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THE UNIVERSITY OF HONG KONG

A STUDY OF THE FACTORS AFFECTING LAND PRICES IN HONG KONG

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

DEPARTMENT OF REAL ESTATE AND CONSTRUCTION

BY

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HONG KONG

APRIL 2006

Declaration

I declare that this dissertation represents my own work, except where due acknowledgement 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.

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Date: _____

Abstract

Land price behaviour has been the major area of studies in land economics. Having been the main source of government revenue for years, land sale is believed to be an important indictor to Hong Kong's economy.

This study aims at investigating the major determinants of land prices in Hong Kong using hedonic price model and empirical data over the period 1989-2002. Auctioned land price are used as dependent variable. Independent variables affecting land prices are identified based on the close interaction between land market, housing market and the local economy.

The regression model is constructed to analyze the influences of demand-side and supply-side variables as well as location variables with different time lags on land prices. The empirical result suggests that the population, employment, stock market performance, and distance to Central Business District are significant demand-side factors affecting land prices. In an attempt to further investigate the effect of expected land use on land prices, dummy variables for commercial, residential, industrial and commercial/residential are used. The result suggests that residential land use has the most significant impact on land price. For the supply side factor, usable floor completed each quarter is significant in affecting residential land prices only. The result suggests the coexistence of conventional variables and economic and financial indicators in land price determination.

Acknowledgment

I would like to express my deepest gratitude to Dr. L. H. Li for his unfailing guidance and support who has provided me with useful insights to the topic. I would also like to express my gratitude to Mr. Alex Cheung and Mr. Hui Man Yam for teaching me some of the statistical techniques. Last but not least, I would like to thank my family and friends for their support throughout this dissertation year.

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Chapter 1 Introduction

1.1 Background

Hong Kong Special administrative Region comprises a total land area of 1,098km^2 (271321.7 acres), which extends over Hong Kong Island, Kowloon Peninsular and New Territories. Its territory has been increased in the past decades through reclamation, which ia gained from sea with an area of 3,600 hectares. The naturally restricted land supply and an increasing population which is approximately 6.9 million in 2003 have aroused much administrative and economical interest.

The Land Tenure System presently used in Hong Kong is closely related to its colonial history since 1984. The government of the HKSAR is effectively the sole perpetual owner of the territory under the leasehold system. All land in Hong Kong is held under Crown leases for a term of years absolute. Land is disposed of mainly through public auctions, tenders, and private treaty grants.

Hong Kong land market plays an indispensable role in Hong Kong's economy. The government acts to maximize land revenue (Tse, 1997) as shown in Table 1.1, which has on average generated 7.6% land revenue to the total revenue in Hong Kong. The amount of land disposed of by the government as the sole supplier highly fluctuated throughout past decade as shown in Table 1.2. During the 12 years after the establishment of flexible quota of land supply set by the Land Commission through the Sino-British Joint Declaration, the colonial government maximized the supply of residential properties with higher development intensity (R1 and R2), and limiting the supply of land for luxurious type of development. This supply policy has caused the limited supply of luxurious end in the market and leading to a substantial surge in this sector. This seemingly indicates a

close relation between land supply and property price. Before the signing of the Joint Sino-British Agreement in 1984, there existed a conspiracy saying that the colonial government had adopted a high land price policy to stimulate prolonged housing demand to maximize revenue. Though land market has long been criticized on its high land price policy, land prices remains to be allocated to the highest bidder.

Financial Year	**Amount of land disposed of by the Hong Kong government (m2)**
1985-86	191,444
1986-87	272,043
1987-88	271,169
1988-89	593,734
1989-90	265,992
1990-91	276,889
1991-92	315,764
1992-93	296,817
1993-94	197,207
1994-95	265,901
1995-96	925,139
1997-98	341,212
1998-99	194,969
1999-2000	276,315.8
2000-2001	235,259.8
2001/2002*	85,694.8
2002/2003*	53,909.6

Table1.1-Annual Land Disposal by the Hong Kong Government, 1985-2000

Source: Hong Kong Annual Reports; Lands Department, HKSAR Government. Note*:there were periodic suspensions of land sales in these years, leading to substantial reduction in the land area sold. [1]

[1] Adopted from Natacha, A and Li, L. H. (2004) Property Markets and Land Policies in Northeast Asia: the Case of Five Cities: Tokyo, Seoul, Shanghai, Taipei and Hong Kong. Centre for Real Estate and Urban Economics, the University of Hong Kong

Year	Urban Area							
	C	C/R	R1	R2	R3	R4	I	CP
1985-86		3	2	3	1			2
1986-78		11		4			4	
1987-88	1	2		3	1		2	
1989-90	4	1	1	2			3	
1990-91	3	1	1				1	
1991-92	1	2	1	6	2		1	
1992-93	1	3	1	2			1	
1993-94	2			2				
1994-95	2		4	2			1	
1995-96	2	3	1	1	1			
1996-97	2	2	1		2	1		
Total	22	29	12	26	7	1	14	2

Table1.2-Major Land Disposal Pattern (Urban Area) 1985-1997

Source: Government land sale record, lands department, HKSAR Government

Notes: R1 to R4 Residential land for different degrees of development intensity. [2]

R1 is the most intensive type.
C: Commercial land,
C/R: Residential land with commercial elements allowed,
I: Industrial Land,
CP: Land for car-parking

In fact, land prices are determined by a number of economic and locational factors. Locational factors such as plot ratio, neighborhood environment of the land, its distance to the central business district, infrastructure and amenity level will all affect the value of land. On the other hand, the overall economy exerts some level of influence on land market. For example, the Asian Financial crisis devalued property assets by more than 50% and as developer became more cautious in their bidding behaviour, land price began to fall. This leads to a more dampening effect onto the sluggish property market.

[2] Adopted from Natacha, A and Li, L. H. (2004) Property Markets and Land Policies in Northeast Asia: the Case of Five Cities: Tokyo, Seoul, Shanghai, Taipei and Hong Kong. Centre for Real Estate and Urban Economics, the University of Hong Kong

Researches previously carried out in Hong Kong mainly focused on the determinants of residential prices despite the fact that land market is of paramount importance to Hong Kong's economy. While determinants of land prices are actively tested and studied in other cities such as United States, Taiwan and the Mainland, similar work in Hong Kong is relatively scarce. There happened to be active discussions and research on the relationship between land supply and housing prices in Hong Kong for the past decade and the determinants of land price were tested only in micro economic level such as the development control. To my knowledge, there has been no research focus specifically on determinants of land prices in Hong Kong.

This dissertation attempts to look at land prices determinants in a comprehensive way in hope of providing insight to developers, investors and practitioners when making investment decision.

1.2 Objectives:

- To examine how economic and locational variables affect land prices
- To identify the major determinants of land prices of different land uses in Hong Kong by constructing a regression model using data over the period 1989-2002
- To explain and investigate the impact of identified determinants on land prices of different uses in Hong Kong

1.3 Framework

A literature review on the theoretical background of land value determination will be first be illustrated as the foundations for discussion. The variables to be tested will be selected based on ideas suggested from previous studies and the local situations in Hong Kong.

A regression analysis will be used to construct a land price model in order to determine and analyze the determinants, in which accommodation value will be the dependent variable and some economic and financial indicators as well as locational factors will be used as independent variables. The model will be empirically tested using quarterly data from 1989 to 2002. Significant variables will be analyzed and investigated in detail on its effect on land prices. Conclusions on findings and limitations of study will be drawn at the end.

This study is divided into six chapters. Chapter 1 is the introduction, which describes the background, objectives and framework of this study.

Chapter 2 will be a review of both overseas literature on two aspects, including the traditional land price behaviour and contemporary land price determination. A short summary of past literature will also be provided.

Chapter 3 will be an overview of the methodology employed in this study. The regression analysis will be described and the general development processes of the land price model will also be outlined.

Chapter 4 will provide an overview of the empirical model. It will firstly identify and justify the explanatory variables to be tested. Their expected effects will also be examined. Finally, it will specify the data used for the empirical analysis.

Chapter 5 will present the empirical results and provide a comprehensive analysis of the results. It will also illustrate the implications of the findings.

Chapter 6 will be the concluding chapter. It will summarize the findings and limitations of this study. Further research areas will also be suggested.

Chapter 2 Literature Review

2.1 Introduction

Previous studies must be reviewed in order to understand the theoretical principles behind land price determination and hence, a sound land price model based on relevant explanatory variables can be developed. Section 2.2 will review the traditional land price behaviour. Section 2.3 will review the contemporary land price determinants so that the relevant approach and explanatory variables can be identified and adopted in this study. Section 2.4 will be a brief summary of findings from the literature review. The relationship between property and land market will be explained in section 2.5.

2.2 Traditional approach to land price behaviour

Value of a commodity or services determines their exchange value. The overall market utility derived from land is represented by the rent accrued from land, and it is the rent of land that represents the market value of land for a certain period of time. Hence, land rent is always the basis for the determination of land value.

The study of rent originates from the major theory of rent laid down by Ricardo (1821). He points out that the most fertile land would first be used, and the less favoured land is used as the demand for agricultural product increases. The rent on the most productive land is based on its advantage over less productive land, with competition among farmers. The advantage a land possesses is equal to the value of the difference in the productivity of land.

Ricardo realizes location affects land rent. He recognizes that land that is closer to the market bears lower transportation costs for its product to the city centre than land far away, and this advantage also accrues to the landlords in the from of rent as farmers compete among themselves for location.

Apart from location, he also devotes much attention to the fertility of land. He explains that land rent does not only account for the natural fertility of land, but also the increased productivity due to the higher capital investment.

In Ricardo's study, the importance of location in determination of land prices is reflected to be a positive influence.

A few years after Ricardo's historical theoretical contribution to land economics, Thunen (1826) further develops his theory of rent. According to Von Thunen, the various agricultural land uses around a market place bid for the use of land, and land is assigned to the highest bidder in each case. The rent that each crop can fetch at each location will be the savings in transportation of its product that the land can afford. The most distant land in cultivation yields no savings in transportation, and consequently there will be no rent for that location. In other words, the rent at any location is equal to the value of its product minus production and transportation cost. Again, location remains the main determinants of the land value.

Alonso (1964) systematically organizes and integrates different theories on land value including Ricardo's theory of rent and tries to apply them to explain the relationship

between land value and land use from a location perspective and in an urban context. Alonso (1964) states that:

"……..the theory will be formulated in such a way that it is congruent with the existing theory of agricultural land uses. Urban and agricultural theory will form a unified theory of land uses and land values."

Basically, Alonso's approach is based on the basic philosophy that land value is residual amount of economic activities carried out on and above the land. Due to the immobile and heterogeneous nature of land, as well as its limited supply, not every user can enjoy the most favored land, and hence marginal land has to be brought to use. Under these circumstances, land rent begins to emerge due to the gap between revenues and costs involved in the economic activities between the land and the marginal land. In other words, a landlord's income from land is equal to the sum of land costs, commuting costs and other expenditures. This is transferred into the budget equation by Alonso as:

$$Y=PZz + P(t)q + k(t)$$

Where

y = income

Pz=price of composite good

Z =quantity of the composite good

P(t)=price of land at distance t from the center of the city

q=quantity of land

k(t)=commuting costs to distance t

Since the equation sets the constraint on land consumption alternatives open to each consumer or land user-group. Under such circumstances, land rent to any particular location becomes (assuming an agricultural economy):

$$Pc(t) = N[\ Pc - C - Kc(t)\ ]$$

Where:

Pc(t) = the rent per unit of land at distance to from the market;

N = number of units of crops produced per unit of land;

Pc = price per unit of the crop at the market;

C = cost of producing one unit of the crop;

Kc(t) = cost of transporting one unit of the product at a distance to the market.

This equation represents the residual surplus profit that a landlord is able to extract after all production and transportation costs have been allowed. When this analysis is expanded to include all other production activities, it can be illustrated below:

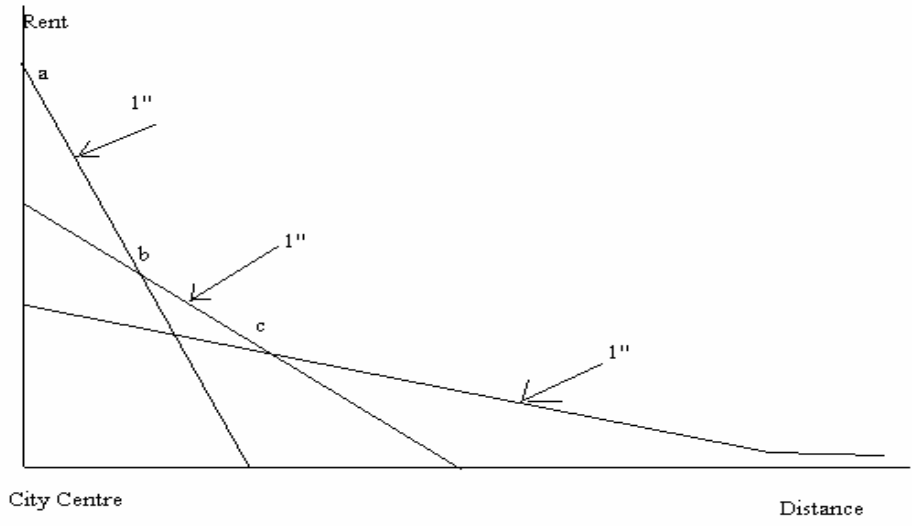

Figure 2.2 Formation of Bid Rent Curve

In this graphical illustration, there are three land user groups each with different budget equation, and hence, different ability to pay rent. They are able to outbid other users over a certain range of distance from the city centre. As result, the bid rent curve of the overall city becomes the curve ‘abcd”. One point to note is that in Alonso’s original analysis, point d touches the X axis such that at the very far end of the city no rent is payable.

Alonso suggests that the main determinants of land value depend on locational differences. However, this point reveals the weakness of the model because the assumptions behind are unrealistic. Alonso’s model assumes featureless plain on which land is with same quality and readily available for development without improvements. Buyers and sellers are assumed to have perfect information.

Owing to the advancement of the society and the unrealistic assumptions of traditional urban structure approach, researchers move on to explain land price determinants from other perspectives and investigate variables other than location.

Li (1997) suggests that new factors affecting land price behaviour emerge due to the advancement in technology especially in areas of telecommunication and increasing complexity of urban land structure and policy. It is therefore necessary to review land price determinants in new perspectives.

2.2 Contemporary land price determinants

This dissertation builds directly on findings published in previous papers.

In early 60s, Knos (1962) and Marble (1959) attempt to explain land values in relation to distance from major business centres as well as Central Business District. Their findings however, are somewhat contradictory, for the former the assumptions are substantiated and in the latter rejected. These differences in their results are attributed by Yeates (1965) to the different surrogates used in their assumptions. Knos uses assessed evaluations while Marble uses the land value plus the improvements e.g. the single family dwellings block.

Yeates (1965) reexamines the relationship between land value and distance from CBD and regional shopping centres in the Chicago area from 1910 to 1960 using regression model and land value map. He first postulates a negative relationship between distance from city centre and land value. He further assumes that population density decreases with increasing distance from city centre. This leads to an assumption of population density increases when land value increases, which however, can be rejected by the existence of "non-white" racial area.

The empirical study substantiates the negative relationship between distance and land value, while the positive relationship between population density and land value are rejected due to several reasons. He recognizes a general flattening of the population density curve through time, the existence of sample points lying around commercial centres where high land price and low population coexist, and the increasing land prices at the periphery of the city.

Yeates' study has presented a fairly conclusive remark on the discussion of distance as the main determinant of land prices. The testing of the conventional main predictor variables such as distance and population density are shown to be consistent with the classical land value theory that land prices are the result of bid rent process. Besides, He has put substantial emphasis on racial component owing to the cultural diversity in Chicago, whereas economic indicators and supply-side variables are neglected.

Yeates' regression model implicitly assumes land prices for different uses are affected by the same set of variables. Hence, the effect of different land uses on land prices is ignored. These are elaborated further in other research.

Adams, Milgram, Green, and Mansfield (1968) develop separate hedonic pricing models to explain residential, commercial and industrial land values (price per acre) as development occurred in a line extending outward in Northwest Philadelphia. They test hypotheses relating to variables for accessibility, state of land (crude proxies for time to expected development), zoning, and plot or property characteristics (size, waterfront location, railroad siding, etc). A time dummy is included in the models to measure the appreciation in land values over the 1945-62 time period. Residential, commercial and industrial area are tested in separate equation. Several accessibility variables are more statistically significant than industrial and commercial uses, such as distance and travel time to CBD (negative), distance from a major commercial boulevard (negative) and distance from public transport. Zoning of land into different uses and availability of sewer services have significant effects and in the direction expected.

Brigham (1965) suggests that land prices in Los Angeles are determined by its plot size, topography, expected land use, plot shape, historical background and distance from CBD**.** He sets up separate hedonic price models for residential, industrial and commercial land uses, in which the most significant factor is found to be the distance of land from CBD.

Hushak (1975) analyzes an urban demand function of the urban rural fringe land surrounding Columbus, Ohio. He uses auctioned land price for testing and has identified six variables affecting the bid-price of land, which includes distance from railroads and major highways, the location with respect to its distance to city centre, zoning and tax structure. The result shows that distance to major infrastructure is significant in determining land prices. A follow-up study by Hushak and Sadr (1979) expand the model and test the model on similar land market getting similar results.

Colwell and Sirmans (1978) reveal that land price is a negative exponential function of distance from CBD, and a positive function of time and parcel size by using empirical data collected in Chicago, Illinois. Chicoine (1981) later confirms with Colwelll and Sirmans on the importance and relationships of parcel size, accessibility with land prices in South of Chicago, Illionis.

Peiser (1987) attempts to explain variations in land prices. Separate models are developed for each type of non residential land uses such as commercial, industrial and office land in Dallas Metropolitan area from 1987 to 1982. The study also focuses on the tendency towards agglomeration for consumers of each land use which is measured by the impact on land values in the central business district, suburban nodes, and other employment concentrations. His model includs six general categorizes measuring physical site

characteristics, development expectations, macro location variables with respect to CBD, macro location variables (size of street, location on the block), macro economic and financial variables.

Peiser's study is influential to later research and his detail study on economic and financial indicators as well as location variables is of great relevancy to my study.

Peiser concluds in the study that land prices for the three uses are affected differently by each parcel's interaction with the dominant structural features of the city. They are explained as follow:

For commercial land, their values appear to be more sensitive to general economic conditions than industrial or office land prices. Peiser attributes this high sensitivity to the fact that commercial rents and commercial absorption rates tend to be affected more quickly by worsening economic conditions. Interest rate is found by Peiser to be significant with positive signs. He indicates the positive relationship as that high interest rate is evidence of inflation and commercial land is a good hedge against inflation due to commercial lease rate is tied closely to store sales and this would respond to inflation quickly. The negative impact of employment rate found by Peiser indicates when employment rates move higher relative to those on the previous quarter, commercial land prices fall.

The macro-location results are summarized as follows:

1. Proximity to the CBD and proximity to suburban nodes have greater effect on office land value than commercial land value, and have the least effect on industrial land value.
2. Proximity to the CBD had greater impact in office land value than on commercial land value.

All the above scholars concentrate on studying land price behaviour in Europe and United States, in which socio-economic conditions are in some way different from Asian cities. The close relationship between property market and land market appears in Asian cities like Hong Kong, Taiwan and Shanghai are neglected in the above studies. In order to develop a more comprehensive study, relevant studies in Asia must be reviewed.

Han et al. (1992) selects variables that can relate to the property and land market at the same time. Han et al. (1992) attempts to explain the changes in land prices over a certain time period in Taiwan, in which 7 cities are included and a total of 23 variables are used to see its influence on land prices:

Population and income	Finance	Taxes	Construction	Economic indicators
Density	Bank deposits	Taxes collected	Gross Floor area	GNP Growth Rate
Working Population	Bank Loans	Capital gains tax on land	Building costs	Exchange rate
Household income	Interest rate	land price tax	Length of Road	Deposit rate
Household expenses	M2 Supply	Conveyance tax securities	Area of Roads	Stock index
	Medium term rate			CPI

By carrying out a stepwise regression procedure, relevant variables are entered into the model and less influential variables are shifted out. Two sets of regression analyses examine the effects of the variables on land prices as whole and individual pieces of land. Their conclusions are divided into these 2 areas. In general,

1. The relationship between population density and land prices is not very high
2. As far as income is concerned, only the deposit rate shows a positive relation to land prices.
3. Different variables in the economic indicators group give different results. If GNP is removed from the model, the stock index shows a negative relationship land prices. This, according to the authors, shows that the stock market and the land or property market are competitors for supply variable. And, predictably, CPI has a positive relationship with land prices, meaning land is a good investment to hedge against inflation.

4. Tax variables show a positive relationship with land prices. The authors' explanation is that a rise in land taxes will increase the land costs in transaction and hence increase land price. However, this should be subject to further analysis of elasticity of demand for land in Taiwan before such a conclusion can be made. Although land is more or less physically fixed, land uses can be flexible, and accordingly, Henry George's notion of 100% land tax is not acceptable.
5. Contrary to traditional valuation theory that the lower the interest rates the higher the property price, the results of the test on interest rate shows a positive relationship: in Taiwan a rise in interest rates will cause a rise in land price. This conclusion can be attributed to two different reasons. Firstly, a rise in interest rates represents a rise in expected inflation and hence, demands for real property increases. Secondly, such a conclusion can also be the result of the interaction of interest rate variables with other variables in the regression model.
6. Finally, both the length and area of roads show a positive relationship with land prices.

In general, economic factors i.e. loan, deposit, stock performance and saving (capital for investment) are shown to be significantly affecting land in Teipei. Land has evolved to be a financial asset that is priced with considerations place on economic and financial indicators. With an efficient and mature land market in Hong Kong, it is expected that economic variables are likely to have impact on land price.

Li (1996) comments on the potential problem of high correlation among predictor variables in the above study such as interest rate, exchange rate and deposit rate. Nevertheless, Han's study is relevant to similar study in Hong Kong because it is a

fairly comprehensive attempt to verify the determination of land prices in Asian Context.

Li (1996) compares Shanghai urban land market with the one in Taiwan as the two cities share similar culture and political background. He identifies a total of 18 predictor variables which were drawn from various similar research.

A stepwise regression analysis is carried out based on these 18 variables. 6 are found to be significantly affecting the determination of land prices in Shanghai. Distances to CBD and population density are again found to have significant negative effect on land price. Plot ratio and percentage of commercial land are positively affecting land price.

Li (1996) explains that the study on Shanghai provides the examination of market at its infancy as the market mechanism starts to become active after 1991. The environmental factors such as population density and physical site characteristics account for a very important role in determining land price, which are highly consistent with traditional analysis of land price behavior and location theories. Shanghai land is not sensitive to financial and economic indicators whereas interest rate, saving rate and performance in the stock market are very sensitive to land in Taipei.

In the transitional economy, Li (1997) sees the possibility of traditional factors fading away and being replaced by modern economic and financial variables such as those in Taipei model.

Li's (1997) explanations and findings of the Shanghai land market are of paramount importance to the understanding on modern land price determination. He observes land gradually acquires the role of financial asset in relatively more mature market. Because of its new role investors when pricing land and given their own investment portfolio, they will look at the normal financial and economic indicators that are normally applied in the assessment of asset values. It is commonly suggested that indicators like interest rate and performance of other investment markets are also determinants in modern view of land price determination.

2.4 Summary of Land price determinants

There exists some common factors among various research though their degree of influence is not the same. Land price determinants are found to be changing through time and differ between regions. Land price in an efficient market is the equilibrium between demand and supply. However, the supply-side factors have not been incorporated in most of the above researches.

There is no one particular factor found to be significant throughout all studies and the fact that assumptions behind each study vary which has led to contradictory result in some study. If a set of assumption is applied on another region or a new time period, the result can be different and the past factors found to be significant previously will then become questionable. Regardless of the differences in chronological, social, geographical and economic variations, determinants can be summarized below. In general,

1. Land prices of residential, industrial and commercial are regressed separately. Expected future income i.e. rental income, property values to be received from a particular use can be derived.
2. Plot ratio is important since higher plot ratio allowed on site, the higher the plot ratio to be built and the higher income to be generated and naturally the higher the land price.
3. Distance from CBD is conventionally a dominant variable that inversely affects land price. However, land market is dynamic through time, its effect on land price has diminishes.
4. Population density ceases to be a dominant factor except in low income or old area.
5. Economic and financial indicators are becoming more important such as interest rate, stock market performance and GDP.
6. Public transport has a certain degree of importance in the Asian setting but not in Western cities where private car ownership is high.
7. Racial component is more significant in the West than in Asia

2.5 Relationship between property and land market

In Han et al. (1992) research, the variables adopts in the land price determination model is based on those variables that affect demand for property. Thus, the treatment of land is closely related to property market. The relationship between land and property market is explained below.

Land price and property price

According to Evans (2004), the traditional theory of land prices dates back to Ricardo (1963) who argues that land rents are high because the price of corn was high, not he reverse, which on the face of it looks exactly the same as the argument that land prices are high because house price are high. But Evans argues that Ricardo's conclusion is based on the assumption that supply of land is fixed and or perfectly inelastic. Given the fixed supply of land, the price will depend on the demand for land which is a function of (or derived from) the price of corn (housing). Evan's main points are therefore land and house price are determined by demand and supply, the restricted supply of land will raise the price of both.

Grigson (1986) states that "house price determine land prices, not the reverse", therefore, one can expect that land price trends to broadly follow house price trends. Such a view is in line with Harvey (1992), which by citing the Digest of Building Land Prices 1974 that in 1972 the average price paid for land on housing estates was 25,000 an acre. In the last quarter of 1973 it has fallen to 21,000 and builders who have acquired land banks at 1972 prices suffer loss. The reasons for the fall in land prices are the fall in house prices and the rise in costs. Harvey therefore concludes that land prices are determined by house prices rather than the other way round.

Derived Demand

According to Fraser (1993), derived demand means that the demand for a factor is derived from the demand for the products of the factor. Harvey and Jowsey (2004) clearly states that the demand for land as a factor of production is a derived demand- it is wanted for the contribution it can make to a final product. It has to be combined

with other factors, labour and capital, to produce the goods that are wanted. Thus, Harvey and Jowsey thus deduce that the price of the final product i.e. property determines the demand for quantity of land.

Ricardo (1963) clearly assumes in his study that demand is fixed, and that a single product is produced from the given supply of land and hence, the rent of land is solely demand determined. Rent of land is high because the price of corn is high and not vice versa, since the demand for land is derived from the demand for corn.

The demand for land in the market is indeed derived from the demand for property. Consequently, the land price must be influenced by the demand for property. Thus, in investigating the demand for land, emphasis shall be placed on the demand for property.

Lam (2002) and Law (2005) further suggest that the property price is dependent on demand factors like household income, population, real interest rate, inflation rate and also supply-side factor i.e. housing supply and land supply. Thus, it can be concluded that land price and its demand are affected by demand and supply of housing within a certain period time.

Chapter 3 Methodology

3.1 Introduction

This chapter gives an overall account of the approach for identifying and analyzing the determinants of land price in Hong Kong. Section 3.2 will introduce the regression model and the statistical tool for constructing the land price model. Section 3.3 will briefly describe the development processes of the model.

3.2 Regression analysis

The result of this study lies on the testing of predictive variables using statistical model. To analyze the relationships between land price and a number of proposed explanatory variables, one of the most efficient ways is to conduct a regression analysis. Achen (1982) remarks that

"……..…the strength of ordinary regression is its great resilience. As the consistency theorem shows, if the researcher sets up the problem correctly, regression will tend to the right answer under any reasonable practical circumstances, even if a great many of the classical postulates are violated."

This study will first model the land price in a single-equation econometric function estimated by Ordinary Least Squares (OLS) technique. The function will be estimated from a set of data in way that will minimize the sum of the squared differences between the actual and estimated values. Since there is no prior knowledge on what functional form to adopt, it is assumed to be linear for the sake of simplicity. Therefore, the linear equation for land price would be:

$$AV = a_0 + a_1x_1 + a_2x_2 + \ldots\ldots + a_nx_n + \varepsilon$$

where AV is the accommodation value (explained in next chapter), which is the dependent variable; X_1, X_2, ……..., Xn are the explanatory variables to be tested. a_0 is the constant term. a_1, a_2,…..... ,a_n are the partial coefficients to be determined; and ε is the stochastic error term.

In order to find out and interpret the result of the model, the following information must be determined and understood:

(1) Coefficient of Determination

The R squared or adjusted R squared indicates the proportion of variation of the accommodation value that can be explained by variations of the independent variables i.e. it indicates the explanatory power of the model specification. The closer its value to one, the better the model specification. The adjusted R squared will be interpreted since its value is not affected by the addition of further variables into the model.[3]

(2) F-statistic

The F-statistic tests the null hypothesis that all the partial coefficients[4] (which will be discussed in later chapters) are equal to zero. If it is greater than the critical value, the null hypothesis is rejected.

[3] States that the value of R-square increases as more independent variables are added to the model, irrespective of whether they are significant.

[4] The critical value of F-statistic is determined from the table of F-distribution with reference to the significance level and two different degrees of freedom i.e. the number of

(3) T-statistics

The t statistic if each explanatory variable will determine whether the variable is a significant determinant of the accommodation value. If the t-statistic is greater than the critical value[5], the variable is statistically significant. Alternatively, the p-value can also be used. The closer the p-value, the more significant the variable.

(4) Partial coefficient

The absolute values of the partial coefficients will tell the marginal effect of a unit change of an explanatory variable on the accommodation value caters paribus. The sign of the partial coefficient will indicate whether the relationship between the accommodation value and the explanatory variable is positive or negative.

(5) Statistical Tool

To perform the linear regression analysis on pool cross section data, Eview will be used. As it is expected to see how each variable relates to land price, Eview should be adopted to see the effect of all explanatory variables on the dependent variable.

2.3 Development of the model

The data set in this dissertation comes in the form of pooled cross section, which contains both cross-sectional and time series feature. Land price occurred at different dates throughout 14 years. Each land price is affected by a set of variables such as the unemployment rate, income, interest rate, gross domestic product and etc. In order to

[5] The critical value of t-statistic is determined from the table of t-distribution with reference to the significance level and the degree of freedom i.e. the number of observations minus the number of independent variables minus one.

show the effect of these variables on land price through time, pooled cross section should be formed.

The empirical analysis of this study is based on the demand-supply interaction of land price determinants as reviewed in Chapter 2. The dependent variable i.e. accommodation value (AV) will be regressed against with a number of variables representing the general determinants of land price from both demand and supply side. Variables chosen are based on the suggestion from previous research that economic factors and conventional variables i.e. distance from CBD and population, coexist in affecting the land price. All of the variables should proxy the demand for land either directly and indirectly by reflecting the demand for property under the concept of derived demand. The variables in the model that can not be measured directly will be represented by proxies. These proxies will be chosen based on their high correlations with the variables and availability of data in Hong Kong.

The starting of the model is based on the demand and supply function in linear regression form. Given that most of the demand-side variables are closely related to the general economic conditions in Hong Kong, there could be high correlation among them. This suggests the likelihood of multicollinearity and will cause distortion in the result. In order to eliminate such distortion and to study the dynamic nature of the land price behaviour, double-log function instead of linear function will be used to find out the relationship percentage change in accommodation value resulted from percentage change in demand and supply factor.

Data collected for the two explanatory variables i.e. distance from CBD and usable floor area newly completed on land price is with respect to different land uses. Their effect on land price could be shown by using interaction terms. That means multiplying the distance of land with the land use dummy variables and also multiplying the usable floor area newly completed with the land use dummies. One would then be able to see how distance of land with different development expectations (land uses) affect land price. The impact of usable floor area newly completed under different land uses on land price could also be revealed.

Considering the likelihood of frictional response of land price to the changes in independent variables, time lag effects will be added to the model. For each independent variable, both contemporaneous and lagged changes will be tested. For the economic independent variable, both contemporary and lagged change will be considered. It is assumed that land development appraisers will take into account the economic situations i.e. GDP, interest rate, employment, income, stock market performance and money supply within 2 quarters. This time frame provides time for the effect of economic explanatory variables incorporated into land price. The best lag combinations will be determined by inputting different combinations of the contemporary or lagged variables into Eview and see which combination gives the highest adjusted R-squared.

The significant variables from the result will be explained. Their signs of partial coefficients of the significant variables will be identified to study their effects on land price, and to justify whether they conform to the initial expectations. The relative degrees of influences of the significant variables will also be examined by comparing the absolute values of their partial coefficients.

Chapter 4 Empirical model

4.1 Introduction

This chapter will provide an overview of the empirical model for investigating the major determinants of land price in Hong Kong. Section 4.2 will identify the explanatory variables that are hypothesized to influence land price in Hong Kong. Section 4.3 will be a detail account of all proposed variables in the model, with reference to past literature and the local situations in Hong Kong. Justifications on choosing these variables will be provided. Section 4.4 will examine the expected effects of the selected explanatory variables on land price. Their expected sins of partial coefficients will also be specified. Section 4.5 will define the period of study and specify the definitions and sources of the proxy data to be used in the model.

4.2 Model specifications

Land prices are expected to respond to both demand and supply conditions in the property and land market, the land price is therefore specified as a general function of demand and supply as follows:

$$\text{Accommodation Value} = f(\text{Demand, Supply})$$

In the linear regression equation, land price is regressed on a series of both demand-side factors (D_t) and supply-side factors (S_t).

That is,

$$\text{AV} = a_o + \sum_{i=1}^{n} a_i D_{it} + \sum_{j=n+1}^{m} a_j S_{jt+\varepsilon_t} \quad (1)$$

Where $a_{o,}, a_i$ and a_j are the coefficients to be determined, t represents the current period and ε_t is the current stochastic error term.

Accommodation value will be incorporated as the dependent variable: while the changes in the variables selected to proxy the demand and supply influences will be included as independent variables. In order to capture the frictional response of land price to fluctuations of certain dependent variables, the economic explanatory variables are expected to have time lags. It is assumed that the selected economic variables will influence the accommodation value for no more than 2 quarters. That will refine the equation to the following specification:

$$\text{AV}= a_o + \sum_{i=1}^{n} a_i D_{t-ki} + \sum_{j=n+1}^{m} a_j S_{t-kj+\varepsilon_t} \quad (2)$$

For each of K_i =0, 1

Where K is the number of lag(s) for the i_{th} demand side variable and K_j is the number of lag(S) for the J_{th} supply-side variable.

This equation focuses on the economic analysis of the demand-side and supply-side influences on the accommodation value. The review of previous land price determination

variables used to proxy the demand for land and or property. With specific considerations of the local situations in Hong Kong, 8 demand-side variables are assumed to affect the overall land price. They are namely unemployment, Hibor, population, money supply, GDP, inflation, stock market performance and income. These demand side variables are in close connections with the economy, land and property market. They can capture the demand for property and hence, the derived demand for land. On the supply-side, usable floor newly completed by types is used. However, due to data unavailability of the existing usable floor of each type of uses, only the new completions of the usable floor area are taken into account. In addition, locational variables are incorporated, i.e. distance of a land parcel from CBD. In an attempt to examine how the expected developments (land uses) affect accommodation value, dummy variables on land uses i.e. residential, commercial, industrial and commercial/residential are used. Time variables are also added. The following equation takes into account of time lag effect of the explanatory variables as well as incorporates the locational variables, time variable and land use dummies:

$$AV_t = a_0 + a_1GDP_{t-k1} + a_2HSI_{t-k2} + a_3INCOME_{t-k3} + a_4HIBOR_{t-k4} + a_5PRICE_{t-k5} + a_6M3_{t-k6} + a_7NEW_{t-k7} + a_8TIME_t + a_9DIS_t + a_{10}RESI + a_{11}COM + a_{13}COM/RESI + \varepsilon_t \quad (3)$$

For each of $K_i = 0, 1$

Where GDP is the Gross Domestic Product; HSI is Heng Seng Index; INCOME is income; UNEM is Unemployment; PRICE is Inflation; HIBOR is Interbank offered rate; DIS is distance from CBD; M3 is Money Supply; NEW is usable floor area newly

completed by types; RESI is residential dummy; COM is commercial dummy; COM/RESI is commercial/residential dummy; IND is industrial dummy.

All land parcels have different distances from CBD and different uses. For the sake of showing the effect of distance on the land price of a particular use, interaction terms are adopted. They are DIS*RESI, DIS*COM, DIS*COM/RESI and DIS*IND. The data for explanatory variable i.e. usable floor area newly completed by types collected is already separated into different land uses. In order to see how the usable floor newly completed of residential, commercial, residential/commercial and industrial affects the land price, interaction terms are also incorporated. They are NEW_t*RESI, NEW*COM, $a_{15}NEW_t$*IND and NEW*COM/RESI. The specification incorporating distance and supply of usable floor area will become:

$$AV_t = a_0 + a_1GDP_{t-k1} + a_2HSI_{t-k2} + a_3INCOME_{t-k3} + a_4HIBOR_{t-k4} + a_5PRICE_{t-k5} + a_6M3_{t-k6} + a_8TIME_t + a_9DIS_t*RESI + a_{10}DIS_t*COM + a_{11}DIS_t*IND + a_{12}DIS_t*COM/RESI + a_{13}NEW_{t-k7}*RESI + a_{14}NEW_{t-k7}*COM + a_{15}NEW_{t-k7}*IND + a_{16}NEW_{t-k7}*COM/RESI + a_{17}RESI + a_{18}COM + a_{19}COM/RESI+\varepsilon_t \quad (4)$$

For each of K_i=0, 1

After making reference to the previous studies, 12 determinants are selected. These determinants are transformed into 14 independent variables including interaction terms, land use dummies and time variables which fit the format of the statistical model.

Among the above format of statistical model, double-log is chosen, it is used in this regression model so that the elasticity of the model is constant. In double-log equation, an individual regression coefficient can be interpreted as elasticity. Since regression coefficients are constant, the condition that the model has a constant elasticity is met by the double-log equation. The way to interpret in a double-log equation in this case is that of an independent variable e.g. GDP increases by 1 percent while other variables are held constant, then accommodation value will change by percentage. Using double-log function can show the percentage change. Since elasticities are constant, the slopes are now no longer constant. In a logarithmic specification, variables such as interest rate, unemployment rate, income, gross domestic product and etc are expected to add a percentage, either constant or multiplicative to accommodation value rather than a constant dollar amount as in a standard linear model.

Semi-log form and linear functional forms are also tested. However, the semi-log and linear functional forms present a much smaller adjusted residual sum of square (R^2). The log-log functional form has the highest explanatory power among the three functional forms.

Dummy variables such as land use dummies, which can take on the value of zero, are not logged, but still can be used in a double log equation. Besides, the time variable will not be logged since time was introduced as a proxy for the sum of these dynamic influences. The final specification (4) will become:

$$LOG(AV_t) = a_0 + a_1 LOG(GDP_{t-k1}) + a_2 LOG(HSI_{t-k2}) + a_3 LOG(INCOME_{t-k3}) + a_4 LOG(HIBOR_{t-k4}) + a_5 LOG(PRICE_{t-k5}) + a_6 LOG(M3_{t-k6}) + a_8 TIME_t + a_9 LOG(DIS_t)*RESI + a_{10} LOG(DIS_t)*COM + a_{11} LOG(DIS_t)*IND + a_{12} LOG(DIS_t)*COM/RESI + a_{13} LOG(NEW_{t-k7})*RESI + a_{14} LOG(NEW_{t-k7})*COM + a_{15} LOG(NEW_{t-k7})*IND + a_{16} LOG(NEW_{t-k7})*COM/RESI + a_{17} RESI + a_{18} COM + a_{19} COM/RESI + \varepsilon_t \quad (5)$$

For each of $K_i = 0, 1$

Equation (5) is then used for empirical analysis using the data summarized in Chapter 4 and the methodology described in Chapter 3.

Variables in initial model specification	Denoted as	Proxied by
Dependent variable		
Land price	AV	Accommodation value
Independent/explanatory variables		
Demand-side variable		
Gross Domestic Product	GDP	Gross Domestic Product
Income	INCOME	Index of payroll per person
Unemployment	UNEM	Unemployment Rate
Stock Market Performance	HIS	Heng Seng Index
Money Supply	M1	M1
Interest rate	HIBOR	The Hong Kong interbank offered rate
Inflation	DEFLAT	GDP implicit Deflator
Population	HSH	Household Number
Supply-side Variable		
Supply of property	New	New completions of usable floor area
Location Variable		
Distance to CBD	DIS	Distance to CBD
Time Variable		
Time	TIME	Number 1 to 48 for first quarter 1989 to last quarter 2002
Land use Dummy		
Residential	RESI	Residential
Commercial	COM	Commercial
Commercial/Residential	COM/RESI	Commercial/Residential
Industrial/Godown	IND	Industrial

Table 4.1 Summary of Proxies of Explanatory Variables

4.3 Investigation of variables for regression

In this section, all variables in the proposed land price model will be investigated. For the dependent variables i.e. accommodation value, its calculation method will be explained. Reasons behind the adoption of each dependent variable will be explained. Justifications will be made with references to past literature and local situations in Hong Kong. Furthermore, their general conditions and trends in Hong Kong are reviewed.

4.3 Investigations of variables for regression

4.3.1 Dependent variable

The dependent variable for regression is the accommodation value (AV). Although the unit land price based on lot size is commonly used in similar studies, Jud (1980) suggests that the unit land price based on per squared foot of floor appears to be more consistent. Li (1997) states in his study that unit land price based on per square foot of floor area is commonly used in Hong Kong to numerate the accommodation of value of lands. AV is the total land price divided by the total floor area allowed on site, which implies the effect of plot ratio on land price has been taken into account. Plot ratio is therefore not included as independent variable in this case.

AV= total market price for land use right/Gross Floor Area Allowed on Site

4.3.2 Independent variables

Time

The data cover a fourteen year span over which the level of land prices may have increased. Hence, in an effort to standardize the observations over the fourteen year period, time was introduced as a proxy for these dynamic influences. Time was set at 0 if the sale took place in 1989 first quarter and increased by 1 each quarter, up to 2002.

GDP

As stated in the Census and Statistics Department (2006 website), GDP is "a measure of the total value of production of all resident producing units of a country or territory in a specified period, before deducting allowance for consumption of fixed capital". GDP is employed in the model of this study because it is worldwide accepted indicator of a territory's economic conditions. It is often regarded as the most comprehensive measure

of the aggregate economic activity because it is compiled from the consumption and expenditure activities of a place. The direct relationship between GDP and the economy is put forward by Key et al. (1994)

"Economic cycles are by convention defined by fluctuations in the GDP growth rate, either absolute fluctuation in growth, or in the growth rate around an underlying trend, or in the level of GDP against the productive capacity of the economy."

GDP is frequently employed in previous macroeconomic property price determinants studies. In a local study on the property cycle by Hui and Lui (2002), GDP is employed in the model to act as an economic indicator. It is also used as a proxy of household income in Hong Kong since that an increase in GDP signifies improvement in wealth and hence income level of local people. These will enhance the demand for property and hence, the demand for land. As GDP also covers the gross value of investment expenditure on building and construction and costs of and property and land ownership transfer, it can therefore reflect the territory's demand for real estate and land. This is expected to have a positive influence on land price.

There are several papers demonstrating the importance of GDP as a macro economic variables determining land price. Han et al. (1992) uses GDP as one of the many variables in his land price analyses in Taipei. GDP is included in this study to capture the effects of general economic conditions in Hong Kong. In view of the possible time delay effect, both contemporaneous and lagged changes in GDP will be considered in regression function. This is to capture the probable delayed influences of changes in economic output on the demand for land.

GDP in Hong Kong

In the context of Hong Kong, GDP is regarded by the Census and Statistics Department (2006 website) as an important economic indicator for analyzing economic situation by reflecting the level of production with the territory. Over the past decade, despite the existence of short term negative growths, GDP in Hong Kong has experienced a gradual overall growth trend, indicating an ongoing growth of the general economic conditions (Figure 4.1). The GDP of Hong Kong has recorded a positive increase of year-on-year percentage change (Figure 4.2), subject to some exceptions, particularly significant negative increases in 1998 and 1999 when Hong Kong was suffering from economic recession resulted from the Asian Financial Crisis.

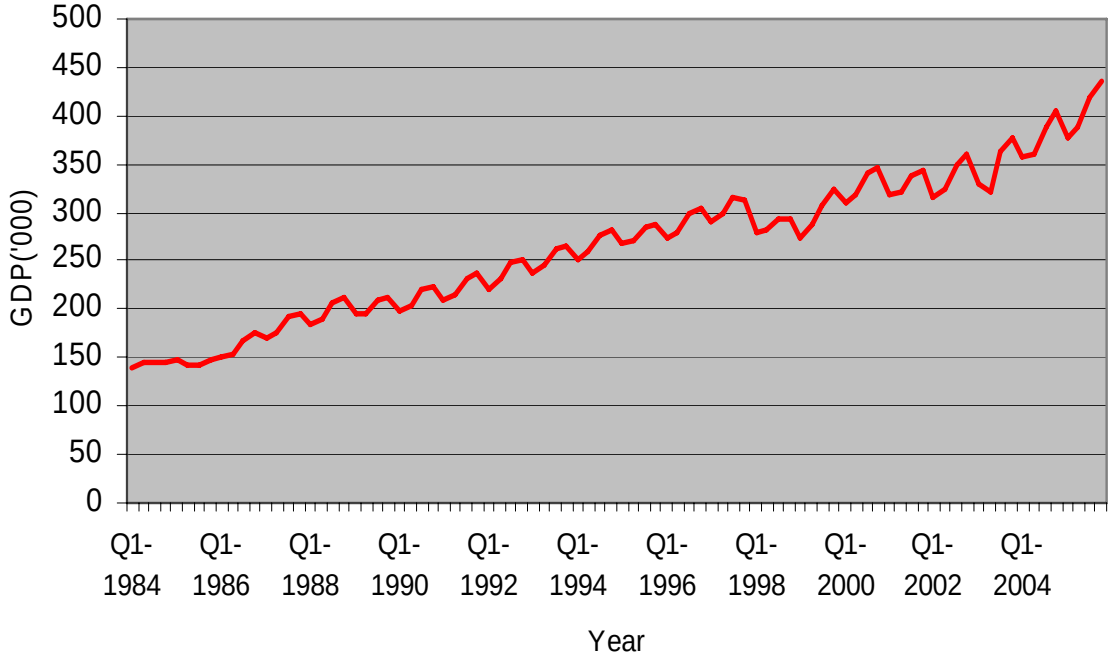

Figure 4.1 GDP at constant market price in Hong Kong
Source: Census and Statistics Department[6]

[6] Cenusus and Statistics Department. (2006 website). Website of the Census and Statistics Department. (online) Available from:

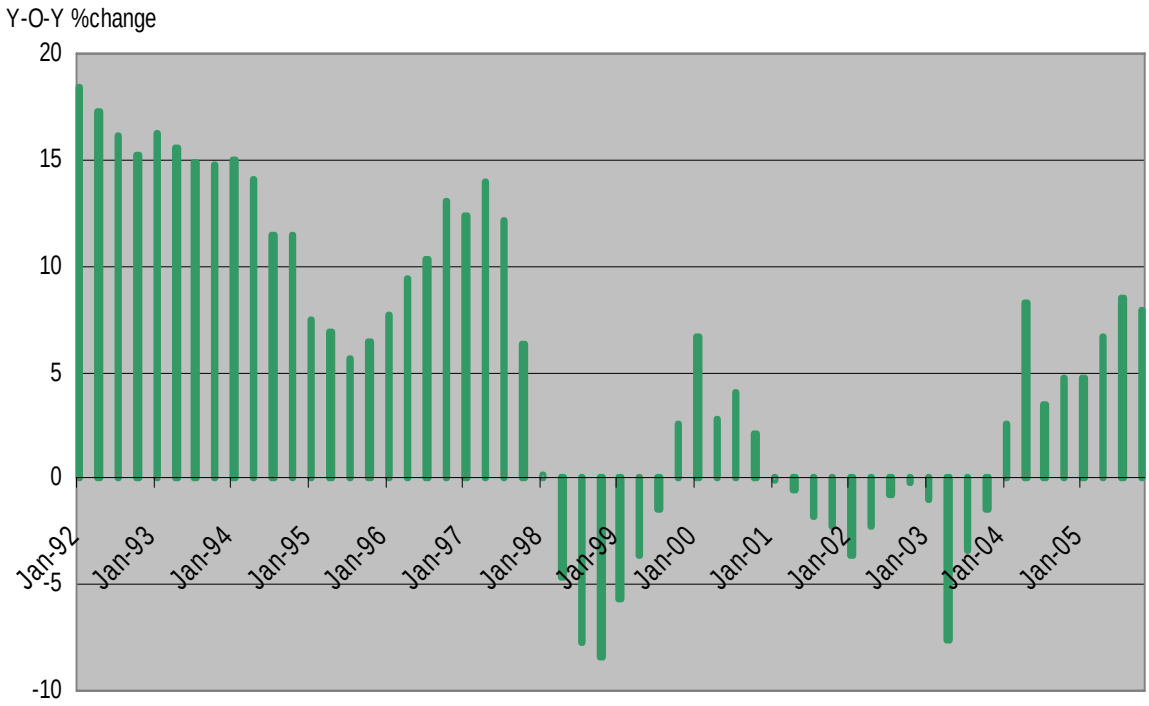

Figure 4.2 Year-on-Year Percentage Change of GDP in Hong Kong
Source: Census and Statistics Department (2006 website)[7]

Unemployment

According to the Census and Statistics Department (2006 website), unemployment rate represents the percentage of people currently available for and seeking a job relative to the labour force aged 15 or above. Unemployment rate is closely related to the purchasing power of a population because the unemployed people tend to spend less in the property market. This in turn affects the demand for property and hence, the derived demand for land.

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http://www.censtatd.gov.hk/hong_kong_statistics/key_economic_and_social_indicators/index.jsp

[7] Census and Statistics Department. (2006 website). Website of the Census and Statistics Department. (online) Available from: http://www.censtatd.gov.hk/hong_kong_statistics/key_economic_and_social_indicators/index.jsp

Furthermore, unemployment rate is an important economic indicator of a territory. This is supported by Brooks and Tsolacos (1999) and Lam (2002) who use employment rates as a measure of general economic conditions. Employment rate tends to be higher when the general economic performance is good. Moreover, people often perceive high employment rate as an indicator of good economy and will have higher intention to invest in property. Increasing income growth and high level of employment rate will push up the investment demand on land, upsurging the land price.

The inclusion of unemployment in this study is supported by some previous studies on land price determination. For example, Li (1997) adopts employment rate to measure the demand for premises by corporations and employees in a particular district. He suggests the idea that more people being employed in private enterprises, the higher the demand for premises by these enterprise and employees, hence higher demand for land for development. Peiser (1987), Han et al. (1992) and Guntermann (1997) have included employment rates as one of the economic variables in their land price model.

Unemployment in Hong Kong

From mid-80s to mid 90s, the unemployment rate in Hong Kong stood at a low level of 3% or below. However, the rate has a general increasing trend over the years. As a result of economic slowdown, the rate has been at high level in recent years. (Fig. 4.3) in 2002 Q4, the unemployment rate was 7.2 per cent. Low unemployment rates seem to have raised demand for residential properties and contributed to the booming market in the second half of the 1980s and the first part of the 1990s (Fig. 4.3). The rise in unemployment has impacted on the demand for housing service in more recent years.

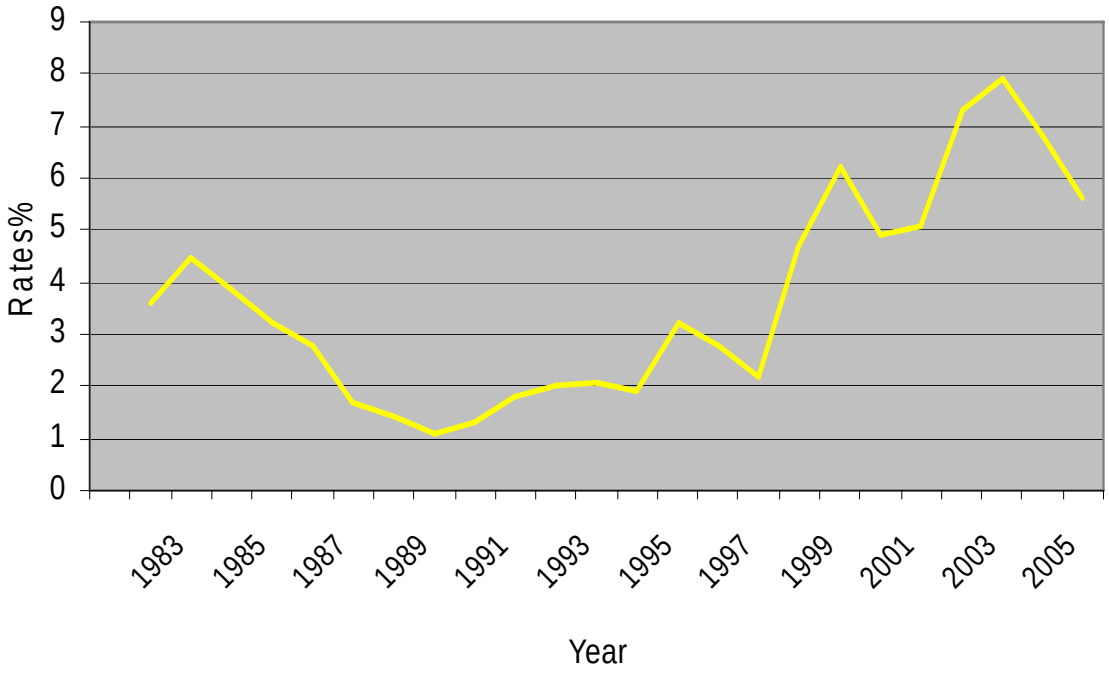

Figure 4.3 Unemployment Rates in Hong Kong
Source: Census and Statistics Department (2006 Website)[8]

Stock market performance

Li (1997) suggests that real estate market has been highly correlated to that of the stock market only before the burst in 1997. Stock market performance has been used by Han et al. (1992) as an economic indicator to land price. This variable is of particular interest and importance in Hong Kong since the stock market has high transaction volume and is sensitivity to economic situation. Hong Kong's economy is sensitive to both local and global financial and political environment, which can almost immediately reflect in the stock market. Moreover, shocks in stock market have determining effects on the local

[8] Census and Statistics Department. (2006 Website). Website of the Census and Statistics Department. (online) Available from: http://www.censtatd.gov.hk/hong_kong_statistics/key_economic_and_social_indicators/index.jsp

economy. It is supported by Norman (2000) on the contention that share price movement reflects economic conditions.

Under the theory of semi-strong form efficiency of the stock market, which states that the capital market is efficient with respect to publicly available information, any expected land acquisition will be reflected before the actual land acquisition on the firm stock prices. Land auction is sometimes seen as the barometer for Hong Kong economic health because of the importance of the real estate sector to the Hong Kong economy.

Blue chips companies listed on the Hong Kong stock Exchange are mostly developers and property-related conglomerates. The total capitalization value of the property value of these companies accounts for more than 30% of the total capitalization value of stock in Hong Kong. (Walker et. al, 1995) Auctioned land price either below or above the anticipated value can easily be reflected in the stock market. Thus, it is expected stock market and land market have more or less the same trend.

Stock market performance in Hong Kong

The stock market performance in Hong Kong is measured by Heng Seng Index (HSI) complied by the HSI Services Ltd. HSI is constructed from 33 constituent stocks in Hong Kong. There was an overall growing trend over the period. 1991 to 1997 (Fig 4.4). However, the stock market of Hong Kong was hit badly by the Asian Financial Crisis, leading to a deep trough between 1998 and 1999. The annual stock exchange turnover reached it peak in 1997 and dropped to HK$1,643 billions in 2002 due to economic downturn in recent years.

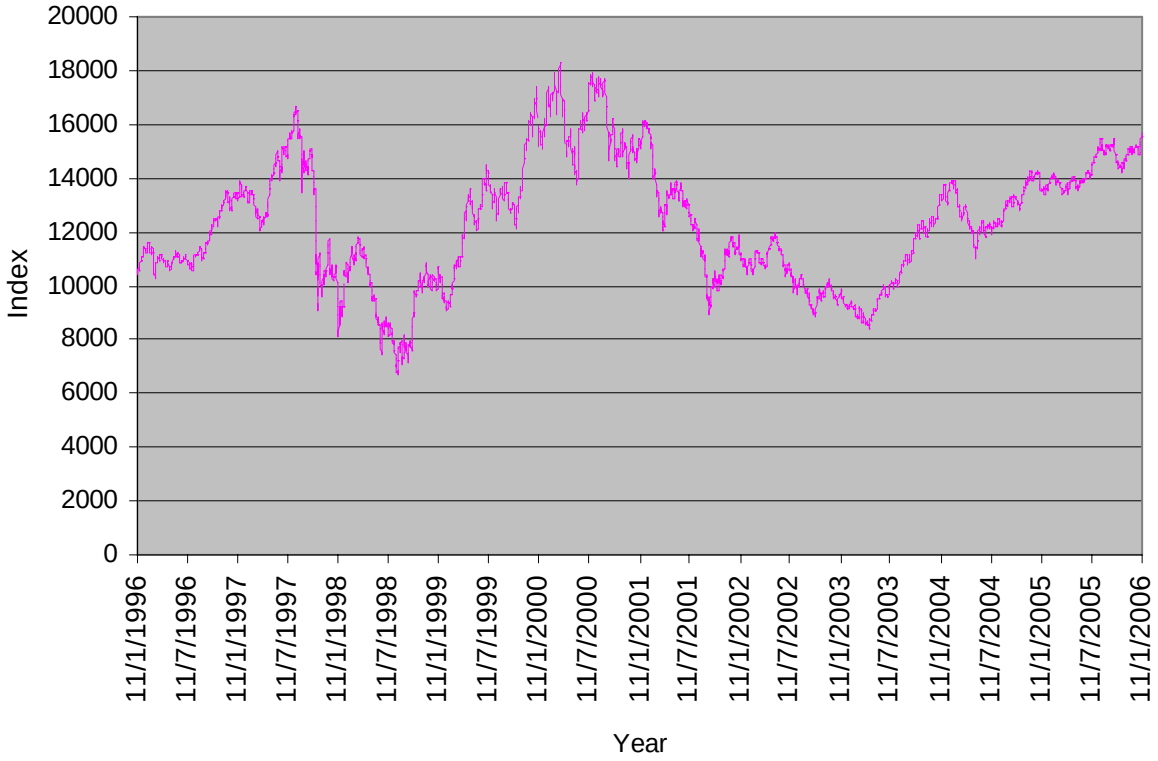

Figure 4.4 Heng Seng Index (31/7/1964=100) in Hong Kong
Sources: Stock Exchange of Hong Kong (1996 -2006)[9]
HSI Services Limited (2005)[10]

Hong Kong Interbank Offered Rate (HIBOR)

Generally speaking, HIBOR is the interest rates banks pay to raise fund for their business. Hibor is defined by the Hong Kong Monetary Authority as the rate of interest offered on Hong Kong dollar loans by banks in the interbank market for a specified period ranging from overnight to one year.

[9] Stock Exchange of Hong Kong. (1996-2006). Stock Exchange Fact book. Hong Kong: Stock Exchange of HongKong
[10] HSI Services Limited. (2005). Hang Seng Indexes 2005. Hong Kong: HSI Services Limited.

Hibor affects the demand for land in two ways. First of all, it is very common for investor on land borrowing money from financial institutions in financing their project. Sometimes a bank may not be able to lend a large sum at one single time. The interbank market provides a mechanism for the movement of deposits among banks in a fairly smooth fashion suitable to the need and requirement of the banking sector and other financial institutions. If the Hibor is high, the investors' and developers' cost of borrowing is high. Thus, discourages demand for land.

Besides, Instead of using prime rate, there has been Hibor mortgage plan in the market. Unlike mortgages that are based on the Hong Kong Dollar Prime Rate, the HIBOR Mortgage Plan uses the Hong Kong Interbank Offered Rate (HIBOR) as its basis, which is promoted by banks and developers in attracting customers. Hibor therefore affects the demand for housing. The argument from Berkman (1979) points out that the interest rates, when increasing, will cause a decline in the demand for houses due to falling consumer ability to afford financing and the unattractiveness of the housing investment. That can be further deduced that Hibor affects demand for land.

Hibor in Hong Kong

The Hibor was highly fluctuated before the signing of the Sino-British Joint Declaration. It becomes fairly steady before 1997 largely due to the fluctuation in capital inflow and outflow affected by the political uncertainty. Interbank rates spiked sharply upwards in early 1998 as the regional financial crisis worsened and domestic liquidity tightened because of some selling pressure on the Hong Kong dollar. Interest rate plummeted to a very low level in later quarter 2004 because of the increased liquidity in face of higher capital inflow. The present Hibor is on the increase, at around 4.3% in Jan 2006 (Fig 4.5).

The interest rate in Hong Kong has a negative relationship with property price. During the episodes of sharp price declines in the past two decades, real interest rates were at relatively high levels (Fig. 4.6).

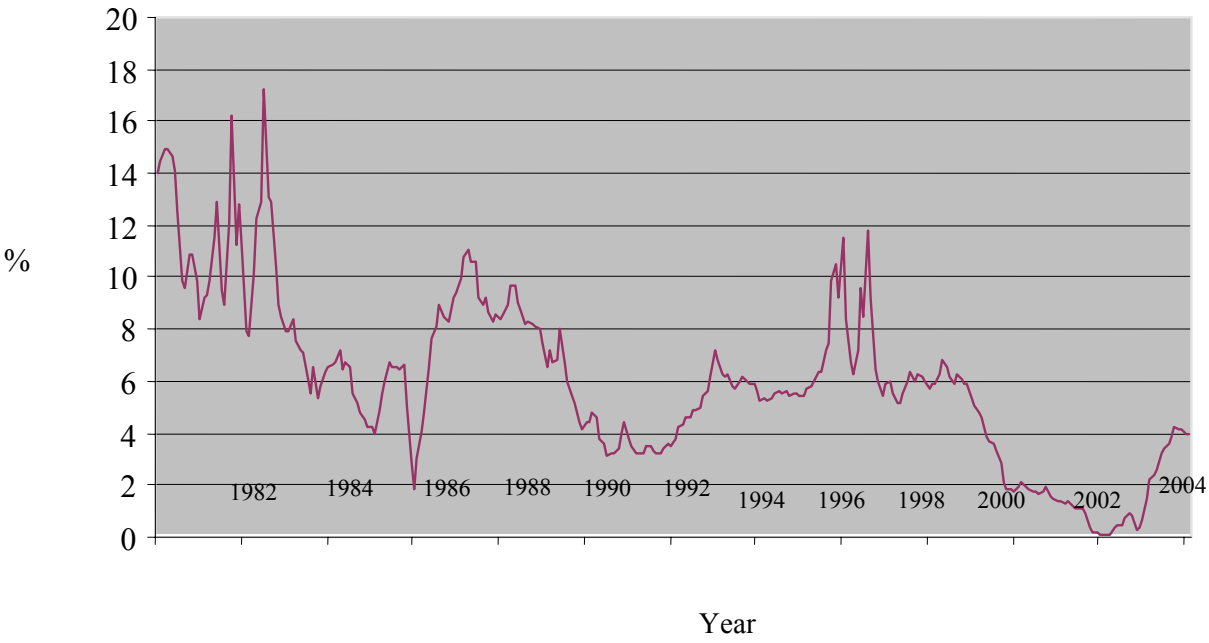

Figure 4.5 3-Month Hong Kong Interbank Offered Rates
Source: The Hong Kong Monetary Authority (2005)[11]

[11] Source: Hong Kong Monetary Authority (2006 website) Monthly Statistical Bulletin (MSB) (online) Available from: http://www.info.gov.hk/hkma/eng/statistics/index.htm

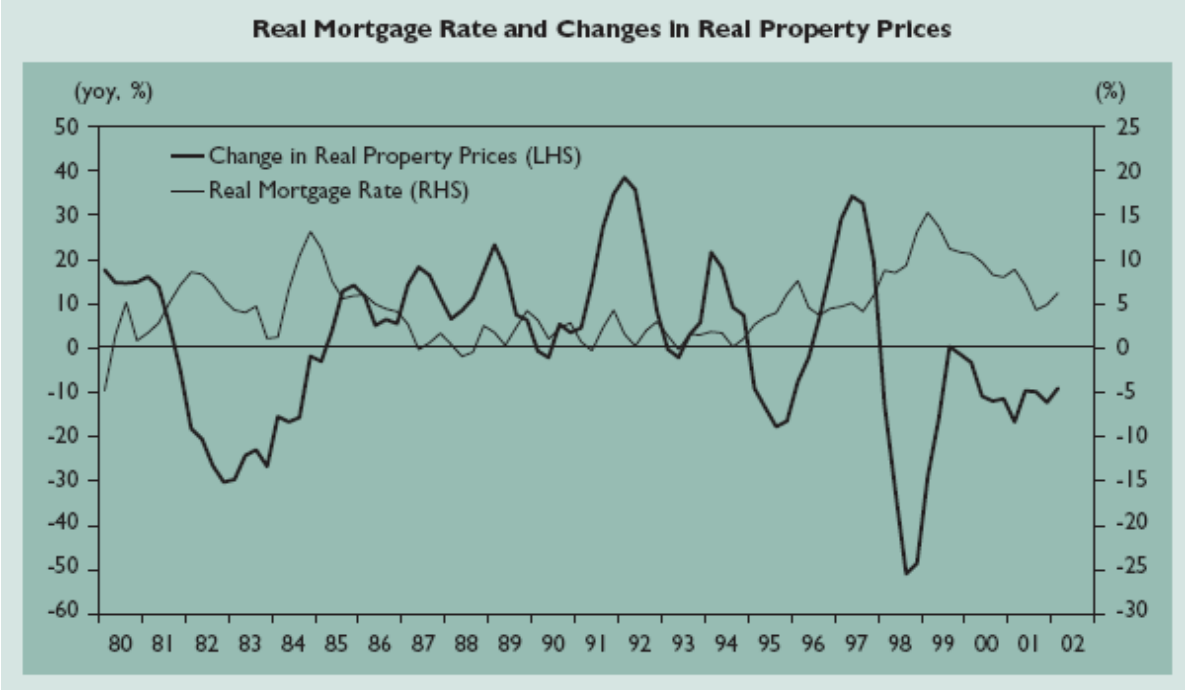

Figure 4.6 Real Mortgage Rate and Change in Property Price
Adopted from Hong Kong Monetary Authority[12]

Income

The level of disposable income determines the purchasing power of an individual and hence his demand for property. Furthermore, this factor determines the peoples' expenditure patterns. People with higher income tend to spend more on higher order goods. Moreover, they usually spend a larger percentage of income on investments and taxes than the lower income group. The higher the income people receive, the higher the demand for housing and the derived demand for land. Fair (1972), Swan (1984) and Goodman (1988) who investigate the income-housing elasticity propose in their studies that housing demand depends on per capita income and the price of housing. At marco economic level, the aggregate income determines the peoples' aggregate purchasing

[12] Adopted from Quarterly Bulletin August 2002. Hong Kong Monetary Authority. http://www.info.gov.hk/hkma/eng/public/qb200208/fa2.pdf

power and hence the demand for property. The aggregate income ultimately drives up the demand for land.

Income in Hong Kong

In Hong Kong, the real index of payroll per person has a gradual increasing trend since 1985 with seasonal fluctuations in each year (Fig 4.7). Over the years, the range between upper and lower quartiles of employment earnings has been widening progressively. In December 2002, the average monthly salary was HK$10,951. Hong Kong people spend high percentage of their income on housing. In 1999/2000, households spent most on housing, accounting for 32.2 per cent of their total income.

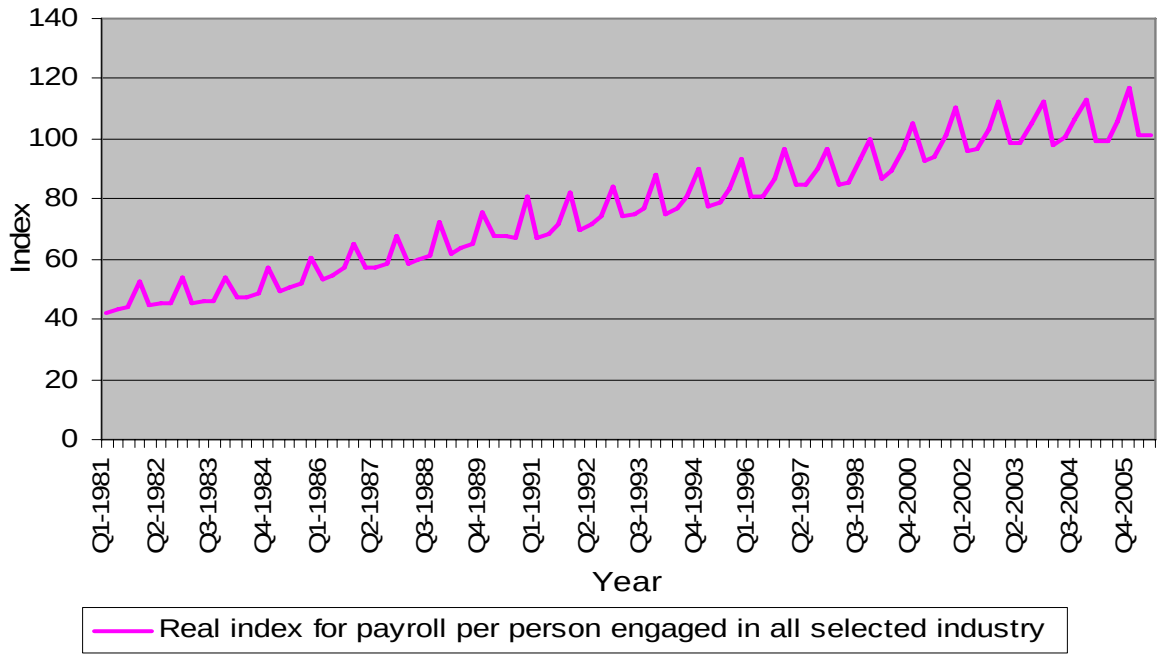

Figure 4.7 Real indices of payroll per person engaged in all selected industries in Hong Kong

Source: Census and Statistics Department (2003)[13]

[13] Source: Census and Statistics Department. (2006 website). Website of the Census and Statistics Department. (online) Available from : http://www.censtatd.gov.hk/hong_kong_statistics/key_economic_and_social_indicators/index.jsp

Price deflator of GDP

Inflation is an increase in the general price level of a territory, as opposed to deflation, which means the contrary. It is a common phenomenon due to the constant adjustments of prices of different commodities and services. Inflation can be measured by consumer price index and price deflator of GDP.

Price deflator of GDP accounts for inflation by converting GDP measured at current prices into constant-dollar GDP. The GDP deflator shows how much a change in the base year's GDP relies upon changes in the price level. It is also known as the "GDP implicit price deflator." It is calculated by current dollar GDP divided by constant dollar GDP. This ratio is used to account for the effects of inflation, by reflecting the change in the prices of the bundle of goods that make up the GDP. Because it isn't based on a fixed basket of goods and services, the GDP deflator has an advantage over the consumer price index (CPI) that changes in consumption patterns or the introduction of new goods and services are automatically reflected in the deflator. Besides, according to the Census and Statistical Department (Website 2006), investment in land is included in the Gross Domestic Fixed Capital Formation as part of calculation of GDP. GDP deflator which is calculated base on GDP is therefore a good proxy of inflation in this study

.

The effects of inflation on land are two fold. Firstly, inflation can reflect the general economic conditions of a territory because from people’s viewpoint, rising prices often indicate better economic performance, which encourage developers and investors to invest in land. Besides, inflation is considered as an investment tool to guard against inflation because the purchasing power of money decreases in time of inflation while the price of property would increases.

Secondly, inflation is a major factor of interest rate fluctuations. As discussed above, buyers of property and investors on land are very sensitive to changes in Hibor and mortgage rates as they usually have to borrow money from financial institutions in the form of loans or mortgages during purchase. This will have indirect and direct demand on land price.

It is further suggested by Peiser (1987) that real estate in general is considered to be a good hedge against inflation, which implies that people's money demand decreases while investment demand on real estate increases in during inflation. As inflation rises, more investors are drawn into the property market, expecting continued appreciation. For example, during the inflationary early 1990s in Hong Kong, residential property was viewed as favourable investments to hedge against inflation (Tse, 1996). Buying a house is viewed as a method for fixing the level of future housing costs.

Inflation in Hong Kong

The inflationary early 1990s in Hong Kong was a period of rising speculative activities. The inflationary spiral began in the mid-1980s, rising from about 3% in 1986, to 12% in 1991, and then stabilizing at an average of 9% in the period 1992 to 95. [14]

The implicit price deflator (IPD) of GDP (2000=100), as an overall measure of inflation in the economy, recorded an inflation from 1980 onwards while suffer from deflation from deflation from 1998 to 2004. It was recorded in 2005 which had a year-on-year

[14] Property Review (Various issues), Hong Kong Rating and Valuation Department.

increase of 0.4% in the fourth quarter of 2005, compared with the 0.2% increase in the third quarter (Fig 4.8). For 2005 as a whole, the IPD of GDP dropped by 0.2%.

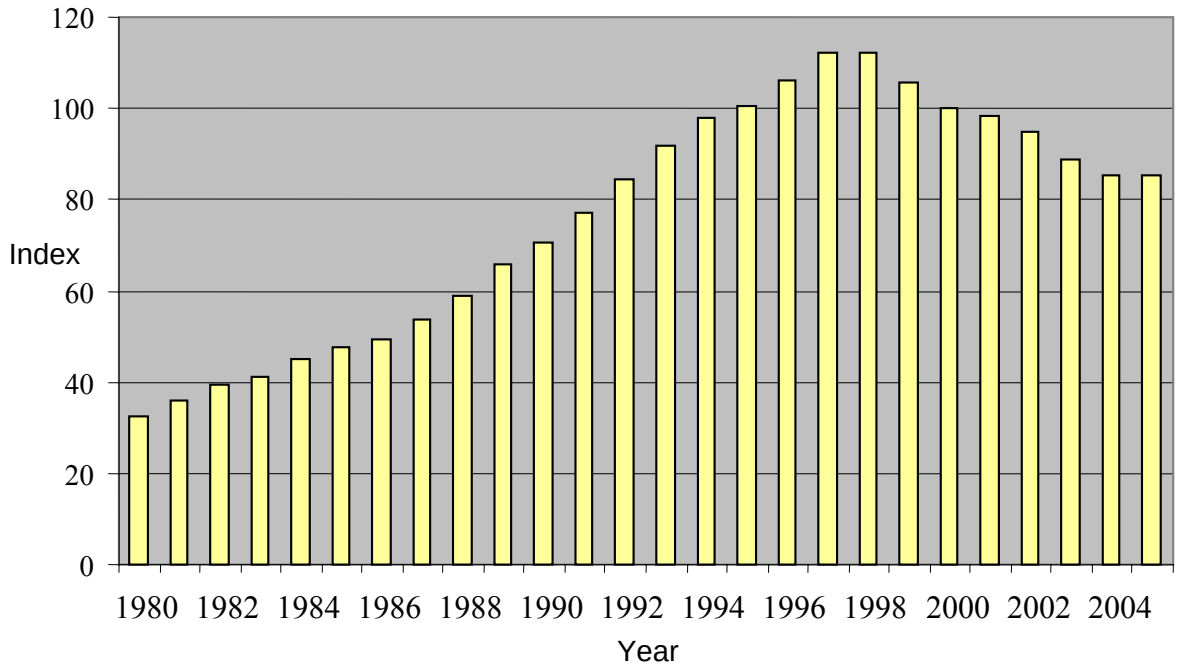

Figure 4.8 The Implicit GDP Deflator Index (2000=100)
Source: Census and Statistics Department (2006 website)[15]

Money supply (Hong Kong Dollar M3)

The total stock of money available in HKSAR is measured by three different monetary aggregates (with money definitions of different broadness). These aggregates can be further broken down into Hong Kong dollar and foreign currency components. M3 is chosen in this study due to the assumption that investment in land requires large sum of

[15] Source: Census and Statistics Department. (2006 website). Website of the Census and Statistics Department. (online) Available from: http://www.censtatd.gov.hk/hong_kong_statistics/key_economic_and_social_indicators/index.jsp

money drawing out from bank, which is best represented by M3. Besides, the seasonality of M3 is relatively lower as laid down in the HKMA Website.[16]

In Hong Kong, M3 is measured in Hong Kong as the total stock of money available in HKSAR is measured by three different monetary aggregates (with money definitions of different broadness). These aggregates can be further broken down into Hong Kong dollar and foreign currency components. There are M1, M2 and M3.

Money supply M3 includes notes and coins with the public, plus any customers demand deposits, savings and time deposits with licensed banks and held outside the monetary sector, and customers deposits with restricted license banks and deposit-taking companies plus negotiation certificates of deposit issued by restricted license banks and deposit-taking companies held outside the monetary sector.

Money supply definition 3 (M3^) = M2 + Customers' deposits with restricted license banks (RLBs) and deposit-taking companies (DTCs) + NCDs issued by RLBs and DTCs held outside the banking sector.

Money supply can mean credit availability. Goh (1998) argues that the amount of mortgage loans has an influence on the demand for residential construction, since house purchasers are financed mainly by mortgage loans from banks.

[16] Hong Kong Monetary Authority (2006 website) Monthly Statistical Bulletin (MSB) (online) Available from: http://www.info.gov.hk/hkma/eng/statistics/index.htm
.

Besides, the flow of credit to finance construction projects can affect the demand for land. (Hillebrat, 1985). A restrictive credit supply means less fund available for financing projects, which leads to decreases in demand for real estate, bonds, stocks, and other assets. For example, a concretionary money supply cuts into bank reserves and reduces bank lending to all enterprises, including property developers. Thus, a decrease in money supply will tend to reduce developers cash flows and thereby leads to a decline in land investment.

Hong Kong Dollar M3

From 2000 onwards, it can be observed that the M3 and bank credit share similar trend, except that in the substantial drop of bank credit in 1999. It is remedied by the decrease in mortgage rate and hence, the money supply is increased.

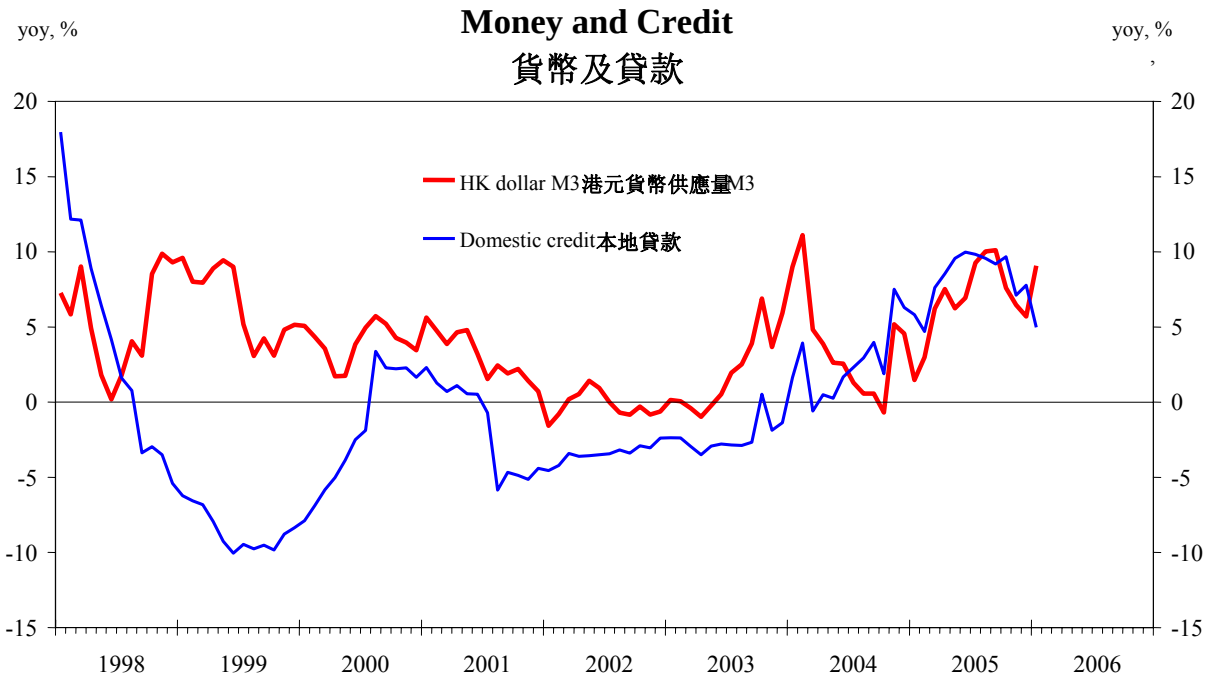

Figure 4.9 Hong Kong Dollar M3 and Domestic credit
Source: The Hong Kong Monetary Authority[17]

[17] Source: Hong Kong Monetary Authority (2006 website) Monthly Statistical Bulletin (MSB) (online) Available from: http://www.info.gov.hk/hkma/eng/statistics/index.htm

Population

In the last decades and till now, sufficient property supply to meet the population growth and economic activities are always a main issue that has aroused much concern in the society. Household number is used here to proxy for population as data available for population is only yearly while a quarterly regression model is adopted in this study.

Shoshany and Goldshleger (2002) have studied the relationship between land use and population changes who found that population is much higher in developed areas and they observed that there is an excess of more than 50% in the growth of built-up and infrastructure areas relative to population increases. Peng and Wheaton (1994) observe the close relationship between private residential property price and population. People have the tendency to fulfill their housing need in the private sector once they are capable to do so. That means higher demand for property with higher population.

Indeed, for a city with significant migration rate like Hong Kong, demographic changes will be an important factor of the demand for the property market. It is a general perception that the growth in total number of households will result in increase in property price, especially residential property. In many previous studies with respect to this issue, DiPasquale and Wheaton (1996) find that "……..demographic forces should only affect the rate of change but not direct change of real estate market……". In this manner, it is believed that the property market will be highly related to the household growth rate.

Number of Households in Hong Kong

The number of households increased strongly in 1980-81, due to immigrations from the Mainland following its opening-up to the outside world. The growth slowed in the latter part of the 1980s-reflecting increased emigration-but returned to a higher level during most of the 1990s, in part because emigrants returned as confidence in Hong Kong's future build up. The growth rate slowed down sharply in 1997, as the cycle if returning emigrants ended, and rebounded in more recent years to a relatively low level by the standards of the 1990s.

It can be seen in figure 4.11 that the household growth rate is generally consistent with the property price movements. There is a significant drop in the household growth rate in 1997 due to the lack of confidence in the economic stability, which is reflected in property price.

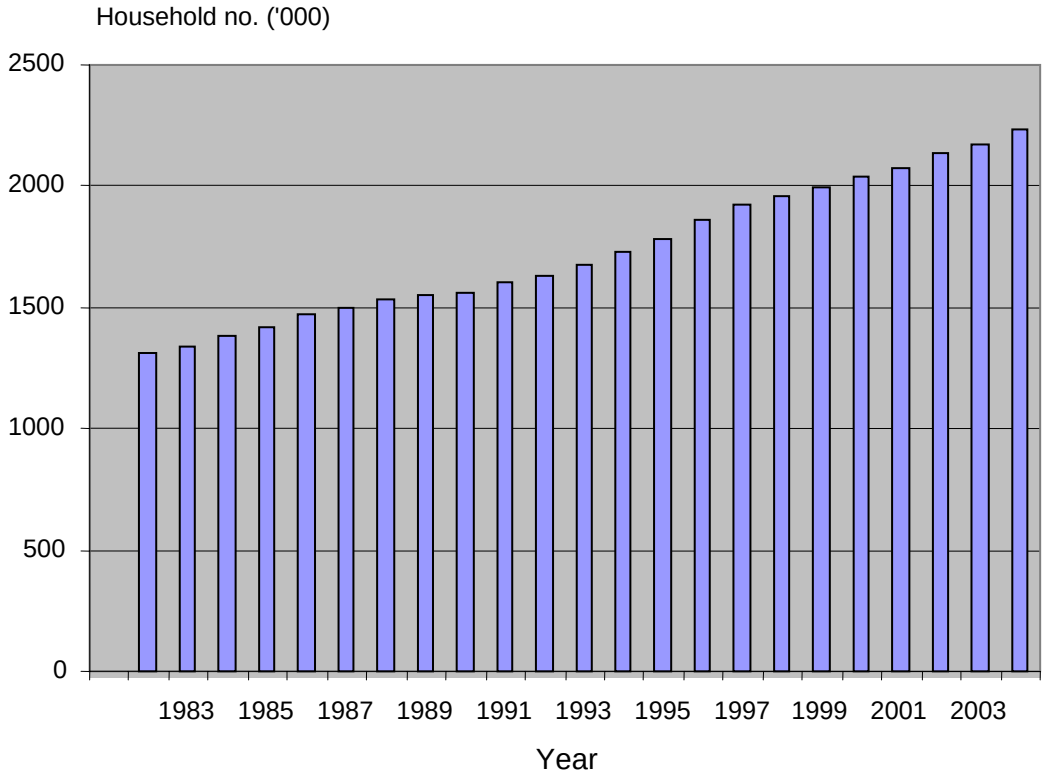

Figure 4.10 Number of Domestic Household (‘000)
Source: Census and Statistics Department[18]

[18] Source: Census and Statistics Department. (2006 website). Website of the Census and Statistics Department. (online) Available from: http://www.censtatd.gov.hk/hong_kong_statistics/key_economic_and_social_indicators/index.jsp

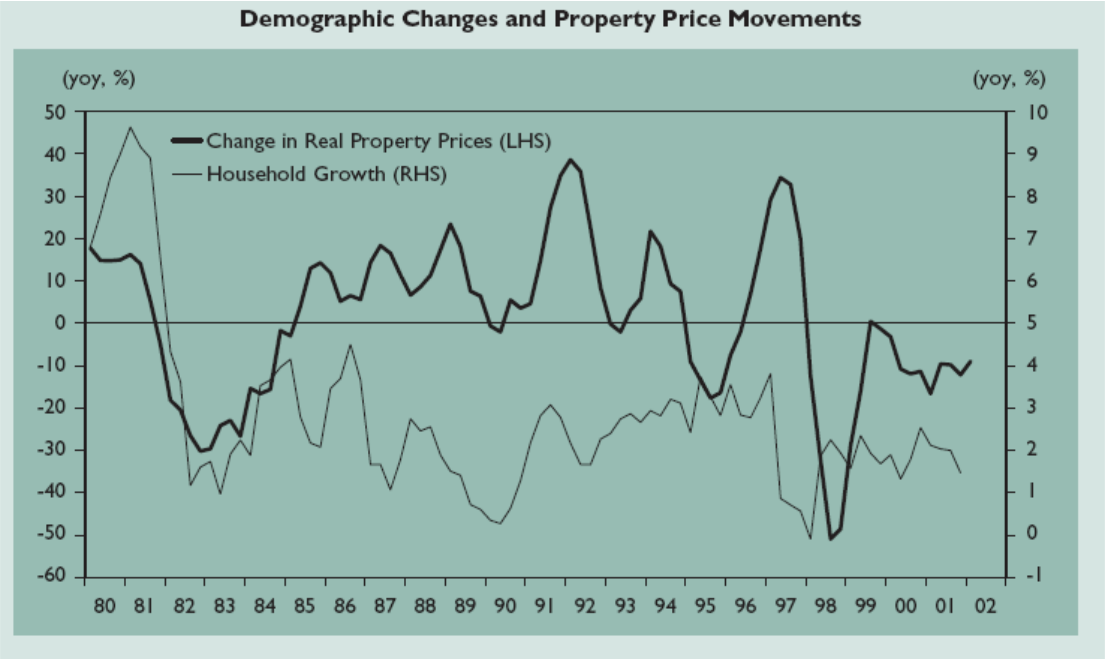

Figure 4.11 Household Growth and Change in Real Property Price
Adopted from Hong Kong Monetary Authority[19]

Distance

For both the conventional land price theory and modern land price determinants, distance is found to be the major determinant of land price. Land parcels close to CBD tends to have peak land value since CBD has the clustering of major commercial activities and transport nodes. The high accessibility of the land at CBD are subject to keen competition from users, bidding up the price to high level and price decreases with increasing distance from CBD. It is likely that the significance of distance in determining land price is gradually removed by new extension of railways and MTR in the past 3 to 4 decades since commuting time from New Territories and New Town are much shortened. This decreasing influence of distance as railways and new types of commuter emerged is proposed by Yeates (1967) and tested by Adams, Milgram, Green and Mansfield (1964).

[19] Adopted from Quarterly Bulletin August 2002. Hong Kong Monetary Authority. http://www.info.gov.hk/hkma/eng/public/qb200208/fa2.pdf

Though it is found that land price decreases with increasing distance from the CBD, the relative effect of this variables on land price differs from place to place. Research done by Peiser in Texas in 1984 reveals that office land values affects land most when compared with industrial and commercial land. He attributes this result to the proximity of employment.

In the context of Hong Kong, there is a general perception residential and commercial land uses that are closer to CBD have higher land price, whereas industrial land are usually more dispersed and less influenced by CBD and transportation nodes. It is hypothesized that rate of change of distance from CBD of residential and commercial land uses are more sensitive than that of industrial land in Hong Kong. In an attempt to see how distance affects land prices of land use i.e. residential, commercial, industrial and commercial/residential will be found by using interaction terms.

Usable floor area newly completed by types

It is understood that the supply of property and land comes in a number of ways such as tender, higher intensity development, lease modification and etc. however, due to the unavailability of data, only auctioned land and the supply of new usable floor area are tested in this study. The supply of property is proxied by the new supply of new floor area completed, while the existing supply of all types of property is neglected.

According to the law of supply and demand, the determination of property price is subject to the joint forces of demand and supply. There has been study conducted by tse (1998) on relationship between supply of property and land price. He explained that higher

property supply will lower the property price and hence, generate lower residual land prices. The new usable floor completed at a certain time will affect the price of land. It is because when there are sufficient supply of property units, developers and investors demand for land will not be strong, hence, the price of land is unlikely to be bid up to a high level.

The impact of property supply on land price is dependent on how effectively supply responds to demand fluctuations. It is suggested by Tse (1998) that supply of property i.e. housing can influence the land price. He further suggests that there exists a time delay for land price to response to changes in supply because of the property and land information is imperfect with poor information flow and limited number of transactions.

Usable floor newly completed by types in Hong Kong

In the 80s, manufacturing is the main economic activities in Hong Kong. The supply of industrial and godown usable floor area is among the highest of all uses, reaching 1,368,000 sq.m. With the economic structural change from manufacturing to tertiary services, usable floor completed for industrial land use declines gradually while supply of commercial area is on the average at around 600,000 sq.m. during the 90s. (Fig 4.12) Industrial market performed independently even at the height of the real estate market cycle. It is owing to the economic restructuring of the manufacturing sector and the exodus of production factories to the southern part of mainland china to take advantage of cheaper rents and labour costs, the values of industrial premises depreciated. This led to the relative under-performance from the late 1980s in this sub-sector.

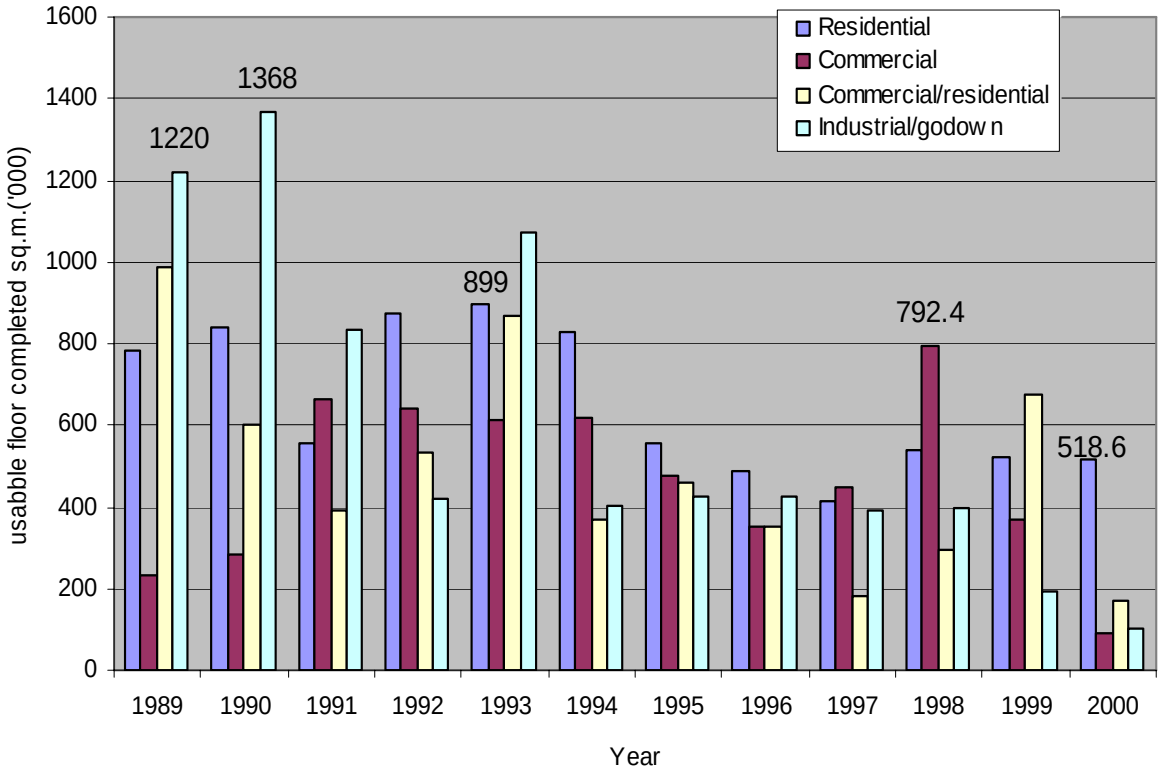

Figure 4.12 Usable Floor Newly Completed By Types
Source: Hong Kong Monthly Digest of Statistics[20]

[20] Hong Kong Monthly Digest of Statistics (1988-2003). Census & Statistics Dept. Hong Kong. Govt. Printer.

4.4 Expected Signs of Coefficients of Independent Variables

The independent variables have been carefully selected after reviewing previous literature and with reference to the situations in Hong Kong. They are expected to have significant impact on land prices. Before the regression analysis, their expected signs of coefficients are discussed in this section. The expected signs are determined base on the expectations on their impacts, either positive or negative, on the accommodation value of land. The expected sign of all independent variables are summarized in Table 4.2.

Gross Domestic Product (GDP)

As discussed, there is a direct and positive relationship between GDP and the economy. An increase in GDP signifies economic growth and improvement in general wealth and hence income levels of local people. Higher income level and economic growth will in turn stimulate the demand for property. Since there exists a derived demand between land and property, the demand for property will drive up the demand for land. Land is also a factor of production mean the higher demand for property will lead to a higher demand for land. This will bid up the land price, given that the supply of land is inelastic.

The positive relationship between GDP and land price is demonstrated by some previous studies. For example, in an American Study, changed in GNP are shown to have significant and positive correlations with land price.

Unemployment

Unemployment is one of the most important economic indicators of land price. An increase in unemployment is likely to lower the confidence in real estate market and people's purchasing power on property. It also somehow implies lower demand for

property and hence, developer and investor's demand for land. Moreover, high unemployment is perceived by people as a sign of weaker economy. Therefore, they are inclined to not to spend on property. It is obvious that a positive impact on employment can be deduced.

Stock market performance

As Li (1997) suggests that financial and economic indicators has an increasing influence on land price, Heng Seng index is therefore expected to have significant impact on land price. Heng Seng index is often perceived as an important indictor of the general economic conditions. Therefore, when it performs better, it has a positive influence on developers' and investors' confidence on the economy and hence their intention to invest in land. There exists a positive relationship between the two.

Evans (2004) comments that stock market and land market are not perfectly efficient, the stock market can not fully reflect the changes in the land market which implies the existence in time lag between the information of both market. It is therefore expected there would be a lagging relation between land and stock market performance.

Implicit GDP Deflator (Inflation)

It has been illustrated before that GDP deflator is an indicator of inflation, which can reflect territory's general economic conditions. Inflation causes the price of valuable commodities to rise. In periods when inflation is accelerating quickly many people will want to invest their currency into real estate and land, bidding up the price of the both. Because land is a scarce good, over time its value usually increases. From the above, it

can be deduced that the there is a positive relationship between inflation and land price. During periods of high inflation this can be especially true.

Income

An increase in the aggregate income level of a place enhances peoples' purchasing power. It is expected that a large percentage of a person's income is spent on housing. Therefore, higher income would mean a higher demand for property in Hong Kong and hence, investors and developers' demand for land. As a result, the price of land is likely to be higher.

Money supply (Hong Kong Dollar M3)

A decrease in money supply would decrease the supply of bank credit. In this way, the amount of mortgage loans that can be offered by banks decrease, which then decrease the demand for residential construction, since property buyers are financed mainly by mortgage loans from banks.

For developers and investors, a concretionary money supply cuts into bank reserves and reduces bank lending to all enterprises, including property developers. Thus, a decrease in money supply will tend to reduce developers cash flows and thereby leads to a decline in land investment. It is therefore expected money supply and land price have positive relationship.

Distance

Distance for all land use is expected to possess a negative relationship with land price. Furthermore, Land price is expected to decrease with increasing distance from CBD for

residential and commercial land uses, whereas industrial land use is relatively less affected by distance.

Number of Households

As household number increases, more infrastructure and built up area are needed to fulfill the housing need. People have the tendency to fulfill their housing need in the private sector once they are capable to do so. That means higher demand for property with higher population.

Hibor

Interest rate affects demand for land in some ways. When HIBOR is high, the cost of borrowing for land developer and investor is high, which will lower their demand for land. As people usually buy property through bank credit, higher interest rate would discourage investment as the cost of borrowing is higher. From the above, it is expected that interest rate and land price will have negative relationship.

Usable floor area newly completed by types

Sufficient supply of property in short and long term will not lead to a higher the demand for land. According to law of demand and supply, with the larger property supply, lower the property price and lower the residual land price. It is expected that there exist a negative relationship between the two.

Variables in initial model specification	Denoted as	Proxied by	Expected sign of coefficients
Dependent variable			
Land price	AV	Accommodation value	N.A.
Independent/explanatory variables			
Demand-side variable			
Gross Domestic Product	GDP	Gross Domestic Product	+
Income	INCOME	Index of payroll per person	+
Unemployment	UNEM	Unemployment Rate	-
Stock Market Performance	HSI	Heng Seng Index	+
Money Supply	M3	M3	+
Interest rate	HIBOR	Hong Kong interbank offered rate(HIBOR)	-
Inflation	DEFLAT	GDP implicit Deflator	+
Population	HSH	Household Number	+
Supply-side Variable			
Supply of property	New	New completions of usable floor area	-
Location Variable			
Distance to CBD	DIS	Distance to CBD	-
Time Variable			
Time	TIME	Number 1 to 48 for first quarter 1989 to last quarter 2002	+
Land use Dummies			
Residential	RESI	Residential	+
Commercial	COM	Commercial	+
Commercial/Residential	COM/RESI	Commercial/Residential	+
Industrial/Godown	IND	Industrial	+

Table 4.2 Summary of Expected Signs of Coefficients of Independent Variables

4.5 Data Specification

The following is a detailed description of the definitions and sources of data. To conduct the regression quarterly, the data collected are either readily available in quarter or are transformed from yearly or monthly to quarterly. The reliability of these data has important implication for the validity of the empirical findings. All the data employed in the analysis is collected form authoritative sources, most of which are from government official publications. The published figures are verified to be of high reliability. The definitions and sources are summarized in Table 4.3.

4.5.1 Period of Data

The data used for this study is restricted the period 1992 -2002, totaling 14 years. Only auctioned land is used due to the unavailability of details of private land transaction i.e. plot ratio and exact date of transaction. Quarterly data (from 1992 Q1 to 2002 Q4) are used since most data collected is in quarterly figures. In order to obtain the complete data set, monthly figures of some variables will be adjusted to quarter. This is a pooled cross section data set, in which cross sectional data is represented by 229 pieces of land spread over 48 quarters.

4.5.2 Definitions and Sources of Data

Time

The data cover a fourteen year span over which the level of land prices may have increased. Hence, in an effort to standardize the observations over the fourteen year period, time was introduced as a proxy for these dynamic influences. Time was set at 0 if the sale took place in 1989 first quarter and increased by 1 each quarter, up to 2002.

GDP

GDP by Expenditure component at constant (2000) market prices are complied by the Census and Statistics Department (C&S). Under the expenditure approach, GDP is compiled as the total final expenditure on goods and services, (including private consumption expenditure, government consumption expenditure, gross domestic fixed capital formation, changes in inventories and exports of goods and services), less imports of goods and services. (Census and Statistics Department, 2006 Website). At constant market prices, the effect of price changes is removed. Quarterly data is obtained from the official website of C&S.

Income

The aggregate income is measured by the real index of payroll per person engaged in all selected industry sectors (1999 Q1=100), which is compiled by C&S. The payroll covers wages and salaries, bonuses and gratuities, commissions, allowances and cash payments in other forms paid directly to employees. The real index indicates changes in the purchasing power of labour earnings. (Census and Statistics Department, 2006 website). The selected industry sectors cover Manufacturing, Wholesale, retail, import/export trades, restaurants and hotels; Transport Services; Financing, Insurance, real estate and business services and personal services. The quarterly index is sourced from the official website of the C&S.

Money Supply (Hong Kong Dollar M 3)

The money supply figures are available in the Monthly Statistical Bulletin (March 2006 –Issue No.139) from the HKMA. Monthly figure is available, which is transformed to quarterly figure by taking average of the monthly figure. M3 is defined in the HKMA

website M2 plus customers' deposits with restricted license banks and deposit-taking companies plus negotiable certificates of deposit (NCDs) issued by these institutions held outside the banking sector.

Hibor

Hong Kong interbank offered rate is used to show the cost of capital for buying land and housing. The rate is measured and defined by Hong Kong Monetary Authority as the rate of interest offered on Hong Kong dollar loans by banks in the interbank market for a specified period ranging from overnight to one year. 3-month interbank rate is available monthly provided in Monthly Statistical Bulletin (March 2006 - Issue No. 139) from the HKMA. Quarterly figures are obtained by taking average of the monthly figures.

Unemployment Rate

The level of unemployment is measured by the seasonally adjusted unemployment rate, which is complied by the C&S. the unemployment rate refers to the proportion of unemployed persons, who are currently available for and seeking a job, to the total labour force, seasonally adjusted unemployment rates are suitable for making comparison over time as the seasonal effects have been taken account of some adjustments. (Census and Statistics department, 2005 website) Quarterly data is collected from the C&S official website.

Number of households

The population in Hong Kong is proxy by the number of household since population provided by C&S is yearly figure which would become inaccurate when transformed to quarterly. The number of household is a quarterly figure, which could more accurately

show the changes relative of changes in land price. The household figure is obtained from the Census and Statistics department, 2006 website.

GDP Price deflator

The implicit price deflator of GDP (2000=100) complied by the C&S shows the changes in price of the economy. The GDP deflator is not based on a fixed market basket of goods and services. The basket is allowed to change with people's consumption and investment patterns. Therefore, new expenditure patterns are allowed to show up in the deflator as people respond to changing prices. The quarterly price deflator is collected from the C&S official website.

Usable floor newly completed by types

The data is obtained from Hong Kong Digest of Monthly Statistics 1988-2003 from C&S. The usable floor newly completed is separated into different uses, including commercial/residential, residential, commercial and industrial or godown. Usable floor area in sq.m. is used in this study. Usable floor area for residential buildings includes non-domestic use, such as club house/recreational facilities, caretakers', office/quarters, transformer room etc. The data is available is by quarter.

Stock market performance (HSI)

Hang Seng Index (HSI) is complied by the HSI services Ltd, is a widely accepted indicator of the stock market performance in Hong Kong. It is constructed from 33 constituent stocks in Hong Kong. The average monthly HSI is available from "Hang Seng

Indexes" published by the Stock Exchange of Hong Kong. Quarterly HSI is then computed by averaging the data of the corresponding three consecutive months.[21]

Distance

The addresses and lot number of the 229 pieces of land sold in the auction are found in the lands department web site. Verification of the exact location of the parcels is done by checking addresses and lot number on the Centamap[22] and statutory Town plan on web[23] respectively. After locating their exact location, their distance from the CBD is measured by the direct linear measurement on the 1:50,000 paper maps collected from the Survey and Mapping Office of the Lands Department. The point of measurement of CBD is set at the Central MTR station.

[21] The average monthly HSI is multiplied by the number of transaction days each month to arrive at a total monthly figure. The sum of total monthly figures of the three consecutive months in a quarter is divided by the total number of transaction days in the three months to arrive at the quarterly average HSI.
[22] Source: Centamap, (2006 Website). http://www.centamap.com/cent/index.htm
[23] Source: Town Planning Board, (2006 Website). http://www.ozp.tpb.gov.hk/

Chapter 5 Empirical Results and Analysis

5.1 Introduction

In this section, the purpose is to provide a comprehensive insight into the empirical results. Section 5.2 will illustrate the detailed steps in arriving at the final estimation equation and summarize the statistical results. Section 5.3 will be a comprehensive analysis of the empirical results. Section 5.4 will illustrate the implications of findings from the results.

5.2 Empirical Results

The following equation is the equation used in the regression model:

$$LOG(AV_t) = a_0 + a_1 LOG(GDP_{t-k1}) + a_2 LOG(HSI_{t-k2}) + a_3 LOG(INCOME_{t-k3}) + a_4 LOG(HIBOR_{t-k4}) + a_5 LOG(PRICE_{t-k5}) + a_6 LOG(M3_{t-k6}) + a_8 TIME_t + a_9 LOG(DIS_t)*RESI + a_{10} LOG(DIS_t)*COM + a_{11} LOG(DIS_t)*IND + a_{12} LOG(DIS_t)*COM/RESI + a_{13} LOG(NEW_{t-k7})*RESI + a_{14} LOG(NEW_{t-k7})*COM + a_{15} LOG(NEW_{t-k7})*IND + a_{16} LOG(NEW_{t-k7})*COM/RESI + a_{17} RESI + a_{18} COM + a_{19} COM/RESI + \varepsilon_t \quad (5)$$

For each of $K_i = 0, 1$

It is necessary to start with determining the best time lag structure of each independent variable. Apart from distance and supply of new usable floor area, it is assumed that some variables i.e. income, GDP, Heng Seng Index , money supply, usable floor newly

completed by types and unemployment rate may possess time lag of not more than 1 quarter. As suggested in Section 3.3, each significant lagged/contemporaneous change of the mentioned variables is combined with each of the others into numerous combinations by using Eview. Then LOG(AV) is regressed on each combinations using the OLS technique to estimate the final equation.

The best result is achieved by incorporating contemporaneous LOG(M3), LOG(UNEMP), LOG(INCOME) and LOG(GDP) while LOG(HSI) lagged 1 quarter. Subsequently, the equation is refined to the following estimated model specification:

$$LOG(AV_t) = a_0 + a_1 LOG(GDP_t) + a_2 LOG(HSI_{t-1}) + a_3 LOG(INCOME_t) + a_4 LOG(HIBOR_t) + a_5 LOG(PRICE_t) + a_6 LOG(M3_t) + a_8 TIME_t + a_9 LOG(DIS_t)*RESI + a_{10} LOG(DIS_t)*COM + a_{11} LOG(DIS_t)*IND + a_{12} LOG(DIS_t)*COM/RESI + a_{13} LOG(NEW_t)*RESI + a_{14} LOG(NEW_t)*COM + a_{15} LOG(NEW_t)*IND + a_{16} LOG(NEW_t)*COM/RESI + a_{17} RESI + a_{18} COM + a_{19} COM/RESI + \varepsilon_t \quad (5)$$

Where ε_t is the stochastic error term of the estimated model.

The statistical results of the estimated specification are presented in Table 5.1.The specification has a high explanatory power as reflected by the high adjusted R-squared. LOG(HSI) Lagged one quarter, the land use dummy COM and COM/RESI are significant

at 0.05 level. LOG(EMP), LOG(INCOME), LOG(PRICE), LOG(HSH), LOG(DIS)*RESI, LOG(DIS)*COM, LOG(NEW)*RESI and the dummy RESI are significant at 0.01 level which have the expected signs of coefficients. A detailed analysis of the empirical results is provided in Section 5.1.

Model Summary			
R-squared	0.738935		
Adjusted R-squared	0.713340		
F-statistics	28.87066		
No. of observations	229		
No. of insignificant variables from the estimated equation (insignificant at 0.05 level)	LOG(R), LOG(GDP), LOG(M1), LOG(DIS)*(COM/RESI), LOG(DIS)*IND, LOG(NEW)*(IND), LOG(NEW)*(COM), LOG(NEW)*(COM/RESI), LOG(NEW)*(IND)		
No. of significant variables from the estimated equation (significant at 0.05 level)	11(as shown below)		
Significant variables in the estimated equation	**Partial Coefficient**	**t-statistics**	**P-values**
LOG(HSI) (lagged 1 quarter)	-0.280942	2.802741	0.0056
LOG(PRICE)	7.145966	4.962985	0.0000
LOG(UNEM)	-0.335504	-3.002071	0.0030
LOG(INCOME)	4.080286	2.817949	0.0053
LOG(HSH)	18.76541	3.113179	0.0021
LOG(DIS)*RESI	-0.410571	-5.909739	0.0000
LOG(DIS)*COM	-0.356774	-2.830491	0.0051
LOG(NEW)*RESI	-0.212797	-2.481356	0.0139
RESI	8.762063	3.621052	0.0004
COM	5.610223	1.991425	0.0478
COM/RESI	7.030110	2.152031	0.0326

Figure 5.1 Statistical Results of OLS Regression using Eview[24]

[24] Detail statistical results of the regression analysis are shown in Appendix II

Test for Multicollinearity

Test for multicollinearity is performed to address the possible problems associated with the estimated model. Multicollinearity arises when two or more independent variables in an equation are highly correlated and this violates the assumption of the OLS regression. (Eastman, 1984) Since most demand-side variables used in this study are influenced by broad economic trends, there may be close correlations among them. Correlation matrix of all the independent variables is constructed. There is no theoretical guidance on the level of correlation that leads to multicollinearitiy, the simple correlation coefficient of several variables representing broad economic trend is high as shown in the Appendix I. However, when some of them are removed, the adjusted R-squared decreases significantly and some variables become insignificant. Therefore, this problem is addressed but not solved.

5.3 Analysis of Empirical Results

This section attempts to explain the impacts of the major determinants of land price in Hong Kong. On the contrary of what previous studies suggest, some important economic and financial indicators are shown to be not significant such as GDP, HIBOR and Money Supply. Section 5.3.1 will analyses the impacts of these determinants on the accommodation value in terms of the signs of their partial coefficients and the time lag structures. Their relative degrees of influences on land price are also be examined by comparing the absolute values of their partial coefficients and time lag. Their relative degree of influences on land price will also be determined by comparing the absolute values of the partial coefficients.

5.3.1Significant variables

Heng Seng Price index

Heng Seng Index is statistically significant. It has a partial coefficient of -0.280942. The effect of HSI on land price involve 1 quarter lag. It means that investors and developers take into account of stock market performance few months ago in determining land price. On the other hand, its negative sign is inconsistent with the initial expectation that Heng Seng index rises represent a higher confidence level in the economy and hence, higher demand for property and land. The negative sign could therefore be explained in a way that Heng Seng Index is an other investment tool other than real estate, people invest in Heng Seng Index may divert the investment from real estate to Heng Seng Index. That result in lower demand for property and hence, the demand for land for development. This idea is consistent with Han et al. (1992) in explaining the negative relationship between land price and stock market performance.

Implicit GDP Price Deflator

Contemporaneous change of inflation LOG(PRICE) has a partial coefficient of 7.145966, indicating that it has a positive impact on accommodation value. Its high significant level shows that it has a coincidence effect on land price within a period of 1 quarter. It conforms to the proposition that land price follows closely the trend of the general price level, as measured by implicit GDP deflator. In times of inflation, the purchasing power of money decreases, while real estate is considered as a good hedge against inflation as real estate prices usually increases when inflation increases. Its relatively high partial coefficient shows that a percentage change in inflation causes a significant percentage change in accommodation value.

Unemployment

Contemporaneous change of unemployment as measured by unemployment rate is shown to be statistically significant. It has a partial coefficient of -0.335504. The unemployment is not regressed with any time lag, it implies that the employment level within one quarter will be taken into account when assessing land price. The relative small partial coefficient shows that a percentage change in unemployment causes a small percentage change in accommodation value.

The negative sign is consistent with the previous logic that higher unemployment rate reduces income level of the population and hence the purchasing power of Hong Kong. This will eventually lead to lower demand for investment in property and land. In addition, the fact that unemployment reflects instability of the economy, which discourages investment and hence, lower demand for land.

Number of Households

LOG(HSH) has the partial coefficient of 18.76541, which is the largest among all the significant variables, which means a percentage change in HSH causes quite a substantial percentage change in land price.

As a proxy of the population, the household number positively affects land price, which is found to be consistent with all past literature. Households number in territory affect land price in many ways. The larger the household number would imply the higher demand for housing, driving up the property and land price. Besides, the number of people within territory increases will lead to higher demand for living space, which would result in more land to be developed or increasing the intensity of development. The former imply

higher demand for land and the latter means higher plot ratio in a development which both lead to an increase in land price.

Income

LOG(INCOME) exerts positive influence on land price. As mentioned in previous chapter, a larger percentage of a person's income is spent on housing in Hong Kong. The population within a territory would in general invest more in property and land with higher income level. A high aggregate income of a territory lead to a higher demand for property and hence, higher derived demand for land.

In addition, it can be seen that the partial coefficient 4.080286 is high relative to other variables, which means a percentage change in income would lead to a relatively high percentage change in land price. Contemporaneous effect of income is taken into account.

Residential usable floor area newly completed

Since supply of all other uses is found to be insignificant, it can be concluded that land price are primarily demand-determined. The supply of residential floor area has the largest negative impact on land price, which implies that if more private residential units is released to meet the high demand in the market, the property price drops and hence, the lower the demand and price of land.

Distance of residential land use from CBD

It is revealed that all land use possesses negative partial coefficient which conforms to previous literature. LOG(DIS)*RESI shows that land with expected residential

development has negative and significant relationship with land price. More importantly, its partial coefficient is -0.410571, which implies percentage change in the distance of residential land declines more sharply than do other land uses. The percentage decline in expected residential development is larger than that in other land use. That can be attributed to the fact that Hong Kong people have high demand for housing that requires less traveling time to work.

Distance of commercial land use from CBD

The negative partial coefficient of LOG(DIS)*COM is 0.35677. Apart from being shown to be significant in determining commercial land price, the result further suggests that the percentage change in distance of commercial land decline less sharply than residential land. That can be attributed to the fact that some commercial land at major transport nodes can also command high land price. Commercial land locates not around CBD but major transport nodes can also command high land price for example the Langham place and Festival work which possess highly accessible Grade A offices. Though Grade A offices[25] and high class shopping malls concentrate at the centre of CBD which gives the peak value, but the fact that there are other similar quality offices and shopping malls that can also command high land price.

Industrial land price is not sensitive to distance from CBD which confirms with the earlier proposition in this study. It can attribute to the fact that industrial area is traditionally planned by the government in area further away from the CBD, such as Chai Wan, San

[25] Grade A modern with high quality finishes: flexible layout: larger floor plates: spacious well decorate lobbies and circulation areas: effective central air conditioning: good life services zoned for passengers ad goods deliveries: professional facility management: parking facilities normally available. (Property Review, 2006)

Po Kong, Tai Po, Kwai Chung, Fanling and etc to avoid serious air and noise pollution in affecting commercial and residential activities.

Land Uses

All land uses exert positive and high partial coefficient in determining land price. The positive relationship represents a percentage increase in land with land of expected development as residential, commercial, and commercial/residential. That implies investor would expect the future selling price or rent of residential and/or commercial to be higher than before development.

Residential land use is the most statistically significant among all the other land uses. It possesses a partial coefficient of 8.7620. The result represents that a high percentage increase in land price when the expected development to be residential. Housing price determines the land price, developers and investors' expectation on residential housing price is high, therefore, percentage increase in land price of expected residential development is higher.

5.4 Implications of findings

This study has investigated the impacts of nine demand-side variables, one supply side variable and 3 land use dummies on the accommodation value.

Among the nine demand-side variables, six of them are significant determinants of land price in Hong Kong. On the other hand, the single supply-side variable is insignificant. The final six-variable specification with only HSI has certain time lags presents a high explanatory power for the land price.

The findings from the empirical results have the following major implications:

Firstly, on the supply-side, the insignificance of the supply-side variable implies the supply of usable floor space is inelastic, which is consistent with past literature. Therefore, the land price is primarily demand determined.

Secondly, percentage change in variables i.e. unemployment, income and household number are shown to be more significant in affecting percentage change in land price than that of other variables i.e. interest rate, GDP and Money supply. That can be attributed to the reason that investors and developers put high emphasis on the affordability and economic situations of the local population in determining land price. All these variables reflect the affordability and demography of the population which are the demand for property. That strongly suggests that land is a derived demand of the property market and further implies that land market is closely related to the economic situations of the population. In addition, supply of new usable floor area appears to be most significant in affecting land with expected residential development. Price of residential property is the equilibrium of its demand and supply in the market. The overall picture appears here that the demand for property as represented by the affordability of the population (income, unemployment and household number) and supply of housing are most responsive to the land price. That revealed an obvious close relationship between price of housing and price of land. Furthermore, land price is mostly affected by the housing price. From logical deduction, the result confirms with the proposition that housing price determines residential land price as well as the fact that property market and land market in Hong Kong has been dominated by transactions in residential sector.

The results show that changes in GDP, interest rates and money supply are insignificant in affecting land price. That can be attributed to the fact that these economic indicators can not always reflect the macroeconomic situations in Hong Kong. The major characteristic of the financial system in Hong Kong is the linked exchange rate between Hong Kong and US dollar. Hong Kong interest rate is linked to US trend, and so as the money supply. The mortgage rate which is based on interest rate can not freely adjust to adapt to the demand for bank credit and hence, can not always reflect the demand for property.

Stock market performance is shown to be significant in affecting land price. This reflects the uniqueness of the limited overall capital and investment market in Hong Kong. There is inactive bond market and relatively less investment tools in Hong Kong when compared with other countries. It is common for investors to choose between stock market and property market.

Besides, traditional land price determinants i.e. distance and populations as well as modern determinants i.e. economic and financial indicators coexist in the Hong Kong land market. When pricing land, investors will look at economic and financial indicators as well as distance and development expectations.

Lastly, with a closer examination, one can see that changes in household number create substantial changes in land price. This revealed that in assessing the accommodation value, investors place much emphasis on changes in population. Among all the other economic indicators, changes in inflation impose higher changes in land price which

suggest investors on land and property tend to concern more on price movements than other economic and financial indicators.

Chapter 6 Conclusion

Despite the importance of land price in the local economy of Hong Kong, little research has emphasized on the land price determination model. Studies on land price determination flourishes in other cities such as United States and Taiwan. Some major studies suggest there is declining importance of conventional variables i.e. physical distance from city centre and population while emerging significance in economic and financial indicators as information technology and transportation renders physical distance between people less crucial. That proposition however is not yet tested in Hong Kong. In view of the above, this dissertation aims to investigate the conventional and economic determinants of land price in Hong Kong.

The theoretical background of land price determination was reviewed at the start. Having seen the land market is a derived demand from the property market, the analysis is based on the demand and supply side interaction in the property market. In order to see the impact of conventional variables and economic indicators on land price, Explanatory variables are identified based on pat literature. All of them are examined in terms of their general relationships with land market. Their trends in Hong Kong are also examined. Quarterly data over the period 1989 to 2002 was analyzed using the OLS regression technique. The empirical analysis produced satisfactory results in identifying the major determinants of land price in Hong Kong. The magnitude and direction of the effect of these variables were also explained. Lastly, implications are deduced from the result.

6.1 Limitations of the study

Some of the variables used in the study is proxy since some explanatory variables can not be measured directly. In this study, the proxy of the income variable i.e. index of payroll per person may underestimate the true aggregate income because some people may fail to

report all their earnings. Besides, population is proxies by the number of household since the population is yearly figure. It does not take into account of the density and expenditure pattern of the population. Moreover, the supply variable is only proxied by the new completions of usable floor area of different uses. It does not indicate the exiting stock of usable floor area. As a result, these proxies cannot give comprehensive measures for their corresponding variables and may affect the validity of the findings from the empirical results.

Owing to the unavailability of plot ratio and transaction price on land transacted through private tender and sale, only auctioned land are taken into account. The sample size may not be large enough to truly reflect the land market in Hong Kong.

Finally, multicollinearity may exist due to the high correlation between the unemployment and inflation variables. This problem can not be solved, which is a potential problem in the study.

6.2 Further Research Areas

This study has established a land price model with several variables. This can be further investigated in other direction.

Researchers can investigate on the micro-economic determinants of land price which may include the neighbourhood environment, its distance to the nearest shopping centers and population density at the time of the auction carried out. This would require reviewing the

land lease of the land and map at the time of the land prior to development so that the either declining or increasing importance of physical environment factors can be seen.

The forecast ability of the land price determination model can be further tested in order to forecast the future land price. However, its forecasting power is not tested It would provide a useful tool for practitioners to predict land price and assist the decision making process.

Appendix I

Results of OLS Regression on Model Specification (5) using Eview

Dependent Variable: LOG(AV)
Method: Least Squares
Sample: 1 229
Included observations: 229

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(PRICE)	7.145966	1.439853	4.962985	0.0000
LOG(R)	0.050129	0.244546	0.204989	0.8378
LOG(EMP)	0.335504	0.111758	3.002071	0.0030
LOG(HSH)	18.76541	6.027731	3.113179	0.0021
LOG(HSI2)	-0.280942	0.381655	2.802741	0.0056
LOG(INCOME)	4.080286	1.447963	2.817949	0.0053
LOG(GDP)	1.231134	0.985777	1.248897	0.2131
LOG(M3)	0.810719	0.884901	0.916169	0.3607
LOG(DIS2)*(OTH+IND)	-0.036120	0.159085	-0.227049	0.8206
LOG(DIS2)*RESI	-0.410571	0.069474	-5.909739	0.0000
LOG(DIS2)*COM	-0.356774	0.126047	-2.830491	0.0051
LOG(DIS2)*CR	-0.280416	0.176443	-1.589270	0.1135
LOG(B)*(OTH+IND)	0.330366	0.117872	-0.736116	0.4625
LOG(NEW)*COM	0.200942	0.131796	1.524646	0.1289
LOG(NEW)*RESI	-0.212797	0.085758	-2.481356	0.0139
LOG(NEW)*(CR)	-0.315267	0.251874	-1.251687	0.2121
C	-135.3133	42.76288	-3.164270	0.0018
TIME	-0.063348	0.045363	-1.396455	0.1641
COM	5.610223	2.817190	1.991425	0.0478
CR	7.030110	3.266732	2.152031	0.0326
RESI	8.762063	2.419756	3.621052	0.0004

R-squared	0.738935	Mean dependent var	7.099169
Adjusted R-squared	0.713340	S.D. dependent var	1.054313
S.E. of regression	0.564486	Akaike info criterion	1.782883
Sum squared resid	65.00343	Schwarz criterion	2.101719
Log likelihood	-179.5744	F-statistic	28.87066
Durbin-Watson stat	1.932269	Prob(F-statistic)	0.000000

Appendix II Correlation Matrix of Independent Variables in Regression Analysis

	LOG(AV)	LOG(PRICE)	LOG(R)	LOG(EMP)	LOG(HSH)	LOG(HSI2)	LOG(INCOME)	LOG(GDP)
LOG(AV)	1.000000							
LOG(PRICE)	0.618507	1.000000						
LOG(R)	0.198915	0.454440	1.000000					
LOG(EMP)	0.163030	0.205794	0.263088	1.000000				
LOG(HSH)	0.467588	0.799019	0.580892	0.115038	1.000000			
LOG(HSI2)	0.547612	0.930123	0.522000	0.256632	0.906570	1.000000		
LOG(INCOME)	0.531406	0.902946	0.570143	0.158197	0.976720	0.962360	1.000000	
LOG(GDP)	0.575009	0.964805	0.533460	0.167137	0.902926	0.968669	0.967716	1.000000
LOG(M3)	0.522349	0.913094	0.703846	0.253426	0.893688	0.953250	0.949980	0.951301
LOG(DIS2)*(OTH+IND)	0.635566	0.363909	0.166845	0.005743	0.408036	-0.390903	0.410021	0.386243
LOG(DIS2)*RESI	0.514635	0.261769	0.118854	0.033560	0.352068	0.316079	0.334335	0.299736
LOG(DIS2)*COM	0.040854	0.040740	0.005947	0.103946	0.036451	0.030377	0.037573	0.038561
LOG(DIS2)*CR	0.079343	0.045978	0.052875	0.059524	0.062330	0.003310	0.023341	0.010212
LOG(B)*(OTH+IND)	0.614045	0.389646	0.197935	0.041214	0.414225	-0.409406	0.425471	0.405100
LOG(B)*COM	0.001513	0.069975	0.034647	0.124419	0.051423	0.054847	0.057948	0.066505
LOG(B)*RESI	0.454461	0.163661	0.088673	0.022086	0.272890	0.237116	0.244385	0.211504
LOG(B)*(CR)	0.071741	0.032926	0.048109	0.059821	0.071120	0.017573	0.035086	0.001691
TIME	0.482345	0.837983	0.630617	0.135141	0.992307	0.928890	0.986707	0.930199
COM	0.034664	0.038879	0.005243	0.105284	0.036834	0.029808	0.037236	0.037215
CR	0.082180	0.042141	0.047897	0.059983	0.064796	0.007354	0.026396	0.006535
RESI	0.536258	0.270688	0.119701	0.034326	0.362425	0.323704	0.345124	0.308859

	LOG(M3)	LOG(DIS2)*(OTH+IND)	LOG(DIS2)*RESI	LOG(DIS2)*COM	LOG(DIS2)*CR	LOG(B)*(OTH+IND)	LOG(B)*COM	LOG(B)*RESI	LOG(B)*(CR)
LOG(AV)									
LOG(PRICE)									
LOG(R)									
LOG(EMP)									
LOG(HSH)									
LOG(HSI2)									
LOG(INCOME)									
LOG(GDP)									
LOG(M3)	1.000000								
LOG(DIS2)*(OTH+IND)	0.364570	1.000000							
LOG(DIS2)*RESI	0.281952	0.685358	1.000000						
LOG(DIS2)*COM	0.024725	0.188939	0.410724	1.000000					
LOG(DIS2)*CR	0.026410	0.138713	0.301540	0.083128	1.000000				
LOG(B)*(OTH+IND)	0.392211	0.979104	0.671008	0.184983	0.135808	1.000000			
LOG(B)*COM	0.052824	0.182089	0.395834	0.958489	0.080115	0.178277	1.000000		
LOG(B)*RESI	0.203924	0.663574	0.963552	0.397669	0.291955	0.649679	0.383252	1.000000	
LOG(B)*(CR)	0.013271	0.136889	0.297576	0.082035	0.984257	0.134023	0.079061	0.288117	1.000000
TIME	0.931475	0.404539	0.340915	0.031640	0.038716	0.416386	0.052621	0.261712	0.049409
COM	0.023929	0.189467	0.411871	0.997214	0.083360	0.185500	0.961063	0.398779	0.082265
CR	0.021710	0.139043	0.302257	0.083326	0.997627	0.136131	0.080305	0.292650	0.984512
RESI	0.290727	0.687686	0.996615	0.412119	0.302564	0.673287	0.397178	0.964937	0.298587

	TIME	COM	CR	RESI
LOG(AV)				
LOG(PRICE)				
LOG(R)				
LOG(EMP)				
LOG(HSH)				
LOG(HSI2)				
LOG(INCOME)				
LOG(GDP)				
LOG(M3)				
LOG(DIS2)*(OTH+IND)				
LOG(DIS2)*RESI				
LOG(DIS2)*COM				
LOG(DIS2)*CR				
LOG(B)*(OTH+IND)				
LOG(B)*COM				
LOG(B)*RESI				
LOG(B)*(CR)				
TIME	1.000000			
COM	0.031776	1.000000		
CR	0.041257	0.083559	1.000000	
RESI	0.350988	0.413270	0.303284	1.000000

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