國立政治大學地政學系
私立中國地政研究所 碩士論文

不動產投資信託與直接不動產投資關係之探討

The Relationship between Real Estate Investment Trusts and Direct Real Estate Investment

研 究 生：邱逸芬
指導教授：林左裕　教授

中　華　民　國　一　〇　一　年　八　月

謝　誌

經過兩年的掙扎與努力，終於熬到了撰寫謝誌和加上浮水印的這一天！綜觀在政大學習的七年期間，浩瀚的知識奠定了我在地政及會計領域的專業基礎，而嚴謹的學術論文則磨練出個人獨立作業與邏輯思辨的研究能力。尤其是在研究所階段，曾面臨的惶恐與挫敗，皆化為促使我成長與進步的原動力。更重要的是，這一路上，有太多給予教導與方向的師長、給予指教與建議的學長姐，以及給予關心與陪伴的家人及朋友們。我由衷地感謝，感謝你們的不辭辛勞與不厭其煩，讓我現在得以享受這小小成就的甜美果實！

在學術研究方面，最想感謝的莫過於我的論文指導教授—林左裕老師。總覺得在老師出國前一天，和老師於綜院 11 樓的 Meeting 彷彿是不久前的事情，實際上卻已經過整整兩年的時間。儘管老師人在國外期間，對於學生論文進度的指導與關切始終不曾間斷，而透過 Skype 進行討論也實屬特別且難忘的經驗。此外，非常感謝老師鼓勵我以英文撰寫論文，不僅有助於增進英文寫作能力，同時亦獲得前往新加坡參加國際研討會的機會。此次發表論文的難得經驗，一方面透過學術交流以拓展國際視野，一方面亦藉此訓練英文簡報的能力與膽識，使得這趟旅程滿載而歸！另外，感謝擔任口試委員的林哲群老師以及彭建文老師，於百忙之中撥空閱讀全文，亦提出許多精闢的指教與建議，使修改後的論文內容更加地嚴謹與完備！感謝博士班的芳妮學姐、淑湄學姐、筱蓉學姐以及曉龍學長，於期初和期末報告時，學長姐們中肯的評論讓我了解自己論文內容的缺失，而寶貴的意見亦提供我有待加強與改進的方向！

研究所這段期間，除了日夜都必須獨自面對的論文外，大概就屬那群說走就走的同學最為重要了！心中只有美漫的國正、又帥又會彈吉他的威霖、潮到滴水的力綸、婚姻幸福美滿的曉瑞、耍寶卻很細心的猴猴、總是親切又可愛的彭彭，以及即將出國交換的蔡家姐妹花—大白和居逼，很幸運有你們的陪伴，因為你們，研究所的生活並不苦悶而是多采多姿，心裡並不孤單而是無限溫暖！感謝在研究室對我照顧有加的薛薛、采螢、淯尹，和你們聊聊天後總覺得又能充滿活力繼續面對論文。感謝碩一的學弟妹們平日給予的協助以及精心策劃的謝師宴，讓我們在畢業之際留下美好的回憶。此外，感謝同甘共苦的左家人—佳貞、耀宗、淑芊，無論是計畫案、行政事務或平日的互相協助，很開心也很感激能與你們一起學習、

一起成長。感謝感情融洽宛如一家人的左家學長姐們所給予的支持與鼓勵，尤其是小侯學姐和博翔學長，更是對於我的論文提供許多寶貴的意見與想法。要感謝的人太多，對於所有曾經幫助或鼓勵過我的人，除了感謝，仍是感謝！

最後，也是最重要的，我要感謝我的家人，感謝你們不辭辛勞地為家庭付出，感謝你們對我多年來的栽培，更感謝你們總是支持我的決定！求學期間，當我因挫敗而陷入低潮或對人生未來的方向感到困惑時，家人們總是願意傾聽、充分諒解、默默地付出關心，讓我能夠找回繼續前進的動力。如今我即將踏入職場，成為社會新鮮人，期盼自己未來能在職場上虛心學習並發揮所學，迎接更多挑戰！

逸芬　謹誌於台北．溫暖的家

2012 年 8 月

摘　要

台灣不動產投資信託（T-REITs）自 2005 年發行至今已逾六年，然其市場表現仍不如發行之初所預期。過去國內已有許多研究針對 T-REITs 市場發展進行探討，然而目前就 T-REITs 與直接不動產投資市場價格表現間之相關研究尚付之闕如。有鑑於此，本研究藉由共整合與 Granger 因果關係檢定，檢視 REITs 與直接不動產市場間之關聯性，了解台灣與美國之 REITs 市場表現差異及其影響因素，進而作為改進 T-REITs 運作機制或架構之參考依據。

實證結果發現，美國之 REITs 與直接不動產市場之間存在共整合關係。此結果表示，長期而言，這兩者可能具有相似之風險分散效益。此外，透過 Granger 因果關係檢定發現REITs領先於直接不動產，乃因前者市場較具效率。另一方面，台灣之 REITs 與直接不動產市場之間則不具有共整合以及領先或落後關係，然直接不動產當期價格仍會受到本身與 REITs 之前期價格影響。

本研究進一步分析台、美兩國實證結果之差異原因如下：資料的樣本期間、REITs 市場規模、存在於 T-REITs 市場之集中性風險以及潛在的代理問題。其中，針對 T-REITs 潛在代理問題，本研究藉由分析股票與 T-REIT 報酬率之波動性，發現 T-REIT 之不動產管理機構若與母集團相關者，則其市場表現較差。因此，我們得出 T-REITs 市場發展主要是受限於代理問題之結論。本研究成果不僅有助於改善 T-REITs 市場效率，亦可提供學術與實務之參考。

關鍵詞：不動產投資信託、代理問題、共整合、向量誤差修正模型、向量自我迴歸模型、Granger 因果關係、資本資產定價模型

Abstract

The mechanism of Real Estate Investment Trusts in Taiwan (or T-REITs) was launched in 2005, however, T-REITs market did not perform as expected. What caused the limited development of T-REITs market? Current literature on the performance between T-REITs and direct real estate investment is limited. Through the cointegration and Granger causality tests, the purpose of this study is hence to explore the short-term and long-term dynamics between REITs and direct real estate markets in the U.S. and Taiwan, respectively.

This study presents evidence of the cointegration relationship between REITs and direct real estate in the U.S. It implies that the diversification properties of these two assets are likely to be similar over the long horizon. According to the Granger causality test, REITs leads direct real estate due to the market information efficiency. These findings are consistent with those of previous studies. On the other hand, we find no cointegration and lead-lag relation between T-REITs and commercial real estate. Moreover, the current commercial transaction price is affected by both its and T-REIT previous price.

By comparing the difference between the results of these two countries, there are several possible explanations for the different results between the U.S. and Taiwan, including difference in sample period, market capitalization, concentrated risk, and most importantly, the potential agency problem existing in T-REITs market. Finally, the underperformance of parent-related management T-REIT is verified through the volatilities of stock and T-REIT returns. Therefore, we conclude that the limited development of T-REITs is caused by the agency problem in REITs market. Results of this study may provide T-REITs market for improving its efficiency, as well as for the reference for both academics and real practices.

Keywords: Real Estate Investment Trusts (REITs), Agency Problem, Cointegration, Vector Error Correction Model (VECM), Vector Autoregression (VAR), Granger Causality, Capital Asset Pricing Model (CAPM)

Contents

List of Figures

List of Tables

Chapter 1

Introduction

This chapter is divided into three sections. The first section describes the general background and the purposes of this research. The second section is the research scope and method of the research. Finally, the research framework and process are presented in the third section.

1.1 General Background and Research Purpose

1.1.1 General Background

Since Real Estate Investment Trusts (REITs) are characterized by liquidity and diversification, the global REITs have expanded substantially over the past decade. By the end of 2011, the number of REITs in the U.S. has reached 153, with a total market capitalization of US$389 billion according to the National Association of Real Estate Investment Trusts (NAREIT).[1] On the other hand, in Taiwan, the first case of REIT (Fubon No. 1) was launched to the public in 2005. Up to 2011, there are eight REITs issued and the accumulated market capitalization of T-REITs has reached NT$62.17 billion.[2] However, the number of T-REITs ceased to increase since 2007. The limited development of T-REITs may be caused by the fact that the performance of T-REITs was not as well as expected.

Most existing literature has focused on the relationship between REITs and direct real estate markets among different countries, for example, the FYSE/NAREIT Equity REITs Index (NAREIT) and the appraisal-based NCREIF index (NCREIF) in the U.S. Since the conventional NCREIF Index is likely to exhibit appraisal smoothing problem, the transaction-based NCREIT Index (TBI) is included in the analysis. In Taiwan, however, few studies with shorter sample period have reported on the actual performance between T-REITs and commercial real estate. Therefore, it is imperative

[1] The exchange rate of NT dollars to US dollars in 2011 is around 28-29.
[2] In 2011, the number of T-REITs was reduced to six due to the liquidation of two T-REITs, Kee Tai Star and Trident.

to examine the relationship between the two markets.

The aim of this study is to investigate the short-term and long-term dynamics between REITs and direct real estate markets in the U.S. and Taiwan, respectively. Moreover, we attempt to analyze the difference between the REITs performance of the U.S. and Taiwan, and then propose the implication of the results. Since most REITs in Taiwan are managed and operated by the management related to their originating companies, we thus intend to discover the potential agency problem existing in T-REITs market, and provide the feasible solution to improve the market efficiency.

1.1.2 Research Purpose

The research purposes of this study are as follows:

(1) To explore the long-run and short-run dynamics between REITs and direct real estate markets in the U.S. and Taiwan, respectively. We analyze the relationship between these two markets by employing cointegration and Granger causality tests. In addition, we attempt to discuss the implication of such empirical results and compare the results of the U.S. and Taiwan.

(2) To investigate whether the agency problem exists in T-REITs market. This study intends to verify the potential agency problem not only by analyzing the type of T-REIT management, but also by applying the Capital Asset Pricing Model (CAPM) framework. Furthermore, we attempt to provide the feasible solution for improving the market efficiency, as well as for the reference for both academics and real practices.

1.2 Research Scope and Method

1.2.1 Research Scope

(1) Research Subjects

This study attempts to explore the relationship between REITs and direct real estate markets in the U.S. and Taiwan, respectively. REITs are classified in one of three categories depending on the substance of investment, i.e., equity REIT, mortgage REIT, and hybrid REIT. In particular, equity REIT is the principal investment form of REITs markets both in the U.S. and in Taiwan.[3] We thus select equity REIT representing REITs market to investigate the relationship with the direct real estate market.

There are numerous property types in the U.S. REITs market, while the primary component of the T-REITs market is commercial property.[4] For the comparability of empirical results, this study selects commercial real estate markets on behalf of direct real estate markets. In addition, to avoid the appraisal smoothing problem suggested in previous literature, we employ transaction price of commercial real estate to examine the relationship between these two markets.

(2) Time and Spatial Scope

For the U.S., the data used in this study cover the period from January 1991 to December 2010 and are acquired from the U.S. REITs and commercial real estate markets. For Taiwan, the study period ranges from January 2006 to December 2010. Since most investment objects of T-REITs are located in Taipei City, the transaction price of direct real estate discussed in this study is that of commercial property in Taipei City.

[3] In the U.S., the percentage of equity REIT and mortgage REIT in the whole REITs market are 92% and 8%, respectively. In T-REITs market, all of the T-REITs are equity REITs.

[4] According to the NAREIT, property types of REITs in the U.S. contains regional malls (14.6%), apartments (13.5%), office buildings (11.3%), health care (10.9%), shopping centers (8.2%), mortgage REITs (7.8%), diversified (7.4%), lodging/resorts (6.0%), timber (5.6%), self storage (5.3%), industrial (4.5%), mixed (2.3%), free-standing (1.9%), and manufactured homes (0.6%).

(3) Limitations

The first limitation of this study concerns the length of study period for Taiwan. We intend to apply cointegration test to examine the long-run equilibrium relationship between T-REITs and direct real estate markets. However, since the mechanism of T-REITs was launched in 2005, the data used in the empirical analysis is only available for five years. The length of time may not long enough to conclude the general long-term relationship. In other words, the results of cointegration test may exist bias due to the shorter study period.

The second limitation is rooted in the data of direct real estate market used in the empirical analysis for Taiwan. The data employed in this study are the transaction cases of commercial real estate, which are provided from the one big (Y) realty company in Taiwan. Although the data representability is taken into consideration, empirical results may substantially different by applying other databases of transaction cases.

1.2.2 Research Method

This study examines the relationship between REITs and direct real estate markets by empirical modeling analysis. In terms of long-run dynamics, we conduct cointegration test to detect the existence of long-run equilibrium relationship. For short-term relation, we examine the interrelations between the variables by estimating Vector Error Correction Model (VECM) and Vector Autoregressive (VAR) model. In addition, Granger causality test is applied in this study to clarify the lead-lag relation between REITs and direct real estate. On the other hand, we employ the Capital Asset Pricing Model (CAPM) framework to verify the potential agency problem in T-REITs market.

1.3 Research Overview

1.3.1 Research Framework

This research is organized as follows. Chapter 1 is “Introduction,” which includes the general background and research purpose, research scope and method, and research overview. Chapter 2 is “Literature Review,” providing a review of the dynamics between REITs and direct real estate and the literature on agency problem in REITs. Chapter 3 is “Research Method and Data Information,” presenting the methodology employed and the data used in the empirical analysis. Chapter 4 is “Empirical Results,” which illustrates the empirical results of the U.S. and Taiwan, and agency problem in T-REITs market. Finally, Chapter 5 is “Conclusion and Discussion,” summarizing the findings and implications of this research.

1.3.2 Research Process

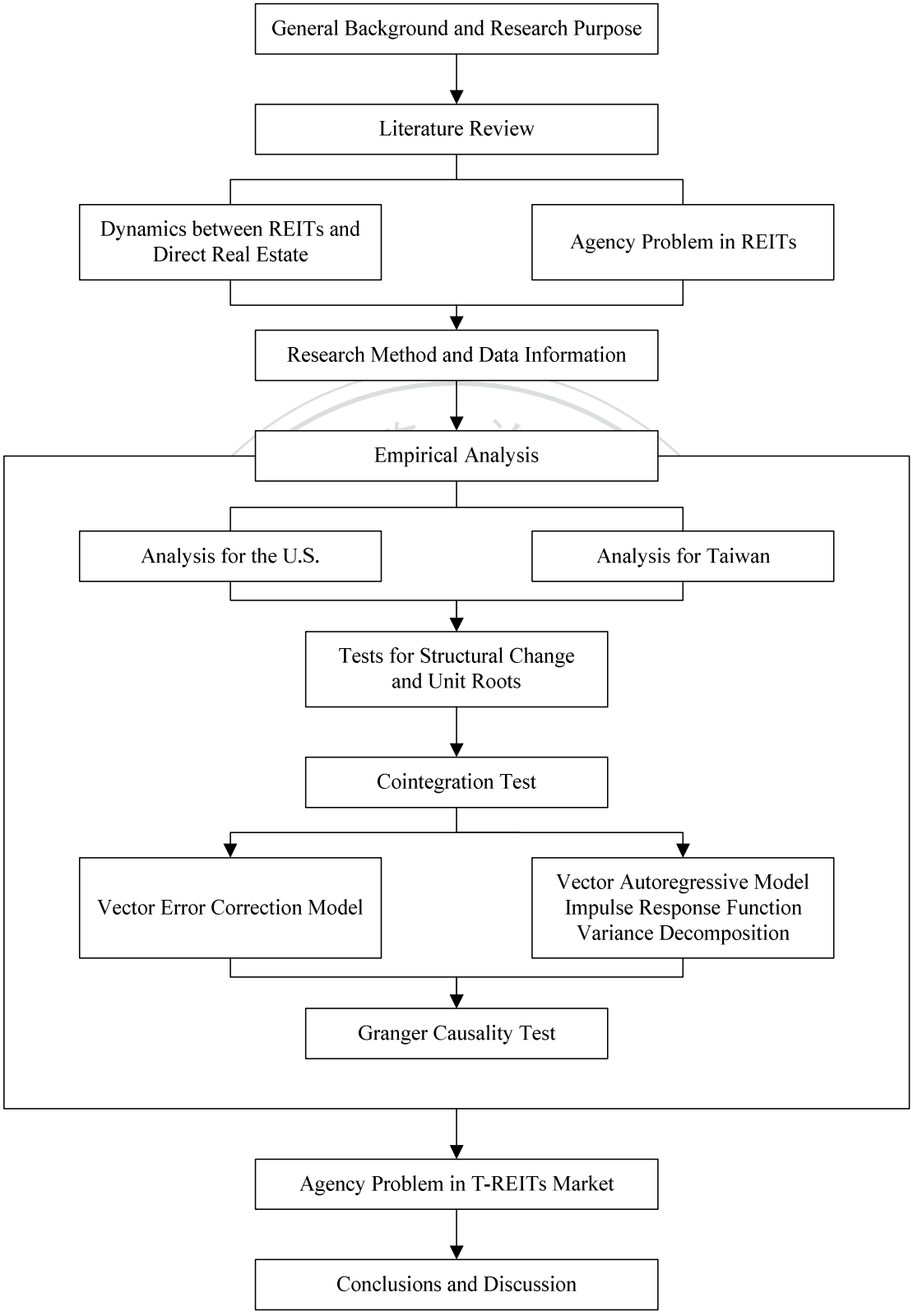

Figure 1-1 Research Process

Chapter 2

Literature Review

This chapter is divided into two sections. The first section explores the dynamic relationship between REITs and direct real estate markets. The second section discusses agency problem in REITs, as the basis for analyzing the performance of T-REITs market.

2.1 Dynamics between REITs and Direct Real Estate

The linkage between REITs, direct real estate, stock, and bond markets has been intensively studied since the late 1980s. Since REIT is the financial asset derived from real estate, much of the previous literature has focused on the correlation between REITs and direct real estate, and the conclusions are quite inconsistent. For example, Giliberto (1990) found that the residuals from regressions of REITs and direct real estate returns on financial asset returns are significantly correlated. This implies that both REITs and direct real estate returns are affected by a common real estate factor that links their performances together (Gyourko and Keim, 1992; Mei and Lee, 1994).

Instead, Goetzmann and Ibbotson (1990) indicated that both return and volatility of REITs were far above that of direct real estate, and two series were only weakly correlated. Since then, the low correlations between REITs and direct real estate in the U.S. have been confirmed in many studies (Ross and Zisler, 1991; Gyourko and Keim, 1992; Barkham and Geltner, 1995; Geltner and Kluger, 1998). Moreover, the same argument has been verified in several countries (Hoesli, Lekander, and Witkiewicz, 2004; Newell, Chau, Wong, and McKinnell, 2005).

In contrast with previous studies, the relationship between REITs and direct real estate has become more closely-related over the past two decades. This argument is supported by Clayton and MacKinnon (2001) who found that REIT returns exhibit an increasing sensitivity to real estate returns through time. Due to the dramatic growth and maturation of the REIT sector, REIT have been more like real estate and less like stock (Ghosh, Miles, and Sirmans, 1996; Ziering, Winograd, and McIntosh, 1997;

McIntosh and Liang, 1998). With better information about REITs available, REITs have begun to better reflect their "true" nature, stated by Clayton and MacKinnon (2001). More recently, Morawski, Rehkugler, and Füss (2008) found that correlations between REITs and direct real estate are clearly higher for longer holding periods. Since direct real estate is deemed as a long-term investment, it should also influence the performance of REITs in a similar manner.

Other studies have focused on the lead-lag relation between REITs and direct real estate markets. For instance, Giliberto (1990) reported that the relationship between REITs and direct real estate returns is remarkably stronger when a lead in the REIT returns being considered. Moreover, Gyourko and Keim (1992) suggest that the correlation analysis between REITs and appraisal-based real estate indices seems to be deviated, since the latter is based on valuations conducted every two to four quarters. Hence, the authors demonstrate a significant relationship between the adjusted returns of NCREIF and the one-year lagged returns of NAREIT indices. Other studies supporting this argument are conducted by Myer and Webb (1993) and Barkham and Geltner (1995), which employed Granger causality test. In more recent studies, Li, Mooradian, and Yang (2009) and Oikarinen, Hoesli, and Serrano (2011) indicated that NAREIT led both NCREIF and TBI indices after 1990. Myer and Webb (1994) and Newell et al. (2005), however, found no Granger causality between REITs and direct commercial real estate in short sample period.

In addition to the analyses of short-run volatility and lead-lag relations between REITs and direct real estate markets, some studies further examined the existence of cointegration through investigating the long-term dynamics between these two markets. Morawski et al. (2008) showed that there are cointegration relationships among NAREIT, NCREIF and the S&P 500 stock indices from 1978 to 2006. More recently, Oikarinen et al. (2011) presented that NAREIT are cointegrated with both NCREIF and TBI but not with the S&P 500 stock indices from 1977 to 2008. The results suggest that REITs and direct real estate are likely to have similar long-term diversification benefits in a stock portfolio.

Not many domestic studies have examined the existence of long-run dynamics

between T-REITs and other markets. Zheng, Chang, and Bai (2008) found that T-REITs index are not cointegrated with the stock index nor be the construction index in two years. The results imply that T-REITs have diversification benefits.

Overall, studies on the dynamics between REITs and direct real estate markets in different countries are extensive, especially on the U.S. However, empirical literature on this issue in Taiwan or other countries is relatively limited. Most studies have discussed the relationship between T-REITs and stock or construction stock indices as a proxy for the stock market, while few researches analyze the relationship between T-REITs and direct real estate markets. The purpose of this study is thus to explore the short- and long-run dynamics between T-REITs and direct commercial real estate markets.

2.2 Agency Problem in REITs

There are two competing property management structures for the corporate organization of REITs: internal and external management. Since one notable characteristic of REIT is the separation of ownership and control, agency problem is likely to occur between shareholders and management. Jensen and Meckling (1976) defined the agency relationship as a contract when the principal engage the agent to perform some service on their behalf which involves delegating some decision making authority to the agent. If the incentive or reward mechanism is not well designed, then there is good reason to believe that the agent will not always act for the best interests of the principal. In this case, the agency cost is inevitable.[5] In addition, the authors suggest that the agency conflicts will affect firm performance, and increasing management's ownership can help mitigate agency problems. Therefore, agency theory implies that suppose agency inflicts appear in externally-managed REITs, their market performance will also be influenced by the ownership structure.

Conflicts of interest refer to situations where the interests for management and shareholders are misaligned: acting on their self-interests, managers make decisions that will not be in the best interests of shareholders. Sagalyn (1996) identified twelve types of conflicts of interest, which cut across all spheres of REIT decision making, i.e., offering formation, investment management, transaction activity, and property management.[6] The author also argues that a misalignment of incentives exists for externally-managed REITs, while the potential for conflicts of interest will decline with internal management.

On the other hand, agency theory suggests that when corporate managers have a significant ownership stake, managerial incentives are more closely aligned with shareholders and agency costs are reduced (Jensen and Meckling, 1976). Cannon and Vogt (1995) found that self-administered REITs outperformed advisor REITs over the

[5] Agency costs include the monitoring expenditures by the principal, the bonding expenditures by the agent, and the residual loss (Jensen and Meckling, 1976).

[6] Types of conflicts of interest (COI) contain allegiance, sponsor control, outside partners, over-compensation, resource allocation, competitive affiliates, tie-in business, captivity, tax timing, expense preference behavior, and malingering (Sagalyn, 1996).

1987 to 1992 sample period even after adjusting for the differences of market risks. Ownership structure has considerably more effect on the performance of advisor REITs, but less effect on self-administered REITs. The authors suggest that self-administered REITs have been able to reduce agency problems effectively by other approaches, for instance, more standardized financial reporting or incentive-based compensation structures. The same findings of underperformance for externally-managed REITs are demonstrated by Howe and Shilling (1990), Hsieh and Sirmans (1991).

More recently, Capozza and Seguin (2000) exhibited that externally-managed REITs consistently underperformed internally-managed REITs due to the high financial leverage over 1985 to 1992. Ambrose and Linneman (2001) examine differences between externally-advised and internally-advised REITs with respect to operating structure, growth prospects, operating revenue and expenses, cash flow and profitability, equity returns, betas and capital costs. The results almost consistent with those found by Capozza and Seguin (2000), and indicate that internally-advised REITs continue to outperform externally-advised REITs. Furthermore, the authors found that internally-advised REITs have significantly higher betas than externally-advised REITs. It reflects the market's perception of these firms as internally-advised (unproven) growth stocks.

In Taiwan, most of T-REIT managements are related to the originating companies (i.e. parent companies). It is likely to induce conflicts of interest and result in the loss of investors' interests. By examining the trends of REIT price and Net Asset Value (NAV), Wang and Chang (2009) suggest that some T-REITs may exist conflicts of interest due to the close business relationships between property management and original owners. In more recent studies, Tsai, Chen, and Chang (2011) found that REITs in Taiwan are not defensive since investors have not yet been familiar with the characteristics of REITs market. However, we conjecture the potential agency problem may be the main reason for the limited development of T-REITs market. Since literature on the agency problem for T-REIT is relatively limited, this study attempts to empirically verify the hypothesis of agency problem.

Chapter 3

Research Methodology and Data Information

This chapter is divided into two sections. The first section presents the econometric methodology applied in this research for empirical analysis. The second section introduces the current development of T-REITs market, describes the data used in empirical tests, and performs preliminary analyses by means of descriptive statistics and time-series graphs.

3.1 Research Methodology[7]

In order to detect the existence of long-run equilibrium relationship between REITs and direct real estate, we employ cointegration test proposed by Johansen (1988). If there exists a cointegration relationship between these two variables, we could analyze the short-term relation by estimating Vector Error Correction Model (VECM). If there is no cointegration relationship, however, we should examine the interrelation between the variables through Vector Autoregressive (VAR) model. Finally, Granger causality test is applied in this research to clarify the lead-lag relation between REITs and direct real estate.

3.1.1 Cointegration

The concept of cointegration was first introduced by Engle and Granger (1987). According to Engle and Granger's original definition, cointegration refers to variables that are integrated of the same order. More specifically, if a time series is non-stationary, it could become stationary after taking *d* time difference, which means to be integrated of the *d* order, i.e., a I(*d*) variable. When two non-stationary time series are integrated of the same order and a linear combination relationship of them is stationary, the time series are cointegrated. In other words, there exists a long-run equilibrium relationship between the variables. Engle and Granger detect whether variables are cointegrated by testing the stationary of the residuals. If the residuals are

[7] The econometric methods applied in this research are referred to Enders (2004), p. 264–310; 320–372.

stationary, then the two variables are said to be cointegrated. If the residuals are non-stationary, however, then the two variables are not cointegrated.

However, the Engle and Granger cointegration approach still have several important defects. First, the results of cointegration test may be contrasting depending on the choice of the variable selected for normalization. In other words, the results may not be consistent. Second, when using three or more variables in cointegration tests, we expect that there may be more than one cointegrating vector. This approach, however, has no systematic procedure for indicating multiple cointegration relationships. Finally, since the Engle and Granger procedure relies on a two-step estimator, any error introduced by the researcher in Step 1 is carried into Step 2. Therefore, Johansen cointegration test is employed in this research, which can avoid aforementioned problems.

The Johansen cointegration approach is a maximum likelihood estimation of a fully specified error correction model, which is based on VAR model. This method is more robust for interpreting the multiple long-run equilibrium relationship between variables. Assuming a VAR model of order *p* and *n* variables can be expressed as:

$$X_t = A_1 X_{t-1} + A_2 X_{t-2} + \cdots + A_p X_{t-p} + \varepsilon_t \quad (1)$$

where: X_t= the $(n \cdot 1)$ vector $(X_{1t}, X_{2t}, \cdots, X_{nt})$;

ε_t= an independently and identically distributed *n*-dimensional vector with zero mean and variance matrix $\sum_\varepsilon$

After adding and subtracting $A_p X_{t-p+1}$ to the right-hand side, we can continue in this fashion to obtain

$$\Delta X_t = \pi X_{t-1} + \sum_{i=1}^{p-1} \pi_i \Delta X_{t-i} + \varepsilon_t \quad (2)$$

where $\pi = -\left(I - \sum_{i=1}^{p} A_i\right)$ and $\pi_i = -\sum_{j=i+1}^{p} A_j$

The key feature to note in equation (2) is rank of the matrix π, which is equal to the number of independent cointegrating vectors. If $\text{rank}(\pi) = 0$, the matrix is null and equation (2) is the usual VAR model in first difference. If $\text{rank}(\pi) = 1$, the system exists a single cointegrating vector.

The number of distinct cointegrating vectors can be obtained by checking the significance of the characteristic roots of π. In practice, we can obtain only estimates of π and its characteristic roots. In order to determine whether there exists cointegration relationship, we can test the number of characteristic roots by using the following two test statistics:

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{n} \ln(1-\hat{\lambda}_i) \quad (3)$$

$$\lambda_{max}(r, r+1) = -T\ln(1-\hat{\lambda}_{r+1}) \quad (4)$$

where: T = the number of usable observations;

$\hat{\lambda}_i$= the estimated values of the characteristic roots (i.e. eigenvalues) obtained from the estimated Π matrix

The trace statistic tests the null hypothesis that the number of cointegrating vectors is less than or equal to *r*. On the other hand, the maximum eigenvalue statistic tests the null hypothesis that the number of cointegrating vectors is equal to *r*.

3.1.2 Vector Error Correction Model

A critical characteristic of cointegrated variables is that their time paths are influenced by the extent of any deviation from long-run equilibrium. After all, if the system is to return to long-run equilibrium, the movements of at least some of the variables must respond to the magnitude of the disequilibrium. Hence, if cointegration relationship exists between two series, according to Granger representation theorem, an error correction term must be added to correct the short-term dynamics influenced by the deviation from the long-run relationship. VECM is a special form of VAR model for I(1) that are cointegrated, making the variables move toward to the direction of long-run equilibrium. To examine the relationship between cointegration and error correction, it is important to study the properties of the simple VAR model:

$$Y_t = a_{11}Y_{t-1} + a_{12}Z_{t-1} + \varepsilon_{Yt} \quad (5)$$

$$Z_t = a_{21}Y_{t-1} - a_{22}Z_{t-1} + \varepsilon_{Zt} \quad (6)$$

where ε_{Yt} and ε_{Zt} are white-noise disturbances that may be correlated with each other and, for simplicity, intercept terms have been ignored.

To ensure that the variables are cointegrated of order (1,1), we must place following restrictions on the coefficients of equation (5) and (6):

$$a_{11} = [(1 - a_{22}) - a_{12}a_{21}]/(1 - a_{22}) \quad (7)$$

$$a_{22} > -1 \quad (8)$$

$$a_{12}a_{21} + (a_{22})^2 < 1 \quad (9)$$

To see how these coefficient restrictions bear on the nature of the solution, write equation (5) and (6) as

$$\begin{bmatrix}\Delta Y_t \\ \Delta Z_t\end{bmatrix} = \begin{bmatrix}a_{11} - 1 & a_{12} \\ a_{21} & a_{22} - 1\end{bmatrix}\begin{bmatrix}Y_{t-1} \\ Z_{t-1}\end{bmatrix} + \begin{bmatrix}\varepsilon_{Yt} \\ \varepsilon_{Zt}\end{bmatrix} \quad (10)$$

After a bit of manipulation, equation (10) can be written in the form

$$\Delta Y_t = -[a_{12}a_{21}/(1 - a_{22})]Y_{t-1} + a_{12}Z_{t-1} + \varepsilon_{Yt} \quad (11)$$

$$\Delta Z_t = a_{21}Y_{t-1} - (1 - a_{22})Z_{t-1} + \varepsilon_{Zt} \quad (12)$$

Equation (11) and (12) form an error-correction model. If both a_{12} and a_{21} differ from zero, we can normalize the cointegrating vector with respect to either variables. Normalizing with respect to Y_t, we get

$$\Delta Y_t = \alpha_Y(Y_{t-1} - \beta Z_{t-1}) + \varepsilon_{Yt} \quad (13)$$

$$\Delta Z_t = \alpha_Z(Y_{t-1} - \beta Z_{t-1}) + \varepsilon_{Zt} \quad (14)$$

where: $\alpha_Y = -a_{12}a_{21}/(1 - a_{22})$;

$\beta = (1 - a_{22})/a_{21}$;

$\alpha_Z = a_{21}$

Notice that α_Y and α_Z have the interpretation of speed of adjustment parameters. The larger α_Y is, the greater the response of to the previous period's deviation from long-run equilibrium. At the opposite extreme, very small values of α_Y imply that the short-term of the variable Y is unresponsive to last period's equilibrium. If both α_Y and α_Z are equal to zero, the long-run equilibrium relationship does not appear and the model is not one of error-correction or cointegration.

3.1.3 Vector Autoregressive Model

If those series are not cointegrated, the vector autoregressive model is a general framework to explore the dynamic interrelationships among economic variables. All the variables in a VAR model are treated symmetrically. In particular, each variable has an equation explaining its evolution based on its own lags and the lags of all the other variables in the model. In this case, VAR model can identify the lags short-term impact on the dependent variable by analyzing the correlation between the lags of the dependent variable and of other variables. Therefore, this study applies the VAR approach to examine the reactions of REIT to direct real estate and the reactions of direct real estate to REIT.

In the bivariate case, we can let the time path of Y_t be affected by current and past realizations of the Z_t sequence and let the time path of Z_t be affected by current and past realizations of the Y_t sequence. Based on this concept, we estimate a VAR in the standard form:

$$Y_t = \alpha_{10} + \alpha_{11s} Y_{t-1} + \alpha_{12s} Z_{t-s} + e_{1t} \quad (15)$$

$$Z_t = \alpha_{20} + \alpha_{21s} Y_{t-1} + \alpha_{22s} Z_{t-s} + e_{2t} \quad (16)$$

It is assumed that (1) both Y_t and Z_t are stationary; (2) the error term (i.e. e_{1t} and e_{2t}) are composites of the two shocks ε_{yt} and ε_{zt}.

In addition, there are two useful techniques employed by VAR analysis to understand the interrelationship between variables. One is impulse response function which can quantify and graphically depict the time path of the short-term impact varies under the long-run fluctuations. In other words, it will present how the variables react to shocks. The other is variance decomposition which allows us to assess the relative contributions of different shocks to the forecast error variance, that is, it will be informative to present the sources of volatility.

3.1.4 Granger Causality

In addition to cointegration test, we can gain some additional insights into the interrelation between two series by performing Granger causality tests both of REIT on direct real estate and of direct real estate on REIT. The main purpose of this methodology is to examine the existence of lead-lag relations between two variables. In other words, it can investigate the ability of one series to predict another, conditional on its own past value.[8] For instance, if current and past value of Y_t is helpful to forecast future values of Z_t, it is said that Y_t does Granger cause Z_t, alternatively called Y_t leads Z_t. Moreover, if there is an interaction between the two variables, then the result indicates the feedback relation between variables.

Suppose two variables in VAR model are stationary, but does not have a cointegration relationship, the Granger causality equation is defined as:

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \Delta Z_{t-i} + \sum_{j=1}^{p} \beta_j \Delta Y_{t-j} + \varepsilon_t, \quad (17)$$

where Y_t is the dependent variable; Z_t is independent variable, *p* is lag terms. The null hypothesis is $\alpha_1 = \alpha_2 = \cdots\cdots = \alpha_p = 0$. If the results reject the null hypothesis that *Z* sequence does not lead *Y* sequence, then the inclusion of *Z* sequence in the equation is useful in predicting *Y* sequence.

If there is a cointegration between two variables, the result of causality test would be biased by using equation (17) directly. In order to avoid the distortion, the deviation from the long-run equilibrium level should be taken into consideration. Hence, we employ VECM to estimate by adding error correction term $\lambda\hat{\mu}_{t-1}$ into the above VAR model, becoming equation (18).

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \Delta Z_{t-i} + \sum_{j=1}^{p} \beta_j \Delta Y_{t-j} + \lambda\hat{\mu}_{t-1} + \varepsilon_t \quad (18)$$

[8] Such causality, based on predictability, is not to be confused with causality based on cause and effect, which can only be tested by performing controlled experiments (Myer and Webb, 1993).

3.2 Data Information

This section is divided into three subsections, including the introduction of T-REITs market, data source and data analysis. The first subsection introduces the current development of T-REITs market and general information of REITs launched in Taiwan. Next, the source and information of data applied in this study are described in the second subsection. Finally, we do some preliminary analyses by presenting the descriptive statistics and depicting the time series trends of these variables.

3.2.1 Introduction of T-REITs Market

In Taiwan, the first case of REIT (Fubon No. 1) was offered to the public in March 2005. By the end of 2010, there are eight REITs issued and the total market capitalization of T-REITs has reached NT$ 62.17 billion, while the number of T-REITs ceased to increase since May 2007. As shown in Table 3-1, the highest percentage of market capitalization is Cathay No.1, whereas Kee Tai Star and Trident possess relatively lower market capitalization, which are liquidated in mid-2011. In other words, the market capitalization of T-REITs has shrunk gradually.

Table 3-1 Market Value of T-REITs Market

T-REIT	Stock Symbol	Issuing Date	Market Value (billion)	Percentage of Total Market Capitalization
Fubon No. 1	01001T	03/10/2005	6.94	11.16%
Cathay No. 1	01002T	10/03/2005	16.47	26.49%
Shin Kong No. 1	01003T	12/26/2005	11.46	18.43%
Fubon No. 2	01004T	04/13/2006	7.96	12.80%
Trident	01005T	06/26/2006	4.77	7.67%
Kee Tai Star	01006T	08/14/2006	2.53	4.07%
Cathay No. 2	01007T	10/13/2006	8.09	13.01%
Gallop No. 1	01008T	05/15/2007	3.95	6.35%
Total			62.17	100.00%

Note: As of December 31, 2010, there are seven T-REITs listed on the Taiwan Stock Exchange and one traded in the OTC market (i.e. Kee Tai Star).

The basic information of T-REITs is summarized in Table 3-2 and ordered chronologically by issuing date. Panel A and Panel B present the details of investment security and investment property regarding each T-REIT, respectively. In terms of the types of REIT, a REIT is classified in one of three categories by investing direct or indirectly in properties. All the REITs in Taiwan are equity REITs, which invest directly in real estate, own and manage the properties, and therefore are responsible for the properties' asset value.

Another distinction method is whether a REIT is closed-ended or open-ended.[9] According to the "Clauses of the Real Estate Securitization Act," the REIT funds shall be only subject to closed-end funds; provided, that open-end funds attached with repurchasing time, quantity or other limits may be collected with the approval of the competent authority. Since the sophisticated evaluation of NAV is required for open-end fund, all the T-REITs are closed-end funds.

As shown in Panel B, most T-REIT properties are commercial office buildings or shopping centers, and located in Taipei City. This is the reason why we choose commercial real estate in Taipei City on behalf of direct real estate market to examine the relationship with T-REITs market. However, investors' interests and the performance of T-REITs may be influenced by the market capitalization or the concentrated risk of properties. In this study, we thus attempt to investigate whether T-REIT price could reflect the fundamentals of direct real estate market. In addition, the economic implication and the deficiencies in T-REITs market would be discussed based on the empirical results.

[9] Closed-end fund shall mean a fund where its investors may not request the trustee to repurchase the beneficiary securities held by them during the duration of the fund. Open-end fund shall mean a fund where its investors may request the trustee to repurchase the beneficiary securities held by them during the duration of the fund.

Table 3-2 Summary Information of T-REITs

Panel A: Investment Security Part

T-REIT	Listing Date	Raising Capital	Trustee	Underwriter	Property Management	Rating Institution	Appraisal Institution	Accounting Firm	Law Firm
Fubon No. 1	03/10/2005	5.83	Land Bank of Taiwan	Fubon Securities	Fubon Real Estate Management	Taiwan Ratings Long-Term: twA- Short-Term: twA-2	1. DTZ 2. Jones Lang LaSalle	KPMG	Baker & McKenzi
Cathay No. 1	10/03/2005	13.93	Land Bank of Taiwan	Jih Sun Securities	Cathay Real Estate Management	Taiwan Ratings Long-Term: twA- Short-Term: twA-2	1. DTZ 2. China Credi Information Service	Diwan & Company	Baker & McKenzi
Shin Kong No. 1	12/26/2005	11.30	Mega International Commercial Bank	MasterLink Securities	New Light International	Taiwan Ratings Long-Term: twAA Short-Term: twA-1+	1. DTZ 2. Honda Appraisers Joint Firm	Deloitte	Lee and Li
Fubon No. 2	04/13/2006	7.30	Land Bank of Taiwan	Fubon Securities	Fubon Real Estate Management	Taiwan Ratings Long-Term: twA+ Short-Term: twA-1	1. DTZ 2. China Credi Information Service	KPMG	Lee and Li

Trident	06/26/2006	3.85	Taishin International Bank	President Securities	Eslite Corporation	Taiwan Ratings Long-Term: twA Short-Term: twA-1	1. DTZ 2. China Credi Information Service	Diwan & Company	Lee and Li
Kee Tai Star	08/14/2006	2.47	Land Bank of Taiwan	Polaris Securities	Aurora Development	Taiwan Ratings Long-Term: twBBB Short-Term: twA-3	1. Honda Appraisers Joint Firm 2. China Credi Information Service	1. CLOCK & CO. 2. PwC	LCS & Partners
Cathay No. 2	10/13/2006	7.20	Mega International Commercial Bank	Jih Sun Securities	Cathay Real Estate Management	Fitch Ratings Long-Term: A(twn) Short-Term: F1(twn)	1. DTZ 2. China Credi Information Service	Diwan & Company	Lee and Li
Gallop No. 1	05/15/2007	4.28	Mega International Commercial Bank	MasterLink Securities	Tai Chai International	Taiwan Ratings Long-Term: twA Short-Term: twA-1	1. DTZ 2. China Credi Information Service	1. Diwan & Company 2. Deloitte	LCS & Partners

Note: 1. The information is summarized from the prospectuses of eight T-REITs.

2. The raising capital is presented in billion NT dollars.

Panel B: Investment Property Part

T-REIT	Investment Property	Original Owner	Major Tenant	Location	Property Type
Fubon No. 1	1. Fubon Life Insurance Building 2. Fubon Zhongshan Building 3. Tianmu Fubon Building	Fubon Land Development	1. Fubon Life Insurance, Securities, Bank 2. TransGlobe Life 3. Foreign Office in Taiwan	Taipei City	1. Commercial Office Building 2. Commercial Office Building 3. Condominium Building
Cathay No. 1	1. Sheraton Taipei Hotel 2. Taipei Ximen Building 3. Taipei Zhonghua Building	Cathay Life Insurance	1. My Humble House Hospitality Management Consulting 2. Eslite Corporation 3. Cathay United Bank, Insurance	Taipei City	1. Hotel 2. Shopping Center 3. Shopping Center
Shin Kong No. 1	1. Shin Kong Tianmu Jasper Villa 2. Shin Kong International Commercial Building 3. Taiwan Securities Financial Center 4. Shin Kong Mitsukoshi Department Store	Shin Kong Life Insurance	1. Motorola Technology, Citibank, DuPont Taiwan 2. Taishin Bank, 104 Corporation 3. THAI Taiwan, Hitachi Asia, Clariant Corporation 4. Shin Kong Mitsukoshi Department Store	1. Taipei City 2. Taipei City 3. Taipei City 4. Tainan City	1. Serviced Apartment 2. Commercial Office Building 3. Commercial Office Building 4. Shopping Center
Fubon No. 2	1. Fubon Minsheng Building 2. Fubon Neihu	1. ZhongShin Development 2. (1)Taipei Fubon Commercial Bank	1. Fubon Securities, Bank, Carat Media 2. Fubon Financial Holding, Bank,	Taipei City	1. Commercial Office Building 2. Industrial-Office

	Building 3. Ruentex Zhonglun Building (partial)	(2)Fubon Insurance (3)Fubon Life Insurance 3. City-Link Development	Insurance 3. Ruentex Industries, Ruentex Development, SinoPac Holdings		Building 3. Commercial Office Building
Trident	1. ARTECH 21 Office Building 2. Champagne Building 3. Eslite Logistic Building	1. Continental Engineering 2. Wellcome Enterprise 3. Eslite Corporation	1. Chinatrust Life, Shin Kong Bank, OCBC Bank 2. Wellcome Market, Chinatrust Commercial Bank 3. Eslite Corporation, HLSC	1. Taipei City 2. Taipei City 3. Taoyuan County	1. Commercial Office Building 2. Shopping Center 3. Logistic Center
Kee Tai Star	1. Century Louvre Building 2. City Lake Hotel	Kee Tai Properties	1. Kee Tai Properties, Management Consulting 2. City Lake Hotel, President Chain Store	Taipei City	1. Commercila Office Building 2. Hotel and Office Building
Cathay No. 2	1. Minsheng Commercial Building 2. World Building 3. Anhe Commercial Building	Cathay Life Insurance	1. Abbott Taiwan, ezTravel 2. ABB Group, Yang Ming Marine Transport Corporation 3. Johnson & Johnson, Mary Kay Taiwan	Taipei City	Commercial Office Building
Gallop No. 1	1. GoldSun Building 2. CTCI Building 3. Honeywell Building	1. (1)GoldSun Development & Construction (2)Taiwan Secom (3)WellPool Corporation 2. CTCI Corporation 3. (1)Chai Shin Assets Management (2)Chai Shin Cement Development	1. GoldSun Development & Construction, Taiwan Secom, WellPool Corporation 2. CTCI Corporation 3. SYSTEX Corporation, EUDAR Technology	1. Taipei City 2. Taipei City 3. New Taipei City	1. Office Building 2. Office Building 3. Industrial-Office Building

Note: The information is summarized from the prospectuses of eight T-REITs.

3.2.2 Data Source

The aim of this study is to explore the relationship between REITs and direct real estate markets in the U.S. and Taiwan, respectively. Since equity REIT is the major investment form both in the U.S. and in Taiwan, we thus take equity REIT price indices as the proxy of REITs markets. On the other hand, the types of investment property are diversified in the U.S. REITs market, while most T-REITs focus on commercial properties. For the comparability of empirical results, this study chooses commercial real estate markets on behalf of direct real estate markets.

Table 3-3 summarizes the data information used in this study. For the empirical analysis of the U.S., the FYSE/NAREIT Equity REITs Index (NAREIT) and the transaction-based Index (TBI) are employed. To avoid the appraisal smoothing problem exhibit in the conventional National Council of Real Estate Investment Fiduciaries (NCREIF) Property Index (Fisher, Geltner, and Pollakowski, 2007), this study applies TBI which is established by MIT/CRE Commercial Real Estate Data Laboratory (MIT/CRE CREDL).[10] On the other hand, the T-REITs price index from the Taiwan Economic Journal (TEJ) is applied for the REITs market in Taiwan. For the direct real estate market, we employ the transaction price of commercial real estate provided from the one big (Y) realty company in Taiwan. Since most T-REIT properties are located in Taipei City, the transaction price of direct real estate discussed in this study is that of commercial property in Taipei City.

There have been numerous studies stated that in the early 1990s the REITs market went through a mature process (Clayton and MacKinnon, 2003), including the increase in investors' interests and the growth in market capitalization. Since the informational efficiency of the U.S. REITs market have been improved, it makes REIT price to better reflect market fundamentals after 1990s. In addition, TBI is only available at the quarterly frequency. Therefore, the study period of the U.S. markets ranges from 1991Q1 to 2010Q4.

[10] The NCREIF Property Index is based on appraised values of the properties in the index. Given the nature of the appraisal process, and because most properties in the index are not fully or independently reappraised every quarter, the index exhibits a degree of "smoothing" and "lagging" relative to the underlying real estate market.

As mentioned in the previous subsection, the first case of T-REIT was offered to the public in March 2005 and there are not more than three REITs until April 2006. In order to avoid the deviation of empirical results, this study covers the period from 2006 to 2010, which involves three to eight T-REITs. In addition, the commercial transaction price index of direct real estate is established by monthly average transaction price. Hence, we use the data with monthly frequency for analyzing these two markets in Taiwan.

Table 3-3 Variable Description

Country	Variable	Code	Type	Source	Time Period
U.S.	REITs	NAREIT	Quarterly	NAREIT	1991Q1-2010Q4
	Transaction-Based Index	TBI	Quarterly	MIT / CRE	1991Q1-2010Q4
Taiwan	REITs	TREIT	Monthly	TEJ	01/2006-12/2010
	Commercial Transaction Price	CTP	Monthly	Y Realty company	01/2006-12/2010

3.2.3 Data Analysis

The descriptive statistics of price indices are reported in Table 3-4. As can be seen, the price volatility of NAREIT is somewhat lower than that of TBI. Moreover, the price volatility of NAREIT is higher than that of T-REIT. The possible explanation is that the longer study period of the U.S. markets. None of the price series of the U.S. appear to be normally distributed. On the contrary, both T-REIT and CTP series are normally distributed at the 1% level.

Table 3-4 Descriptive Statistics of Price Indices

	U.S.		Taiwan	
Variable	NAREIT	TBI	TREIT	CTP
Mean	107.9080	128.9760	100.3698	56.6030
Std. Dev.	34.0906	40.9019	8.4617	8.7593
Minimum	58.5619	78.9581	76.8402	41.0100
Maximum	207.1900	230.2626	115.5035	75.2617
Jarque-Bera (p-value)	0.0002 ***	0.0049 ***	0.1059	0.3144
Observations	84	84	60	60

Note: 1. The descriptive statistics of CTP are presented in 10 thousand NT dollars per ping.

2. *** denotes significance at the 1% level.

Figure 3-1 and Figure 3-2 depict the trends of REITs and direct real estate series for the U.S. and Taiwan, respectively. It appears that NAREIT and TBI indices have the similar volatility over the sample period. In other words, REITs may be positively associated with direct real estate in the U.S. While both T-REIT and CTP series show a relatively steady trend with slight fluctuations. In addition, we can observe from the two figures that all indices reached the highest peak around the middle 2007, and then plummeted until early 2009. It suggests that the significant dynamics both in REITs and direct real estate markets could be attributed to the U.S. subprime mortgage crisis.

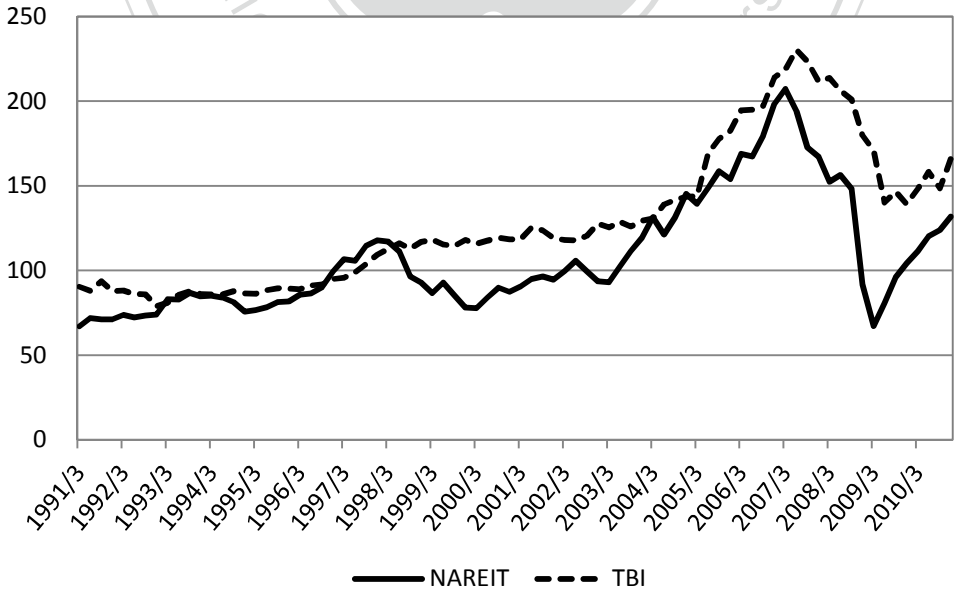

Figure 3-1 Trends of NAREIT and TBI

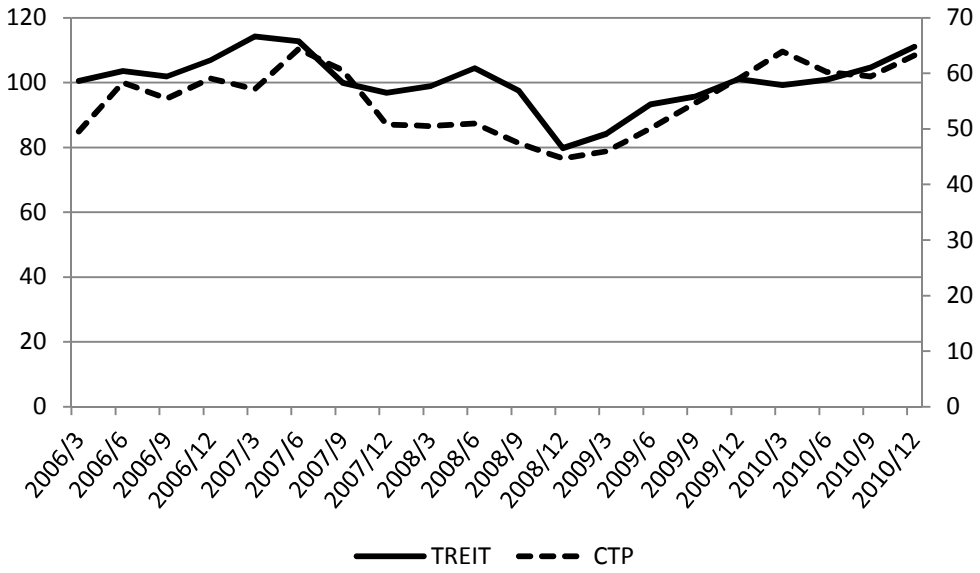

Figure 3-2 Trends of T-REIT and CTP

In this chapter, we first describe the econometric methodology applied in this research, and then introduce the REITs market in Taiwan and the data used in this study. Before conducting the following empirical analysis, we shed more light on the volatilities of these variables through the descriptive statistics and time-series graphs. In order to explore the relationship between REITs and direct real estate markets, several empirical models will be applied to examine the interrelation between them in the next chapter. Finally, the economic implication and the deficiencies in T-REITs market would be discussed based on the empirical results.

Chapter 4
Empirical Results

In this chapter, the relationship between REITs and direct real estate transaction price is examined by testing for the existence of cointegration relation and by estimating VECM. The occurrence of structural change and the order of integration of the variables are checked first. Then cointegration test is conducted. Finally, Granger causality is examined based on the estimated VAR model or VECM.

4.1 Results of the U.S.

4.1.1 Structural Change

In performing unit root tests, special care must be taken if it is suspected that structural change has occurred. When there are structural breaks, the unit root test statistics are biased toward the non-rejection of a unit (Enders, 2004). In order to avoid the results of following examination be deviated, we should identify whether the series has structural change during the sample period. This study applies the Cumulative Sum of the recursive residuals test (CUSUM test) proposed by Brown, Durbin and Evans in 1975.

The results shown in Figure 4-1 and Figure 4-2 are obtained from the CUSUM of forward recursive residuals. It is apparent from Figure 4-1 and Figure4-2 that both the W_t (CUSUM quantity) of NAREIT and TBI do not exceed the critical value at the 5% significance level (dashed line). The result suggests that there is no structural change significantly in the NAREIT and TBI series during the study period. Therefore, it is appropriate to use the original series to conduct the following tests, and the results would not be distorted.

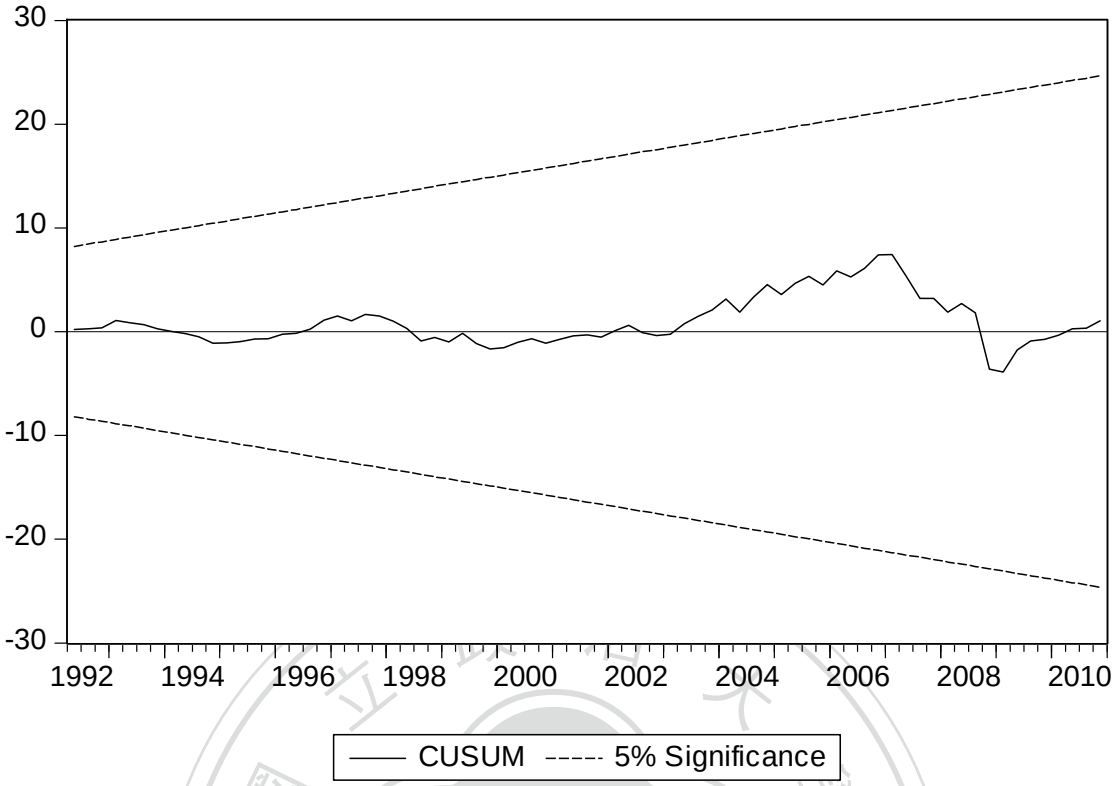

Figure 4-1 Result of CUSUM Test for NAREIT

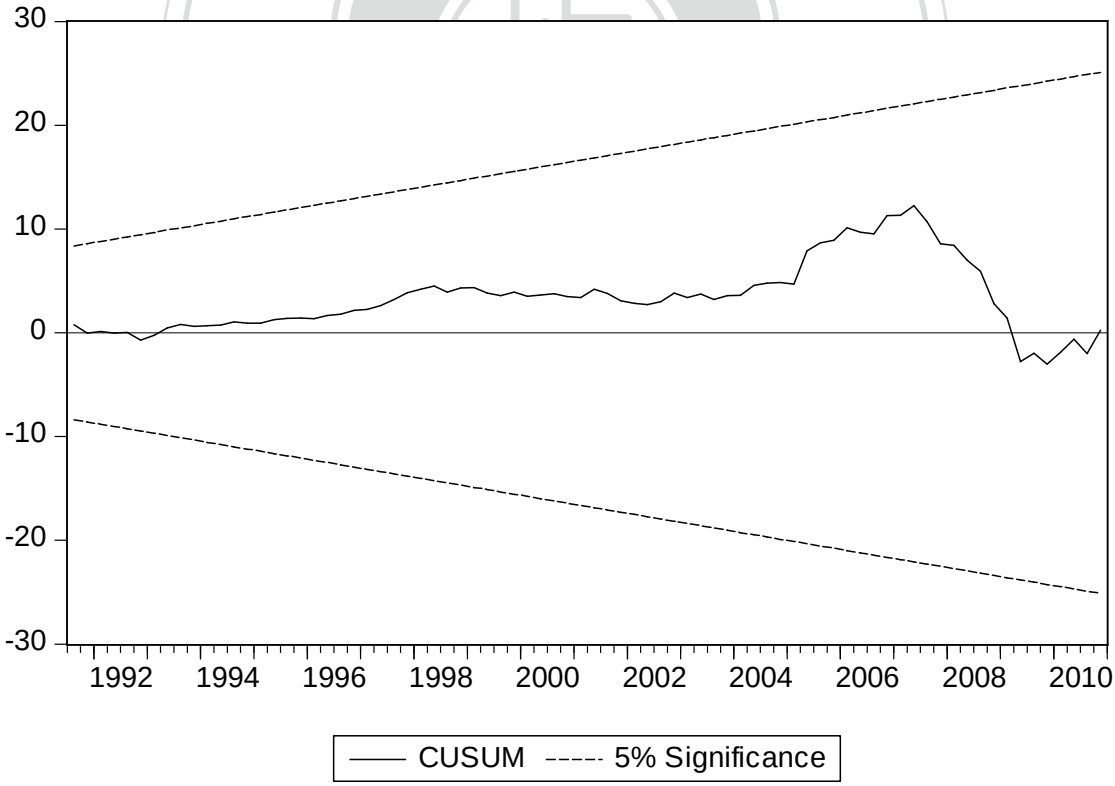

Figure 4-2 Result of CUSUM Test for TBI

4.1.2 Unit Roots Test

In determining the possible cointegration relationships, the second step is to examine whether the time series of variables contain unit roots. Unit root tests provide basis for assessing whether a time series is non-stationary and integrated of a particular order. In the presence of non-stationary variables, there might be spurious regression (Granger and Newbold, 1974). [11] We thus employ Augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1981) and Phillips-Perron (PP) (Phillips and Perron, 1988) tests to examine the existence of unit roots.

Table 4-1 reports the results of unit root tests for the NAREIT and TBI series by using ADF and PP tests. Both ADF and PP tests suggest that the null hypothesis of a unit root cannot be rejected for the level of each series, i.e., these time series are not stationary. However, the ADF and PP tests reject the null hypothesis for the series which take first difference, becoming stationary series. Hence, the results indicate that the NAREIT and TBI series are integrated of order one, and denoted as I(1) series.

Table 4-1 Test for Unit Roots on NAREIT and TBI

	ADF test		PP test	
	Level	1st difference	Level	1st difference
NAREIT	-2.6773	-6.0396 ***	-2.0586	-6.1096 ***
TBI	-2.5401	-6.6199 ***	-2.1042	-8.8425 ***

Note: 1. The null hypothesis is that the series has a unit root.

2. *** denotes significance at the 1% level.

4.1.3 Cointegration Test

Since the existence of cointegration between REITs and direct real estate market would have important implications regarding portfolio diversification, we intend to detect whether the long-run equilibrium relationship exists between these two markets by employing cointegration test proposed by Johansen (1988). If there is a cointegration between I(1) variables, we could observe the short-term dynamics of variables by estimating VECM. If there is no cointegration, however, we should

[11] A spurious regression has a high R^2 and t-statistics that appear to be significant, but the results are without any economic meaning. The regression output looks good because the least-squares estimates are not consistent and the customary tests of statistical inference do not hold.

examine the interrelation between them by using VAR model in first difference.

The results of Johansen cointegration test can be sensitive to the lag length. Hence, it is essential to estimate a vector autoregression using the undifferenced data, and perform the same lag-length tests as in a traditional VAR. In this study, the optimal lag length is selected based on the Akaike information criterion (AIC) and the likelihood ratio (LR) test statistic recommended by Sims (1980).[12] As shown in Table 4-2, the second lag is appropriate for the equations in the VAR model. We then consider the lag length selected by the VAR model to conduct cointegration test.

Table 4-2 VAR Lag Length Selection

Lag	AIC	LR
1	13.8978	
2	13.6977 *	17.7458 *
3	13.7531	11.0739
4	13.7586	2.9847

Note: * denotes the lag order selected by Akaike Information Criterion (AIC) and likelihood ratio test statistic (LR).

According to the trace and maximum eigenvalue tests, the null hypothesis of no cointegrating vector (r=0) can be rejected at the 5% significance level, which is reported in Table 4-3. The results of cointegration test indicate that NAREIT are cointegrated with TBI in the sample period. In other words, the long-run equilibrium relationship exists between the NAREIT and TBI indices. As expected, it appears that there is a long-term price co-movement between these two series. This finding is not only consistent with the long-run relationship between NAREIT and TBI as we conjectured from Figure 3-1, but also in line with the recent findings by Oikarinen et al. (2011).

Since the REITs and direct real estate indices are cointegrated, it implies that there exists a common real estate factor driving the REITs and direct real estate

[12] This type of likelihood ratio test is applicable to any type of cross-equation restriction. Let Σ_u and Σ_r be the variance/covariance matrices of the unrestricted and restricted systems, respectively. If the equations of the unrestricted model contain different regressors, let c denote the maximum number of regressors contained in the longest equation. Sims' recommendation is to compare the test statistic

$$(T - c)(\log|\Sigma_r| - \log|\Sigma_u|)$$

to the χ^2 distribution with degrees of freedom equal to the number of restrictions in the system.
Note: T = number of observations; c = number of parameters in the unrestricted system;
$\log|\Sigma_i|$ = natural logarithm of the determinant of Σ_i

markets in the long run. In addition, the diversification properties of these two assets are likely to be similar over the long horizon. It appears that REITs and direct real estate are substitutable assets in a portfolio of long term. These economic implications of the cointegration results could provide investors to determine the investment portfolio adjustment.

Table 4-3 Test Statistics for the Cointegration between NAREIT and TBI

Null hypothesis： No. of CE(s)	Trace Statistic	0.05 Critical Value	Probability	
r＝0	12.4976	12.3209	0.0467	**
r≦1	0.03850	4.1299	0.8724	

Null hypothesis： No. of CE(s)	Max-Eigenvalue Statistic	0.05 Critical Value	Probability	
r＝0	12.45911	11.22480	0.0302	**
r≦1	0.038498	4.129906	0.8724	

Note: ** denotes that the null hypothesis of no cointegration can be rejected at the 5% significant level.

4.1.4 Vector Error Correction Model

As discussed, there is a cointegration relationship between REITs and direct real estate. It is useful to detect the linkage and causality between two cointegrated variables by VECM. This model allows us to investigate the variables' long-run speed of adjustments of deviation from their equilibrium value in the previous period as well as their short-term dynamic relationship.

Table 4-4 shows that the current NAREIT is affected by the first lag of NAREIT. On the other hand, the current TBI are affected by the first and second lag of NAREIT and the first lag of TBI. The results suggest that the movements in TBI lag NAREIT performance by two quarters.

In terms of speed adjustment parameters, we are concerned about the sign and significance of coefficient. In Table 4-4, the signs of regression coefficients of error terms, denoted as "CointEq1", are negative for the NAREIT variable and positive for the TBI variable, respectively. It suggests that NAREIT would decrease while TBI would increase in response to a positive deviation from long-run equilibrium. The

error correction coefficient of TBI is significant at the 1% level. It implies that the adjustment of TBI will be about 16% of the deviation of ΔTBI from its long-run equilibrium value, which is highly sluggish.

The results indicate that only the TBI series adjusts towards the long-term equilibrium relationship with the NAREIT series. It is possible that the REITs market is more efficient than the direct real estate market. In other words, the information about the real estate fundamentals is reflected more rapidly in REIT price than in direct real estate transaction price.

Table 4-4 VECM Analysis on NAREIT and TBI

Variables	ΔNAREIT		ΔTBI	
	Coefficient	t-statistic	Coefficient	t-statistic
CointEq1	-0.0666	-0.6865	0.1574 ***	2.7529
ΔNAREIT(-1)	0.4384 ***	3.3402	0.1411 **	1.8239
ΔNAREIT(-2)	-0.1517	-1.0957	0.1784 **	2.1862
ΔTBI(-1)	0.1094	0.5941	-0.2431 **	-2.2399
ΔTBI(-2)	0.0350	0.1856	0.1190	1.0693

Note: ***and ** denote significance at the 1% and 5% level, respectively.

4.1.5 Granger Causality Test

Since there is a cointegration relationship between REITs and direct real estate markets, we employ Granger causality test which considers the error correction term to examine the existence of lead-lag relations. In Table 4-5, the result rejects the null hypothesis that NAREIT does not Granger cause TBI at the 1% significant level. As expected and in line with the recent findings by Oikarinen et al. (2011), changes in NAREIT appear to lead movements in TBI without feedback from TBI to NAREIT after 1990. It suggests that NAREIT performance can be employed to predict future movements in the TBI series due to better informational efficiency in the REITs market.

Table 4-5 Granger Causality Test Results

Independent Variable	Dependent Variable		
	NAREIT	TBI	
NAREIT	—	0.0139	***
TBI	0.8293	—	

Note: 1. The table shows the p-values of the Granger causality tests.

2. The null hypothesis is that of no Granger causality.

3. *** denotes significance at the 1% level.

4.2 Results of Taiwan

4.2.1 Structural Change

The results of CUSUM test are presented in Figure 4-3 and 4-4. Figure 4-3 shows that the W_t (CUSUM quantity) of T-REIT do not exceed the critical value at the 5% significance level (dashed line). It appears that the T-REIT series does not have a structural change during the study period. While the W_t (CUSUM quantity) of CTP seems to break above the 5% significance line but not be significant, which is shown in Figure 4-4.

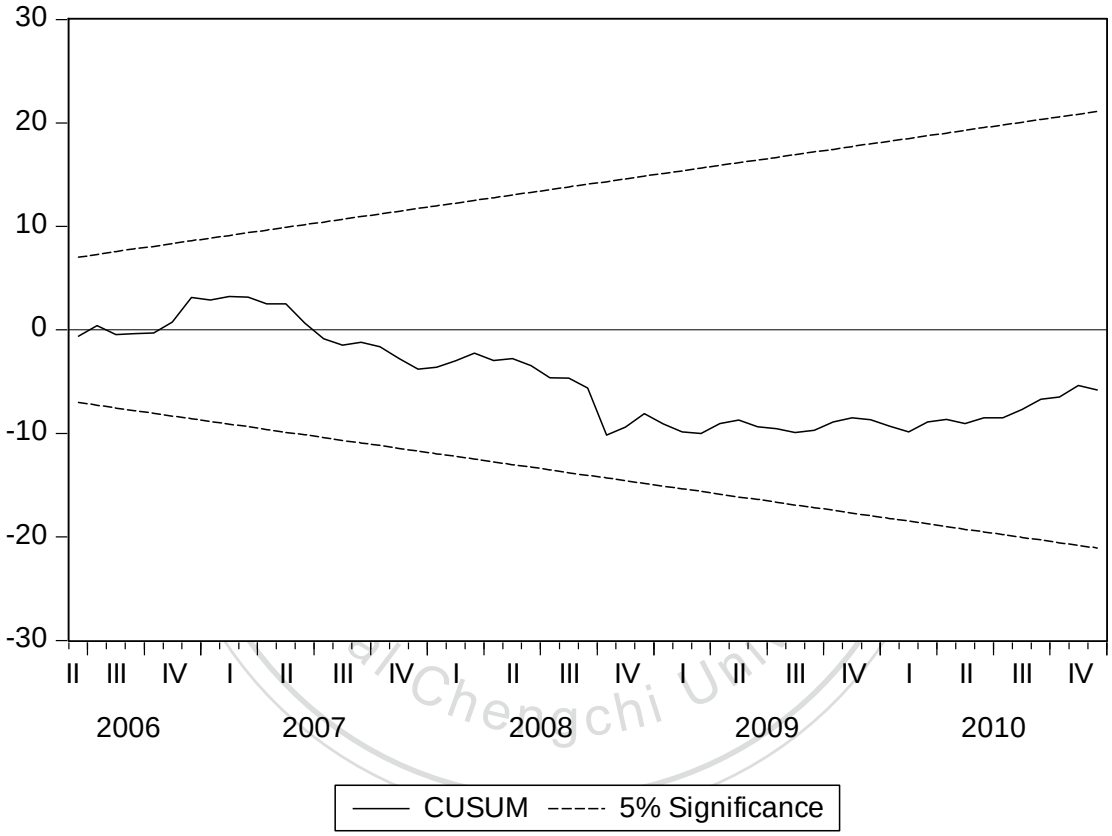

Figure 4-3 Result of CUSUM Test for T-REIT

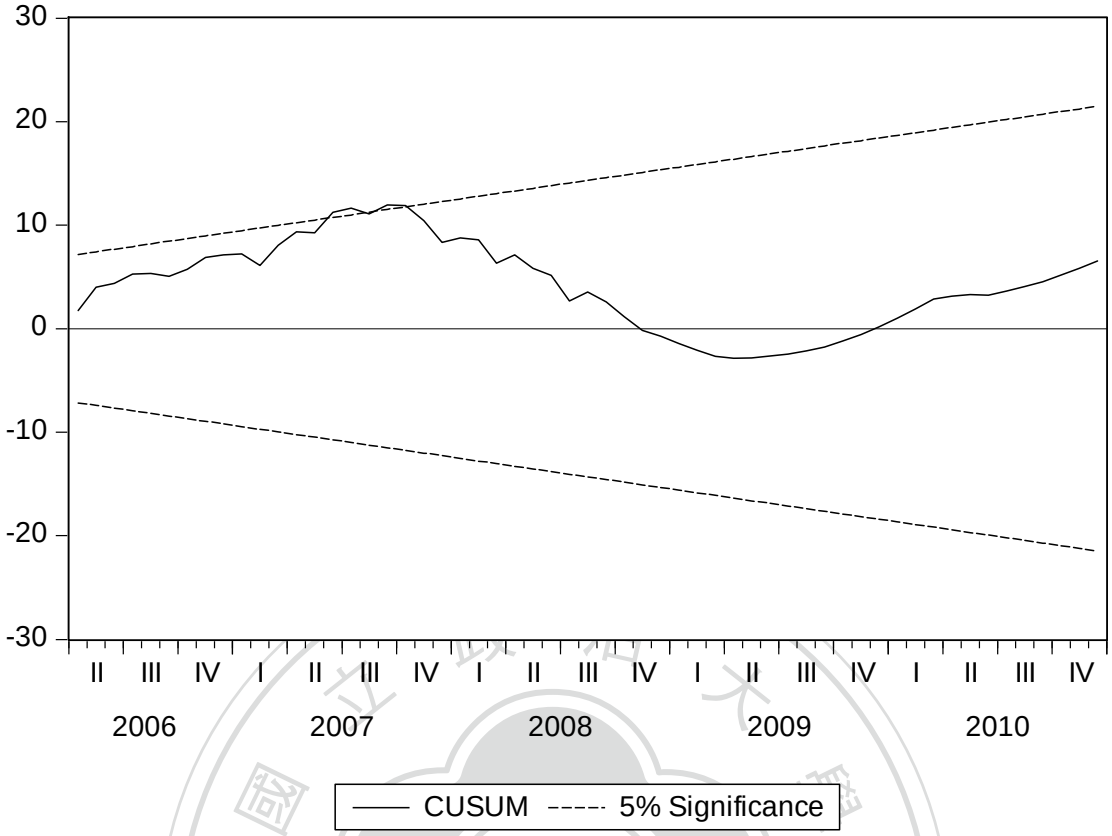

Figure 4-4 Result of CUSUM Test for CTP

4.2.2 Unit Roots Test

Table 4-6 presents the results of unit root tests for the T-REIT and CTP series by conducting ADF and PP tests. Both ADF and PP tests indicate that the null hypothesis of the unit root cannot be rejected for the level of each series, i.e., these time series are not stationary. However, these two tests reject the null hypothesis for the series which take first difference and then appear stationary. Therefore, the results suggest that the T-REIT and CTP series are integrated of order one, denoted as I(1) series.

Table 4-6 Test for Unit Roots on TREIT and CTP

	ADF test		PP test	
	Level	1st difference	Level	1st difference
TREIT	-2.2309	-4.7356 ***	-1.6475	-4.7223 ***
CTP	-1.6190	-9.5501 ***	-3.2220	-12.2347 ***

Note: 1. The null hypothesis is that the series has a unit root.

2. *** denotes significance at the 1% level.

4.2.3 Cointegration Test

In this study, the optimal lag length is selected based on the Akaike information criterion (AIC) and the likelihood ratio (LR) test statistic recommended by Sims (1980). As shown in Table 4-7, the second lag is appropriate for the equations in the VAR model. Then we consider the lag length selected by the VAR model to implement cointegration test.

Table 4-7 VAR Lag Order Selection

Lag	AIC	LR
1	3.2864	
2	3.0853 *	16.4413 *
3	3.1069	8.0564
4	3.1024	5.9132

Note: * denotes the lag order selected by Akaike Information Criterion (AIC) and adjusted likelihood ratio (LR) value.

According to the trace and maximum eigenvalue tests, the null hypothesis of no cointegrating vector (r=0) cannot be rejected at the 5% significance level, which is reported in Table 4-8. The results of the cointegration test indicate that there is no cointegration relationship between T-REIT and CTP in the sample period, i.e., these two markets do not move together in the long run. It suggests that T-REIT price could not reflect the fundamentals of commercial real estate market. On the other hand, there should be diversification function by including both REITs and commercial real estate in the investment portfolio.

Table 4-8 Test Statistics for the Cointegration between TREIT and CTP

Null hypothesis： No. of CE(s)	Trace Statistic	0.05 Critical Value	Probability
r＝0	7.8880	12.3209	0.2455
r≦1	0.5316	4.1299	0.5285

Null hypothesis： No. of CE(s)	Max-Eigenvalue Statistic	0.05 Critical Value	Probability
r＝0	7.3564	11.2248	0.2201
r≦1	0.5316	4.1299	0.5285

4.2.4 Vector Autoregressive Model

Since there is no cointegration relationship between T-REIT and commercial transaction price, we therefore apply VAR model to explore the short-run interrelationship between these two markets. Table 4-9 reports the coefficient estimates of the VAR analysis on the T-REIT and CTP series. The T-REIT series exhibit strong autocorrelation at the 1% level while it does not display a significant economic relation with the past commercial transaction price. On the other hand, the CTP series is positively related to the first lag of T-REIT at the 5% level, and to the first lag of itself at the 1% level. These results support the argument regarding the better informational efficiency in T-REITs markets, i.e., T-REIT price rapidly and accurately reflect the market information.

Table 4-9 VAR Analysis on TREIT and CTP

Variales	ΔTREIT			ΔCTP		
	Coefficient		t-statistic	Coefficient		t-statistic
ΔTREIT (-1)	1.3610	***	10.9190	0.0066	**	1.7602
ΔTREIT (-2)	-0.4965	***	-3.9243	-0.0032		0.8468
ΔCTP(-1)	4.4978		0.9676	0.4503	***	3.2385
ΔCTP(-2)	-1.5178		-0.3425	0.1541		1.1619
C	1.6678		0.1101	1.2514	***	2.7618

Note: ***and ** denote significance at the 1% and 5% level, respectively.

In addition to the VAR analysis, impulse response function and variance decomposition are helpful to analyze the dynamic relation between variables. Figure 4-5 shows the impulse response functions of T-REIT and CTP to both types of one-standard deviation shocks (alternatively called innovations). The effect of a T-REIT shock is to cause an immediate increase in T-REIT and CTP about three months. In particular, the degree of jump in T-REIT is larger than that of CTP. On the other hand, the effect of a CTP shock is to cause an immediate rise in price while it sharply drops and returns to its long-run value. The response of T-REIT to the CTP shocks, however, seems to be relatively insignificant. Since the system is stable, both sequences eventually converge to zero in about 20 months.

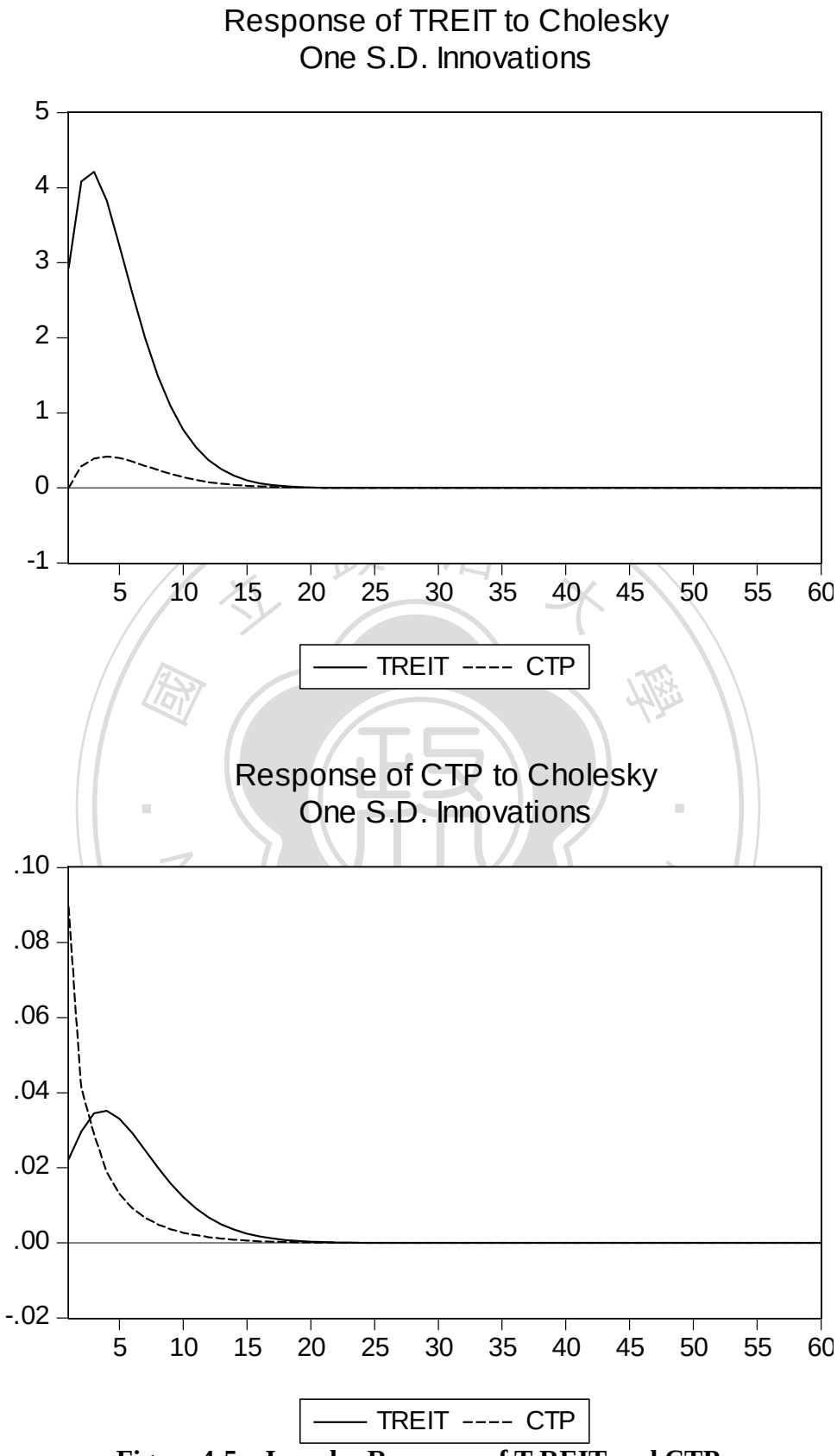

Figure 4-5 Impulse Response of T-REIT and CTP

The results of variance decomposition are presented in Table 4-10. It is apparent that the T-REIT shocks explain almost of the forecast error variance of T-REIT at any forecast horizon. This result suggests that the performance of T-REITs may not be significantly affected by transaction price of commercial real estate. On the other hand, the CTP shocks account for 94 percent of the forecast error variance of CTP initially while the contribution decreases to 69 percent in five months.

Table 4-10 Variance Decomposition Results

Variance Decomposition of TREIT				Variance Decomposition of CTP			
Period	S.E.	TREIT	CTP	Period	S.E.	TREIT	CTP
1	2.93	100.00	0.00	1	0.09	5.85	94.15
5	8.28	99.17	0.83	5	0.13	30.62	69.38
10	9.14	98.94	1.06	10	0.14	38.85	61.15
15	9.17	98.92	1.08	15	0.14	39.39	60.61
20	9.17	98.92	1.08	20	0.14	39.41	60.59
25	9.17	98.92	1.08	25	0.14	39.41	60.59
30	9.17	98.92	1.08	30	0.14	39.41	60.59
35	9.17	98.92	1.08	35	0.14	39.41	60.59
40	9.17	98.92	1.08	40	0.14	39.41	60.59
45	9.17	98.92	1.08	45	0.14	39.41	60.59
50	9.17	98.92	1.08	50	0.14	39.41	60.59
55	9.17	98.92	1.08	55	0.14	39.41	60.59
60	9.17	98.92	1.08	60	0.14	39.41	60.59

Overall, the current T-REIT is only significantly affected by its past performance. As discussed in previous part, the explanatory power of CTP to T-REIT is insignificant during the sample period. However, the current CTP is influenced by the past realization of T-REIT and itself. The explanatory power of T-REIT to CTP is almost 40 percent. This result suggests that T-REIT price seems to serve as a leading indicator to forecast the commercial real estate markets. In order to specifically detect the lead-lag relation between these two markets, we should conduct the following test, i.e., Granger causality test.

4.2.5 Granger Causality Test

Based on the VAR analysis, we conduct Granger causality tests to investigate the possible linear causality between T-REIT and CTP, in which no cointegration relationship was found. In Table 4-11, the result cannot reject the null hypothesis, or T-REIT does not Granger cause CTP. It implies that commercial transaction price cannot be predicted by T-REIT performance. The possible explanation is that the REITs market in Taiwan might be too immature or inadequately capitalized to lead the commercial real estate market.

Table 4-11 Granger Causality Test Results

Independent Variable	Dependent Variable	
	TREIT	CTP
TREIT	—	0.0631
CTP	0.7554	—

Note: 1. The table shows the p-values of the Granger causality tests.

2. The null hypothesis is that of no Granger causality.

Compared with the empirical results of the U.S., there are several possible explanations for the different results between these two REITs markets. The first reason is the difference in sample period. Since it has been only seven years since the first REIT was launched in Taiwan, the data available for empirical analysis is limited. The results of cointegration test may be distorted due to the lack of observation. The second reason is the difference in market capitalization. The market capitalization of U.S. REITs is substantially greater than that of T-REITs. The long-term dynamics is likely to be insignificant as a result of the small-scale REITs market.

The third reason may be the difference in the concentrated risk. In contrast to the sound diversification in the U.S. REITs, T-REIT may confront the concentrated risk in terms of the type and location of REIT properties, which are mostly commercial office buildings in Taipei City. Hence, the performance and volatility of T-REITs seem to be influenced by the concentrated risk. Finally and most importantly, we suggest that the agency problem may exist in T-REITs markets. Since most T-REIT managements are the related parties of original owners or subsidiaries established by the parent companies. With the impact of agency problem, T-REIT price do not reflect the

fundamentals of commercial real estate market. Therefore, this study further attempts to explore this hypothesis in the following section, and proposes to improve the efficiency of T-REITs market.

4.3 Agency Problem in T-REITs Market

According to the results of cointegration test, the T-REIT series is not cointegrated with the CTP series in the sampled period. Since there is no long-run equilibrium relationship between these two indices, it suggests that T-REIT price could not reflect the fundamentals of commercial real estate market. We thus assume that potential agency problem may exist between the shareholders and the management of T-REIT. If the manager's action does not favor the investors' interests, then the market value of REIT may be affected adversely. Therefore, this study tries to analyze the cause of agency problem and provide the feasible solution to improve the market efficiency.

In this section, we first compare the ownership structure of management with the type of management applied by each T-REIT. Moreover, we attempt to empirically verify the existence of agency problem by comparing the volatility of stock returns with those of T-REIT.

4.3.1 Type of T-REIT Management

Table 4-12 summarizes the original owner of T-REIT property, management and its major ownership structure, and the type of management. Since all of the T-REITs are not managed and operated by their original owners, the type of management could be categorized as the external management. In addition, the type of management is further identified by the business relationships between original owners and T-REIT management. If the T-REIT management is the related parties of original owners or subsidiaries established by the parent companies, we define it as "parent-related management". On the contrary, if there is no relationship between original owners and management, then it is defined as "non-parent-related management". As shown in Table 4-12, most T-REITs are parent-related management REITs, whereas only Kee Tai Star is non-parent-related management. For instance, in the case of Fubon No. 1, both the major ownership of management and the original ownership of REIT property originate from the same group, i.e., Fubon Group. On the other hand, the management of Kee Tai Star is not owned or controlled by Kee Tai Properties or related company instead.

Table 4-12 Summary of T-REIT Management

T-REIT	Original Owner of Property	Management	Major Ownership Structure of Management		Type of Management
Fubon No. 1	Fubon Life Insurance	Fubon Real Estate Management	1. Taipei Fubon Commercial Bank 2. Fubon Land Development	30% 53.14%	Parent-Related Management
Cathay No. 1	Cathay Life Insurance	Cathay Real Estate Management	Cathay Real Estate Development	100%	Parent-Related Management
Shin Kong No. 1	Shin Kong Life Insurance	New Light International	1. Shin Kong Life Real Estate Service 2. Shin Kong Life Insurance 3. Taiwan Shin Kong Real Assets Development 4. Taiwan Shin Kong Security	30% 31% 20% 19%	Parent-Related Management
Fubon No. 2	Fubon Life Insurance	Fubon Real Estate Management	1. Taipei Fubon Commercial Bank 2. Fubon Land Development	30% 53.14%	Parent-Related Management
Trident	1. Continental Engineering 2. Wellcome Enterprise 3. Eslite Corporation	Eslite Corporation	1. Eslite Interior Design 2. Cross-Century Investment 3. President of Eslite	20.87% 13.08% 11.23%	Parent-Related Management
Kee Tai Star	KeeTai Properties	AURORA Development	1. AURORA Corporation 2. AURORA International	46.67% 53.33%	Non-Parent-Related Management

Cathay No. 2	Cathay Life Insurance	Cathay Real Estate Management	Cathay Real Estate Development	100%	Parent-Related Management
Gallop No. 1	1. GoldSun Development & Construction 2. Taiwan Secom 3. WellPool Corporation 4. CTCI Corporation 5. Chai Shin Assets Management 6. Chai Shin Cement Development	Tai Chai International	1. IBT Management 2. Chai Shin International	49% 51%	Parent-Related Management

Note: The information is summarized from the prospectuses of eight T-REITs.

It is apparent from Table 3-2 and Table 4-12 that the conflicts of interest incline to exist in parent-related management REIT, since there are close business relationships among the original owners, managements and major tenants (Wang and Chang, 2009). For example, would the related parties of parent companies have priority to become a tenant? If T-REIT management need to make rent concession, would investors' interests be taken into consideration? These conflicts of interest may reduce the market value of T-REIT. Therefore, we attempt to verify the existence of agency problem through the volatilities of stock and T-REIT returns in the following subsection.

4.3.2 Volatilities of Stock and T-REIT Returns

We propose that REITs market is less efficient than stock market in Taiwan due to the agency problem. In other words, T-REIT price do not reflect the fundamentals of direct real estate properties because some parent-related management T-REITs may cause the potential agency problem. Therefore, this study attempts to test the hypothesis that T-REIT price would rise when stock enters an up market, while the rising amount of T-REIT is lower than that of stock.[13] On the other hand, T-REIT price would fall when stock enters a downward market, while the falling degree of T-REIT is similar to that of stock.[14] In addition, we expect that the severity of agency problem differs between parent-related and non-parent-related management T-REITs.

The empirical model applied in this study is an extension of the model employed by Glascock (1990) and Ambrose and Linneman (2001). Since beta measures the systematic variation in returns relative to the market, we explore the correlation of returns between stock and T-REITs market by estimating the beta. T-REIT betas are estimated using the Capital Asset Pricing Model (CAPM) by regressing the T-REIT returns against the market portfolio:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (19)$$

where R_{it} and R_{mt} represent the monthly returns for T-REIT *i* and the stock market

[13] An upward market is defined as when the returns excluding dividends on the stock market portfolio exceeds the risk-free returns.

[14] A downward market is defined as when the returns excluding dividends on the stock market portfolio are inferior to the risk-free returns.

portfolio in excess of the risk-free rate. α_i is the regression intercept, β_i is the estimated equity beta for T-REIT *i* and ε_{it} is the standard error term.

Market portfolio applies monthly returns of Taiwan Stock Exchange Weighted Index. Monthly returns on three-month Treasury bills of Central Bank are employed for the risk-free returns. The data used in this section cover the period from January 2006 to December 2010, whereas the starting date of test for individual T-REIT depends on its issuing date. The descriptive statistics of these returns are presented in Table 4-13.

Table 4-13 Descriptive Statistics of Returns

Variable	Mean	Std. Dev.	Minimum	Maximum	Observations
Stock Market	0.7851	7.2040	-18.8307	15.0020	60
Treasury Bill Rate	1.0940	0.7902	0.1200	2.0300	60
T-REITs Market	0.2281	3.5492	-15.4163	8.4272	60
Fubon No. 1	0.6373	4.5036	-11.9431	8.8550	60
Cathay No. 1	0.5957	3.1276	-10.1213	7.4738	60
Shin Kong No. 1	0.3594	4.2389	-19.0219	11.3951	60
Fubon No. 2	0.5577	5.0807	-15.6833	19.9786	57
Trident	0.8772	6.0688	-16.2861	16.3796	55
Kee Tai Star	0.6520	7.3382	-20.2097	20.6684	53
Cathay No. 2	0.6137	4.2511	-16.2220	9.3122	51
Gallop No. 1	0.3866	6.9804	-22.8741	28.3333	44

Table 4-14 presents the results of regressing the T-REIT returns against the market portfolio. In terms of T-REITs market, the positive coefficient is significant at the 5% and 1% level when stock is the upward and downward trend, respectively. It indicates that the systematic risk of T-REITs would increase both in the upward and downward markets of stock, whereas the increment of risk in the latter is larger than in the former. In other words, the correlation between stock and T-REITs markets is higher in the downward market. This result is consistent with the aforementioned hypotheses, and Tsai et al. (2011) also found that REITs in Taiwan are not defensive.

For parent-related management T-REIT, the positive coefficient of Fubon No. 1, Fubon No. 2, Cathay No. 2, and Gallop No. 1 are not significant for the upward market, whereas they are significant at the 1% and 10% level for the downward market. Furthermore, as the results of T-REITs market, the increment of risk in the

downward market is higher. We may conclude that the slight volatility of beta insignificantly in the upward market results from the agency problem. Since the conflicts of interest exist between T-REIT management and related party of the same parent company, investors' interests tend to be ignored by some T-REIT managements. Hence, it is not surprising that the systematic risk of parent-related management T-REIT would increase in the downward market.

For non-parent-related management T-REIT, the beta coefficient of Kee Tai Star is significant at the 1% level for both the upward and downward markets. The systematic risk is high but less than 1 in the upward market, while it is greater than 1 in the downward market. The results indicate that Kee Tai Star may be similar to an aggressive stock. In addition, the obvious volatility of beta refers to the high correlation and sensitivity of Kee Tai Star REIT returns to the returns on the market portfolio. We thus suggest that non-parent-related management T-REIT could better reflect the market information or fundamentals of direct real estate market.

Table 4-14 Systematic Risk (β) of T-REIT

Panel A: Stock in an Upward Market

T-REIT	Coefficient	Std. Error	t-statistic	Adj. R^2
T-REITs Market	0.2427 **	0.1075	2.2588	0.1375
Fubon No. 1	0.2293	0.1509	1.5202	0.0674
Cathay No. 1	0.3685 ***	0.0920	4.0040	0.3338
Shin Kong No. 1	0.2946 **	0.1306	2.2555	0.1372
Fubon No. 2	0.3342	0.1973	1.6936	0.0873
Trident	0.6075 **	0.2285	2.6587	0.1960
Kee Tai Star	0.7569 ***	0.2341	3.2333	0.2650
Cathay No. 2	0.2020	0.1515	1.3336	0.0618
Gallop No. 1	0.1081	0.2830	0.3820	0.0063

Note: ***and ** denote significance at the 1% and 5% level, respectively.

Panel B: Stock in a Downward Market

T-REIT	Coefficient	Std. Error	t-statistic	Adj. R^2
T-REITs Market	0.4889 ***	0.1074	4.5523	0.4635
Fubon No. 1	0.6450 ***	0.1374	4.6931	0.4786
Cathay No. 1	0.4517 ***	0.1072	4.2119	0.4250
Shin Kong No. 1	0.5278 ***	0.1399	3.7731	0.3723
Fubon No. 2	0.4529 ***	0.1493	3.0338	0.2858
Trident	0.5407 ***	0.1897	2.8501	0.2697
Kee Tai Star	1.0789 ***	0.2528	4.2672	0.4766
Cathay No. 2	0.4499 ***	0.1795	2.5058	0.2389
Gallop No. 1	0.5486 *	0.2993	1.8330	0.1650

Note: ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

By analyzing the type of T-REIT management and applying the Capital Asset Pricing Model, we conclude that the limited development of T-REITs market may be caused by the agency problem of T-REIT management. The existence of agency problem in T-REITs market will not only influence the performance of T-REITs, but also the willingness for investment. According to the current "Clauses of the Real Estate Securitization Act," the regulations are insufficient for supervising the management. Therefore, it is necessary to improve the agency problem by amending regulations governing the T-REIT management.

Chapter 5
Conclusions and Discussion

This study examines the short-term and long-term dynamic relationships between REITs and direct real estate markets in the U.S. from 1991 to 2010, and in Taiwan from 2006 to 2010, respectively. Results show that the cointegration relationship exists between the NAREIT and TBI indices in the U.S. It implies that there exists a common real estate factor driving the REIT and direct real estate returns in the long term. Moreover, the diversification properties of these two assets are likely to be similar over the long horizon. According to the Granger causality test, NAREIT leads TBI due to better informational efficiency of REITs market. These findings are consistent with those of previous studies.

On the other hand, there is no cointegration and lead-lag relation between T-REIT and CTP in Taiwan. According to VAR analysis, the current CTP is influenced by the past realization of T-REIT and itself. There are several possible explanations for the different results between the U.S. and Taiwan, including difference in sample period, market capitalization, types of risk, and most importantly, the agency problem existing in T- REITs market.

To sum up, since the REITs market in Taiwan is not yet mature enough to reflect market information or fundamentals, these findings indicate that there are weak relationship between T-REITs and direct commercial real estate markets. Moreover, the existence of agency problem in T-REITs market will influence the performance of T-REITs and the willingness for investment. In order to enhance the equality, efficiency and performance of T-REITs market, it is necessary to improve this problem by amending the regulations governing the T-REIT management. It is expected that the conclusion of this paper will provide marginal contribution in policy implications to T-REIT investors, management and policy makers.

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