國立政治大學地政學系
私立中國地政研究所 碩士論文

T-REITs 與總體經濟及商用不動產市場關聯性之探討

The Relationship Among T-REITs, Macroeconomy and Commercial Real Estate Markets

研 究 生： 侯蔚楚
指導教授： 林左裕 教授

中 華 民 國 九 十 九 年 七 月

謝誌

期待已久可以在論文蓋上浮水印的時刻終於要到來了!!非常開心研究所可以繼續在政大學習，當初帶著既期待又怕受傷害的心情踏入研究所的生活，而在碩士生涯的兩年中，面臨到自我的學習與論文的奮鬥，在過程中曾經對自己失去信心，也曾懷疑過自己的能力，更常面臨到挫折與不確定感，但也因為這樣的過程，我感覺到自己正一步步的成長，磨練自己研究與獨立作業的能力。在這艱辛的過程裡，幸好身邊有許多幫助我和陪伴我一起走過的好夥伴，讓我能順利的度過碩士生活。

在研究的過程中，最需要感謝的莫過於我的指導教授林左裕老師，從一開始找題目與蒐集文獻時就在討論的過程中提供可以研究的思考方向，當面臨到實證結果解釋有困難或是有疑惑時，也提出不同角度的觀點釐清我的問題，讓我對論文的架構以及內容的撰寫有更多的想法。也謝謝老師鼓勵我以英文進行寫作，藉由這樣的過程訓練英文寫作能力。謝謝口試委員林哲群老師與張元晨老師，在有限的時間內看完全文真是辛苦老師們，而老師們提出的中肯建議也讓我對論文後續修改有更多的發展空間。此外，要特別謝謝張老師在最初進行研究模型設計時給予專業的指導。博士班的芳妮學姐和淑湄學姐，期初和期末報告都麻煩兩位學姐真是不好意思，也謝謝學姐們提出的寶貴意見，讓我更了解自己論文所不足的地方，也提供我改進的方向，讓我獲益良多。謝謝佳君學姐給與的貼心意見，讓我了解研究所的事前準備。

除了老師和學姐們給與我論文專業上的協助，曾經一起同甘共苦的左家人—博翔學長、于芳、小慈、小雞、馬夫、展豪和宗炘，這兩年大家一起為了案子熬夜打拼，連寫報告都有左家人特有的輪班制，建立了屬於我們的默契和友誼，因為有大家的協助，即使時間再緊迫、報告內容再複雜，我們都互相扶持度過那段煎熬的時光。謝謝博翔學長在碩一時提供許多寫作與資料蒐集的協助，雖然做事常出包，但也幫助過我許多，可是說好的氣球呢?于芳的活潑和網拍功力讓我的碩士生活變得有趣許多，雖然有時候讓我很無奈，還有笑聲太開心讓我家人覺得奇怪；小慈會在我心情低落時提供心靈上的輔導，真的是我的心靈導師啊!希望張老師專線可以一直開放；小雞時常發揮搞笑的本領帶給大家歡樂，雖然有時候做事時試圖挑戰我的極限讓我生氣；馬夫原來是個 high 咖，總是在聚餐或是唱歌時帶動大家的氣氛；展豪和宗炘在學長姐們忙碌的時候伸出援手，讓我們可以專心的研究論文；新加入的小學妹逸芬最近跟著大家一起活動也是辛苦了…過往這一切的一切，都要謝謝大家。

碩二的夥伴們，不論是平淡的研究室生活或是放鬆心情的一起出遊，因為有了你們的參與，讓我的研究生活豐富許多，也留下了珍貴的美好回憶。還記得大家在寫論文時會偷偷聚集在研究室的一角聊天，也會一起討論課程或是論文的內容（謝謝于婷在時間序列的部分幫助我許多）；或者是趁著學校放假的時間一起到郊外走走，抒發寫論文時的壓力與體驗放鬆的心境。謝謝常出外勤的香君、王王、汝汝、泳泳、妍汎和伊芳，在南庄、福隆、台中等大小行程中，因為有你們讓我更珍惜這些相處的時光。碩一的學弟妹們，謝謝你們在畢業的前夕給與一個難忘的謝師宴回憶，你們真的很用心，尤其是最後的離別影片，讓我感動到流淚。遠在北大的佳鈴以及大學的好朋友們，雖然我們相聚的時間變少了，但對彼此的關心卻沒有減少，你們偶爾一句鼓勵或是關心的話語，都讓我備感窩心，也慶幸自己可以有機會認識你們。

最後我可以有今天的成果，要感謝我的爸爸、媽媽和弟弟，雖然我很少在家提到論文的事情，但家人總是做為我的後盾在背後默默的付出關心，當我對於某些事情感到疑惑時，也會傾聽我的煩惱並幫助我，讓我可以有最安心的依靠，我愛你們!!

要感謝的人真的太多，對於曾經給過我幫助或鼓勵的所有人，真的很感謝你們。當我有想放棄念頭或是沒有動力繼續的時候，也因為有你們的鼓勵和支持，讓我找回可以繼續前進的力量。碩士生活即將要接近尾聲，過去的兩年有歡笑也有淚水，而現在這些都將成為美好回憶中的一頁。未來的人生道路中一定還會碰到許多問題和難關，但我會記得大家曾給予我的關心和鼓勵，勇敢的邁向新的道路、迎接挑戰。

蔚楚 2010/7 於綜院六樓研究室

摘要

台灣不動產投資信託(T-REIT)自 2005 年發行至今已逾四年，過去國內相關的文獻多集中於法律面、制度架構及問卷調查等相關研究，對於整體市場實際表現的討論則較缺乏。隨著交易歷史資料的延展，本研究針對國內 REITs 施行的現況與總體經濟波動及不動產市場之關係進行討論。在總體經濟部分以股價指數、利率與通貨膨脹進行分析，在不動產市場部分則採用辦公室平均租金水準與實際商辦交易價格為指標，期望探索 T-REITs 價格與總體經濟及不動產市場間之長期關係。

本文發現 T-REITs 與股價指數、商辦租金以及商辦交易價格間，均會存在長期均衡關係，即有共整合情形，而 T-REITs 與通貨膨脹率以及 T-REITs 與利率間不具有長期均衡關係，且股價指數、商辦租金以及通貨膨脹率與 T-REITs 為正向關係，利率及商辦租金與 T-REITs 則為反向關係。此外，根據因果關係檢定，股價指數與通貨膨脹率皆領先 T-REITs，而商辦租金與 T-REITs 為雙向回饋。本文結果顯示，台灣 REITs 與總體經濟及商用不動產市場具有長期均衡關係，亦即總體經濟的變動以及不動產市場的波動可做為探討 T-REITs 長期變化的指標。

關鍵詞：不動產投資信託、REITs、共整合、因果關係

Abstract

Taiwan launched the first Real Estate Investment Trusts (T-REITs) in 2005. However, over the past few years, studies regarding T-REITs mainly focused on legal system, institutional framework and questionnaire surveys, but lack of empirical analysis on the performance of T-REIT markets. This study therefore intends to explore the cointegration and causality relationship among the T-REITs, macroeconomy and commercial real estate markets. The macroeconomic factors in this study include the stock prices, interest rate and inflation rate; and the real estate variables include the commercial rents and commercial prices.

Empirical results first demonstrate that there exists the long-run relationship among T-REITs, stock prices, commercial rents and commercial prices, but not the interest rate or inflation rate. Moreover, T-REITs are significantly related to stock prices, interest rate and inflation rates as well as commercial rents and commercial prices. Third, the changes of stock prices and inflation rate lead the change of T-REITs. Finally, there is a significant feedback relationship between T-REITs and commercial rents.

Key words: REITs, Cointegration, Granger Causality

Context

Figures

Tables

Chapter 1 Introduction

This chapter contains the general background and motivation about the purpose of the paper, the research method and scope, and the research overview; that is, the research structure and process.

1.1 General Background and Motivation

1.1.1 General Background

In the United States, real estate securitization is flourishing in its financial system, especially in real estate investment trust (REITs), and there are lots of academic investigations about it. In Asia, Japan's real estate investment trust is developing steadily; therefore, scholars often choose the United States and Japan as the reference sample when exploring the topic of REITs. In Taiwan, it has been five years since the first real estate investment trust "Fubon No.1" was launched in 2005, but over the past few years, most of the studies about Taiwan real estate investment trust (T-REITs) are focused on legal system, institutional framework and questionnaire surveys. There is still lack of discussion about the actual performance of T-REITs market. From an investment perspective, the price volatility and returns of REITs are the main factors that affect the investors' willingness, and the changes of price and returns are related to the interaction with other economic markets. However, only a small number of studies discuss the actual performance in T-REITs, and only a few explore the risk measurement, feasibility, and portfolio investments. Thus, it is necessary and important to study the performance of T-REITs.

In the past, people discuss the relationship between real estate prices and macroeconomic variables, but due to the non-mobility and heterogeneity of real estate, the securities products with better liquidity were developed. Because the United States has developed REITs earlier, there are many studies between REITs and macroeconomic variables coming from them. For instance, Clayton and Mackinnon (2003) imply that NAREIT returns and risks should be related to macroeconomic variables that effect bond returns such as stock price, but the effects from stock price became weaker after 1980. The dramatic growth and maturation of the REITs sector since 1992 led to claims that the link between REITs prices and real estate market

fundamentals had become much stronger and made REITs more like real estate. Chatrath and Liang (1998) make a case for an investigation into the possibility of fractional cointegration between REITs and general price levels to test if REITs can act as inflation hedging goods. In Taiwan, there is still lack of studies between T-REITs and macroeconomy, and as a substitute product for physical real estate, the relationship between T-REITs and real estate market needs to be discussed. In addition, the past studies can't tell the long-run relationship between T-REITs, macroeconomy and commercial real estate market due to time restriction, and it is also important to know whether the lead/lag relationship exists between T-REITs and other economic variables. For real estate market, most of the studies use construction index rather than actual prices or rents as a proxy for real estate market, and it has room for further debate. To deeply understand the performance of T-REITs, there is a need to study the relationship between T-REIT, macroeconomy and commercial real estate markets.

To sum up, this study tries to explore the long-run and short-run relationship between T-REIT, macroeconomy and commercial real estate markets, and to examine the causality between T-REITs and economic variables.

1.1.2 Research Motivation

From the first launch in March 2005 to December 2008, there are 8 T-REITs on the market in Taiwan. This study attempts to explore the long-run and short-run relationship between T-REIT, macroeconomy and commercial real estate markets within this period. This study intends to discuss the following issues;

(1) To examine whether if there is long-run equilibrium relationship among T-REITs, macroeconomy and commercial real estate markets.

(2) To explore the short-run relationship between T-REITs, macroeconomy and real estate variables.

(3) To examine the lead/lag relationship between T-REITs, macroeconomy and real estate variables.

1.2 Research Method and Scope

1.2.1 Research Method

(1) Theory and Literature Review

The first step is to clarify the macroeconomic variables and real estate market factors that will affect the REITs volatility. We can find the factors that will affect REITs prices, and understand the long-run and short-run relationship between REITs and factors from the past relevant literatures. These theories and findings will be the basis of this study.

(2) Modeling and Empirical Analysis

The Johansen cointegration method is applied to explore the long-run equilibrium relationship between T-REITs and potential factors. If cointegration relationship exists, we then employ vector error correction model (VECM) to estimate the short-term effect; if cointegration does not exist, then we use vector autoregression model (VAR) to estimate the short-term effect. Finally, we will apply Granger causality to test the lead/lag relationship between T-REITs and variables.

1.2.2 Research Scope

(1) Time Scope

This study collected data from the launched date. The study period ranges from March 2005 to December 2008.

(2) Spatial Extent

Currently, most investment objects of T-REITs are located in Taipei[1], therefore the commercial rents and prices discussed in this study are properties in Taipei.

(3) Research Objects

This study tries to explore the relationship between T-REITs and different economic variables, and the variables are divided into macroeconomic variables and the real estate market variables. The current T-REITs investments contain commercial

[1] In all the 8 T-REITs components, there are only one object in Taipei county and one in Tainan city.

buildings, department stores, markets and hotels, but the mainly components are commercial buildings, so this study addresses only the commercial real estate markets.

1.3 Research Overview

1.3.1 Research Framework

This study is divided into five chapters. The first chapter is introduction, which contains the general background, motivation and research overview. The second chapter is literature review, mainly discussing the relationship between T-REITs and other variables. The third chapter is research method, establishing long-run and short-run relationship discussion models, and using the empirical data to establish the T-REITs index. The fourth chapter is the empirical studies and results, analyzing the results of the models and discussing the degree of influence among the various variables. The final chapter is the conclusions and discussion, summarizing the preceding chapters and proposing recommendations for follow-up researches.

1.3.2 Research Process

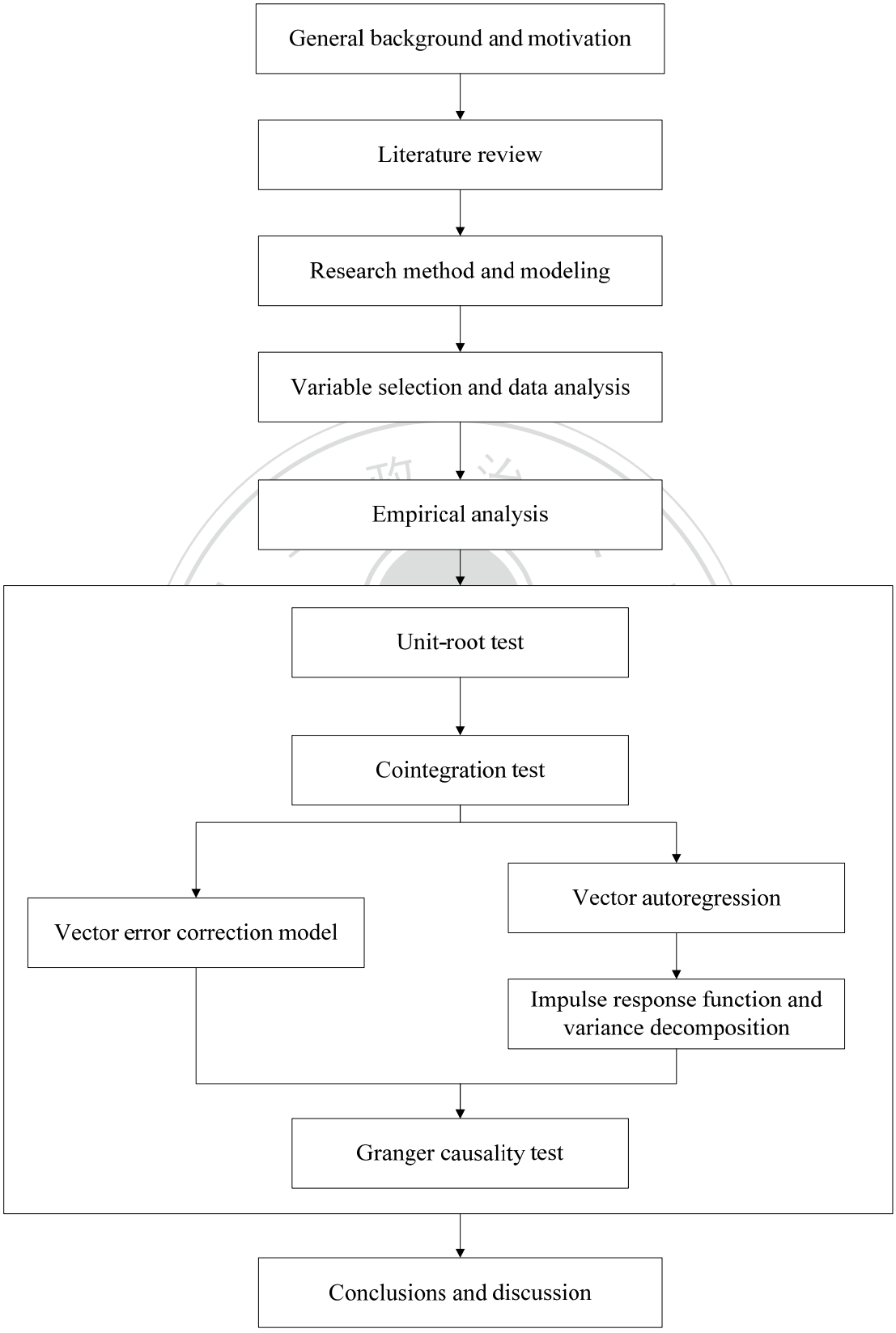


Figure 1-1 The research process

Chapter 2 Literature Review

REITs in Taiwan is still under development and the relevant studies are not as complete as those of the United States and Japan, therefore, most of the researches use data from the United States, Europe and Japan to do the empirical studies, especially about REITs returns on investment, risks, liquidity and portfolio investments. As well as the real property investment, the REITs price volatility and returns are the key factors to the investors willingness, and REITs frequently act as a substitute variable for real estate market, analyzing the relationship between macroeconomy and real estate markets. This chapter reviews the relevant foreign and domestic literatures about the relationship among REITs, macroeconomic variables and real estate markets, and is divided into three parts. The first part explores the "Wealth Effect Theory", as the basis for analyzing the wealth among the various different markets if there will be mutual relations. The second part explores macroeconomic and real estate market factors that affects REITs, and the third part compiles literatures about the models used in this study.

2.1 The Exploration of " Wealth Effect Theory"

According to life cycle hypothesis, there is a relationship between stock price and real estate market price changes; that is, consumption is based on the investors' total wealth and goods, stocks or other assets and physical assets. When the stock prices rise, the investors' wealth will rise, and the consumption increases. Based on the portfolio theory proposed by Markowitz (1952), investors could benefit from portfolio investments by reducing the risk but maintain the same return level or by increasing the portfolio returns under the same risk level. Both of the methods would reduce the overall investment risk. Thus, when investors increase the investments proportion in the stock markets, they will want to invest in other markets in order to achieve risk diversification. Because real estate goods are both consumption goods and investment goods, they become the first choice when investors want to invest outside stocks. That is, the investors' wealth increase when stock prices go up, under the consideration of increasing consumption and risk diversification, investors will transfer part of the funds from the stock markets to the real estate markets, making the real estate prices also rise, and that is the so-called the "Wealth Effect" theory.

There are a lot of studies discussing the wealth effect phenomenon between stock markets and real estate markets. Under the portfolio theory, Poterba (2000) observed the consumption status of U.S. stock holders in 1998, and he confirms that the wealth effect generated by the stock markets does exist. Tracy, Schneider and Chan (1999) analyze the portion of household assets in corporate equity and real estate, and they find that the wealth effect generated by the housing prices volatility is larger than by stock prices change. But for the household investors, the wealth effect generated by the rising house prices will offset the housing costs, so the wealth effect should be less than the stock market.

Benjamin (2004) used consumption function to estimate the U.S. economy with real estate and financial wealth for quarterly data for the period, January 1952 to Apirl 2001, and he finds that the wealth effect generated by the real estate markets is higher than by the financial assets. The decline in the stock market during 2000-2001 had a limited impact on aggregate demand because of an offsetting real estate wealth effect.

With the wealth effect theory, although the real estate market is higher value maintenance, its liquidity is low and with high investment costs relative to other financial markets. Therefore, after investors make profits in real estate market, they may turn to invest in the stock market. In addition to the real estate market affecting the stock market or other financial market, investors' behavior in real estate investment may also affect other financial market through the wealth effect. So it can be extrapolated that the stock market and real estate market may have feedback relations. This study tries to explore whether the wealth effect occurs between T-REITs and other financial markets by analyzing the relationship between T-REITs and other markets.

2.2 Review of REITs Volatility Factors

There are many factors affecting REITs price volatility, and we divide these factors into two parts, the macroeconomy and real estate markets. In this chapter, we will discuss the relationship and impact between these two markets and REITs.

2.2.1 REITs and Macroeconomy

The nature of REITs is mutual funds, and it is similar to macroeconomic markets. Therefore, there are plenty of researches about the relationship between REITs and macroeconomic variables. Besides the legal and institutional side, most of the subjects focus on relationship between REITs returns and volatility and macroeconomic variables such as stock price, inflation rate and interest rate. This chapter reviews the relevant studies of these three variables.

(1) REITs and Stock Markets

In the past, people use linear regression model to discuss the relationship between REITs and other markets. In the relation among REITs, macroeconomy and real estate markets, stock markets can affect real estate markets through the wealth effect; that is, the investors' wealth increase when stock prices go up. Under the consideration of increasing consumption and risk diversification, investors will transfer part of the funds from the stock markets to the real estate markets, influencing the real estate prices.

Giliberto (1990) applied correlations and regression model to explore the relations between equity REITs, stock markets and real estate markets, and he found that when the impact of the bond market and stock market effects are removed, REITs returns are significantly correlated to the traditional real estate investment returns, which implies that there is a common factor (or factors) that affects both REITs and real estate market. The study also found that real estate market has lower volatility and is negatively correlated to EREITs returns. In addition, EREIT's correlation with the stock market has declined over time and their correlation with bond returns has increased.

Liu and Mei (1992) stated that while previous studies have found that EREIT returns resemble large cap stocks, they found that returns on EREITs move more

closely with small cap stocks. Moreover, they found that real estate market conditions influence small cap stocks in addition to EREITs. Lee (1992) suggested that stock returns appear prior to Granger-Causal and help explain a substantial fraction of the variance in real activity, and is positively correlated to shocks in stock returns. Myer and Webb (1994) further explain that there is a positive contemporaneous relationship between retail stocks and retail REITs after controlling the market returns. However, no positive evidence is found for a relationship between retail real estate and either retail REITs or retail stocks, which does not support the previous conclusion about the existence of a stronger relationship between retail REITs and retail real estate. He expected that the differences between the results could be due to the presence of overage rents and perhaps other common factors.

Liu, Hartzell, Greig and Grissom (1990) intended to explore whether the commercial non-form real estate market is segmented from the stock market in U.S. for the period from June 1978 through September 1986 using Capital Asset Pricing Model (CAPM). In general, the results are consistent with the hypothesis that the commercial real estate market is segmented from the stock market as a result of indirect constraints, but commercial real estate market appears to be integrated with the stock market when the tests of integration are performed. Therefore, equity REITs are integrated with the stock market even though the commercial real estate which underlies the equity REITs is segmented from the stock market. They show that indirect barriers such as the cost, amount, and quality of information are the major source of segmentation. Peterson and Hsieh (1997) find EREIT returns significantly related to three stock market factors, whereas MREIT returns are related to the three stock market factors and two bond market factors in return.

From the above literatures, whether we are discussing from the perspective of total REITs and individual REITs or from the perspective of equity REITs and mortgage REITs, the results both occur REITs and stock market are under certain correlation. However, stock market is not the only factor, factors such as bond market and indirect barriers such as cost may also affect REITs performance and reward.

(2) REITs and Inflation Rate

The discussion about whether REITs can act as inflation hedging products, the past researches have not reached the same conclusion. Fama and Schwert (1977) find

that changes in returns on private residential real estate are positively related to changes in inflation, suggesting that such real estate is a hedge against inflation. Park, Mullineaux and Chew (1990) further examine the hedging ability of REITs and stock market based on the conclusion drawn by Fama and Schwert, and they find that for the most part, REITs are perverse inflation hedges just as stocks. Larsen and Mcqueen (1995) state that according to Fisher, real estate products can act as an effective hedge against inflation; however, the follow-up studies show the opposite result. They indirectly use the relation between gold and gold stocks to explore REITs' hedging ability. The results turn out that gold is shown to hedge inflation whereas its securitized form, gold stocks, is shown to be a poor hedge against expected inflation. Therefore, the study from the gold market suggests that conclusions about real estate's ability to hedge inflation should not be drawn from equity REIT studies.

Yobaccio, Rubens and Ketcham (1995) use autoregression model to do the time-series predictions, and the results indicate that REITs only act as a poor hedge against inflation. The results also indicate that REITs, at best, act as a partial hedge against expected inflation and a perverse hedge against unexpected inflation. Studies that have shown the real estate's ability to act as a partial inflation hedge may be the result of well-documented appraisal basis, rather than real estate's innate ability to be an effective hedge. Simpson et al (2007) point that EREIT returns do display a negative relationship with inflation, but only when inflation itself is going down. This result indicates that EREIT returns are shown to rise when inflation goes up and also rises when inflation decreases, and this involves other market mechanisms and fiscal policies. Lu and So (2001), Glascoca et al (2002) conclude that the negative relationship observed between REIT returns and inflation is partially derived from the interaction between monetary policies and inflation.

To sum up, based on the researches about REITs and inflation rate we still can't conclude whether REITs can act as an effective hedge against inflation because the result may change with the time and scope of the research data selection. However, if REITs can be hedged against inflation in the long-run, it implies that there is a long-run relationship between REITs and inflation.

(3) REITs and Interest Rate

In exploring the relationship between REITs and interest rates, Liu and Mei

(1992), Liang and Webb (1995), and Peterson and Hsieh (1997) believe that REITs are sensitive to interest rate changes, so a multi-factor model would be better than a single-factor model. The results of how interest rate affects REITs are divided into two conclusions. The first part thinks that REITs are highly sensitive to interest rate changes (Allen, Madura and Springer, 2000; Chen and Tzang, 1988). The second part believes that the correlation between REITs returns and interest rate changes is relatively low (Park et al., 1990；Mueller and Pauley, 1995；Li and Wang, 1995). However, those researches were not done under the same time frame, so interest rate volatility and the characteristics of REITs are not the same; thus, the relationship between REITs and interest rates still has room to be explored.

Allen, Madura and Springer (2000) find strong evidence to suggest that REITs returns are sensitive to long-term and short-term interest rate changes, but they cannot conclude that REITs can affect their exposure to interest rate changes through asset structure, financial leverage, management strategy, or degree of specialization. The results also show that REITs returns are more sensitive to stock market conditions than to interest rate changes, and there is evidence that individual REITs characteristics would affect REITs riskiness. Chen and Tzang (1988) point that during 1973-1979, both equity and mortgage REITs were sensitive to changes in the long-term interest rates and changes in expected inflation, and for the period 1980-1985, both equity and mortgage REITs were sensitive to short-term and long-term interest rate changes. Swanson, Theis and Casey (2002) indicate that although the particular time frame according to daily market data are unevenly dependent, interest rates still impact REITs. And it appears that the interest rate effects seem to have less explanations than in the time period as a whole, which is consistent with previous short versus long window analyses.

Mueller and Pauley (1995) indicate that REITs price movements have a low correlation with interest rates changes and a lower correlation with interest rates than with movements in the stock markets as a whole. The results of correlation and regression also show that the spontaneous relationship between interest rates changes and REIT price changes is very weak. In addition, the NAREIT Equity Index had a low negative correlation with interest rate movements during the period under study.

Although the correlation between REITs and interest rates were divided into two parts, we can ascertain that REITs and interest rates changes are still correlated.

However, the results may show different degrees of relevance subject to the length of time frame and data sources selected. This study tries to find out whether there is a long-run relationship between REITs and interest rates, or interest rates changes only has a short-term impact on REITs.

2.2.2 REITs and Real Estate Markets

There are also many studies exploring the relationship between REITs and real estate markets. Myer and Webb (1993) analyze the causality between REITs and real estate markets, and show the REIT index is found to Granger-cause the real estate indices, but there is no evidence that the real estate indices Granger-cause the REITs indices. In a time series sense, equity REITs returns appear to be much more like the returns on common stocks and closed-end fund. In addition, REITs returns are much more strongly related to unsecuritized real estate returns than are the returns on stocks or closed-end funds.

Clayton and Mackinnon (2003) find that after 1980, the large-cap stock factors impact on REITs drop dramatically, and the small-cap stock factors impact also occured. Since 1992, the dramatic growth and maturation of the REITs led to claims that the link between REITs prices and real estate market fundamentals become much stronger. Damodaran and Liu (1993) find the second-hand information associated with real estate appraisal announcements does not influence REITs prices. Following the research by Damodaran and Liu, Downs, Guner, Hartzell and Torres (2001) show that REITs prices change is a result of the information content in Barron's "The Ground Floor" column, and that the prices change more in the period following the REITs boom than during an earlier period.

Liang, Chatrath and McIntosh (1996) set up a hedged apartment REITs index by removing the return components of stocks in general and non-apartment equity REITs that invest in apartment real estate, and they use the index to analyze the relation between apartment REITs and apartment real estate. The results indicate that the "double-hedged" apartment REITs index satisfactorily track the performance of appraisal-based apartment real estate. Therefore, the hedged apartment REITs index can be used as a proxy for apartment real estate when making mixed-asset portfolio decisions.

Ling and Naranjo (1997) use a standard multifactor asset pricing model to

examine the macroeconomic factors that will affect real estate returns. This study identifies the growth rate in real per capita consumption, the real T-bill rate, the term structure of interest rates, and unexpected inflation as fundamental drivers or "state variables" that systematically affect real estate returns. The results show that previous findings of significant abnormal returns that have ignored consumption are potentially biased by omitting variables problem, and the dynamic asset allocation strategies involve the predictability of real estate returns using economic data.

Myer and Webb (1994) find there is a positive contemporaneous relationship between retail stocks and retail REITs even after controlling the market returns, and support the hypothesis that the presence of overage rents would tend to link the performance of retail real estate with the performance of retail tenants. Lee, Lee and Chiang (2008) find evidence suggesting that the real estate factor plays an important role in explaining quarterly equity REIT returns, which is consistent with the result explored by Giliberto (1990) that REITs returns reflect the performance of underlying real estate. Moreover, the sensitivity of big-cap REIT returns to lag supports the notion that institutional investors view REITs as potential substitutes for direct real estate investments and switch their capital between public and private real estate markets. Interestingly, when a more sophisticated investor based on the new REITs era improves information flow, a high degree of participation from institutional investors strengthens the linkage between REITs returns and private real estate returns.

Quan and Titman (1999) find a significant positive relation between stock returns and changes in commercial real estate values in contrast to earlier studies. One hypothesis is that real estate and stock prices are both driven up and down by changing expectations of future economic growth which is independent of current fundamentals, such as current rents and GDP. Moreover, they find that rental rates are strongly correlated with GDP growth rates as well as stock returns. The insignificance of the inflation rate coefficient and interest rate variables suggest that commercial real estate is a good long-term hedge against realized inflation, and that changes in anticipated inflation do not have long-term effects on commercial real estate values.

Regardless of using price index or rent as the object, real estate activities do have some influence on REITs volatility and returns, and sometimes REITs can act as a proxy of real estate markets, especially of commercial real estate markets. Therefore,

there is a correlation between the performance of real estate markets and REITs volatility and returns.

2.3 Long-run Relationship Between REITs and Factors

This study applies cointegration method in exploring the long-run equilibrium relationship between REITs and other factors. Variables with cointegration relation are adjusted by a vector error correction term, and variables without cointegration relation are interpreted based on VAR approach. Finally, all the variables will do the causality test. This section reviews the researches about cointegration and VAR models.

2.3.1 Cointegration

Other than using linear regression model to analyze the relation between REITs and other markets, many researches shift to using cointegration to discuss the long-run equilibrium relationship between REITs and other factors in recent years. This concept was proposed by Engle and Granger (1987), where they explore the long-run relationship by using a two-step approach between the two variables. Later, Johansen (1991) proposed the maximum likelihood method for verification of cointegration relationship between multi-variables.

Nasseh and Strauss (2000) indicate that the Johansen framework is a useful setting for analyzing stock market and macroeconomic activity because it incorporates dynamic co-movements or simultaneous interactions. Through this method we can study the channels through macroeconomic variables affect asset prices as well as their relative importance. They find a strong, integrating relationship between stock prices and domestic and international macroeconomic variables in Europe, and the long-term interest rates are shown to negatively influence stock prices; whereas, short-term interest rates are shown to be positively related to stock prices. In addition, stock prices are grounded in economic fundamentals, influenced by production, interest rates, business expectations and the CPI, and the domestic and international macroeconomic activity and cointegration methodology can be an important tool in explaining stock returns. McCue and Kling (1994), Okunev and Wilson (1997) also state that cointegration model is commonly used in the analysis of correlation between real estate market and stock market, focusing on the long-term effects of the economic variables.

Liu, Hartzell, Greig and Grissom (1990), exploring the relationship between real estate market and the stock market, pointed out that the commercial real estate market

is segmented from the stock market as a result of indirect constraints. However, the equity REITs are integrated with the stock market even though the commercial real estate that underlies the equity REITs is segmented from the stock market, and indirect barriers such as the cost, amount, and quality of information are the major source of segmentation. The commercial real estate market appears to be cointegrated with the stock market when the tests of cointegration are performed. Li and Wang (1995) apply the method of two-factor asset pricing model and risk premium. The result lead to a similar conclusion without assuming the existence of a real estate factor premium in the economy, providing further evidence that REIT stocks are integrated with the general stock market.

Ling and Naranjo (1999) support the hypothesis that markets for exchange-traded real estate companies, like REITs, are integrated with the market for exchange-traded (non-real-estate) stocks, and the level of integration significantly increase after 1990s. However, if the evaluated price is replaced by the actual market price, it will have an opposite result from the perspective of real estate portfolio, which means the real estate market and stock market will not be integrated. The hypothesis is that the estimated returns can't accurately represent the actual portfolio returns.

Quan and Timan (1999) study the global relation between stock markets and real estate markets in 17 countries. The results show that apart from Japan, the stock markets and real estate markets are not cointegrated in other countries. However, the stock returns, real estate price changes and rentals would have a significant relationship if all the national data are added up and examined under a longer period. In the long-run, stock returns and real estate returns are still correlated. Chaudhry, Myer and Webb (1999) further use Johansen test and the results suggest that the stocks tend to have an inverse long-run relationship with the real estate.

Johnl, Lu and So (2000) believe that if REITs act more like real estate, there would be a cointegration between inflation and REITs, but they find that before 1992, REITs acted more like fixed-income instruments. The results show that REITs are cointegrated with the bond market before 1992 and that this cointegration relationship vanished afterwards. From 1992 to 1996, the cointegration are found between stocks and REITs, and after 1992, stocks and REITs share some common factors, and asset pricing structures and REITs behave more like stocks. Clayton and Mackinnon (2003)

also find that the dramatic growth and maturation of the REIT sector since 1992 led to claims that the link between REIT prices and real estate market fundamentals had become much stronger as their returns become less dependent on major stock indices and more akin to real estate and sector effects, making REITs more like real estate and less like stock.

Westerheide (2006) states that real estate stocks provide a (weak) hedge against consumer price inflation in almost every country, and cointegration is indicated in the Johansen specification as well. This implies that an equilibrium relationship exists, but the general stock market adjusts to the real estate stock market instead of the reverse. In the study of the U.S., Australia and Japan, there is weak evidence for a long-run equilibrium between real estate stock indicators and the CPI, indicating that real estate stocks could basically serve as an inflation hedge. Adrangi, Chatrath and Raffiee (2004) support the hypothesis the market for REITs and equities is integrated and the real REIT returns are negatively correlated with the inflation rate, and the result is robust for the long-term.

The cointegration literatures discussed above are under a linear assumption. However, Okunev and Wilson (1997) suggest that using a standard cointegration tests β to produce conclusive evidence could be a failure because the relationship between real estate and financial assets markets may be nonlinear rather than linear. The results suggest that the real estate markets are nonlinearly related to the stock market, so there is a relationship between the stock and real estate markets but the link is weak and nonlinear, and the movement of the real estate market towards the stock market is slow. In 1999, the authors further use non-linear method to explore the long-run equilibrium relationship between the real estate market and stock market of the United States, Britain and Australia. The results show that the real estate market and the stock market do not have a significant long-run equilibrium relationship in the U.S. and the U.K., and the result in Australia is not significant. However, if the cutoff point is in 1987, the real estate market in U.S. and the U.K. will be cointegrated.

There are also some domestic researches for cointegration between different markets. Zheng (2008) illustrates that cointegration test is often interpreted as “The economic variables have a long-run equilibrium relationship.” If the linear combination between variables has a cointegration relationship, even a short period of imbalance with a deviation from equilibrium occurred, but the error correction

function will gradually reduce this deviation and eventually adjust to the long-run equilibrium level. If cointegration exists between variables, then the error correction term must be added to fix the short-run non-equilibrium and to explain the short-run changes of the series in inter-relations.

Zheng and Chang (2007) point out that the T-REITs index and stock price index are not cointegrated, neither is T-REITs and construction index, suggesting that the investors can achieve risk diversification and gain profits by joining T-REITs in portfolio investment. In addition, the T-REITs have low correlation coefficient with stock price index and construction index. In this case, investors can effectively reduce the investment risk if T-REITs are included in the portfolio.

Wang (2007) shows that industrial/office, special use, retail and warehousing, and personal use of REITs do not have the characteristics against increasing price. The housing-based REITs, however, have the characteristics against increasing price, they are more able to offset the decline in purchasing power when prices rise. In addition, using unemployment as a macroeconomic indicator, the study found that unemployment only has negative effects on industrial/office-based REITs.

Nie and Zheng (2000) use general linear analysis and non-linear concept proposed by Okunev and Wilson to explore the relationship between housing price index and stock price index in Taipei City, Taipei County, Kaohsiung City, Taichung and Taiwan from March 1991 to April 1999. The results show that the long-term equilibrium relationship does not exist between housing price and stock price except in Kaohsiung City. In addition, the study found that during the study period, the interaction between Taiwan housing price and stock prices are mostly negative, which is contrary to other studies.

Overview of domestic and foreign cointegration literatures and researches of REITs, in foreign researches, the macroeconomic variables such as stock price, interest rate and inflation rate are cointegrated with REITs, thus they have long-term equilibrium relationship. However, the researches in Taiwan find that T-REITs are not cointegrated with stock price index. The foreign discussions about the ability of REITs against inflation do not reach any unanimous conclusion, but some studies suggest that it should not be a portfolio with similar nature products like stocks. In Taiwan, the studies suggest that although T-REITs is not an inflation hedge, they can

serve as an effective tool for risk diversification because of its low stock price index-related.

2.3.2 Vector Autoregression

VAR model can be used to explore the effects and direction of short-term changes among REITs and other variables, and to understand the degree of influence of lag periods. Lee (1992) uses the VAR approach to explore the causal relations among stock returns, interest rate, real activity, and inflation. The results show that the stock returns appear prior to Granger-Cause and help explain a substantial fraction of the variance in real activity, and it responds positively to shocks in stock returns. When adding interest rate in VAR model, the interpretation ability of stock returns on inflation is reduced, but the interest rate is with most of the explanatory power of inflation instead. In addition, the inflation rate has a negative relationship with stock returns when testing with real interest rates. Finally, the inflation explains little variation in real activity.

Ling and Naranjo (2003) apply VAR approach to examine the interrelationships between short- and long-run dynamics among capital flows to the REIT sector and REIT returns, particularly whether REIT capital flows affect REIT prices and returns and whether the effect is temporary or permanent. They also use impulse response functions to provide the time path of the short-run dynamic relationships that result from a shock to the variables in the system. The result suggests there is positive momentum in REIT flows, but this momentum reverses after two quarters. It also indicates that current flows are highly significant in explaining current returns.

Ling and Naranjo (2006) further use VAR to examine the effects of weekly and monthly capital flows into the dedicated REIT mutual fund sector on aggregate REIT returns. They find consistent evidence that REIT mutual fund flows are significantly and positively related to prior industry-level returns, but prior fund flows do not significantly influence subsequent REIT returns. In addition, contemporaneous fund flows do have an initial positive effect on returns, which is partially reversed one period later. Interestingly, the unexpected REITs mutual fund flows have positive contemporaneous effects and the expected portion is insignificant.

Bredin, O'Reilly and Stevenson (2007) apply VAR model to analyze the relationship between REITs and interest rate. They conclude that in comparison to

previous studies of REIT interest rate sensitivity, this study find significant responses in both returns and volatility to unanticipated rate changes. However, the effect of the shock is significant on both returns and volatility and there is no evidence of asymmetry between them.

Glascoca, Lu and So (2002) use VAR to explore the relationship between REITs returns, real activity, monetary policies, and inflation. The evidence suggest that neither expected nor unexpected inflation signal REIT returns, but the finding is consistent with previous findings that REIT returns are sensitive to interest rate changes. In addition, they conclude that REITs returns do not behave as perverse inflation hedges.

To sum up the above studies, foreign researches about the relationship between REITs and other markets are more extensive, and apply different models to explore the long-run and short-run impacts. However, the relative empirical studies in Taiwan are still less prominent. Although there are some studies using cointegration model to discuss the long-run relationship between T-REITs and other variables, most of them focus on relationship between T-REITs and stocks or T-REITs and construction index. There are other economic variables that can still be discussed as regards T-REITs, and that is the research gap this study would like to explore.

Chapter 3 Research Method and Data Information

This chapter is divided into research method, variable selection and T-REITs index presentation. The first part shows the models applied in this study for empirical tests. The second part shows the approaches of variable selection and clarifies the data source. The last part is establishing T-REITs index for the use of empirical study since there is no official REITs index in Taiwan.

3.1 Research Method

The purpose of this study is to explore the long-run and short-run relationship between T-REITs, macroeconomy and commercial real estate market. In the long-run equilibrium section, we employ Johansen cointegration method to analyze T-REITs and other variables, respectively. Variables with cointegration relationship are analyzed through VECM approach for further study; and variables without cointegration relation are interpreted based on the VAR approach, discussing the short-term influence of each variable to T-REITs. Finally, we conduct Granger causality test to explore the lead/lag relation between variables.

3.1.1 Cointegratoin Test

Cointegration test was proposed by Engle and Granger in 1987, which is specifically for the analysis of the relationship between a set of economic variables. When a set of non-stationary variables become stationary through a linear combination, the non-stationary time series are said to be cointegrated. Cointegration is commonly used to explain the long-run equilibrium relationship between economic variables. When there is a cointegration relationship between variables, the characteristics of these variables tend to adjusted to the balanced direction, and the effects from the external factors are only a short-term deviation from equilibrium. Therefore, the error correction function must be applied to decrease the deviation gradually, so that the variables will eventually return to the long-run equilibrium value. The short-run relation between variables is described in the VECM approach.

Engle and Granger (1987) propose a two-step method approach to test the cointegration relation. The hypothesis is that when two non-stationary variables Y_t and X_t become stationary in a first-order differential, the Engle-Granger

cointegration test can be applied. The first step of regression can be written as follow.

$$Y_t = \alpha + \beta X_t + \varepsilon_{1t} \quad (3.1)$$

In this equation, Y_t represents the dependent variable; X_t represents the independent variable and ε_{1t} is the error term. The second-step of Engle-Granger cointegration is to decide the integrated order of residuals using unit-root test. The regression residuals can be expressed as:

$$\Delta\varepsilon_{1t} = \rho\varepsilon_{t-1} + \varepsilon_{2t} \quad (3.2)$$

The null hypothesis of the equation is that there is no cointegration relationship between the two variables. If the result can't reject the null hypothesis of $\rho = 0$, then the residual series has a unit-root, implying there is no cointegration between series Y_t and X_t.

However, the Engle-Granger two-step method can't point out one or more of the cointegration relationship and the relative dynamics of the adjustment process over two variables, thus Johansen (1991) proposes a new method based on VAR approach. This method uses maximum likelihood estimation to clearly point out the existence of one or more cointegration relationship provides a more robust interpretation of the multiple long-run equilibrium relationship between variables. The variables generate a long-run impact matrix after differential, and use the two likelihood ratio statistics to confirm the rank of matrix, which determines the number of cointegration vector. Assuming a VAR model of order p and n variables can be expressed as:

$$Y_t = A_1 Y + A_2 Y + \cdots\cdots + A_p Y + BX_t + \varepsilon_t \quad (3.3)$$

where Y_t is a k-vector of non-stationary I(1) variables; X_t is a d-vector of deterministic variables; ε_t is a vector of innovations generated by the equation. Let $\Pi = \sum_{i=1}^{p} A_i - I_j$，$\Gamma_i = -\sum_{j=i+1}^{p} A_j$, the equation (3.3) can be rewritten as:

$$\Delta Y_t = \prod Y_{t-1} + \prod_1 Y_{t-1} + \prod_2 Y_{t-1} + \cdots\cdots + \prod_{p-1} \Delta Y_{t-p+1} + \epsilon_t \quad (3.4)$$

And equation (3.4) can further be expressed as:

$$\Delta Y_t = \prod Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \, \Delta \, Y_{t-1} + BX_t + \epsilon_t \quad (3.5)$$

where $\prod$ is the long run impact matrix, and the rank of $\prod$ decides the number of cointegration existed in Y_t. The Johansen test is to examine whether the rank generated by $\prod$ can be rejected through the estimation of non-restricted VAR model to the Π matrix. In order to carry out tests of the rank to determine the number of cointegration, Johansen proposed Trace test and Maximum Eigenvalue test.

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{n} \ln(1-\lambda_r) \qquad (3.6)$$

where T = number of sample size, λ_r= max-Eigen statistic of matrix $\prod$. The null hypothesis is H_0：rank≦r.

$$\lambda_{max}(r) = -T\ln(1-\lambda_{r+1}) \qquad (3.7)$$

The null hypothesis is H_0：rank=r, representing number of r cointegration vectors. The alternative hypothesis is H_1：rank=r+1, representing number of r+1 cointegration vectors existing between variables.

3.1.2 Vector Error Correction Model

According to Granger's representation theorem, when cointegration exists between two variables, an error correction term must be added to correct the short-term imbalance between variables, making the time series back to long-run equilibrium. The VECM approach restricts the long-run behavior of the endogenous variables to converge to their cointegrated relationships while allowing for short-run adjustment dynamics. In addition, since the traditional time-series model complies with the requirements of stationary, the non-stationary series have to be differentiated before analyzing. But the difference will result in the loss of long-term information. The adoption of error correction model can also save the problem. Error correction model is derived from the VAR approach, it specifies the correction term should be added into VAR when cointegration exists, making the variables move toward the direction of long-run equilibrium. Therefore, the movement of series is not only affected by the changes of current variables and itself, but also affected by the previous imbalance. Under the assumption of one cointegration and no lags, the cointegration model between series Y_t and X_t is $Y_t = \beta X_t$, and the two corresponding to the VECM can be expressed as:

$$\Delta X_t = \alpha_1(Y_{t-1} - \beta X_{t-1}) + \varepsilon_{1,t} \quad (3.8a)$$

$$\Delta Y_t = \alpha_2(Y_{t-1} - \beta X_{t-1}) + \varepsilon_{2,t} \quad (3.8b)$$

Only the right variables are the error correction terms generated by integrating, and α_i is the speed of adjustment.

From (3.8a) and (3.8b), and in the case of long-run equilibrium, the value of the error correction term should be 0, and the error correction term will not be 0 when Y_t and X_t deviate from the equilibrium. Generally, the error correction model corrects the short-term imbalances through the error correction term, implying that when imbalance occurred in the previous period, it will be partially corrected at current period. Therefore, the error correction term may be regarded as the speed of adjustment between variables and the long-run equilibrium value. In addition, the error correction model contains a variable differential, error correction term, and the short-term changes between variables under long-run equilibrium relationship, which avoids the spurious regression error and the long-run messages that can be ignored by differential.

3.1.3 Vector Autoregression Model

The groups of variables without cointegration relationship apply the VAR approach. The VAR is commonly used for forecasting systems of interrelated time series and for analyzing the dynamic impact of random disturbances on the system of variables. The VAR model uses its own information and characteristics to do the analysis. In each equation, the dependent variable begins with the lags of their own period and together with the lags of other variables. In each regression, the interpreted variable uses its own lags as the explanatory variable, viewed as endogenous variable, to reflect the dynamic relationships between variables. Because the VAR model can indicate the lags' short-term impact on the dependent variable by studying the correlation between the lags of the dependent variable and the lags of other variables. In this study, the VAR model is to explore the short-term impact changes under the long-run fluctuations.

On the assumption that Y_t is influenced by the lag of itself and other variables and all the series are stationary, it includes the following two regressions:

$$Y_t = \alpha_{10} + \sum_{s=1}^{P} \alpha_{11s} Y_{t-s} + \sum_{s=1}^{P} \alpha_{12s} X_{t-s} + \varepsilon_{1t} \quad (3.9a)$$

$$X_t = \alpha_{20} + \sum_{s=1}^{P} \alpha_{21s} X_{t-s} + \sum_{s=1}^{P} \alpha_{22s} Y_{t-s} + \varepsilon_{2t} \quad (3.9b)$$

where Y_t is the value of the dependent variable at time t, and X_t is the value of the independent variable at time t.

3.1.4 Granger Causality Test

Besides using cointegration and VAR to explore the relationship between variables, this study also uses Granger causality test to explore the lead/lag relations between T-REITs and other variables. The causality between two variables A and B is defined as whether placing the lag of A into the prediction equation of B would provide better forecasting results than only place the lag of A into the equation. This means that when there are two series Y_t and X_t, the inclusion of the lag Y_t items would enhance the prediction accuracy of X_t, and will also enhance the overall explanatory power of X_t. At this point, we say Y_t leads X_t, and X_t leads Y_t vice versa. The significance of the test results is that one variable contributes to the forecast of another variable, and provides leading information. If there exists an interaction between the two variables, then the result indicates the feedback relationship between variables. Suppose two variables are stationary, but does not have a cointegration relationship, the Granger causality equation is defined as:

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \Delta X_{t-i} + \sum_{j=1}^{p} \beta_j \Delta Y_{t-j} + \varepsilon_t \quad (3.10)$$

where Y_t is dependent variable; X_t is independent variable, and P is lag terms. The null hypothesis is $H_0 : \alpha_1 = \alpha_2 = \cdots\cdots = \alpha_p = 0$. If the results reject the null hypotheses, meaning it refuses that X does not lead Y, then the results indicating that adding X in the equation is useful in predicting Y.

If there is cointegration between the two variables, there would be bias by using equation (3.10) directly. In order to avoid the bias, the variables deviate from the

long-run equilibrium level needs to be taking into consideration. Therefore, we should use VECM to do the estimation by adding error correction term $\lambda\hat{u}_{t-1}$ into the above VAR model, becoming equation (3.11).

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \Delta X_{t-i} + \sum_{j=1}^{p} \beta_j \Delta Y_{t-j} + \lambda\hat{u}_{t-1} + \varepsilon_t \qquad (3.11)$$

3.2 Variable selection and data source

In this section, we illustrate the reasons for selecting the macroeconomic and commercial real estate market variables and the sources.

3.2.1 Macroeconomic Variables Selection

According to Giliberto (1990), there is a correlation between REITs and real estate market. Because the essence of REITs is similar to the stock market, the stock prices can be an appropriate variable to analyze. Liu and Mei (1992), Liang and Webb (1995), and Peterson and Hsieh (1997) indicate REITs are highly sensitive to interest rate, therefore could be used as a way to investigate the correlation between the two variables. However, Mueller and Pauley (1995), Li and Wang (1995) claim the correlation between REITs returns and interest rate changes is relatively low. The REITs capability of hedge is also under discussion. Larsen and Mcqueen (1995) confirm that REITs can significantly hedge against inflation. However, Yobaccio, Rubens and Ketcham (1995) argue that REITs are only act as a poor hedge tools against inflation. Although the conclusions regarding whether REITs are sensitive to interest rate or whether REITs can hedge against inflation are not consistent, interest rate and inflation is still important economic indicators. This study thus intends to explore their relationship with T-REITs. In sum, the macroeconomic variables discussed with T-REITs in this study are stock price index, inflation rate and interest rate.

3.2.2 Real Estate Market Variables Selection

In addition to macroeconomic variables, the real estate market is also an important factor affecting REITs. Myer and Webb (1993) find that the impact of real estate index to REITs is more significant than the impact of stocks or funds, and the rents tend to affect REITs returns. Therefore, this study adopts the physical real estate prices and rents as the real estate market variables. Since most of the compositions of current T-REITs are commercial office buildings, we thus focus on the relationship between T-REITs and commercial real estate markets, and select commercial real estate prices and rents as variables.

3.2.3 Sources of variables

Variables been explored in this study includes T-REITs price index, stock price index, inflation rate, interest rate, commercial real estate price and rent. The macroeconomic variables collected for analysis are the weighted average stock price index from the Taiwan Stock Exchange, the average interest rate reported by Directorate-General of Budget, Accounting and Statistics (DGBAS), and the inflation rate comes from the annual growth of consumer price index (CPI) as an alternative indicator by DGBAS. The commercial real estate market variables are commercial real estate transaction price provided by a prestigious realtor company and the average commercial office rent from Sinyi Commercial. Table 3-1 shows the brief description of these variables name and data information in this study.

Table 3-1 The Variable Name

Variables	Code	Type	Sources	Time Period
T-REITs	REIT	monthly	Taiwan Economic Journal Data Bank	2005.3~2008.12
Stock price index	Stock	monthly	Taiwan Stock Exchange	2005.3~2008.12
Inflation rate	Inf	monthly	DGBAS	2005.3~2008.12
Interest rate	Int	monthly	DGBAS	2005.3~2008.12
Commercial rent	Crent	quarterly	Sinyi commercial	2005Q2~2008Q4
Commercial price	Cprice	monthly	Realtor company	2005.3~2008.12

As the first T-REIT was launched in March 2005, we set the study period from March 2005 to December 2008, with its monthly data, totaling 46 months of observations. The commercial average rent is quarterly data. For consistent data type, we adopted the moving average method to obtain the monthly data.

3.3 T-REITs Index presentation and data analysis

Most of the researchers use exponential pattern while studying REITs, however, T-REITs index has not yet been officially established in Taiwan. In order to better understand the overall performance of T-REITs and to support the follow-up researches, the T-REITs index should be established. This section reviews the REITs index of United States and Japan, and applies the establishment method proposed by Zheng and Chang (2007) to generate a longer T-REITs index. Further, we intend to outline the basic information on T-REITs and illustrate the past performance and trend of T-REITs.

3.3.1 U.S. REITs Index

The base period of REITs index sets up by National Association of Real Estate Investment Trust (NAREIT) is on December 31, 1971, and the base value is set to be 100. The NAREIT includes all the REITs from New York Stock Exchange (NYSE), the NASDAQ Stock Market and American Stock Exchange (AMEX). In addition to a composite REITs index, NAREIT also provides index of equity REITs, mortgage REITs and hybrid REITs. The methodology is as:

$$\boldsymbol{Index_t = Index_{t-1} \times (1 + I_t)} \qquad (3.12)$$

$$\boldsymbol{I_t = \frac{\sum_{i=1}^{n}\left[\left(P_{i,t-1} \times N_{i,t-1}\right) \times I_{i,t}\right]}{\sum_{i=1}^{n}\left(P_{i,t-1} \times N_{i,t-1}\right)}} \qquad (3.13)$$

where n=the number of companies; $\boldsymbol{I_t}$= price of the current day; $\boldsymbol{P_{i,t-1}}$=stock price of the previous day; $\boldsymbol{N_{i,t-1}}$= stock numbers of the previous day; $\sum_{i=1}^{n}\left(\boldsymbol{P_{i,t-1}} \times \boldsymbol{N_{i,t-1}}\right)$= total market value.

3.3.2 Japan's REITs Index

There are two prestigious REITs index in Japan, one is the STBRI J-REITs index established by Sumitomo Trust & Banking Co., which is the same method as the U.S.. The other one is the Topix REITs established by Tokyo Stock Exchange, the same one that established TOPIX, which is from March 31, 2003 and set a value of 1000. The methodology is as:

$$Index_t = \frac{\sum_{i=1}^{n}(P_{i,t} \times N_{i,t})}{\sum_{i=1}^{n}(P_{i,0} \times N_{i,0})} \times 1000 \qquad (3.14)$$

where n=the number of companies; $P_{i,t}$= price of the current day; $N_{i,t}$= stock numbers of the current day; $P_{i,0}$=stock price of the base period; $N_{i,0}$= stock numbers of the base period.

3.3.3 Establish T-REITs index

This study is based on the establishment of T-REITs index method proposed by Zheng and Chang (2007), using Japan's Topix REITs index mode. The T-REITs index contents all the REITs listed on OTC (Over-the-counter) since the launched date, including Fubon No.1, Cathay No.1, Shin Kong No.1, Fubon No.2, Trident, Kee Tai Star, Cathay No.2 and Gallop No.1.

The method of establishing T-REITs index by Zheng and Chang is a circulation-weighted price index, using each REITs' number of shares as weighted values. REITs index for the day of the date is the total issue value divided by the base value, and the base value is market value of total issued during base period. Total market value is the sum of the daily market price (closing price in this study) multiplied by the number of shares issued. In this study, the launched date of Fubon No.1, March 10, 2005, is the base period, and the base value is 100. The methodology is:

$$Index_t = \frac{\sum_{i=1}^{n}(P_{i,t} \times N_{i,t})}{\sum_{i=1}^{n}(P_{i,0} \times N_{i,0})} \times 100 \qquad (3.15)$$

where n=the number of companies; $P_{i,t}$= price of the current day; $N_{i,t}$= stock numbers of the current day; $P_{i,0}$=stock price of the base period; $N_{i,0}$= stock numbers of the base period. Because this study uses monthly data as research units, we will first establish the daily T-REITs index then calculate the average of each month's index as the study used data on T-REITs.

3.3.4 Basic Information of T-REITs

Taiwan has a total of eight REITs listing. Since the time of this study ranges from March 2005 to December 2008, all the eight REITs are the subjects under study. The basic information of all T-REITs are shown in Table 3-2, the basic information of

T-REITs are obtained from the files of the prospectus, and the index are established by using the closing price index from Taiwan Economic Journal (TEJ) database.

We can learn from the basic information of T-REITs that the highest percentage of current total market capitalization is Cathay No.1; Shin Kong No.1 is second place, and the proportion of total market capitalization of Fubon No.1, Fubon No.2 and Cathay No.2 are close. The least percentage of the total market value is Kee Tai Star, with only 4.19%, which may be related to the relatively small number of combinations on the content.

Table 3-2 Basic Information of T-REITs

T-REITs	Listing Date	Market value (billion)	Percentage of total market capitalization
Fubon No.1	2005. 03. 10	80.9	13.85%
Cathay No.1	2005. 10. 03	139.3	23.85%
Shin Kong No.1	2005. 12. 26	113	19.35%
Fubon No.2	2006. 04. 13	73.02	12.50%
Trident	2006. 06. 26	38.52	6.59%
Kee Tai Star	2006. 08. 14	24.5	4.19%
Cathay No.2	2006. 10. 13	72	12.33%
Gallop No.1	2007. 05. 15	42.84	7.33%
Total		584.08	100%

3.3.5 Variables Descriptive Statistics

The descriptive statistics of the variables are in Table 3-3, including the mean, standard deviation, maximum, minimum, and J-B values. The commercial rent is calculated in the average price per ping, so the mean value of the price is 53.622. We can learn from the Jarque-Bera value that all the variables are at normal distribution because the statistics can reject the null hypothesis of not being under normal distribution at 1% and 10% significant level.

Table 3-3 The Variables Descriptive Statistics

Variable	T-REITs	Stock Price Index	Inflation Rate	Interest Rate	Commercial Rent	Commercial Price
Mean	102.715	7169.963	2.100	2.579	1720.870	53.622
Std. Dev.	7.471	1240.855	1.707	0.236	76.183	7.528
Maximum	116.715	9605.190	5.810	2.958	1871	69.220
Minimum	82.300	4496.383	-1.230	2.261	1624	36.340
Jarque-Bera	0.876 ***	0.658 ***	0.646 ***	5.467 *	5.383 *	1.055 ***
Observations	46	46	46	46	46	46

Note 1: *, **, and *** represent significant level of 10% 、5%、 1% respectively

3.3.6 Performance of T-REITs

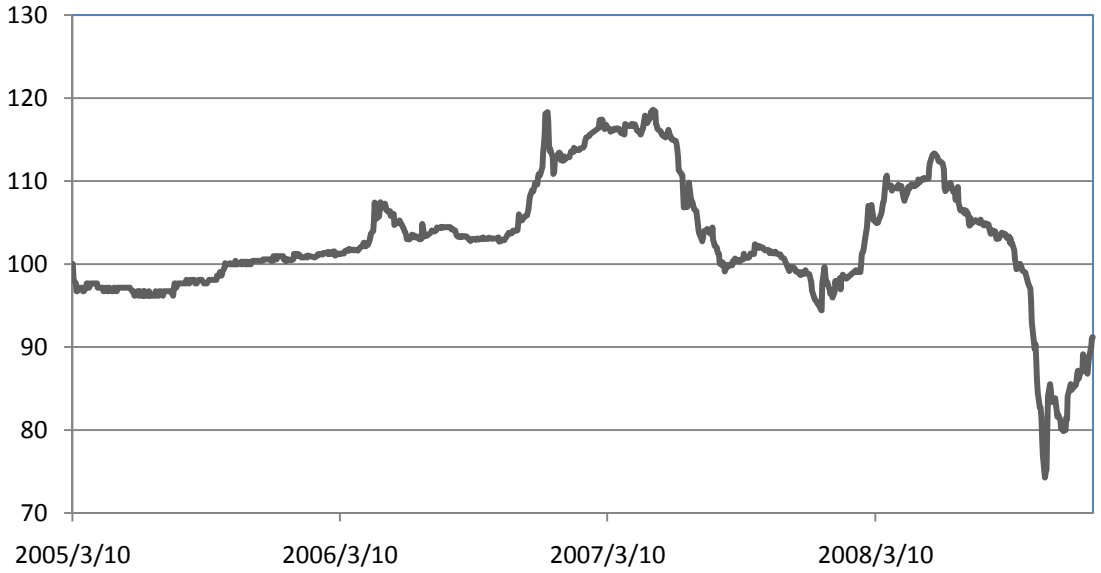


Figure 3-1 Trend of T-REITs Index（Daily）

We can learn from figure 3-1 that before July 2006, T-REITs show a steady growth trend with slight fluctuations, which was during the intensive distribution time for the former 6 REITs. The main reason for the decline in September and October 2006 was the poor performance of Trident and Kee Tai Star, thereby affecting the overall performance of T-REITs. Thereafter, the price index rose sharply until May 2007, and the second half of 2007 was the downturn phase of the performance of T-REITs, mainly due to the U.S. subprime mortgage crisis. January 2008 began another wave of growth. In addition, the overall performance of T-REITs will reach the pinnacle around March each year. We can also learn the figure that the obvious life cycle occurs after 2007.

3.3.6 Trends of T-REITs, Macroeconomy and Commercial Real Estate Market

This section uses monthly data to show the historical trend between T-REITs and other variables, and conducts preliminary study about whether there is long-run equilibrium relationship existed.

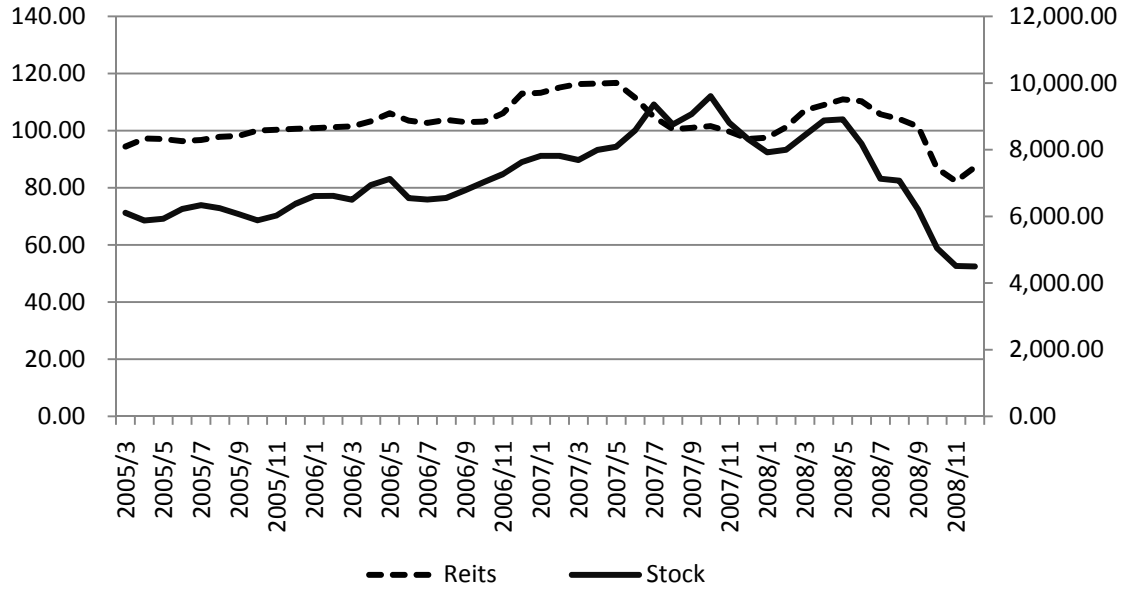


Figure 3-2 Trend of T-REITs and Stock Price Index

Figure 3-2 indicates the past trends of T-REITs and the stock price index. It can be seen from the figure that T-REITs and stock price have the same volatility over time, and that T-REITs could have a positive correlation associated with stock price. Besides the widening gap between the two lines and slightly different fluctuations from March to September 2007, the long-run trend between the two variables is still similar.

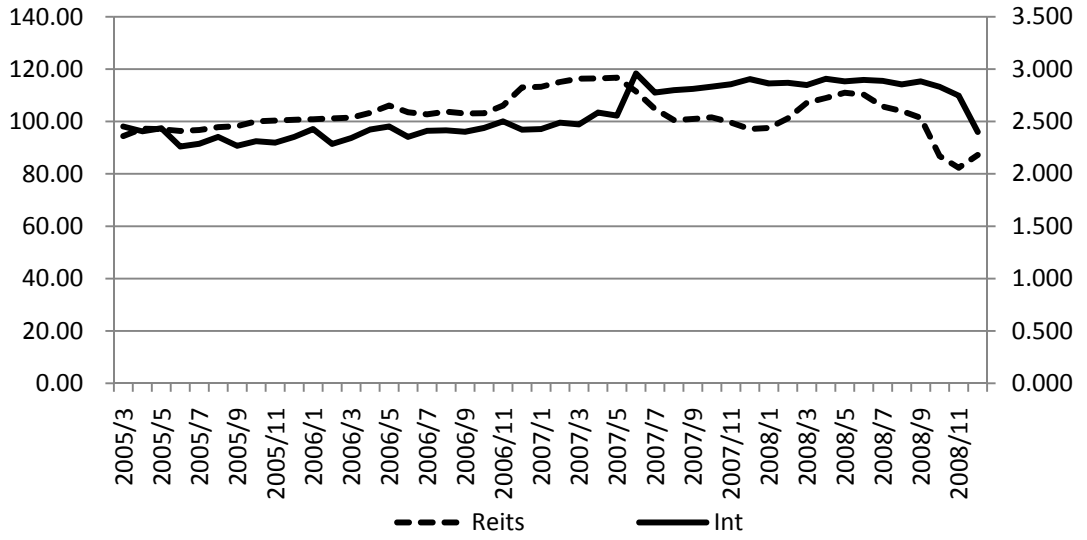


Figure 3-3 Trend of T-REITs and Interest Rate

Figure 3-3 shows the T-REITs and interest rate volatility was similar before May 2007, and the fluctuations were small. There was a severe and significant inverse relationship between T-REITs and interest rate by May 2007, but after that, the direction of correlation vary with time. For example, T-REITs and interest rate were negatively correlated between September and December 2007, while the correlation became positive from July through November 2008. Therefore, it is unable to determine whether the long-run relationship exists between T-REITs and interest rate, and their correlation direction.

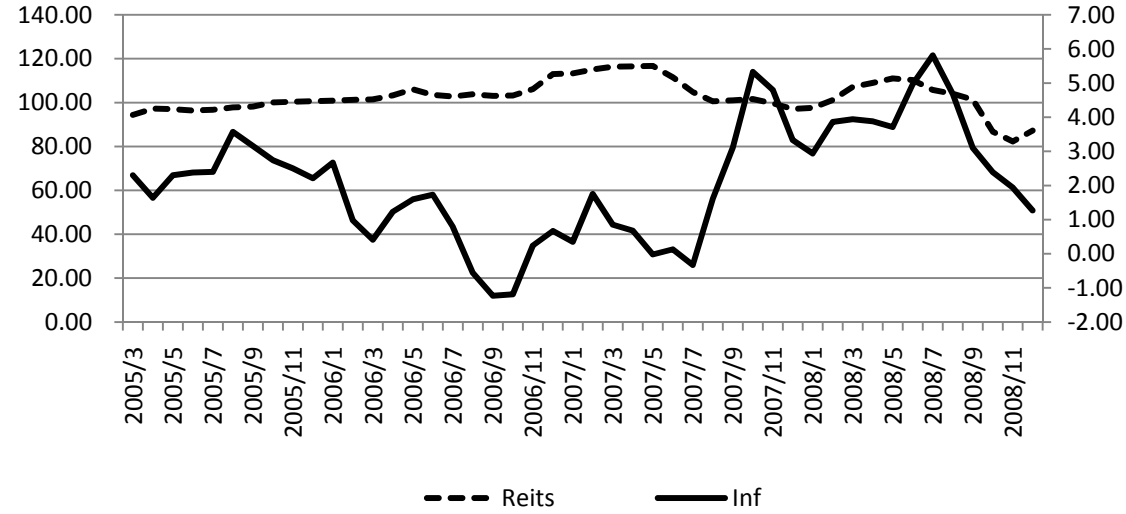


Figure 3-4 Trend of T-REITs and Inflation Rate

From figure 3-4, we can see there may not be a consistent relationship between

T-REITs and inflation, and the inflation volatility is more dramatic and obvious relative to the volatility of T-REITs, which is more gentle. Therefore, there may not be a long-run equilibrium relationship between T-REITs and inflation rate.

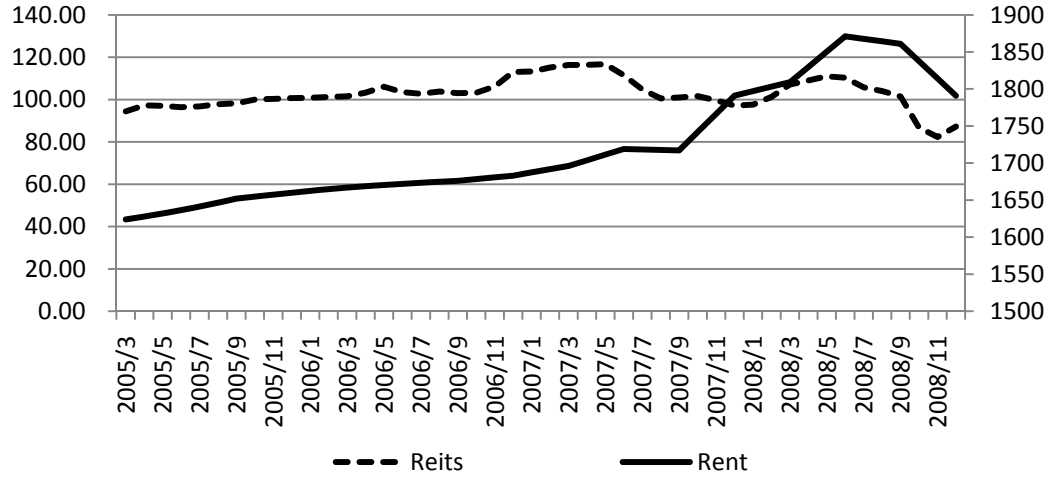


Figure 3-5 Trend of T-REITs and Commercial Rent

Figure 3-5 indicates that the rent shows stable growth until May 2008, when there was a slight decline, and its fluctuations are more similar to the T-REITs trends before 2008, but is not obvious after 2008. The possible reason is that there have not been significant changes in the commercial rent in the past few years, but T-REITs are daily trading so that the price volatility is more obvious. Therefore, we can't determine whether the two variables have a clear long-term relationship.

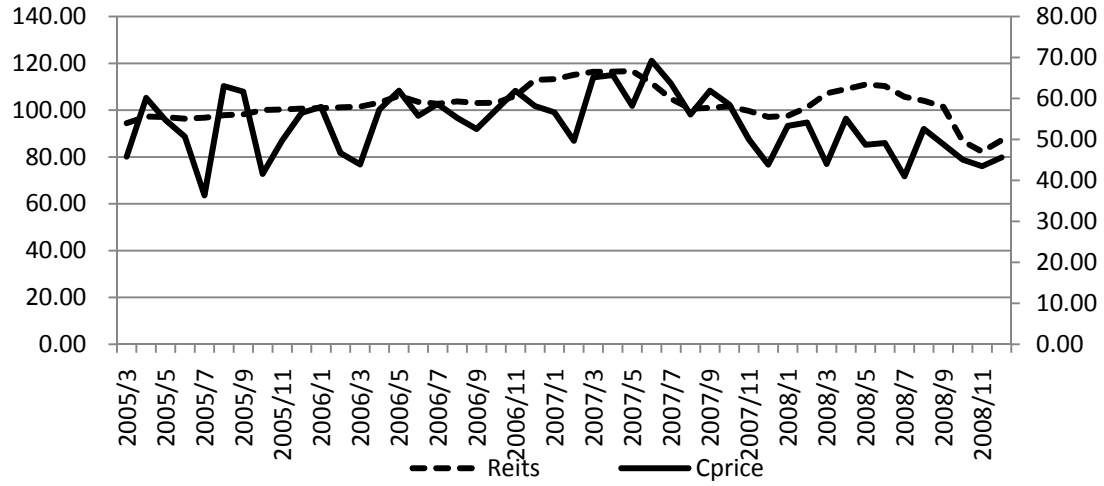


Figure 3-6 Trend of T-REITs and Commercial Price

It can be seen from figure 3-6 that the volatility of commercial price is greater than T-REITs. It may be the transaction price data itself that causes the larger degree

of price volatility. However, the trend between T-REITs and commercial price is still similar, and thus they are likely to have long-run relationship.

Summarizing the results from Figure 3-2 to 3-6, the preliminary view of this study shows that T-REITs are more likely to have a long-run equilibrium relationship with stock price index and with commercial price, and are less likely to have a long-run relationship with inflation rate. We could not explicitly determine whether T-REITs have long-term equilibrium relationship with interest rate and commercial rents. However, we should not conclude whether there is a real long-run equilibrium relationship between the two variables just by their trends. Therefore, it still needs to apply various models to analyze the data, and use empirical results to determine whether the long-run equilibrium relationships exist between T-REITs and other variables.

Chapter 4 Empirical Results

The main contents of this chapter are the empirical results of the study, using the model described in chapter 3 to explore the relation among T-REITs, macroeconomic variables and commercial real estate variables, as well as interpreting the test results.

4.1 Results of Structure Change and Unit-root Test

The first thing in the empirical study is to confirm the T-REITs series does not have structure change during the studying period because it is the main variables being discussed in this study. If the T-REITs series has a structure change, then the results of the following tests would be deviated. The method applies in this study is the Cumulative Sum of the recursive residuals test (CUSUM test), and the result of the test is in Figure 4-1.

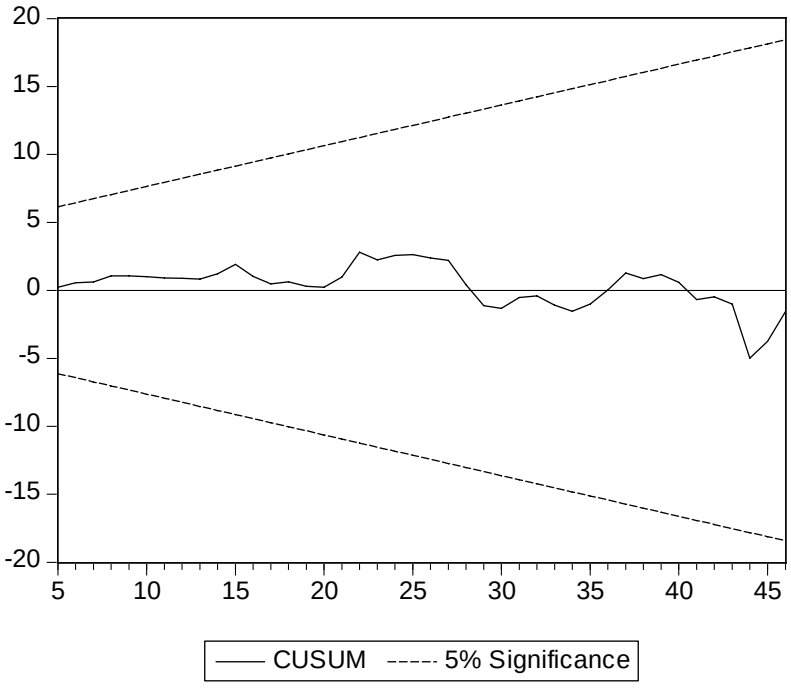


Figure 4-1 The Result of the CUSUM Test

We can learn from Figure 4-1 that the T-REITs series line does not exceed the bound lines at 5% significant level. The result suggests that the T-REITs does not have a structure change phenomenon in the study period. Therefore, the T-REITs series

does not require an adjustment. Thus, it is fine to use the original T-REITs series to do the following tests, and the results would not be distorted.

Before doing the time series estimation, the second thing we need to do is to make sure the series are stationary because only the stationary series can make the effective estimation. This study applies the unit-root test of Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) approaches to examine the stationary of all the variables in this study. We can learn from table 4-1 that T-REITs, stock price index, inflation rate, interest rate, commercial rent and commercial price can't reject the null hypothesis of having a unit-root under level value, however, all the variables reject the null hypothesis at 1st difference order, becoming stationary series. Therefore, all the variables in this study are of I(1) series.

Table 4-1 Result of Unit-root Test

	ADF test	
	Level	1st difference
T-REITs	-0.380	-4.062 ***
Stock Price Index	-0.485	-4.436 ***
Inflation Rate	-1.477	-5.114 ***
Interest Rate	-0.202	-7.668 ***
Commercial Rent	0.092	-1.803 *
Commercial Price	-0.611	-9.600 ***
	PP test	
	Level	1st difference
T-REITs	-0.353	-4.043 ***
Stock Price Index	-0.562	-4.392 ***
Inflation Rate	-1.296	-4.941 ***
Interest Rate	-0.202	-7.667 ***
Commercial Rent	1.507	-1.841 *
Commercial Price	-0.248	-17.260 ***

Note：1.Null hypothesis: The series has a unit-root.

Note：2. *, **, and *** represent significant level of 10% ,5%, and 1% respectively.

4.2 Results of Cointegration Test

In order to explore the long-run relationship between T-REITs and other variables, this study applies cointegration test to determine whether the long-run equilibrium relationship exists between T-REITs and macroeconomy as well as T-REITs and commercial real estate market. If cointegration exists in the variables, we can directly use the standard value to do the VECM estimation. However, if the variables are not cointegrated, we will apply the VAR approach to test the stationary series at first-order differential. This study applies the Trace test and Maximum Eigenvalue proposed by Johansen to examine the cointegration relationship. The Johansen cointegration test is based on the VAR approach, so the lag order of an unrestricted VAR must be determined in the first place in order to avoid the individual lag impact of inconsistencies affecting the final determination of cointegration. In this study, we use AIC and LR values to select the optimal lag order. The results can be seen from table 4-2.

Table 4-2 The Optimal Lag Order

T-REITs and Stock Price Index			T-REITs and Inflation Rate		
Lag	LR	AIC	Lag	LR	AIC
0	NA	-3.493597	0	NA	1.661338
1	137.451	-6.827504	1	109.68	-0.960493
2	19.39852	-7.161313	2	23.59547*	-1.407732*
3	2.131034	-7.031723	3	0.166688	-1.222019
4	16.42720*	-7.339041*	4	8.7205	-1.2958
T-REITs and Interest Rate			T-REITs and Commercial Rent		
Lag	LR	AIC	Lag	LR	AIC
0	NA	-2.341604	0	NA	-5.814883
1	138.5813	-5.704494	1	226.4817	-11.43163
2	17.68494*	-5.991989*	2	38.93902	-12.29356
3	3.534391	-5.902495	3	1.518963	-12.14648
4	5.433225	-5.876662	4	17.76841*	-12.49444*
T-REITs and Commercial Price					
Lag	LR	AIC	Lag	LR	AIC
0	NA	-3.512245	3	8.502966	-5.073092
1	57.68971	-4.800992	4	11.64293*	-5.235432*
2	15.17407	-5.020626			

After selecting the optimal lag order, we can carry out the Johansen cointegration test, and the results are listed in table 4-3. The results of cointegration between T-REITs and stock price index can't reject the null hypothesis of r=0 under the Trace test, but it can be rejected under Maximum Eigenvalue test, meaning that T-REITs and stock price index are cointegrated. The results of cointegration between T-REITs and commercial rent as well as T-REITs and commercial price indicate that the cointegration relationships do exist between the variables at the 5% significant level, ,meaning the variables have long-run relationship. However, the statistic values of Trace test and Maximum Eigenvalue imply that the cointegration relationships do not exist between T-REITs and inflation rate or T-REITs and interest rate at the 5% significant level, indicating that according to Johansen cointegration test, T-REITs and inflation rate as well as T-REITs and interest rate are not cointegrated.

Therefore, the discussion of long-run equilibrium relationship among T-REITs, macroeconomic and commercial real estate market shows that the equilibrium relationship exists only in T-REITs and the stock price index, T-REITs and commercial rents, as well as T-REITs and commercial price, meaning there is a long-run stability movement between T-REITs and those three variables. Interestingly, the result in this study suggests that T-REITs and stock price index are cointegrated, which is contrary to other relevant domestic results. The possible answer may be that the previous study period only contains the first two to three years information of T-REITs, so the cointegration results were not significant. In this study, we obtain four years information, so the long-run relationship becomes significant.

Table 4-3 Results of Cointegration Test

T-REITs and Stock Price Index						
Null hypothesis : No. of CE(s)	Trace Statistic	0.05 Critical Value	Prob.	Max-Eigen Statistic	0.05 Critical Value	Prob.
r=0	25.5522	25.87211	0.0547	22.39063	19.38704	0.0178**
r≦1	3.16159	12.51798	0.8568	3.161591	12.51798	0.8568
T-REITs and Inflation Rate						
Null hypothesis : No. of CE(s)	Trace Statistic	0.05 Critical Value	Prob.	Max-Eigen Statistic	0.05 Critical Value	Prob.
r=0	15.9394	25.8721	0.4974	11.8301	19.3870	0.4311
r≦1	4.1093	12.5180	0.7262	4.1093	12.5180	0.7262
T-REITs and Interest Rate						
Null hypothesis : No. of CE(s)	Trace Statistic	0.05 Critical Value	Prob.	Max-Eigen Statistic	0.05 Critical Value	Prob.
r=0	15.3827	25.8721	0.5429	13.3592	19.3870	0.2999
r≦1	2.0236	12.5180	0.9672	2.0236	12.5180	0.9672
T-REITs and Commercial Rent						
Null hypothesis : No. of CE(s)	Trace Statistic	0.05 Critical Value	Prob.	Max-Eigen Statistic	0.05 Critical Value	Prob.
r=0	33.1480	25.8721	0.0052**	26.4742	19.3870	0.0039**
r≦1	6.6738	12.5180	0.3798	6.6738	12.5180	0.3798
T-REITs and Commercial Price						
Null hypothesis : No. of CE(s)	Trace Statistic	0.05 Critical Value	Prob.	Max-Eigen Statistic	0.05 Critical Value	Prob.
r=0	30.1791	25.8721	0.0136**	23.5554	19.3870	0.0117**
r≦1	6.6237	12.5180	0.3854	6.6237	12.5180	0.3854

According to the cointegration results of T-REITs and other variables, they confirm the equilibrium relationship exists in T-REITs and the stock price index, T-REITs and commercial rents, as well as T-REITs and commercial price. Among them, although the statistic of T-REITs and the stock price index is at significant value only under Trace test, we still view the variables as cointegrated. The results indicate that even if the short-term changes are different between variables, but eventually they will return to a long-term equilibrium value. The results also show that T-REITs and inflation rate, and T-REITs and interest rate are not cointegrated, implying the inflation and interest rates do not have a single long-term impact on T-REITs.

Comparing the cointegration results and the Figure 3-2 and 3-6, the suggesting of the long-run relationship from the linear trend between T-REITs and stock price index as well as T-REITs and commercial price consist with the cointegration results. The result also indicates that the inflation rate does not cointegrate with T-REITs, which is the same result as we suggest.

We could not determine whether T-REITs have long-run relationship with interest rate and commercial rent from Figure 3-3 and 3-4, but the trends of the variables are similar. In Table 4-3 we confirm that T-REITs and interest rate are not cointegrated, but T-REITs are cointegrated with commercial rent.

4.3 Results of Vector Error Correction Model

According to the cointegration results in sector 4.2, we can conclude the long-run equilibrium relationship exists in T-REITs, stock price index, commercial rent and commercial price. To explore the short-run changes under cointegration condition, it would take advantage of VECM analysis. The most important thing of VECM is to understand the long-term equilibrium value adjusting speed between variables. This sector will illustrate the VECM results between T-REITs and stock price index, T-REITs and commercial rent as well as T-REITs and commercial price.

In Table 4-4, under the cointegration between T-REITs and stock price index when T-REITs is the dependent variable, the parameter at lag one of T-REITs and at lag one and three of stock price are significant, implying the current T-REITs are affected by lag one T-REITs and lag one and three stock price. The result also shows T-REIT and stock price are positive correlated, which supports the past conclusion that REITs and stocks are positive. We can also learn from the portfolio theory that when the investors benefit from the stock markets, they will transfer part of the funds to invest in other financial products in order to achieve the purpose of risk diversification. Also based on the theory of wealth effects, the real estate market will be the first choice when investors want to invest in other markets, and REITs can act as a proxy for real estate market. Therefore, the positive correlation also confirms the wealth effect existed between T-REITs and stock price.

Under the cointegration between T-REITs and commercial rent when T-REITs is the dependent variable, the parameter at lag one to three of T-REITs and at lag three of commercial rent are significant, suggesting the current T-REITs are affected by lag one to three T-REITs and lag three commercial rent. Because the commercial rents are on a quarterly basis, in this study three periods is about a quarter, implying the last quarter commercial rent changes impact the current T-REITs. This result shows commercial rent changes are positive to T-REITs, which confirms the positive correlation between REITs and rent in previous studies.

Under the cointegration between T-REITs and commercial price when T-REITs is the dependent variable, the parameter at lag one and three of T-REITs and at lag one and two of commercial price are significant, suggesting the current T-REITs are

affected by lag one and three T-REITs and lag one and two commercial price. In addition, the impact of commercial price to T-REITs is negative, indicating that when the real estate market is at prosperity, the investors will choose to invest in the real property rather than the substitute financial products. Therefore, investors will invest in commercial real estate products directly when rises, and the investment in REITs is relatively reduce, resulting in T-REITs price decrease. When commercial price decreases, the investors will look forward to the development if T-REITs, and choose to invest in T-REITs rather than the real products, making T-REITs price rises.

In the adjusting speed, if the test results of the factor (CE1) is significant, indicating an error correction term is not 0 and a deviation from the long-run equilibrium value exists. At this point, the series will return to long-run equilibrium value will be a specific rate of adjustment. When the coefficient is not significant, the deviations will not be adjusted immediately, but over time, it will ultimately be adjusted towards the long-term equilibrium value. In this study, the adjusting speed for T-REITs and stock price index, T-REITs and commercial rent as well as T-REITs and commercial price are 33%, 54%, 42%, respectively. The adjustment rate between T-REITs and commercial rent is the highest, the reason might be that the rent value directly affect the total revenue of the investment and thereby affect the REITs price. So the T-REITs price could quickly adjust to the equilibrium value when it moves away from the value.

The results suggest that the current T-REITs are not only affected by itself, but also the past stock price, commercial rent and commercial price. Surprisingly, the lag three stock price, commercial rent and commercial price are still impact the current T-REITs. We believe the possible reasons are (1) The inconsistency of the data basis. Because the result can only reflect the information of the past quarter when using the quarter rent data to do the test. Therefore, the result shows T-REITs is affected by lag three rent. (2) Subject to the impact of agency problems, making the information reflected by T-REITs prices is limited. The current T-REITs managers are not the impartial and objective third party but the originators, so it is easy to operate by the impact of the managers and generate the agency problems. This will limit the ability of T-REITs reflecting the market information, and thereby affect T-REITs price volatility. Therefore, the T-REITs price fluctuations arising from the impact of other markets will be delayed. (3) The T-REITs market is still inefficient so that the

T-REITs price changes speed to the economic changes is slow. Thus, the T-REITs price changes response to economic variables is at limit speed.

Table 4-4 Results of VECM

Dependent variable △REITs

Stock Price Index			Results of commercial properties (rent)			Results of commercial properties (price)		
Variables	Coefficient	t-value	Variables	Coefficient	t-value	Variables	Coefficient	t-value
CE1	-0.3270 ***	-2.4773	CE1	-0.5441 ***	-4.2243	CE1	-0.4184 **	-2.1321
△REITs(-1)	0.6943 ***	3.8371	△REITs(-1)	0.8488 ***	6.2951	△REITs(-1)	0.8754 ***	4.3633
△REITs(-2)	-0.0785	-0.3384	△REITs(-2)	0.3408 **	1.7592	△REITs(-2)	-0.0829	-0.3224
△REITs(-3)	0.3171	1.2929	△REITs(-3)	0.6423 ***	3.1898	△REITs(-3)	0.7051 ***	2.5625
△REITs(-4)	0.0658	0.2514	△REITs(-4)	0.1527	0.6255	△REITs(-4)	0.0650	0.2076
△STOCK(-1)	0.0027 **	1.8089	△CRENT(-1)	-0.0867	-1.2406	△CPRICE(-1)	-0.2343 *	-1.6260
△STOCK(-2)	-0.0013	-0.9398	△CRENT(-2)	-0.0327	-0.4317	△CPRICE(-2)	-0.2356 **	-2.1107
△STOCK(-3)	0.0034 ***	2.4297	△CRENT(-3)	0.2739 ***	3.4305	△CPRICE(-3)	-0.0996	-1.0312
△STOCK(-4)	0.0007	0.4823	△CRENT(-4)	-0.0936	-1.1154	△CPRICE(-4)	-0.0279	-0.3637
C	-0.0232	-0.0498	C	-0.4254	-0.7314	C	-0.1604	-0.3258
R-squared	0.4982		R-squared	0.7140		R-squared	0.4392	
Adj. R-squared	0.3525		Adj. R-squared	0.6309		Adj. R-squared	0.2764	

Note 1: △represents series at 1st differential order

Note 2: *, **, and ***represent significant level of 10% , 5%, and 1% respectively.

4.4 Results of Vector Autoregression

In section 4.2 we can know that the T-REITs do not cointegrate with inflation rate and interest rate. In order to explore the short-run relationship between T-REITs and inflation rate as well as T-REITs and interest rate, this study applies the VAR approach to discuss the short-run movements. According to Table 4-5, when T-REITs are the dependent variables, the lag two inflation rate is significant to the current T-REITs, and the lag one and two interest rate impact on T-REITs are not significant. The lag one and two T-REITs are significant to the current T-REITs, implying T-REITs are still significantly affected by its own prices.

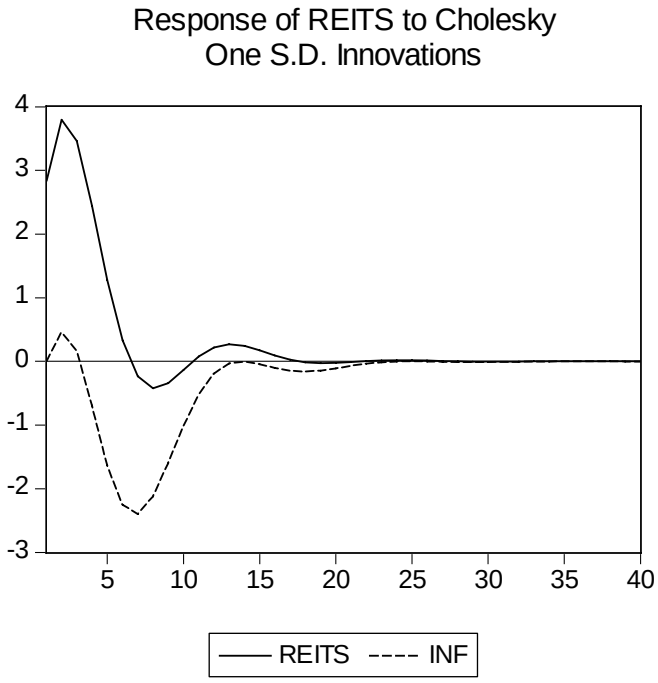
Table 4-5 Results of VAR

Dependent variable REITs

Inflation Rate				Interest Rate			
Variables	Coefficient		t-value	Variables	Coefficient		t-value
REIT(-1)	1.3378	***	10.4457	REIT(-1)	1.3651	***	9.4693
REIT(-2)	-0.5698	***	-4.0964	REIT(-2)	-0.5424	***	-3.3679
INF(-1)	0.5169		1.0568	INT(-1)	-1.7966		-0.3210
INF(-2)	-1.0899	**	-2.2022	INT(-2)	0.1975		0.0357
C	25.1080	***	3.4372	C	22.3653	***	2.5134
R-squared	0.8699			R-squared	0.8477		
Adj. R-squared	0.8566			Adj. R-squared	0.8321		

Note 1: *, **, and *** represent significant level of 10% 、5%、 1% respectively

In addition to the use of VAR approach to explore the short-run movements, this study also applies Impulse Response Function and variance decomposition to analyze the relations between the variables. The impulse response function defines as the impact response direction and influence length through time, and to illustrate the impact of relevant variables of the dynamic process. While the impulse response function traces the shock effects of one endogenous variable on to other variables in VAR, variance decomposition provides the information about the relative importance of each random innovation in affecting the variables in VAR and the growth and decline of the variables.



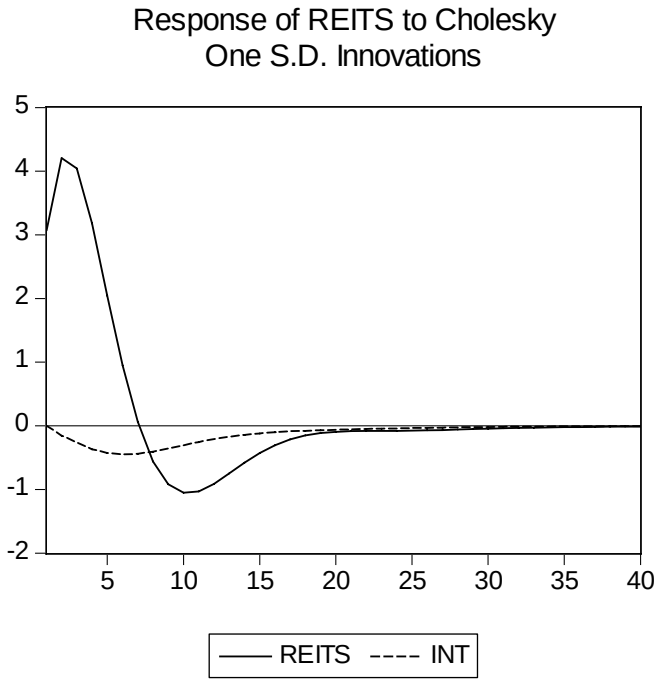


Figure 4-2 The Impulse Response of T-REITs

Figure 4-1 suggests the unintended impact of inflation rate on T-REITs changes in the same direction, but the impact is only significant when inflation rate declines. The influence is strong between period 5 to 10, and the impact declines after that. Compared to the inflation rate, the unintended impact of interest rates on T-REITs

moves in the different direction, but the impact of interest rate is not significant. The impact of T-REITs its own is still more obvious, and the influence gradually disappear after a period of time.

Table 4-6 The Variance Decomposition of T-REITs

Period	S.E.	REITS	INF	Period	S.E.	REITS	INT
1	2.83	100.00	0.00	1	3.07	100.00	0.00
5	6.74	92.56	7.44	5	7.62	99.29	0.71
10	8.05	65.60	34.40	10	7.88	98.08	1.92
15	8.08	65.40	34.60	15	8.08	97.90	2.10
20	8.09	65.32	34.68	20	8.09	97.86	2.14
25	8.09	65.31	34.69	25	8.09	97.85	2.15
30	8.09	65.31	34.69	30	8.09	97.84	2.16
35	8.09	65.31	34.69	35	8.09	97.84	2.16
40	8.09	65.31	34.69	40	8.09	97.84	2.16

Table 4-6 is the result of the variance decomposition, in this study, every 5 months is an observation point, and there are a total of 40 observation points to be analyzed. The result suggests the inflation rate can explain approximately about 35% of the T-REITs forecast variance, and the interest rate can merely explain about 2%. This implies in the power of T-REITs interpretation, the inflation rate is greater than the interest rate, therefore, we inference that the interest rate might not significantly affect the general T-REITs performance.

In general, in the short-run relationship among T-REITs, inflation rate and interest rate, the current T-REITs price is still significantly affected by its past performance. The inflation rate has stronger explanatory power to the short-run T-REITs movement, and it has positive correlation to the T-REITs implying T-REITs can be a hedge against inflation even though the inflation only significantly affect T-REITs when it declines. The explanatory power of interest rate to T-REITs is relatively low, which may due to the small volatility of interest rate in the study period, therefore, interest rate is less relevant to T-REITs in this study. In addition, the result of the impulse response indicates that interest rate has negative correlation to T-REITs changes. In this study, the inflation rate is more suitable to predict the T-REITs movements rather than interest rate because the impact of interest rate is not significant during the study period.

4.5 Results of Granger Causality Test

This study applies the Granger causality test to determine whether the lead/lag relation exists between T-REITs and other variables. It is worth noting that if the cointegration relationship exists between the variables, it requires the series with the error correction term to do the test; the variables without cointegratoin relationship should base on VAR approach, using series at first-order differential to do the test.

Table 4-7 Result of Causality with Cointegration

	Dependent variable			
Independent variable	T-REITs	Stock Price Index	Commercial Rent	Commercial Price
T-REITs	—	5.0730	10.9451***	11.0322***
Stock Price Index	9.3919**	—	—	—
Commercial Rent	15.1868***	—	—	—
Commercial Price	5.6052	—	—	—

Note1: This study conducted VEC Granger Causality/Block Exogeneity Wald Tests

Note2: Figures in the table are Chi-square statistic，*, **, and *** represent significant level of 10% , 5%, and 1% respectively.

Table 4-8 Result of Causality with VAR approach

	Dependent variable		
Independent variable	T-REITs	Inflation Rate	Interest Rate
T-REITs	—	0.2991	18.1340***
Inflation Rate	7.3282***	—	—
Interest Rate	0.5765	—	—

Note1: This study conducted VAR Granger Causality/Block Exogeneity Wald Tests

Note2: Figures in the table are Chi-square statistic，*, **, and *** represent significant level of 10% , 5%, and 1% respectively.

Table 4-7 shows that after the cointegrated series added error correction term, the result rejects the hypothesis that stock price index does not Granger cause T-REITs at 5% significant level, implying stock price index change leads T-REITs volatility. In addition, based on the wealth effect theory, when investors gain more profits in the stock market, they will further invest in other markets, and real estate market is considered to be a good investment target. REITs will serve as a substitute for the real estate market indicators. Therefore, according to the result that stock index will lead T-REITs price volatility, combined with the positive co-movement presented in Table

4-4, confirming the existence of a wealth effect between the stock market and real estate markets.

In the relationship between T-REITs and commercial rent, the result rejects the hypothesis that commercial rent does not Granger cause T-REITs at 1% significant level, and it also rejects that T-REITs do not Granger cause commercial rent, implying the feedback relationship exists between T-REITs and commercial rent. According to the lately market performance, T-REITs are affected by the slow recovery of overall economic, and the commercial rent may decline, thereby affecting the future of T-REITs price may fall. This shows that the commercial rent leads T-REITs. On the other hand, when investors are optimistic about the future economic growth, they will invest in the T-REITs market for the anticipating rising rent. The investors Look forward to the rising T-REITs price affected by the high rent, and obtain higher returns. Therefore, the feedback relationship does exist between T-REITs and commercial rent.

In the relationship between T-REITs and commercial price, the result rejects the hypothesis that T-REITs does not Granger cause commercial price at 1% significant level, therefore, the changes of T-REITs lead the changes of commercial price.

Table 4-8 represents the result of causality with VAR approach. The result the result rejects the hypothesis that inflation rate does not Granger cause T-REITs at 1% significant level, indicating that inflation rate leads T-REITs. According to Figure 4-1, T-REITs and inflation rate are positive correlated, thus the T-REITs could be seen as a hedge against inflation. The result between T-REITs and interest rate rejects the hypothesis that T-REITs do not Granger cause interest rate at 1% significant level, implying that T-REITs lead interest rate changes.

To summarize the causality results, stock price index and inflation rate Granger cause T-REITs, suggesting that the movements of current stock price and inflation rate will affect the performance of T-REITs. The feedback relationship between T-REITs and commercial rent implying that the price changes will affect each other. Therefore, the stock price index and inflation rate can act as a leading indicator of T-REITs volatility, and the feedback relationship suggests that commercial rent can serve as a indicator when forecasting the T-REITs price. The investors can take advantage of these indicators to forecast the T-REITs volatility as a reference when making

investment decisions.

Chapter 5 Conclusions and Discussion

5.1 Conclusions

It has been five years since the first T-REITs launched in 2005, but most literature regarding T-REITs focus on legal system and institutional framework. There is still insufficient discussion regarding the performance of T-REIT markets. Therefore, this study intends to explore the T-REITs performance and the relationship among T-REITs, macroeconomic variables and commercial real estate market.

This study first constructs longer T-REITs index to demonstrate the T-REITs price movement and market performance, including all 8 issued T-REITs. Through the T-REITs index, we can learn that there is a stable growth trend for T-REITs when the first 6 T-REITs were intensively distributed, and there is an obvious life cycle after 2006. In addition, the overall performance of T-REITs usually reaches the pick around March each year. The reason might be the prosperous trading in real estate market during March, which is called the 329 schedule. During study period, T-REITs experience poor performance of Trident and Kee Tai Star, thereby affecting their overall performance. Moreover, the U.S. subprime mortgage in 2007 also lead to T-REITs' sluggish performance.

In addition, this study examines the long-run relationship among T-REITs, macroeconomic variables and commercial real estate markets. The first step is to determine whether cointegration exists between T-REITs and other variables. Results suggest that the equilibrium relationship exists between T-REITs and the stock price index, T-REITs and commercial rents, as well as T-REITs and commercial price. Moreover, the stock price index and commercial rent are positively correlated to T-REITs, and the commercial price is negatively correlated to T-REITs. T-REITs and inflation and T-REITs and interest rate are not cointegrated, implying that inflation and interest rate only have short-run effect on T-REITs. However, inflation rate is positively correlated to T-REITs, and the interest rate is negatively correlated to T-REITs, which is consistent with practical experiences. Interestingly, results in this study suggest that T-REITs and stock price index are cointegrated, which is contrary to other relevant domestic results. The possible answer may be that the study period in this study is longer than previous studies, and the long-run relationship just begins to

emerge.

According to the Granger causality results, the stock price index and inflation rate can act as a leading indicator of T-REITs volatility, and the commercial rents can also serve as an indicator. Investors may employ those indicators to forecast the T-REITs volatility for investment decision making.

In conclusion, through the observation of different interaction between T-REITs and other markets can understand price fluctuations and future market trend. This study also finds that the wealth effect does exist between T-REITs and stock price, and that T-REITs can serve as hedging goods. However, the T-REITs price and return changes could be affected by agency problems, thereby affecting T-REITs actual market performance.

5.2 Limitations

The limitation in this study is the time length. Since there have only been five years the T-REITs launched, using the cointegration test can show that whether T-REITs are cointegrated with other variables, but the time length is not long enough to conclude the general long-run relationship. In addition, the commercial rents in this study are not monthly data, which might generate some bias when analyzing the relations between variables.

5.3 Recommendations for Further Research

The variables in this study are the basic effects in the macroeconomic and real estate markets, the further research can try to add the T-REITs volumes in the analysis, and find out the relationship between T-REITs' price and volume. If the daily data can be found in the macroeconomic variables, applying the daily information to discussion the relationship among T-REITs and other variables could be more convincing. Furthermore, the REITs market in Asia is under continuous growth and prosperity, however, the national economy and the real estate market structure are different. So this study suggests that except for continuous observation of T-REITs, the REITs performance between Taiwan and other Asian countries should also be analyzed to investors a cross-border investment reference.

References

Adrangi, B., Arjun Chatrath and Kambiz Raffiee, 2004, "REIT Investment and Hedging Against Inflation", Journal of Real Estate Portfolio Management, 10:2

Allen, M. T., Jeff Madura, and Thomas M. Springer, 2000, "REIT Characteristics and the Sensitivity of REIT Returns", Journal of Real Estate Finance and Economics, 21:2, 141-152

Benjamin, J. D., Peter Chinloy and G. Donald Jud, 2004, " Real Estate Versus Financial Wealth in Consumption ", Journal of Real Estate Finance and Economics, 29:3, 341-354

Bredin, D., Gerard O'Reilly and Simon Stevenson , 2007, " Monetary Shocks and REIT Returns", Journal of Real Estate Finance and Economics, 35:315–331

Campbell, R. D., Milena Petrova and C. F. Sirmans, 2003, " Wealth Effects Diversification and Financial Deal Structing : Evidence from REIT Property Portfolio Acquisitions", Real Estate Economics, 31:3, 347-366

Chatrath, A. and Youguo Liang, 1998, " REITs and Inflation: A Long-Run Perspective", Journal of Real Estate Research, 16:3, 311-325

Chaudhry, M. K. , F. C. Neil Myer and James R. Webb, 1999, " Stationarity and Cointegration in Systems with Real Estate and Financial Assets", Journal of Real Estate Finance and Economics,18:3, 339-349

Chen, K. C., Daniel D. Tzang, 1988, "Interest-Rate Sensitivity of Real Estate Investment Trust" , The Journal of Real Estate Research, 3:3, 13-22

Clayton, J. and Greg Mackinnon, 2003, " The Relative Importance of Stock, Bond and Real Estate Factors in Explaining REIT Returns", Journal of Real Estate Finance and Economics,27:1, 39-60

Downs, D. H., Z. Nuray Guner, David J. Hartzell and Michanel A. Torres, 2001, " Why Do REIT Price Change? The Information Content of Barron's The Ground Floor", Journal of Real Estate Finance and Economics, 22:1, 63-80

Engle, R. F. and Granger, C. W. J., 1987, "Cointegration and Error Correction Representation, Estimation and Test", Econometrica, 55:2, 251-273

Fama, E. F. and G. William Schwert, 1977, " Asset Returns and Inflation", Journal of Financial Economics, 5:2, 115-146

Giliberto, S. M., 1990, "Equity Real Estate Investment Trusts and Real Estate Returns", The Journal of Real Estate Research,5:2, 259-263

Glascoca, J. L., Chiuling Lu, Raymond W. So , 2002 ," REIT Returns and Inflation: Perverse or Reverse Causality Effects ? ", Journal of Real Estate Finance and Economics, 24:3, 301-317

Johansen, S., 1988, " Statistical Analysis of Cointegration Vectors " , Journal of Economic Dynamics and Control, 12:231-254

Johnl. G., Chingling Lu and Raymond W. So, 2000, "Further Evidence on the Integration of REIT, Bond, and Stock Returns", Journal of Real Estate Finance and Economics, 20:2, 177-194

Kuhle, J. L., 1987, " Portfolio Diversification and Return Benefits－Common Stock vs. Real Estate Investment Trusts(REITs)", The Journal of Real Estate Research, 2:2, 1-9

Larsen, A.B. and Grant R. Mcqueen, 1995, " REITs, Real Estate, and Inflation: Lessons from the Gold Market", Journal of Real Estate Finance and Economics, 10:285-297

Lee, B. S., 1992, "Causal Relations Among Stock Returns, Interest Rate, Real Activity, and Inflation", The Journal of Finance, 4, 1591-1603

Lee, M. L., Ming-Te Lee, and Kevin C. H. Chiang, 2008, "Real Estate Risk Exposure of Equity Real Estate Investment Trusts", Journal of Real Estate Finance and Economics, 36:165-181

Li, Y. and Ko Wang, 1995, "The Predictability of REIT Returns and Market Segmentation", The Journal of Real Estate Research, 10:4, 471-482

Liang, Y., Arjun Chatrath, and Willard McIntosh, 1996, "Apartment REITs and Apartment Real Estate", The Journal of Real Estate Research, 11:3, 277-289

Liang, Y., McIntosh W. and Webb J. R., 1995, "Intertemporal Changes in the Riskiness of REITs", The Journal of Real Estate Research, 10:4, 427-443

Ling, D. and A. Naranjo, 1997, "Economic Risk Factors and Commercial Real Estate Returns", The Journal of Real Estate Finance and Economics, 14: 283–307

Ling, D. and Andy Naranjo, 2003, " The Dynamics of REIT Capital Flows and Returns", Real Estate Economics, 31:3, 405-434

Ling, D. C. and Andy Naranjo, 1999, "The Integration of Commercial Real Estate Markets and Stock Markets", Real Estate Economics, 27:3, 483-515

Ling, D. C. and Andy Naranjo, 2006, " Dedicated REIT Mutual Fund Flows and REIT Performance", Journal of Real Estate Finance and Economics, 32:409-433

Liu, C. H. and Jianping Mei, 1992, " The Predictability of Returns on Equity REITs

and Their Co-Movement with Other Assets", Journal of Real Estate Finance and Economics, 5:401-418

Liu, C. H., David J. Hartzell, Wylie Greig and Terry V. Grissom, 1990, " The Integration of the Real Estate Market and the Stock Market: Some Preliminary Evidence", Journal of Real Estate Finance and Econmics, 3:261-282

Lu, C. and Raymond W. So, 2001, " The relationship between REITs returns and inflation a vector error correction approach", Review of Quantitative Finance and Accounting, 16, 103–115

Markowitz, H., 1952, " Portfolio Selection", The Journal of Finance, 7:1, 77-91

McCue, T. and J. Kling, 1994, "Real Estate Returns and the Macroeconomy: Some Empirical Evidence from Real Estate Investment Trust Data, 1972–1991", Journal of Real Estate Research, 9: 277–287.

Mueller, G. R., Keith R. Pauley, 1995, " The Effect of Interest-Rate Movements on Real Estate Investment Trusts", The Journal of Real Estate Research, 10:3, 319-325

Myer, F. C. N. and James R. Webb, 1993, " Return Properties of Equity REITs, Common Stocks, and Commercial Real Estate: A Comparison", The Journal of Real Estate Research, 8:1, 87-106

Myer, F. C. N. and James R. Webb, 1994, "Retail Stocks, Retail REITs and Retail Real Estate", The Journal of Real Estate Research, 9:1, 65-84

Nasseh, A. and Jack Strauss, 2000, " Stock prices and domestic and international macroeconomic activity: a cointegration approach", The Quarterly Review of Economics and Finance, 40:229-245

Nie and Zheng, 2000, " The Linear and Nonlinear Interactions between Stock Price and Real Estate Price in Taiwan" , Journal of the Land Bank of Taiwan, 37:1, 29-45

Okunev, J. and Patrick J. Wilson, 1997, " Using Nonlinear Test to Examine Integration Between Real Estate and Stock Market", Real Estate Economics, 25:3, 487-503

Ooi, J. T. L., Graeme Newell and Tien-Foo Sing , 2006 ," The Growth of REIT Markets in Asia", Journal of Real Estate Literature, 14:2, 203-222

Park, J. Y., Donald J. Mullineaux, It-Keong Chew, 1990, " Are REITs Inflation Hedges? ", Journal of Real Estate Finance and Economics, 3:91-103

Peterson, J. D. and Cheng-Ho Hsieh, 1997, "Do Common Risk Factors in the Returns on Stocks and Bonds Explain Returns on REITs?" , Real Estate Economics, 25:2,

321-345

Poterba, J. M., 2000, " Stock Market Wealth and Consumption", Journal of Economic Perspectives, 14:2, 99-118

Quan, D. C. and Sheridan Titman, 1999, "Do real estate prices and stock prices move together：An international analysis", Real Estate Economics, 27:2, 183-207

Simpson, M. W., Sanjay Ramchander and James R. Webb, 2007, " The Asymmetric Response of Equity REIT Returns to Inflation", Journal of Real Estate Finance and Economics, 34:513–529

Swanson, Z., John Theis, and K. Michael Casey, 2002, "REIT Risk Premium Sensitivity and Interest Rates", Journal of Real Estate Economics and Finance, 24:3, 319-330

Tracy, J., Henry Schneider and Sewin Chan, 1999, " Are Stocks Overtaking Real Estate in Household Portfolios ? ", Current Issues in Economics and Finance, 5:5, 1-6

Wang, 2007, " The Effect of Inflation and Unemployment on Real Estate Investment Trusts", Department of Finance, Providence University Master Thesis

Westerheide, P., 2006, "Cointegration of Real Estate Stocks and Reits with Common Stocks, Bonds and Consumer Price Inflation", ZEW - Centre for European Economic Research Discussion Paper No. 06-057

Wilson, P. J. and John Okunev, 1999, " Long-Term Dependencies and Long Run Non-Periodic Co-Cycles: Real Estate and Stock Market", Journal of Real Estate Research, 18:2, 257-278

Yobaccio, E., Jack H. Rubens and David C. Ketcham, 1995, "The Inflation-Hedging Properties of Risk Assets: The Case of REITs", The Journal of Real Estate Research, 10:3, 279-296

Zheng and Chang, 2007, " The Performance of T-REITs and the Portfolio", The 16 th Annual Symposium, Chinese Society of Housing Studies

Zheng, 2008, " Performance Comparison and Interrelationship between the US and Asia REITs Indices", Department of Finance, National Sun Yat-sen University Master Thesis