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THE UNIVERSITY OF HONG KONG

AN EMPIRICAL STUDY OF THE MAJOR DETERMINANTS OF INDUSTRIAL PROPERTY PRICES IN HONG KONG

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

DEPARTMENT OF REAL ESTATE AND CONSTRUCTION

BY CHAN SHEUNG WAH

HONG KONG
AUGUST 2006

Declaration

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

Signed: _____

Name: CHAN SHEUNG WAH

Date: 13 August 2006

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Abstract

This study aims to investigate the major determinants of industrial property prices in Hong Kong. The study is motivated partly by a lack of empirical studies on industrial property prices (both in and outside of Hong Kong) and partly by the fact that Hong Kong has been experiencing an economic re-structuring process, and its effect on industrial property prices has not yet been well understood.

In this study, I use industrial property price series and other publicly available data to estimate a reduced form econometric model. I chose independent variables based on a review of previous studies and my own economic analysis of the relevant supply and demand side factors in Hong Kong, including the Hong Kong Government's changing policies toward industrial land use.

The empirical results suggest that the volumes of re-exports, manufacturing sector employment, and industrial production, have lagged positive effects on industrial property prices. The positive impact of manufacturing output and employment is what one would expect in an industrial property market. However, the positive impact of trade volume (re-export) is a result of the economic reforms in China since the late 1970s, which led to a relocation of Hong Kong's industrial base to the Mainland. The use of industrial buildings in Hong Kong gradually changed from production to other supporting uses, such as administration, research and development, storage, and marketing. The volume of re-export is an indication of the turnover of Hong Kong companies' level of production on the Mainland, since most reported goods are semi-finished products that are shipped to Hong Kong for finalizing the production process before they are re-exported to other countries. The larger the volume of a re-export, the higher the demand for its supporting activities,

most of which are carried out in industrial buildings originally owned or rented by the manufacturers in Hong Kong for production purposes. The positive impact of some selected service sector employment also confirms that industrial space in Hong Kong has not been merely used for industrial production.

Similar to other property types, the real interest rate has had a negative impact on industrial property prices. The effect of the total supply of industrial buildings has also been negative, which is expected. Nevertheless, it is not a significant determinant.

The government's industrial land policy has also been adjusted many times during the process of economic restructuring that has resulted in declining demand for industrial space for production use and increasing demand for floor space for backup supports and services. Most of the latter type of activities have been restricted in industrial buildings. Of all the changes to government land policies that have increased the flexibility of the use of industrial buildings, the most significant one was the policy change in 1997 followed by the one in 2001. The 1997 change permitted as of right the commercial use on the lowest three floors within industrial/office (I/O) building. Given the volatility of the commercial market, this has injected a valuable real option into the industrial buildings which can be converted into I/O buildings upon application and in turn realizing the option value. The policy revision in 2001 allowed, as of right, conversion of industrial use to I/O use. This change removed much uncertainty in investing in industrial buildings and in capturing the real option value. As a result, industrial property prices adjusted upward accordingly. All other previous measures that have given incremental flexibility in the use of industrial properties have had no significant impact on their prices.

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Chapter 1 Introduction

1.1 Background

The development of Hong Kong's economy has witnessed a significant structural transformation from a labour-intensive manufacturing economy to a service-sector led tertiary economy. As summarized by Wong (1994) in her study, there has been extensive and massive restructuring in the manufacturing sector from the textile boom in the 1950s and 1960s to the flourishment of garments and plastics in the 1970s and to the development of electronics and toy industries into some multi-billion dollar business today. The manufacturing industries have moved from production of labour-intensive to more technology and human capital-intensive manufactures. Apart from the change in local factor endowment, there has been change in the physical location of labour-intensive manufacturing industries. From the mid 1980s, there had been massive relocation of manufacturing activities to other lower cost countries particularly Pearl River Delta region in China due to its proximity with Hong Kong.

Until 1989, manufacturing sector was the key power engine driving the economic development of Hong Kong. From Table 1.1, we can see that manufacturing sector was either the first or second largest contributor to gross domestic product (GDP) between 1980 and 1989. However since 1990, the importance of the sector as a GDP contributor has been gradually declining, overtaken by such rapidly growing service sectors as financing, insurance, real estate and business services; and community, social and personal

Table 1.1: Contribution to GDP at Factor Cost by Major Economic Activities, 1980 – 2004

Value in HK$ million

Economic activity	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1995**	**2000**	**2004**
Wholesale, retail and import and export trades, restaurants and hotels*	26,490 (19.4)	30,479 (18.2)	34,252 (18.4)	38,763 (18.9)	53,069 (21.7)	55,783 (21.5)	63,811 (21.1)	86,157 (22.9)	105,859 (23.6)	121,095 (23.7)	135,979 (23.7)	262,656 (24.8)	308,600 (24.6)	345,092 (27.5)
Financing, insurance, real estate and business services*	29,502 (21.7)	36,821 (22.0)	38,019 (20.4)	33,018 (16.1)	35,382 (14.5)	39,087 (15.1)	48,851 (16.1)	63,659 (16.9)	80,405 (17.9)	94,132 (18.4)	108,925 (18.9)	240,188 (22.6)	268,399 (21.4)	266,834 (21.2)
Community, social and personal services*	16,180 (11.9)	21,219 (12.7)	27,715 (14.9)	31,981 (15.6)	36,823 (15.1)	42,306 (16.3)	47,199 (15.6)	52,771 (14.0)	60,732 (13.5)	69,852 (13.7)	80,963 (14.1)	174,652 (16.5)	249,997 (19.9)	263,756 (21.0)
Ownership of premises*	11,458 (8.4)	14,367 (8.6)	17,757 (9.5)	21,535 (10.5)	23,458 (9.6)	25,690 (9.9)	28,982 (9.6)	34,400 (9.1)	41,445 (9.2)	49,293 (9.6)	55,838 (9.7)	120,860 (11.4)	141,600 (11.3)	127,799 (10.2)
Transport, storage and communications*	9,411 (6.9)	11,598 (6.9)	13,340 (7.2)	15,701 (7.6)	17,976 (7.4)	20,031 (7.7)	23,671 (7.8)	31,044 (8.3)	39,257 (8.7)	43,795 (8.6)	51,727 (9.0)	99,777 (9.4)	118,974 (9.5)	126,820 (10.1)
Manufacturing	30,995 (22.8)	36,439 (21.8)	36,949 (19.8)	45,065 (21.9)	57,183 (23.4)	55,133 (21.3)	65,651 (21.7)	79,204 (21.1)	88,287 (19.7)	94,451 (18.5)	96,258 (16.7)	81,415 (7.7)	67,646 (5.4)	44,455 (3.5)
Construction	8,846 (6.5)	12,259 (7.3)	13,205 (7.1)	12,729 (6.2)	12,782 (5.2)	12,551 (4.8)	14,118 (4.7)	16,853 (4.5)	20,140 (4.5)	25,331 (5.0)	29,701 (5.2)	53,694 (5.1)	62,054 (4.9)	40,376 (3.2)
Electricity, gas and water	2,040 (1.5)	2,620 (1.6)	3,661 (2.0)	5,208 (2.5)	6,152 (2.5)	7,205 (2.8)	9,025 (3.0)	10,380 (2.8)	11,075 (2.5)	11,857 (2.3)	13,814 (2.4)	25,535 (2.4)	36,917 (2.9)	39,726 (3.2)
Others**	1,315 (1.0)	1,381 (0.8)	1,548 (0.8)	1,541 (0.7)	1,544 (0.6)	1,567 (0.6)	1,654 (0.5)	1,591 (0.4)	1,646 (0.4)	1,610 (0.3)	1,642 (0.3)	1,770 (0.2)	1,161 (0.1)	958 (0.1)
Total GDP at factor cost	136,237 (100)	167,183 (100)	186,446 (100)	205,541 (100)	244,369 (100)	259,353 (100)	302,962 (100)	376,059 (100)	448,846 (100)	511,416 (100)	574,847 (100)	1,060,547 (100)	1,255,348 (100)	1,255,816 (100)

*Classified as service sector activities. **Including agriculture, fishing, mining and quarrying

Notes: Percentage share of the column total in parentheses.

Source: Census and Statistics Department (2006 website).

services. Nevertheless, its absolute contribution of HK$44,455 million in 2004 is by no means small.

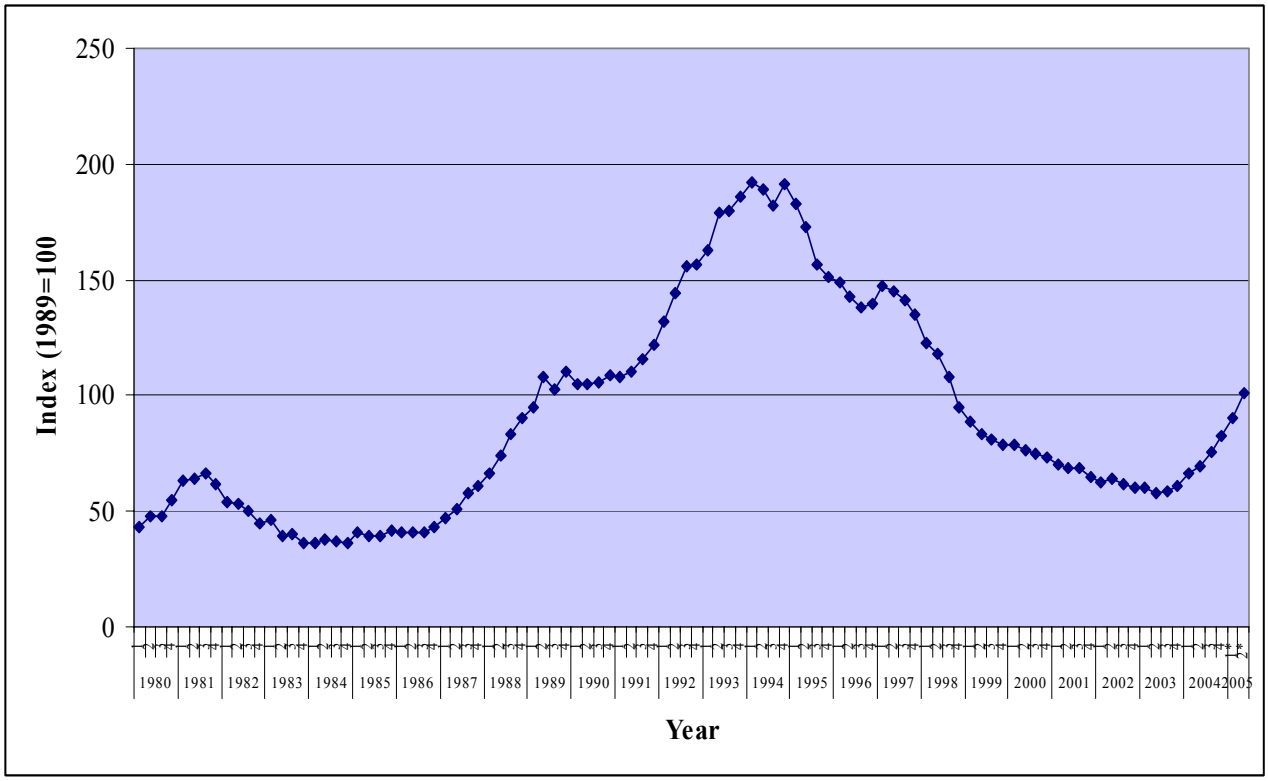
The massive restructuring means that the manufacturing sector in Hong Kong is manufacturing-related but non-manufacturing in nature, moving towards non-production and head-office supporting activities such as administration, documentation, trade financing, materials sourcing, sales, marketing, technology acquisition and the like. This coupled with the relocation to other lower cost countries have rendered many old factory buildings vacant. To tackle the problem of obsolete industrial properties brought about by industrial restructuring, the government revised its industrial land use planning policy by introducing a new land use – the composite industrial-office (I/O) in the late 1980s.

1.2 Aim and Objectives

Figure 1.1 below shows the official private flatted factories price index since 1980. Industrial property price has experienced significant fluctuations during the past 26 years. However, despite the significant role of manufacturing or industrial sector in the economic development of Hong Kong, there has been very little research on the local industrial property sector. Majority of the empirical studies on local property market have been devoted to residential, office and retail property sectors. While there are theories and econometric analyses of the industrial rent and price determination in the UK and US, similar work in Hong Kong is scarce. Even in these countries, the industrial property sector remains a relatively under-researched area. The lack of interest and published empirical work in this sector, as succinctly pointed out by Thompson and Tsolacos (1999), can

partially be attributed to the importance of the owner-occupied sector in the industrial market and the lower weight that industrial property has in institutional portfolios.

Figure 1.1: Hong Kong Private Flatted Factories Price Index (1980 Q1 - 2005 Q2)



Source: Rating and Valuation Department, Property Review/Hong Kong Property Review, various issues

Among the limited studies of industrial sector in Hong Kong, emphasis is placed on the microeconomic study of the locational factors and physical attributes of the industrial space. To the best knowledge of the author, there is no comprehensive research conducted in Hong Kong on the relationship between macroeconomic factors and industrial property

price at an aggregate level. To further advance the limited literature in Hong Kong, this study aims to empirically investigate the determinant factors of industrial property price changes through time from a macroeconomic perspective. It is expected to provide a framework for better understanding of the local industrial property market and to give useful insights to market practitioners such as developers, investors, landlords, regulators and users.

To achieve the aim, this study has three sub-objectives:

- To examine the general relationship between various macro-market factors and industrial property price at an aggregate level.
- To identify factors which shape the movement of industrial property price.
- To estimate an econometric model which explains the movement of industrial property price by the above identified factors.

1.3 Scope of the Study

According to the Technical Notes of the Rating and Valuation Department, Hong Kong, private industrial properties are classified into 4 types: private flatted factories, private industrial/office premises, private specialized factories and private storage premises[1]. The scope and focus of this study is confined to the private flatted factories in Hong Kong. The

[1] Private flatted factories comprise premises designed for general manufacturing processes and uses, including offices, directly related to such processes, and normally intended for sale or letting by the developers. Private I/O premises are floor space designed or certified for industrial/office use. Private specialised factories comprise all other factory premises, primarily purpose-built for specialized manufacturing processes, usually for occupation by a single operator. Private storage premises comprise premises designed or adapted for use as godowns or cold stores and include ancillary offices. Premises located within container terminals are included. Source: Rating and Valuation Department (2006).

rational is threefold. First, private flatted factories have been the key type of industrial buildings housing the operations of a majority of manufacturing activities. Second, compared with other types of industrial properties, this group has undergone much more massive changes in terms of spatial requirements, end users and institutional land use regulations over the past decades. Finally, there is a comprehensive official archive for this type of traditional property which has grown and developed closely with Hong Kong, making an extensive and meaningful econometric study possible.

1.4 Framework

The industrial development characterised by different phases of economic restructuring will be reviewed first so as to have a broad picture of the forces driving the economy in general and the industrial market in particular. As government's role is integral in the successful economic transformation, the successive significant government's policies changes toward industrial land use will be discussed and evaluated. A literature review of the property price and rent determination will then be conducted so as to establish the theoretical underpinning for this study and to identify the determinant factors of industrial property price changes. The macro-market variables will be selected on the basis of ideas from previous studies and the local situations in Hong Kong. In order to determine and analyze the major macroeconomic determinants of industrial property price, multiple regression analysis will be utilized to construct an industrial property price model, with private flatted factories price changes as dependent variable and selected macroeconomic factors as independent variables. The regression result will then be analyzed to examine the

effects of significant variables on industrial property price. Conclusion and limitations of the study will be drawn at the end.

This study is divided into 8 chapters. Chapter 1 is the introduction, which describes the background, objectives, scope and framework of this study.

Chapter 2 will give an overview of the industrial development characterized by different phases of economic restructuring in Hong Kong since the 1950s. The resultant changes in the nature and role of manufacturing sector and in turn the impacts on industrial property market will also be discussed.

Chapter 3 will be an overview of the industrial property market in Hong Kong, including its characteristics and the triggers of institutional change in industrial land use policy. A detailed account of the evolution of industrial land use policy with the relevant policy revisions will then be given.

Chapter 4 will be a review of both local and overseas literature on the theoretical background and previous studies of price determination. A brief summary of the literature will also be provided.

Chapter 5 will be an overview of the methodology employed in this study. The multiple regression analysis together with the statistical tool for constructing and evaluating the industrial property price model will be introduced.

Chapter 6 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 7 will present the empirical results and provide a comprehensive analysis of the results. It will also illustrate the implications of the findings.

Chapter 8 will be the concluding chapter. It will summarize the findings and limitations of this study. Further research areas will also be suggested.

Chapter 2 Overview of Industrial Development in Hong Kong

2.1 Introduction

In the past several decades, the industrial sector in Hong Kong has gone through massive restructuring in response to economic fluctuations and historical turmoil, growing from an entrepot to a highly industrialized city in the 1960s and 1970s to a world commercial and financial city at present times. To identify significant factors shaping the movement of industrial property price, an understanding of the development of manufacturing industries in Hong Kong is essential. Section 2.2 will review the industrial development from the 1950s to 1970s followed by its development from the 1980s onwards in Section 2.3. Changing nature and role of the sector will be discussed in Section 2.4.

2.2 Industrial Development from the 1950s to the 1970s

Hong Kong was mainly an entrepot during the early post-war period. However, owing to the Korean War trade embargo on China in 1951, Hong Kong "was forced to shift economically away from being China's entrepot to seek a future as a newly emerging centre of light manufacturing for export markets in the West" (Sit, 1995, p.166). This process was facilitated and fuelled by the huge influx of immigrants, capital and entrepreneurial skills as a result of the communist takeover of Mainland China in 1949, transforming Hong Kong into an export-oriented industrialized city driven by exports of labour-intensive goods (Sit and Wong, 1989; Industry Department, 1995; Chen, 1996).

During this period of rapid industrialisation, the manufacturing industries underwent significant structural changes which have been well documented (see Sit and Wong, 1989; Chen et al, 1991; Wong, 1994; Sit, 1995; Ho and Chau, 1996; Berger and Lester, 1997 and Chiu et al, 1997). An overview of these changes shows that in the 1950s, textile was the largest export earner which started to decline in the 1960s when it was overtaken by the garment and electronics industries. Both sectors peaked in the early 1970 and began to level off since the mid-1970s. Their role was replaced by the electrical and electronics industry, toys, watches and clocks, and the jewellery manufacturing which flourished in the 1980s and early part of the 1990s (Wong, 1994, p. 536-39).

During this phase of economic restructuring, there were rapid growth of domestic export and manufacturing sector which served as the key economic driver as amplified by its employment and contribution to GDP. Domestic exports grew from HK$2,899 million in 1952 to HK$ 55,912 million in 1979, accounting for 70-80% of total exports during this period (see Table 2.6 on page 23). From 1950 to 1980, the number of manufacturing establishments increased sharply from 1,478 to 45,025 with manufacturing employment from 81,718 to 907,463, accounting for over 49% of total employment[2] in 1980 (see Table 2.1). According to Sit and Wong (1989, p.18-22), the manufacturing sector's contribution to GDP peaked at 30% in 1971 and stabilized at 21.8% in 1981. It grew at an annual average rate of 8% for 1954-62; 15% for 1962-70; and 9% for 1970-81 in real terms.

[2] In 1980, the total employment for all industry sectors (excluding Civil Services) was 1,840,020. Source: Census and Statistics Department (2005 website).

Table 2.1: Number of Establishments and Persons Engaged in Manufacturing Industries, 1950 - 2004

Year	No. of Establishments	No. of Persons Engaged	Average No. of Persons Engaged Per Establishment
1950	1 478	81 718	55
1955	2 437	110 574	45
1960	5 346	218 405	41
1965	8 646	341 094	39
1970	16 507	549 178	33
1975	31 034	678 857	22
1980	45 025	907 463	20
1981	47 996	905 899	19
1982	46 448	847 194	18
1983	45 576	855 417	19
1984	48 038	898 947	19
1985	45 915	847 615	18
1986	46 816	865 614	18
1987	49 403	867 947	18
1988	49 843	837 072	17
1989	50 566	791 519	16
1990	49 449	715 597	14
1991	44 388	629 170	14
1992	42 411	565 137	13
1993	36 847	483 628	13
1994	33 863	423 015	12
1995	30 761	375 766	12
1996	27 412	325 068	12
1997	25 724	288 887	11
1998	22 414	245 457	11
1999	23 553	244 720	10
2000	21 248	226 205	11
2001	19 977	202 984	10
2002	19 106	184 503	10
2003	16 272	168 348	10
2004	15 748	165 268	10

Sources:

(1) Figures for 1950-1975 from Industry Department (1995)

(2) Figures from 1980 onwards from Census and Statistics Department (2005 website)

The characteristics of manufacturing development during this period can be summarized as 1) predominance by small and medium-sized firms with over 65% of manufacturing establishments employing less than 9 persons (See Table 2.2) exporting labour-intensive, low-skill (hence low value-added) light manufactured goods sustained by the abundant supply of labour attributed to baby boom in the early post-war years, influxes of people from China in the early 1950s and early 1960s and increased female labour participation rate; 2) using of standardized category of technology in production which is non-land and non-capital intensive as factories can be housed in multi-storey industrial buildings; and 3) facing the issue of diversification[3] in view of increasing competition from other countries particularly the newly industrialised economies of Singapore, Taiwan and South Korea and protectionism of export markets in the 1970s (Chen, 1996; Chen and Li, 1996; and Chiu et al, 1997).

[3] These competition and protectionism pressures prompted the Government to set up an Advisory Committee on Diversification in 1977, which published a report in 1979. However, the revival of entrepot trade facilitated by China's open-door policy in 1977 and influx of migrants in the mid-1970s again had shifted public attention to other concerns (Chiu et al, 1997, p.53-55).

Table 2.2: Percentage of the Number of Manufacturing Establishments by Employment Size, 1975 - 2003

Size of Establishment (Number of persons engaged)	1975	1980	1985	1990	1995	2000	2001	2002	2003
1 - 9	65.3%	65.5%	67.4%	72.8%	76.9%	79.8%	81.3%	82.8%	81.6%
10 - 19	14.9%	15.3%	14.1%	12.6%	11.0%	11.2%	8.6%	7.7%	8.5%
20 - 49	11.1%	11.3%	11.0%	9.3%	7.8%	5.4%	6.2%	5.7%	5.5%
50 - 99	4.8%	4.6%	4.6%	3.0%	2.4%	2.0%	2.0%	2.1%	2.8%
100 - 199	2.4%	2.0%	1.8%	1.5%	1.2%	0.9%	1.1%	1.0%	0.9%
200 - 499	1.1%	0.9%	0.9%	0.6%	0.6%	0.5%	0.6%	0.6%	0.5%
500 - 999	0.3%	0.3%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
>= 1 000	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Sources:

(1) Figures for 1975 and 1980 from Industry Department (1995)

(2) Figures from 1985 onwards from Census and Statistics Department (2005 website)

2.3 Industrial Development from the 1980s onwards

The 1980s was a period of transition embarking Hong Kong on another massive economic restructuring marked by a drastic decline of manufacturing industry with rapid growth of service industries.

2.3.1 Momentum of Change

The catalysts for industrial restructuring in the 1980s were threefold – local, sub-regional and regional. Firstly, the rising production cost locally was a key triggering factor. This was attributed to rising nominal and real wages which was further aggravated by labour shortage. The cancellation of the "touch-base" policy in 1980 meant that the problem could

no longer be alleviated by the inflows of legal and illegal migrants from China as had repeatedly been in the past[4]. The rising costs for factory premises due to soaring property market further increased the factor cost of production. From 1981 to 1990, rentals for private flatted factories more than doubled and prices also increased by a remarkable 66.6% (Chiu et al, 1997, p.56).

Secondly, at the sub-regional level, there was an important political change – the fall of the Gang of Four in 1976 which led to the resumption of open-door policy in China in the late 1970s. This made possible the revival of entrepot trade in Hong Kong and brought about the massive relocation of manufacturing industries in Hong Kong to Southern China.

Thirdly, in the Asian Pacific region, there was rapid development of economic liberalization in terms of trade liberalizations, financial liberalizations, privatization and deregulation of capital movements so as to attract inflow of foreign direct investment (FDI). All these contributed significantly to the Asian Pacific restructuring and integration and the internationalization of industrial activities in Hong Kong (Wong, 1994).

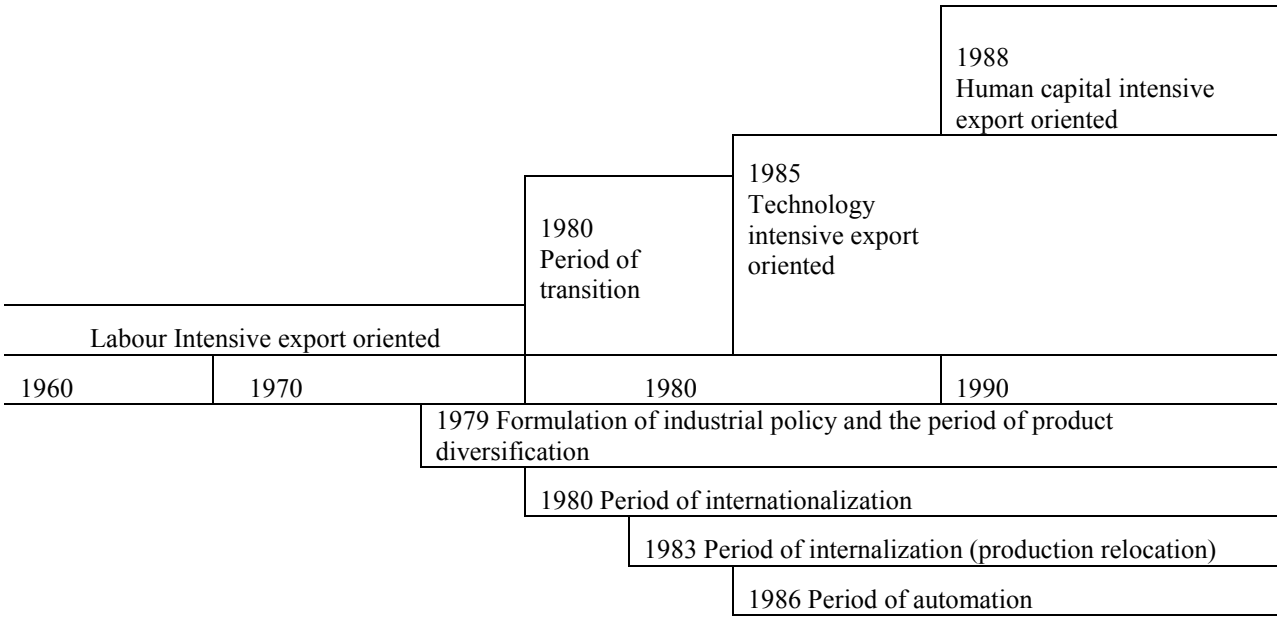
2.3.2 Features of Industrial Restructuring

As put by Wong (1994, p.546-552 and see Figure 2.1), this period of industrial restructuring was characterised by a period of internationalization, internalization and automation with production of more technology and human capital-intensive products. These three significant periods/phases of development reinforce one another, enabling and

[4] In the period 1961 to 1979, an estimated 444,376 legal and 447,547 illegal immigrants arrived in Hong Kong from China (Sit, 1988, p.5).

empowering Hong Kong to weather through the waves of economic restructuring and enter a higher rank in the economic development hierarchy. The key issues facing the sector changed from diversification in the 1970s to quality improvement in the late 1980s and early 1990s (Chen and Li, 1996, p.87).

Figure 2.1: Periods of Development of Hong Kong Manufacturing Sector



Source: Wong, 1994, p.542

Period of Internationalization

The impetus of economic liberalization in the region encouraged the internationalization of industrial activities in Hong Kong. This could be gauged by the increase in both inward and outward FDI. The total value of FDI in Hong Kong manufacturing sector increased from HK$2,548 million in 1980 to HK$48,287 million in 1995 (Lethbridge and Ng, 2000, p.192). As can be seen from Table 2.3 below, the average annual growth per annum of the

total FDI investment was the greatest between 1980 and 1985. Foreign investment, coming as a package with such critical factor supplies as technology, management skill, entrepreneurship and marketing network, was instrumental in upgrading the overall level of technology, product and labour quality of manufacturing industries in Hong Kong (Chen and Li, 1996; Wong, 1994).

Table 2.3: Foreign Direct Investment in Hong Kong Manufacturing (at Year End)

Year	Number of Companies	Investment Value by Fixed Assets (HK$ Million)	Total Investment (HK$ Million)	Employment (No. of Persons)	Export (HK$ Million)
Before 1960	20	n/a	208	6,350	n/a
1960	25	n/a	239	11,630	n/a
1970	217	n/a	916	64,530	n/a
1980	460	n/a	2,548	87,282	n/a
1985	509	1,031	15,527	86,426	24,274
1988	605	2,805	26,172	108,082	50,905
1990	545	2,359	30,933	90,262	45,606
1992	542	2,818	37,279	72,148	54,169
1994	424	3,747	43,969	67,509	61,604
1995	430	5,247	48,287	65,521	82,725
Average growth per annum					
1960-70	24.1	n/a	14.4	18.7	n/a
1970-80	7.8	n/a	10.8	3.1	n/a
1980-85	2.0	n/a	43.5	-0,2	n/a
1985-88	5.9	39.6	19.0	7.7	28.0
1988-95	-4.8	9.4	9.1	-6.9	7.2

Source: Lethbridge and Ng, 2000, p.192

Likewise, there was significant outward investment by Hong Kong in China and other South-east Asian countries like Malaysia, Indonesia, Thailand and Philippines. On the approval basis between 1980 and 1989, China was the main recipient as it took the lion's

share of 72% of Hong Kong's outward FDI (Chen and Li, 1996, p.95). In fact, from 1979 to 1987, Hong Kong ranked as the top foreign country in both the number and amount of foreign investments in China, accounting for 86.7% and 74.99% of the total FDI respectively[5]. This was largely the result of relocation of labour-intensive manufacturing activities to South China which will be discussed in the next section.

During this internationalization phase, there was also increase in the establishment of regional headquarters (RHQ) in Hong Kong. RHQs assumed significance in the 1980s. Not just did they facilitate the transfer of technology to Hong Kong but also create extensive linkages for the service sector owing to the requirement to provide services to subsidiaries over the region. Since a significant proportion of RHQs engaged in manufacturing sector, they helped upgrade the industry's technology and productivity (Wong, 1994, p. 549).

Period of Internalization

The regional economic liberalization and the opening up of China enabled the manufacturers to internalize the locational advantage (such as cheap labour, land, raw materials) by relocating labour-intensive and low-value-added production to these countries (Wong, 1994). This greatly eased the tremendous pressure of rising production costs in Hong Kong. More importantly, it resulted in the fundamental change of manufacturing industries.

[5] The number of Hong Kong FDI in China during this period was 7,431 contributing US$12,883.69 million. Source: Wang, 1991, p.455.

During the 1980s, there were massive relocation of manufacturing activities to China and the ASEAN countries. Owing to linguistic and cultural bonds, China (particularly Guangdong Province) remained the major destination for investment by Hong Kong manufacturers (Industry Department, 1995). This was reflected in the growing significance of trade with China involving outward processing (Table 2.4). Imports from China involving outward processing[6] rose from HK$113,581 million (58.1% of total imports from China) in 1989 to HK$354,912 million (75.9%) in 1994 at an average annual rate of 25.6%. Total export to China involving outward processing[7] also rose from HK76,868 million in 1989 to HK$181,179 million in 1994 at an average annual rate of 18.7%.

[6] Imports from the Mainland related to outward processing refer to processed goods imported from the Mainland, of which all or part of the raw materials or semi-manufactures have been under contractual arrangement exported from or through Hong Kong to the Mainland for processing. Source: Census and Statistics Department (2006 website).

[7] Exports or re-exports to the Mainland for outward processing refer to raw materials or semi-manufactures exported from or through Hong Kong to the Mainland for processing with a contractual arrangement for subsequent re-importation of the processed goods into Hong Kong. Source: Census and Statistics Department (2006 website).

Table 2.4: Estimated Value and Proportion of Outward Processing Trade for Imports from and Exports to China in 1989 – 1994

Trade Type	Estimated Value of Outward Processing Trade (HK$ Million)					
	1989	**1990**	**1991**	**1992**	**1993**	**1994**
Import from China	113,581 (58.1)	145,103 (61.8)	197,384 (67.6)	254,013 (72.1)	295,203 (73.8)	354,912 (75.9)
Total Export to China	76,868 (53.0)	91,914 (58.8)	113,931 (55.5)	141,639 (52.4)	160,178 (47.9)	181,179 (47.7)
Domestic exports to China	31,962 (76.0)	36,418 (79.0)	40,369 (76.5)	44,271 (74.3)	45,141 (74.0)	41,959 (71.4)
Re-exports to China	44,906 (43.6)	55,496 (50.3)	73,562 (48.2)	97,368 (46.2)	115,037 (42.1)	139,221 (43.3)

Note: Figures in brackets denote the estimated proportion of outward processing trade for imports from China or exports to China.

Sources: Industry Department (1995, p. 30)

The relocation of production activities offshore meant that Hong Kong entered a stage of "deindustrialization" with drastic decline of manufacturing sector in the 1980s. Between 1980 and 1990, the number of persons engaged in manufacturing industry decreased from 907,463 to 715,597 (a drop of 26%[8]) and its contribution to GDP from 22.8% to 16.7%[9]. By 2000, manufacturing sector employed 226,205 (accounting for 9.86% of the total) and contributed 5.4% to GDP. Since non-operative Hong Kong premises were engaged in more sophisticated process and supporting services such as sourcing of raw material, design, production management and engineering, marketing and the like, Hong

[8] See Table 2.1 on page 11
[9] See Table 1.1 on page 2

Kong became more of a commercially oriented business networking centre than a manufacturing base (Chiu et al, 1997).

Period of Automation

Prompted by the economic restructuring, there had also been a shift towards more capital-intensive and higher value-added production activities in Hong Kong. In response to the rising labour cost, apart from relocation of production base to China and other Asian countries, many manufacturers responded by increasing the degree of automation and capital investment. Hence, additional fixed asset investment increased at an average annual rate of 8.1% between 1983 and 1993 (Industry Department, 1995, p.8). This structural shift supported an improvement of labour productivity and value-added in the local manufacturing industries. According to the Census and Statistics Department (2005 website), value added for all manufacturing establishments increased significantly from HK$36,049 million in 1981 to HK$92,241 million in 1990 and peaked at HK$97,445 million in 1992 and started to level off then. This automation trend was also facilitated by the growth of overseas investment in Hong Kong's manufacturing sector (see Table 2.3), which was one of the features of the period of internationalization discussed above.

2.4 Changing Nature and Role of Manufacturing Sector in Hong Kong

As succinctly summarized by Chiu et al (1997), there was a "double-restructuring process" in the 1980s. On the one hand, there was the general sectoral shift towards finance, trading and services sector in the economic structure. On the other hand, within the manufacturing

sector, there was a shift away from production towards a more commercially and trade oriented centre.

In a nutshell, there have been significant changes in the nature of manufacturing activities. First, with the massive relocation, an "office-factory" relationship developed between Hong Kong and China (Chen and Li, 1996, p.106). The sector becomes more of non-production and supporting services oriented. Second, the production approach moves from labour-intensive to more technology and skill-intensive and hence higher value-added.

Despite manufacturing sector's contribution to employment and GDP has been gradually declining, its role in the Hong Kong economy remains significant though in an indirect way after 1990s. Owing to the interrelation and interconnection among economic sectors, the linkage effects of the manufacturing sector to other sectors and in turn the economic growth of Hong Kong should not be ignored. Though the relevant linkage effects have not been quantified in Hong Kong, the input-output analysis[10] of 4 advanced industrial countries by Bon and Pietroforte (1990) sheds light on this issue. Their research showed that the manufacturing sector had high linkage effects in these countries. In a quantitative way, as illustrated by Miller et al (2004), each economic activity or sector (through interrelatedness) can have various multiplier effects on GDP and employment. For example, in Table 2.5, the 1.33 GDP multiplier for textile and clothing means that every pound (£) of GDP produced by in this sector generates another 33 pence in GDP in

[10] The basic idea of this analysis is that a sector interacts with other sectors through its backward linkages (such as the sector's requirements for inputs) and forward linkages (when the sector's output becomes input of other sectors), producing significant multiplier effects.

other industries via purchasing and income effects. Likewise, each job in textile and clothing supports another 0.29 of a job in other sectors through these linkages.

Table 2.5: GDP and employment multipliers (Welsh Input-Output Tables for 1996)

	Sector GDP multiplier Emp multiplier	**GDP multiplier**	**Emp multiplier**
1	Agriculture, forestry and fishing	1.61	1.38
2	Extraction	1.45	1.78
3	Food, drink and tobacco	1.48	1.98
4	**Textiles and clothing**	**1.33**	**1.29**
5	Wood, paper, pulp, publishing and printing	1.55	1.63
6	Oil and chemicals	1.5	2.32
7	Rubber and plastic	1.43	1.44
8	Other non-metals	1.5	1.64
9	Manufacture of basic metals	1.86	2.31
10	Metals, mechanical engineering & other machinery	1.43	1.41
11	Electronic engineering	1.52	1.61
12	Automotive components and transport equipment	1.49	1.66
13	Other manufacturing	1.6	1.5
14	Construction	1.7	1.43
15	Retail and wholesale	1.47	1.33
16	Other services	1.4	1.45

Source: Miller et al (2004), p.535.

In addition, as reflected in the studies by Chiu et al (1997), many manufacturing establishments have changed into trading firms following the restructuring in the 1980s. Manufacturers are interested in maintaining their controlling headquarters in Hong Kong, which are responsible for trade and manufacturing-related activities. This undoubtedly contributed significantly to the growth of trade sector in Hong Kong. As the manufacturing production has always been export-oriented, the development of the sector can be gauged

by the activity of export trade, particularly re-export trade, in Hong Kong. As shown in Table 2.6, re-exports dropped drastically in the 1950s due to trade embargo on China and continued to decline in the 1960s and 1970s when Hong Kong was going through rapid industrialization. From the late 1970s till now, it revives and grows rapidly with the deindustrialization of the economy and transformation of the manufacturing sector.

Table 2.6: Value and Percentage Share of Domestic Exports and Re-exports, 1952-2004

	Domestic Export		**Re-export**		**Total export**
	HK$ million	*	HK$ million	*	HK$ million
1952	2,899	-	#	-	2,899
1953	2,734	-	#	-	2,734
1954	2,417	-	#	-	2,417
1955	2,534	-	#	-	2,534
1956	3,210	-	#	-	3,210
1957	1,202	40%	1,814	60%	3,016
1958	1,260	42%	1,729	58%	2,989
1959	2,282	70%	995	30%	3,278
1960	2,867	73%	1,070	27%	3,938
1961	2,939	75%	991	25%	3,930
1962	3,317	76%	1,070	24%	4,387
1963	3,831	77%	1,160	23%	4,991
1964	4,428	77%	1,356	23%	5,784
1965	5,027	77%	1,503	23%	6,530
1966	5,730	76%	1,833	24%	7,563
1967	6,700	76%	2,081	24%	8,781
1968	8,428	80%	2,142	20%	10,570
1969	10,518	80%	2,679	20%	13,197
1970	12,347	81%	2,892	19%	15,238
1971	13,750	80%	3,414	20%	17,164
1972	15,245	79%	4,154	21%	19,400
1973	19,474	75%	6,525	25%	25,999
1974	22,911	76%	7,124	24%	30,036
1975	22,859	77%	6,973	23%	29,832
1976	32,629	79%	8,928	21%	41,557
1977	35,004	78%	9,829	22%	44,833
1978	40,711	76%	13,197	24%	53,908
1979	55,912	74%	20,022	26%	75,934

	Domestic Export		Re-export		Total export
	HK$ million	*	HK$ million	*	HK$ million
1980	68,171	69%	30,072	31%	98,242
1981	80,423	66%	41,739	34%	122,163
1982	83,032	65%	44,353	35%	127,385
1983	104,405	65%	56,294	35%	160,699
1984	137,936	62%	83,504	38%	221,441
1985	129,882	55%	105,270	45%	235,152
1986	153,983	56%	122,546	44%	276,530
1987	195,254	52%	182,780	48%	378,034
1988	217,664	44%	275,405	56%	493,069
1989	224,104	39%	346,405	61%	570,509
1990	225,875	35%	413,999	65%	639,874
1991	231,045	30%	534,841	70%	765,886
1992	234,123	25%	690,829	75%	924,953
1993	223,027	21%	823,224	79%	1,046,250
1994	222,092	19%	947,921	81%	1,170,013
1995	231,657	17%	1,112,470	83%	1,344,127
1996	212,160	15%	1,185,758	85%	1,397,917
1997	211,410	15%	1,244,539	85%	1,455,949
1998	188,454	14%	1,159,195	86%	1,347,649
1999	170,600	13%	1,178,400	87%	1,349,000
2000	180,967	12%	1,391,722	88%	1,572,689
2001	153,520	10%	1,327,467	90%	1,480,987
2002	130,926	8%	1,429,590	92%	1,560,517
2003	121,687	7%	1,620,749	93%	1,742,436
2004	125,982	6%	1,893,132	94%	2,019,114

* Percentage of domestic export or re-export of the total export

Re-export value already included in domestic export value.

Source: Census and Statistics Department (2005 website)

Chapter 3

Overview of Industrial Property Market in Hong Kong

3.1 The Characteristics of Industrial Property Market

In Hong Kong, though private industrial properties comprise flatted factories, industrial/office premises, specialized factories and storage premises; the rapid industrialization from the 1950s to the 1980s coupled with institutional encouragement mean that flatted factories have been the focal point of the industrial property market. This is reflected in the study by Townland Consultants Ltd. and Roger TYM & Partners (1993) for the Planning Department, which indicated that 71% of the total industrial space was in the form of flatted factories. As such, the characteristics of the market can be gauged by the spatial, supply and locational features of the private flatted factory sector.

3.1.1 Spatial Characteristics

While factory building embraces both single-storey factories and flatted factories, as explicitly reflected in the Rating and Valuation Department's classification, it is dominated by flatted factories or multi-storey flatted factory buildings in Hong Kong. This is largely due to the limited territory and dense population in Hong Kong which make land an extremely scarce resource. It is always a premium for all sorts of development. As such, unlike such other Western countries as U.S. where a majority of the industrial properties have been tailor-built for a single (long-term) tenant (Wheaton and Torto, 1990), the flatted factories have been mainly built in a standardized way to capture the greatest market

appetite in Hong Kong. This practice is similar to that in residential and other commercial sectors where properties are built like a commodity. Government policy was also influential. Since the industrial land supplied by the government was geared towards maximizing floor space production from the sites, high floor area ratio (FAR) was the norm. This in turn encouraged the production of multi-story flatted buildings (Tang and Tang, 1999, p. 161).

Industrial properties are also spatially characterized by different sizes of workshop units, particularly small-sized ones so as to cater for the manufacturing sector's needs. As discussed in Chapter 2 above, the industrial structure that had evolved between the 1950s and mid 1980s was generally concerned with the manufacture of a relatively restricted range of products and was highly oriented towards the production of light manufactured goods with high labour content for export purpose. The manufacturing sector was dominated by small and medium industries (SMI). This was borne out by the overwhelming dominance of manufacturing establishments employing less than 49 persons (see Table 2.2 on page 13). These establishments constantly accounted for over 90% of the total manufacturing establishments. The SMI survey in 1987 by Sit and Wong (1989) showed that 70% of the sample firms were in premises of less than 6,000 sq. ft. and half of which were within premises of less than 1,000 sq. ft.

The difficult topography of Hong Kong necessitating the economy in the use of space is one of the key contributing factors for these spatial features. To adapt to the drastic manufacturing restructuring and changes in political circumstances, SMI and the

use of subcontracting[11] were a pragmatic and flexible way out. All these led to demand for small and flexible sized units. Institutional factor also played a role. Starting in about 1978, in the sale of general purpose industrial land, there was an incorporation of a lease condition which required the final superstructure on the site to yield a certain amount of small workshop units of less than 1,000 sq. ft. floor area (Sit and Wong, 1989). This small-sized premises together with multi-story nature of industrial buildings meant high density development.

3.1.2 Supply of Private Flatted Factories

The burgeoning manufacturing sector and the governmental encouragement led to the proliferation of multi-storey industrial buildings in the 1960s and 1970s. The year-end stock of private flatted factories increased rapidly from 5,120,918 m^2 in 1974 to 9,607,300 m^2 in 1980, representing an increase of more than 87% during this period. Table 3.1 shows that the rate of growth in the stock of private flatted factories started to take off in the second half of the 1970s, reached its peak in 1979 and then began to level off.

[11] The SMI survey by Sit and Wong (1989, p. 178) confirmed the existence and significance of subcontracting network between small and larger factories as well as between small factories and large number of local trading companies (import-export houses).

Table 3.1: Year End Stock of Private Flatted Factories

	Stock at yr end (m^2)	**Year-on-year % change**
1974	5,120,918	-
1975	5,336,368	4.2%
1976	5,600,037	4.9%
1977	6,403,400	14.3%
1978	7,466,300	16.6%
1979	8,703,400	16.6%
1980	9,607,300	10.4%
1981	10,656,400	10.9%
1982	11,651,200	9.3%
1983	12,247,900	5.1%
1984	12,673,400	3.5%
1985	13,121,400	3.5%
1986	13,708,700	4.5%
1987	14,461,300	5.5%
1988	15,505,800	7.2%
1989	16,307,100	5.2%
1990	16,680,500	2.3%
1991	17,113,200	2.6%
1992	17,610,100	2.9%
1993	17,641,700	0.2%
1994	17,600,300	-0.2%
1995	17,621,000	0.1%

Source: Rating and Valuation Department, Property Review/Hong Kong Property Review, various issues.

3.1.3 Locational Characteristics

As pointed out by Sit (1983), Hong Kong exemplifies the heavy concentration of small industrial firms within an urban area. Over half of all private flatted factories were located in urban Hong Kong and Kowloon areas (see Table 3.2). A high proportion of these industrial areas also have good accessibility to major transport routes, notably the Mass

Transit Railway. This locational pattern could be attributed to the labour-intensive nature of manufacturing industry in Hong Kong, particularly prior to the relocation of production function overseas in the mid 1980s. The dense urban population constituted an important labour source for the sector, making labour-intensive production viable.

It is also attributable to the heavy government involvement in infrastructural construction – urban development and mass public housing since 1974. New towns such as Tsuen Wan and Kwun Tong were rapidly developed. The new town residents provided essential manpower to industry moving to the new towns. The public housing also functioned as a subsidy to the working class families facilitating the reproduction of labour power (Chiu et al, 1997).

Table 3.2: Location of Private Flatted Factories by Area

	Stock in m^2 at end of					
	1975	**%**	**1980**	**%**	**1985**	**%**
West	88,100	1.7%	91,900	1.0%	127,500	1.0%
Wan Chai	600	0.0%	700	0.0%	700	0.0%
Tai Hang/Causeway Bay	550	0.0%	500	0.0%	500	0.0%
North Point	285,700	5.4%	351,200	3.7%	388,400	3.0%
Shau Kei Wan	179,200	3.4%	429,400	4.5%	509,700	3.9%
Aberdeen	250,300	4.7%	366,500	3.8%	540,000	4.1%
Hong Kong	**804,500**	**15.3%**	**1,240,200**	**12.9%**	**1,566,800**	**11.9%**
Yau Ma Tei/Mong Kok	240,600	4.6%	292,000	3.0%	376,100	2.9%
Hung Hom	363,500	6.9%	509,100	5.3%	645,600	4.9%
Cheung Sha Wan	503,700	9.5%	886,100	9.2%	1,054,400	8.0%
Kowloon City/Wong Tai Sin	646,600	12.3%	692,400	7.2%	777,100	5.9%
Ngau Tau Kok/Kwun Tong	1,123,600	21.3%	1,756,300	18.3%	2,175,400	16.6%
Lei Yue Mun	31,100	0.6%	273,800	2.8%	317,500	2.4%
Kowloon	**2,909,000**	**55.2%**	**4,409,700**	**45.9%**	**5,346,100**	**40.7%**
Kwai Chung/Tsuen Wan	1,550,700	29.4%	3,339,500	34.8%	4,603,000	35.1%
Tuen Mun	5,200	0.1%	446,800	4.7%	843,900	6.4%
Yuen Long	5,000	0.1%	43,100	0.4%	75,000	0.6%
Fanling/Sheung Shui	0	0.0%	17,300	0.2%	20,400	0.2%
Tai Po	0	0.0%	27,900	0.3%	138,300	1.1%
Sha Tin	0	0.0%	82,300	0.9%	527,400	4.0%
Sai Kung/Clear Way Bay	0	0.0%	500	0.0%	500	0.0%
New Territories	**1,560,900**	**29.6%**	**3,957,400**	**41.2%**	**6,208,500**	**47.3%**

Source: Rating and Valuation Department, Property Review/Hong Kong Property Review, various issues.

3.2 The Triggers of Institutional Change in Industrial Land Use Policy

The new wave of industrial restructuring since the 1980s had prompted the government to review its industrial land use policy and introduce a new land use type – composite industrial/office building in 1989. The triggers were fourfold: 1) changing requirement of

industrial space; 2) obsolescence of traditional multi-storey factory buildings; 3) environmental problems and 4) office infiltration into industrial buildings.

3.2.1 Changing Industrial Space Requirements

As discussed in the foregoing Chapter 2, the massive relocation of manufacturing production activities to China and other Asian countries since the mid 1980s had radically transformed the nature of manufacturing sector in Hong Kong. Rather than being a production base, Hong Kong became manufacturing-related service supporting centre. This fundamental change was confirmed by the findings of 1988 survey of manufacturers and traders conducted by the Hong Kong Trade Development Council (1991, p.12-13). Concerning future operation in Hong Kong, 83% of the surveyed companies mentioned "controlling headquarters", 81% "documentation", 73% "business negotiation" and 72% "trade financing". Thus, as highlighted by the Trade Development Council, operations performed by surveyed companies in Hong Kong in the future would concentrate on trade and manufacturing-related services.

Naturally, along with this new role of operation in Hong Kong, there came the new spatial and facility requirements which could not be accommodated by the old-styled flatted factory buildings. A study by the Planning Department (Townland Consultants Ltd. and Roger TYM & Partners, 1993, p 2-6) found increasing level of dissatisfaction of operators with the existing industrial environment. There was rising demand for higher quality space, more office, showroom and storage space, better lifts and building services etc. and higher planning standard for layouts, building design and management.

Apart from orientation towards manufacturing supporting activities, there was also shift towards more technology-intensive productions to which the mismatch of industrial space demand and supply was much more acute. High-tech companies require a concentration of knowledge-based personnel and sophisticated equipment which could not be accommodated in the low-tech, small-sized, vertically-staggered industrial units in the traditional flatted factories. This was also the key rationale for the establishment of The Hong Kong Industrial Estates Corporation (HKIEC) in 1977[12] and the development of specialized factories at Tai Po, Yuen Long and Tseung Kwan O since 1977.

3.2.2 Obsolescence of Traditional Flatted Factories

Apart from the mismatch of industrial spatial requirements which was in effect a functional obsolescence, the physical obsolescence of flatted factories was another pressing problem. As clearly indicated by Table 3.1 above, many industrial buildings were built during the 1960s and 1970s. However, multiple ownership nature of these buildings led to dispersal of management responsibilities which in turn resulted in very low level of repair and maintenance. This, coupled with the natural wear and tear of the building fabric, meant serious physical deterioration/obsolescence. In addition, as these flatted factories were built to house factory units appropriate to the manufacturing sector's needs in the 60s and 70s, most of them were made redundant by the relocation of manufacturing activities to China. As the obsolete factory buildings could not meet the requirements of modern industrialists,

[12] The Hong Kong Industrial Estates Corporation (HKIEC) is a statutory body set up in 1977 by the Government to develop and manage industrial estates in Hong Kong. It offers developed land, at cost, on its industrial estates to companies with new and improved technologies and processes which cannot operate in multi-storey factory buildings. Source: Trade and Industry Bureau (Website 2006).

the economic return in keeping these industrial properties was unattractive. In other words, flatted factory building owners faced serious economic obsolescence. Without viable redevelopment option, there is little incentive for the owners to undertake proper management and maintenance.

3.2.3 Environmental Problems

Since a large proportion of industrial buildings were built more than 3 to 4 decades ago, their environmental conditions are well below present day standards. The study of seven obsolete industrial areas (OIAs) by the Planning Department (Townland Consultants Ltd. and Roger TYM & Partners, 1993) found high level of air, noise, water and waste pollution in all of the OIAs. The environmental degradation is further aggravated by the high-density development in the early days and high intensity of use. The urban location of a large proportion of industrial buildings in Hong Kong also means there is a serious industrial/residential interface issue as the city grows and develops. Areas like Kwai Chung/Tsuen Wan and Ngau Tau Kok/Kwun Tong have not just been the places with the largest percentage of flatted factories (see Table 3.2 above) but also places with high population density.

3.2.4 Office Infiltration into Industrial Premises

In an industrial building, the average proportion of usable floor space for an industrial firm that would be permitted as of right for ancillary office use without planning application is

30%[13]. However, this permissible office accommodation was by no means sufficient, particularly with the controlling headquarter and production supportive function of most industrial operations in Hong Kong after the 1980s' industrial restructuring. Walker (1996, p. 21) found out that:

> "Consequently there was an increase in the level of office use in industrial buildings as companies chose to ignore the regulations. Typically companies could not afford to relocate to office premises and usually did not want to relocate from their established industrial location."

Likewise, despite the growing importance of trade, finance and service sectors in Hong Kong, the commercial office land occupies only 0.2% (2km^2) of the total land area whereas industrial land covers more than 5 times this area and its total floor space is more than 3 times that of offices (Tang and Tang, 1999, p. 159). The shortage of office space coupled with the office decentralization which has been developing rapidly since the early 1980s have led to the development of new office nodes along the major transport route, notably the MTR stations such as Kwun Tong, Mong Kok and Quarry Bay. Some of these office locations are traditional industrial areas (Lai, 1996; Hui and Tse, 2004). As a result, there has been proliferation of office use, whether legal or not, into the industrial buildings.

[13] Source: Town Planning Board (1990c).

3.3 The Evolution of Industrial Land Use Policy

The foregoing discussion indicated that the existing industrial land use planning policy was out of pace with the rapid development of the industrial market which finally prompted the government to take steps to re-formulate its industrial land use policy. The following sections will discuss the major changes in the land use planning policy which affected industrial buildings – both industrial and industrial-office buildings.

3.3.1 Adoption of Composite Industrial-Office (I/O) Building in November 1989

As clearly spelled out by the Town Planning Board (TPB) in its 1990 annual report (Town Planning Board, 1990a, p. 42):

> "In recent years, there has been a trend in industry in Hong Kong towards high technology and high value products. This change has resulted in an increased demand among some industrial firms for floor space to be used for management purposes, design and quality control, and other non-manufacturing activities which cannot be accommodated in a normal commercial building or located away from the industrial operations. To cater for this new demand, the Board approved in November 1989 the introduction of a new type of development called the 'Composite Industrial-Office Building'."

In January 1990, this new property concept was formally recognized by the government through the promulgation of Town Planning Board Guidelines (TPBGs) for such

redevelopment in industrial zone, which was revised in December of the same year. According to the relevant TPBGs (Town Planning Board, 1990b), a composite I/O building was defined as "a dual-purpose building in which every unit of the building can be used flexibly for both industrial and office purposes." In addition, there was no limit on the size of offices to be accommodated within I/O buildings provided that the "offices are ancillary to an industrial operation *within the building*." However, the general intention was to "discourage the infiltration of general commercial uses as restaurants and supermarkets" into this property type. In terms of design and construction, I/O building had to comply with the standards and regulations applicable to both industrial and office buildings, whichever was more stringent. In short, upon application to and with approval from the TPB, redevelopment of the whole site and in-situ conversion of existing industrial building to I/O use would be allowed.

3.3.2 The Revisions in 1992, 1993 and 1994

In order to cater for "the demands of an industrial sector which is undergoing structural change" (Town Planning Board, 1992, p.1), the TPB revised TPBGs for composite I/O buildings in July 1992, allowing accommodation of office ancillary to an industrial operation located "within the same industrial area" rather than "within the building". In addition, 75% of the I/O building would be assumed to be used for office use for the purpose of premium calculation (Town Planning Board, 1992, p.3). The October 1993 revision even relaxed the permitted office use to 100% of the floor area and used it as the basis for premium calculation (Tang and Tang, 1999).

Realizing the problems in defining the term "the same industrial area" and the fact that Hong Kong operations became non-manufacturing and headquarter-oriented after the relocation of production lines overseas, in January 1994, the TPB revised the guidelines to the effect that the requirement of office ancillary to an industrial operation "within the same industrial area" be deleted (Town Planning Board, 1994a, p.56 and 1994b, p.3).

3.3.3 The 1997 Revision

To assist the formulation of appropriate industrial planning strategy to meet the changing industrial sector, the Planning Department commissioned a consultancy study which recommended 1) the revision of the definition of "industrial use" so as to better reflect the modern characteristics of Hong Kong's industries; and 2) the recognition of the trend that industries require a greater proportion of space for ancillary office use rather than for ancillary showroom and that a greater range of commercial uses are necessary to support the increasingly diverse and business-oriented industrial sector (Town Planning Board, 1997a, p.80-81).

In response to this study, the TPB made several major changes to TPBGs related to applications within industrial zones in September 1997.

First, "training" was now regarded as a kind of industrial use and accordingly the definition of "industrial use"[14] had been amended to include "training" (Town Planning Board, 1997a and 1997b).

Second, *within industrial buildings*, under the previous TPBGs (Town Planning Board, 1990c and 1991), the maximum proportion of usable floor space of an industrial firm for ancillary office permitted as of right was 30% and for ancillary showroom use was 20% upon application. Under the new TPBGs (Town Planning Board, 1997b), the Board combined the proportion of floor space permissible for ancillary office and/or showroom uses to a maximum of 50%. Within this 50% limit, the proportion for ancillary showroom was restricted to a maximum of 20% (Town Planning Board, 1997a, p. 83).

Third, *within I/O buildings*, in the previous TPBGs (Town Planning Board, 1994b, p.2) only "industrial operations, quasi-industrial operations and ancillary office activities related to these industrial/quasi-industrial operations" were permitted. Besides, general commercial uses were discouraged though "a limited provision of floor space for such necessary and complementary local services to the industrial area as banks, showrooms and local provision stores might be allowed by the TPB upon application". In the revised guidelines (Town Planning Board, 1997c, p.2):

[14] Previously, industrial use had been defined as "any premises, structure, building or part of building or place (other than a mine or quarry), in which articles are manufactured, altered, cleansed, repaired, ornamented, finished, adapted for sale, broken up or demolished or in which materials are transformed, or where goods and cargo are stored, loaded, unloaded or handled, or where the research and development, design work, quality control and packaging related to the above processes are carried out. Source: Town Planning Board, 1990c, p.1.

"Trading firm, being a type of office use requiring large storage space of no less than 30% of the total usable floor area of the firm and frequent loading/unloading which cannot be accommodated in conventional commercial/office buildings, will be permitted in an I/O building."

In addition, "Commercial uses included in Column 2 of the Notes of 'industrial' zone in the relevant Outline Zoning Plan will be permitted on the lowest three floors of an I/O building and subject to a maximum plot ratio of 1 or 10% of the total gross floor area of the building, whichever is the less."

In other words, trading firms and such commercial activities as banks, fast food shops, restaurants and retail shops were now permitted. These greatly broadened the range of activities that could be accommodated within I/O buildings.

3.3.4 The 2001 Changes

To streamline the use and development within industrial zone and in recognition of the growth of information-based industries, the TPB promulgated a new set of TPBGs for use/development within industrial zone in September 2001 (TPB PG-No.25A) (Town Planning Board, 2001b), replacing three previous sets of TPBGs[15] concerning commercial uses in industrial buildings and office building development within industrial zone.

[15] These 3 sets are Guidelines on "Application for Office and Showroom Uses in Industrial Building within Industrial Zone" (TPB PG-No.1A), "Application for Office Buildings in Industrial Zone" (TPB PG-No.3A) and "Application for Commercial Use in Industrial Building within Industrial Zone" (TPB PG-No.7A). Source: Town Planning Board, 2001b, p.2.

Under TPB PG-No.25A, the major change was that composite I/O building development within industrial zone would now be permitted as of right i.e. redevelopment or in-site conversion of industrial buildings in industrial zone into I/O buildings needed no planning permission. As a result, the guidelines on "Application for Composite Industrial-Office Buildings in Industrial Zone under Section 16 of Town Planning Ordinance" (TPB PG-No.4A) were deleted. (Town Planning Board, 2001b, p.2)

In addition, TPB allowed greater flexibility in *industrial buildings* by permitting as of right information technology and telecommunications industries, offices related to industrial uses and trading firms which required frequent loading/unloading and large storage space of not less than 30% of the total usable floor area (Town Planning Board, 2001a, p.45). In other words, uses permitted as of right in industrial buildings were now more or less at par with those in I/O buildings except that commercial uses (even located at the lowest three floors) within industrial buildings required planning permission.

The major changes to the permitted uses in industrial and/or industrial-office buildings within industrial zone as discussed above are summarized in the following table:

Table 3.3: Major Changes to Permitted Uses in Industrial and/or I/O Buildings within Industrial Zone in Hong Kong

Time	**Major Changes**
November 1989	TPB endorsed the composite I/O buildings concept.
January & December 1990	- Composite I/O development within industrial zone might be allowed upon application. - Within I/O buildings: no limit on the size of offices as long as they are ancillary to an industrial operation "within the building". - Within industrial buildings: ancillary office use no more than 30% of total usable floor area of an industrial firm was permitted as of right.
July 1992	Within I/O buildings: - allow ancillary office use related to an industrial operation "within the same industrial area" rather than "within the building"; - calculate land premium on assumption that 75% of I/O building was for office use.
October 1993	Within I/O buildings: relax the permitted office use to 100% of the floor area and used it as the basis for premium calculation.
January 1994	Within I/O buildings: allow ancillary office use related to an industrial operation irrespective of geographical location.
September 1997	- Within I/O buildings: trading firm and commercial uses, such as banks, fast food shops, restaurants and retail shops, were permitted as of right on the lowest 3 floors. - Within industrial buildings: 50% of the total usable floor area (UFA) of an industrial firm in same premises or building permitted as of right for solely ancillary office use or for a combination of office and showroom uses. Ancillary showroom use no more than 20% of UFA within the 50% limit.
September 2001	- Composite I/O development within industrial zone was permitted as of right. - IT & telecommunication uses were permitted as of right in both industrial and I/O buildings. - Within industrial buildings: trading firms and office related to industrial use were now permitted as of right.

Sources: Town Planning Board Guidelines and Annual Reports, various issues and Tang and Tang (1999)

Chapter 4 Literature Review

4.1 Introduction

After gaining an overall picture of the industrial development featured by economic restructuring and the governmental policy changes toward industrial land use, this section will conduct a literature review so as to establish the fundamentals for understanding the theoretical principles of price determination. Study of previous researches can provide useful insights into the theoretical underpinnings, approaches and explanatory variables for constructing the industrial property price model. Section 4.2 will examine the theoretical background of price determination. Section 4.3 reviews both local and overseas studies on price or rent determination in different property sectors. Section 4.4 will be a brief summary of findings from the literature review.

4.2 Theoretical Framework of Price Determination

This section attempts to review the theoretical framework underpinning the price and rent determination in the property market.

4.2.1 Macroeconomic Studies of Property Market

While microeconomics studies prices and land use across space within a particular market such as the study of impact of property-specific variables on property values, macroeconomics examines the overall movement of prices and real estate development for the metropolitan market as a whole. Macroeconomics deals with aggregate variables that

are averages or aggregations of data measured at each location within the market. As such, it is able to focus more specifically on the time dimension that emphasizes short-run movements and temporary disequilibrium (DiPasquale and Wheaton, 1996, p.31). The driving force behind the macroeconomic studies is that the property market and the economy at large are intimately interdependent.

Inter-relationship between Property and Economy

Being an integral part of the economy, property market is interwoven with the overall performance of the economy. In other words, there is significant interrelationship between property market and the economy in both the short and long run.

On the one hand, as pointed out by Fraser (1993, p.1), "property is an integral part of the nation's economy, and anything which has implications for the economy will have implications for property". Property market is strongly influenced by the broad behaviour of the economy in which it operates. For example, the demand for office space is driven by the general economic activity. Property values are affected by the changes in capitalisation rates which are in turn influenced by interest rates.

On the other hand, property market also affects the behaviour of the macroeconomic variables. Peng et al (2001) found that property price falls adversely affected private consumption and investment (and hence a decline in output growth and real GDP); banking sector performance and fiscal balance. Ball et al (1998, p.137) shared similar view:

> The impacts of property market on the economy are "seen most noticeably in the aftermath of major property market booms when economies experience negative demand shocks arising from a sudden decline in property market activity and the effect on organizational solvency of falling property prices."

Fraser (1993) also pointed out the important role of property market in the creation of wealth and economic growth. Borrowing is important for the creation of wealth. Since property is the collateral on which a large proportion of corporate borrowing is secured, property values affect the capacity to borrow by mortgage, which affects the level of investment and wealth creation and in turn the economic growth. In addition, property is an investment. The owners enjoy not just the right to receive rent as income but also capital gain when property value/price appreciates. As a result, "commercial property as an investment is a medium by which all sections of the population hold wealth, principally through life assurance and pension funds" (Fraser, 1993, p.3). Likewise, being an investment instrument, the property is affected by the behaviour of the investment market which is in turn linked to the overall economy.

In short, the property market and the economy are closely interrelated and interdependent. This is confirmed by Song et al (2005) in their input-output analysis and linkage measure of the real estate sector with other economic sectors. According to their findings, except for agriculture, forestry and fishery, mining, and quarrying sectors, the remaining sectors such as services, construction, wholesale, retail trade etc in the national

economy are easily affected by the real estate sector, and reciprocally these sectors have a significant effect on the real estate sector as well (Song et al, 2005, p.140).

Property and Hong Kong Economy

Real estate sector is well-recognized as the life-blood of Hong Kong's economy. Following Walker et al (1995 cited by Renaud et al, 1997, p.27), the relative importance and size of the sector in the economy can be vividly reflected by the following key indicators:

- During 1983-92, an average of 61% of capital investment was in real estate.
- Although the real estate share of GDP is cyclical, it has averaged over 24% since 1980.
- By market capitalization trends on the Hong Kong Stock Exchange, real estate is only second to "consolidated enterprises" which themselves include a significant real estate component. This capitalization share is larger than that of financial shares.
- Over 35% of bank lending is to real estate and construction sector.
- Over 33% of government revenues comes from real estate and construction related items. Almost 35% of government expenditure is on real estate, mostly infrastructure and housing.

Though the sector's share of market capitalization on Hong Kong Stock Exchange has been overtaken by both finance and industrials in recent years, it still accounted for more

than 11% in 2005[16]. As in the past, since most "consolidated enterprises" include a significant real estate element, real estate sector's share should be a lot larger (though it has not been quantified). In addition, there were 24,106 establishments in real estate and related industries, employing a total of about 226,226 persons in 2004[17]. The study by Peng et al (2001) confirmed the decisive role of the sector in the economy by quantifying its impact on other sectors. Their empirical analyses suggested that the decline in the property price reduced private consumption growth by about 3.5% in 1998, accounting for about half of the overall decline. Taking into account the effects on private investment, the decline in property prices was estimated to have reduced real GDP by 1.25%, compared with the overall contraction of around 5%. The decline in property prices also negatively affected the government's fiscal position (through reduction in land premia and property-related income like stamp duty) and banking performance (through increase in delinquency ratio and classified loan ratio etc.).

As in other economies, real estate sector both influences and is influenced by the general economic conditions. Hong Kong economy is characterised by the practice of laissez-faire capitalism, free from intervention by the government. Studies by Renaud et al (1997) showed that property rental and price levels adjusted rapidly to changes in market

[16] Source: Securities and Futures Commission (2006 website). Securities and Futures Commission Web Site. [online]. Available from http://www.sfc.hk/sfc/html/EN/research/stat/stat.html [Accessed 10 June 2006].

[17] The establishment and employment figures include Building and Civil Engineering; Architectural, Surveying and Project Engineering; Real Estate Development, Leasing, Brokerage and Maintenance Management. Source: Census and Statistics Department (2006 website). Census and Statistics Department Web Site. [online]. Available from http://www.censtatd.gov.hk/hong_kong_statistics/statistical_tables/ [Accessed 10 June 2006].

conditions. This allocational and price efficiency are largely the result of great tenant and investor mobility afforded by the open market economy. However, they also reckoned that the price adjustment mechanism is subject to government policy changes and fundamental economic structural changes. Likewise, He and Webb (2000, p.269) suggested that Hong Kong real estate markets are "very sensitive to important economic and political news with rapid and similar responses in price and rentals". Chau (1997, p.297) found that "there was a discrete jump in the risk premiums when the 1997 issue was revealed to the public in 1983", reflecting the negative impact of political uncertainty on the real estate market in Hong Kong. In addition, the research by He et al (1998) suggested that Hong Kong real estate, overall, is more sensitive than other Hong Kong industries to major political events in China. As a result, both property cycles and property prices are found to be more volatile than the economy and prices of other goods and services (Peng et al 2001). The author also recognizes the relatively inelastic supply of real estate assets vis-à-vis other assets, with the result that shocks to demand are borne mostly by price changes in the short run.

As discussed and illustrated above, the importance of the property sector to the economy in Hong Kong is beyond doubt. A close interrelationship between the sector and other macroeconomic variables/factors is, therefore, expected in the local context. This instigates the study of the impact of macroeconomic variables on the real estate sector, particularly the industrial property market which has to weather through massive industrial restructuring in addition to the general economic and political changes faced by the general property sector.

4.2.2 Approaches to Modelling Property Rent/Price Determination

Review by Leishman (2003) of previous studies shows that among the common modelling strategies[18], multi-equation regression models and single equation regression models are the two main approaches.

Multi-equation Approach

As put by both Fraser (1993) and Keogh (1994) the operation of the property market consists of three main sub-sectors – the letting/user sector, the investment sector and development sector. As argued by Fraser (1993, p.2), the level of rents is determined in the letting sector by demand from tenants to occupy property and capital prices of let property are determined by demand from investors in the investment sector. The level of rents and capital prices are also determined by the supply of properties produced in the development sector. Property price or rent are fixed by the forces of demand and supply in each sub-sectors where these forces are determined by the local as well as regional, national and international economic condition. To capture the dynamics within and interaction between these sub-sectors, multi-equation modelling approach is developed. The basic mechanism of this approach is the construction of a set or system of equations with each equation modelling activities in a sub-sector. By building some of the explanatory variables in an equation as the dependent variables in other equations, different equations are linked

[18] The other common modelling strategies include Vector autoregression models (VARs), Error correction models (ECMs), Autoregressive and moving average models (AR, MA, ARMA and ARIMA) and Autoregressive conditional heteroscedasticity models (ARCH, GARCH). However, these modelling approaches are relatively complex with very few published examples. Source: Leishman (2003, p. 84)

together. This approach has been adopted in the study of office rental market by Rosen (1984), Hekman (1985) and Wheaton (1987) in the US; and Wheaton et al (1997) and Hendershott et al (1997) in the UK (reviewed and cited by Ball et al, 1998).

Single-equation Approach

As commented by Ball et al (1998), single equation or the reduced form models, may be the best practical modelling strategy because they are easier to formulate and require fewer variables to estimate. This explains the employment of single equation methodology in the majority of previous work on real estate rent or price modelling. Unlike multi-equation model where influence of each sub-sector is estimated by a separate equation, proxy variables linked to other sub-sectors are incorporated as explanatory variables in single equation model. For example, the interest rate incorporated in some of the previous studies provides a linkage with the investment sector while construction start, new construction order or absorption rate (the proxy for supply) provides linkage with the development sector.

Demand-Supply versus Demand-Driven Ideology

On the other hand, whether it is by single or multi-equation approach, the building of the rental or pricing model is based on two key types of ideology: demand-supply interaction and demand-driven or rent surplus theory.

a) Demand-supply Interaction

As the name suggests, under the demand-supply interaction ideology, property rent or price is determined by the joint forces of demand and supply. These forces will be studied in the following parts.

Demand

Strictly speaking, as stated by Fraser (1993) while rental values are determined by the occupation demand and supply in the letting/user market, price and yield are determined by the investment demand and supply in the investment market. However, in most of the previous studies, the demand being proxied is largely the occupation demand rather than the investment demand even in the price determination models. For example, in the study of the effect of speculation on residential property price in Hong Kong by Chau and Lam (2001), demand-side variables are proxied by such measures as GDP, marriage rate and stock market performance. The demand being proxied is essentially occupation demand. Nevertheless, the inclusion of real interest rate as an explanatory variable provides a link to the investment market.

The focus on occupation demand (even in modelling price determination) may be due to the fact that investment demand is largely derived from occupation demand. As discussed in details by Fraser (1993, p. 320) while property price is determined in the investment sector by the interaction of investment demand with investment supply, investment demand depends on current rents and rental growth expectations which are determined by the occupation demand and supply in the letting market. In turn, both the

supply of new investments and supply of new occupation property are affected by the development sector. Yet, development activity and site values in the development sector depend on rental and investment values. Ultimately, the main determinant of both investment demand and development activity is the occupation demand.

Another feature underling the dominance of occupation demand in the property market is that the demand for property is a derived demand (Hillebrandt, 1985 and Fraser, 1993). The property demand is not derived from the demand for the property per se but from the demand for the goods or services that a property is suited to provide. As a result, the occupation demand for property depends on the profitability of using it since profitability determines the rent that a tenant is able to pay and in turn the price that the investor will pay. In the end, both investment demand and development demand are largely derived from occupation demand.

Supply

The occupation supply of property normally consists of existing property being offered for relet (or transferred from owner occupation) and new property being let for the first time (Fraser, 1993). As discussed above, investment demand and development demand are mainly determined by the occupation demand. By the same token, the function of supply mechanism in the investment sub-sector can be derived from that in the letting/occupation sub-sector.

As pointed out by Fraser (1993, p.190), the supply of existing property for relet depends on the number of tenants who have recently decided to vacate property. In other

words, this supply tends to vary inversely with changes in occupation demand. With higher expectation on business profitability, there will be higher occupation demand and in turn lower supply of existing property for relet as sitting tenants continue in occupation. Conversely, in times of recession, occupation demand falls and supply rises. On the other hand, the supply of new property to let depends on decisions to develop new property, subject to a time delay as it takes time to construct. The final decision to construct is determined by the expected development profit which is the difference between the completed property value and the total development cost. As property value depends on rental and capital values, new supply tends to increase when these values are rising relative to development cost. All these indicate that supply is related to demand which is in turn affected by the overall economic conditions. Therefore, Fraser (1993, p. 189) argues that property supply should be a flow rather than a stock concept. While long-run supply tend to vary in line with long-run changes in stock, short-run supply (in any week, month or even year) vary according to changes in such variables as consumer expenditure or the level of economic activity. Market supply should therefore be neither stock, nor new additions to stock nor net changes in stock.

However, as the author admits, the analysis of market supply of property is complicated by data unavailability and difficulty to measure the supply in flow terms. What is more, as pointed out by Leishman (2003), the interrelationships between the letting, investment and development sub-sectors in determining the property supply are too complex for a single equation model to realistically capture them. The complexity is further exacerbated by the time lag and difficulty in ascertaining the timing of supply

impact given the means to delay or expedite the new supply. As a result, size of current stock, its growth over time, anticipated new-term new construction and current vacancy rates are used as the key indicators for supply (Schmitz and Brett, 2001). In his review of the single equation rent modelling approach, Leishman (2003) also found that data on new office completions, though not representative of the total supply, are often used as a supply proxy. Likewise, in the study of industrial property rent or price determination, construction start, new construction order or absorption rate has been included as a supply proxy, such as Atteberry and Rutherford (1993), RICS (1994), Thompson and Tsolacos (1999) and White et al (2000).

As widely recognized, both the new and existing elements of supply tend to be relatively inelastic in the short run. This means that supply only increases after a time lag in response to increased demand. Key reason behind is the time taken to develop a project which will very approximately vary from a minimum of 6 months for industrial property to five years or longer for major city centre commercial developments (Fraser, 1993, p. 191). Other possible cause behind the time lag include the information cost which restricts developers from instantly recognizing the increased demand; lack of land supply; institutional and statutory regulations and restrictions and high capital cost outlay for development. All these mean that rent or price is largely determined by demand forces in the short run.

The importance of demand force coupled with the inelastic supply (at least in the short run) and the difficulty in measuring supply have prompted some researchers to model property rent or price on demand-side factors only such as Krashinsky and Milne (1987)

and Cotter and Hoesli (1994) in residential market; Giussani et al (1992) in office market; and Lockwood and Rutherford (1996) and Buttimer et al (1997) in industrial market. The focus on demand-side factors underpins the development of the demand-driven or rent surplus theory which will be discussed in the following part.

b) Demand-driven or Rent Surplus Theory

Fraser (1993, p. 321) suggests the surplus or residual model which is primarily a demand-side model. Price is essentially a residual (or surplus) after deducting target returns from expected returns, especially as market competition forces those acquiring the interests to pay over the residual. For example, in the investment sector, investment value tends towards the residual after deducting investor's target return on capital from the expected return in the form of future rental income and capital growth. The same logic applies to the letting and development sectors. Thus, price in terms of site value, rental value or investment value is a residual (or surplus). Clearly, this model does not take explicit account of factors affecting supply e.g. the impact of new development. However, as commented by Fraser (1993, p.322), this surplus model is "frequently a better indicator of a ceiling price than market price", a full analysis of both demand and supply forces, which are the mechanism driving price changes, is necessary to explain price movements. Moreover, as pointed out by Ball et al (1998), models which omit supply are theoretically weak. As a result, the demand-supply interaction is a better approach to be adopted in this study for the analysis of industrial property prices.

To summarize, it is shown that property rent or price is a function of demand and supply in which demand is a key variable. To be comprehensive and theoretically sound, demand-supply interaction approach should be adopted. Following Fraser (1993), since investment demand and development demand are derived from occupation demand, the demand being proxied in this study will be the occupation demand for industrial premises with the inclusion of interest rate and industrial stock to provide linkage with the investment and development sectors. As has been discussed and shown, both demand and supply are sensitive to the changes in the overall macroeconomy. The incorporation of macro-market variables in the demand-supply framework is therefore essential. While the comprehensive overview of the industrial development in Chapter 2 and the industrial property market with the detailed analysis of government industrial land use policy in Chapter 3 provides a broad economic context within which the local manufacturing sector and in turn the private flatted factories operate, there are difficulties in the selection and measurement of variables to proxy the demand and supply impacts. A thorough review of similar studies is, therefore, essential and beneficial.

4.3 Review of Empirical Studies on Property Price/Rental Determination

This section reviews both local and overseas empirical studies in residential, office and industrial property markets. Both single equation and multi-equation approach have been adopted by researchers in their studies on the basis of demand-supply or demand-driven framework. Compared with other property sectors, price or rent determination studies in the industrial property market is under-investigated, especially in the local market of Hong Kong. As such, similar studies in other property sectors are also reviewed so as to provide useful insights for establishing the fundamentals, including the structure of analysis and selection of explanatory variables, for this study.

4.3.1 Review of Residential Property Market Research

There are numerous econometric studies on overseas and local residential property markets at the macroeconomic level.

Krashinsky and Milne (1987) considered that for assets whose supply does not adjust quickly, the path between equilibria needs not be smooth. Imperfect information can produce destabilizing price expectations. Therefore, in examining short-run fluctuations in real house prices in Canada, they hypothesized that expected price changes are influenced by **waiting times, past actual price changes** and **past price level**. This reduced form econometric model was then tested empirically and all the independent variables were found to be significant.

In analyzing the relative effect of nominal and real interest rate, Harris (1989) build a model of real house price by including **permanent income, total occupied housing stock, vacant housing stock, mortgage interest rate** and **expected appreciation** (measured by a series of lagged past prices). The empirical results showed that income and occupied stock do not exert strong influences on prices. Both the effect of **vacant housing** and **nominal interest rate** are strong and negative while **expected appreciation** is a positive influence. In addition, nominal rates are not sufficient to explain price changes. Rather, it is the interaction of nominal rates and expectations, the real interest rate to the borrower, that affects market prices. Real rates change over time because there is a lag in the process of expectations being reflected in nominal rates. Nominal rates played a role too, primarily in the formation of appreciation expectation.

In the study of the determinants of the average rate of housing sales in the US residential real estate market, Cotter and Hoesli (1994) included as explanatory variables the macroeconomic variables of **inflation, interest rate** (proxied by both mortgage rate and monthly payment)**, economic activity** (proxied by consumer spending, business incorporations, capacity utilization and personal savings rate) and **unemployment rate**. The result shows that the **number of business incorporations**, which indicates an improving economy, has a positive impact on the average sales rate. On the other hand, the sales rate is negatively influenced by the **unemployment rate** and **consumer spending**. Significance of consumer spending indicates a trade-off between consumer spending and housing investment. While both **monthly payment (a measure of affordability of housing)** and mortgage rate variables are negatively signed, the former has a greater

impact on home sales and renders the latter insignificant when put together in the model. Monthly payment is, therefore, considered as a better measure of the impact of interest rate.

There are several studies on residential property prices in Hong Kong. In studying the effect of speculation on residential property prices, Chau and Lam (2001) included a mix of micro and macro explanatory variables in the price determination model. These variables include **lagged price change, nominal GDP, stock market performance** (Hang Sang Index), **transaction volume, marriage rate, error correction term, real interest rate**, **speculation** (measured by changes in the intensity of confirmor transactions) and **housing supply** (measured by the number of residential units with consent to commerce work). All these variables are found to be significant determinants of the official housing price index. While housing supply, error correction term and real interest rate exert negative influence on prices, other variables have positive impact. In addition, both real interest rate and speculation have contemporaneous relationship with house prices. Except nominal GDP which lags behind price by 1 quarter, all other variables lead the price by 1 quarter.

In testing for property price bubbles in the residential housing market in Hong Kong, Peng (2002) regressed changes in real housing prices against its own lags and a set of demand and supply variables and their lags. These explanatory variables are changes in **unemployment rate, real interest rate** and **growth in the real rental index, in the potential demand** i.e. **the number of households adjusted for public housing stock** and **in the private housing stock**. All are found to be significant with real interest rate,

unemployment rate and private housing stock exerting lagged or contemporaneous negative impact on housing prices. Others have lagged positive influence.

4.3.2 Review of Office Property Market Research

Among the commercial property sectors, published researches concentrate largely on the office sector. These researches produce a variety of econometric models to investigate the effects of macroeconomic variables on office rents and prices.

One of the earliest documented reviews of time series rent explanation/prediction models in the UK is provided by Gardiner and Henneberry (1988). The model is a single-equation one based on demand-supply framework. It takes regional office floorspace as a supply variable, in addition to the demand-side variables of regional GDP, unemployment, average incomes and service sector employment. The final cross-sectional model finds a relationship between regional office rent index with regional **GDP lagged two years** and **contemporaneous office floorspace** in which GDP is statistically more significant than office floorspace. The impact of lagged GDP on office rent across the regions studied is generally positive and that of floorspace is negative, though some regions exhibit incorrect sign.

This single equation approach to modelling rent determination is also common outside the UK market. In the study of office rental trends in 10 European cities over the period 1983-1991, Giussani et al (1992) adopted a demand-driven model by examining the relationship between changes in office rents and demand-side variables which capture fluctuations in economic activities. The authors incorporate **real GDP, unemployment**

rate, employment in service sector and **real long-term interest rate** as the explanatory variables. The results suggest that European office rental values are determined by these demand-side variables and in particular **GDP** and **unemployment rates**.

To further extend the research on European office market, D'Arcy et al (1997) examined the influence on office rents in 22 European cities of broad economic trends, and market size over the period 1982-94. The authors constructed a time-series cross-sectional model in which economic growth is proxied by **changes in real GDP, real interest rate** and **service sector employment** while market size is proxied by **office stock**. The results demonstrate the significance of national **real GDP changes** and **real interest rates** in explaining European real office rental movements but market size appears to have insignificant impact.

Aiming to explain new office development, Tsolacos et al (1998) developed three-equation model. The authors estimated econometric models for rents, capital values, and development activity in the national office market in Great Britain. Put it another way, the user, investment and development markets are estimated. In the *user market*, c**hanges in real GDP, employment, volume of new office building output** are used as explanatory variables of the changes in real office rents. Results show that all these variables are significant with 1st, 2nd and 3rd quarterly lags of employment being the strongest variables followed by 2 to 3 quarters lags of changes in GDP. Both have positive impact on rents. The new office output lagged 10 quarters is a negative influence but the magnitude of impact is much smaller than the two demand-side factors, establishing the significance of demand side variables in the user market. In the *investment market*, **lagged rental values,**

real interest rate (both short and long term) and **volume of new office building output** are postulated to affect real office capital values/prices. While diagnostic tests indicate specification problem in this equation, capital values are found to respond to changes in **rents lagged by only one quarter**, implying effective interaction between user and investment markets. **Shot-term real interest rate** appears significant as well, indicating the effect of interest rates operating through the discount model or through price adjustment in financial assets when interest rates change. As for the *development market*, **changes in rental** and **capital values lagged by up to 2 years** appear to affect trends in office building output. This reflects the importance of user and investment market signals in the determination of office building output. The current development is also affected by **interest rate changes with a lag of 9 quarters**, though the effect is weaker than rental and capital values.

On the other hand, there are also macroeconomic studies of office rents in Hong Kong. Ng (1998) studied the effects of **inflation, interest rates and vacancy rates** on the rental adjustment process over the period 1980-1996. Results indicated that real rental changes respond negatively to the **deviations of actual and natural vacancy rates**.

4.3.3 Review of Industrial Property Market Research

In the study of industrial property price and rent, much effort has been devoted to the microeconomic perspective, focusing on the physical/property-specific characteristics of the industrial space such as ceiling height, floor loading, dock doors, accessibility, location and the like. Examples include Ambrose (1990), Hartman (1991), Rauch (1993),

Sivitanidou and Sivitanides (1995) in the U.S.; Salway (1986) and Hillier Parker (1987, cited by Thompson and Tsolacos, 1999) in the U.K; and Yau (2002) and Lau (2005) in Hong Kong.

As noted by Allen et al (1995), full examination of a price function requires consideration of the aggregate market in which properties compete. However, there is no comprehensive research in Hong Kong on the relationship between macroeconomic factors and industrial property price or rent at the aggregate level. Fortunately, a number of overseas studies, primarily in the U.S. and the U.K., have been conducted to examine various regional or national macroeconomic determinants of industrial property price or rent or both. In order to provide valuable insights into the selection of explanatory variables and investigation approach of this study, their studies and results are reviewed in the following section.

In addition to incorporating physical and locaitonal attributes, some overseas (particularly the U.S.) studies model industrial property price using demand-side variables at the macroeconomic level. To overcome the problem of multicollinearity among variables proxying for different determinants of industrial property price, Lockwood and Rutherford (1996) used the linear structural relations model that incorporate demand-side variables namely **employment, income level** and **gross product** adjusted for inflation at both regional and national level. While physical and locational characteristics and regional market variables are found to be influential of the local industrial property price in Dallas/Fort Worth area, national market factor and interest rate factor are insignificant. Likewise, a sub-sector study of the industrial warehouse rent determinants in the same

Dallas/Fort Worth area by Buttimer et al (1997) showed that real industrial rents are related to changes in **prior year net employment** and a number of physical features.

The importance of regional over national variables in industrial property price or rent determination may be due to the fact that the former is much more representative (and so more significant) of the general economic/market conditions at the local aggregate level. Rational for focusing on the demand side variables can also be inferred from the study by Wheaton and Torto (1990). In their study of the national industrial property market[19] in the U.S., they found that 75% and 50% of total space is occupied by single user and owners respectively. Only a small portion is composed of multi-tenant, independently built, rental space. As a result, they concluded that the construction of industrial space may be based on the "investment" decision of firms rather than speculative real estate development i.e. supply may be based on demand. In other words, occupation demand is much more influential than investment demand. Result of their model confirms the dominant role of demand variables. Industrial completions (i.e. supply) are determined by changes in **output (or employment)** and by movements in the **after-tax cost of capital**. As these two factors are the bases of the demand (precisely the derived demand) for industrial space, supply is affected by demand.

Hillier Parker (1985, 1986 cited by Thompson and Tsolacos, 1999) suggested that industrial rent can be determined and forecasted by demand-side proxies which include the **volume of manufacturing output, level of manufacturing employment** and **volume of industrial production.**

[19] The data are from the Coldwell Banker Commercial survey which comprises about 130,000 industrial buildings with 7.3 billion sq. ft. representing about half of the nation's total stock of industrial space. Source: Wheaton and Torto, 1999, p. 532.

On the other hand, several studies employ a demand-supply framework to examine pricing and rental changes of industrial space. In the empirical study of the Dallas/Fort Worth industrial property market, Atteberry and Rutherford (1993) shows that **monetary base** (a proxy for demand for industrial real estate through its effect on firms' cost of capital), **industrial building construction** (a proxy for supply, capturing investors' perception of future industrial capacity) and **past industrial real estate prices** each Granger-cause changes in current industrial real estate prices. The result also indicates that the industrial property market may not be efficient in that current prices do not fully reflect past publicly available information. In their building of a commercial rental value prediction model, McGough and Tsolacos (1995) also suggested that current and future changes in industrial rents are influenced by **past changes in their rental values**.

These findings were further supported by the RICS study of the determinants of industrial rental values (RICS, 1994). At the national level, all lagged demand-side variables proxies: **rental level 1 year ago**, **manufacturing output 1 year ago** and **contemporaneous GDP growth rate** exert positive influence on the current level of industrial rents; except rental level 2 years ago which was a negative influence. As concluded by the study, this may be taken as representing the importance of non-industrial occupiers (such as distribution and low-grade services) in the industrial market. On the other hand, **change in construction starts 2 years ago** (a supply-side proxy) has negative impact (RICS, 1994, p.46). At the regional level, rental level (1 year ago), manufacturing employment and regional GDP (1 year ago) are strong positive demand side variables. On the supply side, both the **total stock (2 years ago)** and construction starts (2 years ago)

appear as negative influence on rental levels though their magnitude of impact is not strong. The results suggest that regional industrial markets are demand-driven with substantial variations in the supply-side response to demand (RICS, 1994, p. 50).

Recognizing the dual role of real estate as a factor of production and an asset, Dobson and Goddard (1992) developed a model in which prices and rents adjust to equate demand (buyers and tenants) and supply (sellers and landlords) i.e. multi-equation approach. Result shows that **changes in employment** and **house price** have strong positive effect on the price and rent for industrial properties while **real interest rate** exerts negative impact. The negative relationship between industrial property price and the interest rate (represented by **industrial capitalization rate** and **prime rate**) was also confirmed by Fehribach et al (1993).

Thompson and Tsolacos (1999) carry out an empirical study of industrial rent determination at the aggregate level in Britain. Two macroeconomic time series - GDP and manufacturing employment quarterly data are used to proxy demand influence, while the absorption rate of industrial floorspace is used to capture supply influence. Lagged industrial rents are also included as an explanatory variable. The real industrial rent model is given by the below equation:

$$\Delta_1 RENT_t = \alpha_0 + \sum \alpha_{1i} \Delta_1 GDP_{t-i} + \sum \alpha_{2i} \Delta_1 EMP_{t-i} - \sum \alpha_{3i} \Delta_1 VAC_{t-i} + \sum \alpha_{4j} \Delta_1 RENT_{t-j} + \varepsilon_t$$

for $i = 0, 1 \ldots I$ and $j = 0, 1, \ldots J$.

where Δ_1 signifies the first difference operator; RENT is an index of national industrial rents adjusted for inflation using the GDP implicit price deflator series and $RENT_{t-j}$

represents past changes in actual industrial rents; GDP is the volume of the gross domestic product; EMP is manufacturing employment; VAC is the level of industrial floorspace vacancy and $\Delta_1 VAC$ represents the absorption rate. t – i and t – j denote lags and I and J maximum lag lengths.

The result shows that all these variables except manufacturing employment, particularly their lagged rather than contemporaneous changes, are significant in explaining rental changes. Depending on the type of rental index (two indexes has been used: Jones Lang Wootton Index and CB Hillier Parker Index) used, **GDP** changes lagged 2 to 6 quarters; **absorption rate** lagged 5 to 7 quarters and **past actual rent changes** lagged 1 to 2 quarters are found to be influential. In addition, changes in real rents are positively related to changes in real GDP and past real rents but negatively to absorption rate. As the information contained by the EMP variable about changes in demand for industrial space is captured by the GDP series, EMP's explanatory power is greatly undermined and becomes insignificant.

White et al (2000) developed a time series econometric model of both demand and supply-side variables for property rental determination in Scotland, Great Britain, London and the South East of U.K.. In case of industrial properties, proxies for demand variables include **manufacturing employment**, **lagged rent (one year ago)** and **GDP** while **lagged new construction orders (one year ago)** are proxies for supply variables. The OLS model indicated that lagged rent and GDP are significant in all regions. Manufacturing employment has a significant impact in all areas except Great Britain while lagged new construction orders only affect (and negatively) rents in Scotland. Difference in the local

economic/market conditions across these regions may be the reason for the different role played by the demand-supply variables in determining the rents.

4.4 Summary of Literature Review

The literature review establishes important theoretical fundamentals for this study. Firstly, while both single and multi-equation approaches have been used, single equation is popular among researchers due to its simplicity in formulation and estimation. In this study , single equation approach will also be adopted. Secondly, while some researches are based on demand-driven ideology, vast majority of researches adopt the demand-supply interactive framework. To be theoretically sound and to be comprehensive, this study will also be founded on demand-supply interaction. Thirdly, it is revealed that various variables are likely to affect real estate rents or prices. The demand-side variable is commonly proxied by such general economic trends as GDP, consumer expenditure, income, employment, unemployment rate and interest rate. The supply-side variables commonly included are existing stock and new building output/order. All these provide inspirations into the structure and choice of explanatory variables for this study.

Chapter 5 Methodology

5.1 Introduction

This Chapter will give an overall account of the approach for the identification and analysis of the major determinants of the industrial property prices at the macroeconomic level in Hong Kong. Section 5.2 will introduce the multiple regression analysis and the statistical tool for constructing and evaluating the industrial property price model.

5.2 Multiple Regression Analysis

This study aims at identifying and analysing the major determinants of industrial property price at an aggregate level in the local context. To establish the relationship between industrial property price and a number of proposed explanatory variables, it is common to use multiple regression analysis as the statistical tool.

This study will model the industrial property price in a single-equation econometric function estimated by Ordinary Least Squares (OLS) which means the function will be estimated from the data pool in a way that will minimize the sum of the squared differences between the actual and estimated values. As there is no prior knowledge of the functional form, a linear form is assumed. As confirmed by Wooldridge (2003, p.47), "for most application, choosing a model that can be put into the linear regression framework is sufficient". The industrial property price model can therefore be represented by the following general multiple linear regression model (also called the multiple regression model):

$$PRICE = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + \ldots + a_nX_n + \varepsilon$$

where PRICE is the industrial property price index, which is the dependent variable; X_1, X_2, … , X_n are the n independent or explanatory variables to be tested; a_0 is the constant term or the intercept; a_1, a_2, a_3, …, a_n are the parameters to be estimated; and ε is the stochastic term[20].

5.2.1 Statistical Tool and Tests

To perform the multiple regression analysis, a computer software, EViews[21], will be used. In this software, three statistical tests, namely coefficient of determination, F-statistic and t-statistic, can be employed to investigate the significance and impact of each explanatory variable on the dependent variable as well as the overall significance and explanatory power of the model.

(1) Coefficient of Determination (R-squared)

The R-squared or the coefficient of determination indicates how well the OLS regression line fits the data i.e. the explanatory power of the model specification. The value of R^2 is always between zero and one, with one indicating a perfect fit. For example, an R^2 of 0.8 means that 80% of the variation in the dependent variable is explained by the variations of the explanatory variables. However, since R^2 increases as more independent variables are added to the model, it is not a good measure of the goodness-of-fit. Instead, adjusted R^2 will be used and interpreted in this study as it is unaffected by the addition of variables.

[20] The stochastic or error term is assumed to follow a normal distribution.
[21] EViews, Version 3.0, Copyright @ 1994-1998, Quantitative Micro Software.

Adjusted R^2 will never be higher than R^2. While the value of R^2 is between 0 and 1 only and can never be negative, adjusted R^2 can have a negative value especially when the model is poorly specified.

(2) t-statistic or p-value

The absolute value of the estimated coefficient indicates the effect of a unit change of an explanatory variable on dependent variable, ceteris paribus. In addition, the sign of each estimated coefficient tells whether the relationship between the dependent variable and the explanatory variable is positive or negative.

While the absolute value of the coefficient indicates the effect of an explanatory variable on the dependent variable, the corresponding t-statistic will indicate whether the coefficient is statistically significant. If the t-statistic is greater than the critical value (by checking the t-table), the variable is significant. Alternatively, the significance of each variable can be directly and easily assessed by looking at the p-value. The closer the p-value to zero, the more significant the variable is. If the p-value is 0.04, the corresponding coefficient is significant at 96% confidence level i.e. we are 96% confident that the estimated value of the coefficient will not be equal to 0. Usually, the coefficient is said to be significant at the 5% level.

(3) F-test for overall significance

The F-statistic tests the null hypothesis that all the coefficients are equal to zero. If it is greater than the critical value, the null hypothesis is rejected, affirming that at least one of

the explanatory variables helps to explain the dependent variable. Similar to the p-value for t-statistic, p-value for the F-statistic is available to check whether the above null hypothesis is rejected or not. If the p-value is smaller than the required significance level, the null hypothesis is rejected. For example, if the p-value = 0.024, the null hypothesis is rejected at the 5% significance level.

5.2.2 Diagnostic Tests

In applying OLS techniques in estimating a regression model involving time series data, there may be the problems of non-stationary, autocorrelation/serial correlation and heteroskedasticity.

(1) Test of Stationary

As pointed out by Chau and Lam (2001), most time series models have trends, specifically an upward trend. This means they are not stationary. If a time series is non-stationary, then all the typical results of the classical regression analysis are not valid. Regression with non-stationary series have no meaning and are therefore called "spurious" (Asteriou, 2006, p. 247). Augmented Dickey-Fuller test in the EViews can be used to test for stationary. If a series is non-stationary, it can be rendered stationary by applying differencing i.e. compute the absolute changes from one period to the next which is known as first-order differencing i.e. it is I(1).

(2) Autocorrelation/Serial correlation

Autocorrelation occurs when the covariances and correlations between different disturbances or errors are not zero. This means that the disturbances are not pairwise independent but are pairwise autocorrelated (or serially correlated), indicating that an error occurring at period t may be carried over to the next period t + 1 (Asteriou, 2006, p.140).

In order to test for autocorrelation, the Durbin-Watson (DW) test will be performed. According to Asteriou (2006, p.149), the rule of thumb is that if the DW test statistic is very close to 2, then serial correlation is not a problem.

(3) Heteroskedasticity

Heteroskedasticity occurs when the assumption that the variance of the unobservable error (conditional on the explanatory variables) is constant is violated. This means the variance of the unobservable factors changes across different segments of the population, where the segments are determined by the different values of the explanatory variables. The presence of heteroskedasticity will adversely affect the validity of t tests, F tests and confidence intervals for OLS estimation of the linear regression model, even with large sample size (Wooldridge, 2003, p.257).

To test for the presence of heteroskedasticity, White's Test will be performed. After correcting for heteroskedasticity, the coefficient of the explanatory variables may become larger or smaller which means that the corresponding p-value may be changed. Therefore, by comparing the significance of the coefficients in the corrected model (with White's Test

being performed) with that in the original model, the magnitude of the problem of heteroskedasticity can be gauged.

Chapter 6 Empirical Model

6.1 Introduction

This Chapter will provide an overview of the empirical model for investigating the principal determinants of industrial property price at the macroeconomic level in Hong Kong. Section 6.2 will describe the explanatory variables that are hypothesized to determine the industrial property price. The model specification will be constructed on the basis of multiple regression function. Section 6.3 will give an account of all the proposed variables with justification by referring to the local situation in Hong Kong and previous studies. The expected effect of the chosen independent variables on industrial property price will also be given with a specification of the expected sign of their coefficients. Section 6.4 will be the data specification section, defining the period of study, source of data and describing any necessary data transformation involved.

6.2 Model Specifications

As discussed in Chapter 5, I have examined the demand-side and supply-side forces that determine the property prices in the industrial property market. In summary, at any point in time the demand function is

Qd = *fd* (Demand-side factors, IPP)

where Qd is quantity of industrial property demanded and IPP is industrial property price and the supply function is

Qs = *fs* (Supply-side factors, IPP)

where Qs is quantity of industrial property supplied and IPP is industrial property price.

At equilibrium

$$Qd = Qs = Qe$$

Substituting this into the supply and demand function yields the following reduced form equation which expresses equilibrium industrial property price (IPPe) as a function of supply-side and demand-side factors

$$IPPe = f(\text{Demand-side factors, Supply-side factors}) \quad (1)$$

To operationalize the above model for empirical estimation, the functional form needs to be specified. For simplicity, I have assumed a linear model, which will be estimated using time-series data. The time series data will also need to be tested for unit roots to ensure stationarity before they can be included in the empirical model. Sections 6.3 and 6.4 describe the variables included in the model.

The observed industrial property price index for private flatted factories (DP) is taken as a measure of the equilibrium price level and is therefore included as the dependent variable. Since previous studies show that it is probable for property price or rent to have frictional response to the changes in the explanatory variables, time lag effect will be incorporated. For each explanatory variable, both contemporaneous and lagged changes will be considered. However, since the maximum lag length and the most significant lag for each explanatory variable cannot be determined *a priori*, it will be estimated by referring to previous studies (particularly those in Hong Kong) and by trial and error.

Following RICS study (RICS, 1994) and Thompson and Tsolacos (1999), it is assumed that a period of two years in the past provides a sufficiently long time horizon for price movements to reflect the effects of different explanatory variables. The use of quarterly data in this study means that the maximum lag length is up to eight periods.

The review of previous industrial pricing and rental determination models overseas identifies several common variables used to proxy the demand for industrial space. With specific consideration of the manufacturing restructuring and government industrial land use policy changes and with reference to previous research in other property sectors, twelve demand-side variables which are hypothesized to affect the industrial property price will be incorporated into the model specification. They include Re-export Volume (REV), Manufacturing Sector Employment (PS), Industrial Production (IP), Service Sector Employment (SS), Interest Rate (RI), six major industrial land use policy changes (F1, F2, F3, F4, F5 and F6 as dummy variables) and Lagged Price Changes Effect (AR(1)[22]). These demand-side variables reflect the broad trends and development of the economy and the characteristics of the industrial property market, thereby capturing the overall demand for industrial space. As for the supply-side variable, Supply of Private Flatted Factories (YS) will be incorporated. Proxies for the demand-side and supply-side variables are summarized in Table 6.1. Details and justification for selecting these explanatory variables are provided in the next section. With specification of the explanatory variables, Equation (1) will now be refined into the following:

[22] This abbreviation AR(1) derives from the fact that the autoregressive of order one model or AR(1) model in the EViews can be used to reflect the impact of the recent past industrial property prices (i.e. lagged price changes) on the current industrial property prices changes.

$$DP_t = a_0 + a_1REV_{t-k1} + a_2PS_{t-k2} + a_3IP_{t-k3} + a_4SS_{t-k4} + a_5RI_{t-k5} + a_6F1_{t-k6} + a_7F2_{t-k7} + a_8F3_{t-k8} + a_9F4_{t-k9} + a_{10}F5_{t-k10} + a_{11}F6_{t-k11} + a_{12}YS_{t-k12} + a_{13}AR(1) + \varepsilon_t \quad (2)$$

for each of k1, …, k12 = 0, 1, 2, 3, 4, 5, 6, 7 or 8; where k1, …, k13 represent the number of lag for their respective explanatory variables.

Table 6.1: Summary of Proxies of Different Variables

Variables in Model Specification	**Denoted by**	**Proxied By**
Dependent Variable		
Industrial Property Price	DP	Industrial property price Index for Private Flatted Factories
Independent/Explanatory Variables		
Demand-side Variables		
Re-export Volume	REV	Re-export Quantum Index
Manufacturing Sector Employment	PS	Number of Persons Engaged in Manufacturing Sector
Industrial Production	IP	Industrial Production Index
Service Sector Employment	SS	Number of Persons Engaged in Manufacturing Related Service Sectors: 1) Transport, Storage and Communications; 2) Wholesale, Retail and Import and Export trades, Restaurants and Hotels
Interest Rate	RI	3-month Hong Kong Dollar Interbank Offered Rates (Hibor)
Industrial Land Use Policy Revision in December 1990	F1	Dummy Variable (Q1 1991 & onwards = 1, 0 for otherwise)
Industrial Land Use Policy Revision in July 1992	F2	Dummy Variable (Q3 1992 & onwards = 1, 0 for otherwise)
Industrial Land Use Policy Revision in October 1993	F3	Dummy Variable (Q4 1993 & onwards = 1, 0 for otherwise)
Industrial Land Use Policy Revision in January 1994	F4	Dummy Variable (Q1 1994 & onwards = 1, 0 for otherwise)
Industrial Land Use Policy Revision in September 1997	F5	Dummy Variable (Q4 1997 & onwards = 1, 0 for otherwise)
Industrial Land Use Policy Revision in September 2001	F6	Dummy Variable (Q4 2001 & onwards = 1, 0 for otherwise)
Lagged Price Changes Effect	AR(1)	Autorgressive of Order One or AR(1)
Supply-side Variable		
Supply of Private Flatted Factories	YS	Stock of Private Flatted Factories at Year End

6.3 Investigations of the Variables

In this section, variables in the proposed industrial property price model will be investigated. For the dependent variable i.e. the private flatted factory price index, its general trend in Hong Kong will be reviewed. For the independent variables, the rationale for their selection and inclusion in the model will be provided with justifications by referring to previous studies and local conditions in Hong Kong. While the significance of the dummy variables for industrial land use policy changes cannot be determined *a priori* and has to be ascertained through the regression analysis, other independent variables are all expected to be statistically significant in the result.

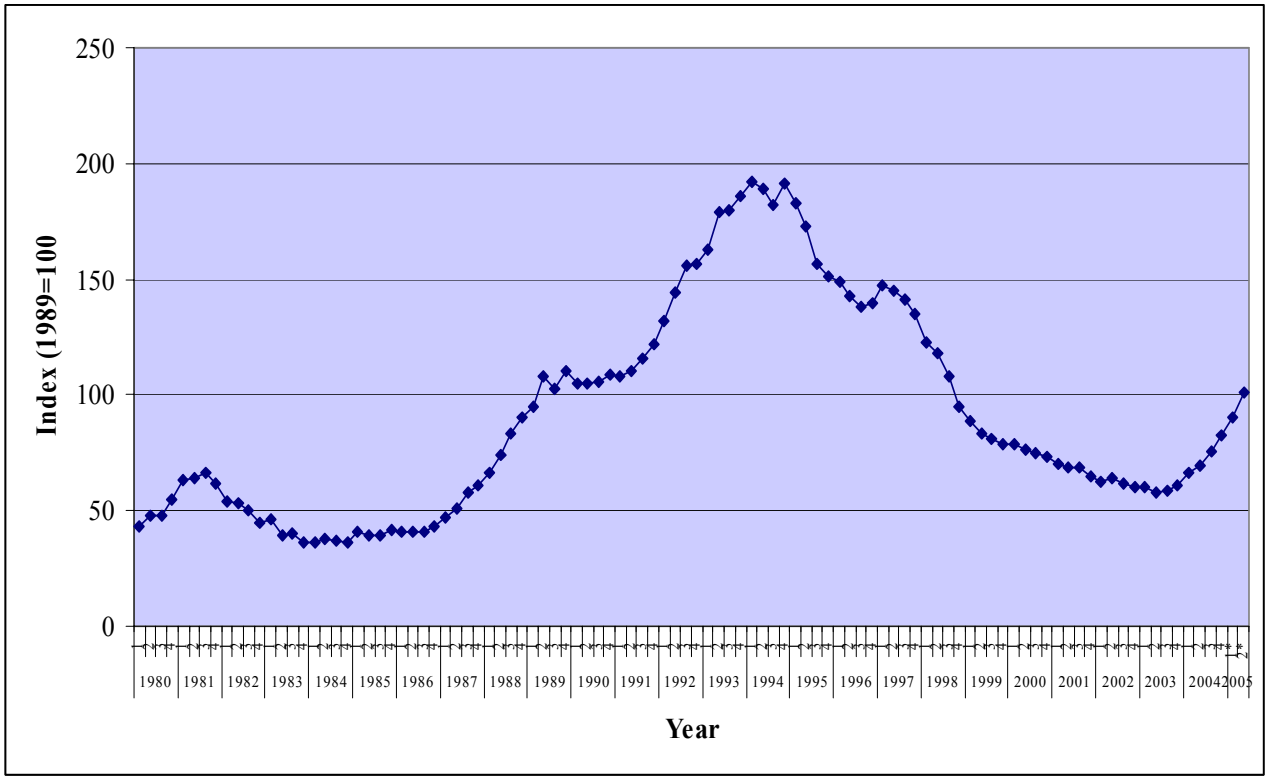
6.3.1 Dependent Variable

Industrial property price (DP)

Industrial property price (DP), the private flatted factories price index, is regressed on thirteen independent variables to identify the principal determinants of industrial property price at an aggregate level. In Hong Kong, Private Flatted Factories Price Index is compiled by the Rating and Valuation Department. It measures the change in average industrial property price per square meter with reference to a base year (1989). As can be seen from Figure 1.1 on page 4 (reproduced below as Figure 6.1 for easier reference), since 1981, industrial property price started to fall and stayed at a low level between 1983 and 1986. The period between 1987 and 1994 was marked by a general increasing trend with some adjustments in the later part of 1989 and levelling off development until 1991 when the industrial property price picked up its rising momentum again reaching its highest level

in 1994. However, from 1995 onwards, the price began to fall. The magnitude of fall was the greatest between 1997 and 1998 amidst the Asian Financial Crisis. Though the degree of fall started to taper off, industrial property price continued to fall reaching its trough in 2003 when Hong Kong was trampled by SARS. Recovering with the economy, the price has experienced an increasing trend from 2004 onwards. In 2005, the average industrial property price was 10,587 per square meter.[23]

Figure 6.1: Kong Private Flatted Factories Price Index (1980 Q1 - 2005 Q2)



[23] In 2005, the average prices in Hong Kong, Kowloon and New Territories were HK$10,736, 13,997 and 7,028 respectively. Source: Rating and Valuation Department (2006) Hong Kong Property Review 2006. Hong Kong: Rating and Valuation Department.

Source: Rating and Valuation Department, Property Review/Hong Kong Property Review, various issues

6.3.2 Independent Variables

Demand-side Variables

Re-export Volume (REV)

Under the concept of derived demand, the demand for industrial space is derived from the demand for manufactured goods. As manufacturing industry in Hong Kong has always been export-oriented, the demand for manufactured products can be directly indicated by the re-export figure. Some may view total export figure (being domestic export plus re-export) as a better indicator. Reason for not using this figure as a proxy of the demand for manufactured products is twofold. Firstly, while domestic export dominated the export activities prior to the mid-1980s; from 1985 onwards with massive relocation of production activities and the rapidly growing service and finance sectors, domestic export has shrunk rapidly. By 2004, it only accounted for about 6% of the total export. Secondly, re-export activity is representative of the changing nature and characteristics of the manufacturing sector – away from production-oriented towards non-production and supportive oriented. In fact, as discussed in Section 2.3, the industrial development and restructuring in Hong Kong can be gauged by looking at the development of re-export sector.

In previous studies, GDP has been the usual and popular measure of local economic condition affecting the property market. However, in this study, GDP is not

included as a demand-side variable. The key reason is that being an indicator of the local economic conditions, GDP does not really reflect the economic conditions affecting the manufacturing sector which is export-oriented. In Hong Kong, there are two main ways to compile GDP: expenditure and factor cost approaches. By expenditure approach, GDP is the total final expenditures on goods and services[24] less imports of goods and services. As shown, these GDP components may not have any relationship with the manufacturing sector. The exports of goods and services do affect the sector but after deducting the imports of goods and services, the figure is one of net trade position which does not reflect the export market conditions faced by the sector. Likewise, under the factor cost approach, components such as construction and agriculture do not have any relationship with the demand for industrial space. Besides, manufacturing activity only accounts for less than 4% of GDP in 2004 (see Table 1.1 for information on components under this approach).

In addition, as pointed out by Jones (1995) in his study of the office property market in the UK, GDP is not an obvious measure of office demand because commercial services only represent approximately 60% of GDP and there is not necessarily any linkage between GDP and demand in the office market. Moreover, as criticized by Leishman (2003), most single equation rent models tend to include such variables as GDP or service sector employment as proxies for office demand, these models do not contain a direct or explicit link between occupation demand and office rents. Therefore, in this study re-export will be used, which is a direct and better indicator of both the demand for

[24] These include private consumption expenditure, government consumption expenditure, gross domestic fixed capital formation, changes in inventories and exports of goods and services.

manufactured output (and in turn industrial space) and the economic conditions affecting the sector.

Manufacturing Sector Employment (PS)

The number of persons engaged in the manufacturing industries will directly affect the industrial spatial demand. The greater the number of person employed, the larger the occupying space required, *ceterus paribus*. It is an indicator of the basic spatial requirement for the manufacturing sector. This variable is particularly relevant given the nature and characteristics of industrial restructuring in Hong Kong. Several courses of industrial restructuring have indeed shifted Hong Kong from the production of low-technology, labour-intensive, light consumer goods to production of higher value-added services. However, as commented by some scholars, rather than developing product-based and technology-based advantage, industrialists tided over the challenges by relocating production base and becoming engaged in outward processing activities in China. In other words, though there has been increase in the level of automation, labour remains as an important factor of production. This can be exemplified by the fact that the average number of persons engaged in manufacturing industries has been in a narrow range of 10-14 since 1990, without prominent change.

The importance of employment in price or rent determination is also demonstrated by numerous previous studies e.g. Giussani et al (1992), and Tsolacos et al (1998) in office property studies. In the realm of industrial property market studies, manufacturing employment is widely recognized as an important explanatory variable. What is more, it is generally found to be significant e.g. Hillier Parker (1985, 1986 cited by Thompson and Tsolacos, 1999), Wheaton and Torto (1990), Dobson and Goddard (1992), Lockwood and Rutherford (1996), Buttimer et al (1997), and White et al (2000). In fact, as summarized by

Chaplin (2000) in the comprehensive review of literature on real estate rent studies, the "consensus" explanatory variables for industrial sector include manufacturing output, manufacturing employment and industrial new orders.

Industrial Production (IP)

In Hong Kong, manufacturing output can be measured by the industrial production index. According to the Census and Statistics Department (2006 website), this index reflects changes in the volume of local manufacturing output after discounting the effect of price changes. The price changes are measured by the producer price indices for manufacturing industries compiled from data on producer prices of industrial goods/services. While re-export volume is an indicator of economic conditions affecting manufacturing sector and employment is an indicator of the basic spatial requirement, industrial production index is an indicator of the overall activity or momentum in the sector. Therefore, industrial production index together with re-export and manufacturing employment proxy for the profitability of occupying industrial premises, determining the derived demand for industrial space and in turn the industrial property price. Moreover, as justified in Chaplin (2000), manufacturing output is one of the two "consensus" demand-side explanatory variables for industrial rent determination studies.

Service Sector Employment (SS)

Service sector employment may not seem to be relevant to the industrial property market. However, a closer look will reveal that it may have implications on the industrial property

values. This is because of the institutional change in industrial land use policy as reviewed in details in Section 3.3. The relaxation of permitted uses in industrial buildings and the construction of I/O buildings permitted as of right coupled with the growing office decentralization mean that the demand in the industrial property market may not only come from the manufacturing sector but also from other related service sectors.

Indeed, not all service sectors will choose to or be allowed to be located in the industrial/IO premises. According to the Census and Statistics Department (2006 website), in compiling the employment statistics (other than those in Civil Service), the industry sector is classified into the following 8 types:

1) Mining and quarrying
2) Manufacturing
3) Electricity and gas
4) Construction sites (manual workers only)
5) Wholesale, retail and import and export trades, restaurants and hotels
6) Transport, storage and communications
7) Financing, insurance, real estate and business services
8) Community, social and personal services

Categories 5 to 8 are collectively regarded as the service sector employment. Among these service sectors, activities (except retail and hotels) in categories 5 and 6 not just have close linkage with the manufacturing sector but also are permitted in industrial or I/O buildings after institutional planning changes. It must be admitted that not all employment in these two sectors will be accommodated in industrial or I/O premises. In general, however, they

represent a good proxy of the additional demand for industrial space from eligible sectors after the changes in planning policy on industrial land use. Moreover, as pointed out by Yau (2002), many companies of non-manufacturing nature have been found to locate their offices in industrial premises which means that non-conforming use in industrial buildings is common, particularly with growing trend of office decentralization and in times of rising office rental. For these reasons, employment in categories 5 and 6 will be included as a demand-side proxy in this study.

Interest Rate (RI)

In the property market, capital availability is an influential element of property purchase which involves a large sum of capital. As demonstrated by Follain (1982), at high interest rates, the households' liquidity problems tend to dampen housing demand. Similar conditions can be inferred for other property types. High interest rate raises the cost of capital and adds to the real burden of debt payments for potential buyers who will then be discouraged to purchase. This in turn reduces the demand for property exerting a downward pressure on property prices.

In addition, as pointed out by Liow (2000), in valuing properties, rents are capitalized using an initial yield which is dependent, *inter alia*, on nominal interest rates. Therefore, in high interest-rate environment, increased yields will lead to falls in capital values of commercial properties. By directly affecting both cost of capital and property yield, interest rate is considered to be a major determinant of property price. As a result, interest rate is commonly employed in various local and overseas studies to capture its

effect on property rent or price such as Harris (1989) and Tse (1996) in housing market; Giussani et al (1992) and D'Arcy et (1997) in office market; and Dobson and Goddar (1992) and Fehribach et al (1993) in industrial market. All these provide support for the inclusion of interest rate in this study. Moreover, the inclusion of interest rate also enable the price determination model to be linked to the investment/capital market which has been ignored in a number of previous studies as criticized by Ball et al (1998) and Leishman (2003).

While interest rate has been widely incorporated in property rent or price determination model as an explanatory variable, different measures have been used to proxy for it. Cotter and Hoesli (1994) use mortgage rate and monthly mortgage payment to proxy interest rate in the study of residential sales rates in the U.S.. Fehribach et al (1993) employ both industrial capitalization rate and prime rate as interest rate proxy. Wu (1999) adopt best lending rate rather than mortgage rate as interest rate proxy due to data unavailability for mortgage rate. As properties are both lumpy and costly, most purchasers need to borrow loans from financial institutions, particularly banks. The loan interest rate thus becomes a crucial factor affecting buyers' purchasing decisions. In the context of Hong Kong, to the financial institutions, their cost of funding is determined to a large extent by the Hong Kong Dollar Interbank Offered Rates (Hibor). Their cost of funding in turn determines the interest rate charged on their corporate customers, including those manufacturing companies which are the key consumers in the industrial property market. As such, Hibor (3-month) is used as a proxy for interest rate in this study.

On the other hand, Harris (1989) concluded that housing demand was a function of expected inflation and the real interest rate but that demand could not be specified as a function of the nominal rate. Housing prices are affected by real interest rates because housing consumers tend to respond to declining real costs rather than rising nominal costs. It is the interaction of nominal rates and expectations, the real interest rate to the borrower, that affects market prices of properties. Studies by Wong et al (2003) also indicated that interest rates do not "Granger-cause" housing prices and that the positive interest rate effect in deflationary periods seems to have been negated by anticipated capital losses. In other words, property demand is affected by real rather than nominal interest rate. Following these studies, real interest rate will be adopted in this study.

The concept of real interest rate requires some elaboration. Fisher (1930) (cited by Wong et al, 2003) found that interest rate (or nominal interest rate) is made up of expected ex-ante real interest rate and expected inflation rate. Fisher posited that people form expectations by taking a weighted sum of current and past actual rates of inflation. Therefore, in theory, real interest rate means ex-ante real interest rate which is equal to nominal interest rate less expected inflation. However, in reality, there is no direct way to measure this real interest rate, but it can be represented by an ex-post real interest rate which is the nominal interest rate less observed inflation. The construction of real interest rate for this study will be detailed in the data specification and transformation part in the next section.

Industrial Land Use Policy Revisions (F1 – F6)

As discussed in details in Section 3.3, there are 6 major industrial land-use planning policy revisions made by Town Planning Board between 1990 and 2001. Since there is no prior knowledge about their influence and in order to ascertain their significance, 6 dummy variables (F1 to F6) are used as their proxies. Inclusion of these institutional policy changes as explanatory variables is justified by the fact that being the regulator of land use in Hong Kong, government has a pivotal role in influencing the industrial property market through its policy changes. After all, given transaction cost, there is no perfect market in the world. Even in one of the freest markets in the world as Hong Kong, the demand and supply forces have to operate within a given institutional framework. Moreover, unlike most other western countries, the industrial space in Hong Kong is dominated by multi-storey multi-tenant flatted factory buildings located in metro urban areas. The industrial property market would have had a very different development had the government not amended its land use planning policies in face of massive production relocation and changing nature of industrial activities in Hong Kong.

Lagged Price Changes Effect (AR(1))

The final specification of the demand-side variable makes use of the results of Atteberry and Rutherford (1993), RICS (1994), McGough and Tsolacos (1995), Thompson and Tsolacos (1999) and White et al (2000). These authors found strong evidence that industrial rents or prices can be reasonably modeled autoregressively. This means that recent past information on industrial property prices or lagged price changes effect can be

used to explain prices in the current period. As pointed out by Thompson and Tsolacos (1999), this findings is important to the construction of industrial property price equations, since past values of prices can be included assuming they convey information that is not contained in other explanatory variables.

Moreover, as reasoned by Chau and Lam (2001) in their study of the impact of speculation on residential property prices, with the existence of high transaction costs and low transaction volume, there is frictional response of housing prices to shocks. This essentially means that housing market will not clear within one period but adjust gradually as households adjust their housing consumption gradually. In other words, partial adjustment model which includes lagged prices as independent variable is likely to represent the reality. This is further justified by the fact that expectation of future prices is formed on the basis of historical price movement. Since industrial market and housing market are part and parcel of the overall property market in Hong Kong, this partial adjustment model incorporating lagged prices is also applicable in the study of industrial property prices.

Supply-side Variable

Supply of Private Flatted Factories (YS)

According to the law of demand and supply, property rent or price is determined by the joint forces of demand and supply. Theory indicates that an increase in the supply of property should lead to a decrease in property rent or price and vice versa, *ceterus paribus*. Atteberry and Rutherford (1993), RICS (1994), Thompson and Tsolacos (1999) and White

et al (2000) justify that industrial space supply has a significant impact on industrial rents or prices. However, as there is time lag for rents or prices to respond to changes in supply because property market is imperfect with poor information flow and a limited number of transactions, the impact of supply on industrial property price is dependent on how efficiently supply responds to demand changes. Timing of the supply is also important as it affects people expectation and response to changes in supply.

As discussed in Section 4.2.2, though rent surplus model discounts supply-side influence and property value is primarily demand-determined in the short run due to inelastic property supply, supply-side proxy should be incorporated in the price determination model in order to be theoretically sound and to capture the price movement, particularly market price rather than ceiling price. It is noted that new industrial building output or order is commonly employed as the supply proxy in the study of industrial rent or price. In this study, year end stock of private flatted factories will be employed as the supply proxy. This is mainly due to the availability of complete record of supply data since 1970s. In addition, the year end stock is in effect an indicator of the net supply of industrial space because it is computed as the beginning stock plus new completion minus demolition during the year. As it takes into account, existing stock, new addition and new demolition during the year, it is a relatively more comprehensive figure than other stock data.

6.3.3 Expected Signs of Coefficients of Independent Variables

The independent variables have been carefully evaluated and selected after reviewing past literature and considering the specific situations of Hong Kong, particularly its

manufacturing development and institutional land use policy changes. While the significance of the dummy variables for industrial land use policy changes cannot be determined *a priori* and has to be ascertained through the regression analysis, other independent variables are all expected to be statistically significant in the result. Before starting the regression analysis, their expected signs of coefficients are discussed in this section. The expected signs are determined on the basis of the expectations of their impacts, either positive or negative, on the average industrial property price in Hong Kong. The expected signs of all independent variables are summarized in Table 6.2.

Re-export Volume (REV)

As discussed, there is a direct relationship between re-export and the manufacturing sector and in turn the industrial property market. Given the export-oriented nature of the industrial sector, an increase in re-export not just indicates an increase in demand for manufactured goods and services but also a favourable economic condition for the manufacturing sector. As industrial space is a factor of production in the industrial sector, a higher demand for manufactured goods and services will directly lead to a higher demand for industrial pace. This will, in turn, drive up the industrial property price level, particularly in the short-run when supply is largely inelastic. As such, the independent variable of re-export quantum index is expected to have a positive sign of coefficient.

Manufacturing Sector Employment (PS)

As widely recognized, the number of persons engaged in the manufacturing industries will directly affect the industrial space required. As there is a minimum physical space requirement for each person employed, the greater the number of person employed, the larger the industrial space required *ceterus paribus*. In other words, there is a positive relationship between manufacturing employment and industrial property price. The study by Lockwood and Rutherford (1996), Buttimer et al (1997), Dobson and Goddard (1992) and White et al (2000) all indicated a significant and positive relationship between industrial rent or price and the manufacturing employment. These illustrate that manufacturing employment generally has a positive impact on industrial property prices and so it is expected to have a positive sign.

Industrial Production (IP)

As pointed out earlier, industrial production index together with re-export and manufacturing employment constitute the key components of the derived demand for the industrial space. Therefore, similar to the above two explanatory variables, IP is expected to have a positive relationship with industrial property price. The positive role of manufacturing output or industrial production is also confirmed in the study of the industrial rents by Hillier Parker (1985, 1986 cited by Thompson and Tsolacos, 1999) and RICS (1994).

Service Sector Employment (SS)

The influence of the service sector employment on industrial property price should be similar to that of the manufacturing employment except that the former exerts an indirect rather than direct impact on the demand for industrial space. This is particularly the case as the industrial space demand derived from the related service sectors is affected by such factors as changes in the office rentals/prices and the pace of relaxation of the permitted commercial uses in the industrial buildings. Despite this indirect relationship, *ceterus paribus*, an increase in related service sector employment will increase the demand for industrial space, driving up the industrial property price level. The sign of SS is, therefore, expected to be positive.

Interest Rate (RI)

The relationship between interest rate and industrial property price is expected to be a negative one. This negative relationship has been widely studied and shown in the previous research. In the residential property market, Harris (1989) showed that effect of real interest rate on housing prices is strong and negative in the U.S.. This is echoed in the findings of Tse (1996), Chau and Lam (2001) and Peng (2002) which show that housing prices are negatively affected by rising real interest rates in Hong Kong. Similarly, in the industrial property market, both Dobson and Goddard (1992) Fehribach et al (1993) found significant negative relationship between industrial property price and interest rate.

Industrial Land Use Policy Revisions (F1 – F6)

Since the inception of the industrial-office concept in the late 1989, the Government had gradually changed and relaxed the regulations about the use of industrial buildings. Each policy revision introduced an added flexibility in the use of industrial properties. As such, with incremental flexibility, each policy change is expected to have a positive impact on industrial property price and so a positive sign is expected for each dummy variable.

Lagged Price Changes (AR(1))

While Atteberry and Rutheford (1993) found negative relationship between lagged industrial property prices and current prices, both Thompson and Tsolacos (1999) and White et al (2000) confirmed a positive relationship. As such, the influence of lagged price changes on current price changes may not be straight forward and fixed. However, as noted above, expectation plays an important role in the formulation of property price. The RICS study (1994, p.43) concluded that the significance of lagged rental values (whether it is negative or positive impact) for all retail, office and industrial rental models reflects that rental values do not often move wildly from high to low levels but adjust in a series of annual steps. In other words, as asserted by Chau and Lam (2001) future price expectation depends on historical price movement. This means that the relationship between lagged price changes and current price is likely to be positive. AR(1) is therefore expected to have a positive sign.

Supply of Private Flatted Factories (YS)

As mentioned earlier, the law of supply and demand postulates that an increase in the supply of industrial properties should have a negative effect on prices, *ceterus paribus*. A shortage of industrial space usually causes prices to rise because of competition among buyers, while an oversupply may lead to a decline in prices due to higher vacancy rate and reduced competition. It is, therefore, expected that supply has a negative relationship with industrial property prices and will be negatively signed in the result.

Table 6.2: Summary of Expected Signs of Coefficients of Independent Variables

Variables in Model Specification	**Denoted by**	**Proxied By**	**Expected Signs of Coefficients**
Dependent Variable			
Industrial Property Price	DP	Industrial property price Index for Private Flatted Factories	N.A.
Independent/Explanatory Variables			
Demand-side Variables			
Re-export Volume	REV	Re-export Quantum Index	+
Manufacturing Sector Employment	PS	Number of Persons Engaged in Manufacturing Sector	+
Industrial Production	IP	Industrial Production Index	+
Service Sector Employment	SS	Number of Persons Engaged in Selected Service Sectors	+
Interest Rate	RI	3-month Hong Kong Dollar Interbank Offered Rates (Hibor)	-
Industrial Land Use Policy Revision in December 1990	F1	Dummy Variable	+
Industrial Land Use Policy Revision in July 1992	F2	Dummy Variable	+
Industrial Land Use Policy Revision in October 1993	F3	Dummy Variable	+
Industrial Land Use Policy Revision in January 1994	F4	Dummy Variable	+
Industrial Land Use Policy Revision in September 1997	F5	Dummy Variable	+
Industrial Land Use Policy Revision in September 2001	F6	Dummy Variable	+
Lagged Price Changes Effect	AR(1)	Autorgressive of Order One or AR(1)	+
Supply-side Variable			
Supply of Private Flatted Factories	YS	Stock of Private Flatted Factories at Year End	-

6.4 Data Specifications and Transformation

The 13 independent variables selected will be tested for their significance in the single equation industrial property price determination model on the basis of supply-demand interaction methodology. Since most of them cannot be measured directly due to data unavailability, they are measured by indirect indicator or proxies. As a result, the validity of the model results will be determined to a certain extent by the quality and reliability of these proxy data. This Section aims to provide a detailed account of the data used in this empirical study. The period of data used in this study is defined in Section 6.4.1. The definitions, sources and necessary transformation of the proxy data for each variable are described in Section 6.4.2.

6.4.1 Period of Data

The data used in this study is restricted to the period between 1982 and 2004, totalling 23 years. It is the longest time period within which full data sets are available for all selected variables. Quarterly data from 1982 Q1 to 2004 Q4 are used as majority of the data are in quarterly figures. More importantly, this enables large enough sample size for efficient OLS process. In order to obtain the complete data set, monthly and yearly figures of some variables will be adjusted to quarterly basis.

6.4.2 Definition and Sources of Data

Below is a detailed account of the definitions and sources of the data for each variable. The quality and reliability of data has important implication for the validity of the empirical

findings. All the data employed in this empirical analysis are publicly available information and collected from various authoritative sources - government websites and official publications. The definition and sources of the data are summarized in Table 6.4.

Industrial property price (DP)

The quarterly Industrial property price Index for Private Flatted Factories (1989 = 100), the proxy for Industrial property price, is compiled by the Rating and Valuation Department (RVD). This index is designed to measure price changes with quality kept at a constant by making reference to the factor of price divided by rateable value of the property rather than to the price per square meter of floor area. The index is derived from the average prices on an analysis of transactions scrutinised by the RVD for stamp duty purposes (RVD, 2006). Over the period of the study, since the indices spread over two data series with different base year (1989 = 100 and 1999 = 100), adjustment has been made to standardize the data to the same base year of 1989. The data are sourced from "Hong Kong Property Review", both annual reports and monthly supplement from various years, published by the RVD.

Re-export Volume (REV)

The Re-export Quantum Index (2000 = 100) is used to measure the re-export trade in Hong Kong. It is compiled by the Census and Statistics Department (CSD) based on information contained in import/export declarations. This quantum index also includes Hong Kong's merchandise trade with the mainland of China and measures the changes in volume of external merchandise trade (CSD, 2006 website). Since the indices are in monthly figures,

quarterly indices are then obtained by averaging the corresponding monthly data. The data are obtained from the official website of the CSD.

Manufacturing Sector Employment (PS)

Persons engaged in the manufacturing sector (excluding those in Civil Services), compiled by the CSD, are used as a measure of the manufacturing sector employment. The quarterly figures are collected from the CSD official website (2006).

Industrial Production (IP)

The industrial production in the manufacturing sector is measured by the Indices of Industrial Production (2000 = 100) compiled by the CSD. The indices reflect changes in the volume of local manufacturing output after discounting the effect of price changes. The price changes are measured by the producer price indices for manufacturing industries compiled from data on producer prices of industrial goods/services collected from the same survey (CSD, 2006 website). In other words, the price component has been taken care of and the index is a real data series. The quarterly index is sourced from the official website of the CSD (2006).

Service Sector Employment

As discussed, persons engaged in manufacturing related service sectors: 1) Transport, Storage and Communications; 2) Wholesale, Retail and Import and Export trades, Restaurants and Hotels are used as a measure of the service sector employment. Like the

manufacturing employment, the quarterly figures exclude those Civil Services and are obtained from the CSD official website (2006).

Interest Rate (RI)

The 3-month Hong Kong Dollar Interbank Offered Rates (Hibor) is used as a proxy of the interest rate. The rate is at end of period and refers to the middle rate which is the average of bid rate and offered rate (CSD, 2006 website). The quarterly data are sourced from the official website of the CSD (2006).

Industrial Land Use Policy Changes (F1 – F6)

Being the qualitative variables, these policy changes are neither numerical nor easy to quantify. It is possible to include them into econometric models by what are known as dummy or dichotomous variables. It is assumed that each policy change may affect the industrial property price in the month when it was introduced. As such, for the policy revision in December 1990, F1 represents the time series in which the first quarter in 1991 and all subsequent quarters are equal to 1, the quarters prior to Q1 1991 are 0. By the same token, other policy changes can be represented and defined by the following dummy variables:

- Policy revision in July 1992 - F2: representing the series in which Q3 1992 and all subsequent quarters are equal to 1, and 0 otherwise

- Policy revision in October 1993 – F3: representing the series in which Q4 1993 and all subsequent quarters are equal to 1, and 0 otherwise
- Policy revision in January 1994 – F4: representing the series in which Q1 1994 and all subsequent quarters are equal to 1, and 0 otherwise
- Policy revision in September 1997 – F5: representing the series in which Q4 1997 and all subsequent quarters are equal to 1, and 0 otherwise
- Policy revision in September 2001 – F6: representing the series in which Q4 2001 and all subsequent quarters are equal to 1, and 0 otherwise

Supply of Private Flatted Factories (YS)

The stock of private flatted factories at year end, compiled by the RVD, is used to proxy the supply of private flatted factories. The figure in a given year is compiled by adding completion and demolition during the year to the stock figure at the previous year end. According to the RVD (2006), stock figures are based on rating record, completions comprise those premises deemed completed by virtue of the issue of an occupation permit and demolition show rated private accommodation deleted during the year under review due to demolition. All these figures exclude public sector ones. Year-end stock figures are available from the RVD on a yearly basis (year end) only. For the purpose of this study, quarterly figures are estimated by linear interpolation between the available year-end figures.

6.4.3 General Data Transformation

In addition to the specific data transformation for each variable as discussed above, the following general data transformation is applied to all the data series.

Real Data Series

As pointed out by Asteriou (2006), since nominal series incorporate a price component, comparison of two nominal variables becomes problematic. This is because the dominant price component in each will produce close matches between the series, resulting in a spuriously high correlation coefficient. Converting nominal series to real terms by using an appropriate price deflator can resolve this problem. Therefore, in this study, all variables will be expressed in real or quantity terms. As can be seen from the above data definition, the variables which require conversion include the industrial property price index and interest rate. All other variables are already in real or quantity/volume terms. Implicit Price Deflator of GDP, compiled by CSD and available from its website will be used as the price deflator. However, since this GDP deflator exhibits strong seasonality, the series has to be deseasonalized before use.

Logarithmic Transformation

Except the dummy variables and the time series for interest rate which is already in percentage term, logarithmic transformation will be applied to the time series for all dependent and independent variables (denoted as ln(Variable)). The reasons are threefold (Asteriou, 2006, p. 18-19). Firstly, many economic time series exhibit a strong trend and

when this is caused by some underlying growth process, a plot of the series will reveal an exponential curve. In such cases, this exponential/growth component dominates other features of the series and may obscure the more interesting relationship between this variable and another growing variable. Taking the natural logarithm of such a series will effectively linearize the exponential trend. Secondly, as there is no prior knowledge about the functional form of the price determination model, a linear form is assumed. Logs are useful in this case as it can be used to linearize a model which is non-linear in the parameters. Thirdly, the transformation allows the regression coefficients to be interpreted as elasticities, since for small changes in any variable x, change in log $x \simeq$ relative change in x itself.

Stationarity and Differencing

As pointed out above, many economic time series exhibit a strong trend (i.e. a consistent upward or downward movement in the values), they are not stationary. Since presence of non-stationary series in a regression model produces spurious result, the test statistics cannot be interpreted in the usual manner. However, most time series data become stationary after taking first-order differencing i.e. they are I(1) (Chau and Lam, 2001). Differencing is generally denoted by the sign Δ. Augmented Dickey-Fuller test, available in the EViews, will be used to test for stationarity. Dummy variables will not be tested as they do not have the non-stationarity problem. The corresponding test statistics are shown in Table 6.3 below.

Table 6.3: Augmented Dickey-Fuller Test Staistics

Variable	**Denoted by**	**Level**	**First-difference**
Industrial property price	ln(DP)	-1.142832	-3.13211**
Re-export Volume	ln(REV)	-1.89148	-10.72221*
Manufacturing Sector Employment	ln(PS)	2.084726	-5.440208*
Industrial Production Index	ln(IP)	-3.061431**	-13.53373*
Service Sector Employment	ln(SS)	-3.176326**	-5.419647*
Interest Rate	RI	-2.914298**	-9.190683*
Supply of Private Flatted Factories	ln(YS)	-2.388215	-2.638802***

* Rejects presence of a unit root at the 1% level
** Rejects presence of a unit root at the 5% level
*** Rejects presence of a unit root at the 10% level

The above result shows that, except IP, SS and RI, all other time series requires the application of differencing in order to be stationary. To be consistent and to improve the significance level, first order differencing will also be applied to IP and SS. As for RI, in theory level should be used for interest rate which tends to be a stationary time series. This can also be gleaned from the fact that the significance level only improves a little bit from 5% (at level) to 1% (at first difference form). Therefore, in this study, level will be used for interest rate time series.

In summary, the definitions, sources and general data transformation concerning all the variables are shown in the following table:

Table 6.4: Summary of Definitions, Sources and General Transformation of Data

Variables in Model Specification	Definitions of Proxies	Source of Proxies	Data Transformation	
			Taking Log	First Difference
Dependent Variable				
Industrial Property Price (DP)	Real Industrial property price Index for Private Flatted Factories (1989 = 100)	Hong Kong Property Review, various issues, RVD	√	√
Independent/Explanatory Variables				
Demand-side Variables				
Re-export Volume (REV)	Re-export Quantum Index (2000 = 100)	CSD, 2006 website	√	√
Manufacturing Sector Employment (PS)	Number of Persons Engaged in Manufacturing Sector	CSD, 2006 website	√	√
Industrial Production (IP)	Real Industrial Production Index (2000 = 100)	CSD, 2006 website	√	√
Service Sector Employment (SS)	Number of Persons Engaged in Manufacturing Related Service Sectors: 1) Transport, Storage and Communications; 2) Wholesale, Retail and Import and Export trades, Restaurants and Hotels	CSD, 2006 website	√	√
Interest Rate (RI)	Real 3-month Hibor	CSD, 2006 website		
Industrial Land Use Policy Revision in December 1990 (F1)	F1: Time series where Q1 1991 and subsequent quarters = 1, otherwise = 0	Dummy Variable		
Industrial Land Use Policy Revision in July 1992 (F2)	F2: Time series where Q3 1992 and subsequent quarters = 1, otherwise = 0	Dummy Variable		
Industrial Land Use Policy Revision in October 1993 (F3)	F3: Time series where Q4 1993 and subsequent quarters = 1, otherwise = 1	Dummy Variable		
Industrial Land Use Policy Revision in January 1994 (F4)	F4: Time series where Q1 1994 and subsequent quarters = 1, otherwise = 2	Dummy Variable		
Industrial Land Use Policy Revision in September 1997 (F5)	F5: Time series where Q4 1997 and subsequent quarters = 1, otherwise = 3	Dummy Variable		
Industrial Land Use Policy Revision in September 2001 (F6)	F6: Time series where Q4 2001 and subsequent quarters = 1, otherwise = 4	Dummy Variable		
Lagged Price Changes Effect (AR(1))	Autorgressive of Order One or AR(1)	-		
Supply-side Variable				
Supply of Private Flatted Factories (YS)	Stock of Private Flatted Factories at Year End	CSD, 2006 website	√	√

Model Re-specification

From Section 6.2, the initial model specification is:

$$DP_t = a_0 + a_1REV_{t-k1} + a_2PS_{t-k2} + a_3IP_{t-k3} + a_4SS_{t-k4} + a_5RI_{t-k5} + a_6F1_{t-k6} + a_7F2_{t-k7} + a_8F3_{t-k8} + a_9F4_{t-k9} + a_{10}F5_{t-k10} + a_{11}F6_{t-k11} + a_{12}YS_{t-k12} + a_{13}AR(1) + \varepsilon_t \quad (2)$$

With the above data transformations, Equation (2) is further refined to the following:

$$\Delta_1 ln(DP_t) = a_0 + a_1\Delta_1 ln(REV_{t-k1}) + a_2\Delta_1 ln(PS_{t-k2}) + a_3\Delta_1 ln(IP_{t-k3}) + a_4\Delta_1 ln(SS_{t-k4}) + a_5RI_{t-k5} + a_6F1_{t-k6} + a_7F2_{t-k7} + a_8F3_{t-k8} + a_9F4_{t-k9} + a_{10}F5_{t-k10} + a_{11}F6_{t-k11} + a_{12}\Delta_1 ln(YS_{t-k12}) + a_{13}AR(1) + \varepsilon_t \quad (3)$$

where Δ_1 signifies the first difference operator; ln(Variable) signifies the natural log of the variable; and each of k1, …, k12 = 0, 1, 2, 3, 4, 5, 6, 7 or 8; where k1, …, k13 represent the number of lag for their respective explanatory variables.

Chapter 7 Empirical Result and Analysis

7.1 Introduction

To this end, the real industrial property price (DP) has been regressed on the 13 independent variables. Ordinary Least Squares regression has been employed to ascertain the significance of the independent variables. The purpose of this Chapter is to provide a comprehensive insight into the empirical results. Section 7.2 will present and summarize the statistical results. Section 7.3 will be a comprehensive analysis of the empirical results. Section 7.4 will illustrates the implications of the findings from the result.

7.2 Empirical Results

From Section 6.4.3, the revised model specification is:

$$\Delta_1 \ln(DP_t) = a_0 + a_1\Delta_1 \ln(REV_{t-k1}) + a_2\Delta_1 \ln(PS_{t-k2}) + a_3\Delta_1 \ln(IP_{t-k3}) + a_4\Delta_1 \ln(SS_{t-k4}) + a_5 RI_{t-k5} + a_6 F1_{t-k6} + a_7 F2_{t-k7} + a_8 F3_{t-k8} + a_9 F4_{t-k9} + a_{10} F5_{t-k10} + a_{11} F6_{t-k11} + a_{12}\Delta_1 \ln(YS_{t-k12}) + a_{13} AR(1) + \varepsilon_t \quad (3)$$

where Δ_1 signifies the first difference operator; ln(Variable) signifies the natural log of the variable; and each of k1, …, k12 = 0, 1, 2, 3, 4, 5, 6, 7 or 8; where k1, …, k13 represent the number of lag for their respective explanatory variables.

The starting point of the empirical analysis is to determine the best time lag structure for each independent variable. Based on the past studies, particularly those in the industrial real estate and the comprehensive housing price research in Hong Kong by Chau and Lam (2001), and my own analysis, the supply variable (YS) lagged 0-8 quarters; REV, PS, IP and SS lagged 0-4 quarters; and contemporaneous RI (interest rate) and dummy variables (F1-F6) will be tried and estimated. The effect of lagged price change has been taken care of by using the autoregressive AR(1) function in the EViews.

The best result is achieved by incorporating contemporaneous RI_t, F5 and F6; $\Delta_1 \ln(PS_{t-1})$ and $\Delta_1 \ln(SS_{t-1})$ (both lagged 1 quarters); $\Delta_1 \ln(IP_{t-2})$ lagged 2 quarters; $\Delta_1 \ln(REV_{t-3})$ lagged 3 quarters; and $\Delta_1 \ln(YS_{t-5})$ lagged 5 quarters as independent variables. The statistical results of the estimated specification are presented in Table 7.1 below.

Table 7.1: Result of Estimating Equation 3 ***with*** Application of White's Test

Variable	**Coefficient**	**t-Statistic**	**P-value**
Constant	0.042817**	2.045587	0.0443
D(REV(-3))	0.118846**	2.22846	0.0288
D(PS(-1))	0.667166**	2.146466	0.0351
D(IP(-2))	0.095681**	2.008535	0.0482
RI	-0.006289**	-2.18156	0.0323
D(YS(-5))	-3.76489	-1.641824	0.1048
D(SS(-1))	0.623844***	1.93936	0.0562
F1	-0.016689	-0.923739	0.3586
F2	-0.009621	-0.419175	0.6763
F3	-0.004975	-0.175992	0.8608
F4	-0.028796	-1.111842	0.2698
F5	0.053192*	4.118905	0.0001
F6	0.045196**	2.324625	0.0228
AR(1)	-0.195014	-1.405086	0.1641
Model Summary			
Dependent variable	$\Delta_1 \ln(DP_t)$ (Real Industrial Property Price Index)		
Number of observations	89		
R-squared	0.579027		
Adjusted R-squared	0.506059		
F-statistic	7.93529		
P-value (F-statistic)	0.00000		
Durbin-Watson stat	1.861491		
White-test has been performed			

* Significant at the 1% level
** Significant at the 5% level
*** Significant at the 10% level

7.2.1 Interpretation of the Results

For a model estimated using data in log differences, the adjusted R-squared of 0.51 is a reasonably good level of fit (Leishman, 2003, p. 92). In addition, the probability value of

F-statistic (p-value) is approaching zero, which means that the null hypothesis that all the coefficients are equal to zero is rejected. As expected REV, PS, IP, SS and RI are correctly signed and significant. While YS is correctly signed, it is insignificant. As for AR(1), it is neither correctly signed nor significant. Among the policy dummy variables, F5 and F6 are found to be significant with correct sign. A detailed analysis of the empirical results is provided in Section 7.3.

7.2.2 Diagnostic Tests

Finally, a number of diagnostic tests have been performed to address the potential problems associated with the application of OLS techniques in estimating a regression model involving time series data. The test results can be seen from Table 7.1 and are summarized in the following.

Test for Autocorrelation/Serial correlation

As this study involves the use of time series data, error terms of the observations may be correlated i.e. auto-correlation may occur and violate the assumption of the OLS regression. As mentioned in Section 5.2.2, the Durbin-Watson (DW) test can be performed to test for autocorrelation. From Table 7.1, it can be seen that the DW test statistic of 1.86 is very close to 2. As such, the serial correlation is not so much a problem.

Test for Heteroskedasticity

To test for the presence of heteroskedasticity, White's Test can be performed. Table 7.1 shows the result with the application of White's Test. By comparing the result with that in Table 7.2 below where no White's Test has been performed, it can be seen that there is no much change in the result. The significant variables remain statistically significant whether White's Test has been applied or not. The only exception is YS which becomes significant at 10% level when there is no White's Test. This indicates that heteroskedasticity does not materially affect the results of the analysis and so is not so much of an issue.

Table 7.2: Result of Estimating Equation 3 ***without*** Application of White's Test

Variable	**Coefficient**	**t-Statistic**	**Prob.**
C	0.042817***	1.829926	0.0712
D(REV(-3))	0.118846**	2.184952	0.032
D(PS(-1))	0.667166**	2.463363	0.0161
D(IP(-2))	0.095681**	2.004319	0.0486
RI	-0.006289***	-1.954675	0.0543
D(YS(-5))	-3.76489***	-1.855125	0.0675
D(SS(-1))	0.623844***	1.886375	0.0631
F1	-0.016689	-0.936603	0.352
F2	-0.009621	-0.395467	0.6936
F3	-0.004975	-0.092069	0.9269
F4	-0.028796	-0.52357	0.6021
F5	0.053192*	3.434979	0.001
F6	0.045196**	2.136814	0.0359
AR(1)	-0.195014	-1.651275	0.1029
Model Summary			
Dependent variable	$\Delta_1$ln(DPt) (Real Industrial Property Price Index)		
Number of observations	89		
R-squared	0.579027		
Adjusted R-squared	0.506059		
F-statistic	7.93529		
Prob(F-statistic)	0.00000		
Durbin-Watson stat	1.861491		

* Singificant at the 1% level
** Singificant at the 5% level
*** Singificant at the 10% level

7.3 Analysis of Empirical Results

This section attempts to examine and explain the impacts of the major determinants of industrial property prices in Hong Kong. As briefly summarized above, while all the demand-side variables are significant except AR(1), the supply-side variable is insignificant. F5 and F6 are found to be the significant determinants of industrial property prices among all the policy changes. Section 7.3.2 will analyze the impacts of the significant determinants on the average industrial property price in terms of their signs of coefficients and the time lag structure. Their relative degrees of influences on industrial property prices will also be examined by interpreting the implication of the value of their coefficients. Section 7.3.3 will try to provide explanation for the insignificant variables.

7.3.1 Significant Variables

Industrial Land Use Policy Revision in September 1997 (F5) and Industrial Land Use Policy Revision in September 2001 (F6)

Among the industrial land use policy changes, only the one in 1997 and 2001 are found to be statistically significant. As expected, both exert positive impact on industrial property price. They are registered with no time lag, indicating contemporaneous adjustment of industrial property price in response to the introduction of new policy revision. Among the 8 significant explanatory variables, they have the greatest magnitude of impact on price as reflected in their coefficient value which is the largest. Being level data, the coefficient of 0.0532 for F5 and 0.0452 for F6 indicates that land use policy revisions in 1997 and 2001

respectively increase industrial property price by 5.32% and 4.52%. In other word, F5 and F6 together cause the most substantial change in industrial property price.

In fact, among all significant explanatory variables, the most significant one is the policy change in 1997. The 5.32% impact is not only the greatest but also the most significant at 1% level. To recap, the revision in September 1997 included:

- Within I/O building: trading firm and commercial uses, such as banks, fast food shops, restaurants and retail shops, were permitted as of right on the lowest 3 floors.
- Within industrial building: 50% of the total usable floor area (UFA) of an industrial firm in same premises or building permitted as of right for solely ancillary office use or for a combination of office and showroom uses. Ancillary showroom use no more than 20% of UFA within the 50% limit.

The change within industrial building is in fact a "retrospective" approval of the existing non-conforming uses in the industrial buildings, which is a means to reduce enforcement costs. Thus, it will not have much impact on industrial property price. The most influential and significant change was the permission as of right the commercial uses on the lowest 3 floors within I/O buildings. Unlike the non-conforming uses in the upper floors, these lucrative commercial uses in the lower floors are easily being regulated and controlled. As such, this revision represents a drastic change, greatly increasing the value of I/O buildings and in turn the industrial buildings which can be converted to I/O type upon application. The policy change has in essence injected a real option into the industrial properties. In other words, there is imbedded option value in industrial properties.

The option value is derived from three sources: 1) unconstrained option in that the owner has the right but not the obligation to exercise the option i.e. establish the commercial use; 2) volatility in the commercial market and 3) institutional land administration process. The first source is straight forward as it spells out the essence of option while the other 2 sources require some explanation.

As pointed out by Chiang et al (2005), option value increases with implied volatilities. If the commercial market for shops, banks, restaurants etc is not volatile at all, the option will not have much value as the land premium charged in modifying the lease to accommodate the commercial portion in industrial buildings will capture all the added value contributed by the commercial uses. In reality, even the wet food market is sometimes highly volatile, let alone the larger commercial world. With volatility, there is always chance now and then that the commercial value is far greater than the premium charged, thereby increasing the value of this real option.

In addition, the land administration process in Hong Kong makes possible the fullest exploitation of the volatility in the commercial market when exercising the imbedded option. According to the Lands Department (2006 website), a time period of 1 month is allowed for applicants to decide whether to accept the premium offered by the department on lease modification application. In addition, applicant can appeal against the premium assessment. All these give people the leeway to exploit the volatile commercial mark to their advantage, thereby increasing the value of the option.

As for the policy change in 2001, it is the second most significant one after F5. The revision in 2001 allowed conversion, as of right, industrial use to industrial/office (I/O) use.

While F5 brings about a drastic change, F6 removes much uncertainty in investing in industrial buildings. People can now realize the option value at will by converting the industrial buildings into I/O type and therefore, industrial property prices have adjusted upward accordingly. The increase industrial property prices is also fuelled by the permission of far many uses in the industrial buildings making it more comparable to I/O buildings.

Re-export Volume ($\Delta_1 \ln(REV_{t-3})$)

Change of re-export volume has a coefficient of 0.1189 and is registered with a lag of 3 quarters. This indicates that a 1 percent increase in re-export volume increases industrial property price by about 0.12%. In other words, there is a positive relationship between re-export volume and industrial property price as expected. The lag of 3 quarters means that re-export volume 9 months or so ago has a significant impact on price or re-export activity is leading the price movement. This is reasonable as most trade orders are not ad-hoc but placed in advance to allow for production, delivery and the like. This is analogy to fashion/garment business where design and order are usually made several quarters or 1 year in advance.

Manufacturing Sector Employment ($\Delta_1 \ln(PS_{t-1})$) and Industrial Production ($\Delta_1 \ln(IP_{t-2})$)

Conforming to the logical proposition and expectation, being the direct indicator of the activity in the manufacturing sector, these 2 variables have significant positive relationship

with industrial property price. However, while PS has a coefficient of 0.6672, IP only has 0.0957. This means that PS has a much greater impact on industrial property price than IP. As pointed out before, there is a minimum physical space requirement for each person employed. An increase in the employment will increase the demand for industrial space and in turn drive up the prices. However, an increase in industrial production index may not lead to a large increase in industrial space demand, particularly if the increase is brought about by technological improvement and enhancement e.g. automation. Though technological enhancement may induce extra spatial requirement e.g. for equipment accommodation, the net increase in demand may not be significant after taking into account the reduced employment brought about by technological improvement. Thus, IP only has a minimal impact on prices.

The relatively short lags for these variables compared with re-export volume is reasonable as both PS and IP have a rather direct impact on industrial space demand which is the key force driving the price. Moreover, it also means that industrialists do not make reference to current immediate change in employment and production when assessing and adjusting spatial requirement which is rational.

Service Sector Employment ($\Delta_1 \ln(SS_{t-1})$)

As expected, this variable has a positive relationship with industrial property price. As with manufacturing employment, its recent changes affect industrial property price. As discussed, increase in employment has a rather direct impact on industrial property price. Thus 1-quarter lag SS is significant. Its coefficient value of 0.6238 is very close to that of

manufacturing employment, but not as significant (indicated by the lower 10% significance level). This may be due to the limitation that SS is only a gross indicator of the demand from related and potential service sectors for space in industrial premises. Indeed, though related, not all the selected service sectors will opt for or be allowed to locate in industrial premises. In fact, it may only be those lower grade services which will be the likely demanders. Activity like hotel cannot be accommodated in these premises as well. All these affect the capability of SS in capturing the underlying demand from the selected service sector and in turn its significance in this model.

Real Interest Rate (RI_t)

As in most past studies and conforming to the expectation, real interest rate has a negative relationship with industrial property price. Unlike the above variables for which the data are log difference ones, the interest rate data are level. Thus, the coefficient of -0.006289 means that a 1% increase in real interest rate decreases industrial property price by about 0.63%. Since RI is not registered with any time lag, it implies that the contemporaneous change in real interest rate is influential. This conforms to the proposition that real interest rate is significant in that it affects not just the cost of capital but also the yield of investment which are integral in the price formation.

7.3.2 Insignificant Variables

Supply of Private Flatted Factories ($\Delta_1 \ln(YS_{t-5})$)

Though correctly signed, the supply factor is found to be insignificant. This may be a support of the demand-driven or surplus model proposed by Fraser (1993). However, it is reasoned as more of the inherent data problems. While the year-end stock is a comprehensive indicator of the net supply of private flatted factories in Hong Kong, it is not equivalent to a measure of the direct impact of supply in the market. This is due mainly to the flexibility enjoyed by the developers in launching new buildings into the market. As the completion figure in the year-end stock is identified by the issues of occupation permit, it does not take into account the effect of pre-sale. In fact, developers in Hong Kong are allowed to pre-sell their units several months in advance prior to the expected issuance of occupation permit. In addition, there is no way to measure the impact of new supply transferred from the owner-occupied. In view of these, the year-end stock figures may not duly capture the actual timing of the supply and in turn the supply impact on industrial property price.

Moreover, the year-end figure indicates the physical stock of property. However, as commented by Fraser (1993), this is not equivalent to the stock of tenanted and investment properties. This is because the latter can vary independently of changes in physical stock due to the existence of owner-occupied property. This undermines the explanatory power of the supply factor. However, this data availability and reliability is an inherent problem which is well recognized as the main culprit restricting the evaluation of the impact of supply factor. On the other hand, the rejection of the presence of unit root at 10% for this

supply variable means that there may be non-stationarity problem. Therefore, as commented by White et al (2000), there may be an issue of whether any long term relationship between supply and industrial property price can be said to exist.

Early industrial land-use policy changes between 1990 and 1994

Though all the policy changes since 1989 have given incremental flexibility in the use of industrial properties, except 1997 and 2001, all of them have had no significant impact on their prices. As pointed out by Tang and Tang (1999), the key reason is the piecemeal revisions made by the government to the original industrial-office policy since its inception in 1989. The planning authority has been somewhat reluctant to amend and relax the rather restrictive regulations until 1997 when a drastic change was introduced. High construction cost (resulting from the institutional requirement to comply with all existing building design regulations for both industrial and office uses rather than a new set of rules) and the high land premium[25] charged adversely affect the effectiveness of these policy changes.

Lagged Price Changes (AR(1))

While signed differently from expected, this variable is statistically insignificant. This indicates that buyers and investors do not take into account recent past price changes when making the selling or purchase decisions. This may be due to the fact that with the massive industrial restructuring and development of service and finance sectors, the industrial property market is more driven by demand from other sectors than by industry property

[25] In this respect, it has been argued that the government relied heavily on a sale revenue figure achieved at a public land auction for an I/O site in March 1994, which was considered as unrealistically high, deterring many I/O development schemes (Tang and Tang, 1999, p.166).

sector itself. This is supported by the significant influence of selected service sector employment on industrial property price. As a result, rather than basing their price expectation on past price information, people tend to use the above significant factors as a gauge of the expected demand for industrial premises.

7.4 Implications of Findings

This study has investigated the impacts of 12 demand-side variables ($\Delta_1$ln(REV), $\Delta_1$ln(PS), $\Delta_1$ln(IP), $\Delta_1$ln(SS), RI, F1-F6 and AR(1)) and one supply-side variable ($\Delta_1$ln(YS)) on the industrial property price ($\Delta_1$ln(DP)). Among the demand-side variables, 7 of them are significant determinants of the industrial property price in Hong Kong. On the other hand, the supply-side variable is insignificant. Overall, the reduced form econometric model with the demand and supply-side variables has a reasonably good level of fit.

Though the estimated equation has not been tested for its forecasting power of industrial property prices, this study can provide insights into the price dynamics of the industrial property market and the effect of industrial restructuring on industrial property prices, filling a major gap in the industrial property market research. The findings from the empirical results have the following four major implications.

Firstly, while the positive impact of manufacturing employment and industrial production on industrial property prices is what one could and would expect, the positive impact of re-export volume is the result of the economic restructuring locally and the economic reforms in China regionally since the late 1970s. This is somewhat peculiar to Hong Kong and its impact on industrial property price has not been examined before.

China's open door policy since 1978 has led to a profound change in local industrial operation and the profile of the industry property market. With massive relocation of production base to China, there is rapid growth of industrial support services. As a result, the use of industrial buildings has been gradually changed from production to other industrial support uses. With the outward-processing orientation of most industrial establishments, the re-export volume is an indicator of local companies' level of production on the Mainland because most goods are semi-finished products shipped to Hong Kong for finalizing the production process before being re-exported to other countries. The larger the volume of re-export, the greater is the demand for its supporting activities which are mostly accommodated in industrial buildings. The significant positive impact of some selected service sector employment has confirmed that industrial space in Hong Kong has not been merely used for industrial production purposes.

Secondly, among all the significant explanatory variables, the institutional land-use policy changes in 1997 and 2001 exert the most substantial impact on industrial property price. Institutional policy effect has not been widely studied in the previous research. The result of this empirical study lends support to the scholars, like Howes (1989) and Ratcliffe (1978) cited by Tang and Tang (1999), who postulate the heavy influence of planning system on the property market.

Thirdly, the overwhelming significance of the demand-side variables with insignificant supply factor implies that industrial property prices may be primarily demand determined. In other words, price is primarily a function of the profitability of the business use for which the property is best suited. This can also be confirmed by the strong impact

of the policy revisions in 1997 when the permission of commercial use made possible higher profitability from industrial properties. The rather insignificant role played by earlier policy changes (F1-F4) where the key obstacle is high construction and land conversion costs further lends support to the argument that profitability rather than development cost is the key determinant of price (see Fraser, 1993).

Finally, the significance of the selected service sector employment on industrial property price indicates the existence of interrelatedness between different sectors. As mentioned above, this is also a reflection of the fundamental change in the nature of manufacturing industries and the growth of general service sectors in Hong Kong. The functioning of the industrial property market is no longer dictated by the industrial activities but is also affected by other sectors and in turn the overall economy. It is consistent with the previous literature which suggests close relationship between property and economy.

Chapter 8 Conclusion

Despite the pivotal role played by industrial/manufacturing sector in the local economy of Hong Kong, empirical studies on industrial property price, whether local or overseas, are very limited. In addition, while the economic restructuring in Hong Kong together with the political and economic reforms in China in the 1970s and 1980s have been well documented and recognized, their impacts on industrial property prices have not yet been well researched and understood. It is against this backdrop and gaps that this empirical study is motivated and being carried out.

The industrial development of Hong Kong's manufacturing industry was reviewed in the beginning to establish the broad economic and structural conditions underlying the industrial property market. In light of the crucial role of the government amidst economic restructuring, the institutional policy changes towards industrial land-use were also presented and discussed. All these enable me to identify the broad demand and supply forces driving the local industrial property market. Past literature on property price and rent determination was then reviewed to establish theoretical fundamentals and to provide guidelines in the selection of explanatory variables. Thirteen explanatory variables were then incorporated into the industrial property price model to capture both demand-side and supply-side influences on the industrial property price. Quarterly time series were analyzed using the OLS regression technique. The empirical analysis produced a reasonably good result in identifying the major determinants of industrial property price in Hong Kong. The direction and magnitude of impacts of these determinants on industrial property prices

were also investigated and explained. Finally, several implications were concluded from the empirical findings.

Section 8.1 below is a brief summary of the findings and implications of this study. Limitations of this study will be addressed in Section 8.2. Finally, suggestions for further research areas are given in Section 8.3 which makes the end of this study.

8.1 Summary of Findings and Implications

Twelve demand-side variables and one supply-side variable were empirically tested for their impact on industrial property price determination in Hong Kong. Data stationarity was ensured by taking first difference where necessary. The OLS regression technique was then employed to develop a reduced form of price model. The empirical results suggest that re-export volume, manufacturing sector employment, industrial production and selected service sector employment have lagged positive influences on industrial property prices. Likewise, policy changes in 1997 and 2001, represented by the dummy variables F5 and F6 respectively, have strong positive impact while contemporaneous real interest rate is a negative factor. On the other hand, the supply-side variable together with other institutional industrial land use policy changes are insignificant in explaining fluctuations in industrial property prices. Overall, the reduced form econometric model is a reasonably good fit, explaining over 50% of the changes in industrial property prices over the period of investigation.

The findings of this study give four major implications. Firstly, the positive impact of trade volume (re-export) is a result of the economic restructuring in Hong Kong and the

economic reforms in China since the late 1970s which lead to the massive relocation of manufacturing production and the resultant change in the nature and requirement of demand in the industrial property market. Secondly, the significant positive impact of the institutional land-use policy changes in 1997 and 2001 confirms that planning system has a heavy influence on the property market, affirming the significant role played by government. Thirdly, the overwhelming significance of the demand-side variables with insignificant supply factor implies that industrial property prices are primarily demand determined. In other words, price is primarily a function of the profitability of the business use for which the property is best suited. Finally, the significance of the selected service sector employment on industrial property price indicates the existence of interrelatedness between different market sectors and between property and economy as a whole.

8.2 Limitations of the Study

Since some of the explanatory variables cannot be measured directly, indirect proxies are used. The validity and reliability of the model depends on the quality of these proxies. However, in this study, the proxy of the demand for industrial premises from other sectors i.e. the Service Sector Employment may overestimate the true demand because not all the businesses, particularly retail and hotel in these selected service sectors will choose to or be allowed to be located within private flatted factory buildings. Nonetheless, there is no way to extract the desired employment figures for the relevant service sectors identified.

Besides, the supply variable is only proxied by the year-end stock figures. However, as mentioned earlier, we cannot equate this physical stock of property with the stock of

both tenanted and investment properties which can vary independently of changes in this physical stock because of the existence of owner-occupied properties. Added to this limitation is the potential problem of non-stationarity for the supply variable as reflected by the rejection of presence of a unit root at 10% level. Yet, further differencing will only dilute the long run relationship between this variable and the price, adversely affecting its explanatory power. As a result, these proxies cannot truly capture the corresponding variables and may affect the validity of the findings from the empirical results.

8.3 Further Research Areas

This study has established an industrial property price model and investigated the major determinants of industrial property prices in view of the successive phases of economic restructuring weathered through by Hong Kong and the government's changing policies towards industrial land use. This study can be further extended into two directions.

Further research can be undertaken to investigate the dynamics of the industrial property cycles. Since re-export volume is found to be a significant determinant of industrial property price, there is a close interrelationship between industrial property market and the economic restructuring. The industrial property cycles can be examined to see if they are closely linked to different phases of the economic restructuring. The lead-lag relationships between them can also be studied. The future movements of industrial property prices and rents may also be projected, thereby providing useful insights about the dynamics of the industrial property market in Hong Kong.

Apart from examining the effects of underlying explanatory variables, the industrial property price model can also be used to forecast future average price for private flatted factories. However, its forecasting ability has not been tested in this study. Predicting and forecasting industrial property prices allow market practitioners to project and assess the prospects of the industrial market, assisting them in making decisions in the marketplace.

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