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THE UNIVERSITY OF HONG KONG

FACTORS AFFECTING CAPITALIZATION RATES
IN HONG KONG

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

DEPARTMENT OF REAL ESTATE AND CONSTRUCTION

BY
LEUNG CHING CHING

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 or other qualification.

Signed: _________________________________

Name: ___Leung__Ching__Ching__

Date:    29 April 2004
ACKNOWLEDGEMENTS

The accomplishment of a dissertation does not depend on the effort of one person, but on the goodwill of many people to whom I sincerely extend my thanks. First of all, I would like to express my deepest gratitude to my supervisor Professor K. W. Chau for his valuable advice, guidance, and most importantly encouragement and support at any time for preparing this dissertation. Without his enlightening advice during the consultation sessions, my dissertation would not been completed. However, the responsibility of error is mine.

I must extend my thanks to Dr. S.K. Wong and Mr. Adam Lee who so generously have given me invaluable advice on various aspects that I am not familiar with. Their contributions are essential for the completion of this dissertation.

Last but not least, I would like to thank my beloved family members and closet friends for their encouragement. Special thanks are given to Natalie, Stanley, Queenie and Gloria for their technical support, endless care and guidance.
ABSTRACT

This study is motivated by the observation that the capitalization rate varies significantly across different properties. Such variation must not be random as in a competitive and efficient market. The capitalization rate captures the expected rental growth and risk premium, which are associated with observable attributes of a property. Due to the lack of disaggregate cross sectional data (price and rent of a property cannot normally be observed at the same point in time), there have been very little empirical studies that attempt to explain variation in capitalization rate across properties at the same point in time. This dissertation aims at investigating the effects of other attributes of properties, in addition to property types and location, affecting the capitalization rates.

In this study, the cross sectional data are used to examine the effects of various attributes of properties on the capitalization rates in the four sub-sector of the Hong Kong’s property market (i.e. residential, office, retail and industrial). Since there is no simultaneous data on rent and price of a property, rent is proxied by the rateable value and prices are actual transaction prices. The validity of this approach is justified by the relatively homogeneous lease terms (mainly two years) in Hong Kong’s rental market and the very advanced computer assisted mass valuation technique developed by the Rating and Valuation Department of the Government of the Hong Kong SAR. The homogeneous nature of the properties in Hong Kong and frequent rental transaction assure that the rateable values are good proxies for rent, despite some inevitable noise in the data. One empirical model is estimated for each sub-sector.
Hypotheses on how physical and other observable attributes of a property affect its capitalization rate are developed. The theoretical foundation of the hypotheses is based on (a) differential perception between the tenant’s short-term (2-years) use value and the owner’s long-term investment valuation of different attributes of a property and (b) the effects of institutional factors (such as Landlord and Tenancy Ordinance, illegal or non-forming use of floor space etc) on the risk premium. The empirical results confirm most hypotheses. We also found that the effects of many attributes are non-linear. The explanatory power of the model for residential property is the highest followed by those of the industrial and office sub-sectors; the model for the retail sub-sector has the largest proportional of unexplained variation in capitalization rates. These results are likely to be attributable to then the homogeneous nature of residential properties and the heterogeneous nature of retail properties.

This is the first empirical study on how physical and locational attributes of a property affect its capitalization rate using cross-sectional data. The results contribute to our understanding of how capitalization rates of different properties are determined in a competitive market. The results of the study are of practical use for investors and valuers. In particular, this study set out a framework on the choice of capitalization rate, which is important for feasibility study and valuation using income approach.
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CHAPTER 1
INTRODUCTION

1.1 Background
Although the market capitalization rates are used to estimate the property values worldwide, the figure of the capitalization rate is always heavily debated especially on the valuation aspect. The capitalization rate, which is sometimes called rental yield, is the ratio of annual rental income to property value. The term yield is commonly used in the field of equity investments and it refers to the amount earned as a return on capital. In line with this, the concept of capitalization rate originates from the finance academics. The widespread use and acceptance of this investment valuation method indicates that it most nearly represents the thought processes and market behavior of buyers and sellers (Appraisal Institute, 1992)

The application of capitalization rate analysis is not limited to the valuation of individual properties. The rate is also used by market analysts to interpret property developments (e.g. Giliberto, 1996) and by academic researchers to test for market efficiency (Jud and Winkler, 1995). In the searching process of property purchases, potential buyers usually take the due time to do their diligence by researching comparable transactions and considering a bundle of factors affecting property values, for example, the likely range of rental income scenarios, location and view. The capitalization rate is thus one of the major factors influencing purchasing property decision.

1 Appraisal Institute, *the Appraisal of Real Estate*, 10th Edition. Chicago., IL: Appraisal Institute, 1992
The wide application of capitalization rate mentioned above indicates the importance of the derivation of an accurate capitalization rate, but it is not an easy work. Also, it is known that slight variances in the capitalization rate can have dramatic effect on the subject property’s value. The figure of capitalization rate once is more complicated to be analyzed than the property price itself as it represents the relative magnitude of annual rental income to price. Rent and price are sometimes on the divergent trends. This is the situation of Hong Kong property market now as the rental yield continues to contract. This so happens as the present rents remain static, while prices continue to move up sharply.\(^4\) By the end of 2003, as the SARS impact waned, many businessmen predict that Hong Kong economy is on the recovery path. Therefore, property prices begin to surge again.

As stated at the beginning, for the valuation of properties by income capitalization approach, the choice of the capitalization rate is sometimes quite arguable. Understanding of how capitalization rates of different properties are determined in a competitive market is then necessary for the choice of an appropriate capitalization rate. Some empirical studies confirm that the variation in capitalization rates is driven by property types.\(^5\) In Hong Kong, we can obviously notice that the capitalization rate varies significantly across different properties. From the published data of Rating and Valuation Department of Hong Kong Government, the highest average capitalization rate is generally found in the category of industrial buildings. An interesting question arises, what affects the variation in the capitalization rate across different properties at the same point of time? The author suggests that the answer should be the expected rental growth and risk premium which are associated with the observable attributes of

\(^4\) South China Morning Post, February 25, 2004

\(^5\) Ambrose, B.W. and Nourse H. O., Factors Influencing Capitalization Rates, Journal Of Real Estate Research, 1993, 8:2, 221-37
a property. These two elements are captured into the capitalization rate. However, there have been very few empirical studies investigating the effects of the physical and other observable attributes affecting capitalization rate and most rely on time series data. By employing cross sectional data, this dissertation aims at investigating the effects of other attributes of properties, besides property types and location, on the capitalization rates.

1.2 Aims and Objectives
The above actually has provided some clues about the aims and objectives of this dissertation. The main aim of this dissertation is to examine the effects of various attributes of properties on the capitalization rates in the four sub-sector of the Hong Kong property market. This aim is subdivided into three objectives of this dissertation. First of all, it tries to find out the relationship between the capitalization rate and physical and locational characteristics of the property. Secondly, it is also of the interest of the author to assess the potential impact of institutional factors (such as Landlord and Tenancy (Consolidation) Ordinance) on the risk premium. Lastly, the author attempts to explain for the empirical findings of the relationship between the capitalization rate and the attributes under investigation.

1.3 Approach of This Dissertation
In order to achieve the objectives stated above, the author would conduct an analysis of the private real estate market of Hong Kong, developing a set of hypotheses that explain the variation of capitalization rates across different properties. The hypotheses are tested using cross sectional regression data in Hong Kong. There are four types of properties included in this study, namely residential, office, retail and industrial
properties. In each sub-market, one regression model is set up for empirical testing of
the hypotheses. Since there is no simultaneous data on rent and price of a property,
rent is proxied by the rateable value and prices are actual transaction prices. This
approach is justified to be highly reliable by the author.

1.4 Organization of This Dissertation
An abstract of the dissertation is provided at the very beginning. The Introduction
comes after it, providing the overview of the topic of this dissertation. The following
chapter gives some stylized facts of the property market in Hong Kong as background.
In Chapter 3, this dissertation briefly covers the literature reviews which identify the
key attributes of the links between the real estate’s space and capital markets and
explain the conceptual framework. Chapter 4 will further explain the hypotheses of
this dissertation in a finer detail. The construction of a useful model requires not only
practical applications for the model and a good theoretical base, but also statistical
methods that make the best use of the available data. Therefore, methodology and
data would be described in Chapter 5 and 6 respectively. Chapter 7 arranges the
empirical results and the underlying reasons for the results are suggested. The final
chapter is devoted to conclusion, which includes a summary of the modeling results,
the limitation of this study and areas for further study in this topic.
CHAPTER 2
BACKGROUND

This chapter is devoted to some solid factual descriptions of the property market in Hong Kong. These include the general overview of the whole property market, the real estate space market, the real estate capital market and the rental yield trends of Hong Kong. Some analyses are provided in the concluding remarks.

Empirical data would be drawn for the regression models in the subsequent chapters. The data used for the analysis are from the Rating and Valuation Department of Hong Kong Government for the period of the fourth quarter of 2001. The only exception is in the retail market of which the data is for the period of the second half of 2001. Therefore, the author would just put the focus on the property market situation of Hong Kong in terms of space market and capital market from 2001 up till now.

2.1 Overview

As a matter of fact, Hong Kong is a highly densely populated city as land is one of the most precious resources due to its nature of limited supply. To illustrate this, statistical figures from Hong Kong Government data are quoted. Hong Kong’s population was about 6.816 million at the end of 2002. With a total area of 1102 square kilometers, the population density is 6300 people per square kilometer. This demonstrates the importance of the role of real estate in Hong Kong economy as people need space for accommodation, business and economic or leisure activities.
Analysis of the Hong Kong industry usually differentiates five real estate market sectors. (Renaud *et al*, 1997) These five sectors are:

- Offices
- Retail
- Industrial and warehousing
- Residential
- Hotels

There is a slight difference from the approach adopted by Rating and Valuation Department of Hong Kong Government. The properties are categorized according to the use for which the occupation permit was originally issued, unless known to have been structurally altered. Since the data source for modeling in this dissertation is from Rating and Valuation Department, the author would follow its classification.

Four major types of properties in this study are private domestic, office, retail shops and flatted factories. It is a common belief that different sectors have different fixed characteristics and different performance in response to changes in market conditions over time. (Sivitanides and Sivitanidou, 1997) Conversely, all sectors of Hong Kong property market have some important characteristics in common (Renaud *et al*, 1997), for example the lease duration and the asset ownership pattern.

However, when we come to analyze the market of real estate, its dual role needs to be taken into account. It is noted that real estate plays the major dual role of a factor of

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7 Rating and Valuation Department is mainly responsible for the assessment of properties to Rates and Government Rent under the Rating Ordinance (Cap. 116) and the Government Rent (Assessment and Collection) Ordinance (Cap. 515).
8 See Technical Notes attached to Hong Kong Property Review, annual review published by Rating and Valuation Department.
production and an asset. (Fisher et al, 1993\textsuperscript{10}) This comes into the distinction of space market (the market for leasable space) from capital market (the market for asset ownership claims) and capital market. Being a factor of production, the property provides the space for accommodation and productive activity. In theory, the rental income derived acts as the market clearing price for real estate space. However, in reality, due to the market imperfection by legal restrictions, the contract rent somehow deviates from the market clearing rent.

On the other hand, the pricing of real estate as an asset includes two major activities. (Renaud et al, 1997). Firstly, the property asset yields a rate of return competitive with other alternative investment tool returns. The owners may not be the occupiers as they lease the properties out to gain a stream of rental income as a return. Or their investment is made with the purpose of capital appreciation to earn profits as a short term strategy, i.e. speculation. Secondly, people may choose to purchase the properties so as to secure their flow of services. Therefore, the prices of real estate assets are both driven by the investment demand and owner occupier demand. (Renaud et al, 1997)

Therefore, the demand for real estate space cannot be confused with the demand for real estate asset. The key point is that capitalization rate constitutes the vehicle by which equilibrium is maintained and communicated between the space and capital markets (Fisher et al, 1993)\textsuperscript{11}. For this, the author would briefly review the behaviors of both space market and capital market in the context of Hong Kong individually at first.


\textsuperscript{11} Ibid
2.2 Real Estate Space Market

The participants in the space market are users of space (tenants) and providers of space (landlords). In The United States, Europe and Australia, typical office leases frequently last for at least five years and are often for periods in excess of ten years, while traditional terms of typical leases in Hong Kong are comparatively short. (Pretorius et al, 2003). Instead, short term leases and high rates of tenant mobility characterize all sectors of the real estate industry in Hong Kong. (Renaud et al, 1997) The standard lease duration of Hong Kong for any kind of properties is two to three years. This represents the general occupancy period for tenants. Shorter tenancies demand a rental premium. Leases cannot be terminated except in accordance with the terms of the lease. In another perspective, such short but relatively homogeneous lease term of the rental market of Hong Kong renders higher feasibility of the study of this dissertation.

In the economic downturn, concessions offered by landlords have been popular for attracting renters. The concessions can be taken in different forms. Free rent period offered is a common kind of concession in Hong Kong rental market. Most commonly 2 months rent-free are available on a two year lease, often 3 months on a 3 year lease. There is no fixed rule in this regard though and each property much be considered independently. During rent-free periods the tenant is still responsible for all other costs; management fees, air conditioning, utilities, government rent etc. It is important to recognize the effects of these concessions on rentals.

---

There is no rent control\textsuperscript{13} in Hong Kong at present. Hong Kong Government housing policy claims to allow the residential property market to operate as freely as possible and to take the initiative to provide the infrastructure and the supportive financial environment. On the other hand, the Landlord and Tenant (Consolidation) Ordinance of Hong Kong \textsuperscript{14} gives the excessive protection of security of tenure in the residential sector. According to the Ordinance, in Hong Kong a tenant can enjoy the security of tenure while he remains in occupation. A tenant of a domestic property under Part IV of this Ordinance enjoys security of tenure in that upon expiry of the tenancy he / she may continue to enjoy possession of the property by paying the market rental unless the landlord successfully proves one or more grounds of possession as specified in Part IV (e.g. self-use or rebuilding). This means that the tenancy will not come to an end unless the tenant agrees so. To renew their tenancy, tenants are required to pay the prevailing rents of the premises. In November 2002, the government once announced to review this ordinance so as to relax the overemphasized tenant rights. It should be noted that there is no statutory control on the rent and the security of tenure of non-domestic premises.

\textbf{2.3 Real Estate Capital Market}

In the capital market, the participants are investors and owner occupiers. As mentioned before, real estate can be regarded as a kind of investment vehicle. Therefore, real estate capital market is somehow concerned about the general movement of property price relative to other investment goods. In this way, capitalization rate provides an important basis for rational investing and finance.

\textsuperscript{13} The rent control in Hong Kong came to an end in 1981
\textsuperscript{14} Cap. 7, Law of Hong Kong. Or one can refer to \textit{A Simple Guide to the Landlord and Tenant (Consolidation) Ordinance}, Rating and Valuation Department of Hong Kong
decision. On the other hand, the owner occupier demand somehow involves both the elements of investment and consumption decisions.

One of the very obvious features which are common to all sectors of real estate industry in Hong Kong is the fragmented asset ownership patterns, i.e. multiple ownership within a building. (Renaud et al, 1997) The high rise density occupation within single structures in Hong Kong has encouraged the fragmented property ownership rights which are further advanced by the well developed and accepted strata-title legislation. (Renaud et al, 1997) However, this fragmented pattern of asset ownership in one single block gives an important implication from the investor’s point of view (Chau et al, 2003). According to Chau et al (2003), refurbishment can increase the property value but may not easily take place in the multiple ownership residential buildings. They thus highlight that caution should be taken to make decision of investing these properties.

In Hong Kong, there exist high rates of owner-occupation in all sectors. It is especially true in the residential market, a large proportion of people living in private housing are owner occupiers who merely purchase the units for self accommodation rather than for investment. (Chau, 1997) While half of the populations lived in public housing, over 70% of private housing units were owner-occupied in 1996. On the other hand, there are a lot of institutional players in the real estate investment market. Those institutional investors engage themselves in keeping on buying and selling of properties, so as to gain from capital appreciation, to maintain certain

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17 Hong Kong Census Reports, various issues
liquidity for their funds and to optimize the portfolio returns. Moreover, Many Hong Kong commercial landlords are publicly listed property development companies.

From another perceptive, with only one exception, i.e. St John’s Cathedral in Garden Road, for which the land was granted freehold, all land in Hong Kong is leased or otherwise held from Hong Kong Government. Besides the type of ownership, another major concern is the length of term. We should trace back to the history of land tenure system in Hong Kong. Because of historical reasons, there is no standard lease term for all leases granted in Hong Kong. From 1842 onwards, changing policies gave rise to changes in the terms of lease sold for various periods. All lands were leased for long term use which varies from 999 years; 99 year, to 75 years. (Li, 1997)\(^\text{18}\)

Virtually all private land in Hong Kong is thus held on long leases from the Government, many of which were due to expire in 1997. However, under the Sino-British Joint Declaration on the Future of Hong Kong, these leases would be renewed for fifty years, subject to payment of ground rents at 3% of rateable value. At present, Hong Kong SAR Government can issue new leases with terms expiring not later than 30 June 2047 through the existing land disposal system.

Although the above section has provided the separate review of space market and that of capital market in Hong Kong real estate sector, this dissertation aims to integrate these two markets econometrically by a cross sectional regression model with the capitalization rate to be tested. Nevertheless, it is necessary to come across the general trend of rental yield generated by different property types in Hong Kong, i.e. to

\(^{18}\) Li L H (1997) Development Appraisal of Land in Hong Kong, Hong Kong: the Chinese University Press
integrate the real estate space market and asset market into one picture. The immediate remaining part of this chapter serves this purpose.

### 2.4 Rental Yield of Hong Kong

Many scholars have considered the effect of property types on their capitalization rate in their studies. This will be further explained in the literature review. The author here would briefly describe the general trends of capitalization rates differentiated by property types. The base reference is drawn from Property Review issued annually by Rating and Valuation Department of Hong Kong Government and property market reports published by large real estate consultancy firms.\(^{19}\)

The very major source for the market yield analysis of Hong Kong is from Rating and Valuation Department. However, according to its published technical notes\(^{20}\), the yields have been derived by comparing the average rent/rateable value and price/rateable value factors. The properties featuring in the rental analysis are similar to those in the price analysis, but necessarily are not one and the same. Therefore, it is reminded that the figures should therefore only be regarded as providing a very broad indication of market yields and trends only. In accordance with its published data, the capitalization rate for flatted factories is the highest followed by office and retail sectors. The residential market generally has the lowest rental yield.

Up until the late 1980s, the average capitalization rate for Hong Kong real estate market stayed about 10%. The average capitalization rate has turned down since then.

\(^{19}\) For example, Jones Lang LaSalle Ltd and Chesterton Petty Limited

\(^{20}\) The notes referred here is from the issue of Hong Kong Property Review, 2002

\(^{21}\) The concept of rateable value would be introduced in the later chapters
In 1997, the capitalization rate on average was around 5%. (Chau, 1995) There was a sharp increase in rental yield between 1982 and 1984. The major reason behind suggested by Chau is the political uncertainty associated with 1997 issue increasing risk premium which is one of the basic components in capitalization rate. Empirical evidence shows that the increase in the risk premium is larger and more significant for nonresidential property types. Also, among the residential property types, the results are more significant for larger units than smaller ones. This gives us an insight that rental yields of diverse property types in Hong Kong have different sensitivity to economic variables and market conditions over time.

**Residential Sector**

As evidenced by the volume of property market transaction recorded in Lands Registry, the residential market is the most actively traded and the largest sub-sector of the property market. Figure 1 exhibits the price/rental trends of private residential property market in Hong Kong.

---

After the breaking out of Asian Financial Turmoil in mid-1997, the whole of Hong Kong property market has experienced a downturn situation. The price trend and rental trend of the residential market have been generally downward since then, due to the economic slump, the abundant supply of new flats and the volatile external environment. In particular, the yield rose in 2001 as prices fell more than rents.

In November 2002, government announced several major measures for the revival of residential property market. Some of them are the suspension on government land auction until the end of 2003, the review of the Landlord and Tenant (Consolidation) Ordinance to relax excessive protection of security of tenure and the removal of some anti speculation measures. All measures announced aims to push up the property prices. However, both leasing activity and sales market of residential property have not turned to be more active until the fourth quarter of 2003, after the bitter memories
of SARS have faded over time and there has been the sign of improved economy outlook.

**Non-Residential Sectors**

The non-residential sub-sectors boomed during the 80’s and 90’s until the Asian Financial Turmoil. Among all property types in Hong Kong, the office market was the most volatile in nature. (Chau and Ho, 2000)\(^{23}\)

After the Asian Financial turmoil in late 1997, the losing competitiveness of Hong Kong among Asian countries was a worrying sign for foreign investors and business operators. The declining derived demand for office space has been leading to a substantial fall in both price and rentals afterwards. In 2001, the office market was adversely affected by 911 terrorist attacks on the United States which resulted in corporate downsizing and consolidation. The office yield in 2001 thus rose above the 2000 level, as rents decreased much less than prices. Figure 2 exhibits the price/rental trends of office property market in Hong Kong.

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\(^{23}\) Chau K W and Ho K O (2000) The Dynamics of Hong Kong Property Market in The New Millennium, Asian Infrastructure Research Review 2:2
In the latest years, the economic downturn discourages the spending of local consumers. In 2001, the situation was prominent that prices of retail properties reduced significantly, while the rent level was less adversely affected. This gave rise to a higher capitalization rate of this property category than that of year 2000. Without exception, the retail property sector was hardly hit by the spread of SARS during the second quarter of 2003; it generally revived in the second half of the year after the Individual Visit Scheme has implemented so as to encourage more tourists from mainland China to visit Hong Kong. Figure 3 shows the price/rental trends of retail market in Hong Kong.
Basically, when compared to other sectors, the industrial market of Hong Kong has been the least satisfactory since 1980. The demand for warehouses and flatted factories has declined continuously due to the structural change of Hong Kong economy and the massive shift of manufacturing activities across the border to mainland China. The main industrial activities that now take place in Hong Kong are concerned with design, innovation, marketing, storage and distribution of industrial products. (Roberts, 2001)  

As the government has recognized the need to accommodate the structural changes within that sector, office related to industrial use, IT and telecommunications industries as well as other industrial related activities has been now allowed as of right in the industrial zone since these recent years. Nevertheless, both rents and prices of flatted factories declined in 2001, with prices recording a larger fall than rents. Therefore the market yield increased. According to a series of issue of reports from Rating and Valuation Department, up to now, the

overall industrial market remains inactive. Figure 4 exhibits the price/rental trends of flatted factory industrial market in Hong Kong.

Figure 4 The Price and Rental Trends of Flatted Factory Industrial Market in Hong Kong

Source: Financial Services Branch, Financial Services and the Treasury Bureau, HKSAR Government

2.5 Chapter Summary

The purpose of this chapter is to provide brief and relevant background information for interpreting analyses in the subsequent chapters. The above has outlined the trend of property price and rent in these recent years. In general, the economic downturn has led to decreases in price and rent levels of every property type to different extents. Moreover, the above has affirmed the common view that rent levels are more stable than the price levels in Hong Kong. This has resulted in the general rise of the rental yield of each property type over time towards the end of our study period.
Since this dissertation aims to investigate the relationship between various physical attributes and the capitalization rate by a cross sectional approach, time series movement is not so relevant. A more important implication derived from the above description is the difference between the occupancy period of tenants and the long term valuation period of landlords. Without selling properties out, the owner occupiers or investors hold the stocks over a much longer time horizon than the average period of two to three years of tenancy agreement in Hong Kong. That is one of the significant differences between the real estate rental market and asset market in Hong Kong that the author would like to point out.

Such difference has an important implication. The two parties of owners and tenants have different perceptions towards the use values derived by property, as the reference to time frame is greatly different for them. In short, the renters look for the short term, i.e. current use value derived from the property while the investors consider the long term investment issue. This implication will be further explored in the subsequent chapters.
CHAPTER 3
LITERATURE REVIEW

From the previous chapter, it is noted that the analysis of the capitalization rate should be interpreted upon the space market and the capital market together. Therefore, it is more appropriate that the literature review begins with a general examination of space market and capital market. Then it continues with an identification of capitalization rate components.

As capitalization rate is the ratio of current rental income to price, a glance on previous studies focusing on the major factors affecting property prices and rents is necessary to provide a comprehensive picture. Finally, relevant researches on the determinants of capitalization rate will be demonstrated. After going through these literatures, the significance of this study can be identified and stated at last.

3.1 Space Market, Capital Market and Capitalization Rate

It is noted that the property market attracts a lot of researchers to study on different aspects of space market and capital market separately. On the other hand, a number of scholars also seek to explain for the relationship between these two markets. In this section, the author tries to explore those literatures on all these.

Space Market

Since real estate space is a kind of capital goods, the demand for the use of space is thus derived from the demand for services flowing from the use of real estate space. (Renuad et al, 1997) Those services include shelter for accommodation and business
activity, recreation and accessibility. The use value of properties perceived by tenants therefore depends on the flow of services that the properties generate. Moreover, such valuation is time specific and subject to the duration of lease term only. In short, this derived demand for space, together with the existing supply of leasable space, determines the market clearing rental level. (Archer and Ling, 1997)25

Regarding to space market, central interests from researchers are on the location attribute as demand for accessibility. Locational Theory26 provides an explanation for the rental differential with respect to spatial differences. The bid rent model derived explain for the land use patterns by stating that the use which offer the highest bid rent for a site is the “highest and best use” of that site. Ultimately, rents tend to fall with distance from the central business district up to the edge of the urban area. However, this theory is only a static model. (Tse, 1993)27 It does not explain changes in the demand for space over time in such highly changing world nowadays.

One can imagine that the demand for space is always shifting. Archer and Ling (1997) figure out the dynamic nature of demand for space due to the always changing economic activities and technology advances. This implies an element of risk to real estate investors within the demand for space and thus the volatility of the market clearing rental rate.

Capital Market

26 Among many literatures, Alonso (1964) was one of the earliest researchers to study locaitonal theory. One can refer to his work: Location and Land Use, Cambridge: Harvard University Press.
27 Tse R Y C (1993) Dynamics of Real Estate Market and The Determinants of The Capitalization Rate: With Reference to Hong Kong
Mentioned previously, the total demand for real estate asset can be decomposed into investment demand and owner occupier demand. Quite a number of literatures attempt to link the space market and capital market together. DePasquale and Wheaton (1992)\textsuperscript{28} set up four quadrant model to explain for linkages between them. One of the important linkages, based on their model, is the rental rate. This rental rate represents a cash flow stream which creates an interest to the ownership of real estate as an investment. Therefore, as an investment vehicle, the pricing of capital asset depends on the rental income earned by the real estate asset during its economic life. This is simply because for an investor, the benefit gained from owning those real estate assets should compensate the cost paid out. For that reason, investors purchase a current and future rental income stream, and the observed prices reflect the current valuation of the expected rental income stream. (DiPasquale and Wheaton, 1992).\textsuperscript{29} In this way, the property valuation of landlord is on the longer term basis, of which the time horizon concerned is much longer than the current lease term. Moreover, since the future revenue is uncertain, expectation of changes in the future revenue (for example, rental growth or decline) and the riskiness of the income stream also play an important role of the real estate asset pricing. (Renaud et al, 1997)

**Derivation of Capitalization Rate**

After having the above background, we realize that rents or prices as the market clearing outcome from supply and demand conditions in either the space market or property asset market. (Philips, 1988a)\textsuperscript{30} Capitalization rate, or called initial yield, is


\textsuperscript{29} Ibid

used to capture the relation between rentals and price. (Ong et al, 2002)\textsuperscript{31} Capitalization rate (C) is expressed as the ratio of rental income generated over price:

\[ C = \frac{R}{P} \]

Where R is the current market annual rental income and P is the price of the property. As there are different ways of defining income, i.e. the inclusion of different cash flow elements, there are variations to this expression of the capitalization rate. (Ong et al, 2002) For simplicity and the consistency within this dissertation, capitalization rate refers to the ratio of the current annual rental income to price. In general, the figure of capitalization rate can provide some insights into the performance of real estate return compared with another investment tools, thus it acts a market indicator for potential investors. This idea is consistent with the DiPasquale and Wheaton Model. Referring back to the real asset pricing (valuation) based on their model, given a fixed supply of space in the short run; the property market determines rents which act upon the property prices through the required capitalization rate in the asset market. According to Archer and Ling (1997), the capitalization rates in DiPasquale and Wheaton Model are assumed to be exogenous determinants and thus are independent of the level and riskiness of rents in the space market. However, Archer and Ling suggest that the capitalization rate should be endogenously determined in property markets. Their theoretical base is that given competitive rents in the space market, the property value (prices) should be adjusted to provide the expected holding return equal to the risk adjusted discounted rate. Therefore, property values, and thus capitalization rate, are endogenously determined in property markets. After all, one central question then

remains, i.e. How to derive the capitalization rate? To answer this, we shall refer to
the real estate asset pricing by discounted cash flow model which is commonly used
in the finance literature.

**Discounted Cash Flow Model**

As mentioned before, the asset value of a unit of real estate capital should be equal to
the sum of the present values of the asset’s expected cash flows. Algebraically, this is
expressed as:

\[
V = \frac{A_1}{(1+k)^1} + \frac{A_2}{(1+k)^2} + \frac{A_3}{(1+k)^3} + \ldots
\]

\[
V = \sum_{T=1}^{\infty} \frac{A_t}{(1+k)^t} \quad (1)
\]

Where \(V\) is the asset value, \(A_t\) denotes the net cash flow (revenue less expenses) at
constant price level in year t, and \(k\) is the appropriate discount rate (required rate of
return) for cash flows. This required rate of return is a measure of the return that the
investor requires relative to the risk in investing in the asset when compared to other
investment opportunities. Therefore, in theory, \(k\) should include the nominal risk free
rate of return (opportunity cost of money) and the return for bearing the risk of real
estate investment (risk premium). (Chau, 1995) Furthermore, the discount rate is
assumed to be the same for all periods. The symbol \(\infty\) above the summation sign
further assumes that the investor has an infinite holding period of the asset.

The use of discounted cash flow model requires the forecast of future cash flows at
different points of time in the future. This forecast depends on a set of assumptions
each of which contributes to the final outcome of the asset value. (Li, 1997) Those assumptions are about the growth factor, the rent review pattern and the risk element. Among all, the most important one is the growth rate. Furthermore, the one that the author would explain is the constant growth model.

The constant growth model assumes that cash flows will grow from period to period at the same rate in perpetuity. Therefore,

\[ V = \sum_{t=1}^{\infty} \frac{R (1+g)^t}{(1+k)^t} \]  

(2)

Where \( V \) is the capital value of the property, \( R \) is current market rental income per annum, \( g \) is the constant growth rate, \( k \) is the nominal discount rate that reduces the nominal stream of rental income to current market capital value, taking into account the expected future rental growth.

As mentioned, the capitalization rate is the rent to value ratio \( C \), i.e.

\[ C = \frac{R}{V} \]

Or this formula can be rearranged as:

\[ V = \frac{R}{C} \]  

(3)

Said before, all private land in Hong Kong is held on long leases from the Government, so we can assume land is freehold with an infinite stream of income.
Therefore, freehold formula is employed for a good approximation enough. Then C is also the discount rate in this case since (3) can also be written as:

\[
V = \sum_{T=1}^{\infty} \frac{R}{(1+C)^T} \quad (4)
\]

Comparing (2) and (4),

\[
\frac{1+g}{1+k} = \frac{1}{1+C}
\]

\[(1+C)(1+g)=1+k\]

Therefore,

\[k=C+g+Cg\]

Since C and g is less than 20%, Cg is negligible, we can approximate

\[k=C+g \quad (5)\]

As mentioned, the nominal rate of return is not directly observable but is determined by the rate of return in alternative investment (opportunity cost of money) and the risk of real estate investment. There are three major components in the nominal discount rate, namely, risk free interest rate, transactional cost differential and risk premium of investing in real estate. i.e. (Chau, 1995)

\[k=r_f+r_s+r_p \quad (6)\]

Where

\[r_f = \text{risk free interest rate such the yield to maturity}\]

of long term government bond
\( r_s \) = transaction cost differential
\( r_p \) = risk premium of investing in real estate

Since the transaction cost differential between investing in risk free vehicles and real estate assets is not important for the purpose of this study, \( r_s \) can be ignored. Above all, combining (5) and (6),

\[
C = r_f + r_p - g \quad (7)
\]

Some remarks can be drawn from the above formula. Firstly, this initial yield rate indicates the investor both the initial return he can receive and the potential growth of the property. Baum and Crosby (1995)\(^{32}\) consider that a high quality investment is likely to produce a low initial yield. The underlying reason is that for the high quality investment, the investor would accept a lower initial yield for a greater expected rental growth. Therefore, the initial yield is commonly used as a market measure of the quality of an investment, as far as the current income level of the investment is ascertained. On the other hand, Hamilton and Schwab (1985)\(^{33}\) regard that the variation in the initial yield (they refer to rent to price ratio) mainly reflects the variation in the expected future price appreciation, especially in the short term when interest rate are strongly inelastic to change.

The element of riskiness of the income stream generated by the asset is important, since there may be other investment opportunities which provide the same rate of return but with less risk and thus would be more preferable. When there is perceived higher risk attached to the real estate investment, i.e. higher risk premium, the rental

yield increases too so as to absorb the higher risk premium. The principle of higher risk higher return in the finance field still holds. The total effect on rental yield is a combination of the stated effects of changes in the above variables over time.

So far, the change of the capitalization rate over time can provide us an insight into the general trends in rent and price movements. It is noted that capitalization rate is the ratio of current rental income to price and that the derivation of the capitalization rate is related to the real estate asset valuation. Then, the next question is whether the theoretical derivation of capitalization rate is consistent with those empirical studies. To get the answer, it is essential to cover the researches on the determinants of capitalization rate. Back to a step, it is more necessary to have a brief review on the studies on determinants of price and rentals.

### 3.2 Determinants of Property Price and Rent

Among various aspects of property market, price and rent are the key variables of particular interest in the academic research field due to their measurability and data availability. Among these studies, most look into the effects of certain determinants on property price or rent, either by taking the cross sectional approach, showing time series movement or by the panel approach.

Property is noticeably characterized by its heterogeneity as no two property units are the same. Therefore, from this point of view, the feature of uniqueness identifies any property as the aggregate of numerous attributes. In fact, many researchers propose that property is a combination of different housing traits and identify the effects of different housing traits on property values. Some of them tried to quantify how those
attributes affect the property values, for example, the floor level, the building age and the proximity to amenity park. Among all researchers, Harris, Tolley and Harrell (1968) \(^{34}\) are the pioneer to recognize that housing is composed of different site characteristics and that the composition and the level of housing quality are both important factors of residential choices. While pointing out the over emphasis on the travel cost motives of those earlier studies, they also explicitly discuss the importance of amenity as the major component of property value.

Following this study, Blomquist and Worley (1980), Diamond (1980), Freeman (1979), Harrison and Rubinfield (1978) Nelson (1978) and Pollard (1977) have shown the impact of a variety of amenities on the property values. Besides amenity levels, researchers such as Edel and Sclar (1974), Linneman(1980) and Oates (1969) have highlighted the role of neighborhood locational traits, such as the school quality and public roadways. They all use models to quantify the impacts of housing traits on the property values. In this context, property is not seen as a homogeneous service but as a vector of attributes comprising the property structural, qualitative and quantitative features and neighbor characteristics. As hedonic theory forms part of the theoretical framework of this dissertation, relevant researches on this theory would now be demonstrated.

### Hedonic Price Theory

Plentiful research studies have employed the hedonic function for econometric modeling of those attributes which contribute to property values. This hedonic

approach is based on the seminal work on differentiated market by Rosen (1974).\textsuperscript{35} He is the first to employ the hedonic model to study the supply and demand of the characteristics which differentiate products in competitive markets. Based on this model, he can study the implicit price (the hedonic price) of housing commodity estimated from the model.

The underlying assumption is that goods are supposed to be valued for their utility bearing characteristics. Therefore, he models housing as a vector of traits that directly relating to the consumer’s utility function. The demand for housing can be interpreted as the bundle of demand functions for the housing traits. These housing traits however cannot be bought in the market\textsuperscript{36} separately and directly. The demand for them can only be satisfied through, what Rosen called, the implicit market. The hedonic prices are then defined as the “implicit prices of these attributes and are revealed from observed prices of differentiated products and the specific amounts of characteristics associated with them.” Therefore the total amount of observed payment in housing transaction can be interpreted as the sum of prices of housing traits bought in each implicit market.

Based on the sample observations, the hedonic price model can be empirically tested by a regression function, of which the regression coefficients can identify the underlying parameters of the determinants of the transaction prices, i.e. the implicit prices of the housing attributes. Therefore, in mathematical form, the partial derivation of the equation with respect to the housing trait is the implicit price and thus is a measure of the contribution of the trait to the property price. The model is


\textsuperscript{36} Rosen called it the explicit market
basically a representation of the particular market equilibrium conditions, so the hedonic function and associated partial derivatives are the locus of supply-equal-demand conditions.

Butler (1982)\textsuperscript{37} further elaborates on the hedonic function and suggests that the formulation of the function includes those housing attributes which are only relevant to the determination of market price. This means that only those housing attributes which are costly to produce and yield utility to occupants should be included. However, the constraint of information scarcity and the varied data quality cannot keep this statement valid. In short, the thumb rule is that the inclusion of variables into the hedonic model is only based on strong reasons.

In most of the studies, the housing attributes are generally categorized into the following three types which are thought to be important determinants in the valuations.

(1) Structural traits (S)

(2) Locational traits (L)

(3) Neighborhood traits (N)

In brief, the structural traits are descriptors of the building which relates to the structure itself. The structural attributes that can be included are plenty. Most of these attributes included are, as in Apps (1971), the building age, the floor area, the storey height and the lot area. Locational traits refer to the locational characteristics of the properties. With the same nature as all other traits, a large number of locational attributes can be taken into account in the hedonic function. In spite of this, the thumb

rule mentioned is that only those variables are included for strong reasons, i.e. which are costly to produce but yield utility levels to consumers only. Therefore, as a common practice, the accessibility to employment centre and to social facilities is the most prominent locational traits. Neighborhood traits associated with a property refer to the quality of the neighborhood of a property. Both of the amenity and unpopular structures nearby are under the subjects of empirical investigation by researchers.

Following above all, the hedonic function of the market price of a property can be expressed as

\[ P = a_0 + \sum a_j S_j + \sum a_k L_k + \sum a_q N_q + \varepsilon \]

Where

- \( P \) = Property price of an individual property unit
- \( a_0 \) = Constant term
- \( a_j, a_k, a_q \) = regression coefficients of corresponding variables
- \( S_j \) = variables for structural trait \( j \)
- \( L_k \) = variables for locational trait \( k \)
- \( N_q \) = variables for neighbourhood trait \( q \)
- \( \varepsilon \) = stochastic or error term

The above section provides an insight into the determinants of property prices by the hedonic approach. Since rent can be regarded as the price paid for using the space, physical characteristics and amenity level associated to the property during the occupancy period, the above stated hedonic concepts can be applied to the rental market too. Indeed, most of the researches investigate the determinants of rent based
on the hedonic approach. Therefore, the market rent of a property can also be stated in
the hedonic functional form as:

\[ R = b_0 + \sum b_j S_j + \sum b_k L_k + \sum b_q N_q + \varepsilon \]

Where

- \( R \) = Rental of an individual property unit
- \( b_0 \) = Constant term
- \( b_j, b_k, b_q \) = regression coefficients of corresponding variables
- \( S_j \) = variables for structural trait \( j \)
- \( L_k \) = variables for locational trait \( k \)
- \( N_q \) = variables for neighbourhood trait \( q \)
- \( \varepsilon \) = stochastic or error term

**Time Variables**

It should be noted that there is no time variable in the hedonic model. Therefore, according to the hedonic model, the transactions of two properties should be sold at the same price if they have the same set of traits; despite the fact that they are subject to different dates of transaction. However, in reality, the external environment and the property market is ever changing due to changes in macro economic factors and government policy, so these two properties cannot be sold at the same price in practice.

Therefore, if the empirical data span across a wide time horizon, the time effect on price should be dealt with. However, since this dissertation investigates the effects of
observable attributes of properties affecting the capitalization rate at the same point of
time. The time variable is not our consideration here.

For each type of property, empirical studies on the effect of the various attributes on
property prices and rents are plentiful. The author here just shows the picture in brief,
understanding that it is impossible to list all the studies on these attributes. Therefore,
for each type of property, the most common ones for empirical studies and those
relevant to this study will be covered below.

**Residential Sector**

As far as Hong Kong is concerned, Mok *et al* (1995)\(^{38}\) show in their four models that
(1) the older the properties, the lower the property price, keeping other traits constant,
(2) the larger the size of the property, the lower the property price (area per unit), (3)
the higher the floor level, the higher the property price. In particular to locational
traits, Mok *et al* (1995) include the distance from Central Business District (CBD) as
an independent variable in their study on the price effect for the private residential
properties in Hong Kong. The boundary of CBD is defined in the study and then the
distance of the subject properties can be measured from the edge of the defined area.
This empirical investigation confirms their hypothesis that the property price exerts a
negative relationship with the distance from CBD. In addition to distance from
employment centre, as in the work done by Apps (1971), the accessibility to school
demanded by residents is considered as the determinant of property values.

For the neighborhood attributes, Huang (1996) employs the hedonic regression method to study the price differential among residential properties of Hong Kong due to the estate factors and the amenity level within an estate. The empirical results show that the estate type development deserves a higher property price due to some desirable inherent amenities enjoyed by residents. Also, the estate development can provide opportunities for careful overall planning to deal with combination of block relationships, pedestrian movement and provision of facilities etc. All these command a higher premium.

For the rental market, Benjamin and Sirmans (1994) summarize the factors found to be the determinants of rent in the US for both rent controlled and uncontrolled markets. For the rent uncontrolled apartment markets, they categorize those factors into four groups: unit characteristics, rental information (minimum lease periods and concessions etc), quality of life measures (neighborhood quality and security etc) and demographics (i.e. population characteristics such as density and income level). For the first three categories, they recognize that the theoretical basis is the hedonic price theory. Rent levels thus result from unit characteristics and location which are both supplied and demanded. Several stylized facts have emerged in the literature they reviewed. Firstly, the size of the unit, the number of bathrooms and the floor level are positive variables affecting apartment rents. Secondly, the structural attribute mentioned most as having a negative effect on rent is age. Thirdly, the distance to employment centre and to transportation has the negative effect on rent.

Office Market

Compared with the residential property, office property attracts less empirical studies on the price determinants. With reference to Hong Kong office market, Lee (1999)\(^\text{41}\) has identified the relationship between various factors and the grade A office unit prices in Central, Wanchai and Tsimshatsui. In particular, his study shows that changes in capital values for Grade A offices due to the changes in rental market performances varies with locations in Hong Kong. In Central, the unit rent has the greatest effect on the unit price.

Studies on rent determinants take into account either the physical characteristics, spatial issues or rental characteristics that impact rents. Slade (2000)\(^\text{42}\) provides an examination of five important rent determinants during distinct periods of a market cycle. He uses the dataset of office properties located in a large metropolitan during a six year period. The distinct time periods of the market cycle are decline, trough and recovery. Specifically, the results show that the rental rates increase at a decreasing rate with respect to the average floor area, the number of floors, and the load factor, but decline at a decreasing rate with age and number of buildings. Tests of structural change undertaken help him to draw the conclusion that market participants value differently towards the determinants of rents during the time observed.

Among all, Colwell and Sirmans (1978, 1980) and Colwell and Munneke (1997, 1999) have examined the structure of urban land prices and their findings describe the

\(^{41}\) Lee K M G (1999) Factors affecting the grade A office unit price in Hong Kong, Unpublished Dissertation (MSc in Property Development and Investment) -- University of Greenwich in association with School of Professional and Continuing Education, University of Hong Kong

pattern of rent depending on the distance to city center. Glascock, Jahanian and Sirmans (1990) \(^{43}\) empirically analyze the office building rents based on the data for a five year period on a medium sized city. Their results reflect the rent levels being responsive to various building attribute in the expected manner. They find that the rent vary across classes of office building, geographical boundary and contract term and conditions. As their model is the time series approach, the results can further support the vacancy adjustment process of the rental market by showing the statistically significant relationship between rental rate changes and vacancy rate changes. Also, this relationship holds significantly across different locations.

**Retail Sector**

By employing hedonic model and the data of Hong Kong, Yu (1998) \(^{44}\) has examined how the locational and structural traits affect the unit price of high street shops, assuming that the demographic and social factors do not vary much across different districts. His results have demonstrated that locational variables, for example, the distance from the nearest MTR exit, are more significant than the structural variables including frontage and area. He suggests the underlying reason is that the pedestrian flow is more critical to the success to the retail business and that the physical attributes of the shops can be artificially changed. Renovation is one of the instances.


\(^{44}\) Yu, C.K.E (1998) An Empirical Study of Factors Affecting Retail Space Prices in Hong Kong, Unpublished BSc(Surveying) Dissertation, the University of Hong Kong
Tay et al (1999) have estimated a model of shopping center rents using the sample of data from Hong Kong and have found their results being consistent with the previous findings of other researchers. The rental per unit of a retail shop in the shopping center is positively related to the size and the age of the shopping center but is negatively related to its own size.

**Industrial Sector**

Fehribach, Rutherford and Eakin (1993) estimate multivariate hedonic pricing models for industrial real estate sales price using physical, financial, locational and economic variables for each property. Among all traits affecting industrial real estate price, the significant ones are ceiling height (headroom), office space, size of building, distance to airport and type of tenant (single vs. multiple) They find that ceiling height, office space, size of building, the number of dock high loading doors are positively related to price, while the distance to airport and age are negatively related to sales price.

A number of studies seek to explain the rental rate patterns and the factors of industrial rent variation including those by Buttimer, Rutherford and Witten (1987), Sivitanidou and Sivitanides (1995). Analyzing the determinants of pooled industrial warehouse rents with empirical data, Buttimer, Rutherford and Witten (1987) find that ceiling height, percentage of office space and building age are negatively related to

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rent while location variables exert significant impacts on the industrial property rent. They also find that the number of ground level doors is positively related to the rental. Specifically, Sivitanidou and Sivitanides (1995) explore the relationship between location and industrial rental rates within decentralized metropolitan areas. Their studies find that amenities for both of the firm and workers can have significant effects on the rental rates achieved by industrial properties. Those amenities for firm include the access to raw materials and other markets, available services and freeway while those for workers include proximity to shopping areas.

The above literature reviews figure out the major determinants of property price and rent. More importantly, the reviews enable us to realize that each of the property types has distinct attributes and some characteristics in common, thus generally having different sets of determinants of prices and rents.

The first half of this chapter reviews the role of capitalization rate as the ratio of current rental income to property price, and demonstrates series of attributes affecting the property price and rent. From this point of view, there should be a number of factors significantly affecting capitalization rates. Below is the brief review on this issue.

Variations In the Capitalization Rate

The number of empirical research on the real estate capitalization rates have been on the increase. Among all efforts on various relevant issues, particular emphasis is put on the topic of determinants affecting the time series movement of aggregate capitalization rates in a macro view. Such determinants include capital market factors
and public policy factors, such as interest rates and expected inflation. Regular studies are also done by private firms to evaluate the short term movement of capitalization rates as this information is vital to making investment decisions. Academic studies on the time series movements in aggregate capitalization rates of foreign countries can be found in the works of Fisher, Lentz and Stern (1984)\textsuperscript{49}, Nourse (1987)\textsuperscript{50}, Froland (1987)\textsuperscript{51}, Ambrose and Nourse (1993)\textsuperscript{52}, Jud and Winkler (1995)\textsuperscript{53}.

In particular, Fisher and Lentz (1986)\textsuperscript{54} examined the effects of proposals for tax reform on the value of income producing properties. Such effect is measured in changes of capitalization rates. They explain the relationship between capitalization rate and tax laws, “taxes are a cost of holding an asset which has to be covered by the rental price of the asset. Differential taxation of assets implies different costs of owning alternative assets. Therefore, the larger the tax benefits, ceteris paribus, the lower the rental price that the owner of the preferentially treated asset has to charge to obtain the required after tax rate of return.” This explanation is more or less the same as that of Philips (1988b).\textsuperscript{55} By using imputed average housing capitalization rates for twelve metropolitan areas for the years 1974 through 1979, he finds out that the capitalization rates are lower where the effective property tax rates are higher. This

\textsuperscript{54}Fisher, Jeffrey D., and George H. Lentz (1986) Tax Reform and the Value of Real Estate Income Property \textit{AREUEA Journal}: 14, pp287-315
means that the higher effective property tax rates depress housing asset prices relative to current market rents. He explains that the higher effective property tax rates increase the cost of producing housing services from the capital stock, thus resulting in a higher capitalization rate. Although there is no capital gains tax and low tax regime in Hong Kong, institutional factors in different forms have great influence in the real estate market of Hong Kong, for example, the tenancy protection in the domestic market by legislation. One main point derived from this literature is that the capitalization rates are related to the cost of ownership of real asset capital imposed by institutional factors. Therefore, it gives us an insight that if the institutional factors in Hong Kong affects the ownership cost of real estate asset, the capitalization rates respond too.

However, due to the relatively short period of time series data available for estimation, there are not so many academic studies on time series movement of capitalization rate of Hong Kong. For the particular interest, one can refer to Chau (1995) 's study which analyzes the effect of the political uncertainty due to the repossession of Hong Kong by China. Such effect is found to have profound influence on the real estate risk premium which is implicit in the capitalization rate. Lai (1996) examines the relationship between the various market variables in macroeconomic aspects and the office capitalization rate of Hong Kong through the application of regression model. Since this study does not cover time series model, the above mentioned literature review in this area will not be gone through into details.

However, from another point of view, as each property is regarded as being heterogeneous in nature, the author hopes to pay more attention to the distinct
attributes of individual property on the micro level. Those attributes can also be influential to the property prices and rentals, so the resultant capitalization rates. While some studies focus on capitalization rate analysis across property types, some choose to investigate the variation in the regional specific capitalization rates. Most of these studies aim to prove whether the real estate markets are segmented by property types and geographical location. The following comes with the existing literature involving studies which have explored cross section variations in capitalization rates.

Instead of adopting an overall capitalization rate, Ambrose and Nourse (1993) analyze the capitalization rates by property type and location factors. Their attempt is to explain the variations in the quarterly capitalization rate of United States from 1966 through 1988. One of the results shown by them conveys an important message that using the overall capitalization rate for all property types eliminates important information, thus leading to biased results. By using the band of investment approach to develop a theoretical model, they can explain the variations of the capitalization rate in terms of property characteristics, i.e. property types in the study, and alternative investment returns. The insignificant results obtained for the location factors maybe a result of the rough measure of location used in the study as they just divide the region concerned into five sub-regions, namely the North, South, East and West regions of the United States and the remaining denoting foreign investment.

Sivitanides et al (2001)\textsuperscript{56} attempt to study whether the real estate capitalization rate acts like the price-earning ratios of stock market. They, in particular, examine whether the real estate appraisal valuation estimates move with the opportunity cost of capital

and reflect realistic expectations about future income growth and risk. To study this, they use the average appraisal based capitalization rates over 16 years and across 14 metropolitan markets by employing panel-based regression models. One of their results shows that the capitalization rates levels highlight systematic differences across metropolitan markets. They explain that these differences are due to the variations in the fixed market characteristics which in turn affect investor perceptions towards risk and income growth expectations.

According to Hendershott and Turner (1999)\(^5^7\), quality adjustment is important in the capitalization rate formulation. Their studies have estimated constant quality capitalization rates for apartments and commercial properties using Sweden market transaction during the early July 1990 to December 1992 period. The constant quality capitalization rate means holding property characteristics constant. The property characteristics chosen for their studies include property type, location, lease terms and financing term. They have found out that holding other factors constant, apartment capitalization rates were lower than commercial capitalization rates. For the location factor, capitalization rates for the properties in the more preferable location were much lower than those for the properties in the poorest location. Moreover, their estimated quality capitalization rates have moved substantially different from the averages of capitalization rates of individual apartment and commercial properties in Sweden. This result has confirmed their point of views that quality adjustment is indeed necessary in capitalization rate derivation. Although no comprehensive explanations for these variations are provided, their studies have demonstrated the importance of property type and location affecting capitalization rate formulation.

Contrary to the common belief, an empirical result showing that the capitalization rates for the anchor department stores are greater than for mall stores is demonstrated by Kinnard et al., (1996). They observe from national time series data that as anchor department stores occupy larger spaces, the sale price and the rent per unit of them are lower than those of mall stores. Those department stores also have lower growth in sales prices and rents over time. Kinnard et al recognize greater risk and consequences of loss for the owner of the anchor department store space. Given this background, they have developed the hypothesis that the capitalization rate for anchor department stores is greater than that for mall stores as a group. Their results confirm this hypothesis, but in the conclusion, they point out further studies with more data are necessary to confirm the wide applicability of their findings.

According to Parker (1992), the literature review conducted by him so far could not identify the existence of a comprehensive list of the determinants of the capitalization rate in the work of any individual author. Therefore, Parker listed (1992) out the various factors as determinants of the capitalization rate stated in the work of several authors and regarded such list he made original research per se. However, those various determinants should not be neglected in their special nature that they are varied and numerous rather than similar and limited (Shepherd, 1935; Dubois, 1953)

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59 Three of his series works on this include:
The list was subsequently used as the basis for his questionnaire to ascertain the relative importance of the various determinants identified to the capitalization rate of office properties in Australia. Subject to the CBD office property type, the result of the ranking of these determinants shows that location is considered as the most important factor. The second most important determinants are tenant strength and growth prospects which are supposed to be closely linked together in the depressed market at that time. One interesting result from his survey shows that the building factor (in terms of characteristics, services and finishes) is also considered to be a key issue by those valuers and is ranked as the fourth most important. Parker compares the results of two surveys carried out in 1991 and 1992. To summarize the questionnaire results of these two surveys, Parker then establishes a hierarchical framework for these various determinants of the capitalization rate. The determinants on the top of the hierarchical framework are tenants, growth risk, state of the property market and location. Comparison of these two surveys confirms that the determinants of the capitalization rate vary over time.

All these studies of Parker offer insights for practitioners into the determinants of capitalization rate, but the methodology of practitioner questionnaire does not explicitly estimate the relationship between these factors and capitalization rates. Moreover, Parker notices that most valuers assess the appropriate capitalization rate for valuation through subjective mental deliberation rather than on the objective basis. This view is consistent with the author’s opinion and affects the methodology of this studies which will be detailed later.
Mooney et al (1998) have observed that cash flow and property value are much more dependent on tenant and lease quality in a single tenant property than in a multi-tenant property. Therefore, following Parker’s studies mentioned above, Mooney et al have tried to empirically verify the significant impact of lease and tenant quality on the overall capitalization rate in the transaction of single tenant properties. They therefore have analyzed the overall capitalization rate or return on investment through regression model. The significant factors that are regarded as potential indicators of lease and tenant quality in their studies are the lease term plus options in the lease, rent steps in the lease and the beta of the tenant’s stock (market’s assessment of the riskiness of the tenant’s returns).

3.4 Significance of This Study

This chapter so far has introduced the relevant literatures underlying this dissertation. It can be seen that the above literatures are of great significance to this dissertation. Most of them have empirically analyzed the capitalization rates vary across different properties which are associated with growth expectation and risk premium. They confirm the above stated theoretical derivation of capitalization rate.

We can observe that the capitalization rate varies significantly across different properties. From the literature review, it is known that the capitalization rate captures the expected rental growth and risk premium, which should be associated with the observable attributes of a property. On the other hand, substantial researches have been conducted on the issues of the determinants of property values and rental level in terms of a bundle of structural, locational and neighbourhood attributes. Given that

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capitalization rate is the ratio of rental income to value, there is a logical deduction that the capitalization rate is affected by this bundle of such attributes. However, relatively little empirical works have put the focal point on the determinants of capitalization rate in this micro level.

The author believes that the primary reason for the lack of study on this area is the data scarcity. It is not easy to obtain the information on the rental price for owner occupied housing or the asset price of rental units. On the other hand, the changes of capitalization rate over time can be observed from relevant indices published on national basis. This also partly explains for the reason why the majority of studies on the determinants of capitalization rate are done in aggregate level or on the movement of capitalization rate over time. However, in spite of the difficulty of obtaining the data, cross sectional analysis is indeed essential to interpret the patterns of capitalization rate. After all, the above literature reviews show that the capitalization rate exhibits systematic differences across different property types and locations.

Each city has its own unique features of political and institutional environment. Therefore, no two countries have the same set of legislations and ordinances. The above literature review provides us the clue that the institutional factors are at work to influence the capitalization rate. This is another area of interest that the author would like to examine in the context of Hong Kong.

The relatively few empirical studies on these areas, for the author, create the opportunity to explore more into the effects of observable attributes and institutional factors on the capitalization rate. In the context of relatively homogenous lease terms
in Hong Kong rental markets with frequent transactions, the rateable values can be used as good proxies for rent. Therefore, for one sale transaction record, the price are actual transaction price and the rent is proxied by the rateable value. By adopting this approach, the cross sectional data are available to be used to examine the effects of various attributes of properties on the capitalization rates. Moreover, because of the problem of data scarcity, the previous studies on cross sectional analysis of capitalization rate are rather separate and piecemeal. Finally, as a natural extension of earlier studies, the author would like to find out the relationship between the various building attributes and the capitalization rate based on a derived theoretical framework. This dissertation studies the four property sub-markets of Hong Kong so as to provide a more comprehensive picture for understanding of the capitalization rates.

However, since the figure of capitalization rate itself involves the element of rent and price, neither rental market mechanism nor property price determinants alone can explain for any variation in the capitalization rate. In the next chapter, a theoretical framework is derived based on both of the property asset and rental market for further testing.
CHAPTER 4
HYPOTHESES

The following theoretical base represents every sector of the real estate market: residential, office, retail and industrial real estate. It forms a framework to identify and discuss the relationships between the physical attributes and the capitalization rates within all sectors prior to in-depth empirical analysis of such relationships. Based on the following derivation of the theoretical framework, there are five hypotheses offered by the author in this dissertation.

4.1 Theoretical Derivation

In the last chapter, researches on the determinants of property price and rent have been reviewed. It is noticeably known that the hedonic function can be used to describe the relationship between price (and rent) and building attributes. Also, those attributes can be categorized into three major types, namely structural, locational and neighborhood.

The semi log form of hedonic function is commonly employed to tackle the problem of heteroscedasticity and describe the percentage change of the dependent variable with respect to the attribute (i.e. independent variable). Here, the semi log form is used for the illustration purpose below and the setting up of the models. Therefore, the market prices and rents, denoted by \( P \) and \( R \) correspondingly, can be expressed as follow:

\[
\ln P = f(S, L, N)
\]
\[
\ln R = f(S, L, N)
\]
Furthermore, by assuming a linear relationship, the above equations can be written in the following ways:

\[
\ln P = a_0 + \sum a_j S_j + \sum a_k L_k + \sum a_q N_q + \varepsilon \quad (8)
\]

\[
\ln R = b_0 + \sum b_j S_j + \sum b_k L_k + \sum b_q N_q + \varepsilon \quad (9)
\]

Where

- \( P \) = Property price of an individual property unit
- \( R \) = Rental of an individual property unit
- \( a_0, b_0 \) = Constant term
- \( a_j, a_k, a_q, b_j, b_k, b_q \) = Regression coefficients of corresponding variables
- \( S_j \) = variables for structural trait \( j \)
- \( L_k \) = variables for locational trait \( k \)
- \( N_q \) = variables for neighbourhood trait \( q \)
- \( \varepsilon \) = stochastic or error term

Subtracting (8) from (9), i.e.

\[
\ln R - \ln P = (b_0 - a_0) + \sum (b_j - a_j) S_j + \sum (b_k - a_k) L_k + \sum (b_q - a_q) N_q + \varepsilon
\]

\[
\ln \frac{R}{P} = (b_0 - a_0) + \sum (b_j - a_j) S_j + \sum (b_k - a_k) L_k + \sum (b_q - a_q) N_q + \varepsilon
\]

Therefore, it can be rewritten as

\[
\ln C = (b_0 - a_0) + \sum (b_j - a_j) S_j + \sum (b_k - a_k) L_k + \sum (b_q - a_q) N_q + \varepsilon \quad (10)
\]
Formula (10) can serve as an approximation of the unknown relationship between capitalization rate and those traits, based on the combined hedonic functions of rental and price. It is interesting to note that for each attribute, say for example the structural trait $S_j$, the coefficient $(b_j - a_j)$ is actually the difference between the corresponding regression coefficient in the rental model and that in the price model. In another word, when there is a change in the structural trait $S_j$, the percentage change in $C$ (the capitalization rate) is reflected in the difference between the coefficients of $b_j$ and $a_j$.

According to Formula (10), alternative scenarios can be developed under which the percentage changes in $C$ could occur. When there is a unit change in any trait, for example, $S_j$, the capitalization rate changes depending on the direction and magnitudes of two components, $a_j$ and $b_j$. According to the discounted cash flow model, there is a predictable positive relationship between rent and price. (Philips, 1988b) Moreover, the majority of studies reviewed in the last chapter provide an obvious clue that the property attributes empirically affect rent and price level in the same direction. However, knowing the prevailing directions (i.e. positive sign or negative sign) of regression coefficients $a_j$ and $b_j$ is not enough information because the relative magnitudes of $a_j$ and $b_j$ must be known to figure out the direction of capitalization rate. For instance, it is known that the building age adversely affect the rental, as well as the property price. This is not sufficient to know the relationship between capitalization rate and the building age factor. However, if we further know that the percentage decrease in price (reflected in regression coefficient $a_j$ of variable AGE in price model) is greater than the percentage decrease in rental (reflected in regression coefficient $b_j$ of variable AGE in rental model) i.e. the price decreases by a larger percentage than the rental, we can identify how the building age affects the
capitalization rate when comparing the magnitudes of regression coefficients $a_j$ and $b_j$ Therefore, in the capitalization rate model, the resultant sign of coefficient of AGE is positive. We can then say that there is a positive relationship between the building age factor and the capitalization rate.

Another important question remains. What affects the differential magnitudes of the regression coefficients of an attribute? To answer this, we refer back to the last chapter that covers about the space market and capital market. It is known that there are a number of fundamental differences between those two markets. One of the obvious differences is the time frame to them. The relatively homogeneous lease terms (mainly for two years) are common leasing practices in Hong Kong’s rental market. In the capital market, it is noted that the investment valuation of a property is on a much longer term basis. This formulates the base of the differential perception between the tenant’s short-term (2-years) use value and the owner’s long-term investment valuation of different attributes of a property. Such differential perception is then reflected in the differential magnitudes of regression coefficients $a_j$ and $b_j$ respectively.

Actually the last chapter provides the clues of the topic of the differential perceptions. Here is the refinement of those disaggregate information into one clear picture. Li (1997) has provided a comprehensive description of the objectives of valuation. In short, according to him, valuation aims to find out the value, but not the price. The price can only be realized through the market transaction. Given this context, it is understood that the measure of values of the property perceived by tenants and landlords can be reflected in rentals and sale prices. Specifically, all of these benefits
and costs associated with property characteristics should have been expected at points of time during the property transaction, thus reflected in the transacted price or rental.

In the space market, subject to the budget constraint, tenants rent properties for use by balancing the gains and costs incurred during the occupancy period. However, subject to the short lease terms of tenancy agreement in Hong Kong, it is also expected that tenants will not pay for benefits in the remote future. As users of space, tenants do not consider much about the future space market situation. Mentioned previously, this derived demand for space, together with the existing supply of space, determines the current rental rates.

On the other hand, in the capital market, the landlords acquire properties based on the expectation of long term benefits and costs to accrue during their ownership of property. It is better to illustrate this point with the discounted cash flow model again.

Recalled from the last chapter, Equation (1) is:

\[ V = \sum_{t=1}^{n} \frac{A_t}{(1+k)^t} \]  

(1)

It can be decomposed into three components:

\[ V = \frac{A_1}{(1+k)^1} + \sum_{t=2}^{j} \frac{A_t}{(1+k)^t} + \sum_{T=j+1}^{n} \frac{A_T}{(1+k)^T} \]

Where the first term is the current year rent, the second term is the discounted rental stream during the balance of the expected holding period \( j \), and the third term is the
anticipated resale price in year j, which equals the present value of the net rental flow for the property’s remaining useful life. Therefore, the value of income producing properties includes the current rental rates (space market equilibrium), the streams of future income flow during the expected holding period and the resale price (Philips, 1988b). The asset pricing then takes into account the expectation of rentals growth and decline and capital appreciation. The adjustment of risk premium to the required return of the real estate investment is essential due to the volatility of rental income and the uncertainty about the future space market. From this approach, the current temporary short term effects discounted would affect the use value insignificantly. After all, the current and future perceived (potential) benefits and costs associated with property characteristics are discounted at points of time during the sale transaction, thus reflected in the transacted price at a particular point of time. Two examples are provided below for better understanding on this.

For instance, if there is the government announcement that there will be the construction of railway network within ten minutes walking distance of one housing estate, such effect will be immediately reflected in a dramatic increase in flat prices of that estate. It is because the owners expect that the completion of railway work will be beneficial to those residents living there in the future. However, the construction of railway network will be completed after at least five years. Therefore, the current rental level of the estate does not respond to this announcement. A potential tenant, who now would like to rent a unit in the estate for two years, is not willing to pay for an extra premium for that “future” accessibility to transport route. Therefore, in this scenario, this locational trait, the accessibility to transport route, will immediately increase the price but not for the rent of that estate, thus resulting in a lower
capitalization rate. This example reflects the fundamental differences of the perception between landlords and tenants.

Another example of negative externality is that there is road construction work in front of a shop. It is supposed that the construction work lasts for three months only and that the shop is kept vacant. A potential tenant comes into negotiation with the retail property owner. The tenant, in estimating the use value of that retail property, should take into account the disturbance of the construction work. It is because the survival of retail business is greatly dependent on the pedestrian flow. Also when compared with two years standard lease term, the period of three months occupies certain proportion of time. All these would be reflected in the current rental of that shop. However, the potential buyers of the shop will not discount the effect of this construction work into the retail price so heavily. The construction work adversely affects the retail property temporarily, but not on the long term. This temporary effect reflects in a very minor part of the income stream only during the whole economic life of the retail property. In line with this thought, it is expected that this construction work will decrease the capitalization rate, given that the percentage decrease in rent is greater than that of price.

Given the theoretical background, the author can develop the following series of hypotheses.

Hypothesis One

Holding other attributes equal, the capitalization rate of an older unit is higher than that of a newer unit.
Hypothesis Two
Holding other attributes equal, the capitalization rate of an upper floor unit is lower than that of a lower unit.

Hypothesis Three
Keeping other attributes constant, a larger premise has a lower capitalization rate than a smaller one.

Hypothesis Four
When all other qualities of properties are controlled to be equivalent, the capitalization rate of a property rises with the increasing proximity to Mainland China.

Hypothesis Five
Existence of tenancy agreement will exert positive effect on the residential property, but not on other types, keeping other traits constant.

Now, the author would like to provide the explanations for these five hypotheses.

4.2 Hypothesis One

*When all other qualities of properties are controlled to be equivalent, the capitalization rate of an older unit is higher than that of a newer unit.*
There are numerous empirical studies on the effect of the age factor affecting property prices and rents. Most of them significantly show that the age factor affect the property price and rental negatively. The older the property unit is, the lower the property price and rental should be. Simply speaking, if two apartment buildings are adjacent to each other, one of them is newly built while another is fifty years old. Then, in the view of owners and tenants, the older one would be considered as being inferior and thus be less preferable. This concern should be addressed with the concept of the property depreciation which is defined as a reduction in capital or rental value created by physical deterioration and obsolescence (Ellis, 1990).  

Physical deterioration means “an absolute loss in utility” and obsolescence refers to “relative loss of utility”, i.e. a decline in utility not directly related to physical usage or the passage of time. (Flanagan et al, 1989) The building age is regarded as a good proxy of these two factors contributing to the effect of depreciation, i.e. the loss in the existing use value of property.

Basically, the physical deterioration of the aging building requires the landlords to spend more capital expenditures on more maintenance and repair work for defects while the landlords cannot pass the substantial portion of this cost to tenants under the competitive rental market. This higher maintenance cost is taken into consideration for the investment valuation by landlord. In this way, when the building is getting older, the property price decreases by a larger extent than rentals.

A specific design which was dominated in the past probably becomes obsolete nowadays. Mainly, According to Khalid (1992), there are functional and

technological obsolescence. Generally speaking, the functional obsolescence occurs as a result of technological change inducing further changes in occupiers’ requirement and the introduction of new building products. One example is the trend to raised floor layout to accommodate the new technology. The technological obsolescence refers to components of a building which become technologically inefficient, for example building electrical system. Therefore, together with the ever changing requirements of occupiers and technology level, the obsolescence effect takes place a result of appearance of newer assets with technologically superior designs which reduces the price and the rentals of existing properties at a point of time.

It can be seen that obsolescence effect is basically the outcome of the dynamic nature of the world. As mentioned, the dynamism implies an element of riskiness as no one can fully foresee how the future is going on. For this uncertainty about how technology takes places, it is expected that the more recently built property units are less prone to functional obsolescence than the older properties. For investment or owner occupying, obsolescence effects impose higher risk premium on the older properties than the recently built one. When higher risk is foreseen, the investors or owner occupiers are only willing to pay a lower price to buy older properties for a given level of rental income generated or for self occupation.

Last but not least, the building age can also be interpreted as a proxy of economic life of the building asset. When the building is getting older, the shorter its expected economic life remains. From the discounted cash flow model, the asset value depends on three elements: the cash flow amount, the discount rate and the holding period. In this way, the building age affects the stream of income flow generated. The older the
building is, the less of total rental income can be received, thus the lower asset price should be. However, for tenants, aging building only means physical neglect, outdated design and poorer facilities. They probably do not consider the economic life issue. The rental value thus does not reflect the expected holding period of the property unit.

From above, the building age means different things for tenants and landlords. All these differential perceptions of the age factors between tenants and landlords imply that with respect to the increasing age, there is a greater percentage decrease in price relative to rentals, thus a higher capitalization rate.

4.3 Hypothesis Two

Holding other attributes equal, the capitalization rate of an upper floor unit is lower than that of a lower unit.

Regarding the author’s interpretation, the floor level does not merely represent the height between the property and the land on which it is located on in the context of Hong Kong. The high building density in Hong Kong stresses the close interrelationship between the property units and the external spatial environment. In this way, the higher price and rental for upper floor units are justified. Firstly, the occupiers (who may be owners or tenants) of the upper floor units can enjoy a better view. Secondly, there are fewer disturbances for the upper units from outside. The disturbances can include noise, air pollution and disamenity nearby. All these benefits enjoyed by occupiers of upper units can be reflected in the higher price and rentals. This just reveals the time fixed relationship between the spatial environment and
property units. At a particular point of time, the real estate asset valuation of prices however should further consider the future prospects on a longer term basis.

Therefore, again, the more relevant considerations of property pricing are the dynamic nature of the external environment. This makes the differential percentage change between prices and rentals with respect to the floor level. The actively changing spatial environment is especially prominent in Hong Kong. The dynamic nature of the external environment creates the “physical” riskiness to the property investment, as no one can fully predict how the future of the spatial environment is. For this aspect, the lower floor units are more vulnerable to the changes in spatial environment nearby in the future. The changes may be related to deterioration of air quality and the construction of unpopular structures, e.g. rehabilitation centre. This kind of perceived riskiness for lower floor units can only be reflected in lower sales prices of these properties. However, this risk is not considered so substantially from the tenant side, given the lease term is as short as two years in Hong Kong. This perceived risk of lower floor units results in the larger percentage decrease in price than that in rental, thus increases the capitalization rates, keeping other things constant.

Although it is true that most pre-war residential buildings in Hong Kong have not installed lift services, this would cause inconvenience to those occupiers who live in the units of the upper floor. This may distort the picture of the effects of floor levels to the capitalization rate. Since the total number of pre-war buildings occupies relatively small proportion of the total building stocks, this issue is considered not to be significant.
4.4 Hypothesis Three

Keeping other traits constant, a larger premise has a lower capitalization rate than a smaller one.

The larger the area of a property unit, the higher price and rental should be. It is simply because the larger unit can provide more space to be utilized by an occupier. From another perspective, the size of the unit, to a large extent, represents the affluence of the residential occupiers who are either owners or tenants, the corporate size of business company, the size of the production base of industrial enterprises, the scale of the retail business. For this reason, the author suggests interpreting the impact of the area attribute is put in the context of economic variables within each sector, and the economic outlook as a whole in Hong Kong.

In this way, the current rental rate of a property unit takes into account the present situation of economic variables. The valuation for investment additionally involves expectation about the future. Then, the interpretation of capitalization rate regarding the unit size does not just limit to the present situation of the economy within each sector, but also the future prospect of growth and trend inside it. The overall impression is that Hong Kong economy has suffered from depression and restructuring in these recent years. For domestic sector, the economic depression worsens the uneven income distributions of household. It is noted that the default risk of current rental payment for a larger flat is lower. This trend of uneven income distributions turns out to be a better future prospect of promising rental growth and capital appreciation for investing in luxurious residential market (which provides the
majority of large flats). Therefore, for domestic sector, with respect to the increasing size of properties, the percentage increase in price is greater than that in rentals then.

For the long term investment in the non domestic sectors, large business, industrial firms and retail shops are typically the last to suffer in poor markets and the first to recover. The default risks of tenants occupying the larger units are generally less. Therefore, with respect to the larger size of the property units, the proportion of increase in rental is smaller than that of increase in property prices, as the default risk of tenants of larger properties is generally less from the view of landlords in this current market situation as well as future prospects.

4.5 Hypothesis Four

When all other qualities of properties are controlled to be equivalent, the capitalization rate of a property rises with the increasing proximity to Mainland China.

Referred to the last chapter, locational factor is one of the determinants of the capitalization rate. The capitalization rates across regional markets differ due to the variations in the fixed inherent locational characteristics which in turn affect the investor perceptions of risk and income growth expectation. (Sivitanides et al, 2001)

Although Hong Kong is a small city, there are great diversified features of geographical and built environment within its boundary. As Hong Kong is situated in the southeastern tip of China and has become part of the China after the handover of sovereignty, there is a closer and closer economic link between China and Hong Kong.
Shenzhen and Guangzhou have also witnessed the growing prosperity of their economies for decades. Accessibility to properties in Shenzhen and Guangzhou from Hong Kong also has been improving a lot. As the author sees, the improved economy and accessibility turn out into either direct or indirect effects on the demand for space in Hong Kong. For the direct one, properties somehow in Shenzhen and Guangzhou can be treated as “substitutes” for those in Hong Kong, which are more costly to occupy. The substitution effect indeed has taken place for a decade. This has been evidenced by the massive shift of production base of industrial sector to Mainland China for decades. Another indirect effect is on the space demand for retail properties. Given the increasing convenience of traveling to Shenzhen and lower average prices of those consumer goods sold there, many and many people now prefer to go to Shenzhen for multi purpose shopping. The poor economic environment in Hong Kong also partly encourages people to travel more to Shenzhen for buying cheaper goods. As always stated, the demand for space is a derived one, so the effect of increasing preference to shopping in Shenzhen indirectly affects the demand for retail space in Hong Kong.

However, such the extent of substitution effects varies across different locations. The whole of Hong Kong can be roughly divided into Hong Kong Island, Kowloon Peninsula and New Territories, each of which exhibits the distinct diversity. There is Victoria Harbour separating Hong Kong Island and Kowloon Peninsula. While New Territories is physically closer to the Mainland China, Hong Kong Island is the most farthest from mainland. Regarding this, those properties in Shenzhen should be better substitute for properties in New Territories than that on Hong Kong Island.
Meanwhile, the substitution effect, undoubtedly, affects both the current rental market and sale market of property. The extent of this effect is not constant in these two markets, thus creating the variation in the capitalization rate. As the substitution effect is perceived as a continuous trend issue rather than as a short term event, it is proposed that with the increasing proximity to Shenzhen, higher risk is perceived in the property long term investment. With respect to the stronger substitution effect derived by a closer distance to Shenzhen, the property prices decreases by a larger percentage than the current rentals then, keeping other attributes are constant.

So far, we have come across four hypotheses on how capitalization rates are related to those physical attributes of properties. The entire theoretical base is on the differential perception between the tenants’ short term use value and the owners’ long term investment valuation of different attributes. However, there is another invisible player in the property market, i.e. the Government.

Besides the differential perceptions of market participants in Hong Kong, the institutional factors are also supposed to shape the patterns of capitalization rates of different properties in Hong Kong. The significance of the institutional factors is recorded in the literature review in the last chapter. In the mathematical form, the capitalization rate, as the ratio of current rental income to price, varies if either rental or price varies to respond the outside forces. The two most common forms of institutional factors in the private rental market are the rent control and the tenancy protection legislation. In Hong Kong, particular focus should be on the tenancy protection issue, as the rent control policy has been abolished. The tenancy protection
aims to protect tenants from being evicted by unscrupulous landlords, as places for residence are very essential to everyone.

As a number of researchers have pointed out that the tenant quality is an important determinant of capitalization rate, for example the questionnaire survey result shown by Parker. Among them, Mooney et al (1998) have observed that the tenant quality is more critical to the income flow, thus the property value and capitalization rate of single tenant properties. The underlying reason for such importance is stated by Parker that the tenant quality affects the security and reliability of the income stream from an investment property. All these issues occur in the context of a free property market.

Therefore, building on their works, the author has realized that tenant quality is a more important determinant of the capitalization rate in these recent years, given the depressed economic market consideration. Adding the institutional factor of the tenancy protection, tenant quality becomes a more and more key variable for the consideration of the capitalization rate. This point of view has been verified by the increasing number of complaints against so-called "professional tenants". 63 and the increasing number of legal proceedings in landlord-tenant disputes. 64 As mentioned, the tenant quality means the security and reliability of the income stream, and the tenancy protection somehow is to increase the uncertainty, thus the riskiness of the expected cash flow. Therefore, more risk premium is required for such

63 South China Morning Post, Nov 18,2002
64 Judiciary figures show the number of such cases filed with the Lands Tribunal rose 15 per cent from 4,509 in 1999 to 5,207 in 2001.
investment, and higher capitalization rate is resulted. From this theoretical derivation, the last hypothesis can be formulated.

**4.6 Hypothesis Five**

*Existence of tenancy agreement will exert positive effect on the capitalization rates of residential properties in Hong Kong, but not on other types, keeping other traits constant.*

This comes with a further explanation. As already pointed out, the Landlord and Tenant (Consolidation) Ordinance provides the tenancy protection of domestic properties. The Ordinance is still legally binding to the subsequent purchasers of the tenanted domestic properties. However, the rent and the security of tenure of non-domestic premises are not subject to any statutory control.

For domestic units, owners can either choose to rent them out or sell them to buyers for self occupation purpose. Above all, when a domestic unit is subject to tenancy agreement, the potential buyers cannot occupy it for self use after the transaction. The potential purchaser would perceive a higher risk in the rental income paid by the existing tenant. Therefore, he is only willing to pay a lower purchasing price for compensation of the higher risk suffered.

For income producing properties other than domestic ones, without the statutory control on the tenancy protection, whether the properties are subject to tenancy agreement does not matter in the determination of the capitalization rate.
4.7 Chapter Summary

The five hypotheses on how physical and locational attributes of a property and institutional factors affect its capitalization rate are developed. The theoretical foundation of these hypotheses has also been introduced by the author. One question thus arises: How to verify the author’s hypotheses?

One of the methods is to carry out the questionnaire survey. Sample of respondents can be randomly selected for filling in the questionnaire survey. However, as pointed out by Parker, this method involves the process of subjective mental deliberation on a series of variables of almost identical importance. As this study hopes to improve the estimation of capitalization by a more objective approach, the questionnaire survey is not suitable then.

A more scientific method is more appropriate for this dissertation. As shown from above, the empirical testing by regression model is found to be very popular among researchers. The popularity lies upon the reliability derived from the more objective approach of data collection and analyses. Therefore, the author would adopt the regression model to test the hypothesis. The next chapter will cover mainly about the methodology.
CHAPTER 5

METHODOLOGY

To examine the effects of those property attributes on capitalization rates, the empirical research of this dissertation utilizes the multiple regression analysis. As five hypotheses have been derived in the last chapter, the author can test them by estimating the regression models using transaction records. Before applying the empirical models, it is necessary to discuss the methodology of the regression analysis approach.

5.1 Regression Analysis

In this study, a regression analysis serves to provide a statistical technique for developing equation which can describe the relationship between dependent and explanatory (independent) variables.

Under the condition that more market transaction data is available, the statistical model of multiple regression analysis can be applied. Regression model is based on the assumption that the unknown variable, i.e. variable to be forecast, for example, construction cost and property market value, can be expressed as a function of some known and measurable variables, for example, design variables ($X_i$) or measurable attributes of property ($A_i$).

By assuming a linear relationship, the regression model can be expressed as:

$$ C = a_0 + \sum_i a_i X_{ij} + e_j $$
Where C is the dependent variable, \( a_0 \) is the constant term, \( a_i \) is the coefficient of the attribute variable \( X_i \) and \( e_j \) is the stochastic or error term. By the above statistical model, the regression analysis can show the extent to which a dependent variable is affected by a set of other variables.

The regression coefficients \( a_i \) measure the changes in C associated with a unit change in \( X_i \) holding all other factors constant, i.e. \( \frac{dC}{dX_i} = a_i \). In another word, the change in C caused by a unit change in \( X_i \) is reflected in the corresponding regression coefficient, \( a_i \). The simplest and most common method of estimating the parameters \( (a_i) \) of the regression model is the Ordinary Least Squares (OLS) technique.

**Ordinary Least Squares Technique**

Ordinary Least Squares (OLS) technique, a method of curve fitting, estimates the true but unobservable function by a regression equation:

\[
C = b_0 + \sum b_i X_{ij} + r_j
\]

of which the residual sum of squares (sum of the squares of the differences between the actual and the forecast values of C) is a minimum one, where C is the dependent or the regress, \( X_i \) are the independent variables or the regressors, \( r_i \) is the residual and \( b_i \) is the OLS estimator of \( a_i \) (the true unobservable coefficient of \( X_i \))

### 5.2 Functional Form

Based on theoretical grounds, the structure of regression models specifies a number of hypothesized relationships between the dependent variable and the independent variables. Unfortunately theory provides no definitive answer concerning the structure
of the regression model. (Adair et al, 1996) As one of the common methodological problems, the failure in the choice of correct functional form specification will give an overestimated result (Linneman, 1980). This stresses the importance of an appropriate functional form for the regression model. The main rule of the choice depends on the nature of the relationship. There are two different situations which affect the choice of functional form, which are as follows:

- A prior information about the relationship between variables can be logically deduced.
- There is no prior knowledge about the shape of the function

It is easier to deal with the first case, as the functional form would be the one which assumes the established relationship. For example, J curve functional form is commonly adopted to model the relationship between the unit construction cost and number of storeys. Actually this is logically deduced from the situation that the unit construction cost tends to go down (up to the number of storeys = 3 to 4) and then goes up again.

If it is the latter case, try and error approach based on empirical observation should be adopted. But, there are still common procedures followed as shown below:

- Assume a linear function as the first attempt
- Use more flexible functional forms (which can assume different shapes depending on the estimated parameters) if the linear assumption fails. Examples, the polynomial function and Box-Cox transformation, can be used.

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66 Linneman, Peter(1980), Some empirical results on the nature of the hedonic price function for the urban housing market, *Journal of Urban Economics*, 8, pp.47-68
In this dissertation, there is no priori knowledge of the determination of the functional form. Although many different formulas can be used to hypothesize the regression relationship, the linear functional form has been widely applied in the real estate research. It is notably employed partly due to the econometric convenience and due to the fact that it serves a close approximation to otherwise complicated regression equations. (Miller and Miller, 1999)\(^67\) So far, as the main concern is the sign and magnitude of the coefficients, the relationships between the dependent variable and the independent variables can be approximated enough by the linear form. Therefore, the author would try the linear form as the first attempt. If the results are not sufficiently significant, the transformation of data will be undertaken to overcome the nonlinearity problems and the interaction terms are also used. Moreover, to be consistent with the theoretical derivation model in the last chapter, the semi log model based upon the transformation of the dependent variable will be used.

**Assumptions of Log Linear Model**

The following assumptions apply to the normal linear regression model, as well as the semi log ones.

(1) The true unobservable relationship between the dependent and independent variable is linear form.

(2) The independent variables are non-stochastic and linearly independent of each other.

(3) The expected value of the error term is zero for all observations. This means that the average effect of the left out factors is zero or constant. This also requires that

---

there is no bias exists in the measurement of the independent variable or if bias exist it must be the same for all observations. Assumption (2) and (3) implicitly imply that the independent variables are not correlated with the error term.

(4) The variance of the error term is constant for all observations. This means that all the factors generating the error term do not change over the set of observations

(5) Error terms of different observations are uncorrelated

(6) All error terms are assumed to be normally distributed. This assumption is required to perform the t-test.

5.3 Variables

Besides the appropriate functional form, the importance of the identification of appropriate variables is well recognized. The following comes with a discussion on the dependent variables and independent variables.

Dependent Variable

In this dissertation, the study aims at investigating the variations of the capitalization rate which can be explained by the property attributes and locational factors.

Therefore, based on the theoretical model in the last chapter, the capitalization rates will be the dependent variables. Additionally, the capitalization rate will be transformed into the log form in the regression function.

The failure to allow for temporal stability can produce unstable regression coefficients. (Gloudemans, 1990)68 As briefly stated, the capitalization rate is not kept constant over time. Therefore, it is necessary to isolate the influence of time on capitalization

rate so as to maintain the temporal stability of regression models. To achieve this, the nature of the data employed in this regression analysis is restricted to the transactions within a quarter thus the data can be considered as cross sectional in nature rather than time series bases. Then the data on transaction record is appropriate for the study.

**Dummy Variables**

Most of the factors in this study can be quantified, for example, building age and floor level. However, some factors, which are supposed to affect the capitalization rate, are qualitative. Examples are location and existing tenancy. To encounter this situation, dummy variables are employed to model qualitative factors in the analysis.

The usefulness of dummy variables lies upon the fact that it can measure the effects of discontinuous factors or an existence of a particular condition (event) affecting the capitalization rate. For example, when a domestic premise possesses the sea view attribute, the dummy variable of sea view is given the value of 1; otherwise the value is 0. The coefficients of the dummy variables then can measure the differences in intercepts. In general, if q qualitative factor can be categorized into n different categories, (n-1) dummy variables are required to model the effects of the factor.

In this dissertation, dummy variables will be used to represent the locational and tenancy status.

**Independent Variables**

The last chapter has hypothesized the effect of various attributes of properties on rental yield. Therefore, in this study, a vector of these attributes will be the
independent variables. One regression model is set for each of the four sub-markets of Hong Kong’s real estate (i.e. residential, office, retail and industrial). Each model would have its own set of independent variables depending on the characteristics of that property type. Meanwhile, the four models would have common types of independent variables which actually have been introduced in the last chapter. These common ones for modeling can be now described briefly first.

**Age of Property (AGE)**

This variable AGE is incorporated to describe the physical age of the transacted property. It is calculated from the difference between the date of issuance of occupation permit and the date of transaction. From the Hypothesis One, when other attributes are held constant, the older the building is, the higher the capitalization rate will be. The coefficient of AGE is thus expected to be positive.

**Square of Age (AGE²)**

The addition of square term of the age variable helps to capture any potential non-linear effect that increases at an increasing/decreasing rate. When a building is getting older and older, owners would probably undertake renovation work to maintain the property values. However, since the ownership pattern within a building is critical for the possibility of the rehabilitation work of older buildings, the signs of AGE² cannot be expected yet.

**Floor Level (FLOOR)**

FLOOR variable approximates the vertical distance between the property and the land on which it is located. From Hypothesis Two, the higher floor level, the smaller the
capitalization rate is, provided that other things are held constant. The signs of the floor level are anticipated to be negative. However, due to the special feature of retail properties, this variable is not applied in the retail sector model. Another treatment will be described below.

Floor Area (AREA)

It is hypothesized that when all other characteristics are held to be constant, the larger the area of a property unit, the lower its capitalization rate should be. As a result, the coefficient of AREA is expected to be negative. However, there are different terms of area used to describe premises. This issue will be further explored in the subsequent chapter about data processing.

Locational Traits

In Hypothesis Four, the physical distance to Shenzhen is the locational consideration to affect capitalization rate. It is not practical to take the measurement of the physical distance for each individual property. Regarding this, it is better to use district classification as a proxy of this factor. It is commonly accepted that Hong Kong is divided into Hong Kong Island, Kowloon and the New Territories. These three districts are represented by dummies DHK, DKLN and DNT respectively. As stated, since this locational factor can be divided into three dummy variables, in principle only two of them need to be incorporated into the model. However, due to the uneven distribution of different property types, for example, there should be more industrial transaction records in New Territories. To increase the significance of results, the dummy variable which has the highest number of records will be deliberately chosen.
not to be incorporated. The effect of it will be absorbed into the constant term of the equation.

Existing Tenancy (DET)

It is hypothesized that if a domestic premise is subject to the existing tenancy agreement, the capitalization rate rises then. This factor is represented by dummy DET. For the model of domestic sector, the expected sign of DET is positive. On the other hand, the remaining types of properties are not subject to the statutory control, thus at this stage we do not know how DET variable affects the capitalization rate on other property types. The signs of DET cannot be expected in these models.

5.4 Empirical Models

The above has introduced those common sets of variables in the four models. It is notable that there are great distinct differences of observable features between the four markets. The thumb rule is applied here that variables are only added to the equations based on strong reasons for inclusion. Therefore, for each property kind, the effect of these distinct features would be taken into account because those characteristics are significant to shape utility to occupiers but costly to produce. This comes to the next part regarding the formation of each model.

Residential Sector

Besides the independent variables stated above, one more variable would be included, i.e. roof dummy. The following equation can test the effects of those attributes on rental yields of residential properties.
\[ \ln C = a_0 + a_1 \text{AGE} + a_2 \text{AGE}^2 + a_3 \text{FLOOR} + a_4 \text{AREA} + a_5 \text{DET} + a_6 \text{DROOF} \]

**Roof (DROOF)**

A property is located at the top floor and may be transacted with the roof as an ancillary item. The DROOF dummy is used to represent the existence of roof attached to the subject transaction. DROOF dummy variable is used with 1 to represent the case of existence and 0 otherwise.

The expected results are summarized as follows:

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Expected Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td>+</td>
</tr>
<tr>
<td>\text{AGE}^2</td>
<td>?</td>
</tr>
<tr>
<td>FLOOR</td>
<td>-</td>
</tr>
<tr>
<td>AREA</td>
<td>-</td>
</tr>
<tr>
<td>DET</td>
<td>+</td>
</tr>
<tr>
<td>DROOF</td>
<td>?</td>
</tr>
</tbody>
</table>

It is noted that due to the technical reasons, the author can just obtain the domestic records of Hong Kong Island. Therefore, no locational dummy is included here. The next chapter will address this problem.

**Office Sector**
The capitalization rate is regressed against the observable attributes as follows:

\[ \ln C = a_0 + a_1 \text{AGE} + a_2 \text{AGE}^2 + a_3 \text{FLOOR} + a_4 \text{AREA} + a_5 \text{DKLN} + a_6 \text{DNT} + a_7 \text{DET} \]

The expected results are summarized as follows:

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Expected Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td>+</td>
</tr>
<tr>
<td>AGE^2</td>
<td>?</td>
</tr>
<tr>
<td>FLOOR</td>
<td>-</td>
</tr>
<tr>
<td>AREA</td>
<td>-</td>
</tr>
<tr>
<td>DKLN</td>
<td>+</td>
</tr>
<tr>
<td>DNT</td>
<td>+</td>
</tr>
<tr>
<td>DET</td>
<td>?</td>
</tr>
</tbody>
</table>

**Retail Sector**

In the retail sector model, due to the heterogeneous nature of properties, more variables (i.e. ground floor dummy, headroom, yard and cockloft) are added to the equation as follows.

\[ \ln C = a_0 + a_1 \text{AGE} + a_2 \text{AGE}^2 + a_3 \text{AREA} + a_4 \text{HK} + a_5 \text{DET} + a_6 \text{DGROUND} + a_7 \text{HR} + a_8 \text{DYARD} + a_9 \text{DCL} \]

Locational Factors (DHK)
Only dummy DHK is added as a locaitonal variable in the equation. The author deliberately did so, realizing potential stronger impact of Kowloon Canton Railway (KCR) to stimulate the substitution effect of Shenzhen. Since KCR runs from Hung Hom to Lo Wu (i.e. from Kowloon to New Territories) The author would like to combine these two districts to one. Therefore only DHK dummy is one if the property is located on Hong Kong Island and zero otherwise. The expected sign of DHK is negative.

Ground Floor Level (DGROUND)
Instead of FLOOR variable, the dummy variable DGROUND is used to estimate the effects of floor level of retail shops on the capitalization rate. DGROUND equals one if the unit is located on the ground floor and zero otherwise. It is done so because basically more pedestrian flows are found on the ground floor high street shops and the ground level retail units in the shopping arcade. This is evidenced by the fact that the ground floor level shops are transacted or rented at higher prices. Generally, the pedestrian flows become immediately less for retail properties above or below the ground floor level. However, the sign of DGROUND cannot be deduced logically and thus cannot be expected.

Headroom (HR)
The headroom of a property may affect the market value of the property. The variations of headroom of different retail properties are quite obvious. Therefore, this variable is added to test how the attribute affect the capitalization rates. However, the result cannot be logically deduced, so the sign is unexpected at this stage now.
Yard (DYARD)

If there is a yard with the retail property, property prices and rentals should include the main retail premise and the yard. Therefore, yard is perceived as a tie in sale. DYARD equals one if the unit has a yard ancillary item and zero otherwise. However the tie in sale effect cannot be expected at this stage, so the sign of DYARD cannot be estimated yet.

Cockloft (DCL)

Similar to yard, cockloft is an ancillary item. One interesting point to note is that it can be legally or illegally built in Hong Kong. Higher rentals and prices should reflect the existence of this kind of structure (whether legal or illegal). In this way, DCL dummy is equal to one if the retail has a cockloft, and zero otherwise. At this stage, the sign of this variable cannot be logically figured out.

The expected results are summarized as follows:

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Expected Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td>+</td>
</tr>
<tr>
<td>AGE2</td>
<td>?</td>
</tr>
<tr>
<td>AREA</td>
<td>-</td>
</tr>
<tr>
<td>DHK</td>
<td>-</td>
</tr>
<tr>
<td>DET</td>
<td>?</td>
</tr>
<tr>
<td>DGROUND</td>
<td>?</td>
</tr>
<tr>
<td>HR</td>
<td>?</td>
</tr>
</tbody>
</table>

Table 3 Expected Sign of Coefficients of the Model for the Retail Sector
Industrial Sector

In addition to those common variables, one more independent variable, i.e. headroom variable (HR) is included to the equation of industrial sector. It comes out the following equation:

\[
\ln C = a_0 + a_1 \text{AGE} + a_2 \text{AGE}^2 + a_3 \text{AREA} + a_4 \text{FLOOR} + a_5 \text{DHK} + a_6 \text{DKLN} + a_7 \text{DET} + a_8 \text{DHR}
\]

Headroom (HR)

As shown in the chapter of literature review, headroom is one of the considerations influencing purchase or renting decision of industrial properties. Regarding this, the author would find out the effects of headroom on the capitalization rate. The sign at this stage cannot be expected by logical deduction and is not yet known.

Therefore, the expected results are summarized as follows:

Table 4 Expected Sign of Coefficients of the Model for the Industrial Sector

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Expected Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td>+</td>
</tr>
<tr>
<td>AGE2</td>
<td>?</td>
</tr>
<tr>
<td>FLOOR</td>
<td>-</td>
</tr>
<tr>
<td>AREA</td>
<td>-</td>
</tr>
<tr>
<td>DHK</td>
<td>-</td>
</tr>
</tbody>
</table>
5.5 Hypothesis Testing

After formulation of models, the author can test the hypothesis using empirical evidence. Therefore, the interpretation of analysis is of particular importance to evaluate whether the results are significant and the hypotheses are accepted in the view of statistical evidence. For this purpose, this study would exhibit three test statistics in the models. They are the t-statistics, the coefficient of determination ($R^2$) and F-statistics. They would be introduced in the next section.

T-statistics

It is a kind of statistics to test the significance of the effect of each independent variables on the dependent variable $C$. The value of $t$ depends on the regression coefficient of the independent variable ($b_i$) and the standard error of that coefficient ($Sb_i$),

$$T = \frac{b_i}{Sb_i}$$

The larger the value, the more accurate the estimate is, so it is less likely that $b=0$

Statistical significance refers to the likelihood that the statement “$C$ is affected by $X_i$” is true. Significance has nothing to do with the magnitude of the effect of $X_i$ on $C$, i.e. $b_i$ can be very significant (high t-value) but the effects of $X_i$ on $C$ can be very small.
The relationship between the dependent variable $C$ and the independent variable is significant at $(1-\alpha) \times 100\%$ confidence interval if

$$l t l > T(\alpha, df)$$

where $\alpha = \text{probability of } "b=0"$

$df = \text{degree of freedom}^{69}$

$T(\alpha, df) = \text{critical value for a given } \alpha \text{ and } df$

For example, $\alpha$ is set to be 0.1. If the calculated $t$ is higher than the critical $T(0.1, df)$, then the regression coefficient $b$ is said to be “significant at the 90% confidence interval” or “significant at the 10% level” and the chance that $b=0$ is only 10% (type I error). In this study, an independent variable will be regarded as insignificant if it is not significant at 95% confidence interval.

**Coefficient of Determination- $R^2$**

It is used to give the level of statistical explanation, i.e. to indicate the proportion of variation in the dependent variables which can be explained by the variation in the independent variables, thus representing the explanatory power of the model. Irrespective of whether the independent variables are statistically significant, the more independent variables are added to the regression model, the higher value of $R$ will be obtained. For example, if $R^2 = 0.6$, it implies that 60% of the changes in the dependent variable $C$ is due to the changes in the independent variables. The reasons for the remaining 40% variation in $C$ are unknown or unexplained by the independent

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$^{69}$ Degree of freedom (df) associated with a calculated statistics is the number of available observations minus the number of constraints placed on the data by the calculation procedure. For t-statistics, df is the number of observations (N) minus the number of independent variables (k) minus one, i.e. $df = N-k-1$
variables in the equation. Therefore, coefficients of determination can be thought of as an indicator which demonstrates the explanatory capability of the selected variables.

F-Statistic
This statistics can be used to test the significance of the $R^2$ statistic. The $R^2$ follows an $F$ distribution with $k$ and $N-k-1$ degree of freedom. The $F$-test is employed to test the null hypothesis that none of the independent variables helps to explain the variations of the dependent variable about its mean, i.e.

$$b_i = 0 \text{ for all}$$

If the $F$-value is high, then it means that at least one of the independent variables is significant and able to explain the variation of the dependent variable. The method for determining whether an $F$-value is high or not is similar to that of $t$-value. If the calculated $F$-value is higher than critical $F$-value for a given significance level and degree of freedom, then all the null hypothesis is rejected. This gives the additional information to show the significance level of results.

5.6 Chapter Summary
In this chapter, one regression model is set up for each sub-market in Hong Kong. Each model contains the capitalization rate as dependent variable and various attributes as independent variables. This formulation of models allows the author to test the hypotheses empirically. Therefore, after developing the models, we need to employ and process the suitable data for empirical testing. The next chapter is the description of data employed.
CHAPTER 6
DATA

Empirical study of capitalization rates across different properties invites the need to compile the simultaneous data on rents and prices of properties. However, such information is not readily available in Hong Kong. A proxy for rental is used in this study. In brief, issues about the sources of data, the formulation of an appropriate dataset and the reliability of the data will be demonstrated below.

6.1 Sources of Data

The major sources of data for this empirical study include

1. *Capital Valuation System* of Rating and Valuation Department

2. *Hong Kong Property Review* and *Technical Notes* published by Rating and Valuation Department

3. *Website* of Rating and Valuation Department\(^{70}\)

4. Map

*Capital Valuation System of Rating and Valuation Department*

This is the most important source of data for this dissertation. First of all, it is noted that there are readily available information on public sale and rental transaction records, but not on the historical capitalization rate. The use of proxy is then considered when the data on a certain variable is not available or difficult to quantify.

\(^{70}\) http://www.info.gov.hk/rvd/
In Hong Kong, rates are tax on the occupation of property, and are charged at a percentage of the rateable value of property. Rateable value is, briefly, the annual rent at which the property might be expected to let. The whole territory has become liable to the assessment to rates. Rating and Valuation Department of Hong Kong SAR Government is then responsible for the rental (rateable) valuation for the collection of rates and government rents. Also, it takes the role of capital (sale price) valuation in the property transfer process as all sale prices are scrutinized by the Department for stamp duty purpose. The heavy workload highlights the application of computer assisted valuation processing and the use of central property database sharing information between valuation related systems. Rateable value and sale price of a transferred property can be obtained from Capital Valuation System of the Rating and Valuation Department at the same time. More importantly, rateable value is used as a proxy of rent in this study. The validity of this approach is stated at the later part in this chapter.

Relevant information which can be revealed from each property transaction entry in the system includes:

1. Property Address (Street Name, Floor Level)
2. Valuation Date and Occupation Permit Date
3. Share
4. Price and Valuation
5. Ratio of Price to Transacted Rateable Value (P/TRV), Ratio of Valuation to Transacted Rateable Value (V/TRV)
6. Floor Area
7. Headroom
The address of the transacted property is specified in the street level, but not the district level. Map is a necessary tool for the author to find out which districts of the properties are located at.

*Hong Kong Property Review and Technical Notes published by Rating and Valuation Department, the Website of Rating and Valuation Department*

*Hong Kong Property Review* is an annual publication reviewing the state of the property market in the previous calendar year. Property information and statistical data, including the stock, completions, vacancy and completion forecasts by main property types, are compiled on a calendar year basis. Though obtaining the data from the Capital Valuation System is important, knowing how to make the best use of them should not be neglected. This requires the understanding of how the Rating and Valuation Department defines, collects and compiles the relevant data for computation in the Capital Valuation System. Series of these technical issues are addressed in the *Hong Kong Property Review* and *Technical Notes*. All these issues influence the formulation of data set in this study.

**6.2 Description of Data**

**Rateable Value**

As rental is proxied by the rateable value, it is necessary to come across the term of rateable value. The following paragraphs were extracted from technical notes of the Rating and Valuation Department. (1994), showing how the rateable value is derived:
The rateable value of a property is an estimate of its annual open market rental value at a designed valuation reference date made on the assumption that the property was then vacant and to let. Neither restrictions on sale or letting, such as those that apply to Home Ownership Scheme flats, nor the financial status of the ratepayer, can be taken into account. It also makes no difference to the rateable value whether the property is owner-occupied or let.

If a property is let, its rateable value may not necessarily be the same as the rent passing, since there are many factors affecting the rental level, such as commencement date of the rent and other terms of the tenancy agreement. Regard must be had to other open market rents agreed at or around the date of valuation, for similar properties in the locality, adjusted to reflect any differences in size, location, facilities, standards of finish and management. Furthermore, changes in property price do not affect the level of rateable value.

According to the latest published information from Rating and Valuation Department, the rates charge and valuation reference date applicable to the recent years are shown below:

<table>
<thead>
<tr>
<th>Financial Year</th>
<th>2001-02</th>
<th>2002-03</th>
<th>2003-04</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valuation Reference Date</td>
<td>1 October 2000</td>
<td>1 October 2001</td>
<td>1 October 2002</td>
</tr>
<tr>
<td>Rates Charge</td>
<td>5.0%</td>
<td>5.0%</td>
<td>5.0%</td>
</tr>
</tbody>
</table>
After all, to assess the rateable value of a subject property, the rental reference rate (based on market evidence) is applied but modified by attribute adjustment to reflect value differences. Since rates are a tax on occupation, and any property which can be separately occupied is liable to assessment, regardless of whether or not the structure is authorized. In this way, rateable value can serve as a proxy of annual rental income in the reality then. The ratio of rateable value to transacted prices can be inputted as the figure of capitalization rate.

**Definition of Floor Areas**
Mentioned before, different terms of area are used in different categories of properties. However, this issue is supposed not to affect the significance of the result, provided that the consistency of adopting the same term in each type is maintained.

From its Technical Notes, Rating and Valuation Department clearly states about the issue of how to define the floor area of different property types. The floor area for a domestic unit is its ‘saleable area’. Saleable area is defined as the floor area exclusively allocated to the unit including balconies and verandahs but excluding common areas such as stairs, lifts shafts, pipe ducts, lobbies and communal toilets. It is measured from the outside of the exterior enclosing walls of the unit and the middle of the party walls between two units. Bay windows, yards, gardens, terraces, flat roof, carports and the like are excluded from the area.

The floor area for non-domestic accommodation is measured in its ‘internal floor area’. Internal floor area is defined as the area of all enclosed space of the unit measured to the internal face of enclosing external; and/or party walls.
All ancillary parts are measured as additions and stated separately with their respective areas. They are not included in the saleable area or internal floor area for domestic and non-domestic premises respectively. The relevant ancillary accommodation in this study is cockloft, yards and roof. By separating these items from the floor areas, all the effects of the existence of these ancillary items can be solely reflected in the coefficients of their dummy variables.

**Time Period**

To isolate the time effect on the relationship between all variables, the time period studied is kept as short as possible. Therefore, the analysis is confined to the period of the fourth quarter of 2001. The only exception is the retail sector. Understanding the relatively heterogeneous nature of retail properties, the author would obtain the retail property data transacted within longer time phase, i.e. the second half of 2001. By this cross sectional approach, the result of the analysis would not be affected by the time factor.

**Locations**

It is common to divide Hong Kong into three districts, namely Hong Kong Island, Kowloon and New Territories. However, rare people know the official definitions of these three regions. On the other hand, Tsuen Wan and Kwai Chung which are in the New Territories are regarded by some people as part of Kowloon. This thought is underpinned by the early development of new towns of Tsuen Wan and the network
of Mass Transit Railway. However, in this study, the three areas will be distinguished in accordance with the classification of 18 District Council Districts. Under this division, the 18 districts can be put into the baskets of Hong Kong Island, Kowloon and New Territories according to the government information. This is in line with the division done by some property agencies which regard Tsuen Wan as part of New Territories. The definition of locations in Hong Kong according to the above classification is as follows:

Table 6 Areas and Districts of Hong Kong

<table>
<thead>
<tr>
<th>Area</th>
<th>Districts Included</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hong Kong Island</td>
<td>Central and Western&lt;br&gt;Wan Chai&lt;br&gt;Eastern&lt;br&gt;Southern</td>
</tr>
<tr>
<td>Kowloon</td>
<td>Yau Tsim Mong&lt;br&gt;Sham Shui Po&lt;br&gt;Kowloon City&lt;br&gt;Wong Tai Sin&lt;br&gt;Kwun Tong</td>
</tr>
<tr>
<td>New Territories</td>
<td>Kwai Tsing&lt;br&gt;Tsuen Wan&lt;br&gt;Yuen Long&lt;br&gt;North&lt;br&gt;Tai Po&lt;br&gt;Sha Tin&lt;br&gt;Sai Kung&lt;br&gt;Islands</td>
</tr>
</tbody>
</table>

71. The nine new towns in Hong Kong can be classified into three generations. Tsuen Wan is in the first generation which started work in the 1970s.

72. For example, Midland Realty and Centaline Property Consultants Limited
Formulation of Data Set

After all variables are clearly defined and stated, the author can now make the best use of the obtained data in the prescribed period from Capital Valuation System. Those transaction records of the Capital Valuation System are obtained from the Land Registry and Inland Revenue Department for transfer tax purposes.

It is supposed that all transaction records wherever in Hong Kong within the prescribed period should be used as the input data of the regression equations. This principle can apply to office, retail and industrial sectors, but not the residential one. In the residential sector, since there are very especially high transaction volume within residential sector and technical reasons, the author have chosen Hong Kong Island for study only. The author further randomly sampled 500 records each month from the quarter period. For all property types, transactions which are not of the whole share, properties built or owned by government or related departments and incomplete records will also be excluded. After all, the remaining usable transaction records form the data sets which are readily available to be inputted into the regression models for empirical tests. Table 7 is the summary of sample data amount. Furthermore, Tables 8-11 show the summary statistics of the data of each model.

Table 7 Summary of Sample Data Amount and Time Period of This Study

<table>
<thead>
<tr>
<th>Sub-Market</th>
<th>Number of Usable Observations</th>
<th>Time Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>1282</td>
<td>The Fourth Quarter of 2001</td>
</tr>
<tr>
<td>Office</td>
<td>216</td>
<td>The Fourth Quarter of 2001</td>
</tr>
<tr>
<td>Retail</td>
<td>705</td>
<td>The Second Half of 2001</td>
</tr>
<tr>
<td>Variable</td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>----------</td>
<td>------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Cap Rate</td>
<td>0.067786</td>
<td>0.021786</td>
</tr>
<tr>
<td>AGE (Years)</td>
<td>20.03276</td>
<td>10.34203</td>
</tr>
<tr>
<td>FLOOR</td>
<td>12.67083</td>
<td>8.463223</td>
</tr>
<tr>
<td>AREA (Saleable Area in sq. m)</td>
<td>53.42387</td>
<td>33.90677</td>
</tr>
<tr>
<td>DET</td>
<td>0.020281</td>
<td>0.141014</td>
</tr>
<tr>
<td>DROOF</td>
<td>0.022621</td>
<td>0.148750</td>
</tr>
<tr>
<td>Variable</td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Cap Rate</td>
<td>0.089915</td>
<td>0.028550</td>
</tr>
<tr>
<td>AGE (Years)</td>
<td>15.00000</td>
<td>7.408355</td>
</tr>
<tr>
<td>FLOOR</td>
<td>12.88889</td>
<td>7.698183</td>
</tr>
<tr>
<td>AREA (Internal Area In sq. m)</td>
<td>72.83565</td>
<td>85.98927</td>
</tr>
<tr>
<td>DKLN</td>
<td>0.481481</td>
<td>0.500818</td>
</tr>
<tr>
<td>DNT</td>
<td>0.064815</td>
<td>0.246771</td>
</tr>
<tr>
<td>DET</td>
<td>0.134259</td>
<td>0.341723</td>
</tr>
</tbody>
</table>
### Table 10 Summary Statistics of the Variables Used in Model for the Retail Sector

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cap Rate</td>
<td>0.085036</td>
<td>0.031843</td>
<td>0.196078</td>
<td>0.021008</td>
</tr>
<tr>
<td>AGE (Years)</td>
<td>23.75461</td>
<td>11.30357</td>
<td>59.00000</td>
<td>0.000000</td>
</tr>
<tr>
<td>AREA (Internal Area In sq. m)</td>
<td>40.04865</td>
<td>37.18792</td>
<td>285.0000</td>
<td>2.100000</td>
</tr>
<tr>
<td>DHK</td>
<td>0.269504</td>
<td>0.444017</td>
<td>1.000000</td>
<td>0.000000</td>
</tr>
<tr>
<td>DET</td>
<td>0.365957</td>
<td>0.482040</td>
<td>1.000000</td>
<td>0.000000</td>
</tr>
<tr>
<td>DGROUND</td>
<td>0.778723</td>
<td>0.415401</td>
<td>1.000000</td>
<td>0.000000</td>
</tr>
<tr>
<td>HR (m)</td>
<td>4.104965</td>
<td>0.890299</td>
<td>6.500000</td>
<td>2.400000</td>
</tr>
<tr>
<td>DYARD</td>
<td>0.236879</td>
<td>0.425470</td>
<td>1.000000</td>
<td>0.000000</td>
</tr>
<tr>
<td>DCL</td>
<td>0.289362</td>
<td>0.453788</td>
<td>1.000000</td>
<td>0.000000</td>
</tr>
</tbody>
</table>
Table 11 Summary Statistics of the Variables Used in Model for the Industrial Sector

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cap Rate</td>
<td>0.146666</td>
<td>0.046561</td>
<td>0.322581</td>
<td>0.022989</td>
</tr>
<tr>
<td>AGE (Years)</td>
<td>15.03787</td>
<td>6.263904</td>
<td>36.00000</td>
<td>0.000000</td>
</tr>
<tr>
<td>FLOOR</td>
<td>9.908778</td>
<td>6.190672</td>
<td>39.00000</td>
<td>0.000000</td>
</tr>
<tr>
<td>AREA (Internal Area In sq, m)</td>
<td>130.3170</td>
<td>143.4714</td>
<td>1601.000</td>
<td>10.00000</td>
</tr>
<tr>
<td>DHK</td>
<td>0.079174</td>
<td>0.270243</td>
<td>1.000000</td>
<td>0.000000</td>
</tr>
<tr>
<td>DKLN</td>
<td>0.352840</td>
<td>0.478265</td>
<td>1.000000</td>
<td>0.000000</td>
</tr>
<tr>
<td>DET</td>
<td>0.070568</td>
<td>0.256323</td>
<td>1.000000</td>
<td>0.000000</td>
</tr>
<tr>
<td>HR (m)</td>
<td>3.355422</td>
<td>0.535008</td>
<td>7.100000</td>
<td>2.500000</td>
</tr>
</tbody>
</table>

6.3 Reliability of Data

It is not easy to obtain the information on the rental price for owner occupied housing or the asset price of rental units. In this study, so rent is proxied by the rateable value and prices are actual transaction prices. The validity of this approach is justified by the relatively homogeneous lease terms (mainly two years) in Hong Kong’s rental market and the very advanced computer assisted mass valuation technique developed by the Rating and Valuation Department of the Government of the Hong Kong SAR.

Moreover, the reliability of this approach depends on two more features of real estate market in Hong Kong, namely the high trading volume of rental transaction and the relatively homogeneous nature of the properties within each sector. The high trading volume of rental transaction is contributed by the rather short lease terms, the well known dynamic characteristics of Hong Kong economy and simple taxation system.
There is no capital gains tax in Hong Kong. The tangible transaction cost involved is also quite low. (Chau, 1996) Normally, agent leasing fees account for not more than one month’s rental equally shared by each party. Agent’s acquisition fees are charged at around 1% of sale price. Besides agent’s fees, only stamp duty and legal charges are additional transaction costs.

The physical environment of small size of Hong Kong and hilly landscape indicate the high rise dominated building environment. This factor, together with the rather short building economic life in Hong Kong, renders properties within each sector less heterogeneous.

6.4 Chapter Summary

As mentioned, the data scarcity hinders the study on the capitalization rate in the micro level. This study utilizes the data of the rateable value as a proxy of rental income. This approach renders this empirical study on capitalization rate feasible. After displaying the sources of data and data processing, the next step comes to the estimation of the four equations to verify the author’s hypothesis.

---

73 Chau K W (1996) How efficient are Hong Kong's real estate markets: Hong Kong : Department of Surveying, Faculty of Architecture, University of Hong Kong
74 Agency Commission Information is available at the website of Century 21 Hong Kong Ltd: http://www.century21-hk.com/english/page8_p5.htm#Leasing
In this chapter, the results of the four regression models would be illustrated. The data sample is inputted into the models. With the aid of the software EViews, the unknown parameters of each model can be estimated. Together with the test statistics, the empirical results would be analyzed for the hypothesis tests described before. Underlying reasons for the results would also be discussed. Finally, a brief conclusion would be provided.

### 7.1 Residential Sector

In order to find out the effects of property attributes and institutional factors on capitalization rates, the model of the residential sector to be estimated is shown as below:

\[
\text{Model (1) } \ln C = a_0 + a_1 \text{AGE} + a_2 \text{AGE}^2 + a_3 \text{FLOOR} + a_4 \text{AREA} + a_5 \text{DET} + a_6 \text{DROOF}
\]

The results of the regression equation are summarized as follows:
Table 12 Empirical Results of Model (1)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C**</td>
<td>-2.855600</td>
<td>0.021658</td>
<td>-131.8482</td>
<td>0.0000</td>
</tr>
<tr>
<td>AGE**</td>
<td>0.014983</td>
<td>0.001668</td>
<td>8.982774</td>
<td>0.0000</td>
</tr>
<tr>
<td>AGE²</td>
<td>4.22E-05</td>
<td>3.86E-05</td>
<td>1.092765</td>
<td>0.2747</td>
</tr>
<tr>
<td>FLOOR**</td>
<td>-0.005061</td>
<td>0.000669</td>
<td>-7.563137</td>
<td>0.0000</td>
</tr>
<tr>
<td>AREA**</td>
<td>-0.002600</td>
<td>0.000154</td>
<td>-16.90123</td>
<td>0.0000</td>
</tr>
<tr>
<td>DET*</td>
<td>0.075219</td>
<td>0.037038</td>
<td>2.030864</td>
<td>0.0425</td>
</tr>
<tr>
<td>DROOF*</td>
<td>0.082789</td>
<td>0.035206</td>
<td>2.351567</td>
<td>0.0188</td>
</tr>
</tbody>
</table>

R-squared 0.563880  F-statistic 274.7510
Adjusted R-squared 0.561828  Prob(F-statistic) 0.000000

** significant at the 1% level
*significant at the 5% level

All coefficients are significant at 95% confidence interval except the variable AGE². Therefore all the coefficients can be regarded as statistically significant different from zero and can be accepted except the variable AGE². Most signs of coefficients of independent variables follow the expected. The adjusted $R^2$ is 0.56, which means that 56% of the change in capitalization rate can be explained by the selected variables. The result is satisfactory. Specifically, the coefficient of AGE² is positive but insignificant. As observed from the results, the coefficient is negligible in value and
insignificant. This suggests that the relationship between age and capitalization rate may be simply linear.

**AGE and AGE^2**

The coefficient of age is positive and significant, which is expected. Other attributes being kept constant, when a building is getting older, it is expected that the owners will suffer larger amount of maintenance costs for a safe and healthy building condition and that the building is more vulnerable to obsolescence. Additionally, due to the limited economic life of building as capital goods, the older the building, the shorter the remaining economic life for generating rental income is. All these turn out that with the increasing age of property, price decreases at a larger percentage than rentals, thus capitalization rate rises.

The positive sign of the squared term is negligible in value and insignificant. This insignificant result cannot support the non-linearity effect of age attribute contributing to capitalization rate. This may imply that the relationship between capitalization rate and age factor is simply linear. Any kind of private domestic buildings in Hong Kong are investigated in this study. Theoretically, the market value of aged buildings would be enhanced by refurbishment. However, in the context of Hong Kong, the fragmented pattern of ownerships within a single building prohibits the possibility of rehabilitation. The decision of rehabilitation requires a collective agreement from all owners of the building. Consequently, when a building is getting older, the market value is allowed to depreciate at a greater constant rate than the rental. This can address why non-linearity effect of age attribute may not exist then.
The result of the negative and significant coefficient statically matches the hypothesis that with the increasing floor level, the capitalization rate decreases, ceteris paribus. Due to the dense building environment, the spatial environment becomes an important consideration for renting or ownership decision. This is especially true for domestic properties as people need space to rest, relax and reflect. The lower floor domestic units are more vulnerable to the external changes in the spatial environment in the long term. The higher risk is then perceived for the ownership of lower floor properties. This reflects in the higher capitalization rate required.

Again the result of the negative and significant coefficient of AREA supports the hypothesis. It states that ceteris paribus, a larger unit has a lower capitalization rate than a smaller one. The analysis of the impact of area should be linked to the market competition from government bodies. According to Chau (1995)\textsuperscript{75}, the public rental housing, Home Ownership Scheme (HOS) and Private Sector Participation Scheme (PSPS) are substitutes for small residential units in the private sector. The Housing Authority of Hong Kong Government is the biggest developer in Hong Kong. This is evidenced by the fact that at the end of 2002, about 2.1 million people lived in public rental housing estates. The stock at that time was 684 500 flats. Moreover, the Government has built subsidized flats for sale under various home ownership schemes since 1978 to assist low and middle income families to purchase homes at prices below market value.\textsuperscript{76} At the end of 2002, about 375 400 subsidized flats had been

\textsuperscript{75} Chau K W (1995) Market Concentration and Competition in Hong Kong's Residential Market: Some Empirical Evidence, Hong Kong: Department of Surveying, Faculty of Architecture, University of Hong Kong

\textsuperscript{76} Such information is available at government website:
sold to qualified persons. It is noted that there had been the government announcement of moratorium on the sale of HOS and PSPS flats in September 2001. It has already been effective during the prescribed study period. However, in terms of secondary market and rental market, there are still the competitions faced by investors of smaller units from the public bodies.

According to Rating and Valuation Department, private domestic units are categorized into five classes in accordance with their sizes:

Class A – saleable area less than 40m$^2$
Class B – saleable area of 40m$^2$ to 69.9m$^2$
Class C – saleable area of 70m$^2$ to 99.9m$^2$
Class D – saleable area of 100m$^2$ to 159.9m$^2$
Class E – saleable of 160m$^2$ or above

<table>
<thead>
<tr>
<th>Class</th>
<th>Owner Occupied</th>
<th>Let</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>81.8%</td>
<td>18.2%</td>
</tr>
<tr>
<td>B</td>
<td>91.5%</td>
<td>8.5%</td>
</tr>
<tr>
<td>C</td>
<td>90.2%</td>
<td>9.8%</td>
</tr>
<tr>
<td>D</td>
<td>80.3%</td>
<td>19.7%</td>
</tr>
<tr>
<td>E</td>
<td>48.0%</td>
<td>52%</td>
</tr>
</tbody>
</table>

Source: Hong Kong Property Review 2003, issued by Rating and Valuation Department

http://www.info.gov.hk/info/hkbrief/eng/living2.htm#housing
As shown in Table 13, about 50% of new luxury flats are let and more than 80% of Class A flats are owner-occupied. These figures point out one fact that the highly volatile luxury residential sector has a high value for investment compared with the small/medium sector. (Berry et al, 1999) One of the underlying reasons is the above mentioned competition from the government in the small residential units market. It is worthwhile to consider this issue in the wider economic context. The problem of the seemingly greater disparity in the income distribution in Hong Kong has been pointed out for long by some researchers. The primary reason for this problem is the restructuring of Hong Kong economy. The structural change in Hong Kong has arisen from the increasing economic integration with the Mainland China. This integration means the massive shift of manufacturing base to Mainland while the manufacturing workers have lost their job opportunities. The capitalists, on the other hand, have made some handsome profits due to the low margin production cost in China. Therefore, there has been the trend of the redistribution of income from workers to capitalists. (Yam, 2003) Above all, these trends mean better future prospects for capital appreciation or rental growth for luxury flat units. This would be appraised in the real estate value for the long term investment but not in the current rental income. Therefore, regarding to the larger size of a flat, the increase in price is greater than that of rentals, consequential to the smaller rental yield.

DET

The magnitude of that coefficient specifies the fact that the existence of tenancy factor actually exerts quite a large and positive effect to the capitalization rate in a relative sense if we compare the value of this coefficient 0.076 to others. The result somehow demonstrates the higher risk perceived by domestic owners on the domestic property which is subject to the tenancy agreement. It is notable that this higher risk is induced by the institutional protection for tenure security. Higher risk premium is then required for the ownership of tenanted domestic property. This comes up with a higher capitalization rate for the let domestic premises, ceteris paribus.

**DROOF**

According to the classification of Urban Renewal Authority, there are three categories of rooftop interests. In this study, the type of rooftop interest belongs to the top floor unit so that they can be transferable together. Therefore, the top floor owner shall assume the full responsibility to maintain and manage the rooftop. At the same time, renters and landlords would perceive the greater possibility of roof leakage problem, thus discounting this risk element into rental income and sale prices. Finally, the outcome of the rental yield is higher for the top floor properties with rooftop interest due to the larger burden of landlord in terms of long term maintenance responsibility.

### 7.2 Office Sector

Having included the location dummy variables, so the model of office sector becomes:

\[ \ln C = a_0 + a_1 AGE + a_2 AGE^2 + a_3 FLOOR + a_4 AREA + a_5 DKLN + a_6 DNT + a_7 DET \]

The results of estimating Model (2) are shown below.
Table 14 Empirical Results of Model (2)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-2.667206</td>
<td>0.096418</td>
<td>-27.66289</td>
<td>0.0000</td>
</tr>
<tr>
<td>AGE</td>
<td>0.035478</td>
<td>0.010676</td>
<td>3.323263</td>
<td>0.0011</td>
</tr>
<tr>
<td>AGE^2</td>
<td>-0.000905</td>
<td>0.000310</td>
<td>-2.918114</td>
<td>0.0039</td>
</tr>
<tr>
<td>FLOOR</td>
<td>-0.007628</td>
<td>0.002718</td>
<td>-2.806946</td>
<td>0.0055</td>
</tr>
<tr>
<td>AREA</td>
<td>-0.000873</td>
<td>0.000230</td>
<td>-3.793036</td>
<td>0.0002</td>
</tr>
<tr>
<td>DET</td>
<td>0.063773</td>
<td>0.058373</td>
<td>1.092519</td>
<td>0.2759</td>
</tr>
<tr>
<td>KLN</td>
<td>0.176108</td>
<td>0.040556</td>
<td>4.342381</td>
<td>0.0000</td>
</tr>
<tr>
<td>NT</td>
<td>-0.048438</td>
<td>0.079913</td>
<td>-0.606133</td>
<td>0.5451</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.297936</td>
<td>F-statistic</td>
<td>12.60988</td>
<td></td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.274309</td>
<td>Prob(F-statistic)</td>
<td>0.000000</td>
<td></td>
</tr>
</tbody>
</table>

** significant at the 1% level

As observed from the results, all coefficients are significant at 99% confidence interval except the variable DET. Again, most signs of coefficients of independent variables follow the expected. The adjusted $R^2$ is 0.25, which means that 25% of the change in capitalization rate can be explained by the selected variables. This result is considered as acceptable as only a few variables are inserted in the regression equation.
AGE and $AGE^2$

The coefficient of age is positive and significant, which is expected. It is interesting to note that the squared term of $AGE^2$ is statically significant and opposite in sign to $AGE$ variable. This result displays the diminishing effect of the $AGE$ variable. This addresses the dissimilar ownership patterns of office buildings to that of apartment buildings in Hong Kong.

In Hong Kong, it is rare to see that some private residential developments have been held for investment purposes by the developers for a certain period after completion. In contrast, besides district and quality classification, office buildings in Hong Kong can be subdivided into under strata title and single ownership. Instead the single ownership, prime office buildings are dominant in the market too. Furthermore, the majorities of office space users prefer to lease rather than buy. (Berry, 1999) For these reasons, in general, the continued rehabilitation and better maintenance can be achieved much more easily within a single office building. This allows the property price and rental rate to decline at decreasing rate with respect to age. However, the office prices decline at a more noticeably decreasing rate than rental, i.e. the diminishing effect of age variable on price is stronger than on rental. It is because the continued rehabilitation and better maintenance are supposed to benefit in long term investment rather than in short term use. This implication means that when a building is getting older and older, the capitalization rate increases at a decreasing rate, assuming there is a constant rehabilitation and renovation.

---

The estimated negative and significant coefficient of FLOOR variable is consistent with the hypothesis regarding to floor level. The majority of our transaction records are in urban areas. Accessibility is critical to the face to face contact which enhances the efficiency of management decisions. (Slade 2000) Therefore, office buildings are always close to major roads and highways, besides conveniently be reached via Mass Transit Railway System. The increased visibility, sea view and recognition stemmed from the upper floor office units demand higher prices and rentals at the particular point of time. Financially stronger enterprises prefer to occupy the upper floor units more. Additionally, given the dense building environment and high vehicle densities, the upper floor units provide more favorable conditions which are less adversely deteriorated by the external environment for the long term investment. All these represent that the upper floor units demand less risk premiums for external environment and less default risks which are resulted from the occupation by the companies with better outlook. Therefore, lower capitalization rates are resulted.

According to the latest published Technical Notes of Rating and Valuation Department, offices in Hong Kong are graded into Grade A, B and C. Since there is no prior published information of the grades of the office transaction sample, and the definition is rather arbitrary, the author cannot verify the grade of each transaction objectively. One criteria for defining the grades is the area of floor plates. Grade A office buildings provide large floor plates while Grade B and C ones provide averaged size and small floor plates respectively. Therefore, it is noticeable that most large office units are probably found in Grade A office building. Clearly pointed out in the
notes, the location is not a feature of grade. As mentioned, most commercial buildings are owned by single owners, a lot of office units in Hong Kong are strata-titled and sold to individuals. These units may get listed through different agents and channels. This phenomenon makes office search a difficult process due to the lack of transparency. In terms of transaction cost per unit area, one single large office unit can save more the searching cost and the management fee than the multiple small units on one floor. In this way, the transaction cost per unit area involved in the leasing and management of large office unit is generally lower than that of small units. Lower rental per unit of area can be provided to large office premises, ceteris paribus.

More importantly, capitalization rate can reflect the changing environment and such effect of the dynamics. Hong Kong Government is not a major developer in non-domestic property markets. However, its planning legislation exhibits prominent effects on the behaviour of the non domestic market. Recognizing the need to accommodate the structural change of Hong Kong economy taking place, the Government has begun to accept the application for office building in industrial zones, that is so called “I-O” Building. According to the Planning Guidelines form Planning Department, the activities permitted in I/O buildings within "I" zone should be industrial and industrial-related. There is no restriction on the size of an office to be established within an I/O building, as long as it is directly related to an industrial operation. There has been a trend for offices uses to infiltrate into industrial premises (Berry et al, 1999). This is partially because of the rental/price differential between industrial and office properties and the economic downturn of the local region. However, this trend does not apply to every category of office users. While small scale business can relocate their premises to industrial buildings either legally or
illegally, the large office sites of big corporations cannot be substituted so easily due to their prominent market position and substantial background to clients and business partners. Also, within the office market, for larger end-users requiring over 10,000 sq.ft. of space, available stock is limited. The prime office sites are on reclaimed land. All these trends affect the financial decisions for ownership of these properties. In particular, the prices of office units decrease at a greater percentage than the rentals with respect to the smaller size. This explains why the capitalization rates are higher for small office units.

DKLN & DNT

The positive and significant parameter of dummy variable DKLN is consistent with the expected result. Unfortunately, the coefficient of dummy NT exhibits the negative and insignificant sign which is out of the expectation. The inconsistency of these two results lies on the possible reason that there are very few number of office transaction records in New Territories. Another suggested reason is the small sample office size. As a result, Hypothesis Five cannot be supported by this set of empirical data. It is not appropriate to conclude that the lower rental yields of office properties are found in Hong Kong Island as its location is the most remote from Mainland.

More detailed interpretation of the results is required. It is statically proved that the office premises in Hong Kong Island generally have lower rental yields than those in Kowloon. Let us compare these two places briefly. First of all, it is necessary to map out the distribution of office stocks. In accordance with Rating and Valuation Department, the core office districts are the sub-districts of Sheung Wan, Central, Wan Chai, Causeway Bay and Tsim Sha Tsui. Office space in the core districts
accounted for 67% of the total stock at the end of 2002. The former three districts are on Hong Kong Island and only the latter is in Kowloon. It is interesting to note that it is only takes about seven minutes to travel by ferry from Tsim Sha Tsui to Central.\footnote{See Website of StarFerry \newline \url{http://www.starferry.com.hk/new/}} However, even though these two places are just alienated by the Victoria Harbour, it is observable that the characteristics and the demand for office space vary widely from these two districts. The business natures of the occupants in all these core districts are quite different. Activities in Tsimshatsui and Wanchai are dominated by small to medium sized tenants engaged in China-trade while in Central, there is high concentration of corporate headquarters, professional services firms and establishments such as banks, law firms, accounting firms, business hotels. As stated, it is the inherent characteristics of the locations which affect the perception of investors towards risk and rental growth. To sum up, the more prestigious position due to the premier business centre on Hong Kong Island provides an advantage to the office property long term investment there. Therefore, rental yields are lower for those office properties on Hong Kong Island, keeping other attributes to be equivalent.

**DET**

The insignificant coefficient of the dummy variable DET simply means that this inputted data set cannot provide evidence to show any significant effect of existing tenancy on the capitalization rate. So far, the tenancy security regulation does not apply in non domestic sector. Upon expiry of leases, tenants are required to return their premises after reinstatement. Therefore, when an office property is transacted, the existing tenancy agreement does not invite higher risk premium imposed by any
tenancy security law. Moreover, the existing tenancy agreement can be perceived as an income source for the investor at the point of time in transaction.

7.3 Retail Sector

In order to measure the effect of different attributes of retail properties, an empirical model accounting for the variations of the capitalization rates comes as follows:

Model (3) \[ \ln C = a_0 + a_1 \text{AGE} + a_2 \text{AGE}^2 + a_3 \text{AREA} + a_4 \text{HK} + a_5 \text{DET} + a_6 \text{DGROUND} + a_7 \text{HR} + a_8 \text{DYARD} + a_9 \text{DCL} \]

Below is the presentation of the results.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C **</td>
<td>-2.690787</td>
<td>0.102005</td>
<td>-26.37896</td>
<td>0.0000</td>
</tr>
<tr>
<td>AGE**</td>
<td>0.026542</td>
<td>0.005093</td>
<td>5.211640</td>
<td>0.0000</td>
</tr>
<tr>
<td>AGE*</td>
<td>-0.000451</td>
<td>0.000101</td>
<td>-4.449891</td>
<td>0.0000</td>
</tr>
<tr>
<td>AREA</td>
<td>5.66E-05</td>
<td>0.000417</td>
<td>0.135660</td>
<td>0.8921</td>
</tr>
<tr>
<td>HK**</td>
<td>-0.084742</td>
<td>0.031119</td>
<td>-2.723119</td>
<td>0.0066</td>
</tr>
<tr>
<td>ET</td>
<td>-0.033153</td>
<td>0.028656</td>
<td>-1.156945</td>
<td>0.2477</td>
</tr>
<tr>
<td>DGROUND*</td>
<td>-0.082930</td>
<td>0.037594</td>
<td>-2.205903</td>
<td>0.0277</td>
</tr>
<tr>
<td>HR</td>
<td>-0.009604</td>
<td>0.019712</td>
<td>-0.487232</td>
<td>0.6262</td>
</tr>
<tr>
<td>DYARD **</td>
<td>-0.165801</td>
<td>0.037901</td>
<td>-4.374581</td>
<td>0.0000</td>
</tr>
<tr>
<td>DCL</td>
<td>0.051349</td>
<td>0.041649</td>
<td>1.232881</td>
<td>0.2180</td>
</tr>
</tbody>
</table>

R-squared 0.091462  F-statistic 7.773897

Adjusted R-squared 0.079697  Prob(F-statistic) 0.000000

* significant at 5% level
** significant at 1 % level

Only some of the variables are significant at 95% confidence interval. Particularly, DET, DCL, AREA and HR are highly insignificant. Moreover, the $R^2$ is less than 0.1. The result is not satisfactory. DET, DCL, AREA and HR have very low t values which are problematic. There are signs of correlation between variables. Only ground
floor retail units can have cockloft. It is also true that ground floor units have higher headrooms, larger unit areas (to take the best advantage of the pedestrian flow). To verify the existence of correlation, DGROUND is regressed against the variables DCL, AREA and HR. The results come as below:

**Table 16 Empirical Results of Simple Correlation Testing (1)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C **</td>
<td>0.404038</td>
<td>0.076309</td>
<td>5.294791</td>
<td>0.0000</td>
</tr>
<tr>
<td>DCL **</td>
<td>0.189977</td>
<td>0.038636</td>
<td>4.917081</td>
<td>0.0000</td>
</tr>
<tr>
<td>AREA **</td>
<td>0.003469</td>
<td>0.000387</td>
<td>8.951490</td>
<td>0.0000</td>
</tr>
<tr>
<td>HR **</td>
<td>0.050487</td>
<td>0.019424</td>
<td>2.599267</td>
<td>0.0095</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.209848</td>
<td></td>
<td>46.47642</td>
<td></td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.205333</td>
<td>Prob(F-statistic)</td>
<td>0.000000</td>
<td></td>
</tr>
</tbody>
</table>

** Significant at 1 % level

Since the coefficients of these three variables are highly significant, the existence of correlation between these variables and ground floor position is possible. One way to minimize correlation problem is to omit the independent variables which are likely to be associated with one or more of the other independent variables. Therefore, AREA, DCL and HR are dropped from Model (3). A new model of retail sector is formed.

Model (4) \( \ln C = a_0 + a_1 \text{AGE} + a_2 \text{AGE}^2 + a_3 \text{HK} + a_4 \text{DET} + a_5 \text{DGROUND} + a_6 \text{DYARD} \)
The following is the empirical results.

Table 17 Empirical Results of Model (4)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C **</td>
<td>-2.739273</td>
<td>0.060569</td>
<td>-45.22548</td>
<td>0.0000</td>
</tr>
<tr>
<td>AGE **</td>
<td>0.027569</td>
<td>0.004987</td>
<td>5.527759</td>
<td>0.0000</td>
</tr>
<tr>
<td>AGE**</td>
<td>-0.000462</td>
<td>0.000100</td>
<td>-4.601781</td>
<td>0.0000</td>
</tr>
<tr>
<td>DHK **</td>
<td>-0.084989</td>
<td>0.030995</td>
<td>-2.742067</td>
<td>0.0063</td>
</tr>
<tr>
<td>DET</td>
<td>-0.031813</td>
<td>0.028193</td>
<td>-1.128383</td>
<td>0.2595</td>
</tr>
<tr>
<td>DGROUND *</td>
<td>-0.074529</td>
<td>0.034908</td>
<td>-2.135016</td>
<td>0.0331</td>
</tr>
<tr>
<td>DYARD **</td>
<td>-0.154376</td>
<td>0.035381</td>
<td>-4.363283</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared  | 0.089359    | F-statistic | 11.41545    |

Adjusted R-squared | 0.081531 | Prob(F-statistic) | 0.000000 |

* significant at 5% level

** significant at 1% level

Based on this model, all coefficients are significant, except the DET. But still, the R squared remains below 0.1 level. For the ground floor position attribute, the coefficient of this dummy is significant and negative. The ground floor submarket is not large as the supply of the quality ground floor shops is limited. Adding up the inelastic demand, the future prospect for the ground floor shops is better in terms of the less risk perceived and capital appreciation anticipated. This perception behaviour
is underpinned by the well tourism, the limited supply and the inelastic demand for
the high street shops in Hong Kong. This results in low capitalization rate for this
category property. For age attribute, it is observed from the result that the non
linearity relationship is found between age and capitalization rate. This is consistent
with the results of those previous models for non domestic (income producing)
properties. Once more, the coefficient DET is found to be statically insignificant and
thus responds to the lack of tenure security regulation.

The location factor is represented by dummy variable DHK. The negative and
significant coefficient of dummy DHK is in line with our expectation derived from
Hypothesis Four. Shopping arcades and malls have proliferated, particularly in
complexes built in conjunction with MTR and KCRC. While the KCRC transport
network provides the convenience for shoppers, it also encourages the multi purpose
shopping behaviour in Shenzhen. This substitution effect is not the same everywhere
in Hong Kong. The empirical evidence proves that the district of Hong Kong Island
is less vulnerable to this substitution effect due to the most distant location and non
availability of KCRC network on Hong Kong Island.

One interesting result is about the effect of the existence of yard on the capitalization
rate. Yard is more or less a kind of tie-in sale product. From the landlord’s point of
view, there is a tradeoff between the expected higher real rent and duration of vacancy.
The landlord will hold the vacant unit in searching a tenant who is willing to pay a
higher real rent. Given the non zero transaction cost, the searching process is longer in
order to find out the renter who have the highest use valuation towards the property
including the yard. However, the longer vacancy time means loss of rental income.
Rosen and Smith (1984) point out that heterogeneity of the housing market tend to increase the dispersion in rents, which will then give rise to a higher search time for tenants and therefore a higher natural vacancy rate. Therefore, as the yard may not be desired by every occupier, the existence of yard is reflected in general lower yield, given the same price.

This model provides a base for the testing of most of the hypothesis. Since the correlation problem exists, it is difficult to evaluate the effects of the omitted variables and ground floor attribute together. The only way to study the effects of the omitted variables on rental yield is isolating the ground floor attribute. For this reason, the author would set up another model by deliberately further sampling of data. To isolate the effect of ground floor attribute, the author can either choose ground floor or non ground floor position data set. Since there are 550 out of 705 transaction records of ground floor shops in the sample, the author would choose the ground floor shops sample as the base for further regression.

In this data set, nearly half of the properties have yard or cockloft. Instead of finding out the impact of the existence of yard and cockloft, the author would try to quantify the effect of these two ancillary items by using their sizes as independent variables. It can be done so by specifying the area of these two ancillary items as variables YARD and CL in the equation. Another Model particularly for the ground floor shops is formed.

Model (5)
\[
\ln C= a_0+a_1\text{AGE}+a_2\text{AGE}^2+a_3\text{AREA}+a_4\text{AREA}^2 \\
+a_5\text{HK} +a_6\text{DET} +a_7\text{HR}+a_8\text{YARD}+a_9\text{CL}
\]
The capitalization rate is then regressed against the selected attributes. The results is shown in Table 18 below.

### Table 18 Empirical Results of Model (5)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C**</td>
<td>-2.615571</td>
<td>0.116218</td>
<td>-22.50567</td>
<td>0.0000</td>
</tr>
<tr>
<td>AGE**</td>
<td>0.016498</td>
<td>0.005670</td>
<td>2.909785</td>
<td>0.0038</td>
</tr>
<tr>
<td>AGE*</td>
<td>-0.000264</td>
<td>0.000113</td>
<td>-2.346407</td>
<td>0.0193</td>
</tr>
<tr>
<td>AREA**</td>
<td>-0.003054</td>
<td>0.001026</td>
<td>-2.975754</td>
<td>0.0031</td>
</tr>
<tr>
<td>AREA*</td>
<td>1.25E-05</td>
<td>4.14E-06</td>
<td>3.009691</td>
<td>0.0027</td>
</tr>
<tr>
<td>DHK**</td>
<td>-0.105985</td>
<td>0.034150</td>
<td>-3.103514</td>
<td>0.0020</td>
</tr>
<tr>
<td>DET</td>
<td>-0.005600</td>
<td>0.033093</td>
<td>-0.169226</td>
<td>0.8657</td>
</tr>
<tr>
<td>HR</td>
<td>-0.006024</td>
<td>0.022144</td>
<td>-0.272017</td>
<td>0.7857</td>
</tr>
<tr>
<td>YARD*</td>
<td>-0.007608</td>
<td>0.003089</td>
<td>-2.462970</td>
<td>0.0141</td>
</tr>
<tr>
<td>CL</td>
<td>0.001526</td>
<td>0.000872</td>
<td>1.750600</td>
<td>0.0806</td>
</tr>
</tbody>
</table>

* R-squared 0.071950, F-statistic 4.651687, Prob(F-statistic) 0.000006

* significant at 5% level

** significant at 1% level
Most of the explanatory variables have statically significant coefficients. The exceptions are DET, CL and HR. This invites the problem of correlation again. As it is logically regarded that higher headrooms are related to the cockloft provision, CL variable is regressed against the HR to test the correlation existence then.

Table 19 Empirical Results of Simple Correlation Testing (2)

<table>
<thead>
<tr>
<th>Dependent Variable: CL</th>
<th>Method: Least Squares</th>
<th>Included observations: 550</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable</td>
<td>Coefficient</td>
<td>Std. Error</td>
</tr>
<tr>
<td>HR**</td>
<td>15.93786</td>
<td>0.984328</td>
</tr>
<tr>
<td>C**</td>
<td>-52.57116</td>
<td>4.249655</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.323597</td>
<td>F-statistic</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.322363</td>
<td>Prob(F-statistic)</td>
</tr>
</tbody>
</table>

This statistical proof suggests the occurrence of correlation between these two variables. Therefore, for the above Model (5) of ground floor data set, the variable HR is dropped. It is replaced by Model (6) then.

Model (6)

\[
\ln C = a_0 + a_1 \text{AGE} + a_2 \text{AGE}^2 + a_3 \text{AREA} + a_4 \text{AREA}^2 \\
+ a_5 \text{HK} + a_6 \text{DET} + a_7 \text{YARD} + a_8 \text{CL}
\]

This comes with the following empirical results:
Table 20 Empirical Results of Model (6)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C**</td>
<td>-2.641293</td>
<td>0.067507</td>
<td>-39.12619</td>
<td>0.0000</td>
</tr>
<tr>
<td>AGE**</td>
<td>0.016530</td>
<td>0.005664</td>
<td>2.918528</td>
<td>0.0037</td>
</tr>
<tr>
<td>AGE*</td>
<td>-0.000264</td>
<td>0.000112</td>
<td>-2.346099</td>
<td>0.0193</td>
</tr>
<tr>
<td>AREA**</td>
<td>-0.003013</td>
<td>0.001014</td>
<td>-2.970856</td>
<td>0.0031</td>
</tr>
<tr>
<td>AREA*</td>
<td>1.24E-05</td>
<td>4.12E-06</td>
<td>3.000213</td>
<td>0.0028</td>
</tr>
<tr>
<td>DHK**</td>
<td>-0.105906</td>
<td>0.034119</td>
<td>-3.103988</td>
<td>0.0020</td>
</tr>
<tr>
<td>DET</td>
<td>-0.006249</td>
<td>0.032978</td>
<td>-0.189489</td>
<td>0.8498</td>
</tr>
<tr>
<td>YARD*</td>
<td>-0.007657</td>
<td>0.003081</td>
<td>-2.485286</td>
<td>0.0132</td>
</tr>
<tr>
<td>CL*</td>
<td>0.001387</td>
<td>0.000706</td>
<td>1.965215</td>
<td>0.0499</td>
</tr>
</tbody>
</table>

R-squared 0.071823 F-statistic 5.232855
Adjusted R-squared 0.058097 Prob(F-statistic) 0.000003

* significant at 5% level
** significant at 1% level

Regarding to the t-statistics, the result is satisfactory as only the coefficient of DET is insignificant. The adjusted $R^2$ stays below 0.1, which suggests the selected variables are not enough for explanation. Compared with the previous model of all retail property data set, this model obtains the same sign of coefficients of AGE, AGE$^2$ and DHK. Moreover, the significant coefficients of AREA and AREA$^2$ support the diminishing effect of retail size on rental yield. Similarly, it is believed that the large
retail stores occupied by large chain stores or large retailer have the least default risk and better prospects for rental growth. This results in general lower rental yield for the large retail space.

It is worth for us to pay attention to the variables YARD and CL. Both can be regarded as tie in sale in rental transaction. However, the two variables exhibit interesting results that their coefficient signs are opposite to each other. Nevertheless, it is consistent with the derived theoretical framework that the differential perception between the long term investment valuation by owners and short term use value by renters. As discussed, any illegal structure of cockloft is also subject to the assessment to rate tax. This conforms to the real world situation that the existence of cockloft (whether legal or illegal) is reflected in higher rental. The existence of an unauthorized structure in a flat or house is an encumbrance as it might lead to the issuance of a building order against the owner of the property. There is a real risk of enforcement action by the Building Authority. The risk is perceived by the owners only, as the tenants have no legal responsibility for this. Therefore, higher risk premium and so the higher rental yield is required for the tie-in rental sale of the retail unit with the cockloft item. Since it is impossible to illegally construct a yard, no risk perceived by landlord is imposed on the existence of yard. Generally lower rental yield of properties with yard reflects the fact that not every tenant utilizes the yard.
7.4 Industrial Sector

The following model is particular to the industrial market.

\[
\ln C = a_0 + a_1 \text{AGE} + a_2 \text{AGE}^2 + a_3 \text{AREA} + a_4 \text{FLOOR} + a_5 \text{DHK} + a_6 \text{DKLN} + a_7 \text{DET} + a_8 \text{DHR}
\]

Below Table 21 show the empirical results.

Table 21 Empirical Results of Model (7)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C**</td>
<td>-1.957995</td>
<td>0.133280</td>
<td>-14.69084</td>
<td>0.0000</td>
</tr>
<tr>
<td>AGE**</td>
<td>0.051860</td>
<td>0.008415</td>
<td>6.162438</td>
<td>0.0000</td>
</tr>
<tr>
<td>AGE^2**</td>
<td>-0.000940</td>
<td>0.000243</td>
<td>-3.870157</td>
<td>0.0001</td>
</tr>
<tr>
<td>FLOOR*</td>
<td>-0.004110</td>
<td>0.001994</td>
<td>-2.061690</td>
<td>0.0397</td>
</tr>
<tr>
<td>AREA**</td>
<td>-0.000283</td>
<td>9.43E-05</td>
<td>-3.002181</td>
<td>0.0028</td>
</tr>
<tr>
<td>DHK*</td>
<td>-0.104404</td>
<td>0.043692</td>
<td>-2.389536</td>
<td>0.0172</td>
</tr>
<tr>
<td>DKLN**</td>
<td>-0.140953</td>
<td>0.025507</td>
<td>-5.526061</td>
<td>0.0000</td>
</tr>
<tr>
<td>DET</td>
<td>-0.044775</td>
<td>0.045180</td>
<td>-0.991040</td>
<td>0.3221</td>
</tr>
<tr>
<td>HR**</td>
<td>-0.120477</td>
<td>0.024219</td>
<td>-4.974442</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.304923  F-statistic 31.36634
Adjust R-squared 0.295202  Prob(F-statistic) 0.000000

* significant at 5%  level
** significant at 1% level
All of the coefficients are highly significant, except the dummy variable DET. Most signs of coefficients of independent variables follow the expected. The adjusted $R^2$ is 0.30, which means that 30% of the change in capitalization rate can be explained by the selected variables.

For the floor attribute, however it is noted that the units located on the ground floor of flatted factories are distinct from those on above floors. Therefore, we can add a dummy variable denoted as DGROUND in the model. If we add the dummy variable DGROUND into the equation, DGROUND and FLOOR these two variables cannot be independent to each other. As a result, it is necessary to drop the variable FLOOR from the equation if we are interested in finding out any significant effect of ground floor position on the capitalization rate. To examine such effect, the following model is adopted.

Model (8) \[ \ln C = a_0 + a_1 \text{AGE} + a_2 \text{AGE}^2 + a_3 \text{AREA} \\
+ a_4 \text{DHK} + a_5 \text{DKLN} + a_6 \text{DET} + a_7 \text{DHR} + a_7 \text{DGROUND} \]

The regression results of the revised model are displayed below in Table 22
Table 22 Empirical Results of Model (8)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C**</td>
<td>-2.202159</td>
<td>0.125926</td>
<td>-17.48776</td>
<td>0.0000</td>
</tr>
<tr>
<td>AGE**</td>
<td>0.057736</td>
<td>0.008172</td>
<td>7.064787</td>
<td>0.0000</td>
</tr>
<tr>
<td>AGE2**</td>
<td>-0.001078</td>
<td>0.000238</td>
<td>-4.529343</td>
<td>0.0000</td>
</tr>
<tr>
<td>AREA*</td>
<td>-0.000210</td>
<td>0.000098</td>
<td>-2.213771</td>
<td>0.0272</td>
</tr>
<tr>
<td>DHK**</td>
<td>-0.112313</td>
<td>0.043118</td>
<td>-2.604804</td>
<td>0.0094</td>
</tr>
<tr>
<td>DKLN**</td>
<td>-0.128758</td>
<td>0.025040</td>
<td>-5.142137</td>
<td>0.0000</td>
</tr>
<tr>
<td>DET</td>
<td>-0.050491</td>
<td>0.044780</td>
<td>-1.127530</td>
<td>0.2600</td>
</tr>
<tr>
<td>HR**</td>
<td>-0.077665</td>
<td>0.025396</td>
<td>-3.058168</td>
<td>0.0023</td>
</tr>
<tr>
<td>DGROUND**</td>
<td>-0.350550</td>
<td>0.108085</td>
<td>-3.243291</td>
<td>0.0013</td>
</tr>
</tbody>
</table>

R-squared       | 0.312403    | F-statistic| 32.48531    |

Adjusted R-squared | 0.302786 | Prob(F-statistic) | 0.000000 |

* significant at 5% level

** significant at 1% level

In this model, from the t-statistics, all the coefficients remain highly significant. Dummy variable DET is insignificant yet. Most signs of the coefficients follow expected. $R^2$ has improved slightly to 0.3029. In particular, the magnitude of the significant coefficient of the added variable DGROUND specifies the quite great
effect to the rental yield. This selection of explanatory variables is satisfactory. Therefore, the latter model is chosen for illustration below.

**AGE and AGE**

The regression outputs of coefficients of AGE and AGE\(^2\) of industrial premises are the same as those of office and retail properties. Despite the phenomenon of the relocation to industrial base to China, many manufacturing establishments have shifted their roles towards non-production activities such as administration, design, sales and marketing, prototype production, research and development, quality control and packaging. On the other hand, manufacturing processes that have emerged in recent years have tended to be higher value-added and technology- and information-based production activities such as printing, multi-media computer hardware and software production.

These changes again affect financial decision for ownership at the property level, thus the capitalization rate. Industrial buildings vary in age and therefore in layout and design according to the particular eras in which they were constructed. From above, it is noted that the conventional flatted factories cannot accommodate the high quality and technological industrial facility Functional and technological obsolesce is a serious problem for the older industrial properties. Therefore, it can be seen that the positive value of the coefficient of variable AGE is quite great and significant, compared with other variables. The opposite and significant coefficient of AGE\(^2\) suggests a diminishing effect of age attribute due to the rehabilitation work undertaken.
AREA

Section 25 of the Buildings Ordinance requires an owner to seek the Building Authority's permission for any material change of user of a building after the issue of the occupation permit. Failure to secure the required permission might render the title defeasible. A breach of the user of a property may lead to government's re-entry. As regards the industrial, it remains depressed and inactive. While the owners of flatted factories seek changes of land use to meet likely demand for other purposes, it is common that they rent out the smaller flatted premises for office user due to the high vacancy rate. For this reason, higher risk premium is demanded from landlord of smaller units for compensation then. The larger sizes of units are occupied by companies for manufacturing process. 81 In the long term valuation, high risk premium is required for the ownership of small factory units, thus a higher capitalization rate.

DHK and DKLN

Dummy variables for location capture for any influence of the geographical location of properties. Both coefficients of dummy variables DHK and DKLN obtain significant and negative sign. These results confirm the previous hypothesis that the locations of industrial premises in New Territories (DNT) have a significant positive impact on capitalization rates due to the stronger substitution effect from Shenzhen.

DET

The parameter for DET is insignificant again. This finding, however, is consistent with the premise that non domestic properties are not subject to any statutory control

81
on tenure security. Therefore, it is reasonable that no evidence can prove that the tenanted industrial units would have any significant effect on rental yields.

**DGROUN**

The coefficient of this dummy is very significant and negative. It seems contradicts to our hypothesis regarding to floor level. The hypothesis states the capitalization rate for lower floor units is higher than upper units, ceteris paribus. However, in reality, the upper floor units (excluding the ground floor units) and ground floor workshops are two kinds of goods. Due to the highly convenient location, the investors and space users are willing to pay for a premium for the ground floor position of industrial premises to utilize this advantage.

While realizing that the high street retail properties have performed well even in the depressed market, investors also pay attention to the ground floor workshop of industrial buildings. The ground-floor workshops are normally used for warehouses or showrooms. Taking advantage of the government's tendency to relax restrictions on land usage of excessive industrial space, owners have been gradually offering them for retail use for capitalization growth potential. Moreover, the market is relatively small as the supply of quality ground floor workshops is limited. As shown, the ground floor workshop is worth of higher percentage increase of price than rental, compared with upper floor units.

**HR**

The results demonstrate the coefficient of variable HR exhibits the significant and negative sign. Firstly, it is necessary to understand that the higher headroom provides
higher flexibility to the use of industrial space. It is easier for landlord to find potential tenants who may or may not make use of the high headroom. However, high headroom is not an attribute demanded by every industrial occupant. Only some kinds of industrial users can fully utilize the high headroom provided by the premises. At the same time, the high headroom submarket is small due to the limited supply of high headroom industrial buildings. From this point of view that as not all tenants fully utilize the high headroom, the tenants do not pay the full rent to reflect the high headroom value after negotiation. Even the tenants desire and make use of the high headroom; the tenants still need to pay for the cost of alteration works. Therefore, that tenant is not willing to pay for the full rent to reflect the high headroom value. Therefore, this explains the fact that the rental and prices are not responding to the same extent with respect to increasing headroom. In general, the price increases at a larger percentage than the rental with respect to the higher headroom.

7.5 Chapter Summary

Empirical Results of the models of the four markets have been elaborated in this chapter. More importantly, the empirical results confirm most hypotheses derived in the Chapter of Hypotheses. We can also see that the effects of some attributes are non-linear. The following table shows the summary results of hypothesis testing.
<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Residential</th>
<th>Office</th>
<th>Retail</th>
<th>Industrial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypothesis</td>
<td>Model (1)</td>
<td>Model (2)</td>
<td>Model (4)</td>
<td>Model (6)</td>
</tr>
<tr>
<td>One: AGE</td>
<td>YES</td>
<td>YES*</td>
<td>YES*</td>
<td>YES*</td>
</tr>
<tr>
<td>Two: FLOOR</td>
<td>YES</td>
<td>YES</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Three: AREA</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>YES*</td>
</tr>
<tr>
<td>Four: DHK, DKLN &amp; DNT</td>
<td>No Data</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Five: DET</td>
<td>YES</td>
<td></td>
<td>YES**</td>
<td></td>
</tr>
</tbody>
</table>

YES: the result is highly statically significant and confirms the hypothesis

NO: the result cannot confirm the hypothesis

YES* means non-linearity effect is shown

NA: "Not Applicable". In Hypothesis Two, as floor level is concerned, Model (4) and (8) just adopt ground floor dummy. Model (6) employs the data set of ground floor shops only.
YES**: Hypothesis Five is confirmed in the sense that insignificant statistical result is shown on all sectors, except the residential model due to the tenure security protection on the domestic market only.
8.1 Summary of Findings

This study has presented and tested an analytical model of capitalization rates. This study develops a set of hypotheses that explain the variation of capitalization rates across different properties. The hypotheses are tested using cross sectional regression data in Hong Kong. In theory, the capitalization rates have been shown to be a function of observable property characteristics that vary across both properties.

One regression model is set for each of the four sub-markets of Hong Kong’s real estate. With the exception of the retail shops sub-market, the results confirm the hypothesis that the physical attributes, i.e. building age, floor level and area are important in determining the capitalization rates due to the difference between the tenants’ short term valuation and landlords’ longer term valuation of these attributes. The models suggest that capitalization rates are positively related to building age, negatively related to area and floor level. Some of the insignificant results for the location factors may be a result of the lack of detail locational information in the dataset used in this study.

8.2 Implications

The results of the study should be of interest to institutional and individual investors as well as real estate appraisers. Since the attributes’ risk premium is implicit in the capitalization rate, an explicit estimation of those attributes’ risk premium can help
investors to assess the risk premiums they have to pay. These results are potentially very important for making investment decision.

For real estate appraisers, the assessment of an appropriate capitalization rate is a critical for valuation and feasibility study. It is well known that the value of a property is very sensitive to the choice of capitalization rate when the income/investment approach is used. (Parker, 1992) When there are no comparable sales of transactions in the market or there is existing tenancy for the subject property, investment method of valuation is sometimes more preferable than the sale comparison method. The current practice of income approach requires the appraisers choose a capitalization rate based on market evidence, which can a highly subjective exercise. Then appraisers usually can choose a capitalization rate and make adjustments based on various factors. However, the adjustment process is based on professional judgment and varies across different appraisers. This dissertation contributes to the development of a more systematic approach for determining a capitalization rate for the purposes of valuation and development appraisal.

Last but not least, this study attempts to link the real estate’s space and capital markets in that it refined the linkage between the two markets cross-sectionally by introducing attributes of the properties. The study provides insights for developers how physical attributes of a property can affect rent and price differently and thus provide guideline for design optimization for different purposes (investment and trading)

8.3 Limitations
Due to the limited availability of information provided in the data sample from the database, some of the key attributes cannot be incorporated into the regression function. Say for example, the author would like to add an office grade dummy in the model of office. However, the information about the office grade in the sample cannot be obtained from Rating and Valuation Department. Therefore, this problem gives rise to low adjusted $R^2$.

Another limitation is that the models cannot reflect some of the underlying factors that contribute to the effect on capitalization rate. This lies to the fact that the sample size is not large enough to produce a significant result. For example, due to the lack of market transaction, the obtained number of data sample for office is about two hundred and is considered not to be large enough. Also, the best functional form is not searched for using Box and Cox transformation since the log-linear specification is supposed to be enough to serve the purpose of this study.

8.4 Further Areas for Research

In the reality, the housing attributes which attach to the property altogether cannot be traded separately. The coefficients of different attributes in this dissertation are just used to show the contribution of each particular trait to the capitalization rate. The estimation results obtained are specific to Hong Kong only. Given that the leasing practices varies among different countries, the estimated effects of those attributes in other property markets, e.g. China should not be the same as those acquired in this study. Nonetheless, this study provide a useful starting point for further empirical studies that attempt to link real estate’s space and capital markets.
Another area for study is the effect of property market cycles on the coefficients of these attributes. The demand for those various desirable characteristics may change over time that the results of this study can only explain for variation of capitalization rates in part of the property cycle. It is suggested that more and more amount of transaction data and property attributes are needed in the case of panel data hedonic pricing model.
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