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THE UNIVERSITY OF HONG KONG

**COINTEGRATION BETWEEN HONG KONG COMMERCIAL
REAL ESTATE AND PROPERTY STOCKS:
PRE- AND POST- 1997 EVIDENCE**

**A DISSERTATION SUBMITTED TO THE
FACULTY OF ARCHITECTURE
IN CANDIDACY FOR THE DEGREE OF
BACHELOR OF SCIENCE IN SURVEYING**

DEPARTMENT OF REAL ESTATE AND CONSTRUCTION

**BY
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**HONG KONG
APRIL 2004**

DECLARATION

I declare that this dissertation represents my own work except where due acknowledgment is made, and that it has not been previously included in a thesis, dissertation or report submitted to this University or to any other institution for a degree, diploma, other qualification.

Signed: _____

Name: _____

Date: _____

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ABSTRACT

This study examines the long-term relationship between commercial real estate and property stocks in Hong Kong over the period 1986-2003. Real estate plays an important role in every economy and Hong Kong is particularly so due to its historical background. Investing in commercial real estate is a form of direct real estate investment and indirect real estate investment commonly include REITs in US, UK, Australia etc. and property stocks, while in Hong Kong it consists primarily of property stocks. Studying the relationship between direct and indirect real estate is important for the questions whether indirect real estate is a good proxy for direct real estate, and whether or not diversification by including direct property in portfolio can be achieved in the long run. Studies in foreign context, however, provides mixed evidence for the existence of long-run equilibrium relationship between the two markets. The Asian Financial Crisis which took place in 1997 hit seriously both the direct real estate market and property stock market in Hong Kong. Some investors may worry that contagion effect takes place between the two markets and correlation between them will be increased. The effect of 1997 financial crisis on the long-term relationship between the two markets is important question to investors, especially the institutional investors who are more concerned about long-term investment strategy. The question can be addressed by dividing the study period into two sub periods: pre- and post- 1997.

Co-integration tests are carried out to analyse the relationship between the commercial real estate and property stock markets in Hong Kong. The results of this test suggest that the long-run equilibrium relationship does not exist between the commercial

real estate and property stocks in Hong Kong and that the Asian Financial Crisis does not have effect on the long-term relationship between the two markets. Several reasons are proposed in this study to explain the lack of such relationship, namely presence of endogeneous factors, the fact that property companies are not pure plays in the Hong Kong market and the property sector (they are actually conglomerates), and that the series representing commercial real estate (COM) does not represent all kind of property investment of the property companies. The results can have great implication to potential and existing investors in terms of their long-term investment strategy. Another importance of the study is that a framework is provided for investigating co-integration between real estate and other financial assets, and the same procedure can be applied to investigate the long-term relationship between direct and indirect real estate when REITs are implemented and time is sufficiently long.

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CHAPTER ONE

INTRODUCTION

1.1 Background

Hong Kong is a major international financial centre. According to the official data of HKSAR government which quotes information from the World Federation of Exchanges (WFE)¹, stock market of Hong Kong was the eighth largest in the world and the second largest in Asia in terms of market capitalization as at the end of September 2003.

The property sector is a very important sector in the structure of the Hong Kong economy. In 1996, the real estate and construction sector contributed about 15% of Gross Domestic Product (GDP) of Hong Kong according to official statistics (but according to Hang Seng Economic Monthly, property and construction sector contributed approximately 32% in 1996). Given the special importance of real estate in Hong Kong, the cost of transacting real estate and its relative illiquidity compared with financial assets, knowing the nature of linkages between different types of real estate and between real estate and financial assets can provide useful information to many investors. Real estate professionals frequently seek suitable hedging vehicles to reduce their exposure to real

¹ See Securities and Futures Commission <<http://www.hksfc.org.hk>> under the section “International Market Comparisons”.

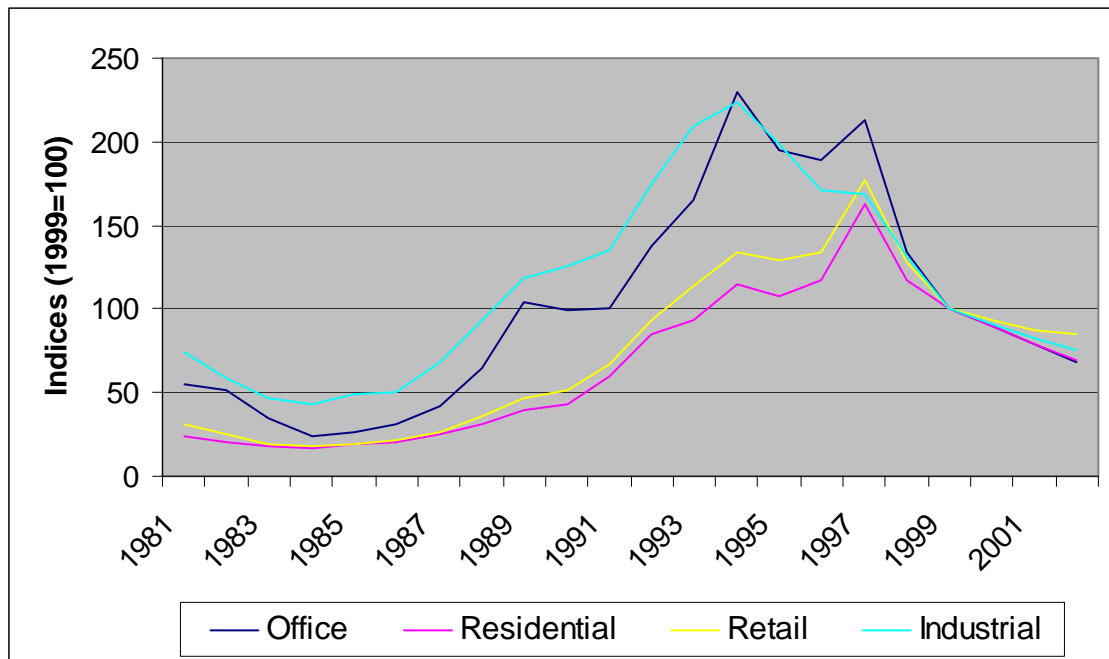
estate, while investors, including institutions, evaluate the usefulness of real estate as investment and diversification tools. For example, they may provide the institutional investors with cross-hedging opportunities. Some institutional investors invested in direct real estate may use returns in indirect real estate as a proxy of returns for direct real estate. On the other hand, some hypothesize that the property stocks are more integrated with the stock market for they can see direct real estate and property stocks display low correlations. They invest in both direct and indirect real estate for diversification purpose. Understanding the relationship between the two markets can make it clear whether or not diversification can be achieved. This question can be addressed by investigating the long-term relationship between direct and indirect real estate. Studies on relationship between the two markets are dominant on both diversification and price discovery. Price discovery refers to the process by which asset market prices are formed. In real estate, price discovery is studied on direct and indirect real estate (Giliberto, 1990, 1993; Sagalyn, 1990; Barkham and Geltner, 1995; Chau et al., 2001). Obviously, they are important issues to institutional investors.

Ironically, little work have been done on the long-term relationship between the two important markets in local context. Chau and Newell (1996) examine the linkages between property company and commercial property performance in Hong Kong over 1984-1994. A one quarter lag is observed, with evidence of a “pure” property factor (as per Giliberto (1990)) seen in several property companies. However, they did not investigate the long-term relationship. Chau et al. (2001) study the price discovery

between direct and indirect property in Hong Kong but they only take into account of the short-term relationship between the two investments.

The Asian financial crisis occurred at late 1997 hit seriously the property market in Asia. For instance, the purchase price of housing in Korea dropped by 12.6 percent and the construction of new houses decreased by 48.7 percent in 1998.² In Hong Kong the price of the residential property dropped by a half and the price of the commercial property dropped even more. We can see from Figure 1-1 that the prices of different types dropped significantly from the peak.

Figure 1-1: Property price indices by type of premises



Source: Rating and Valuation Department

² See Kim (2000)

Hong Kong is a major international financial centre but was the least affected after the Asian Financial Crisis when compared with many other Asian economies. Property market and stock market are the two most important asset markets in Hong Kong. And despite the fact that the two markets suffered a serious hit, they remain to be the focus of investors given their high capital value and favourable investment conditions of Hong Kong. With the downturn of the property market in Hong Kong and the rise of illiquidity problem, understanding the relationship between direct and indirect property investment became even more important to institutional investors. From a theoretical perspective, the presence of a common 'real estate' factor might be expected as the major underlying asset of most indirect property vehicles is property (Gilberto, 1990). While the Asian Financial Crisis was a disastrous event to both the direct and indirect property markets in Hong Kong, one possible concern was a contagion effect where the occurrence of crisis in one market can increase the probability of a similar crisis in another market. In an environment where contagion exists, a negative shock in one market would be followed by an increase in correlations so that the two markets become more integrated, undermining the rationale for diversification. It is thus prudent to examine if there is change of the linkage between the two markets. Any change of the long-run relationship between the direct and indirect real estate can have great implication to investment strategy of institutional investors.

Research on Hong Kong property stocks has not been as extensive as in the US and UK. Few researches were done on examining the characteristics and performance of property stocks in Hong Kong. To examine these linkages the nature of the underlying

data used needs to be established. This study investigates the inter-relationship between the Hong Kong direct and indirect property markets over a period from 1986 to 2003; the time-frame of the investigation is divided into two sub-periods covering the pre- and post- 1997 Asian Financial Crisis.

1.2 Scope of study and objectives

The main focus of this dissertation is the long term relationship between direct and indirect real estate in Hong Kong. The question of whether the 1997 financial crisis has any effects on the long-run relationship between the two markets will also be addressed. The study period covers from quarter one in 1986 to quarter two in 2003 so that the market cycle of declining period and recovery is covered. Among the four main types of properties in Hong Kong (office, residential, retail and industrial), only the office market is studied. Commercial real estate is often regarded as a good candidate to be included in multi-asset portfolio for they can generate income. The existence or absence of the long-term relationship has great implication to institutional investors to make investment in a portfolio context.

Under this theme, the objectives of this study can be summarized into the following three main aspects:

- 1) To review the characteristics and the performance of the direct and indirect real estate market in Hong Kong

- 2) To examine if a long-term relationship between direct and indirect property exists, also with specific reference to the influence of the Asian Financial Crisis
- 3) To explore the implications of the long-term relationship in portfolio allocation for institutional investors who wish to make investment in Hong Kong

1.3 Methodology, data and organization of study

In order to achieve the objectives of this dissertation, background information about property investment in Hong Kong is first overviewed in chapter two. Then, the literature about past studies on relationship between the direct and indirect property investment are reviewed to identify the research gap and significance of this study. The subject of this study is the long-run relationship between direct and indirect property investment. Property price indices compiled by Rating and Valuation Department are used as a proxy of direct real estate investment in Hong Kong and it is labeled as COM in this study. For indirect property investment, which are property stocks in Hong Kong, Hang Seng Property sub-indices are used as proxy of them and they are labeled as HSP in this study. The methodology employed in this study are the commonly used ADF unit root test for testing stationarity of the two time series and the co-integration test for testing if there is long-run equilibrium between the two investment. The co-integration test has wide-ranging applications and its inventors, Engle and Granger, were awarded Nobel Prize in Economics for this important discovery in 2003. So the data are collected and analysed systematically. In this dissertation, there are in total seven chapters.

Chapter one is the introduction which gives the background, objectives, the methodology and data employed and general organization of this dissertation.

Chapter two gives the background information of both the direct and indirect real estate markets in Hong Kong. It starts with introducing briefly the situation of the real estate investment environment in Hong Kong, followed by a critical examination of the characteristics and performance of the two markets. Then the relationship between the two markets will be discussed.

Chapter three is a review of literature related to the relationship between the two markets. Past studies of property as an asset class and its relationship with other financial assets in the context of portfolio, together with literature of co-integration are reviewed. The argument that studying the long-term relationship between the two markets is important will be understood as the research gap of this dissertation. Also, the studies about different market conditions may affect the co-integration are reviewed so that another question of whether 1997 Asian financial crisis have influence on the long-term relationship between the two markets which is to be addressed in this study can be understood.

After reviewing the literature, **chapter four** focuses on the methodology employed in this study. Unit root tests are carried out in each series to test for stationarity. After that co-integration test will be carried out to see whether the two series are co-integrated. The co-integration test is carried out for different study period to study the impact of 1997

economy crisis on the linkage between the two markets. The data and its sources are also accounted for in this chapter. Property price indices provided by Rating and Valuation Department and the Hang Seng Property sub-indices will be employed as a proxy for the performance of the commercial real estate and indirect real estate in Hong Kong.

Chapter five presents the findings of the study. The implications of these empirical results are studied in detail. Some reasons are proposed to account for the results obtained from the co-integration analysis.

Chapter six presents the conclusion of this study. The work is summarized and the limitation of this study and recommendation for further study are highlighted.

CHAPTER TWO

PROPERTY INVESTMENT IN HONG KONG

2.1 Introduction

This chapter serves the purpose of introducing the background of real estate investment in Hong Kong. Firstly, the reasons why property investment in Hong Kong is attractive are discussed. Secondly, the role of property sector in Hong Kong's economy will be examined by quoting some statistics. Thirdly, the difference of direct and indirect real estate in Hong Kong and their background will be briefly discussed. Fourthly, past performance of the two markets will be briefly reviewed. By describing the characteristics of the two markets and reviewing the performance, the first objective of this study can be achieved. Finally, the relationship between the direct and indirect real estate investment in Hong Kong will be briefly discussed.

2.2 What is attractive about Hong Kong property investment?

Hong Kong real estate market is attractive for investors because of its special features. During 1984 to 1995, the economy in Hong Kong was thriving and GDP in

Hong Kong was growing at an annual rate of 6.3% in real terms on average.³ Demand for land and properties was keen due to the rapidly expanded economy. The nominal interest rate in US was low for during the period of 1988 to 1995.⁴ Demand for more office space and accommodation for both multi-national enterprises and the individual investors was stirred up due to the high economy growth and the negative interest environment. However, despite the high demand, before the handover of sovereignty in 1997, “new” land release was limited to 50 hectares per year.⁵ The Hong Kong government has adopted a de facto high land price policy over the years before 1997 and income from land sale has been an important source of government’s revenue. In addition, real estate development in Hong Kong is dominated by a few large developers. As a result, the supply of real estate properties could not meet the high demand and the real estate price escalated in the 1980s and the early 1990s. The real estate prices went on increasing, thus there is high yield on real estate investment. Also, Hong Kong has historically been a highly successful economic powerhouse with an attractive business environment (Peterson et al., 2003) and Hong Kong is renowned for its laissez-faire policy, low tax rate, absence of exchange controls, no restrictions on remittances of profits and dividend, no practical restrictions on foreign investment and no restrictions on the foreign ownership of land, thus it is an attractive place for investors to invest. All these explain why there is active investment in Hong Kong real estate.

³ Sources: Hong Kong Annual Digest of Statistics, Census and Statistics Department

⁴ Hang Seng Economic Monthly, various issues

⁵ Agreed in Sino-British Joint Declaration (1985)

2.3 Significant contribution of real estate to economy

In addition to the high returns that can be achieved, another attractive point about Hong Kong real estate is its high capital value. The real estate and construction industry has played a very important role in the economy of Hong Kong and its significance can be viewed from its high contribution to the GDP, the fact that property-related investment accounted for 49-72% of total investment expenditure during 1988-2001, the banking and finance sector was highly dependent on property-related loans, which comprised 30-58% of all loans and advances during 1984-2001 and Hong Kong government participated actively in the property sector and derived an important portion of its revenue from land sales and other property-related taxes.

From 1982 to 1995, its contribution to local GDP kept beyond 20% (Walker et al., 1995). Even after the Asian Financial Crisis, which caused a property slump, the figure still lingers at 16-23% (Census and Statistics Department, 2002). During the period between 1996-2002, the average is 19.29%. The figures are shown in table 2-1.

Table 2-1: Gross Domestic Product by Economic Activity at Current Prices (HK\$mil) (1996-2002)

Year/ Industries	1996	1997	1998	1999	2000	2001	2002
Construction	65,992	72,759	71,000	67,232	64,026	61,267	60,677
Real Estate	116,758	135,651	114,132	87,314	77,652	71,936	74,371
Ownership of premises	147,547	171,383	170,660	162,448	155,303	159,118	158,500
Less: financial expenses	89,356	90,164	89,446	94,580	95,945	95,582	90,562
Total GDP	1,210,925	1,344,456	1,279,850	1,246,134	1,288,338	1,269,975	1,259,771
% of total GDP	19.89%	21.54%	20.81%	17.85%	23.37%	15.49%	16.11%

Average: 19.29%

Source: Hong Kong Annual Digest of Statistics, Hong Kong Census and Statistics Department

The property sector has played an important role in the economic growth of Hong Kong over the past decades. The property sector contributed an average of 26.1% to the Gross Domestic Product (GDP) at factor cost from 1980 through 2000, outweighing other major sectors like i) manufacturing, ii) wholesale, retail, import/ export trades, restaurants and hotels, iii) transport, storage and communications, and iv) finance, insurance and business services.⁶

Besides GDP and economic growth, the significance of the property market in Hong Kong can also be demonstrated by the fact that a large portion of investment has been spent on properties. Property-related investments, including expenditure on building and construction, costs of ownership transfer, and real estate developers' margins, accounted

⁶ The GDP data can be collected from the Census and Statistics Department of the HKSAR Government.

for 59%, on average, of the total investment expenditure of Hong Kong between 1980 and 2001, despite the dramatic growth in the proportion of non-property investments since 1986. Table 2-2 shows the percentages of fixed capital in total capital investment over the period 1988-2001.

Table 2-2: Gross Fixed Capital Formation (1988-2001)

	Total Property Related Capital Investment
1988	52.8%
1989	58.8%
1990	62.4%
1991	60.1%
1992	56.1%
1993	61.1%
1994	62.0%
1995	51.6%
1996	72.0%
1997	58.7%
1998	58.7%
1999	58.0%
2000	49.0%
2001	58.6%

Source: Census and Statistics Department, HKSAR Government

Property in Hong Kong is important to other sectors. The banking and finance sector in Hong Kong is highly dependent on the property sector. As of the end of 2001, banking loans and advances for use in Hong Kong was HK\$1,790,063 million, of which 58% were used for building, construction, property investment, and home purchases. The

portion of funds flowing to the property sector has also been rising since 1988, at an average of 42% over the period of 1984-2001. The data for banking loans and advances can be collected from the Hong Kong Monetary Authority (HKMA). Historically, the two serious banking crises of 1965-66 and 1983-86 were closely associated with slumps in the property market.

The Government has also participated actively in the property sector by spending 20-31% of its expenditure on housing and infrastructure during 1989-2000, and deriving an important proportion of its revenue from land sales and other property-related taxes.

2.4 Direct and indirect real estate investment in Hong Kong

2.4.1 Direct and indirect real estate

Property investment can be divided into two types. One is direct real estate (also called non-securitized real estate) which involves direct ownership of physical property assets. Investors can engage in direct property through assignments or leases. In Hong Kong, the four main direct property sectors are residential, office, retail and industrial. Though these sub-markets share some common characteristics they are exposed to different market conditions.

The other type of property investment is indirect real estate (also called securitized real estate), for which investors own physical property indirectly through acquiring equity or other interests in a separate legal entity. In US, the most commonly used vehicle for indirect real estate is REITs, the counterpart for REITs in Australia are the property unit trusts. In Hong Kong, the only form of indirect real estate investment presently is through investment in listed property stocks. The property stocks in Hong Kong will be discussed in the subsequent section 2.4.2.

The main advantages of indirect property over direct property are divisibility and liquidity. Divisibility refers to the ease of splitting up ownership. To purchase a property, the transaction amount is usually very large. This bars many potential individual buyers from entering the market. Indirect property provides a means to split the ownership of assets into shares without physically alienating the assets. This arrangement lowers the initial capital requirement for investors. Liquidity refers to the ease of transferring ownership. While divisibility can enhance liquidity through increasing the number of potential investors, the high degree of liquidity is achieved mainly by listing on stock exchanges. Besides divisibility and liquidity, another advantage for investing in indirect property is that the trading cost of indirect property is much lower. The difference ranges from a minimum of 1.9% to a maximum of 4.9% (Wong, 2003).

2.4.2 Commercial real estate in Hong Kong

Commercial real estate, more specifically, the office sector is the subject under investigation in this study. Commercial real estate is a significant and essential component of the economy in Hong Kong as elsewhere. It represents the supply of space necessary to produce goods and services for companies in Hong Kong. For investors, they regard real estate as a long-term, low-risk asset. For example, Chau et al. (1996) analysed the annual return and risk of property market, stock market and property companies in Hong Kong from 1984-1994 and found that property sector risks were much lower than the others despite the fact that they have similar yields.⁷ For institutional investors, commercial real estate represents an asset class that provides potential diversification benefits by including them in their multi-asset portfolio.

In US, UK or other countries like Japan and Singapore, trends have emerged regarding direct and indirect property as investment vehicles for institutional investors. In Hong Kong, listed property companies have been successful indirect property vehicle, largely attributable to their good reputations and the general acceptance amongst investors of the property companies. Fundamental to these trends has been the limited liquidity and indivisibility of direct property, especially in the recent depressed property market over 1997-2003. The current institutional strategy is to utilize indirect real estate investment, most commonly REITs (but only property companies in HK), to balance or fine-tune property portfolios, thus enabling responsive portfolio adjustments for asset allocation. They actually assume indirect property is a good proxy for the direct property.

⁷ The average annual return and the annual risk for office sector is 21.6% and 19.64% respectively, while the average annual return for stock market is 21.5% and with average annual risk 36.33%

Intuitively it is correct for market price of a property stock is essentially the market value of the underlying assets of the property companies and both property stocks are property are influenced by common factors (Giliberto, 1990). On the other hand, some investors hold both direct and indirect property by assuming that the two markets are fundamentally different. However, whether it is true is challengeable especially in the long term, if the direct and indirect property has a long-term equilibrium, then the diversification benefit will be undermined by the fact that the two markets are integrated.

2.4.3 Property stocks in Hong Kong

Hong Kong is a major international financial centre. According to the official data of HKSAR government which actually quotes information from the World Federation of Exchanges (WFE)⁸, stock market of Hong Kong was the eighth largest in the world and the second largest in Asia in terms of market capitalization as at the end of September 2003. Table 2-3 shows the total market capitalizations of the top twelve stock markets in the world and the four major stock markets in Asia. Compared to other countries in Asia, the Hong Kong market remains strong even after the Asian Financial Crisis. The stock trading activities in Hong Kong are mainly administered by the Stock Exchange of Hong Kong. As at the end of 2003, 852 companies were listed on the main board of the SEHK, with a total market capitalization of HK\$ 5,477,670.33 million.

⁸ The information can be found in the homepage of Securities and Futures Commission <<http://www.hksfc.org.hk>> under the section “International Market Comparisons”.

Table 2-3: World Stock Exchanges in 2003

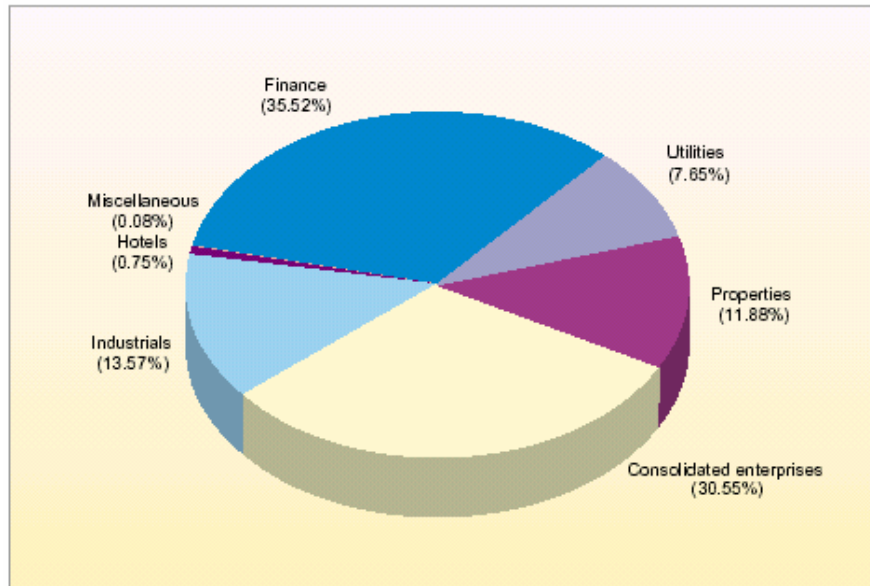
Exchange	Total Market Capitalization (US\$ billion)
World	
US(NYSE+Nasdaq)	12,759
Japan (Tokyo)	2,746
UK (London)	2,111
Euronext	1,742
Germany (Deutsche Bourse)	841
Canada (Toronto)	771
Switzerland	626
Hong Kong	619
Spain	579
Italy	524
Australia	496
Mainland, China (SHSE+SZSE)	472
Asia Pacific	
Japan (Tokyo)	2,746
Hong Kong	619
Australia	496
Mainland, China	472

Source: World Federation of Exchanges

As said in section 2.3, the real estate sector exerts great influence on the development of the Hong Kong's economy. It is not surprising that tock market in Hong Kong is characterized by the substantial real estate or related activities. As at the end of 2003, there was an estimated number of 99 property or property-related companies listed on the Stock Exchange of Hong Kong (SEHK), with a total capitalization of about HK\$591.9 billion and an average daily turnover of over HK\$1,020 million in the year

2003.⁹ The property sector also accounted for 20% of reported earnings in the Hang Seng Index. Figure 2-1 shows the breakdown of the stock market capitalization by sector in 2003. The figures show that consolidated enterprises (30.55%), finance (35.52%) and industrials (13.57%) made up the major part of the stock market in terms of market capitalization, while the property sector only ranked fourth (11.88%). The sectors that had the largest number of stocks were industrials (378), consolidated enterprises (269) and properties (98).

Figure 2-1: Composition of the Stock Exchange of Hong Kong at the end of 2003



Source: Hong Kong Exchange and Clearing Limited

The relative importance of property or property-related stocks among the fifty leading companies in terms of market capitalization in Hong Kong as at the end of 2003 is shown in table 2-4.

⁹ Source: Market and Industry Statistics, Securities and Futures Commission

Table 2-4: Property companies among the 50 leading companies in 2003¹⁰

Rank	Company	Market capitalization (HK\$ mil)	% of equity total
3	Hutchison Whampoa	244,078	4.46
6	Sun Hung Kai Properties	154,258	2.82
8	Cheung Kong (Holdings)	143,023	2.61
11	CLP Holdings	89,105	1.63
13	Swire Pacific	69,194	1.26
16	Henderson Land Development	62,240	1.14
18	MTR Corporation	54,205	0.99
19	Wharf (Holdings)	52,621	0.96
22	CITIC Pacific	43,332	0.79
30	Hang Lung Properties	28,749	0.52
31	PCCW	27,112	0.49
38	Wheelock and Co.	18,998	0.34
40	China Resources Enterprise	18,376	0.34
42	Sino Land Co.	17,197	0.31
49	New World Development Co.	15,434	0.28
	Total	1,037,922	18.94
	Equity total	4,459,823.29	100

Source: HKEx Fact Book, Hong Kong Exchange and Clearing Limited

From 1988 to 2002, property stock contributes an average of 22% to total market capitalization of Hong Kong's stock market. Table 2-5 shows the trends of market capitalization in different industries over the period 1988-2003.

¹⁰ The 50 leading companies in market capitalization - February 2004 are shown in Table A-2 in Appendix

Table 2-5: Market Capitalisation trends in different industries as a percentage of equity market total (1988-2003)

Year/ Industries	Finance	Utilities	Properties	Consolidated Enterprises	Industrials	Hotels	Miscellaneous
1988	13.76%	17.26%	28.44%	29.45%	6.63%	4.29%	0.17%
1989	14.78%	18.08%	26.21%	30.11%	5.80%	3.99%	1.03%
1990	12.80%	20.32%	26.06%	30.83%	6.48%	2.85%	0.65%
1991	16.23%	18.51%	26.93%	28.52%	6.94%	2.19%	0.67%
1992	22.36%	16.72%	24.98%	26.45%	6.95%	2.11%	0.43%
1993	20.16%	14.14%	28.79%	27.86%	6.27%	2.47%	0.31%
1994	21.70%	15.43%	25.58%	27.88%	6.17%	2.83%	0.41%
1995	24.27%	13.97%	26.45%	27.04%	5.85%	2.22%	0.21%
1996	23.17%	10.28%	31.05%	25.98%	7.25%	1.98%	0.27%
1997	26.98%	18.70%	21.21%	21.07%	9.99%	1.51%	0.54%
1998	29.58%	19.83%	21.14%	19.84%	8.15%	1.19%	0.28%
1999	25.89%	23.96%	16.36%	24.76%	7.99%	0.85%	0.19%
2000	30.05%	6.05%	14.56%	41.05%	6.96%	0.72%	0.16%
2001	19.40%	6.84%	14.84%	36.94%	11.10%	0.72%	0.16%
2002	35.52%	7.65%	11.88%	30.55%	13.57%	0.75%	0.08%
2003	37.93%	6.31%	10.81%	27.46%	16.59%	0.68%	0.21%
Average	23.41%	14.63%	22.21%	28.49%	8.29%	1.96%	0.36%

Source: Stock Exchange Fact Book 1988-2003, The Stock Exchange of Hong Kong Limited

Looking at the above figures, we can already be impressed by the significant role of real estate in stock market. However, merely looking at the above figures can understate the significance of the property sector in the stock market. The reason is that many companies classified as consolidated enterprises actually invest heavily in the property

sector. Examples include Hutchison Whampoa, Swire Pacific, Wharf (Holdings) and New World Development. Walker et al. (1995) estimated that two-thirds of the consolidated enterprises were property-related so that the property sector accounted for about 45% of the total capitalization of the stock market in the period from 1983 to 1992.

2.5 Overview of performance of the two markets

Both direct and indirect real estate investment in Hong Kong are reviewed above. The real estate market in Hong Kong attracts a large amount of investment from local and foreign institutional investors. According to research of Jones Lang Wotton, during 1996, out of the HK\$67.5 billions value of property transaction 28.2% comes from Mainland China, 3.9% comes from overseas and the remaining 67.9% comes from local origin.¹¹

Before 1992, Japanese investors are the major source of overseas investment in Hong Kong real estate. The total value of Japanese investments in real estate market amounted to HK 5 billions in 1987. During the past decade, the role played by the Mainland China companies in the real estate market has become more and more significant. One reason is that the closer relationship between Hong Kong and Mainland China after handover of Hong Kong. By the end of 1995, Chinese investment in Hong Kong has surpassed that of the US and Japan. It is estimated that 7.8 per cent of Chinese

¹¹ 17th March, 1997, South China Morning Post

entitles are involved in building and real estate business and the total investment in Hong Kong real estate market can be amounted to HK\$11 billion.¹²

Real estate market tends to be cyclical¹³ and Hong Kong real estate market is no exception. The property market has experienced booms and steep fall in the past decade. Here the performance of both direct and indirect real estate market in Hong Kong is briefly reviewed.

But the Asian Financial Crisis may affect the confidence of investors for it hit both the direct and indirect property markets seriously. Overall performance of real estate market from 1983 to 2003 is presented in this section. The time series is broken down into two periods i.e. the pre-1997 period and post 1997 period.

Office Sector

Offices have been a popular form of property investment. In Hong Kong, the office market is affected by the changes in economic structure and the availability of earning opportunities in Hong Kong. China's open door policy and economic reforms not only provide a huge production hinterland for local manufacturers, they also created abundant business opportunities for a wide range of services in Hong Kong, including freight transport, telecommunication, banking, real estate development, and professional services

¹² Li, L. H. 1994. Direct and Indirect Influence of China's Investment Funds in Hong Kong's Real Estate Market, Department of Surveying, University of Hong Kong.

¹³ Tse, Y.C. 1992. Real Estate Market in Hong Kong, Hong Kong: Commercial Press

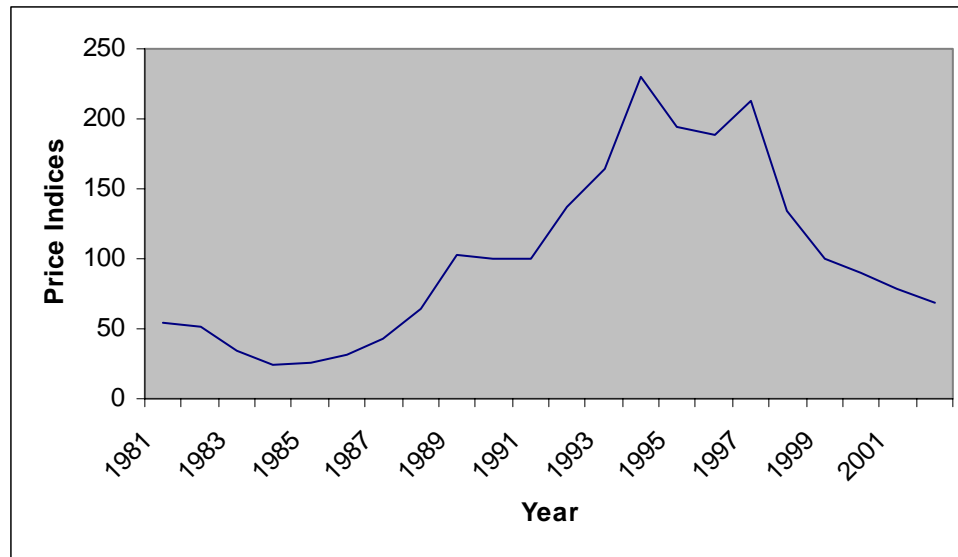
such as legal, accounting and insurance services. Hence since the mid-1980s, there has been a further orientation of the Hong Kong economy towards services.

Over the past decades before 1997, the tertiary service sector has become increasingly important in terms of contribution to GDP. The economic activities in the territory have experienced a remarkable boom. This leads to a strong demand for offices. Towards the end of 1999, the successful negotiations between China and the United States on agreement to the World Trade Organization (WTO) improved the prosperity in the stock market. It supports the commercial activities and it is expected that strong demand for office spaces can be sustained.

The real estate market in Hong Kong has undergone booms and busts. The year 1997 is regarded as a watershed of the real estate market. The real estate prices have always been high in pre-1997 period due to the limited land supply and serious speculative activities. The price index of non-residential sectors has increased more than two times since 1990.¹⁴ However, after the outburst of the Asian Financial Crisis, the real estate prices and the stock prices of those property companies have substantially fallen. Hong Kong could not escape from the regional economic turmoil and the real estate market is adversely affected. To present the performance of real estate market in a systematic way, the review is divided into periods, i.e. the pre-1997 period and the post-1997 period. Figure 2-2 shows the price indexes of office property from 1981 to 2002 and from the figure both booms and busts can be observed.

¹⁴ Hong Kong Property Review, Rating and Valuation Department of the HKSAR Government, various issues

Figure 2-2: Private office price indexes (1981-2002) (1999=100)



Source: Hong Kong Property Review, various issues

Pre-1997 period (1986-1996)

In 1987, the crash in the world stock market made the local property market inactive. However, it soon recovered within a short period. By the early 1989, property prices in most sectors had raised 130% compared with those in 1984. The real estate market kept on rising until the June 4 incident had broken out. After 1989, the prices continued to soar and the price doubled within 1991. During the Gulf War, the overall property price could still maintain at price level of 1990's. The opening up of China and her rapid economic growth had generated plenty of high value-added economic activities in Hong Kong which had been very profitable. It has been estimated that the re-export margin which

Hong Kong earned from re-export of products from the Mainland was as high as 21.1 percent to 35.3 percent in 1990-1994.¹⁵

According to Renaud and Pretorius (1995), the main reasons that accounted for the property boom between 1991 and 1994 were as follows¹⁶:

1. Negative real interest rate due to the effect of pegged currency with US;
2. Massive capital inflow from China
3. High leverage effect of low interest rates

The property prices had a great upswing at this period. Even though the property prices were lightly softened in 1995 due to

1. 70 % limit on mortgage loans
2. macroeconomics austerity measures in China in 1993
3. an interest rate hike in the United States, speculation and expectations of asset inflation in the property market managed to keep property prices from a significant correction.

The rise of property prices softened to 10.2 % in 1993 and then resumed an excessive rise until the first half of 1994. From the second half of 1994, the above said three factors had begun to outweigh market expectations of further increases in property

¹⁵ Census and Statistics Department. 1996. Analysis of Hong Kong's retained imports, 1989-1994, Hong Kong Monthly Digest of Statistics, February 1996, Hong Kong: Government Printer.

¹⁶ Renaud, B. M., Pretorius, F. 1995. The dynamics of the Hong Kong Real Estate Economy. 1st International Real Estate Society Conference. Stockholm, Sweden pp. 11-13.

prices. By the second quarter of 1995, property prices for private offices by 12.6 percent, compared with the same period in 1994.¹⁷ Over the period of 1985 to 1995, property prices increased at a compound annual growth rate of nearly 18% compared with inflation rate which was (for the composite consumer index) 7.7 percent.

We can see the property market in Hong Kong, before 1997 generally followed a rising trend. The price indexes of private commercial premises showed fluctuations and stood at 217 at the end of June 1997, more than double at the level at the end of 1989.

Post-1997 period (1997-2002)

The upward trend in real estate market continued at the beginning of the 1997. However, the Asian financial turmoil took place in October 1997, the business environment deteriorated. After “Black Thursday” on October 23, 1997, interest rate soared and liquidity tightened, the property market in Hong Kong, in tandem with the securities markets, also fell sharply. Price indexes for private commercial office buildings peaked in Q2 of 1997. By Q4 1998, they had fallen by 51.6 % from their peaks.

The Hong Kong Government has taken positive initiatives e.g. land sale stoppage for nine months, broadening of Hong Kong’s investment such as the Cyberport and the Disney Theme Park. Together with the China’s access to the World Trade Organization

¹⁷ Rating and valuation Department, Hong Kong Government, Economic Prospects (1995), Hong Kong: The Government Printers.

(WTO) which brought hopes for more business opportunities. It is expected to be another positive factor for the property market.¹⁸

2.6 Relationship between the two markets

Property and stock investment markets in Hong Kong are well-developed among all types of investment, and they form the two major investment markets in Hong Kong as discussed in above sections. Hong Kong is special in that strong relationships exist between the two markets and they are both speculative and volatile (Chiang, 1994).

In Hong Kong, investing in listed property stocks is the only way to invest indirectly in property. Most of these property companies are involved in real estate investment, development and trading (e.g. Sun Hung Kai Properties, Cheung Kong Holdings, Henderson Land, Hang Lung Development, Sino Land, New World Development) while some are primarily investment vehicles (e.g. Hong Kong Land, Hysan Development, Great Eagle Holdings). From the theoretical perspective, the presence of a common ‘real estate’ factor might be expected as the major underlying asset of most indirect property vehicles is property (Gilberto, 1990). Given the special importance of property in both markets, understanding the intertemporal relationship between the performances of the two markets over time can help institutional investors evaluate whether profitable arbitrage opportunities exist in the stock and property market. This is the question

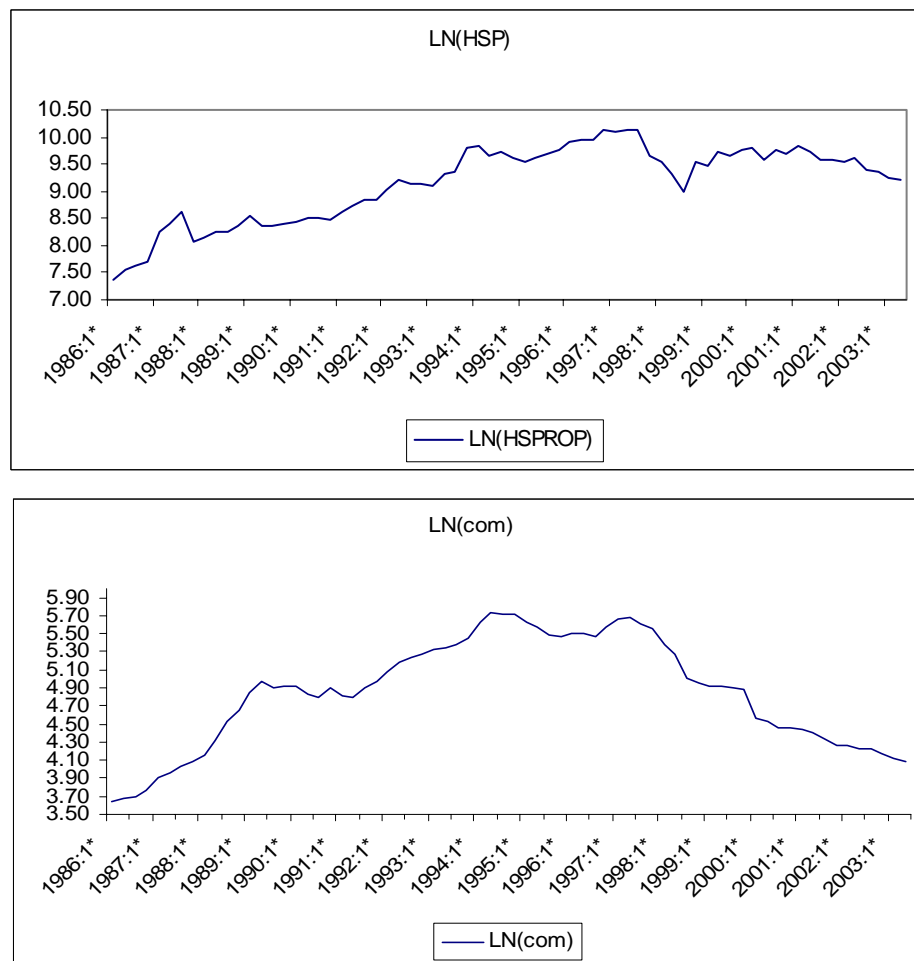
¹⁸ Rating and Valuation Department, HKSAR Government, Property Review 2001, Hong Kong: The Printing Department

whether price discovery mechanism exists between the two markets. However, for institutional investors, diversification is a more important issue for they normally hold property as long-term investment. Literature in both overseas and local context generally supports the diversification benefits. The justification is usually made by the low correlations between the two markets. According to Markowitz portfolio theory, diversification benefit can be achieved. But this study argues that the long-term relationship needs to be looked at too for existence of long-run equilibrium between the two markets can undermine the diversification benefit. Institutional investors focus on long-term investment strategy and it is argued that long-term relationship between the two markets should be focused. The study of the long-term relationship can add evidence to the diversification benefit or challenge the results of previous studies.

Given the value of real estate, the cost of transacting real estate and its relative illiquidity compared with financial assets, investors may use property stocks as proxies for direct real estate investment and include them in their multi-asset portfolio to avoid the disadvantages of investing directly in real estate. Knowing the nature of linkages between different types of real estate and between real estate and financial assets can provide useful information to investors, including institutions, for evaluating the usefulness of real estate as investment and diversification tools. The information can also be useful to real estate professionals who frequently seek suitable hedging vehicles to reduce their exposure to real estate.

We have briefly reviewed the performance of the two markets. We can observe that both real estate and property stock prices in Hong Kong have historically been volatile and they have witnessed boom and bust over the last decade (Figure 2-3).¹⁹ The real estate sector has such an important role and the good investment environment in Hong Kong have attracted many investors, both local and overseas, to make investment in Hong Kong.

Figure 2-3: Performance of property stock and commercial real estate in Hong Kong (1986-2003)



Source: calculation by the author

¹⁹ For ease of observation, natural logs of HSP and COM are taken

Direct property investments are commonly regarded as good portfolio diversifiers as their return and risk characteristics differ from those of financial assets, and their returns are lowly correlated with those on financial assets.²⁰ For large institutions, it appears that direct property investments should be included in the portfolio to achieve optimal portfolio diversification. Some characteristics of direct property investments, however, may limit the attractiveness of such investments as we have discussed in section 2.3. Despite the attractiveness of direct real estate investment, its disadvantages cannot be disregarded. That's why indirect real estate investment is so popular among institutional investors. They include indirect real estate into their multi-asset portfolio assuming that indirect real estate is a good substitute of the direct real estate. Listed property stocks, or Real Estate Investment Trusts (REITs) in US, have long provided a conduit for indirect property investment. It then becomes common practice to use property stock or REIT returns as a proxy for real estate investment returns. The rationale for this is that the market price for a stock is essentially the market value of the underlying assets of the company (Martin and Cook, 1991). Fundamentally, the returns on the derivative asset would not be independent of its underlying asset, suggesting that the returns on the two series representing underlying and derivative assets would not always diverge, at least in the long run (after considering the risk premia), even if in the short run, there might exist no clear relationships. It would be perfect if the indirect properties are good proxy of direct property for they avoid the disadvantages of direct property but still they can capture the returns from the property. But the question is whether indirect real estate in Hong Kong is a good proxy of the direct real estate investment and this issue can be addressed by investigating the long-term relationship between the two markets.

²⁰ See Chau et al. (2001)

Even to those investors who invest in property only, they of course want to diversify risks using different types of properties. Whether indirect real estate should be included is a question whether the two markets are integrated or not. Markowitz suggested that the essence of portfolio investment is having the assets which have low correlation. But for institutional investors, the investment is normally long-term, the long-term relationship of the two markets actually need to be studied in order to know whether the diversification is actually justified in the long run. The long-term relationship between the two markets is worth studying given its importance in Hong Kong. Many of the property companies in Hong Kong invest heavily in the office market in Hong Kong. To purchase shares in a property company enables the investor to share in the returns arising from development, active property management and rises in property values.

Indirect property vehicles clearly represent an alternative to direct property investments. It is clear that the two sectors are related somehow. However, whether it is a good proxy for direct real estate is a matter of degree and is actually an empirical question. The answer of the question not only has great implication on diversification issue in portfolio context, but also on price discovery of the two markets.

In addition, the question whether the 1997 financial crisis has any impact on the integration between the two markets can be studied. The theory is that two correlated market, even they are only moderately correlated during the periods of stability, if one market sustains a shock and has ripple effects leading to significant increase in market co-movement, this would constitute contagion. The historical performance of the two

markets tells us they do not exactly move together. Chau and Newell (1996) find that the correlation between the two markets is low. However, in an environment where contagion exists, a negative shock in one market would be followed by an increase in correlation.

Many of the property companies in Hong Kong invest heavily in the office market in Hong Kong. To purchase shares in a property company enables the investor to share in the returns arising from development, active property management and rises in property values. Fundamentally, the returns on the derivative asset would not be independent of its underlying asset, suggesting that the returns on the two series representing underlying and derivative assets would not always diverge, at least in the long run (after considering the risk premia), even if in the short run, there might exist no clear relationships. This is the rationale for assuming a co-integration framework in the investigation of real estate investment in the two markets.

2.7 Conclusion

Both commercial real estate and property stocks in Hong Kong are attractive investment tools to investors given their high capital value and attractive investment environment in Hong Kong. Despite the hit of 1997 financial crisis, the attractiveness remains.

The main difference between direct and indirect property to investors are the issue of divisibility, transaction cost and liquidity. They are such significant issues that investors may consider to use indirect property as a proxy of direct property investment so to achieve diversification in both multi-asset portfolio or ‘within-property’ portfolio and capture the return of direct real estate. The question is whether this assumed relationship between the direct and indirect property is true or not. Intuitively, indirect properties are good proxy of direct property for the property companies in Hong Kong invest heavily in the direct real estate market. The long-term relationship can be affected by shock, Asian financial crisis hit seriously both direct and indirect property investment market in Hong Kong. This raises an important concern for investors whether they should hold indirect property instead of direct property for illiquidity problem increases. This question can be addressed by studying the long-term relationship between the two markets and whether the 1997 financial crisis has caused any effect to the long-term relationship between them.

CHAPTER THREE

LITERATURE REVIEW

3.1 Introduction

In this chapter, literature and findings on the relationship between the stock market and the property market, both short-term and long-term, are examined in order to understand why studying long-term relationship is important. Some literature on co-integration method and some suggested implications of co-integration are reviewed so to understand in what other studies co-integration test was employed as the research methodology.

3.2 Studies on the two markets

The study of the relationship between the direct real estate market and indirect real estate market are extensive in both local and overseas context. The relationships between the two assets have actually been considered from a number of perspectives and they can roughly be divided into studying the relationship of short-term and long-term. Some early studies include comparison of risk and returns between real estate and stocks (Asabere et

al., 1991; Ross and Zisler, 1991; Kuhle, 1987 and Ibbotson and Siegel, 1984). Generally, real estate exhibits high α s and low β s. Several authors have considered the performance of direct real estate and securitized real estate in the form of equity REITs (for example, Firstenberg et al., 1988; Ross and Zisler, 1991). Understanding the relationship between the direct and indirect real estate market has many implications, and the most important ones include diversification and price discovery.

Diversification

Diversification is a dominant theme in the property investment literature. The rationale actually has strong theoretical support. Markowitz (1952) suggests that portfolio efficiency may be improved by diversifying across different assets. His mean-variance portfolio theory is in fact an ex ante model exploiting the low correlations between two assets. Quite a number of studies have made use of the mean-variance model by Markowitz (1952) to estimate the optimal proportion of funds to invest in each class of asset.

If, and as has been hypothesized, low correlations of returns exist, diversifying across various categories of property investment may allow investors to reduce portfolio risk while holding expected return constant. This is the main idea of the portfolio theory. However, despite the obvious importance of this body of thought to institutional investors, the application of Markowitz portfolio theory to the property market is comparatively recent, with the original focus on the property's role in a mixed asset portfolio (Hamelink

et al., 2000). More lately, there has been an increasing interest in investigating the implications of portfolio theory within the property portfolios which include both direct and indirect property. The motivation for including indirect property in the property portfolio is to achieve more efficient reduction in risk. (for example, Young and Grieg, 1993)

Multi-asset portfolio

The first strand of empirical endeavour about diversification has largely concerned itself with the optimal allocation of property in a mixed-asset portfolio. Hartzell et al. (1986b) discover that real estate offers diversification opportunities for stock and bond investors. Rowland (1996) analyses the direct property and property shares in London. He find that returns on property shares outperformed returns on direct property to reflect total returns. Coyne (1993) finds that real estate yields better returns than stocks or bonds during the long-run period. He pointed out that including real estate in a portfolio of stocks and bonds may reduce risk. In principle, diversification by real estate offers a lot of potential. Researches are extensive on investigating the real estate market and the stock market (for example, Brueggeman et al., 1984; Miles and McCue, 1984; Hartzell et al., 1986a; Chen et al, 1990; Martin and Cook, 1991). Hoag (1980) investigates farmland, office and industrial real estate for the period from 1965 to 1978. He finds that all sectors appear to have low correlations with stock returns, thus confirming their suitability as a good diversifying asset. Studies are extended to include relationship between real estate and other assets besides stock market. For example, Ibbotson and Siegel (1984) compare

a composite of commercial, residential and farmland real estate returns with bill, bond and stock returns from 1974 through 1982. Their study shows that real estate has correlations between stocks and bonds nearly equal zero. Hartzell et al. (1986b) study commercial real estate for the period of 1973-1983 and conclude that its returns have zero correlations with common stock and significant negative correlation with bond returns. Fogler (1984) proposes a minimum commitment of 20% to property. Ennis and Burik (1991) study the real estate, stocks and bonds market and found that the optimal portfolio should have 10-15% of its assets being real estate. Irwin and Landa (1987) demonstrate that real estate returns have only moderately positive correlations with bond and stock returns, and negative correlations with bill returns.

We can see researches on correlation between real estate returns and market portfolio returns using CAPM are extensive and further examples include Goetzmann and Ibbotson (1990) who examine the data obtained from REITs, CREFs (Commingled Real Estate Funds), residential and commercial real estate in USA, showing that there is slight correlation with real estate returns and stock and bond returns. In Hong Kong, Chau and Newell (1996) examine the relationship between the change in property market returns and the change in stock market returns in Hong Kong over 1984-1996 and the results from the correlation tests show that returns on property market and stock market are of little contemporaneous relationship between them. Also, Miles et al (1990) identify that real estate offers appealing diversification for stock, bond and bill portfolio. Lins et al. (1992), Rubens et al. (1998), Gordon et al. (1998), Giliberto et al. (1999), Chandrashekar (1999) have examined the prospects for diversification for mixed asset

portfolios that include a property component. This work has generally concurred that property investment appears to offer significant diversification benefits, at least during certain time periods (Chandrashekar, 1999). However, they focus only on short-term in order to provide evidence.

“Within property” portfolio

The second strand of empirical endeavour has examined “within property” portfolio diversification by property type and/or geographic region. Studies in this area include Hartzell et al. (1986b), Graff and Young (1996), Williams (1996), Sivitanides (1996), Hoesli et al. (1997), Wolverton et al. (1998), Cheng and Black (1998), Henneberry (1999), Viezer (2000), Brown et al. (2000) and Bryne and Lee (2001). However, the evidence concerning “within property” diversification is somewhat mixed.

In HK context, Chau et al. (1996) assess the relationship between Hong Kong property company and commercial property market performance over 1984-1994. Their findings show that low correlations exist between the stock market and the property markets, particularly for office ($r=0.01$) and retail ($r=0.10$). In addition, low correlations are found between each of the property companies under the study and the property market, particularly for office ($r=-0.03$ to 0.19) and retail ($r=0.04$ to 0.24). Chaing (1997) studies the correlations between total returns of property in all four types, namely residential, industrial, retail and office and stock investments on quarterly, annual and five-year bases. He quoted similar results with Chau and Newell (1996) that very low and

even negative correlations are found between property and stock investment, rendering property a good candidate for inclusion in mixed-asset portfolio for diversification purpose. While such literatures address the question of real estate's role in institutional portfolio, Giliberto (1992) studies several scenarios and determines that real estate of 5% to 15% in a mixed-asset asset portfolio can be justified when the real estate returns are in the 10%-12% range. Similar study is carried out by Lee et al. (1996) in UK context. Conflicting evidence can actually be found. For instance, Byrne and Lee (2001) carry out study in UK and conclude that risk reduction is limited because of high positive correlations between assets in the property portfolio.

Actually the studies in this area are such extensive that it is impossible to quote all here. However, Seiler et al. (1999) provide a useful review of literature concerning the diversification benefits of property in both mixed asset and within property portfolios.

Price Discovery

Price discovery is about how agents discover the true value of assets among different markets (O' Hara, 1995). The literature on price discovery in real estate has focused primarily on unsecuritized real estate and securitized real estate (Giliberto, 1990, 1993; Sahalyn, 1990; Barkham and Geltner, 1995; Chau et al. 2001). The focus is to ascertain in which market price formation occurs first. The existence of a large and active public real estate market creates potential money-making opportunities in the private real estate market if the participants have the knowledge of private market pricing. Similarly,

money may be made in the public market from knowledge of private market pricing. The polar positions on the issue of private/ public pricing comparison range from little relationship at all to a direct, perhaps not perfectly, contemporaneous movement.

However, the findings of literature are not consistent. While, generally, the literature suggests a low contemporaneous correlation between the returns of direct property and securitized real estate, there is strong evidence of autocorrelation in the direct real estate returns and of lagged cross correlations with securitized returns. Blundell and Ward (1987), MacGregor and Nanthakumaran (1992) and Barkham and Geltner (1994), all identify autocorrelation in UK-appraisal-based series. Chau and Newell (1996) demonstrate significant first-order autocorrelation in quarterly appraisal-based series in Hong Kong, but up to fourth order in the USA, the UK and Canada. However, it is suggested that the autocorrelation and the cross correlations suggest price discovery between the two markets can actually be explained by appraisal smoothing. The existence of autocorrelation in direct real estate series indicates that appraisal-based indices for property represent smoothed versions of a true underlying price series. The most criticized difficulty about the quality of the data being used in this area of study. The difficulties in compiling a reliable transaction driven real estate index have prompted many real estate researchers to use some sort of proxies to a real estate index.

Problems of data

The lack of sales-based commercial property performance indices is due to the infrequent trading of commercial properties and the absence of a centralized exchange for property transactions. Careful study of property-level and public real estate return movements have been impeded by the number of problems involving the assembly of reliable and comparable return series. The problems these studies suggested are highlighted here. One problem is that the return variance may be systematically underestimated by appraiser smoothing behaviour when appraisal-based indexes of returns are used to represent true returns (Geltner, 1989a, 1989b, 1993). Lai and Wang (1998) highlight another problem that it is possible to have overestimated appraisal variance at one point in time. If transaction-based returns are used to measure true returns, the return distribution may be altered by buyer and seller behavior (Quan and Quigley, 1991). Another set of questions surfaces when measuring the “true” returns on real estate firms. If publicly traded real estate market indexes, NAREIT, are used to represent true returns, then the return variance may be overestimated because of noise in securitized market trading. Giliberto (1993) and others (Liang, Chatrath and McIntosh (1995) and Liang, Chatrath and Webb (1996)) develop hedged indexes that results from general market activity. Another approach to bringing the volatility of public market indexes and appraisal-based indexes in line is the cross-market price index approach suggested by Giliberto and Mengden (1996).

An alternative data source for property performance is available from the transaction-based indirect property series. Indirect real estate is commonly used as a proxy for direct real estate with the rationale that these securities have heavy real estate backing. Another reason is that REITs and property are both influenced by common factors (Giliberto, 1990). In the US, real estate investment trusts (REITs) are widely used for this purpose. In HK, there is no exact REIT counterpart, and the share price/ total return index of real estate companies seems to be the only source with this merit.

Indirect property as a proxy

Some may conveniently use property stocks as a proxy for real estate investments by assumption that since property companies predominantly hold property assets, they can be regarded as an indirect vehicle for investing in real estate. However, some recent studies challenged the use of property stocks or REITs as a proxy for real estate. Findings in this area are again not conclusive.

The literatures which generally support use of indirect real estate as a proxy for direct real estate are reviewed here. A series of recent research (Barkham and Geltner, 1995, 1996; Giliberto, 1990; Gyourko and Keim, 1992; and Webb et al., 1993, 1994) have shown that indirect and direct commercial property performance are more closely related than previously thought. During the 1990s REIT returns are becoming more highly and positively correlated with unsecuritised property returns, as measured by appraisal indexes. We know that the private/ public market pricing comparison cannot be

drawn contemporaneously. Studies by Gyourko and Keim (1992) and Barkham and Geltner (1995) provide evidence that public real estate markets lead the private markets as much as one year. Academic research also has informed us about some of the fundamental linkages between private and public real estate markets. Liu and Mei (1992) conclude that property capitalization rates contain useful information about securitized real estate returns. Geltner (1993) finds that the two markets share a common component that reflects real estate fundamentals. Geltner (1990) establishes that noise is present in returns from both markets, but he could not find a strong relationship in this volatility component of the returns between the two markets. Giliberto (1990) uses equity REITs to identify a common factor associated with both direct and indirect property in the U.S., with the lagged values of the equity REITs (of 1-4 quarters) explaining direct property performance. This common factor is labeled as “pure” property in the sense of it representing property market fundamentals that are not shared with financial asset markets. Gyourko and Keim (1992) show that lagged REIT returns can predict direct property returns after controlling for “persistence” in the appraisal-based Russell-NCREIF series in the US. Myer and Webb (1993) examine equity REITs and commercial property in the US and found that equity REIT returns “Granger-caused” commercial property returns. This is more evident at the property index level, with variable results achieved for individual REITs. When retail REITs are considered, Myer and Webb (1994) finds no positive evidence of relationship. Other researches (Barkham and Geltner, 1994; Fisher et al, 1994; Geltner, 1993) have highlighted the need to correct for appraisal-smoothing in the direct property series; and correct for leveraging in property company series. Using these techniques, analyses for both US and UK property markets have

shown linkages between property companies and property market performance. Lags of up to one year in the UK and two years in the US were identified, with the property companies and REITs leading the property market. Liang, Chatrath and McIntosh (1995) employ a “hedged” apartment REIT index to track the performance of apartment real estate and assess the performance of apartments in efficient multi-asset portfolios. They argue that the hedged apartment REIT index captures a substantial amount of the volatility unique to apartment real estate and the hedged apartment REIT index does not suffer from the appraisal-smoothing problem and the apparent seasonality of appraisal-based indices. They suggest the hedged apartment REIT index can be employed as a proxy for apartment real estate in portfolio allocation decisions. For Hong Kong, Fu et al. (1994) examines the dynamics of the residential property market and the stock market in Hong Kong over 1984-1993. Changes in stock prices lead changes in residential property prices by one quarter in most cases. Chau and Newell (1996) examine the linkages between property company and commercial property performance in Hong Kong over 1984-1994. A one quarter lag is observed, with evidence of a “pure” property factor (as per Giliberto (1990)) seen in several property companies. However, Newell and McFarlane (1995) finds that property trusts do not capture a significant portion of direct property returns using correlation between the Australian property trust and commercial property returns over 1984-1994.

Opposite view

However, the use of indirect property as proxy for direct property can still be challenged for there is autocorrelation between the two series due to the smoothing of price indices. However, some studies show that even taking smoothing effect into account (by de-smoothing the series), the correlation is justified. Many US studies have focused on the nature of Equity Real Estate Investment Trust (EREIT) returns owing to their common use as proxies for real estate returns (for example, McCue and Kling, 1994). Giliberto (1990) studies the relationship between the National Association of Real Estate Investment Trusts (NAREIT) Equity Index returns and the NC Index returns. He finds no significant correlation between the NC Index returns and the NAREIT returns. He removes non-real estate variation from the two series by regressing both the NC Index returns and NAREIT Equity Index returns on stock market, bond market and seasonal variables. Giliberto finds the residuals of the two regressions are significantly correlated, suggesting there is extraneous variation masking the correlation. Giliberto also finds that the NC Index residuals are correlated with lags of the NAREIT residuals. The separate regressions are partially removing the effects of time and seasonality from the series. Giliberto (1993) extends this line of research by removing the stock market influences from the NAREIT Equity Index returns with a hedge factor. The adjusted returns are found to be correlated on a current and lagged basis with the NC Index returns. Giliberto (1990, 1993) suggests that there is a time offset between the two return series, and suggests that there is an extraneous variation disguising the relationship between the two return series. Liu et al. (1990) suggest that REIT are more integrated with the stock

market, while Ross and Zisler (1991) show that REITs are more volatile than valuation-based property returns. Gyourko and Linneman (1988) find evidence REITs behave more like stocks than real estate. Ambrose et al. (1992) prove that REITs follow a random walk when adjusted for short-run bias, and suggest that REIT returns may not be a good proxy for property returns. Downs (1994) argues that valuations in the property market and securities market naturally diverge. He claims that property markets look backward while securities markets look forward; securities market participants do not think about or place values on properties unless a REIT represents a securitized claim against only one property and REIT prices reflect movements in the stock market and not the real estate.

In Hong Kong context, the only form of indirect real estate investment is through investment in listed property stocks since there is no equivalent of the REITs as in the US context or the property unit trusts. As such, property stock returns have been a convenient proxy for real estate returns. However strong the intuitive arguments for using property stock returns as a proxy for property returns are, the question remains: ‘How good a proxy is the property stock index?’

3.3 Long-run relationship (integrated/ segmented)

From the review of the above literature, the question whether the diversification benefits can be achieved and whether indirect property are good proxy of direct real estate are important. However, notwithstanding the evidence concerning whether

property should be included in mixed asset portfolios, or whether property portfolios should be extended to include both direct and indirect property, most existing work fails to analyse the price of different assets as part of a co-integrated system of individually nonstationary series. This is important because the co-integration of price series for different assets have several implications, not least for asset diversification but also for price discovery (Barkham and Geltner, 1995).

Implication on Diversification

Existence of some long-run relationship between markets means that movements in one market are transmitted to movements in another. It implies that there may be little gain in risk reduction through holding investments in both areas. Traditionally, portfolio managers have held 5 and 20% of their investments in real estate.

It is true that most research were done on short-term for understanding them can help investors to capture on arbitrage between the two markets. The types of relationships investigated include cross-correlations (Firstenberg et al. 1988; Sagalyn, 1990), autocorrelations (Bluendell and Ward, 1987; MacGregor and Nanthakumaran, 1992) and causality tests (Myer and Webb, 1993; Gyourko and Keim, 1992, 1993; and Barkham and Geltner, 1995, 1996). They, however, concentrate on short-term relationships.

Implication on price discovery

A long-run view differs from the correlation analysis on returns which results in information loss. Hence it would be possible to find a stronger price discovery mechanism in the long run between the two real estate investment markets, to help analyze and predict the direct real estate investment market. So understanding the long-term relationship is important. The correlation is usually weak and the real estate return is typically lagged for several periods, so not much information seemed utilizable from other sources, including the indirect real estate investment market. Another problem is that if the asset prices are co-integrated, which means they have positive long-run relationship, the benefits of asset diversification may be less than implied by correlation alone. Then the conclusions of the many researches are actually incorrect. Alexander and Johnson (1994) stated that even if the correlation between assets is low and suggests potential gains from diversification, the existence of long-run relationship may limit the long-term benefits.

Previous empirical researches

Studies on the long-term relationship between the two markets are carried out in overseas context. No conclusive findings are made but they can provide more background for this study and they are reviewed here. Previous studies before Myer and Webb (1993) focus on the mean and standard deviation of returns. The authors extend the study of Giliberto (1990) by examining the intertemporal relationship between equity

REIT and real estate returns in the period 1978 to 1990 using a vector autoregressive model and carrying out granger causality test on the two return series. They found that the equity REIT index returns granger caused commercial property returns. Mixed results were obtained for individual REITs. Finally, some evidence of a common fundamental factor (or factors) in addition to the market return was present in both the retail REITs and retail stock (Myer and Webb, 1994). However, they question the significance of such factors when they discovered no contemporaneous relationship between retail real estate and either retail stocks or retail REITs. Liu et al. (1990) investigates the extent to which commercial real estate markets are segmented from capital markets in the context of the CAPM. Using a test developed by Jorion and Schwartz (1986), these authors find evidence to suggest that the commercial real estate market is segmented from the stock market. However, in the Liu et al. (1990) study, the evidence was actually contingent on whether the real estate returns were computed from appraised values or from imputed sales values, so the evidence was unclear as to whether the commercial real estate market and the stock market were segmented.

In Singapore, research studies employed price indices instead of REITs. Lau and Demon (1990) examined the characteristics and performance of property stocks, but no attempt was made to establish any relationship between property stock and real estate prices. Chan and Sng (1991) analyse the returns of real estate and property stocks in Singapore in 1976-1988. They conclude that the differences in real estate and property stock returns are not significantly different. However, no conclusive evidence has been offered to show how good property stock returns are not significantly different. Ong

(1995) investigates the relationship between property and stocks and real estate by testing for cointegration between the two price indices, but he fails to find any evidence that was supportive of a long-term contemporaneous relationship. Nevertheless, there was some evidence to suggest that the Singapore property price index leads the real estate market by a quarter. Due to inconclusive evidence obtained, Ong (1995) questions the use of property stocks as a proxy for real estate. Liow (1998a, 1998b) investigates the relationship between Singapore property stock and direct property returns in the period 1975 to 1994. He shows that the property stock returns exhibit market return characteristics associated with both the stock market and property market and that property stock returns appear to lead property returns by three to six months even in the presence of a common “pure” property factor in both market. He suggests property stocks can be regarded as proxy for direct property investments.

Oliver (1993) studies the influence of speculation on residential real estate prices in Australia. He argued that a high degree of integration between residential real estate markets and capital markets is unlikely. His proposed reasons are the high transaction costs, thin markets, heterogeneous commodity (no two parcels of real estate are exactly the same) and so on.

In HK, there are no REITs and thus studies are carried out using property stocks and the literature suggests segmentation between the two markets. Fu et al. (1994) applied Granger (1969) causality test to quarterly data of residential property prices in Hong Kong and the Hang Seng Index of the Hong Kong stock market. These authors found that

changes in stock prices led to changes in property prices, but not vice versa. Such results appear to support market segmentation. However, Okunev et al. (1996) doubted the result for the study period was relatively short- from 1984 to 1993. Chau et al. (2001) examines price discovery for four sectors of the Hong Kong property market. He uses data for his analysis from year 1984 to 1996. The authors conclude that the returns to securitized real estate in Hong Kong convey little or no information about the appraisal-based returns to Hong Kong real estate.

3.4 Co-integration

Co-integration analysis is a test for relationships between non-stationary variables. It is an econometric tool pioneered by Engle and Granger (1987) and it has very wide ranging application value. Dr. Clive Granger and Dr. Robert Engle won Nobel Prize for economics in 2003 for having made critical breakthroughs in techniques to handle "time series" variables. Previously, economists had often claimed a correlation between two or more such variables which turned out to be spurious, being driven simply by the fact that both followed a trend - an error pointed out by Professor Granger in the mid-1970s. The prize clearly reflects how widely the co-integration techniques have become used. The statistical analysis of time-series is often predicated on covariance stationarity. Non-stationary data is usually differenced to obtain stationarity. Such treatment, however, may result in a loss of long-run characteristics of the data. Engle and Granger (1987) show that if two non-stationary variables, though stationary only after differencing, can be

linearly combined such that the combination is stationary in level, then the two variables are said to be co-integrated. If two series variables are co-integrated, then their permanent trends would adjust to an equilibrium state, and error correction models could be identified to adjust for transitory deviations. Co-integration analysis can thus sieve out spurious regressions.

The co-integration method can be used to test whether there is an equilibrium relationship between the price processes generating the returns for two assets. Co-integration tests encompass tests based on the rate of return and have the advantage of retaining all of the stochastic and nonstochastic trend information available in the price series.

In overseas studies in real estate, this technique has actually been widely used. He (1995) analyses the relationship between equity and mortgage real estate investment trust (REIT) stock prices performing co-integration tests and causality tests and estimating an error correction model. Ong (1994) tests for co-integration between the price indices for property shares and direct property in Singapore and finds no evidence of a long-term relationship. However, when Ong (1995) models changes in direct property prices using changes in property share prices, interest rate and an error correction term, he finds a long-term equilibrium relationship between property share prices, real estate prices and interest rates. Matysiak et al. (1996) finds a co-integrating relationship between indirect property and the share and direct property market in the UK. They also found error correction from indirect property to direct property and this error correction occurs with

an 18-month lag. Okunev and Wilson (1996) test for integration between the markets for various REITs and the US stock market as measured by the S&P 500. They find a relationship between the real estate markets and the stock market but admit that ‘the tie is weak and non-linear’ (Okunev and Wilson, 1996, p.16). Chang and Lee (2000) also employ the co-integration test and error correction model (ECM) to investigate the short-term and long-term relationships between the housing market and stock market from 1991 to 1998.

There are several reasons proposed for why such relationship should exist. Tse (2000) examined the impact of real estate prices on real estate stock prices in Hong Kong. He suggests real estate market is a major determinant of changes in real estate stock prices by arguing that real estate-related stocks account for a substantial portion of Hong Kong’s stock market (over 30% in 1997). Indirect property vehicles such as property companies are specialized portfolios of real estate asset holdings whose underlying performance is expected to tie to the property market. However, their shares are valued in the stock market. Under the rationale that the market price for a stock is essentially the market value of the underlying assets of the company, the performance of indirect real estate may be more reflective of stock market performance than the underlying physical property performance (Martin and Cook, 1991). Fundamentally, the returns on the indirect real estate investment would not be independent of its underlying asset, suggesting that the returns on the two series representing the two assets would not always diverge, at least in the long run, even if, in the short term, there might exist no clear relationships. Intuitively, this long-term relationship exists.

3.5. Effect of 1997 financial crisis

If the long-run relationship exists, it means that there exists a common factor of between the two assets. e.g. property factor. If the fundamental between the two markets holds, the two markets shall respond similarly to changes in common price factors. The rationale is that prices adjust quickly in response to market changes in a efficient and competitive markets. Allen et al. (1999) study the relationships between mortgage rates and capital-market rates under alternative market conditions and find that their co-integration change in different market conditions. Daly (2003) examines the linkage between Southeast Asian stock markets and makes a comparison between two periods: Pre- and Post-Asian Financial Crisis to examine the effect, if any, on the integration of those markets.

Degree of integration can be strong or week and the integration between the direct and indirect real estate market in Hong Kong is the subject of this study. Although Market conditions change (down in real estate and down in property), if the fundamental does not change, the integration should more or less remain. It is worth to study whether this integration change for this have great implication to institutional investors. Whether the relationship changes or not, it warrants further researches for the behind reasons because they can have great implications for institutional investors. No conclusive findings on whether the direct and indirect real estate markets are really segmented.

3.6 Conclusion

So the literature on relationship between direct and indirect real estate investment are reviewed. It should be understood that the main theme for this area of research are diversification and price discovery when we talk about portfolio. Inconclusive evidence for diversification and price discovery between the two markets lead to the need to answer the question of whether indirect property is a good proxy of direct property and also whether the diversification benefit can be achieved. These two questions can actually be explained by examining the long-term relationship between the two markets. This is an empirical question whether the long-term relationship exist or not. As reviewed in the above section, co-integration analysis is a suitable method to be employed. The 1997 financial crisis is a watershed of both markets in Hong Kong and it is reviewed from literature that long-run relationship can be affected by shock. So the effect of 1997 on the long-term relationship between the two markets is an interesting question. This study extends the time of study and market cycles to address the question whether the relationship hold or not during different market conditions.

CHAPTER FOUR

METHODOLOGY AND DATA

4.1 Introduction

In this study, the long-run equilibrium relationship between direct and indirect real estate will be examined. Literature on the background and some applications of co-integration in real estate are reviewed in previous chapter. Co-integration test is suitable for the purpose of this study and the tests will be applied in two separate market times. The objectives of this chapter are to describe the general principles of co-integration methodology, to specify the co-integrating regressions and to outline the testing procedure. Finally, the data required and the source will be discussed.

4.2 Stationarity and Non-stationarity

A time series consists of a collection of observations, made sequentially through time, on a variable that is or may be represented as numerical (Peracchi, 2001). A time series is said to be stationary if its mean, variance and covariances remain constant over

time. Any series that fails to satisfy any part of the above definition is said to be non-stationary.

The canonical example of a non-stationary time-series is the random walk:

$$Y_t = Y_{t-1} + \varepsilon_t \quad (1)$$

where ε is a stationary random disturbance term.

The series Y has a constant forecast value, conditional on t , and the variance increases over time. The random walk is a difference stationary series if the first difference of Y is stationary:

$$Y_t - Y_{t-1} = (1 - L)Y_t = \varepsilon_t \quad (2)$$

A differenced stationary series is said to be integrated and is denoted as $I(d)$ where d is the order of integration. The order of integration is the number of unit roots contained in the series, or the number of difference operations it takes to make the series stationary. For the random walk model, there is one unit root, so it is an $I(1)$ series. Similarly, a stationary series is $I(0)$.

4.3. Spurious regression

Suppose we are interested in relationship between X and Y so that we estimate the following regression: $Y_t = \alpha + \beta X_t + e_t$. e_t is used here to highlight the fact that residuals from a regression will not generally be white-noise. The assumptions of the classical regression model necessitate that both X_t and Y_t series be stationary and that the errors have a zero mean and a finite variance. In such a case, autocorrelation and distributed lag models can be used conveniently using the OLS estimation to establish the relationship between X and Y . If X and Y are non-stationary, i.e. they have unit roots then all the usual regression results are actually spurious as Granger and Newbold (1977) suggests. A spurious regression has a high R^2 and t-statistics of coefficients that appear to be significant, but the results are without any meaning. The regression output “looks good” even in the absence of any causal relationships between them because the data on variables trend consistently over time making the least-squares estimates not consistent and the customary tests of statistical inference do not apply.

4.4. Co-integration

As mentioned in the above section, a regression of Y on X should never be run if they both are non-stationary. However, if X and Y are co-integrated, the problem of spurious regression problem needs not be worried. Engle and Granger (1987) show that, if two non-stationary variables, though stationary after differencing, can be linearly combined such that the combination is stationary in levels, then the two series are said to

be co-integrated. Thus co-integration is said to occur between X and Y when the following two conditions occur simultaneously: (1) both the time-series X and Y are I(1), that is, become stationary on first differencing, and (2) there is some linear combination of X and Y that is I(0), that is, stationary. Co-integration is actually the statistical equivalent of the existence of long-run economic relationship between I(1) variables. Many economic time series are I(1) and they are useful data for different tests in many different areas. That's why co-integration is widely cited in many studies.

4.5 Unit Root Test

This study is about long-term relationship between the direct and indirect real estate market. So co-integration is employed. However, a two-variable co-integration test requires that variables be integrated of order one, the data should be stationary only in the first difference, and not in levels. Time series of I(1) exhibit trend behavior but we cannot ascertain stationarity of a time series by merely observing the time series plot. The reason is simple because there are many other models also imply trend behavior. So unit root test need to be applied to test the unit roots. Actually, Maddala (1992, p.585) warns that both visual inspection and the unit root test should be carried out before deciding on whether the time-series process is nonstationary.

The most commonly used test for testing unit roots is the Dickey-Fuller test (Dickey and Fuller, 1979). So the first step in the test is applying the Augmented Dickey-Fuller (ADF) test to the data to establish the order of integration.

In this study, the Dickey-Fuller test is applied in three models: the standard stochastic process, stochastic process with drift, and deterministic trend with drift. Formally stated, the three models are:

$$\Delta Y_t = \lambda_t \cdot Y_{t-1} + \varepsilon_t \quad (3.1)$$

$$\Delta Y_t = \lambda_0 + \lambda_t \cdot Y_{t-1} + \varepsilon_t \quad (3.2)$$

$$\Delta Y_t = \lambda_0 + a \cdot t + \lambda_t \cdot Y_{t-1} + \varepsilon_t \quad (3.3)$$

The three models are estimated and see which one may be rejected before moving onto the subsequent analysis. The reason for using difference stationary series instead of AR(1) processes is to prevent multicollinearity problems. The difference between the three regression concerns the presence of the deterministic elements λ_0 and $a \cdot t$. In all cases, the parameter of interest in the regression equations is λ_t ; if $\lambda_t = 0$, the Y_t contains a unit root. The test involves estimating one (or more) of the equations (3.1-3.3) using OLS in order to obtain the estimated value of λ_t and the associated standard error.

Comparing the resulting τ statistic with the critical values reported in the Dickey Fuller tables, it can be determined whether to accept or reject the unit root hypothesis.

The methodology is precisely the same regardless of which of the three forms of the equations is estimated. However, the critical values of the τ statistic do depend on whether an intercept and/or time trend is included in the regression equation. In their Monte Carlo study, Dickey and Fuller (1979) found that the critical values for $\lambda_t=0$ depend on the form of the regression and sample size. The ADF test consists of running a regression (equation 2) of the first difference of the series against the series lagged once, lagged difference terms, and optionally a constant and a time trend.

ADF test is actually a modified version of (3.3) by augmenting extra differenced terms. The reason for adding additional terms is to control for the possibility that the error term in one of the equations (equations 3.1 to 3.3) is autocorrelated. Thus, the following regression needs to be estimated:

$$\Delta X_t = \lambda_0 + \lambda_t X_{t-1} + \sum_{i=1}^n \Psi_i \Delta X_{t-i} + \varepsilon_t, \quad (4)$$

where Δ is the difference operator;

X is the natural logarithm of the time series;

λ and Ψ are the parameters to be estimated; and

ε_t is the error term

Choosing numbers of lags

One step here is to determine the n_{\max} . The coefficients of the lagged values of ΔX_{t-1} in equations 3.1 through 3.3 are generally not of interest. However, it is important to have a suitable lag length to ensure that the ε_t approximates white noise. Including too many lags reduces the power of the test to reject the null of a unit root since the increased number of lags necessitates the estimation of additional parameters and a loss of degrees of freedom. The degrees of freedom decrease because the number of parameters estimated has increased and because the number of usable observations has decreased. (One observation cannot be used for each additional lag included in the autoregression.) On the other hand, too few lags will not appropriately capture the actual error process so that λ_t and its standard error will not be estimated. Nevertheless, the theory provides little guidance on choosing this. Schwert (1987) shows that if the lag length is not properly chosen the unit root test may often lead to a false conclusion that the economic data are stationary. He suggests that the optimal value chosen for n should be allowed to determine the appropriate lag in the ADF test as:

$$n = \text{Int} \left\{ 4 \left(\frac{T}{100} \right)^{\frac{1}{4}} \right\} \quad (5)$$

where T is number of observations;

and n is number of lags

After choosing a tentative lag length, we can conduct a diagnostic checking. The residuals are plotted as a diagnostic tool. There should not appear to be any strong

evidence of structural change or serial correlation. Moreover, the correlelogram of the residuals should appear to be white noise. The Ljung-Box statistic should not reveal any significant autocorrelations among the residuals. In this study, we use Schwartz criterion that we choose the number of lags so that the SC statistic is the minimum.

If the estimated coefficient of the target variable, λ , is significantly less than zero, the null hypothesis that X contains a unit root ($=0$) should be rejected. The t-statistic used here is not the student t-distribution because X follows a random walk if the null hypothesis is true. Rather, augmented Dickey-Fuller (ADF) statistic or τ (tau) statistic will be used and be compared to specially constructed critical values generated from Monte Carlo Simulations.

The critical values of the τ (tau) ratios are originally tabulated by Dickey and Fuller (1979) and the test using these critical values has become known as the D-F test. The critical values can also be found in Engle and Granger (1987), Engle and Yoo (1987), Philips and Ouliaris (1990) or Guilkey and Schmidt (1989). In addition to testing if a series is a random walk, Dickey and Fuller also developed critical values for the presence of a unit root (a random walk process) in the presence of a drift. Mackinnon (1991) criticizes the values by previous studies as inaccurate for they are based on a few finite sample sizes. He calculates his own set of values by much larger set of simulations permitting the calculation of Dickey-Fuller values for any sample size and for any number of right-hand variables and he concludes that his set of value should be accurate enough for all practical purposes. So the critical values of Mackinnon (1991) can be

regarded as an extension of those calculated by Dickey and Fuller (1979). This study uses the Mackinnon (1991) critical values for the unit root test and co-integration test.

If the tau statistic is less than the critical values, then the null hypothesis of a unit root (non-stationarity) is rejected, i.e. the series is stationary. If not, then the first-differenced time series is used to estimate the regression in equation 4. If the null hypothesis is rejected, then the first-differenced time-series is considered stationary, and the level series is integrated of order one, i.e. $X \sim I(1)$.

4.6 Tests for co-integration

Testing for co-integration implies stationarity for linear combination of the subject time series. Although, when X_t and Y_t are co-integrated, the simplification search in a general-to-specific investigation should lead to an ECM (error correction model) of some kind. Engle and Granger (1987) suggest a Engle-Granger two-stage procedure will be employed to test for co-integration between the two variables X and Y . In section 4.5, the two series X_t and Y_t are tested to see if they are both $I(1)$. In this two-stage procedure, the disequilibrium error u_t in (4) will be tested to see if it is $I(0)$.

The first step in this Engle-Granger two-stage procedure is to estimate the co-integration regression such that:

$$Y_t = \alpha + \beta X_t + u_t \quad (6)$$

where α and β are co-integrating parameters;

and u_t is the error term

This equation represents the hypothesized disequilibrium condition between the time-series X and Y if u_t is white noise. So, first OLS is used to compute the following:

$$\hat{Y}_t = \hat{\alpha} + \hat{\beta} X_t \quad (7)$$

The second step is using the residual from (5) to estimate u_t in (4):

$$\hat{u}_t = Y_t - \hat{\alpha} - \hat{\beta} X_t \quad (8)$$

\hat{u}_t is then tested to see if they are stationary. Stationary residuals imply that X_t and Y_t are co-integrated. Three tests are usually applied: the Dickey-Fuller and augmented Dickey-Fuller tests and also the Durbin-Watson statistic (referred to as the Co-integration Regression Durbin Watson (CRDW) test).

CRDW (Co-integrating Regression Durbin-Watson) test is the simplest test for co-integration. After estimating the co-integrating regression, equation (6), the next step is calculating the Durbin-Watson statistic which is given by

$$DW = \frac{\sum(\hat{u}_t - \hat{u}_{t-1})^2}{\sum \hat{u}_t^2} \quad (9)$$

If the residuals, \hat{u}_t , of the co-integrating regression are integrated of order 1, then the CRDW statistic will be close to zero, suggesting that the two variables are not co-integrated. If the CRDW is significantly different from zero, then X and Y are co-integrated. The DF and ADF procedures are carried out on \hat{u}_t using the ADF regression estimated as in the following equation:

$$\Delta\hat{u}_{t-1} = \delta_1\hat{u}_{t-1} + \sum_{i=1}^n \delta_{1+i}\Delta\hat{u}_{t-i} + \varepsilon_t \quad (10)$$

Thus evidence of co-integration is provided by:

- a ADF test statistic smaller than the critical value; or
- a CDRW statistic significantly greater than the critical values (where critical values can be obtained also from Engle and Granger (1987)).

Here DF and ADF tests are applied to the residuals from the co-integrating regression (7) rather than to the true disequilibrium errors u_t in (6). Since OLS minimizes the sum of the squared residuals, it naturally seeks out a sample regression line that has stationary residuals. Consequently, the downward bias in the OLS estimate of δ is even greater than in the normal tests for stationarity. Thus the t-ratio on the OLS estimate $\hat{\delta}$ has to be even more negative than the critical values used in normal DF and ADF tests before the null hypothesis of non-stationary residuals can be rejected.

4.7 Data and procedures

This dissertation employs the data of the Hong Kong commercial property market and the Hong Kong stock market from the first quarter of 1986 to the second quarter of 2003.

4.7.1 Direct property

This study employs the Property price Index of the overall office market as the proxy for Hong Kong direct property price. The data are compiled by the Rating and Valuation Department (RVD). These property indices are based on actual transactions but not on appraisals. RVD divided property in Hong Kong into four main types: residential, office, retail and industrial. For each type, smaller categories are defined. For instance, offices are further defined into grade A, B and C. Here in this study, the overall price index of office will be employed and it is denoted as COM. Quarterly data are reported until 1993 and RVD started to publish monthly index since then. It is better to use the monthly index for carrying out the statistical tests as outlined above for this can increase the number of samples by four times. However the study period covers time before 1993, thus only quarterly data are used. The property price indices are extracted from various issues of Hong Kong Property Review published by Rating and Valuation Department.

The base index for the indices before 1999 was $1989 = 100$, later the base was changed to $1999=100$. So the prior indices are transformed to the same base $1999=100$ first using the following formula:

$$NI_t = \frac{OI_t}{I_{1999}} \times 100 \quad (11)$$

where NI_t = transformed property price index with new base of 1989=100 at time t;

I_{1999} = non-transformed property price index at 1999;

and OI_t = non-transformed property price with base of 1989=100 at time t

4.7.2 Indirect property

The proxy for the indirect property market is the Hang Seng Property sub-index²¹ and it is denoted as HSP. Hang Seng Property sub-indices are compiled and managed by the Hang Seng Index Services Ltd.

The Hang Seng Index is the most widely quoted indicator of the Hong Kong stock market performance given its long history and popularity among both local and international investors. The Hang Seng Index is made up of 33 stocks. There are four sub-indices- Finance, utilities, Properties and Commerce & Industry. Table 4.1 lists the 33 constituents stocks of Hang Seng Index as at the end of. However, in this case, quarterly Hang Seng Property sub-indices need to be used to compare the quarterly property price index. The quarterly Hang Seng Property sub-indices are computed by averaging the monthly indices extracted from various issues of Hong Kong Monthly Digest of Statistics published by the Hong Kong Census and Statistics Department.

²¹ For constituents of property stock sub-index, refer to table A-1 in appendix

4.7.3 Procedure

In this study, the natural logarithms of overall office price indices (base: 1999=100) and the Hang Seng Property sub-indices are used. They are labeled as LNCOM and LNHSP respectively. Applying the above methodology of unit root tests (DF tests and ADF tests, using appropriate specifications), each series is first checked whether they are stationary and integrated of what orders. In the co-integration tests, Y_t is LNHSP series and X_t is LNCOM series. Two co-integration regressions for property stocks and property price indices are estimated using HSP and LagHSP as the dependent variables. The rationale is predicated on the reasoning advanced by Martin and Cook (1991). The performance of property stocks is expected to be influenced by the performance of the real estate market since property stocks derive their value from the property market. Lucas (1976) propounds the efficient market theory and the rational expectations theory to argue that the stock market speedily discounts information affecting its future outlook. Therefore, HSP lagged one (one quarter) is also tested. The lagged dependent variable is denoted by LagHSP. The detailed procedures and equations are provided in section 6 of this chapter. The whole procedure for unit root tests and co-integration tests is carried out for three times. One is on the pre-1997 period (1986Q1 – 1997Q3), one is for post-1997 period (1997Q3 – 2003:Q2) and one is for the whole study period of 1986Q1 – 2003Q2. The testing procedures are similar for the three tests except that there may be difference for choosing the number of lags and the specifications.

4.8 Conclusion

Considering the applications of co-integration tests, the long-term relationship can be tested by running the co-integration regression between COM and HSP. The data cover the period from 1986-2003. Each series is tested for stationarity by ADF tests. The specification of the equations (equation 3.1 to 3.3) will be chosen and the number of lags to be included (equation 4) will be determined by using Schwert's formula (equation 5) and Schwartz criteria. After checking whether both series are $I(1)$, the residual of the co-integrating regression between COM and HSP will be tested to see if they are stationary. It is actually another ADF test for it is essentially a unit root test, but another set of critical values are used. If the residuals are stationary, then the two series are co-integrated and vice versa.

CHAPTER FIVE

RESULTS AND ANALYSIS

Following the methodology explained in the previous chapter, the stationarity of logarithms of HSP and COM indices were tested by both DF and ADF tests. Then co-integration test was applied to the two series. In this chapter, first the results of the stationarity tests and co-integration tests are presented. Then the results from the pre-1997 and post-1997 period are compared. The implications of the results will be studied in order to achieve the third objective of this study.

5.1 Pre-1997 period (1986 – 1997)

5.1.1 Unit root test

For both time series, LNCOM and LNHSP, specifications in Model 3 are tested first. In the LNCOM series, model 3 was rejected and the intercept is statistically significant (i.e. drift was significant for COM), and Model 2 was adopted for the subsequent analysis. In the LNHSP series, both the trend and intercept are significant and Model 3 was adopted for subsequent analysis. According to the Schwert's formula, 3 lags were

adequate to generate white noise for both series. The ADF tests were based on 3-order lags and the best specification for ADF tests was selected. Using the critical values generated by Mackinnon (1991), the null hypothesis of unit root is only rejected when the computed t-ratio (tau statistic) for the lagged term is less than the lower bound critical value at the 1% confidence level. The more stringent 1% confidence limit is deemed to be more appropriate in unit root analysis since one simulation of t-ratio critical value for $m=0$ can differ remarkably from another (see Charemza and Deadman, 1992, pp. 132 and 317).

Table 5-1 shows the results of the DF and ADF tests. The tau statistics for both DF and ADF tests are higher than the critical value {1%} on levels, leading to the non-rejection of the null hypothesis of unit root. However, the first-differenced series of HSP shows that the null hypothesis can be rejected even at the 1% confidence interval and the first-differenced COM series shows that the null hypothesis can be rejected at 1% for DF test and 5% for ADF test. Hence, the COM and HSP are stationary when first-differenced. Using the terminology as explained, COM and HSP are therefore integrated of the first order, i.e. $COM \sim I(1)$ and $HSP \sim I(1)$

Table 5-1 Results of the DF and ADF tests for pre-1997 period

	DF Level	DF Difference	ADF Level	ADF Difference
COM	-2.597093	-3.839721*	-2.237174	-3.403769**
HSP	-3.639834	-7.220450*	-3.48569**	-5.09327*

Note: * indicates that the t-ratio of the lagged term is less than the critical value at 1% confidence level, while ** indicates that the t-ratio is less than the critical value (lower bound) at 1% confidence level, implying that the null hypothesis of unit root is rejected.

5.1.2 Co-integration test

Two co-integration regressions for property stocks and property price indices are estimated using HSP and LagHSP as the dependent variables. The performance of property stocks is expected to be influenced by the performance of the real estate market since property stocks derive their value from the property market. HSP lagged one (one quarter) is also tested and the lagged dependent variable is denoted by LagHSP. The three co-integration tests (CRDW, DF and ADF) tests are carried out on the residual terms from the co-integration regressions, since the co-integrating vectors are not known a priori.

The tests results are shown in table 5-2. The CRDW statistic 0.326 is higher than the critical value of 0.322 at 10% confidence level but lower than critical values of 0.386 and 0.511 at 5% and 1% confidence levels. The co-integration may exist, although it is not likely. Benerjee et al. (1986) provides that CRDW test is highly dependent on the goodness of fit of the ordinary least squares (OLS) estimate and the general rule of thumb is that if the CDRW is less than the coefficient of determination (R^2), then the co-integration hypothesis may be false. In this case, the co-integration hypothesis is not rejected only at 10% interval and the fact that CRDW is less than the R^2 suggest the co-integration hypothesis is likely to be false.

The Engle and Granger critical values for 1%, 5% and 10% are -3.77, -3.17 and -2.84 respectively. The t-ratios under the DF and ADF tests are higher than the upper bound critical values. The DF and ADF tests do not reject the null hypothesis of unit root

even at 10% confidence level. Since the error terms under the DF and ADF tests are non-stationary and are not integrated, the study concludes that HSP and COM are not co-integrated.

When LagHSP is used to regress against COM, the CRDW statistic is 0.308 which is even smaller than the critical value of 0.322 at 10% confidence interval, although they are quite near. The tau statistics under the DF and ADF tests are higher than the upper bound critical values and thus the null hypothesis of unit root cannot be rejected. So there are no co-integration between LagHSP and COM.

Table 5-2 Co-integration test- CRDW, DF and ADF tests for pre-1997 period

	Coefficient of Const	LNCOM	Adjusted R ²	CRDW	DF	ADF
LNHSP	3.450685 (9.633936)	1.110506 (15.50634)	0.838849	0.326372***	-1.7048	-1.60025
LagLNHSP	3.230133 (8.918518)	1.14308 (15.86577)	0.84783	0.308485	-1.56986	-1.47213

Note: Figures in parenthesis indicate the t-ratios associated with the coefficients.
 * indicates significance at 1% confidence level and *** indicates significance at 10% confidence interval.

5.2 Post-1997 (1997 – 2003)

5.2.1 Unit root test

For both time series, LNCOM and LNHSP, the estimated coefficient for t were found to be insignificant and the intercepts in both time series were tested to be

significant statistically. Thus model two was adopted for the DF test and the subsequent analysis. The results for the unit root tests are shown in table. Taking into account of Schwart criterion, the number of lags should be chosen was 0, so in this case only the DF test was adopted for unit root tests on both series. Table 5-3 shows the result of the DF tests. The tau statistics for both COM and HSP are higher than the critical values even on only {10%} level. Thus the null hypothesis of unit root cannot be rejected. On the other hand, the first- differenced series of both COM and HSP show that the null hypothesis can be rejected even at the 1% confidence interval. Hence, COM and HSP are stationary when first-differenced and therefore COM and HSP are integrated of the first order, i.e. $COM \sim I(1)$ and $HSP \sim I(1)$.

Table 5-3 Results of DF and ADF tests for post-1997 period

	DF Level	Difference	ADF Level	ADF Difference
LNCOM	-2.04912	-4.66239*	Follow DF	Follow DF
LNHSP	-2.37966	-5.69194*	Follow DF	Follow DF

Note: * indicates that the t-ratio of the lagged term is less than the critical value at 1% confidence level

5.2.2 Co-integration test

The results of the co-integration test are summarized in table 5-4. For the HSP series, the CRDW statistic of 0.754 is significantly higher than the critical value at even 1% confidence level (0.511) and suggesting that co-integration exists. However, the adjusted R^2 of the regression is very small and the CRDW is much larger than the R^2 . So the co-

integration hypothesis may be false. The tau statistics under the DF and ADF tests are higher than the critical values. The null hypothesis cannot be rejected even at the 10% confidence interval. It should be concluded that HSP and COM are not co-integrated.

When LagLNHSP is used to regress against LNCOM, the CRDW is also significantly higher than the critical values and suggesting that co-integration exists. However, by the same argument, the adjusted R^2 in the regression is very small and the co-integration hypothesis should be regarded as false. The tau statistics under the DF and ADF tests are higher than the critical values even of {10%}, thus the null hypothesis cannot be rejected. It should be concluded that LagLNHSP and COM are not co-integrated.

Table 5-4 Co-integration test- CRDW, DF and ADF tests for post-1997 period

	Coefficient of Const	LNCOM	Adjusted R^2	CRDW	DF	ADF
LNHSP	8.941692 (17.68782)	0.135144 (1.252831)	0.024166	0.754471*	-2.67212	-1.54177
LagLNHSP	8.709646 (17.07055)	0.193019 (0.0901)	0.085241	0.725651*	-2.32041	-2.2146

Note: Figures in parenthesis indicate the t-ratios associated with the coefficients.

* indicates significance at 1% confidence level

5.3 Whole sample period (1986 – 2003)

The test over the whole sample period was carried out to ensure the robustness of the study. The results from table 5-5 and 5-6 confirm the robustness of the initial tests.

5.3.1 Unit root test

In the LNCOM series, the estimated coefficients are significant for both the time trend t and the intercept. Thus model 3 was adopted as the specification for the DF test and the subsequent analysis. In the LNHSP series, the estimated coefficient for t was shown to be insignificant but the intercept was tested to be significant statistically. Thus model two was adopted for the DF test and the subsequent analysis. The number of lags is determined on the Schwert’s formula and Schwartz criterion. In the case of COM series, one-order lag was already adequate to generate white noise. So the ADF test on COM series was based on one-order lag. In the case of HSP series, taking the SC criteria into account, the best specification should be based on $n=0$, i.e. the DF test is enough for the unit root test. The results for the unit root tests are shown in table. For both LNCOM and LNHSP series, the tau statistics on DF and ADF tests are higher than the critical values. However, the tau statistics of DF tests and ADF tests for both COM and HSPCOM first-differenced series are more negative than the critical values of even {1%}, this suggests that the COM and HSP are integrated of the first order, i.e. $COM \sim I(1)$ and $HSP \sim I(1)$.

Table 5-5 Results of the DF and ADF tests for the whole period

	DF Level	Difference	ADF Level	ADF Difference
LNCOM	-0.913814	-5.808941*	-1.245503	-4.383513*
LNHSP	-2.715452	-8.726481*	-2.715452, DF	-8.726481, DF*

Note: Figures in parenthesis indicate the t-ratios associated with the coefficients.

* indicates significance at 1% confidence level

5.3.2 Co-integration test

In both cases when HSP and LagHSP were used as the regressors against the COM series, the CRDW statistics are much lower than the critical values. Also, the tau statistics under the DF and ADF tests are higher than the critical values. The null hypothesis cannot be rejected even at the 10% confidence interval. It should be concluded that neither HSP nor LagHSP is cointegrated with COM.

Table 5-6 Co-integration tests- CRDW, DF and ADF tests for the whole period

	Coefficient of Const	LNCOM	Adjusted R ²	CRDW	DF	ADF
LNHSP	5.613323	0.729787 (6.539880)	0.377088	0.106501	-1.646498	-1.319845
LagLNHSP	5.729230	0.703186	0.326500	0.090743	-1.556459	-1.194544

Note: Figures in parenthesis indicate the t-ratios associated with the coefficients.

* indicates significance at 1% confidence level

5.4 Comparison of the two periods

From the above results, it can be shown that both the HSP and COM are non-stationary but they are integrated of first order in both the pre-1997 and post-1997 periods.

However, there is no evidence to support a long-run relationship between the Hong Kong commercial property and property market over either the pre- or post-1997 periods, since the null hypothesis cannot be rejected in either case.

5.5 Implications of study

After carrying out the tests and having the results presented, in this section the implications of the results will be discussed. Also, reasons will be proposed to explain the lack of long-term relationship between the two markets.

Investors generally use assumptions about economic forces to guide their investment strategies. However, it is unlikely one will have a good investment strategy without an understanding of the competitive environment. Given the importance of property in Hong Kong economy, particular attention should be directed to the interaction of direct and indirect real estate prices, for they are two important and interesting sectors in Hong Kong. The question whether long-term equilibrium exists between the two important investments in Hong Kong has great implications to the investment strategy of the institutional investors. The results in last chapter that there is no co-integration between the direct and indirect real estate investment have many implications and these implications will be investigated in this chapter.

Non-stationaroty

The unit root tests are carried on the series representing the value of investment in direct commercial real estate (COM) and that represents the value of investments in property stocks (HSP). The two series are not stationary in each of the study period. So the non-stationary nature of the two time-series is confirmed. One important implication of the non-stationary nature of the two series is that conventional tests are no longer valid

because most established statistical procedures require stationarity and the co-integrated process should be employed instead to discern whether real estate indices exhibit a long-run equilibrium relationship with the time series of other financial assets.

Co-integration

The co-integration test shows in no unambiguous terms that there is no contemporaneous co-integration between the COM and the HSP. There is also no evidence of co-integration between the lagged term of the HSP and the COM index. The co-integration regression can pass none of the CRDW, DF and ADF tests. The finding that the LagHSP did not have a superior long term relationship with the COM contradicts with the rational expectations and efficient market theories that price discovery in direct real estate investment and indirect real estate investment in the stock market can be achieved.

The finding of no co-integration between the two markets in either of the period of study indicates that the long term relationship between the two markets cannot be established. Giliberto (1990) identifies that there be a common factor associated with both direct and indirect real estate in the US and named this factor as “pure” factor. Intuitively, Hong Kong indirect and direct real estate should have a common factor between them too so that they can co-move together in the long-run for the property companies invest heavily in the office sector. This linkage however is shown to be a weak one. There are fundamental differences between the characteristics of direct and

indirect property in Hong Kong. The finding that there is no common stochastic trend between direct and indirect real estate in Hong Kong has important implications in real estate pricing, market efficiency and also asset diversification. Engle and Granger (1987) have shown that, if a system of variables is co-integrated, then these variables are tied together in a long-run equilibrium relationship. In that event, an error-correction mechanism (ECM) can represent the co-integrated variables. However, the lack of co-integration suggests that co-integration is consistent with market efficiency. It is difficult to profit by trading in commercial real estate indices.

Diversification

Markowitz proved that low correlations are necessary for diversification. However, when asset prices are co-integrated such that there is some tendency in the long run for two or more series not to drift too far apart or move together then the benefits of correlation may be less than that implied by correlation alone. This is because short-run correlation coefficients will underestimate the long-run relationship between asset classes. The lack of long-run equilibrium relationship between the two markets in either study period has important implication on diversification. The two markets are segmented and hence institutional investors can achieve diversification if the portfolio consists of both direct real estate and property stocks. Also, the lack of long-run equilibrium renders the property stock not a good proxy of the direct real estate investment in Hong Kong. The implication is that the institutional investors cannot substitute the direct real estate investment with the property stocks. Of course it is tempting to use property stock as a

proxy for real estate in Hong Kong for it is an attractive sector for them to invest. If the indirect real estate, the property stock, is a good proxy of the direct property, they can simply substitute the direct real estate with the property stock so that they can

Price discovery

Second, co-integration of assets may also affect the analysis of the dynamic relationships among these assets. For example, the price discovery process that establishes causal flows from one or more asset class to another may be misspecified, resulting in the spurious forecasting of prices. It is then important to ascertain the co-integration (or lack thereof) for price series under investigation. If the series are co-integrated, it is possible to increase the accuracy of previous results by including the long-run relationships in the study of returns. If the long-run equilibrium

Asian Financial Crisis

The question whether Asian Financial Crisis has increased the integration between the two investments is answered. The economic crisis did not cause substantial change of the integration between the two markets. The results lends support to the literature for the lack of integration between direct and indirect real estate. This lack of long-run relationship has great implications to institutional investors for their investment strategy in property investment in Hong Kong.

Market integration implies the existence of long-run equilibrium relationship between markets such that movements in one market are transmitted to movements in another.

Possible reasons for lack of co-integration

After studying the implication of the lack of long-run equilibrium between the two markets on the investment strategy and asset allocation of institutional investors, attempt is made here to explain why it is so:

Firstly, Property stocks are affected by exogeneous as well as endogeneous factors which impact the stock market as a whole. Stock market shocks in 1993, 1997, 1998 and 1999 increased the volatility of stock returns. The volatility of property stock and real estate returns. The effects of exogeneous shocks on real estate are usually felt more slowly and are less transient. The nature of real estate transactions that there is no central market-place and complex finance agreements need to be relied upon also leads to a more gradual adjustment on prices. The disparate volatility of property stocks and real estate has been noted by Duben and Sayce.²² Such an observation is also consistent with the findings from Ross and Ziser (1991) and Scott (1990).

Secondly, the location-specific nature of real estate makes comparison between property and property-stock indices difficult.²³ Property companies can only be evaluated

²² See Dubben and Sayce (1991) page 69.

²³ See Jaffe and Sirmans (1989) page 22-25 for unique nature of real estate investment.

on the finite number of property assets they hold, and they cannot adequately represent the unique and differentiated characteristics of real estate in general (Ferguson, 1984). In Hong Kong, although the area is small, however, the property price can differ a lot when they are in different districts. And the properties in prime location are much more expensive than others.

Thirdly, the asset composition of property companies differs from the property composition of the Commercial real estate price series (COM). They hold different types of asset, for example, some residential buildings, hotels, factories and retail shops. Take Sun Hung Kai Properties as an example, it holds large portfolio of properties which include offices, shopping centers and hotels. These types of properties are the common types of commercial properties held by the large property companies (e.g. Cheung Kong which has factories too, Henderson, Sino, Swire Properties etc.).

Fourthly, the geographical diversity of assets held by property companies also accounts for the lack of co-integration. Property companies such as Cheung Kong²⁴, one of the biggest property companies in Hong Kong, have diversified into real estate in Mainland China, Singapore and United Kingdom²⁵. Therefore property stocks in Hong Kong are not pure play on Hong Kong real estate. Actually it is a common trend that the property companies in Hong Kong made investment in the Mainland China and they hold a portfolio of properties which include mainly offices and shopping centers in China.

²⁴ Foreign property investment of some HK Property companies are shown In table A-3 in Appendix

²⁵ Company webpage of Cheung Kong (Holdings) Limited. <http://www.ckh.com.hk/eng/property/index.htm>

Finally, and which is the most important reason, the property companies hold a properties hold by the property companies, and they are diversifed into different business. They are geared and its performance may diverge from the performance of the properties they manage and control in the short term. Many property companies like Cheung Kong Holdings, Sun Hung Kai Properties, Henderson Land Development, New World Development. Also, some large conglomerates play an important role in property too although their core business area is not property, for example China Light and Power, Take Sun Hung Kai again, one of the most respected property companies in Hong Kong, as an example. The company has long been regarded as a great real estate developer and investor in Hong Kong, but in recent years they actually invest heavily in other sectors too. They set up individual subsidiaries Kai Shing Management Services Ltd. and Hong Yip Services Company Ltd. and earn a considerable income and profit by providing property management services to its own portfolios and the residential development. Sun Hung Kai also owns different companies in different sectors (see table 5-1). The gross turnover of Sun Hung Kai Properties in 2003 was HK\$22,945 million of which HK\$ 4,717 million (more than 20% of the total) is attributable to its non-property business. On the reverse, some property companies play important role in direct property market but they are not listed, for example Hong Kong Land.

Table 5-7: Subsidiaries of Sun Hung Kai Properties²⁶

Information Technology & Telecommunications
SUNeVision SmarTone
Transportation
Franchised Bus Operation Kowloon Motor Bus (KMB) RoadShow
Toll Road
Route 3 (Country Park Section)
Transport Infrastructure
Wilson Group
Port Business
Asia Container Terminals River Trade Terminal Hoi Kong Container Services Faith and Safe Transportation
Air Transport & Logistics Business
Airport Freight Forwarding Centre (AFFC) Sun Hung Kai Super Logistics Sun Logistics HK Business Aviation Centre
Waste Management
Green Valley Landfill South China Transfer Pearl Delta

Source: Homepage of Sun Hung Kai Properties

²⁶ See table A-4 in Appendix for subsidiaries of some other listed property companies (like Cheung Kong)

In short, the lack of co-integration highlights rather than subjugates the differences between real estate and property stocks. Property stocks are subject to factors specific to the stock market. The fundamentals of the two markets, although have common factor, but it is not a strong one. Property may also over-react to markets factors while the real estate market tends to be more sluggish in response, hence the higher volatility associated with property stock returns. Moreover, property stocks in Hong Kong are inadequate in representing the diversity and non-homogeneity of real estate investment. Therefore investment in property stocks cannot fully substitute direct property investment. But the diversification benefit by including both direct and indirect real estate is justified for the two markets are not integrated. The relationship between the two markets is further studied in the period 1997 to 2003 which is after the economic crisis. However, the crisis has no significant effect on the long-term relationship between the two markets.

CHAPTER SIX

CONCLUSION

6.1 Introduction

In this study, it could be seen that the economic structure and the investment market in Hong Kong have undergone rapid and drastic change over the past decade. The boom and bust cycles are witnessed in both the property market and indirect property market which are two important sectors in Hong Kong. There exists similarities and close inter-connection between the two markets. However, there are fundamental differences between the two in terms of divisibility, liquidity, availability of information, speed of transaction, length of cycle etc. The long-term relationship between direct real estate investment and property stock investment is investigated in this study and the findings are as follows:

6.2 Principal findings

The first objective of this study is to review the characteristics and the performance of the direct and indirect real estate market in Hong Kong. This is done in chapter two in

which the background and characteristics of property investment in Hong Kong are described. Chapter two has provided statistics to illustrate the deepness and attractive attributes of the two markets to investors and the relationship between the two markets is discussed briefly. The performance of the two markets before and after the Asian Financial Crisis is briefly reviewed and a cycle can be observed in both markets for 1997 being the watershed.

The second objective of this study is to examine if a long-term relationship between direct and indirect property exists, also with specific reference to the influence of the Asian Financial Crisis. Literatures are reviewed in chapter three to understand why studying long-term relationship between direct and indirect real estate is important. From past literature, diversification through including both direct and indirect real estate in property portfolio is often justified by studying the short-term relationship between the two markets. Indirect property are often used as a proxy of the direct property so that indirect real estate are incorporated in multi-asset portfolio which can avoid the trouble and cost in investing property directly but may capture some portion of Hong Kong property market returns. The assumption that is often made is that since property companies predominantly hold property assets, they can be regarded as an indirect vehicle for investing in real estate. Also, it is often suggested that a shock in one market will have contagion effect to another related market. The Asian Financial Crisis has brought both markets fell sharply from their peaks and even now, they are not recovered. The diversification issue and the established practice of using property stocks as a proxy for real estate investments are re-examined by assessing the long-term relationship

between the two markets. The study period is divided into two sub-periods: pre- and post-1997 Asian financial crisis so that the question of whether the 1997 financial crisis has had substantial effect on the long-run relationship between the two markets is addressed. Co-integration test applied to the office price and property stock indices in Hong Kong demonstrates that, although there are some similarities between the two markets and there is strong intuition they are related and Giliberto (1990) suggests that a common factor called “pure” property exists, long-run equilibrium between the two markets does not exist. Co-integration cannot be found in the post-1997 period means that the 1997 financial crisis does not cause structural change on the level of integration between the two markets.

The third objective of this study is to explore what are the implications of the existence or non-existence of the long-run equilibrium relationship between the two markets and propose the reasons why the relationship exists or why it does not exist. The validity of using total correlation between property returns and stock returns for asset allocation is re-examined. The result that no long-run equilibrium between the two markets increases the accuracy of results of Chau and Newell (1996), confirming the diversification benefits of inclusion of direct real estate in mixed asset portfolio. In the past decade, the downturn in Hong Kong property market makes understanding the linkage between direct and indirect property investment a very challenging issue faced by institutional investors. If the two markets are co-integrated so that the diversification benefit may not be achieved, there is no reason why investment should be made on the direct property market. However, the results of the co-integration analysis show that

using property stocks as a proxy for real estate is far from infallible. Although the real estate and property stock indices in Hong Kong are first-difference stationary (i.e. they are $I(1)$) making co-integration test possible, the linear combination between them is not integrated. The error terms from the co-integration regression are highly autocorrelated and non-stationary.

The study lends further evidence to the belief that the use of property stocks as a proxy for property may be unwarranted (Ambrose et al., 1992). As discussed, there are marked differences between real estate and property stock investment in Hong Kong. This study shows that there is insufficient evidence to establish a contemporaneous relationship between property stocks and real estate in Hong Kong. The result that long-term relationship cannot be established even when the lagged values of Hang Seng Property Sun-index are regressed against the real estate price index. Ong (1995) finds in Singapore this co-integration can be detected but the finding is not conclusive. The finding is consistent with what Chau et al. (2001) suggested that the returns to securitized real estate in Hong Kong convey little or no information about the returns to Hong Kong real estate. The use of property stocks as a proxy for real estate is questionable at best for it must be appreciated that property stocks do not adequately represent the investment characteristics of real estate in Hong Kong.

6.3 Limitation of study

In this study, there are several problems which may lead to inaccurate results. These limitations are discussed as follows:

Firstly, the availability of data is limited to quarterly indexes only, for they are the most assessable data. The robustness of the result can be increased by incorporating more data, say use monthly indices instead of quarterly data.

Secondly, both the property stock price series (HSP) and the commercial property price series (COM) represent capital gains only. The dividend payment of the companies and the rental income for property are neglected. However, these income flows are actually negligible when compared with the great change (either increase or decrease) of capital value. So even if we neglect the two income flows, the results should not be greatly affected.

Thirdly, this study assumes that there are no other exogenous factors which in fact could impact on property stock and real estate prices, such as the interest rate, economic turndown etc. However, it is reasonable to assume that the information would affect the two markets equally.

Finally, the gearing of the companies may have influence on the financial performance and hence on the stock prices. The impact of gearing on profit and the stock prices vary over time for the gearing of these companies is not constant. Despite the fact

that profit of highly geared companies would always be more volatile, the direction of change of the stock prices would be the same as if the gearing ratio is constant. So it may still be reasonable to assume that it would not significantly affect the results.

6.4 Further study

This study can be extended by increasing the number of observations. Although property price indices are not available on a monthly basis, the technique of interpolation can be employed for constructing the missing data of the property price indices on a monthly basis.

Moreover, this study suggests that in addition to the short-term relationship, long-term relationship between different classes of assets need to be studied for they can challenge the results of previous studies which focused on studying the short-term relationship. In this study, only the direct commercial property and indirect real estate markets are studied. The study can be extended by studying the properties of time series of real estate of different sector (retail, domestic etc.). Besides property stocks, other classes of financial assets can be studied too. For example, bonds can be included in the analysis for their importance has increased in these few years. Some quasi-government bodies like Mass Transit Railway Corporation (MTRC), Hong Kong Mortgage Corporation Ltd (HKMC) issued bonds in 2001 and 2002 respectively. In the 2004-2005 financial budget, the government makes the announcement to issue bonds of total

capitalization of HK\$20billion. Besides bonds, other financial assets like common stocks, treasury bills or even real estate in other countries are interesting to institutional investors. Knowing the relationship between different classes of assets has great implication for institutional investors on allocating the assets in the multi-asset portfolio.

Although there are some reasons suggested in Chapter five of this study to explain why there is a lack of long-run equilibrium between the direct and indirect real estate market in Hong Kong, the reasons are only preliminary and further study of the economic nature of the two markets is warranted.

Finally, this study provided a framework for understanding the relationship between direct and indirect property in Hong Kong. REITs will be set up in Hong Kong and later studies can follow the framework employed in this study to study the long-term relationship between the direct real estate and REITs.

APPENDIX

Table A-1: Constituents of Hang Seng Property Sub-index (as to Feb 2004)

Code	Company Name
1	Cheung Kong
10	Hang Lung Group
12	Henderson Land
14	Hysan Development
16	Sun Hun Kai Property
20	Wheelock
28	Tian An
34	Kowloon Development
41	Great Eagle Holdings
49	New Asia Realty
56	Allied Property (HK)
83	Sino Land
97	Henderson Investment
101	Hang Lung Property
127	China Estate Holdings
171	Silver Grant
173	Kah Wah International
202	Interchina Holdings
246	Henderson China
480	HKR International
604	Shenzhen Investment
659	NWS Holdings
683	Kerry Properties
688	China Overseas
699	Chia Hsin Cement
914	Kah Wah International
917	New World China
983	Shui On Construction
1109	China Resource Land

Source: Hang Seng Index Services Ltd.

Table A-2: 50 leading companies in market capitalization - February 2004

Rank	Company	Market capitalisation (HKD mil)	% of total
1	HSBC Holdings plc	1,407,509.80	23.11
2	China Mobile (Hong Kong) Ltd.	541,961.17	8.90
3	Hutchison Whampoa Ltd.	279,250.79	4.58
4	Hang Seng Bank Ltd.	211,258.62	3.47
5	Sun Hung Kai Properties Ltd.	183,671.25	3.02
6	Cheung Kong (Holdings) Ltd.	171,975.20	2.82
7	BOC Hong Kong (Holdings) Ltd.	168,107.21	2.76
8	Standard Chartered PLC	162,553.62	2.67
9	CNOOC Ltd.	129,373.11	2.12
10	China Unicom Ltd.	125,561.50	2.06
11	CLP Holdings Ltd.	96,570.66	1.59
12	Swire Pacific Ltd.	77,887.01	1.28
13	Hong Kong and China Gas Co. Ltd.	75,907.12	1.25
14	PetroChina Co. Ltd. - H Shares	73,406.60	1.21
15	Henderson Land Development Co. Ltd.	71,857.37	1.18
16	Hongkong Electric Holdings Ltd.	71,284.34	1.17
17	MTR Corporation Ltd.	65,347.15	1.07
18	Wharf (Holdings) Ltd., The	59,473.68	0.98
19	China Petroleum & Chemical Corporation	54,956.10	0.90
20	Cathay Pacific Airways Ltd.	53,007.70	0.87
21	CITIC Pacific Ltd.	52,670.95	0.86
22	Cheung Kong Infrastructure Holdings Ltd.	44,746.07	0.73
23	Li & Fung Ltd.	44,140.53	0.72
24	China Life Insurance Co. Ltd.	41,298.52	0.68
25	Bank of East Asia, Ltd., The	37,136.34	0.61
26	Yue Yuen Industrial (Holdings) Ltd.	36,444.35	0.60
27	Esprit Holdings Ltd.	36,252.07	0.60

28	Johnson Electric Holdings Ltd.	34,349.93	0.56
29	PCCW Ltd.	33,017.84	0.54
30	Hang Lung Properties Ltd.	32,729.84	0.54
31	Denway Motors Ltd.	31,576.81	0.52
32	Henderson Investment Ltd.	28,173.27	0.46
33	COSCO Pacific Ltd.	25,475.75	0.42
34	Legend Group Ltd.	24,484.39	0.40
35	China Merchants Holdings (International) Co. Ltd.	24,292.33	0.40
36	China Telecom Corporation Ltd.	24,282.92	0.40
37	China Resources Enterprise, Ltd.	23,014.22	0.38
38	Huaneng Power International, Inc.	22,533.15	0.37
39	Wheelock and Co. Ltd.	22,045.56	0.36
40	Hong Kong Exchanges and Clearing Ltd.	21,618.32	0.35
41	Aluminum Corporation of China Ltd.	20,789.16	0.34
42	New World Development Co. Ltd.	20,744.18	0.34
43	Sino Land Co. Ltd.	20,685.81	0.34
44	Guoco Group Ltd.	19,414.03	0.32
45	Shanghai Industrial Holdings Ltd.	19,358.75	0.32
46	Techtronic Industries Co. Ltd.	17,094.74	0.28
47	China Resources Power Holdings Co. Ltd.	16,660.00	0.27
48	Television Broadcasts Ltd.	16,644.00	0.27
49	Hang Lung Group Ltd.	16,192.45	0.27
50	Kerry Properties Ltd.	16,002.40	0.26
	Total	4,904,788.67	80.52
	Market Total	6,091,605.97	100.00

Source: Hong Kong Exchange and Clearing Limited

Table A-3: Foreign property investment of some HK Property companies

Company	Property investment in foreign markets
Cheung Kong Property	Mainland China Singapore United Kingdom
Sun Hung Kai Properties	Mainland China
Swire Properties	United States Mainland China
Wharf	Mainland China
Hutchison	Mainland China United Kingdom Japan Singapore
Kerry Properties	Mainland China Australia Phillipines
Sino Land	Singapore
Henderson Land	Mainland China
Hysan Development	Mainland China Singapore
Great Eagle	Europe North America

Source: WebPages and annual reports of the companies

Table A-4: Subsidiaries owned by some major HK listed property companies

Company	Subsidiaries
Cheung Kong Holdings	Hutchison Whampoa Limited Cheung Kong Infrastructure Holdings Limited Hongkong Electric Holdings Limited CK Life Sciences Int'l., (Holdings) Inc. TOM Group Limited iMarkets Limited PowerCom Network Hong Kong Limited iBusiness Corporation Limited Priceline.com Critical Path Inc. Excel Technology International Holdings Limited mReferral Corporation (HK) Limited Net Infinity Technology Development Co., Limited.
Swire Pacific	Swire Property Cathay Pacific Airways Limited Hong Kong Dragon Airlines Limited (Dragonair) Air Hong Kong Limited Hong Kong Aircraft Engineering Company Limited Hong Kong Aero Engine Services Limited Cathay Pacific Catering Services Hong Kong Airport Services Limited Hong Kong Air Cargo Terminals Limited Vogue Laundry Service Limited Swire Pacific Offshore Limited Modern Terminals Limited Shekou Container Terminals Limited Chiwan Container Terminals Co. Limited Swire Resources Limited Many other joint ventures (e.g. Reebok HK Limited)
New World Development	NWS Holdings Limited New World Mobility New World Telecommunications Limited New World Department Store (Holdings) Ltd. New World TMT Limited New World China Enterprises Projects Ltd.
Wharf	Wharf Estates Limited Wharf Estates Development Limited "Star" Ferry Hongkong Tramways.

i-CABLE Communications Limited
Wharf T&T Limited
Wharf China Limited

Hutchison

5 business areas:

- **Ports** (e.g. Hong Kong International Terminals)
- **Telecommunications** (e.g. Hutchison Telecommunications (Hong Kong) Limited, Mobile telecom (3G) operator)
- **Property and hotels**
- **Retail and Manufacturing** (e.g. Fortress Limited, A.S. Watsons Water Ltd.)
- **Energy and Infrastructure** (e.g. Hong Kong Electric)

Henderson

Henderson Investment Limited
Henderson China Holdings Limited
The Hong Kong and China Gas Company Limited
Hong Kong Ferry (Holdings) Company Limited
Miramar Hotel and Investment Company, Limited

Sources: WebPages and annual reports of the companies

Bibliography

Alexander, C., and Johnson, A. 1994. Dynamic Links, *Risk*, February, 56-9.

Allen, M.T., Rutherford, R.C. and Wiley, M.K. 1999. The relationships between mortgage rates and capital-market rates under alternative market conditions, *Journal of Real Estate Finance and Economics*, **19**(3), 211-21.

Ambrose, B.W., Ancel, E. and Griffiths, M.A. 1992. The fractal structure of real estate investment trust returns: the search for evidence of market segmentation and nonlinear dependency, *Journal of American Real Estate and Urban Economics Association*, **20**, 25-54.

Asabere, P.K., Kleiman, R.T. and McGowan, C.B. Jr. 1991. The risk-return attributes of international real estate equities, *Journal of Real Estate Research*, **6**(2), 143-52.

Barkham, R. and Geltner, D. 1994. Unsmoothing British valuation-based returns without assuming an efficient market, *Journal of Property Research*, **11**, 81-

Barkham, R. and Geltner, D. 1995. Price discovery and efficiency in American and British property markets, *Real Estate Economics*, **23**(1), 21-44.

Banerjee, A., Dolado, J.J., Hendry, D.F. and Smith, G.W. 1986. Exploring equilibrium relationships in econometrics through static models: some Monte Carlo evidence, *Oxford Bulletin of Economics and Statistics*, **48**, 253-77.

Bluendell, G.F. and Ward, C.W. 1987. Property portfolio allocation: a multi-factor model, *Land Development Studies*, **4**(2), 145-156.

Brown, R.J., Li, L.H. and Lusht, K. 2000. A note on intracity geographic diversification of real estate portfolios: evidence from Hong Kong, *Journal of Real Estate Portfolio Management*, **6**(2), 131-40.

Brueggeman, W., Chen, A. and Thibodeau, T. 1984. Real estate investment funds: performance and portfolio considerations, *American Real Estate and Urban Economics Association Journal*, **12**(3), 333-54.

Bryne, P.J. and Lee, P.J. 2001. Risk reduction and real estate portfolio size, *Managerial and Decision Economics*, **22**, 369-79.

Census and Statistics Department. 1996. Analysis of Hong Kong's retained imports, 1989-1994, *Hong Kong Monthly Digest of Statistics*, February 1996, Hong Kong: Government Printer.

Chan, S.L. and Sng, G.N. 1991. Real estate versus property stock investments, *Securities Industry Review*, **17**(2), 9-15.

Chandrashekar, V. 1999. Time series properties and diversification benefits of REIT returns, *Journal of Real Estate Research*, **17**(1), 91-112.

Charemza, W.W. and Deadman, D.F. 1992. New directions in econometric practice: general to specific modeling, cointegration and vector autoregression. London: Edward Elgar Publishing Ltd.

Chau, K.W. and Newell, G. 1996. Linkages between direct and indirect property performance in Hong Kong, *Journal of Real Estate Finance*, **7**(4), 9-29.

Chau, K.W., Macgregor, B.D. and Schwann, G.M. 2001. Price discovery between Hong Kong real estate market, *Journal of Property Research*, **18**(3), 187-216.

Chen, K.C., Hendershott, P.H. and Sanders, A.B. 1990. Risk and return on real estate: evidence from equity REITs, *American Real Estate and Urban Economics Association Journal*, **18**(4), 431-52.

Cheng, P. and Black, R.T. 1998. Geographic diversification and economic fundamentals in apartment markets: a demand perspective, *Journal of Real Estate Portfolio Management*, **4**(2), 93-105.

Chiang, W.L. 1994. Comparative study of the investment characteristics of real estate and other assets. Unpublished B.Sc. (Surveying) dissertation, Department of Real Estate and Construction, University of Hong Kong.

Chiang, Y.H. 1997. Property investment in a portfolio context: analysis of risk and return of office property investment in Hong Kong. Unpublished (Ph.D.) thesis, University of Hong Kong.

Coyne, T.J. 1993. Returns to financial assets vs. returns to residential real estate: the business cycle matters, *Journal of Real Estate Finance*, **10**(1), 53-59.

Daly, K.J. 2003. Southeast Asian stock market linkages, *ASEAN Economic Bulletin*, **20**(1), 73-85.

Dickey, D.A. and Fuller, W.A. 1979. Distributions of the estimators for autoregressive time series with a unit root, *Journal of American Statistician Association*, **74**, 427-31.

Downs, A. Public, private market valuations do diverge. *National Real Estate Investor*, **36**(13), 20-4.

Duben, N. and Sayce, S. 1991. Property portfolio management: an introduction. London: Routledge.

Eichholtz, P. and Hartzell, D. 1996. Property shares, appraisals and the stock market: an international perspective, *Journal of Real Estate Finance and Economics*, **12**(2), 163-79.

Engle, R.F. and Granger, C.W.J. 1987. Co-integration and error correction: representation, estimation and testing, *Econometrica*, **55**, 251-76.

Engle, R.F. and Yoo, B.S. 1987. Forecasting and testing in co-integrated systems, *Journal of Econometrics*, **35**, 143-59.

Ennis, R. and Burik, B. 1991. Pension fund real estate investment under simple equilibrium pricing model, *Financial Analysts Journal*, **47**, 20-30.

Ferguson, J.T. 1984. Fundamentals of real estate investing. Scott, Foreman and Co.

Firstenberg, P., Ross, S. and Zisler, R. 1988. Real Estate: The whole story, *Journal of Portfolio Management*, **14**(3), 23-32.

Folger, H.R. 1984. 20% in real estate, can theory justify it? *Journal of Portfolio Management*, **10**(2), 6-13.

Fu, Y. 1994. The dynamic of residential property markets and the stock market in Hong Kong, Paper presented at the 4th Asia Pacific Finance Conference, 10 September, Sydney, Australia.

Geltner, D. 1989a. Biases in appraisal based returns, *American Real Estate and Urban Economics Association Journal*, **17**(3), 338-52.

Geltner, D. 1989b. Estimating real estate's systematic risk from aggregate level appraisal-based returns, *American Real Estate and Urban Economics Association Journal*, **17**(4), 463-81.

Geltner, D. 1990. Return risk and cash-flow risk with long-term riskless leases in commercial real estate, *Journal of the American Real Estate and Urban Economics Association*, **18**(4), 377-402.

Geltner, D. 1991. Smoothing in appraisal based returns, *Journal of Real Estate Finance and Economics* **4**, 327-45.

Geltner, D. 1993. Estimating market values from appraised values without assuming an efficient market, *Journal of Real Estate Research*, **8**(3), 325-46.

Giliberto, M. 1990. Equity real estate investment trusts and real estate returns, *Journal of Real Estate Research*, **5**(2), 259-64.

Giliberto, M. 1992. The allocation of real estate to future mixed-asset institutional portfolios, *Journal of Real Estate Research*, **7**(4), 423-46.

Giliberto, M. 1993. Measuring real estate returns: the hedged REIT index, *Journal of Portfolio Management*, **19**(3), 94-99.

Giliberto, M. and Mengden, A. 1996. REITs and real estate: two markets reexamined, *Journal of Real Estate Finance*, **5**(2), 259-63.

Giliberto, M., Hamelink, F., Hoesli, M. and MacGregor, B. 1999. Optimal diversification within mixed-asset portfolios using a conditional heteroskedasticity approach: evidence from the US and UK, *Journal of Real Estate Management*, **5**(1), 31-45.

Goetzmann, W.N. and Ibbotson, R.G. 1990. The performance of real estate as an asset class, *Journal of Applied Corporate Finance*, **2**(1), 65-76.

Gordon, J.N., Canter, T.A. and Webb, J.R. 1998. The effect of international real estate securities on portfolio diversification, *Journal of Real Estate Portfolio Management*, **4**(2), 83-91.

Graff, R.A. and Young, M.S. 1996. Real estate return correlations: real world limitations on relationships inferred from NCREIF data, *Journal of Real Estate Finance and Economics*, **13**(2), 121-42.

Granger, C.W.J. and Newbold, P. 1977. Forecasting economic times series. New York: Academic Press.

Guilkey, D.K. and Schmidt, P. 1989. Extended tabulations for Dickey-Fuller tests, *Economics Letters*, **31**, 355-7.

Gyourko, J. and Keim, D. 1992. What does the stock market tell us about real estate returns? *Journal of the American Real Estate and Urban Economics Association*, **20**(3), 457-86.

Gyourko, J. and Keim, D. 1993. Risk and return in real estate: evidence from a real estate stock index, *Financial Analysts Journal*, September, 39-46.

Gyourko, J. and Linneman, P. 1988. Owner-occupied homes, income-producing properties and REITs as inflation hedges: empirical findings, *Journal of Real Estate Finance and Economics*, **1**(4), 347-72.

Hamelink, F., Hoesli, M., Lizieri, C. and MacGregor, B.D. 2000. Homogeneous commercial property market groupings and portfolio construction in the United Kingdom, *Environmental and Planning A*, **32**, 323-44.

Hang Seng Bank Limited. *Hang Seng Economic Monthly*, various issues.

Hartzell, D. and Mengden, A. 1986a. Equity real estate investment trusts- are they stocks or real estate? Stock Research-Real Estate, August, Solomon Bros. Inc., New York.

Hartzell, D.J., Hekman, J. and Miles, M. 1986b. Diversification categories in investment real estate, *Journal of the American Real Estate and Urban Economics Association*, **14**(2), 230-54.

Henneberry, J. 1999. Convergence and difference in regional office development cycles, *Urban Studies*, **36**(9), 1439-65.

Hoag, J.A. 1980. Towards indices of real estate value and return, *Journal of Finance*, **35**(2) May, 569-80.

Hoesli, M., Lizieri, C. and MacGregor, B. 1997. The spatial dimensions of the investment performances of the English commercial property, *Urban Studies*, **34**(9), 1475-519.

Hong Kong Census and Statistics Department, *Estimates of gross domestic products*, various issues.

Hong Kong Census and Statistics Department, *Annual digest of statistics*, various issues.

Hong Kong Census and Statistics Department, *Monthly digest of statistics*, various issues.

Hong Kong Monetary Authority, *Monthly statistics bulletin*, various issues.

Hong Kong Rating and Valuation Department, *Hong Kong property review*, various issues.

Ibbotson, R.G. and Siegal, L.B. 1984. Real estate returns: a comparison with other investments, *Journal of the American Real Estate and Urban Economics Association*, **12**, 219-42.

Irwin, S.H. and Landa, D. 1987. Real estate, futures and gold as portfolio assets, *Journal of Portfolio Management*, **13**(Fall), 29-34.

Jones Lang Wotton. 1995. Direct and indirect property: close relations? JLW: Sdney.

Jorion, P. and Schwartz, E. 1986. Integration vs. segmentation in the Canadian stock market, *Journal of Finance*, **41**(3), 603-16.

Kim, K.H. 2000. Korea: could a real estate bubble have caused the economic crisis. In: Mera, Koichi and Renaud, eds. Asia's financial crisis and the role of real estate, 99-114.

Kuhle, J.L. 1987. Portfolio diversification and return benefits: common stocks vs. real estate investment trusts (REITs), *Journal of Real Estate Research*, **2**(2), 1-9.

Lai, T.Y. and Wang, K. 1998. Appraisal smoothing: the other side of the story, *Real Estate Economics*, **26**(3), 511-36.

Lau, L.C. and Damon, T. 1990. Property units and equities: a comparative examination, *Proceedings of Property Investment in a Modern Business Environment*, Inter-Faculty Conference, National University of Singapore.

Lee, S., Bryne, P. and French, N. 1996. Assessing the future of property in the multi-asset portfolio: the case of UK pension fund, *Journal of Property Research*, **13**, 197-209.

Li, L. H. 1994. Direct and Indirect Influence of China's Investment Funds in Hong Kong's Real Estate Market, Department of Surveying, University of Hong Kong.

Liang, Y., Chatrath, A. and McIntosh, W. 1995. Apartment REITs and apartment real estate, *Journal of Real Estate Research*, **11**(3), 227-89.

Liang, Y., Chatrath, A. and Webb, J.R. 1996. Hedged REIT indexes, *Journal of Real Estate Literature*, **4**, 175-84.

Ling, D.C. and Naranjo, A. 1999. The integration of commercial real estate markets and stock markets, *Real Estate Economics*, **27**, 483-515.

Lins, D.A., Sherrick, B.J. and Venigalla, A. 1992. Institutional portfolio: diversification through farmland and investment, *Journal of American Real Estate and Urban Economics Association*, **20**(4), 549-71.

Liow, K.H. 1998a. Singapore commercial real estate and property equity markets: close relations, *Real Estate Finance*, **15**(1), 63-71.

Liow, K.H. 1998b. Relationship between Singapore property stock and real estate returns, *Journal of Real Estate and Construction*, **8**, 1-16.

Liu, C., Hartzell, D., Grieg, W. and Grissom, T. 1990. The integration of the real estate market and the stock market: some preliminary evidence, *Journal of Real Estate Finance and Economics*, **3**, 261-82.

Liu, C. and J. Mei. 1992. The predictability of returns on equity REITs and their comovement with other assets, *Journal of Real Estate Finance and Economics*, **5**(4), 401-18.

Lucas, R. 1976. Economic policy evaluation: a critique, Carnegie Rochester Conference Series on Public Policy, No.1.

MacGregor, B.D. and Nanthakumaran, N. 1992. The allocation to property in the multi-asset portfolio: the evidence and theory revisited, *Journal of Property Research*, **9**(1), 5-32.

Mackinnon, J.G. 1991. Critical values for co-integration tests, in *Long-run Economic Relationships*. Engle, E.F. and Granger, C.W.J., eds. Oxford: Oxford University Press.

Maddala, G.S. 1992. *Introduction to Econometrics*. New York: Macmillan.

Markowitz, H. 1952. Portfolio Selection, *Journal of Finance*, 7, 77-91.

Martin, J.D. and Cook, D.O. 1991. A comparison of the recent performance of publicly traded real property portfolios and common stock, *Journal of the American Real Estate and Urban Economics Association*, **19**(2), 184-212.

Matysiak, G., Hoesli, M., MacGregor, B.D. and Nanthakumaran, N. 1996. The long-term inflation-hedging characteristics of UK commercial property, *Journal of Property Finance*, **7**(1), 50-61.

McCue, T.E. and Kling, J.L. 1994. Real estate returns and the macroeconomy: some empirical evidence from real estate investment trust data, 1972-1991, *Journal of Real Estate Research*, **9**(3), 277-87.

Miles, M., Cole, R. and Guilkey, D. 1990. A different look at commercial real estate returns, *Journal of the American Real Estate and Urban Economics Association*, **18**(4), 403-30.

Miles, M. and McCue, T. 1984. Historic returns and institutional real estate portfolios, *Journal of the American Real Estate and Urban Economics Association*, **10**, 184-99.

Myer, F.C.N. and Webb, J.R. 1993. Return properties of equity REITs, common stock and commercial real estate, *Journal of Real Estate Research*, **8**(1), 87-106.

Myer, F.C.N. and Webb, J.R. 1994. Retail stock, retail REIT and retail real estate, *Journal of Real Estate Research*, **9**(1), 65-84.

Newell, G. and MacFarlane, J. 1995. Linkages between property trust performance and property market returns, Paper presented at the *1st International Real Estate Society Conference*, 20 July, 1995, Stockholm.

O' Hara, M. 1995. *Market microstructure theory*. Cambridge, MA: Basil Blackwell.

Okunev, J., Wilson, P. and Ta, G. 1996. Are real estate and securities market integrated? some Australian evidence, *Journal of Property Valuation and Investment*, **14**(5), 7-24.

Oliver, S. 1993. Speculation in the Australian residential real estate market, Conference of Economics, Perth.

Ong, S.E. 1994. Structural and vector autoregressive approaches to modeling real estate and property stock prices in Singapore, *Journal of Property Finance*, **5**(4), 4-18.

Ong, S.E. 1995. Singapore real estate and property stocks: a cointegration test, *Journal of Property Research*, **12**(1), 29-39.

Peracchi, F. 2001. *Econometrics*. New York: Wiley.

Petersen, D. and Roberts, E.V. 2003. The Hong Kong business environment since 1997. In: Ash, R., Ferdinand, P., Hook, B. and Porter, R., eds. *Hong Kong in transition: one country, two systems*, London: Routledge Curzon.

Philips, P.C.B. and Ouliaris, S. 1990. Asymptotic properties of residual based tests for cointegration, *Econometrica*, **58** (1), 165-93.

Quan, D.C. and Quigley, J.M. 1991. Price formation and the appraisal function in real estate markets, *Journal of Real Estate Finance and Economics*, **4**, 127-46.

Rating and Valuation Department. 1995. Hong Kong Government, Economic Prospects, Hong Kong: The Government Printers.

Renaud, B. M. and Pretorius, F. 1995. The dynamics of the Hong Kong Real Estate Economy” 1st International Real Estate Society Conference. Stockholm, Sweden, 11-13.

Ross, S.A. and Zisler, R.C. 1991. Risk and return in real estate, *Journal of Real Estate Finance and Economics*, **4**, 175-90.

Rowland, P.V. 1996. Direct property and property shares, *Journal of Valuation*, **8**(4), 272-89.

Rubens, J.H., Louton, D.A. and Yobaccio, E.J. 1998. Measuring the significance of diversification gains, *Journal of Real Estate Research*, **16**, 73-86.

Sagalyn, L.B. 1990. Real estate risk and the business cycle: evidence from security markets, *Journal of Real Estate Research*, **5**(2), 203-19.

Schwartz, W. 1989. Tests of unit roots: a monte-carlo investigation, *Journal of Business and Economic Statistics*, **7**, 147-59.

Schwert, G.W. 1987. Effect of model specification on tests for unit roots in macroeconomic data, *Journal of Monetary Economics*, **20**, 73-103.

Scott, L.O. 1990. Do prices reflect market fundamentals in real estate markets? *Journal of Real Estate Finance and Economics*, **3**(1), 5-24.

Seiler, M.J., Webb, J.R. and Myer, F.C.N. 1999. Diversification issues in real estate investment, *Journal of Real Estate Literature*, **7**(2), 163-79.

Seddighi, H.R., Lawler, K.A. and Katos, A.V. 2000. *Econometrics: a practical approach*. London: Routledge.

Sivitanides, P.S. 1996. Property-type diversification in real estate portfolios: multi-period return measures vs. single-period return measures, *Journal of Real Estate Portfolio Management*, **2**(2), 127-40.

Stock Exchange of Hong Kong Limited, *Fact Book*, various issues.

Thomas, R.L. 1997. *Modern econometrics: an introduction*, 2nd ed. England: Addison Wesley Longman Limited.

Tse, R.Y.C. 1992. *Real estate market in Hong Kong (in Chinese)*, Hong Kong: Commercial Press

Tse, R.Y.C. and Webb, J. R. 2000. Public versus private real estate in Hong Kong, *Journal of Real Estate Portfolio Management*, **6**(1), 53-60.

Viezer, T.W. 2000. Evaluating 'within real estate' diversification strategies, *Journal of Real Estate Portfolio Management*, **6**(1), 75-95.

Walker, A., Chau K.W. and Lai, W.L. 1995. *Hong Kong in China: Real estate in the economy*, Brooker Hiller Parker Research, Hong Kong.

Wang, P. 2001. *Econometric analysis of the real estate market and investment*. London: Routledge.

Williams, J.E. 1996. Real estate portfolio diversification and performance of the twenty largest MSAs, *Journal of Real Estate Portfolio Management*, **2**(1), 19-30.

Wolverton, M.L., Cheng, P. and Hardin, W.G. 1998. Real estate portfolio risk reduction through intracity diversification, *Journal of Real Estate Portfolio Management*, 4(1), 35-41.

Wong, S.K. 2003. The Performance Of Property Companies In Hong Kong: A Style Analysis Approach, unpublished Ph.D. Thesis, University of Hong Kong.

Young, M.S. and Grieg, D.W. 1993. Drums along the efficient frontier, *Real Estate Review*, Winter, 18-29.