders, such as voting rights. The second is unsponsored DR, which means that a depositary receipt (DR) is issued without the foreign company whose stock underlies the DR getting involved. Shareholder benefits, voting rights and other attached rights may not be extended to these particular securities' holders.

According to NYC Mellon Bank statistics, 64 DRs were issued worldwide in the first half of 2010, and 50 DRs were listed in the second half. Overall, there were 3214 DRs worldwide in 2010. Most DRs are issued by businesses in India, Japan, UK, China, and Russia. DR trade volume was 1.84 trillion US dollars in the first half of 2010, which increased 41.5% from 2009. Therefore, DR issuing volume and DR trade volume are growing rapidly.

According to the Taiwan Stock Exchange in 1998, the ASE Test issued the first TDR in the Taiwanese capital market. Only 5 TDRs were issued before 2006 by ASE Test, Eastech, Medtecs, Mustek Limited, and Cal-Comp Electronics. In fact, TDRs were not popular at that time. In the last 3 years, issuing TDRs has become more popular, and there were 31 TDRs in the Taiwanese market by July 1, 2010, which raised 42.7 billion New Taiwan dollars overall. The total number of companies issuing TDRs is expected to be 41 by the end of 2011. While China's capital market will grow in the future, IPOs in China or Hong Kong and issuing TDRs in Taiwan will be the most popular model in the capital market for Chinese-owned companies.

Even though ADR/GDR is traded in other markets, it represents underlying stock assets in the original market. Therefore, a relationship could exist between them. Some researchers have already proved such an interaction (Kim et al., 2000). The currency exchange rate may affect the price of ADR because ADR is denominated by the US dollar. Mathur et al. (1998) researched the relationship between ADR and the currency rate. Much of the literature found that the US market and the ADR price exists a certain relationship (Parteo, 2000; Jaiswal-Dale and Jithendranathan, 2001).

Many researchers use the results of ADR/GDR research to discuss TDRs. However, there are differences between ADRs/GDRs and TDRs because of the difference in markets. There is no literature exists concerning the relationship between TDR price and underlying stock price or other variables that could affect TDR price. Based upon variables such as underlying stock price, the Taiwan Stock Index, and the exchange rate, this article tries to find the key factor that affects TDR price and the degree to which that influence compares to the ADR/GDR result. The research objectives are below:

Ji, Cheng, Lee & Huang

1. Find the price transmission and the degree of deterministic variables on TDR price.
2. Compare the TDR price transmission result with the ADR/GDR result.

The rest of this study is organized as follows: Section 2 reviews the relevant literature and discusses our hypothesis development, and Section 3 describes the methodology, including data, study variables, and the models. Section 4 presents empirical results and Section 5 concludes the study. Section 6 provides the academic and practical implications.

2. Literature Review

2.1 Review of the Literature on the Relationship Between DR Price And Underlying Stock Price

Much of the literature about international capital markets discusses whether there are Granger Causality relations, cointegration or dynamic relationships between different markets and analyzes the dynamic transmission about price fluctuation (Karolyi & Stulz, 1996; Jiang, 1998; Choi & Kim, 2000; Ely & Salehizadeh, 2001). Most of these results show that new information in the US stock market and price fluctuations will cause other countries to change quickly, while fluctuations in other countries do not cause the US market to change quickly.

Shen (1998) studied four Taiwanese companies, including China Steel, Asia Cement, Chia Hsin Cement Group, and Tuntex Synthetic Corp to analyze whether their stock trends have causal relationships between GDR and underlying stock. The empirical result found that the GDR of China Steel and Asia Cement showed long-term cointegration, but the GDR of Chia Hsin Cement and Tuntex Synthetic Corp did not have a long-term relationship. He also found that GDR daily return was directly affected by underlying stock return, but the daily underlying stock return was not directly affected by GDR daily return.

Yen (2000) used cointegration test methods, the Granger Causal relations test and the error correction model to test information transmissions. The result was that GDR price and underlying stock price have a random walk effect. The result was the same as Shen's (1998) conclusion: the relationship between DR and domestic underlying stock only exists as a one-way relationship.

2.2 Review of the Literature on the Variables That Affect DR Price

Park (1990) tested 12 British and 20 Japanese Companies using the statistic test that issued ADRs from July 1977 to June 1987. He found that ADR price is relative to the underlying stock and that the US market is less relative to ADR price. Patro (2000) used 123 ADRs in 16 countries as samples and used the SUR (Seemingly Unrelated Regression) model to test the international market returns, the domestic underlying stock return, and whether the currency rate and January effect will affect the ADR return. The result is that the ADR return is affected by the international market return and the domestic market return.

Jaiswal-Dale & Jithendranathan (2001) also used monthly ADR returns in 12 countries as samples to test the relationship between ADR and its domestic underlying stock.

Ji, Cheng, Lee & Huang

Using a regression model, they found that ADR price is positively relative to the US market index and domestic market index, and they also found that when ADR-issued volume increased, ADR had less domestic market premium. The correlation between ADR-issued volume and the US stock market index was greater when the ADR-issued volume increased.

Kim, Szakmary & Mathur (2000) believed that ADR price was not only affected by underlying stock but also by the currency rate and US market, so they analyzed how shocks influence ADR price. He used the VAR model and regression model to test the ADR in five countries, including Japan, the United Kingdom, Netherland, Switzerland and Australia. The results showed that most shocks in these markets were noticeable within ten days. The affected currency rate and US market index were simultaneously increased in recent years, but the affected underlying stock decreased. This result showed that ADR was overly influenced by US market index shocks and the currency rate, but the shock of underlying stock was insufficiently affected. The most probable reason is that investors usually price ADR with the US market index, not the price of underlying stock. Another explanation is that investors might overestimate the degree of the shock that the US market index can have on ADR price the following day. ADR price is set by an overreaction by the US market index, but an underreaction by the underlying company's assets, which shows that the correlation between ADR price and the US market is greater than the correlation between ADR price and the country with underlying stock. Kim et al. (2000) used this result to plan a trade strategy for gaining abnormal returns. However, the result shows that the days of the over-affected only exists over several days and cannot balance the transaction cost.

Lee (2001) applied the research method of Kim et al. (2000) to analyze the ADR issued by Taiwanese companies, including Taiwan Semiconductor Manufacturing, Advanced Semiconductor Engineering Inc, United Microelectronics Corporation, Macronix and Ase Test Ltd. She used the VAR Model, error correction model, Granger causal relations test, impulse response analysis, and variance decomposition to analyze how the variables of ADR price affect markets and whether there are arbitrage opportunities. The empirical result showed that even though the five ADRs were issued at different time, the variables affected the price on all of them. The currency rate caused a negative shock to the ADR price, but the price of underlying stock and the NASDAQ index caused a positive shock. She found that there are arbitrage opportunities. Huang (2001) also used the same method to analyze the other company issued ADR to discover whether information transmission efficiency exists. The result showed that the daily underlying return affected the ADR daily return, but the daily underlying stock return did not affect ADR daily return. The US market cycle could also affect ADR return, but the information transmission efficiency was low. The currency rate's fluctuation did not explain ADR return.

Ely & Salehizadeh (2001) used 26 ADRs in the United Kingdom, Japan, and Germany as samples and used the vector error correction model to analyze the co-movement. Because the trading days are not all the same, they used the error correction model and two sets of "current period" and "next period" to study the interaction between ADR and underlying stock. The result showed that the market of underlying stock and the US market are the sole variables that affect ADR return, and the market of underlying stock affects ADR price more.

Ji, Cheng, Lee & Huang

Wang (2002) used 15 GDRs issued by Chinese companies as samples to analyze the causal relations of underlying stock, depositary receipt, stock index, interest rate and currency rate. He also used the GRACH model to test the price transmission effect. The result of a causal relation test supported the outcome that the fluctuation of interest rate affected GDR price less, but there is a causal relationship between GDR price, underlying stock price, and the currency rate. The empirical study also supported the result that underlying stock price affected GDR price, but GDR price did not affect underlying stock. If using the public listing location to discuss effects, the underlying stock listed in Hong Kong had both a significant one- and two-way effect. However, the return of underlying stocks listed in Shanghai and Shenzhen were not easily affected by GDR: the effect is a one-way effect.

Lin (2003) used 21 ADR issued by Taiwanese companies from 1997 to 2000 as samples and used the GARCH model to build up a dynamic volatility model that considered the price of ADR, the price of underlying stock, and the currency rate to analyze the transmission effect. She divided groups by the bullish market and bearish market to analyze the volatility transmission effect in each situation. The result showed that underlying stock price affects ADR price more than ADR price affects underlying stock price. The result also showed that the volatility transmission effect existed. When the New Taiwan Dollar falls, the volatility transmission effect and currency rate affect ADR price more strongly.

The trading day of depositary receipts is not the same as that of underlying stock; sometimes one market trades while another does not. Park (1995) confirmed two conditions: “the market of underlying stock is non-trading but the market of ADR is trading” and “the market of underlying stock is trading but the market of ADR is non-trading”. He found that when “the market of underlying stock is non-trading but the market of ADR is trading”, the variability of ADR return decreased by 40%. However, when “the market of underlying stock is trading but the market of ADR is non-trading”, the variability of ADR return increased. The result showed that underlying stock price is an important factor of ADR return’s variability, and it also revealed that new information about the US market would shock ADR return’s variability, but the trading volume would not directly.

Chung (2000) researched the topic of the co-movement between the depositary receipts issued by Taiwanese companies and the US stock returns, finding variables that affect the return correlation. She found that the correlation between the depositary receipt returns and the economic indicators is not high. In other words, the shock on the issuing of US economic indicators is low. The correlation among the GDR portfolio, the portfolio of US stock return, and the S&P500 return is high. The correlation among the GDR portfolio, the underlying stock portfolio, which is in same industry as the US market, and Taiwan’s stock index’s future return are high. According to literature in previous parts, this study’s hypotheses are below:

H1: TDR price will be affected by underlying stock price.

H2: TDR price will be affected by the Taiwan Weighted Stock Index.

H3: TDR price will be affected by the exchange rate (HKD/TWD).

3. Research Methodology

3.1 Data Source

To study the relationship between the TDR and variables, we referred to literature about ADRs and determined the variables we wanted to discuss, including TDR price, underlying stock price, Taiwan market price, and the exchange rate. The Taiwan Weighted Stock Index defines the Taiwan market price.

Since the regulations were lessened in 2009, foreign companies start to issue TDRs in Taiwan Stock market. Because TDRs do not become popular for a long time, there are still not many observations. Therefore, the sample contains eight companies that issued stocks in the Hong Kong Exchange and issued TDRs in the Taiwan Stock Exchange. The reason that we used the Hong Kong-listed companies is that most TDRs issued by Hong Kong and China listed companies. After considering the sample number, we found that there are only 11 TDRs in which the observations exceed 300. Eight of the eleven are Hong Kong-listed companies. Although the number of TDRs China issues is also a significant portion, time was short, making the number of observations small. Most of China's TDRs are smaller than 100. Therefore, we used Hong Kong-issued TDRs instead of Chinese-issued TDRs.

All the data are from the Taiwan Economic Journal (TEJ), and the data are all daily data. TDR price and underlying stock price are defined as adjusted price. The exchange is the New Taiwan Dollar against the Hong Kong Dollar. The sample period was from December 16, 2009 to April 6, 2011.

Table 1. All Sample Companies

Company Name	Code Name
Neo-Neon LED lighting International Limited	Neo-NeoN
Tingyi Holdings Corp.	MasterKong
SandMartin Holdings Corp.	SandMartin
New Focus Auto Tech Holdings Limited	New Focus
JU TENG International Holdings Ltd	Ju Teng
Want Want China Holdings Limited	Want Want
Solargiga Energy Holdings Limited	SolarGiga
YORKEY Optical International Ltd	YORKEY

Table 2. Information About TDR Issuing Companies

Company	Issue Date	Sponsored / Unsponsored	Issue Price	Total Fund(NT\$)
Neo-NeoN	2009/10/29	Sponsored	\$12.9 NTD	\$1,806,000,000
MasterKong	2009/11/02	Sponsored	\$45 NTD	\$17,100,000,000
SandMartin	2009/10/30	Sponsored	\$8 NTD	\$1,120,000,000
New Focus	2009/07/29	Sponsored	\$7 NTD	\$630,000,000
Ju Teng	2009/10/09	Sponsored	\$17.3 NTD	\$1,730,000,000
Want Want	2008/10/14	Sponsored	\$15.5 NTD	\$3,255,000,000
SolarGiga	2009/10/15	Sponsored	\$9.45 NTD	\$945,000,000
YORKEY	2009/10/08	Sponsored	\$8.2 NTD	\$656,000,000

3.2 Research Process

This paper's main purpose is to analyze the relationship between Taiwan Depositary Receipts (TDRs) issued by Hong Kong-listed companies and variables. This study's variables are underlying stock price, Taiwan Weighted Stock Index, and the exchange rate.

Previous studies try to find out the characteristic of ADRs or GDRs. Moreover, in this study, we follow the previous literature to find out the factors that affect TDRs. The research methodology used is the Vector Autoregressive Model (VAR), which analyzed the transmission of TDR return and variable return. We applied Impulse Responses Analysis to analyze how variables affect TDR return and each factor's shock degree in ten periods. In the second part, we used the Granger Causality Test to test whether there is a causality relationship between TDR return and variable return.

Firstly, the research process is that during the data processing phase, we sorted the daily data from the same calendar day, including TDR price, underlying stock price, Taiwan Weighted Stock Index, and the exchange rate. We deleted data that were incomplete. Secondly, we used the Unit Roots Test, Cointegration Test, and Vector Autoregressive (VAR) Model to analyze the data. Thirdly, we used the Granger Causality Test to analyze the causality relationship between TDR and variables.

4. Empirical Analysis

4.1 Result of the Unit Root Test and Cointegration Test

Before applying the VEC/VAR model to analyze the data, the Unit Root Test confirms whether data are stationary or not. If they are not stationary, they should first use the difference method to confirm the time series data as the $I(1)$ sequence. This study proceed the Unit Root Test by using the ADF method and deciding the most applicable lag length using the Akaike Info Criterion. The test results are shown in Table 3 below.

According to Table 3 & Table 4, variables such as TDR price, underlying stock price, Taiwan Stock Weighted Index, and the exchange rate have unit roots. In other words, they are not stationary. After applying the first difference to cope with these variables, each factor rejects the hypothesis that it has a unit root. The results show that all variables are $I(1)$ sequence.

Table 3. ADF Test of TDR Price and the Price of Underlying Stock

Company	TDR	Underlying Stock
	Value of Difference	Value of Difference
Neo-NeoN	-14.14161***	-10.76297***
MasterKong	-16.57315***	-16.95589***
SandMartin	-8.447636***	-8.798294***
New Focus	-13.22380***	-4.852335***
Ju Teng	-10.46350***	-17.38821***
Want Want	-17.82707***	-10.51503***
SolarGiga	-15.02805***	-17.01049***
YORKEY	-16.26487***	-20.81254***

The critical value is Mackinnon. Critical values reject the null hypothesis that has a unit root.

*indicates that the reject has a unit root in the 10% level

** indicates that the reject has a unit root in the 5% level

*** indicates that the reject has a unit root in the 1% level

Table 4. ADF Test of Taiwan Stock Weighted Index and Exchange Rate

Variance	Value of difference
Taiwan Weighted Index	-12.90744***
Exchange Rate (NTD against HKD)	-17.35545***

The critical value is Mackinnon. Critical values reject the null hypothesis that has a unit root.

*indicates that the reject has a unit root in the 10% level

** indicates that the reject has a unit root in the 5% level

*** indicates that the reject has a unit root in the 1% level

Before we used the cointegration test to check whether there is a similar trend among the variables of these eight Hong Kong-listed companies, we needed to ensure that all these variables have the same sequence. According to the unit root results of these eight Hong Kong companies, all variables of these Hong Kong companies are $I(1)$ sequence.

If a cointegration relationship exists among these variables, it shows that there is a similar trend among them. This research used the Johansen trace test to test the variables and decided the most applicable lag length by Akaike Info Criterion. The test results are shown in Table 5.

Table 5. Johansen Cointegration Test

Company	Trace test			
	$D=0$	$D=1$	$D=2$	$D=3$
Neo-NeoN	54.95435	28.27096	11.77064	3.538878
MasterKong	76.17560**	35.26721	17.35918	1.746712
SandMartin	55.27300*	24.72097	12.07295	1.438768
New Focus	48.68975	21.92095	8.495175	3.141974
Ju Teng	66.49955**	36.62882	17.28744	4.590711
Want Want	73.24882**	37.50672	9.026826	2.493849
SolarGiga	48.39770	17.21517	7.241493	2.933078
YORKEY	50.54996	24.58304	8.068371	2.991662

Trend assumption: No deterministic trend (restricted constant)

* indicates that the reject null hypothesis is in the 5% level

** indicates that the reject null hypothesis is in the 1% level

4.2 Result of the VAR Model

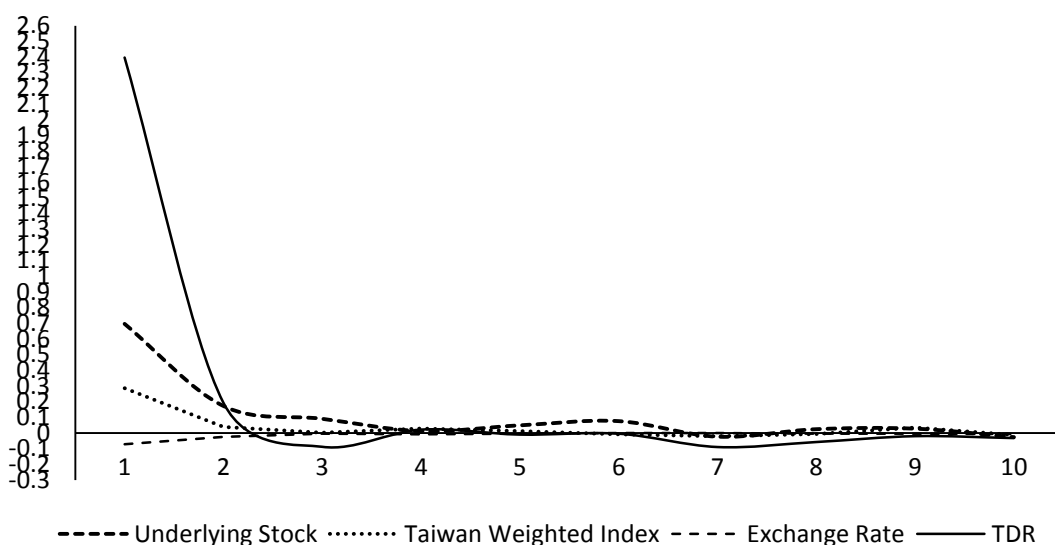
By using the Vector Autoregressive Model, we discussed the interaction between variables, including TDR return, underlying stock return, and Taiwan Stock Weighted Index. We used the residual test to determine the most favorable lag length.

4.2.1 Result of the Impulse Response Analysis

By using the Impulse Response Analysis, we discussed the impulse effect when variables in the VAR model change in a standard deviation during a short period. Table 6 shows the function of three variables' responses to TDR return in ten periods.

Figure 1 shows the impulse response figure, with days on the horizontal axis and response function on the vertical axis. According to figure 1, we found that the response effect of underlying stock return to TDR return increases more than the response effect of the Taiwan Weighted Index, Exchange Rate to the TDR return before fifth period (fifth day). It demonstrates that changing underlying stock return will affect TDR return more than changing the Taiwan Weighted Stock Index and exchange rate.

Figure 1. Impulse Response of Factors to the TDR Return



It also shows that underlying stock return and the Taiwan Weighted Stock Index have a positive effect on TDR return from period 1 to period 5. In other words, when underlying stock return and the Taiwan Weighted Stock Index increase, TDR return increases from period 1 to period 5.

However, the impulse effect of the exchange rate to TDR return is negative, which shows that when the exchange rate return increases, TDR return falls from period 1 to period 5. When the exchange rate return falls, TDR return increases from period 1 to period 5. There is not a certain trend that shows how underlying stock return, the Taiwan Stock Weighted Index return, and exchange rate return affect TDR return from period 6 to period 10.

A certain trend that shows how underlying stock return, the Taiwan Stock Weighted Index return, and exchange rate return affect TDR return only exists from period 1 to period 5. This finding shows that variables such as TDR return, Taiwan Weighted Stock Index return, and exchange rate return will certainly affect TDR return in the short-term.

Table 6. Impulse Response Analysis

Impulse Response Function of TDR				
Period	Underlying Stock	Taiwan Weighted Index	Exchange Rate	TDR
1	0.6973	0.2867	-0.0709	2.3966
2	0.1733	0.0385	-0.0231	0.1935
3	0.0915	0.0021	-0.0024	-0.0872
4	0.0131	0.0301	-0.0075	0.0224
5	0.0498	0.0120	-0.0034	-0.0094
6	0.0766	-0.0080	0.0005	-0.0035
7	-0.0227	-0.0193	0.0014	-0.0886
8	0.0252	-0.0057	-0.0037	-0.0567
9	0.0285	0.0364	-0.0025	-0.0193
10	-0.0256	-0.0113	-0.0045	-0.0315

Ji, Cheng, Lee & Huang

Compared with other research on ADR, this result is similar to Kim, Szakmary & Mathur's result (2000) and Jaiswal-Dale & Jithendranathan's (2001). The underlying stock of DR and the stock market will affect DR price positively, and the exchange rate will affect DR price negatively. However, there is a different degree of effect between ADR and TDR. The effect that the ADR underlying stock, US Stock Index, and the exchange rate have on ADR price is more significant than the effect that the TDR underlying stock, Taiwan Stock Index, and the exchange rate have on TDR price. In a TDR market, the degree that variables affect the TDR price is smaller, especially Taiwan stock and exchange rate on TDR. The time during which variables influence DR price is different as well. Time of influence in the ADR market is longer, which shows that variables affect the ADR longer than TDR. The TDR market is very short-term. It shows that variables only affect TDR in the short run.

There are potential reasons to explain these two differences. The first is market size. Compared with a TDR market, a ADR/GDR market is a huge market. The trading volume of ADR/GDR is much larger than TDR. Taiwan's TDR market is still growing, and perhaps investors in the Taiwan market do not understand this financial product. This situation leads to low trading volume and low liquidity. Secondly, there are no price limits in the ADR/GDR market. Therefore, the degree of price change of ADR/GDR could be larger than TDR. The third reason is the arbitrage chance. According to Lee (2000), there is an arbitrage opportunity in the ADR market, so the degree of change in the ADR market and underlying stock market will be higher than TDR. In accordance with these three reasons, the effect of TDR is not significant when compared to the ADR/GDR market.

4.3 Result of Granger Causality Analysis

The Granger Causality Test is used to explain the relationship between variables (X and Y). It reveals whether there is Granger cause. By using the Granger test, we can test the causality relationship between the TDR return and the other individual variables, which include underlying stock return, Taiwan Weighted Stock Index, and the exchange rate so that we could ensure that the relationship between variables has a one-way effect or a two-way effect. The results are shown in the tables below.

Table 7. Granger Causality Analysis between the return of TDR and the return of underlying stock

Company	Underlying Stock Return to TDR Return	TDR Return to Underlying Stock Return
Neo-NeoN	0.3445	0.3914
MasterKong	0.0273 **	0.0451 **
SandMartin	0.0311 **	0.4172
New Focus	0.4304	0.8971
Ju Teng	0.0422 **	0.0235 **
Want Want	0.0000 ***	0.2534
SolarGiga	0.0274 **	0.0178 **
YORKEY	0.0579 *	0.1861

***indicates that the result is significant in the 1% level

** indicates that the result is significant in the 5% level

* indicates that the result is significant in the 10% level

Ji, Cheng, Lee & Huang

Table 7 shows the result of the Granger causality relationship test between TDR return and underlying stock return. We found that three of eight companies show that there are two-way effects between TDR return and underlying stock return. Six of eight companies have significant results that the underlying stock return will affect TDR return. These companies include Master Kong, Sand Martin, Ju Teng, Want Want, Solar Giga, and YORKEY. However, only three of eight companies show that underlying stock return affects TDR return.

Most of the TDRs issued by Hong Kong-listed companies have a one-way relationship to their underlying stock. Underlying stock returns affect most TDRs, and TDR affects some underlying stock. This result supports the impulse response test result, which is shown in the previous step. Underlying stock return will affect TDR return and reveal that underlying stock has significant variables that affect TDR.

Compared with ADR, the result is not the same as Shen's (1998). The result of Shen's Granger Test shows that only a one-way relationship exists between the ADRs and underlying stock. In Shen's study, ADR affects the underlying stock, but the underlying stock does not affect ADR. However, this study's result shows that there is not only a one-way relationship, but also a two-way relationship between the TDR, which a Hong Kong-listed company issues, and the underlying stock. The TDR return will affect underlying stock return, and underlying stock return will affect TDR return as well.

Table 8 shows the result of the Granger causality relationship test between TDR return and Taiwan Weighted Stock Index return. We found that in four of eight companies, Taiwan Weighted Stock Index return affects TDR return significantly, including Neo-NeoN, New Focus, Ju Teng, and YORKEY. We also discovered that three of the eight companies show that the Taiwan Weighted Stock Index return affects TDR return.

Table 8. Granger Causality Analysis Between the Return of TDR and the Return of Taiwan Weighted Stock Index

Company	TWI return to TDR return	TDR return to TWI return
Neo-NeoN	0.0016 ***	0.9833
MasterKong	0.1818	0.0352 **
SandMartin	0.7057	0.3020
New Focus	0.0092 ***	0.4083
Ju Teng	0.0394 **	0.0654 *
Want Want	0.0468 **	0.3408
SolarGiga	0.5370	0.8468
YORKEY	0.0680 *	0.0484 **

***represents that the result is significant in the 1% level

**represents that the result is significant in the 5% level

*represents that the result is significant in the 10% level

Half of the TDRs listed by Hong Kong companies has a one-way relationship between TDR return and Taiwan Weighted Stock Index return; three of them have a two-way relationship. This result supports the impulse response test result, which is shown in

Ji, Cheng, Lee & Huang

the previous step: the Taiwan Weighted Stock Index return will affect the TDR return. It also indicates that sometimes the Taiwan Weighted Stock Index return is the variable that most affects TDR return.

Table 9. Granger Causality Analysis Between the Return of TDR and the Return of Exchange rate

Company	Exchange Rate Return to TDR Return	TDR Return To Exchange Rate Return
Neo-NeoN	0.9966	0.5633
MasterKong	0.2310	0.8720
SandMartin	0.6888	0.8479
New Focus	0.3387	0.7470
Ju Teng	0.7508	0.2100
Want Want	0.4155	0.5331
SolarGiga	0.4330	0.5246
YORKEY	0.9850	0.9625

***indicates that the result is significant in the 1% level

**indicates that the result is significant in the 5% level

*indicates that the result is significant in the 10% level

Table 9 shows the result of the Granger causality relationship test of TDR return and the exchange rate return. In this test, we did not find a significant result in either a one-way relationship or a two-way relationship. The Granger Causality Test shows that exchange rate return does not affect TDR return in all of these Hong Kong-listed companies, nor does TDR return affect exchange rate return. This result does not support the impulse response test result in the previous chapter. The impulse response test shows that there is a weak and short-term effect from the exchange rate return on TDR return. However, the Granger causality test shows that no significant result supports the result of the impulse response test.

4.4 Results of the Empirical Study

In the part of transmission relation of TDR and Variables, we find that underlying stock return and the Taiwan Weighted Stock return positively affects TDR return from the Impulse Response Test, while the exchange rate return negatively affects TDR return. Moreover, the degree to which the underlying stock return affects the TDR return is larger than the degree that the Taiwan Weighted Stock Index affects the TDR return and the degree that the Exchange Rate affects the TDR return.

For these three variables, firstly, the result of the degree to which underlying stock affects TDR is the same as the literature about ADR/GDR details (Park, 1990; Shen, 1998; Yen, 2000; Huang, 2000; Ely & Salehizadeh, 2001; Lee, 2001; Wang, 2002; Lin, 2003). Secondly, the degree to which the market index affects TDR is the same as the literature about ADR/GDR details (Patro, 2000; Kim et al., 2000; Ely & Salehizadeh, 2001; Jaiswal-Dale & Jithendranathan, 2001; Lee, 2001; Wang, 2002; Lin, 2003). Thirdly, the degree to which the exchange rate affects TDR is the same as the literature about ADR/GDR details (Kim et al., 2000; Lee, 2001; Wang, 2002; Lin, 2003).

The Impulse Response Test result shows that the affect periods of these three variables (Underlying stocks, Taiwan Stock Index, and exchange rate) are very short-term. This result is different from the literature of ADR/GDR (Kim et al., 2000; Lee,

Ji, Cheng, Lee & Huang

2001). Kim et al.,(2000) and Lee (2001) found that the period that underlying stock, stock market price, and exchange rate could affect ADR/GDR was longer than that of TDR.

On the other hand, in the Granger Causality Test, underlying stock return and Taiwan Weighted Stock Index return significantly affect TDR return in most sample companies. The result is similar to the Impulse Response Test result. TDRs are traded in the Taiwan stock market, which opens at 9:00 and closes at 13:00. Underlying stocks are traded in the Hong Kong stock market, which opens at 10:00 and closes at 16:00. The trading time difference between these two markets could explain the two-way relationship. Underlying stocks in Hong Kong affect TDR prices in Taiwan. This phenomenon appears in most DR studies. After the Taiwan market closes, TDR price will refer to pricing of the underlying stock from 13:00 to 16:00. This pricing shows that there is an arbitrage opportunity between TDR and underlying stock. Furthermore, in the Granger Causality Test, exchange rate return in all Hong Kong-listed companies does not significantly affect TDR return. The result is different to the Impulse Response Test result.

The results of Granger Causality Test also showed that TDR return could affect underlying stock return and Taiwan Weighted Stock return. In other words, there is not only a single-way relationship, but also a two-way relationship between TDR and variables. Comparing the result to the literature about ADR/GDR (Yen, 2000; Huang, 2001), the results are different because in the ADR study, only a one-way relationship between ADR and underlying stock exists. ADR could affect underlying stock, but underlying stock could not affect ADR. However, this study's result shows that both a one- and two-way relationship exists between TDRs issued by Hong Kong-listed companies and the underlying stock. TDR return affects underlying stock return and underlying stock return affects TDR return as well. This finding consists with Wang (2002) and Lin's (2003) results.

There are a few reasons for the difference between TDR research results and ADR/GDR literature results. The first difference is the sample number. Hundreds of listed ADR and GDR exist worldwide, and their issue periods are very long, many over 10 or 15 years. However, TDR is different. TDR exists in much smaller numbers than ADR and GDR; under 30 are issued in the Taiwan Stock Exchange and most of them are issued for under five years. This causes the difference between TDR and GDR/ADR research results. Another possible reason is that the degree change in TDR price is smaller than GDR/GDR, underlying stock, market price, and the exchange rate. TDR price always changes minimally or not at all after being issued. Therefore, the empirical result comparing TDR and its variables will not match ADR or GDR because significant effects exist between DR and variables.

This study's hypotheses are as follows:

H1: TDR price is affected by underlying stock price.

According to the VAR Model and Granger Causality Test results, TDR price is significantly affected by underlying stock price. Both a one-way and a two-way relationship exist between TDR and underlying stock price in most samples. Therefore, H1 is valid.

(Shen, 1998; Yen, 2000; Park, 1990; Lee, 2001; Ely & Salehizadeh, 2001)

H2: TDR price is affected by the Taiwan Weighted Stock Index.

According to the VAR Model and Granger Causality Test results, TDR price is

Ji, Cheng, Lee & Huang

significantly affected by the Taiwan Weighted Stock Index price. Not only does a one-way relationship exist between the two, but a two-way relationship also exists in most samples. Therefore, H2 is valid.

(Jaiswal-Dale & Jithendranathan, 2001; Kim, Szakmary & Mathur, 2000; Lee, 2001; Ely & Salehizadeh, 2001)

H3: TDR price is affected by the exchange rate (HKD/TWD). According to the VAR Model result, TDR price is affected by the exchange rate price. However, in the Granger Causality Test, the exchange rate price of all Hong Kong-listed companies does not significantly affect TDR price of, and no causality relationship exists between them. Therefore, H3 is not valid.

(Huang, 2001;)

5. Research Conclusion

This paper's main purpose is to analyze the transmission relationship between Taiwan Depositary Receipts (TDR) issued by Hong Kong-listed companies and various variables, including underlying stock price, Taiwan Weighted Stock Index, and the exchange rate in an effort to understand whether these variables could affect TDR and the degree to which TDR is affected. The conclusion of this empirical study is outlined below.

The underlying stock return and the Taiwan Weighted Stock return are the significant variables that may affect TDR return, and the degree to which that underlying stock return affects TDR return is much more significant than the degree that the Taiwan Weighted Stock return affects TDR return. However, the exchange rate return does not significantly affect TDR. The periods during which the underlying stock return and the Taiwan Weighted Stock return affect TDR return are short-term. In this research, we found that an obvious trend before period 4 exists, but after period 5, no trend exists during which underlying stock and the exchange rate affect TDR. TDR return is significantly affected by the underlying stock return and the Taiwan Weighted Stock Index return. However, TDR could also affect the underlying stock return and the Taiwan Weighted Stock Index return. In other words, this finding shows the relationship between TDR return and the underlying stock return. The relationship between TDR return and the Taiwan Weighted Stock Index return are two-way relationships, which affect one another. However, no significant evidence shows that the exchange rate return will affect or be affected by TDR return.

6. Research Contribution and Suggestion

Academically, this is the first study to research TDR in the world. In the past, researchers studied ADR or GDR. Until now, no one had chosen to research TDR. This study finds that underlying stock and the Taiwan Weighted Stock Index affect TDR significantly.

Practically, for listed companies, the purpose of issuing stocks is similar to that of issuing TDR. Enterprises want a higher price to raise funds for operations. Enterprises that want to issue TDRs can refer to this study, which discusses the variables that affect TDR price. They can use this study to make decisions about when to issue high-priced DRs and to collect funds efficiently. According to this paper's result, companies that issue TDR should choose the timing during which underlying stock return or the Taiwan Weighted Stock Index return is high, especially if the underlying stock return is high.

Ji, Cheng, Lee & Huang

However, when TDR returns are high, many investors will want to buy TDRs, which leads to a high TDR price.

For underwriters, securities underwriters should coordinate the IPO price or SPO of TDR with the enterprise that seeks to issue TDR. Underwriters can refer to the variables that affect TDR price so that they can establish the appropriate TDR price for their clients to issue. According to this study's result, underwriters can refer to the underlying stock and Taiwan Weighted Stock Index and decide the best timing for issuing TDRs.

For investors, DR is deemed to be stock because it is one of the investing tools, and investors could make profit from the dividends and capital gain of TDR. If the main purpose for investors is to raise profit from TDR capital gains, they can refer to the variables that affect TDR price so that they understand the factors that affect TDR to make the right investing decision about timing and thus make a profit. According to the result of this study, investors should buy TDR when underlying stock returns and the Taiwan Weighted Stock Index returns are expected to rise. When underlying stock or Taiwan Weighted Stock Index returns are high, TDR returns will rise as well. On the other hand, investors should sell TDRs when underlying stock and the Taiwan Weighted Stock Index return are expected to fall because TDR returns might be positively affected by the low return of underlying stock and Taiwan Weighted Stock Index. This study also found that an arbitrage opportunity between TDR and underlying stock exists. TDR return and underlying stock return will affect each other. Investors can use the arbitrage opportunity to price TDR and underlying stock to gain interest.

In the future, researchers can examine not only the TDR listed by companies in Hong Kong, but also by companies in other countries, such as China. More Chinese companies will issue TDRs and want to raise funds from the Taiwan capital market, so the number of TDRs listed by Chinese companies will be a large part of the TDR market. Researchers can compare the results of Hong Kong-listed companies and understand the difference in TDR between Hong Kong companies and Chinese companies.

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Ji, Cheng, Lee & Huang

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