Impact of the Hong Kong – Zhuhai – Macau Bridge

Upon the Property Markets of Hong Kong, Zhuhai and Macau

By

Department of Building and Real Estate
The Hong Kong Polytechnic University

Hung Hom, Kowloon

Hong Kong

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Executive Summary

International bidding for the Pearl River Delta Bridge linking Hong Kong, Macau, and Zhuhai is expected within months under a tight planning schedule that aims for building to start before the end of the year. In a loop network at the heart of the Pearl River Delta, the construction of the purposed bridge will provide a much faster route than now, a reduction of about 20 minutes from Hong Kong to Macau.

This study was commissioned by the Hong Kong Institute of Surveyors and completed in March 2005 (i.e. cut-off date). It aims (i) to review the three property markets and (ii) to provide statistical estimate of the likely impact of the Bridge on the three real estate markets. The methodology includes several models to project possible changes in terms of accessibility, property price, traffic flow and property price gradient.

The Accessibility Improvement Model (AIM) first gauges the improvement in the level of accessibility once the bridge is completed. The outcomes are then used to estimate the likely impacts on the property prices of the markets. The Factor-Mobility Price Gradient Model (FM-PGM) analyses the price gradients: between (1) Hong Kong and Macau & (2) Hong Kong and Zhuhai.

The bridge would cut travel time by 40% between Hong Kong and Macau and by 50% between Hong Kong and Zhuhai. The AIM and FM-PGM shows the price gradients will be flattened in both residential and office markets. The findings suggest that residential and office property prices in Hong Kong are expected to increase by 26% and 35% respectively by 2011 (year of completion). The corresponding increases are 33%-66% (residential) and 31%-58% (office) for Macau, and 17%-18% and 22% in Zhuhai.

The caveat of this study is obviously that as the detailed design and precise locations of the bridge are yet to be finalized, the estimates of the magnitude of price change and price gradient change, based on the empirical study, are indicative only and subject to change.

ACKNOWLEDGEMENTS

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1.1 Introduction

A. The background

As interactions between the three places of Hong Kong, Zhuhai and Macau are becoming prevalent these days, whether economically or socially, the construction of a bridge was proposed by the HKSAR Government, to gather these three areas, in an attempt to further enhance the aforementioned relationships. It is expected to cause significant effects to the three areas, either economically and politically, considering the foundations already set under "One country, two systems".

This idea was originated from a meeting between the officials of Hong Kong and the Chinese Mainland on September 20, 2002. According to a report sent to the Legislative Council by the Environment, Transport and Works Bureau dated August 6, 2003, it was agreed that Hong Kong and the Mainland should have cooperated in studying the feasibilities of a transport network joining Hong Kong and western Zhuhai together. Issues such as the projected amount of freight traffic in the future and the economic efficiency of such network were to be studied as well.

The studies commenced in January 2003 and proceeded until July 2003. The findings suggest that the transportation network between Hong Kong and Zhuhai was considered inactive, as water transport is the only alternative for shipping, incurring more transportation cost in the process. Moreover, the studies make a projection that, in year 2020, there would be a flow of 38-54 million passengers and 46.7-62.2 million tons of freight traffic between Hong Kong and western Pearl River Delta. The projected numbers are even higher if the construction of a bridge, linking the two areas together, is being put into consideration.

Essentially, it is anticipated that the Hong Kong, Zhuhai, and Macau will be benefited from the construction of a bridge in a number of ways:

- Promoting social-economic developments of Pearl River West.
- Consolidating Hong Kong's role as the international freight/logistics centre.
- Promoting the development of regional tourist industries.
- Creating a more completed regional transportation network.

It was then approved by the State Council (國務院) on August 4, 2003 that a Hong Kong-Zhuhai-Macau Bridge Advance Work Coordination Group (the Coordination Group) should be set up, by the governments of Guangdong, Hong Kong, and Macau, to handle the various matters relating to the bridge. The first meeting of the Coordination Group was held on August 29, 2003, which signaled the official commencement of the advance work for the building of the Bridge.

It is not surprising that dissensions, or even conflicts, are likely to occur when it comes to a number of topics. The first topic is whether the bridge will be under a "Single-Y" or a "Double-Y" structure. A "Single-Y" structure means that the Bridge will be constructed only to link Hong Kong, Zhuhai and Macau together. On the other hand, a "Double-Y" structure suggests the inclusion of Shenzhen into the aforementioned three areas. The governments of Hong Kong and Zhuhai favor the "Single-Y" proposal, while the government of Macau favors the "Double-Y" setting. There is an idea from the Macau government that the exclusion of Shenzhen gives Hong Kong an unfair advantage over their own interest. It is supported by the Chairman of the Guangdong Academy of Social Sciences, who comments that the "Single-Y" proposal is too short-sighted. He even mentions that Hong Kong's economic interest is prioritized over Macau's in the Chinese's government planning philosophy.

To the Hong Kong government, however, the exclusion of Shenzhen from the transport network will provide a new-found edge in terms of shipping and transportation, as Shenzhen's transport network, to this day, is more competitive than Hong Kong's. The advantages would be obvious when it comes to the freight traffic between Hong Kong and the Pearl River West, and Western China in general. If the Bridge would be constructed under the "Double-Y" proposal, in hindsight, some of the freight traffic may turn to Shenzhen. To the Zhuhai government, the general feelings are similar as such of the HKSAR government. Currently, the plan is to build the Bridge, based on the "Single-Y" proposal, with Shenzhen not considered to be a part of.

Of course, it is not saying that there are no dissensions between Hong Kong and Zhuhai. It is apparent when the issue of the Landing Points of the Hong Kong-Zhuhai-Macau Bridge is discussed. Originally, 10 different areas have been proposed as the possible Landing Points of the Bridge. The alternatives were then reduced to 4 in December 2004. Currently, the respective Landing Points of Hong Kong and Macau have been settled, while the only wild card of the project is the Landing Point of Zhuhai.

The HKSAR government has declared that a place called **San Shek Wan (散石灣)** in Lantau Island is chosen as the Eastern Landing Point of the Bridge (Hong Kong). The Macau government has also declared that an artificial island named **Perola (明珠, or Pearl Island)** in Macau will be built as the Western Landing Point for the Bridge. The only thing unclear was where the Zhuhai government would pick as the location for the Landing Point. At the time of this study in March 2005, there were two proposals. One was **Gongbei (拱北)**; the other was **Hangqin Island (橫琴島)**.[1]

The origin of the dissensions is that both Hong Kong and Macau support the idea of using Gongbei as Zhuhai's Landing Point of the Bridge. The reasons are twofold. Firstly, Gongbei is a more established area, which implies that a higher volume of passengers and freight traffic is more likely. In the meantime, Hangqin is a rather undeveloped area, which gives Zhuhai a hard time convincing both Hong Kong and Macau. Secondly, in Hong Kong's perspective, the distance between Hong Kong and Gongbei is 3 kilometers shorter than that between Hong Kong and Hangqin Island. This insinuates that the cost incurred in freight traffic and traveling would be lower if Gongbei is selected.

1 On 4 April 05, the landing site was announced to be Gongbei in Zhuhai.

But, Guangdong's idea seems to suggest otherwise. As Gongbei has already been established, the Zhuhai government worries about the extra burden, in terms of traffic thus environmental impact, if Gongbei is chosen as the Landing Point. On the other hand, the current plans of the Guangdong government involve the development of Hangqin. The selection of Hangqin as the Landing Point will vastly enhance the progress of the development there. However, there has been a change in Zhuhai's preference towards this topic recently. The reason is that the project is more for the development of the whole Pearl River Delta, not just Hangqin. According to the Hong Kong Economic Daily on December 15, 2004, it is almost a sure thing that Gongbei would be picked as the Landing Point of the Western side of the Bridge.

At press time, with the exception of Zhuhai's choice for the Landing Point, the other issues have been basically settled. The only thing left between now and the official commencement of the construction of the Bridge will be the State Council's approval. Basically, the construction can be started as soon as 2006 after the State Council grants its approval, and it takes approximately 5–6 years to complete. Therefore, the soonest commencement date will be around year 2011 or 2012. The distance between Hong Kong (San Shek Wan) and Macau (Pearl Island) is 35 km. The traveling time will be around 30 minutes, much shorter than 70 minutes nowadays via water transport. The estimated construction cost of the Bridge would be between HKD20-30 billion. The construction cost of the artificial Pearl Island would likely play a major role in determining the final cost of the project.

Environmentally, the major issue of the possible invasion of areas under the preservation of the Chinese government has been taken care of as well, as the selections of the Landing Points and the routes have considered such needs. It is already mentioned by the respective government officials that they will play no part in the management and operation of the Bridge. It will be constructed and operated by private corporations. Further, as the Bridge is supposedly built for enhancing the flow of freight traffic, so that it will be open mainly for trucks. Meanwhile, there will be a tariff set for the number of private users in order to avoid the problem of congestions.

B. Research Objectives and Scope

Against this background, the objective of the study is to investigate the potential impact of the Hong Kong-Zhuhai-Macau Bridge (the Bridge) upon the property markets of Hong Kong, Zhuhai and Macau.

The scope of the study is:

1 To provide, in general context, an overview of the prevailing property markets of Hong Kong, Zhuhai and Macau, and

2 To provide statistical / estimate of the likely impact of the Bridge on the three property markets, elaborate on the findings and give possible reasons for the outcome of the analysis.

C. Report Overview

There are two parts in this report. Following this introduction, the remainder of this Part 1 presents the current trends of property markets in the three cities. Part 2 is the quantitative analysis of the price impact. Two location choice models are discussed: (1) the Accessibility Improvement Model, and (2) the Factor-Mobility Price-Gradient Model. The price change estimates and price gradients of the three cities are then discussed. The last section concludes the study.

1.2 Current trends of property markets in Hong Kong, Zhuhai and Macau

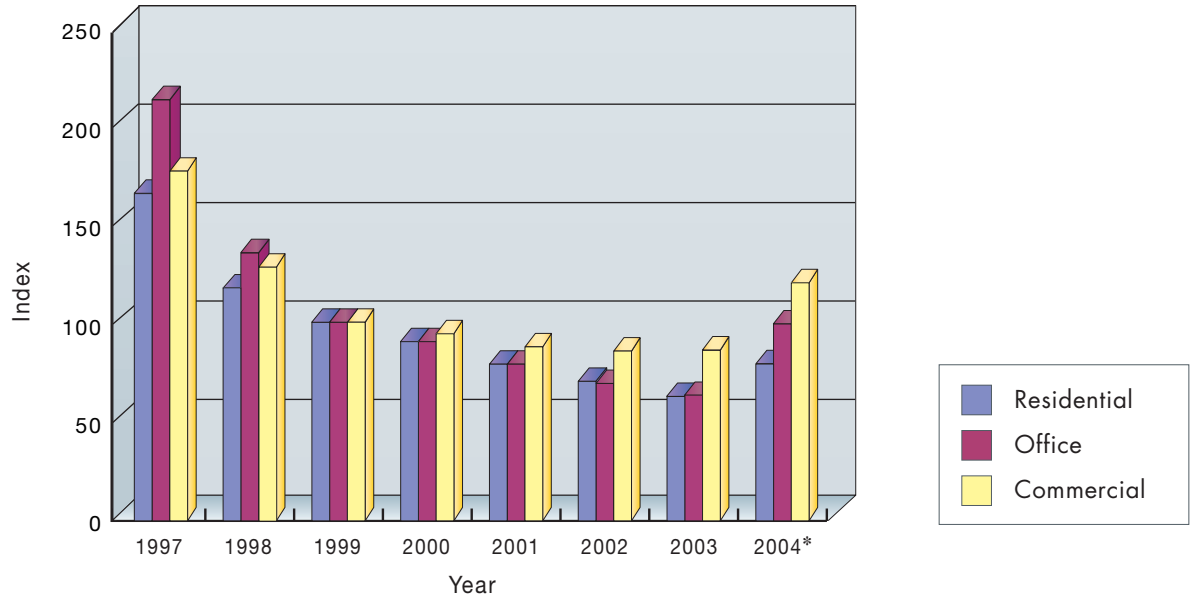
Before discussing the possible ramifications that the Bridge will give to the property markets, it is necessary to have a look at the recent property market trend in the three concerned areas.

A. Hong Kong

Right after the turnover back to China's sovereignty, Hong Kong was badly hit by the Asian Financial Crisis in late 1997. Unfortunately, it was around the same time that Chief Executive Tung Chee-Hwa announced the plan of building an average of 85,000 housing units per year. The combined effects led to the unprecedented decline in house prices, no matter it is residential, commercial, or offices. Unemployment rate has been surging for years and people still employed were worried about their future. The confidence level of Hong Kong people have reached a new low, as the phenomenon of negative equity has been prevalent during that period even though the house price has dropped to a rather affordable level.

The declining trend continued until a sign of recovery in residential and office prices was observed towards the end of 2003. The commercial buildings are a bit more fortunate, compared to residential and office buildings, as a stable price trend was recorded in late 2002. Then, a recovery started in late 2003, which was actually delayed due to the epidemic named Severe Acute Respiratory Syndrome (SARS) running rampant in Spring 2003. Figure I1 illustrates the general price trend of residential, office and commercial buildings after the takeover. But, the price level today is nowhere close to that in 1997.

Figure I1 Price Movements of Hong Kong's property markets (1999=100)



Note : The above figures are the price indices of the concerning sectors. (Source: Rating & Valuation Department)

* Provisional Figure

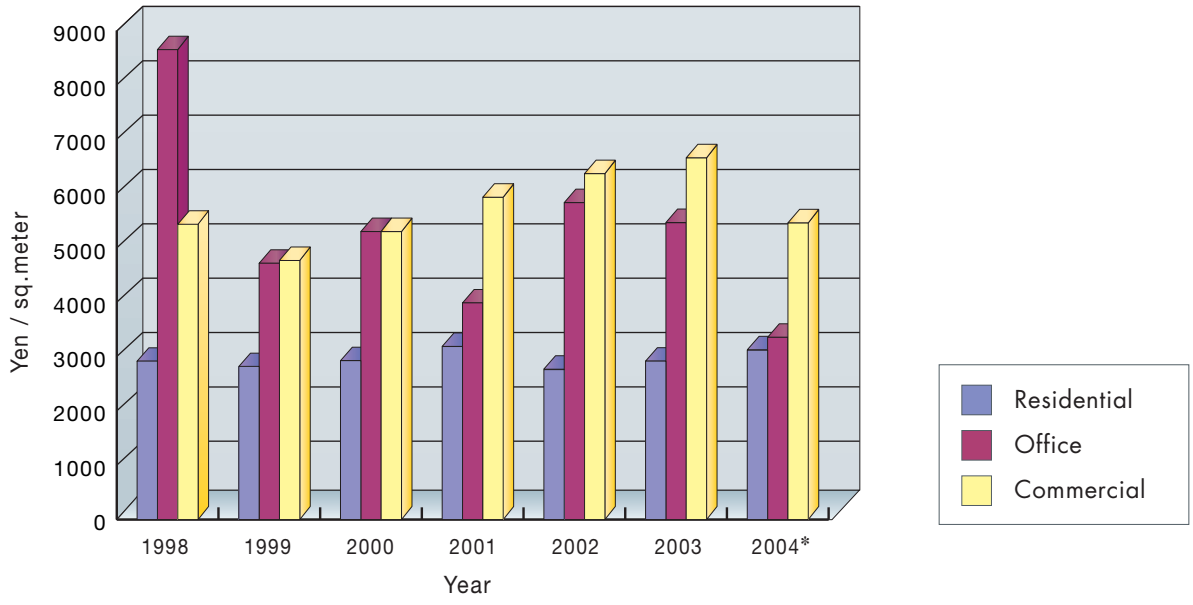
By the time when Hong Kong's economy was slowly recovering after the onslaught of SARS, Hong Kong and the Mainland reached a mutual agreement concerning the offering of benefits for Hong Kong businesses in the Mainland. The agreement, named the Closer Economic Partnership Arrangement (CEPA), gives Hong Kong businesses a more competitive leverage in entering the gigantic, yet unexplored, Chinese market. This would create a new source of dynamics in not only the Hong Kong economy, but also Hong Kong's property markets as well.

B. Zhuhai

In essence, Zhuhai's property markets have some similarities to Hong Kong's property market, judging from the price movements of residential, office and commercial buildings in recent years. For residential buildings, the average price attenuated in 1999, then going back up until 2001. However, a sudden drop in residential house prices was discerned in 2002. Still, the price movement of residential buildings is rather stable, compared to office buildings.

The average price of office buildings had decreased by more than 40%, from Yen 8,685/sq. meter (1998) to Yen 4,731/sq. meter. Afterwards, the price level has been fluctuating between Yen 4,000-6,000 sq. meter. Concerning the commercial buildings, with the exception of a decrease in 1999, the price level has been going up at a stable rate. In 2004, however, there was a drop in the price levels of office buildings and commercial buildings. Figure I2 below shows the price trends in residential, office and commercial buildings in Zhuhai from 1998 to 2004.

Figure I2 Price Movements of Zhuhai's property market



Source : 珠海房地產開發簡報（【2004】，第十一期）

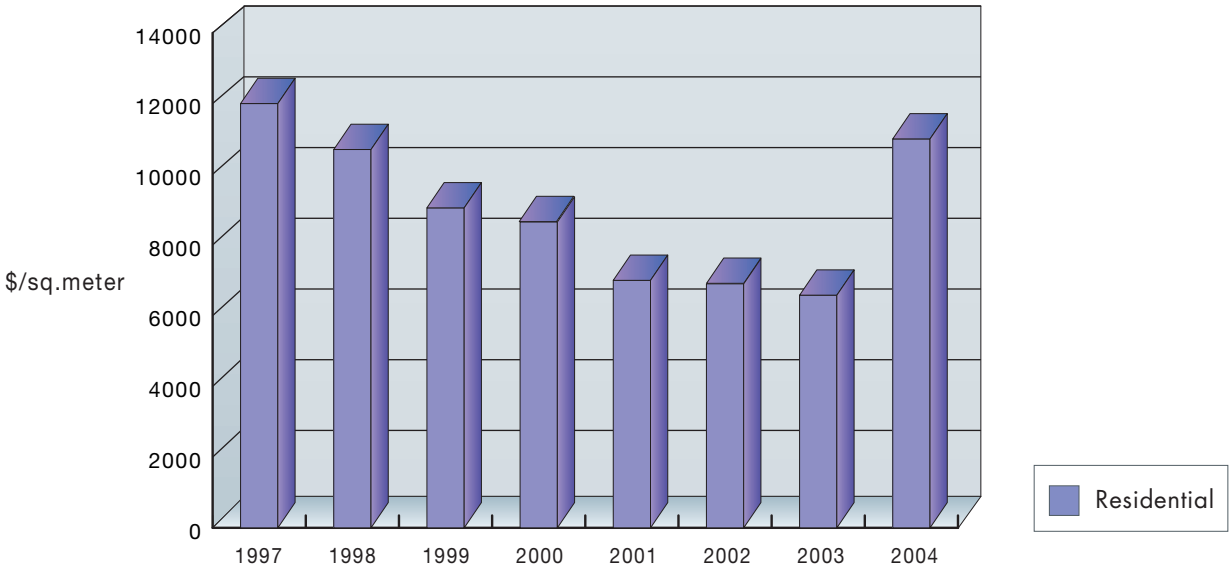
It looks like there would be various new opportunities for Zhuhai in the near future. The commencement of CEPA with Hong Kong and the progress of the discussions of the Bridge look to provide some bright elements to the economic development of Zhuhai. According to a survey conducted at a property exhibition on May 1, 2003, 77% of the interviewees predict that the price of properties in Zhuhai will surge in the next 2 years. Also, more than half of the interviewees would invest in Zhuhai's properties in the near future. To sum up, the future looks to be positive for Zhuhai's economy and its property markets.

C. Macau

Macau's situations are not that much different from Hong Kong, in terms of property market. By the time when Hong Kong's property market suffered badly from the aftermath of the Asian Financial Crisis, in addition to the dubious housing policies at the time, Macau, an economy more or less relies on Hong Kong's economic performance, was the receiving end of the adverse economic impacts as well. The situation was made even worse as Zhuhai posed as a competitor, rather than a companion, of Macau. This does not help Macau at all in recovering from the repercussions of the Asian Financial Crisis.

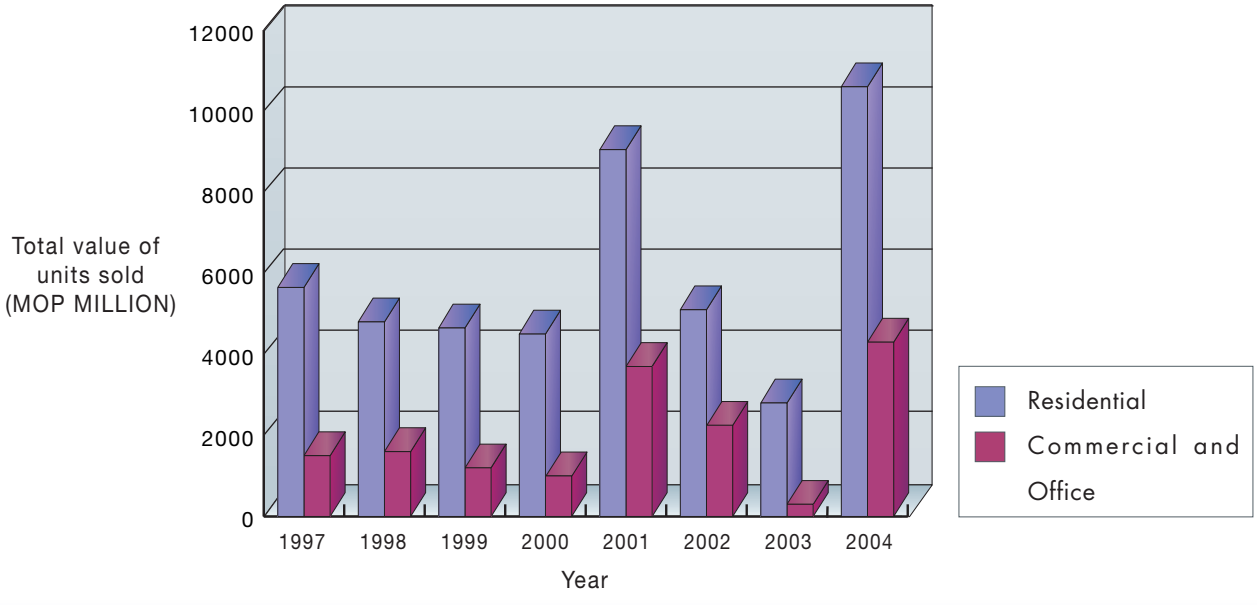
There appeared to be a huge turnaround in year 2004 in Macau's residential property market, as the average price of residential units in Macau has surged by around 70% in one year. Some reports suggest a much higher price difference (Sing Pao, December 30, 2004). One of the possible reasons of such dynamic changes can be attributed to the liberalization of the Gambling Industry in Macau. This creates much more job opportunities for not only the locals, but also foreigners as well, and would easily drive up the demand for residential space in Macau. Fig. I3 shows the price movement of Macau's residential property market from 1997 to 2004.

Figure I3 Price Movement of Macau's Residential Property Market



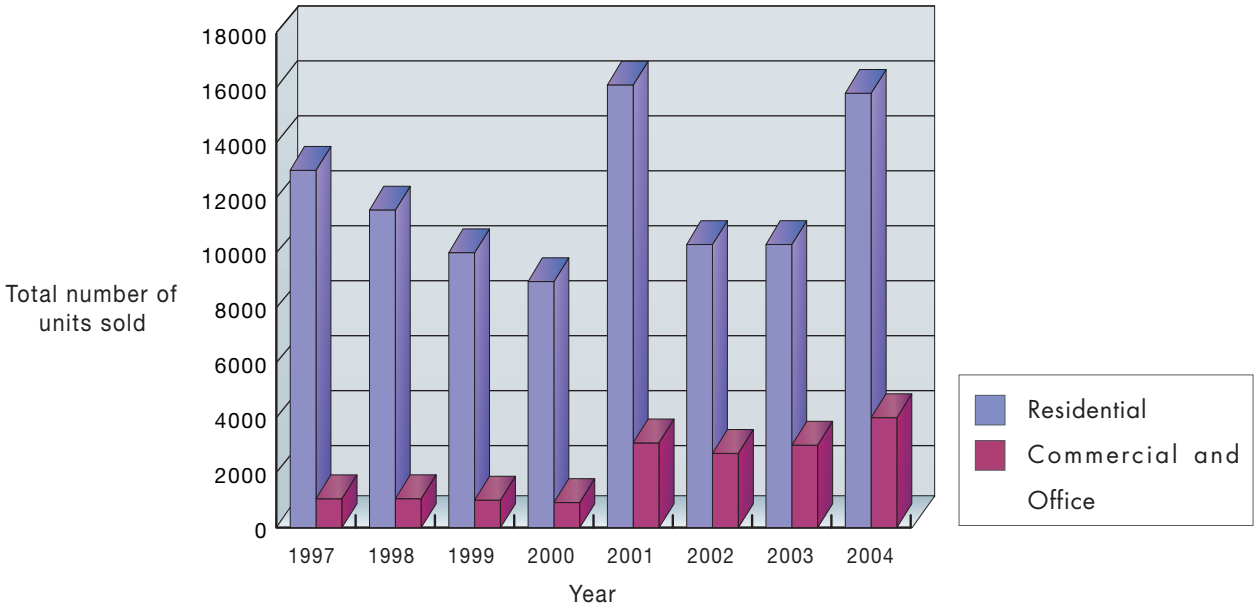
Source: DSEC, Macau Government

Figure I4 Total value of units sold



Source: DSEC, Macau Government

Figure I5 Total number of units sold



Source : DSEC, Macau Government

It is generally expected that the construction of the Hong Kong-Zhuhai-Macau Bridge would induce quite a good deal of positive effects on industries such as logistics, tourism, among others. In general, those positive effects will lead to further economic growth. Consequently, a better economy would induce higher purchasing power on the part of the people, or affordability in general. On the other hand, is the situation really that simple to explain? The possible undercurrents of such construction have to be considered also. For instance, would there be intensified competitions between the three areas, after the construction is completed? The main focus of this study is to explore what the construction of the Bridge would bring to the respective property markets in Hong Kong, Zhuhai, and Macau.

2 Quantitative Analysis

2.1 Data Sources and the Date of Analysis

Unless otherwise stated, data and information up to the end of March 2005 were used in this study. The cut-off date of the analysis is therefore March 2005. Regarding the data sources, unless otherwise stated, average unit property prices and property transactions computed by the Rating and Valuation Department of the HKSAR Government, Macau SAR Government and 珠海市建設局住宅與房地產業科 were used for the analysis of price impacts in Hong Kong, Macau and Zhuhai, respectively.

2.2 Scope of Study

This part studies quantitatively the impacts of the Hong Kong - Zhuhai - Macau bridge (the Bridge) on property prices of three cities, namely, Hong Kong (HK), Zhuhai (ZH) and Macau (M). The estimations of the price impact are confined to the affected areas (the access points) of the Bridge, details of which have not yet been announced. Further, this study focuses on residential and office properties only.

2.3 Caveats

The adopted and developed urban location choice models are for explanatory instead of predictive purpose, they are developed to explain the directional change, rather than predicting the magnitude of change, of property prices or price gradients between the affected areas due to the improvement of transportation. Furthermore, as the design and location of the Bridge are yet to be announced, the estimates of the magnitude of price change and price gradient change, based on empirical studies, are indicative and therefore illustrated for reference purpose only.

This report is produced solely for the reference of the General Practice Division of the Hong Kong Institute of Surveyors, We are not liable to any consequences due to the use of the information of this report.

2.4 Approach and Basic Assumptions

A ceteris paribus (other things being equal) approach is adopted in the estimations of the price and price gradient impact of the Bridge. The supply of property is assumed to be inelastic or fixed and the relative demands of property in the three cities are also assumed to be constant. The impacts are the mutual-added benefits derived from the Bridge without allowing for the transfer of demands of property (Mohring, 1961). Further, the general assumptions and theoretical predictions in urban location choice models, such as Turnbull's (1995) negative relationship between traveling cost and housing demand; and Strasheim's (1987) positive effect of traveling cost on the price gradient from a residential location to the central business district (CBD) were followed.

2.5 Current Property Prices

Table 2.1 shows the current property prices in the residential and office sectors in the three cities. Unit prices were drawn from various government official sources and they are expressed in Hong Kong dollars at exchange rates at the end of 2004 of HK$1.00: MOP0.95, and HK$1.00: RMB0.94. Clearly, as shown, property prices in Hong Kong were the highest among the three cities at the time.

Table 2.1 Summary of property prices

Estimated Average Unit Prices at the end of 2004 (HK$/m^2)			
Property Sectors	Cities		
	Hong Kong	Macau	Zhuhai
Residential	HK$ 45,000 [2]	HK$ 7,300 [3]	HKD 3,000 [4]
Office	HK$ 63,000 [5]	HK$ 6,700 [6]	HKD 3,400 [7]

2 Average unit price per square metre of "all classes" of residential properties in Hong Kong reported in the Property Reviews published by the Rating and Valuation Department, Hong Kong SAR Government.

3 Average unit price per square metre of "all districts" in Macau reported in the Direcca dos Servicos de Estatistica e Censos Web of Macau SAR Government.

4 Average unit price per square metre of all transactions of residential properties in Zhu Hai reported in 珠海房地產開發簡報 (29 January 2005) published by 珠海市建設局住宅與房地產業科.

5 Average unit price per square metre of "all grades" of office properties in Hong Kong reported in the Property Reviews published by the Rating and Valuation Department, Hong Kong SAR Government.

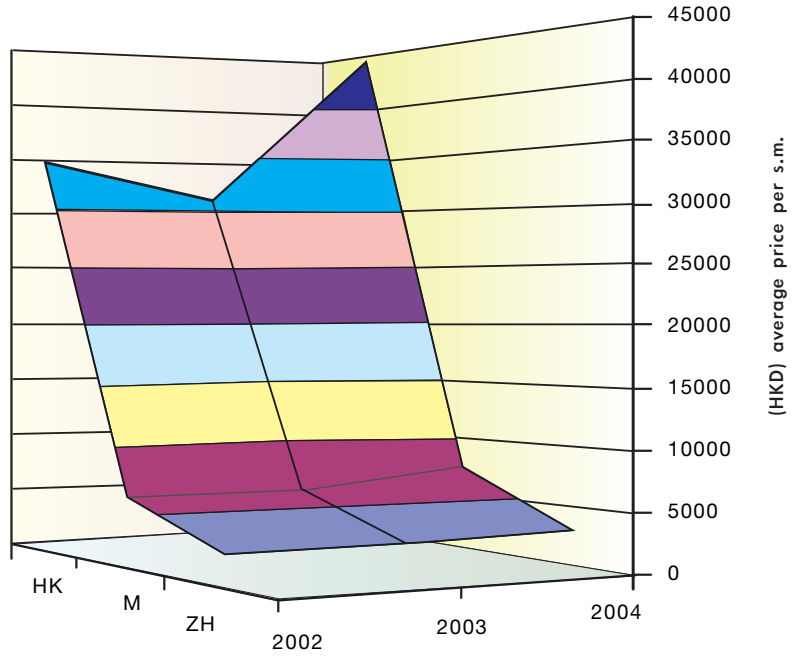
6 Average of the total transaction value of office property in Macau reported in Direcca dos Servicos de Estatistica e Censos Web of Macau SAR Government. Since the data provided are price per transaction, for comparison sake, we assume that the average size of the office in each transaction is 200 s.m.

7 Average unit price per square metre of all transactions of office properties in Zhu Hai reported in 珠海房地產開發簡報 (29 January 2005) published by 珠海市建設局住宅與房地產業科.

2.5.1 Residential Sector

Figure 2.1 shows the price contour of the residential property in Hong Kong (HK), Macau (M) and Zhuhai (ZH) from 2002 to 2004. The trends as well as the relative changes of price levels of residential properties in the three cities are also presented. As shown, Hong Kong saw more volatile change in housing prices, relative to Macau and Zhuhai.

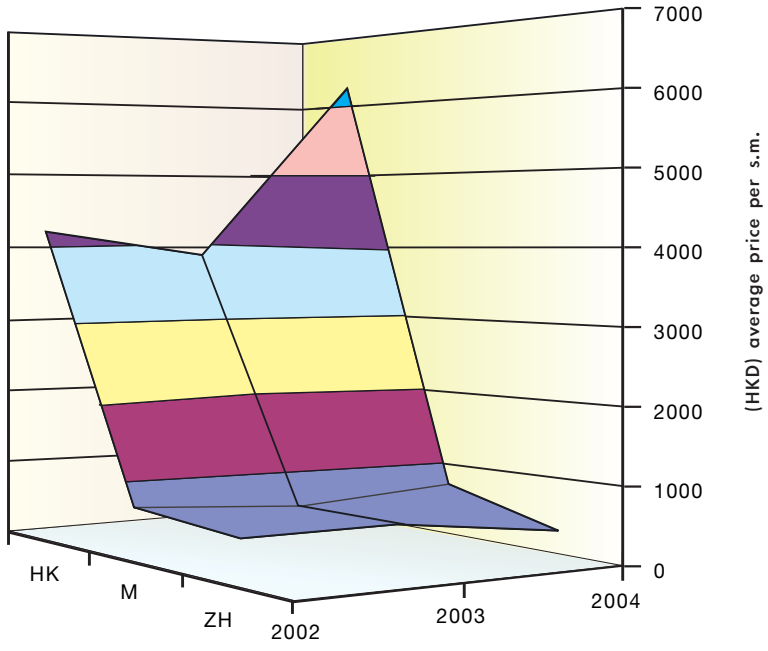
Figure 2.1 Price contour of residential property in Hong Kong, Macau and Zhuhai



2.5.2 Office Sector

Figure 2.2 shows the price contour of the office property in the three cities from 2002 to 2004. In the office sector, a similar pattern, but relatively lower rate of price change, in Hong Kong is observed. The price levels of office properties in Macau and Zhuhai remained fairly moderate.

Figure 2.2 Price contour of office property in Hong Kong, Macau and Zhuhai



2.6 Accessibility Improvement Model (AIM)

2.6.1 Theoretical Justifications

Turnbull (1995) derived an urban location choice theory based on Muth's (1969) seminal location demand theory. It deduced that the consumer's housing demand is negatively related with the transportation costs. This theory also agrees with Alonso's (1964) bid rent curve and is confirmed with empirical evidences as reviewed in Yiu and Tam (2004). It forms the basis of our analysis of the impact of the Bridge on property prices. It was assumed that a "mono-centric urban area was situated on a featureless plane, centered on the CBD, a dimensionless point at which all employment and shopping activities take place."

2.6.2 Empirical Model

Yiu and Wong (2005) studied the impact of the Western Harbour Tunnel in Hong Kong on the price of housing located in the proximity of the tunnel exit. Using the hedonic pricing model, they found a positive and significant price effect before the completion of the tunnel. It is reasonable to assume that a shortening of traveling time to and from the CBD to the affected area is linearly related to price change of properties, other things being equal. The results suggest that the Western Harbour Tunnel produces in an average of 0.52% increase in the housing prices per one-minute reduction in traveling time from Hong Kong (the Western district) to the CBD in Kowloon (Tsim Sha Tsui).

Similarly, Yiu et al. (2005) studied the impact of the tunnel on the price of office located in the proximity of the tunnel exit by the repeated sales method. The results show that the office property price in this district increased by an average of 0.70 % per one-minute reduction of traveling time [8]. Mathematically, the accessibility improvement model can be written as:

$$E\left(\Delta\lambda^{S}_{AB,t}\right) = \phi^{S}{}_{t}\, E\left(\Delta T^{5}_{AB,t}\right) \qquad (2.1)$$

where $E(*)$ represents the expectation operation; $\Delta\lambda^{s}_{AB,t}$ is the percentage change of property price in sector0s, including residential (r) and office (o) sectors at time t due to the accessibility improvement in workplace A to the regional CBD, B; $\Delta T_{AB,t}$ the expected time saved by using the new infrastructure traveling between (to and fro) the workplace A to the CBD at time t; $\phi^{s}{}_{t}$ is the estimated coefficient of the percentage change of property price per unit time saved at time t. Empirically, the estimated coefficients for residential and office are $\phi^{r}{}_{t} = 0.52\%$ and $\phi^{o}{}_{t} = 0.70\%$ respectively.

2.6.3 Limitations

Since the exact location of the affected areas of the Bridge is not known, the estimated coefficients used in the analysis are based on the Western Harbour Tunnel results, which may not be generalizable to this Bridge study. Nonetheless, the tunnel study can be treated as one of the best alternatives in Hong Kong. The selection of these two tunnel routes for comparison is arbitrary, but reasonable in light of the unique traffic condition in the Hong Kong context. Finally, the assumptions of a linear relationship between traveling time and property price changes, and the three regional CBDs are also subject to debate. The AIM is also an untested model.

8 *Details of the empirical assumptions and calculations are presented in Appendix A.*

2.7 Accessibility Improvement and Price Change Estimations in Hong Kong

2.7.1 Estimation of the accessibility improvement

The Institute of Comprehensive Transportation (2003) estimated that the traveling time through the Bridge between Hong Kong and Macau and between Hong Kong and Zhuhai will both be reduced to about 30 minutes. The current traveling time between Hong Kong and Macau by jet-boat is about 50 minutes; and between Hong Kong and Zhuhai by ferry is about 60 minutes, according to the schedules of the jet-boat and the ferry. Therefore the traveling time saved between Hong Kong (**H**) and Macau (**M**) ($\Delta T_{HM,t}$) would be 20 minutes; and between Hong Kong (**H**) and Zhuhai (**Z**)($\Delta T_{HZ,t}$) would be 30 minutes accordingly.

2.7.2 Estimation of Property Price Change in Hong Kong

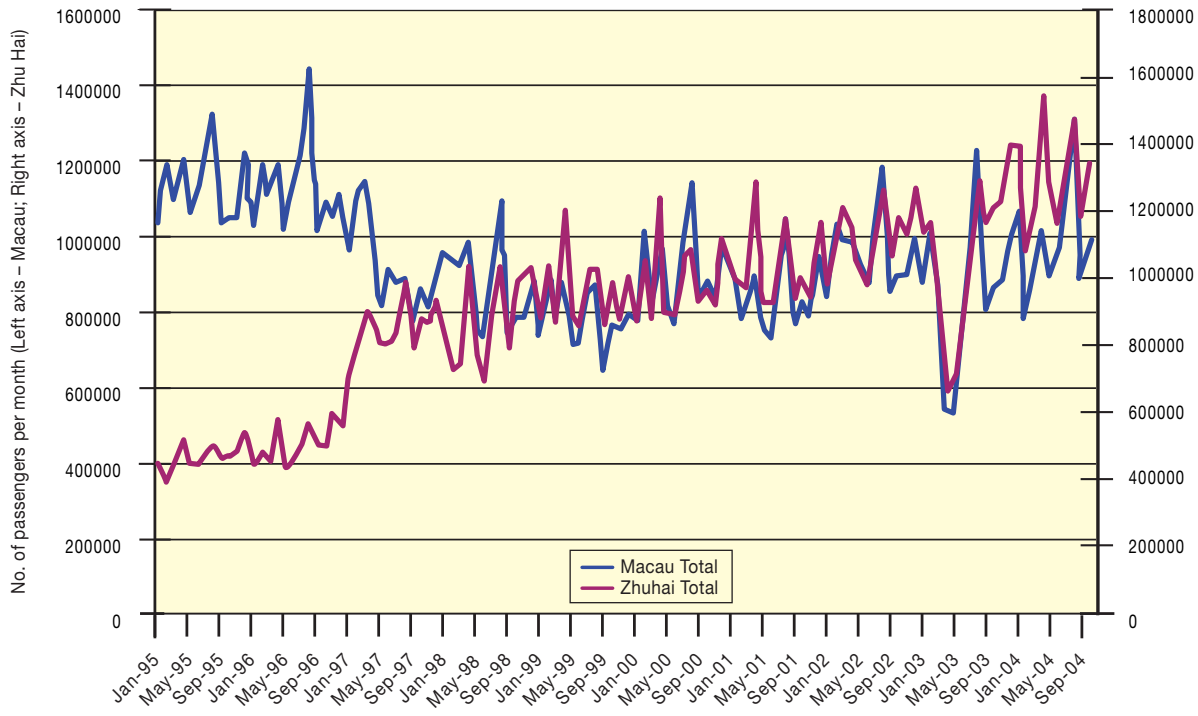
Assuming a fixed supply of real estate property, and the three cities have their own regional CBDs in the three cities, it is possible to capture the impact by applying the AIM (equation 2.1) to estimate the price change brought by the Bridge. The impact is expected to be reflected even before the commencement of operation of the Bridge according to the findings in Yiu and Wong (2005). The residential property price in the affected area in Hong Kong ($\Delta\lambda^{o}_{HM,t} + \Delta\lambda^{o}_{HZ,t} = 10.4\% + 15.6\%$) is expected to increase by **26%** at the 2004 price level upon the completion of the Bridge, ceteris paribus. On the office front, the expected price increase ($\Delta\lambda^{o}_{HM,t} + \Delta\lambda^{o}_{HZ,t} = 14.0\% + 21.0\%$) would be **35%**.

2.8 Bridge Flow Estimations

2.8.1Current Flow

Figure 2.3 shows the current passenger flows between Hong Kong and Macau, and between Hong Kong and Zhuhai by sea from 1995 to 2004. The latest figures in 2004 were about 3,000,000 and 400,000 passengers per quarter between Hong Kong and Macau, and between Hong Kong and Zhuhai, respectively. However, the average ratio of passenger flow of Hong Kong – Macau to Hong Kong – Zhuhai is about 8.3: 1. As shown, it appears to be a significant difference in passenger flows prior to 1997, but there seems to be a fairly stable with a moderate rising trend thereafter.

Figure 2.3 Current passenger flows between Hong Kong-Macau and Hong Kong-Zhuhai; 1995-2004



2.8.2 Empirical Model

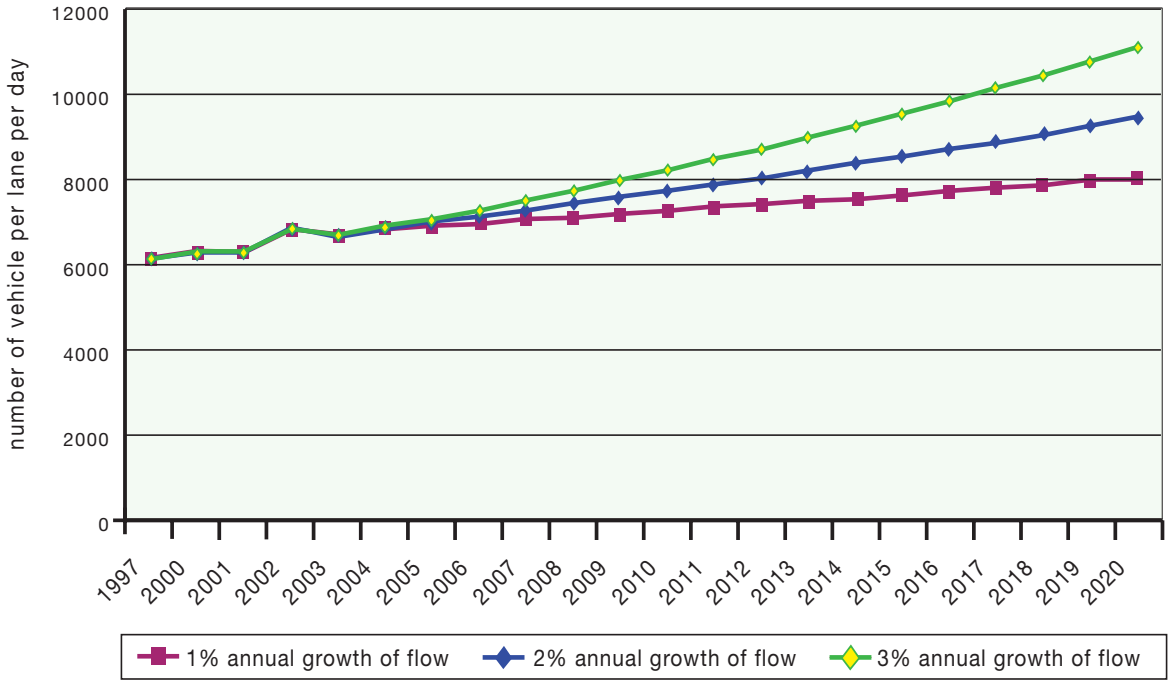
The Institute of Comprehensive Transportation (2003) projected that there will be a flow of 38-54 million passengers going through the Bridge per annum in 2020. However, the flow rate of the Bridge cannot be precisely estimated due to: (1) construction details of the Bridge being not decided, (2) clear lack of comparables for this unprecedented large-scale cross-boundary infrastructure, and (3) uncertainties affecting the demands of travel among the three cities. With the limited information available, we are able to adopt the current flow rate of the Tsing Ma Bridge (i.e. the Lantau Link) in Hong Kong as a proxy for our estimation because it shares high similarity with the Bridge, as far as the nature and the inter-city traveling purpose are concerned. Both estimates were made up to 2020 for ease of comparison, an estimate of 2011 is expressed in brackets for later use. In addition, it is assumed that the Bridge is not fully loaded in 2020.

2.8.3 Official Forecasts and our Empirical Results

Figure 2.4 shows the current and projected daily vehicle flow per lane of the Tsing Ma Bridge (the Lantau Link) from 1999 to 2020. Three projected growth rates are considered: 1%, 2% and 3%. It is projected that there would be 8,000 to 11,000 vehicles flow per lane per day in 2020 [7,400 to 8,500 in 2011]. Assuming that the Bridge is a 6-lane two-way traffic (i.e. two 3-lane traffics) and is a Y-shaped design, as shown in Figure 2.5, the estimated daily flow of vehicle between Hong Kong and Macau (two-way) and between Hong Kong and Zhuhai (two-way) in 2020 will be 43,000 to 59,000 vehicles per day [39,700 to 45,500 in 2011] and 5,100 to 7,000 vehicles per day [4,700 to 5,500 in 2011], respectively. (The passenger flow ratios between the two destinations are based on the average ratios 8.3:1.) Further assuming an average of two heads per vehicle, the estimated quarterly passenger flow rate in head count between Hong Kong and Macau (two-way) and between Hong Kong and Zhuhai (two-way) will be 7,800,000 to 10,600,000 heads per quarter in 2020 [7,200,000 to 8,300,000 in 2011] and 940,000 to 1,270,000 heads per quarter in 2020 [860,000 to 1,000,000 in 2011], respectively. In the estimation, the maximum number of passengers traveling by ferries among the three cities after the completion of the Bridge, ranged from 0 to the

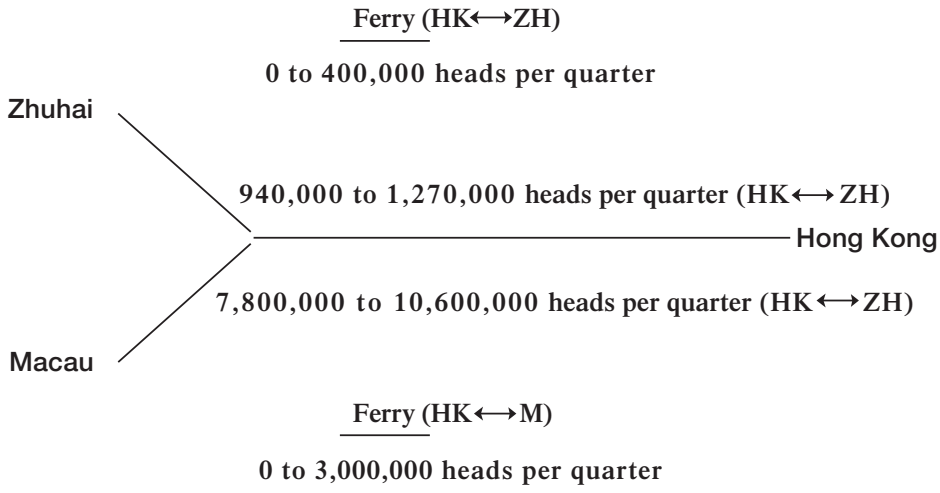
current flow rate of 3,000,000 heads per quarter between Hong Kong and Macau; and 400,000 heads per quarter between Hong Kong and Zhuhai was used to produce the forecasts. Figure 2.5 depicts these estimations diagrammatically. Under three different growth rate scenarios. In short, Hong Kong – Macau is estimated to have a total flow rate in head count from 7,800,000 to 13,600,000 heads per quarter in 2020 [7,200,000 to 11,300,000 in 2011] and Hong Kong – Zhuhai passenger flow is estimated to be from 940,000 to 1,670,000 heads per quarter in 2020 [860,000 to 1,400,000 in 2011]. The estimation is based on the assumption that there will be no traffic between Macau and Zhuhai passing through the Bridge.

Fig. 2.4 Current and projected flow rate of the Tsing Ma bridge, Hong Kong; 1999–2020



Source of current traffic flow rates 1999–2003 : Hong Kong Link 2004 Limited (2005)

Fig. 2.5 Estimation of passenger flows of the HK-ZH-M Bridge in 2020



2.8.4 Limitations

The Tsing Ma Bridge (the Lantau Link) is different from the Bridge in some aspects. The models employed in the Tsing Ma Bridge study to produce statistical forecast may not be fully applied to the current study. Further, the adoption of 1% to 3% exponential growth rates per annum is also arbitrary. As such, the growth of passenger flow is of course dependent of many other factors, including the economy of the cities. Changes to these estimations as a result of new real factors cannot be captured until they can be observed in actual data, for instance, the impacts of the introduction of Individual Visit Scheme for travelers from various cities in China to Hong Kong. As such, the above estimations are limited by the assumption of a favourable growth of passenger flow, other things being equal. Furthermore, the impact of the Bridge on the passenger flows by sea is hardly predictable at the time of the study. Finally, the estimation ignores any traffics among the three cities by air.

2.9 Factor-Mobility Price-Gradient Model (FM-PGM) and Price Change Estimations of Macau and Zhuhai

2.9.1 Empirical Model

Yiu and Tam (2005) developed the Factor-Mobility Price-Gradient Model (FM-PGM) and empirically showed that an increase of human mobility across boundary will flatten their property price gradient. Mathematically, the FM-PGM is as follows:

$$E\left(g^{S}_{AB,t}\right) = c^{S}_{AB,t} + \alpha E\left(F_{AB,t}\right) \tag{2.2}$$

where $g^{S}_{AB,t}$ is the price gradient or price ratio of the two workplaces **A** and **B** at time t of sectors, with the higher-priced city as a nominator; c is a constant term; and is $F_{AB,t}$ the monthly flow rate in head count between workplaces A and B. Their empirical results showed that the price gradient between Hong Kong and a cross-boundary city: Shen Zhen in Mainland China connected by a railway can be derived by the following equation:

$$g_{AB,t} = \text{constant}_{AB} - 2.43 \times 10^{-7} F_{AB,t} + e_t \tag{2.3}$$

where constant_{AB} is a constant term with different values for different pair of cities **A** and **B**; e_t is the random error term. By using the current price level of residential and office properties in the three cities, the constant terms for Hong Kong – Macau gradients and Hong Kong – Zhuhai gradient can be found. Intuitively, the results show that one unit increase in human flow rate per quarter decreases the price gradient by about 2.43 X 10^{-7} unit.

2.9.2 Empirical Results

Table 2.2 summarizes the empirical results. Columns 1 and 2 show the current gradients and current passenger flows between Hong Kong – Macau (**HK:M**) and Hong Kong – Zhuhai (**HK:ZH**) in the residential and the office sectors. Column 3 estimates the constant terms, while columns 4 – 7 depict the estimations of the passenger flow rates and the gradients in 2020. Estimations of year 2011 are in brackets.

Table 2.2 Summary of estimations of expected price gradients and passenger flows

		Current g_{AB}	Current F_{AB}	Derived Constant	F_{AB} grows at 1% p.a.		F_{AB} grows at 3% p.a.	
					Expected F_{AB} in 2020 [2011]	Expected g_{AB} in 2020 [2011]	Expected F_{AB} in 2020 [2011]	Expected g_{AB} in 2020 [2011]
Residential Sector	HK - M	6.00	3,000,000	6.73	7,800,000 [7,200,000]	4.83 [5.00]	13,600,000 [11,300,000]	3.43 [4.00]
	HK - ZH	15.00	400,000	15.10	940,000 [860,000]	14.87 [14.89]	1,670,000 [1,400,000]	14.69 [14.76]
Office Sector	HK - M	9.20	3,000,000	9.93	7,800,000 [7,200,000]	8.03 [8.18]	13,600,000 [11,300,000]	6.63 [7.18]
	HK - ZH	20.00	400,000	20.10	940,000 [860,000]	19.87 [19.89]	1,670,000 [1,400,000]	19.69 [19.76]

The residential price gradient between Hong Kong and Macau, $g^{r}_{HM,\,t}$, as shown in Table 2.2, when F_{AB} falls from 3% to 1% p.a., would be reduced to 3.43-4.83 in 2020 [4.00 – 5.00 in 2011] from the current g^{r}_{HM} ratio of 6.00. The office price gradient, $g^{o}_{HM,\,t}$ would also be reduced accordingly to 6.63-8.03 in 2020 [7.18 – 8.18 in 2011] from the current g^{o}_{HM} of 9.20. Similarly, the residential price gradient between Hong Kong and Zhuhai will be reduced to 14.69-14.87 in 2020 [14.76-14.89 in 2011] from the current ratio of 15.00. Their office price gradient, $g^{o}_{HZ,\,t}$ would be reduced to 19.69 – 19.87 in 2020 [19.76 – 19.89 in 2011] from the current ratio of 20.00.

The AIM and the FM-PGM results suggest that, relative to the 2004 price level, the residential property price in the affected area of Macau is estimated to increase by 33.05%-66.48% in 2011; and Zhuhai, by 16.50% – 17.53%. Similarly, the office property price of the affected area in Macau is estimated to increase by 30.53%-58.09% in 2011; and Zhuhai, by 21.56%-22.36%, **other things being equal**.

2.9.3 Limitations

The price estimates in Macau and Zhuhai are calculated on the basis of change in property prices and price gradients. These changes may be inappropriate in the Macau and Zhuhai contexts. The results may also be inaccurate and therefore they should be treated as tentative and indicative. Moreover, the effective cut-off dates of AIM and FM-PGM results are different (coupled with different estimation parameters of the models): the former depends on the operation of the Bridge, while the latter depends on the passenger flow rate of the Bridge. It is arbitrary to assume that the results derived are reasonable until such time the assumptions on the operation time and flow rate will be reviewed in light of updated forecasting model results.

3 CONCLUSIONS

The effects of the Hong Kong – Macau – Zhuhai Bridge on residential property and office property prices and price gradients around the affected area in the three cities are studied. Built on the established urban location choice models and taking consideration of the traveling frequency, and subject to the assumptions and limitations, the results are summarized in Table 3.1 below.

Table 3.1 Summary of Expected Property Prices

Expected change of property prices in 2011 (at 2004 price level)			
Sectors	Cities		
	Hong Kong	Macau	Zhuhai
Residential	$\lambda_H^r \uparrow$ 26.08%	g^r_{HM} = 4.00 - 5.00	g^r_{HZ} = 14.76 - 14.89
		$\lambda_M^r \uparrow$ 33.05% - 66.48%	$\lambda_Z^r \uparrow$ 16.50%-17.53%
Office	$\lambda_H^o \uparrow$ 34.82%	g^o_{HM} = 7.18 - 8.18	g^o_{HZ} = 19.76 - 19.89
		$\lambda_M^o \uparrow$ 30.53% - 58.09%	$\lambda_Z^o \uparrow$ 21.56%-22.36%

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Appendix

The calculation of the reduction of traveling time is based on a vehicle route from the Western Police Station at No. 7 Des Voeux Road, Hong Kong to the HSBC Building, Tsim Sha Tsui at No. 26 Nathan Road, Kowloon, Hong Kong. The traveling distance of these two points through the Cross Harbour Tunnel in Hung Hom is about 9 km measured on map, while the traveling distance through the Western Harbour Tunnel in the Western District is about 4 km. Taking the average speed of about 50 km per hour; this 5 km difference would then take about 6 minutes to travel. In addition, it is assumed that it takes, on average, another 15 minutes to get through the congested Cross Harbor Tunnel. In other words, the total traveling time saved by using the WHT is about 20 minutes.

By the results of Yiu and Wong (2005), the operation of the Western Harbor Tunnel (WHT) raised the average housing price in the Western District [9] by about 10.43%, ceteris paribus. The traveling time saved by using the WHT from the Western District to the CBD in Kowloon (Tsim Sha Tsui) is about 20 minutes when compared to the route going through the Cross Harbour Tunnel in Hung Hom. It implies that the WHT has raised the residential property price by 0.52% per each minute saved.

A similar approach is adopted in the analysis of office property by Yiu et al. (2005). They found that the WHT has raised the average price level of office in the Western District by about 13.93%. By the same magnitude of time saved, it implies that the office price has been raised by 0.70% per each minute saved.

9 The studied zone is an area of about 200m diameter in Sai Ying Pun district (details see Yiu and Wong, 2005)