THE IMPACT OF GOVERNMENT HOUSING POLICY AND DEVELOPMENT CONTROLS ON THE DYNAMICS OF HONG KONG’S RESIDENTIAL PROPERTY MARKET

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The Impact of Government Housing Policy and Development Controls on the Dynamics of Hong Kong's Residential Property Market

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CERTIFICATE OF ORIGINALITY

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----------Yu Ka Hung---------- (Name of student)

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ABSTRACT

In view of Hong Kong's exorbitant housing price/rental levels in recent years, this research study investigates this issue from a variety of perspectives, namely 1) the major determinants of Hong Kong's housing prices and rents; 2) housing construction decisions by developers; and 3) the Town Planning Board's planning control decisions on the development of different types of housing, against the backdrop of the Linked Exchange Rate System (between Hong Kong Dollar and the U.S. Dollar) in an increasingly globalized world.

The findings first show that a higher housing supply only manages to bring about a moderate short-run negative impact on housing prices and rents. Rather, the soaring property prices and rents faced by Hong Kong residents, in the last few years, have been demand-driven, in that housing in Hong Kong has become costlier than ever due to U.S. unconventional monetary policy measures (launched in the aftermath of the 2008 Global Financial Crisis) via the Linked Exchange Rate System as well as a bullish stock market (which has been increasingly susceptible to global conditions). The former, by causing an unprecedented boost in Hong Kong's money supply, provides prospective homeowners with easy access to very low-cost mortgages, thus stimulating housing demand. Meanwhile, the latter, which is found to have been increasingly susceptible to global stock market/economic movements since the introduction of unconventional monetary policies, generates capital gains for many Hong Kong people to at least afford the downpayment necessary for home purchase.

The findings also show that, even when the government releases more land sites for sale (i.e. higher total supply of residential land), this does not necessarily trigger more housing constructions. However, more housing constructions are triggered when a higher proportion of the total land supply comes from land exchange. Besides, property developers also tend to postpone housing construction, should they expect property prices and construction cost to grow further or should the actual interest rate rise. By contrast, only when property price and interest rate get more volatile that developers would initiate construction sooner.

However, delays in housing development are not solely caused by developers. The Town Planning Board is found to reject applications for housing development in R(A) zone and in CDA zone more often (and small house applications in Greenbelt zone), despite soaring property price (which has essentially been driven by non-domestic factors). Also, the TPB's decisions are generally not found to be in line with the government's housing policy directions to supply more housing units through re-zoning non-residential land sites for housing development. The TPB's irresponsiveness towards the government's housing policy priority, along with its hardened stance towards permitting housing development in light of soaring housing price, results in repeated applications by developers, hence a lengthier planning control process. This, in turn, could cause further delays in housing development as the financial viability of development projects changes over time.

Publications Arising from the Thesis

Published Publications:

Yu, K.H. and Hui, C.M. (2018), Colonial History, Indigenous Villagers' Rights, and Rural Land Use: An Empirical Study of Planning Control Decisions on Small House Applications in Hong Kong, *Land Use Policy*, 72 (March 2018), 341-353

Yu, K.H. and Hui, C.M. (2017), An Empirical Analysis of Hong Kong's Planning Control Decisions for Residential Development, *Habitat International*, 63 (May 2017), 89-102

Hui, C.M., Leung, B.Y.P., and Yu, K.H. (2014), The Impact of Different Land-Supplying Channels on the Supply of Housing, *Land Use Policy*, 39 (July 2014), 244-253

Publication Accepted for Publication:

Yu, K.H. and Hui, C.M. (Forthcoming), Housing Market Dynamics Under a Pegged Exchange Rate -- A Study of Hong Kong, *International Journal of Strategic Property Management*

Publications Currently Under Peer Review:

Yu, K.H. and Hui, C.M., Residential Development and Non-Residential Land Uses: A Study of Hong Kong's Planning Control Decisions (Submitted to *Land Use Policy*)

Yu, K.H. and Hui, C.M., Land Supply and Housing Development under Uncertainties in a High-rise City (Submitted to *Habitat International*)

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CHAPTER 1: INTRODUCTION

1.1 Background of Research

Housing has been the most talked-about social issue in Hong Kong in the last few years. On the one hand, property prices and rents are extremely high and have been soaring rapidly (Figure 1.1). On the other hand, as the income level of Hong Kong residents in general has failed to catch up with the upward price/rental trends, housing has become all the more "unaffordable". According to the Census and Statistics Department (2016), by 2014-2015, households that resided on Hong Kong Island, in Kowloon, and in the New Territories spent as much as 44%, 35%, and 32% of their monthly expenditures, respectively, on housing-related expenses alone. To put this situation in a wider and more global context, the recently-released *13th Annual Demographia International Housing Affordability Survey* (Demographia, 2017) reports that, in 2016, Hong Kong's median multiple (i.e. median house price divided by gross annual median household income) was 18.1. Not only is it regarded as "severely unaffordable", it also means that Hong Kong's housing market is the most unaffordable among 406 metropolitan housing markets within 9 countries[1].

Hong Kong's housing affordability problem has also given rise to the phenomena of sub-divided private housing units (for rental purpose) across the territory, which are not officially part of the rental housing sector. This issue, however, is not exclusive to the private housing sector, as the impact of high private property price appears to have spilled over to the public housing system as well. For instance, transaction prices for resale Home Ownership Scheme (HOS) flats have been remarkably higher lately in

[1] The nine countries are: Australia, Canada, China (Hong Kong), Ireland, Japan, New Zealand, Singapore, United Kingdom, and the United States.

comparison to what they were years before. Additionally, the growth in the amount of people on the waiting list for public rental housing (PRH) has accelerated. In accordance with the Housing Authority, by the end of March 2017, there were around 275,900 applicants on the PRH Waiting List, including 147,300 general applicants (with an average waiting time of 4.6 years) and 128,600 non-elderly one-person applicants under the Quota and Points System (QPS). In comparison, the total number of applicants by March 2006 was approximately 97,000.

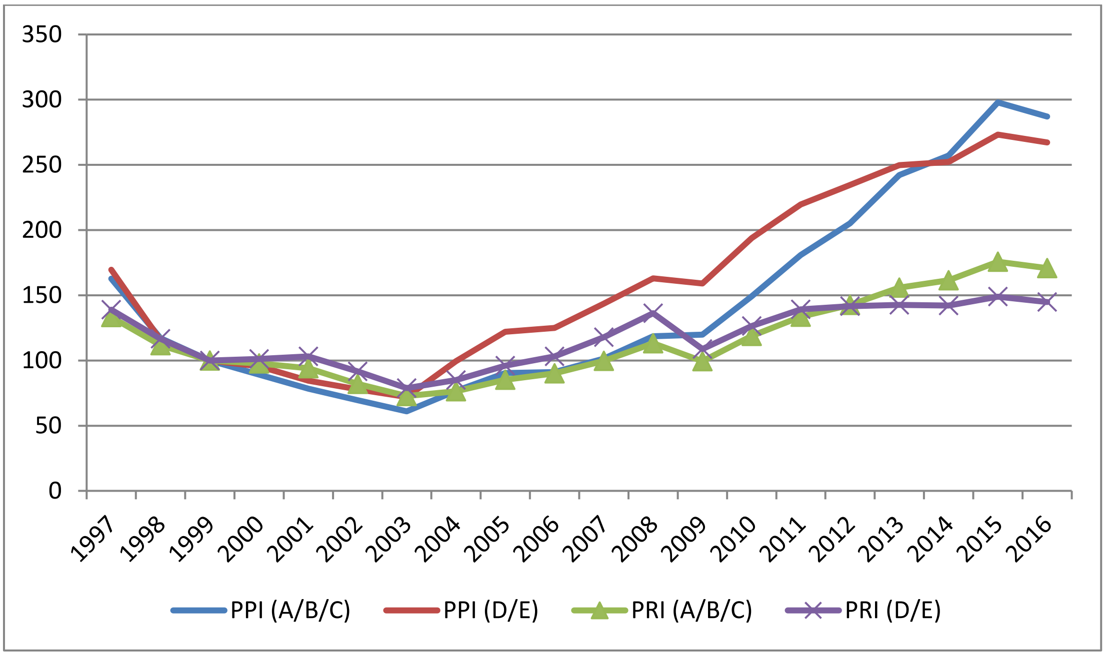

Figure 1.1: Property Price Indices (PPI) and Property Rental Indices (PRI) for Mass (Classes A, B, and C) and Luxury (Classes D & E) housing markets & New Supply of Residential Units, 1997-2016 (in ‘000 units)
(Sources: Rating and Valuation Department & Buildings Department)

It will come as no surprise to many that the supply-side is blamed for the current housing affordability problem by the public and the media alike. On the one hand, property developers, some of which with a large amount of undeveloped land sites at disposal, are being accused for not supplying sufficient housing units in response to the upward housing price movements. On the other hand, the government, as sole owner of all land in Hong Kong, is being criticized for not releasing enough residential land sites for sale, usually perceived as a by-product of its infamous "high land price" policy, for housing development. Given that the supply of new housing units has been much lower in the last 10 years (Figure 1.2), this claim does appear to hold some ground.

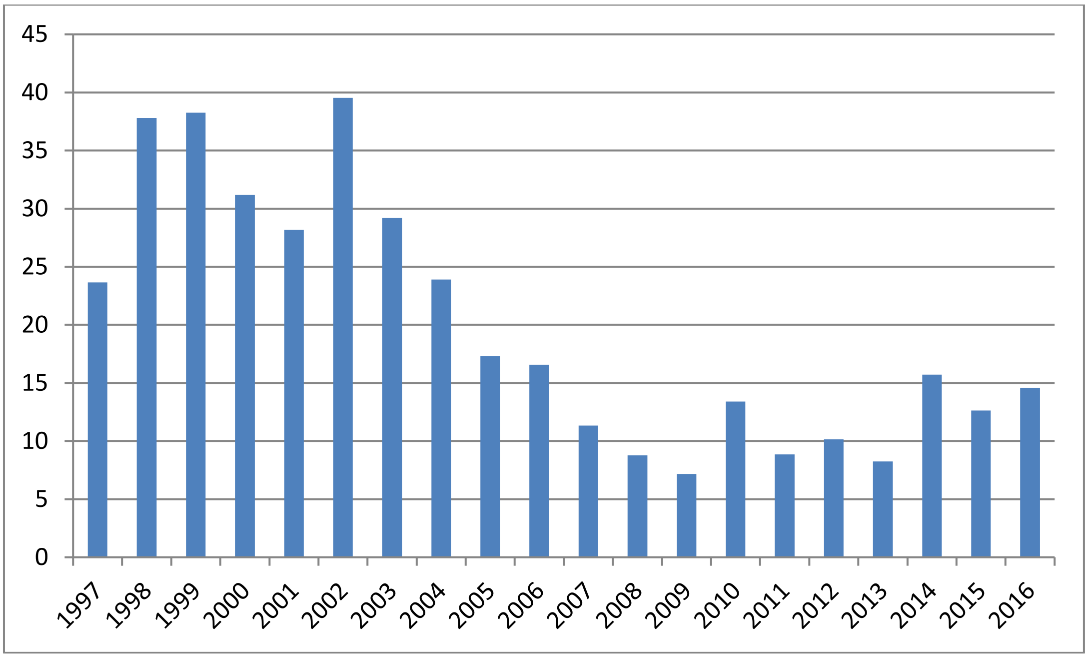

Figure 1.2: New supply of residential units from 1997 to 2016 (in '000 units) (Source: Buildings Department)

In view of the consistently soaring housing price, the public has called for the construction of more housing units, especially small- and medium-size flats; and for the release of more developable land sites for housing construction. Aside from releasing more land site, many Hong Kong residents had earlier demanded for the construction of more public rental housing units as well as the re-launching of the Home Ownership Scheme (HOS) which had been suspended since Autumn 2002. In response to these demands, then-Chief Executive Donald Tsang, in his *2011-12 Policy*

Address, announced 1) the resumption of HOS flats construction (and provision)[2]; 2) the continuation of the sale of sites with specified minimum number of units to be built and sizes of these units; and 3) the supply of more residential land. The current Chief Executive, C.Y. Leung, essentially following Tsang's policy directions, declared before his inauguration, that some of those land sites were to be sold, only under the condition that only permanent Hong Kong residents are eligible for purchasing the residential flats constructed on those sites[3]. In addition, in numerous *Policy Addresses* since then, Leung has also proposed variety of short-, medium-, and long-term measures with the aim to increase the amount of developable land, including the loosening of the existing development density restrictions, the re-zoning of non-residential land sites for housing development, and the planned development of a number of New Development Areas (NDAs) in the New Territories[4]. In addition to measures intended to provide more land for housing development, the government promulgated a new Long-term Housing Strategy (LTHS) in December 2014, following the release of the LTHS Consultation Document a year before (Long Term Housing Strategy Steering Committee, 2013). The government's new LTHS essentially takes the position established in the Consultation document, in that a housing supply target of 480,000 units is to be met between 2015-16 and 2024-25.

A careful examination of these demands, however, points to a variety of perceptions by the public (and the media) when it comes to residential development. They are:

[2]According to the *2011-12 Policy Address*, "With the sites identified at this stage, we plan to provide more than 17,000 flats over four years from 2016-17 onwards, with an annual production of between 2,500 and 6,500 flats. For the first year, 2,500 flats can be made available. As more sites become available, we will set our planning target at 5,000 flats a year on average."
[3] Besides this arrangement, the Leung administration also launched demand-side measures such as a new Buyer's Stamp Duty (BSD), and upward adjustments in the existing Special Stamp Duty (SSD) Rate and the Ad Valorem Stamp Duty Rate (AVD) on sale or transfer of properties in Hong Kong.
[4] Such as the Kwu Tung North and Fanling North NDA and the Hung Shui Kiu NDA.

- Property developers have total control as to when to supply new housing units (which follows that they should construct more housing units when housing price increases); and
- Land sale is the only source of land supply in Hong Kong (which follows that a higher land supply [via the sale of more land by the government] should result in more housing constructions; see Beer *et al.,* 2007; Demographia, 2007; Moran, 2006, 2008; Nelson *et al.*, 2002; White and Allmendinger, 2003);

A major issue with these perceptions, however, is that they either demonstrate the public's misunderstandings towards the land development process, or overlook several critical demand-side factors which can affect housing prices and rents. These factors are to be discussed in detail in Sections 1.1.1 & 1.1.2, respectively.

1.1.1 Misunderstandings by the public

1.1.1.1 Do property developers have total control as to when to supply new housing units?

One of the major accusations levied by the public and the media alike is that a handful of large property developers withhold the supply of housing in order to maximize profits. This criticism reflects the commonly-held view that property developers have total control as to when (and the number of) new residential flats should be constructed, and that land development should correspond to housing demand conditions at the time. However, as the government authorities involve themselves heavily in the land development process, property developers have a much lower degree of control in the land development process than most people believe.

Hong Kong, at 6,777 persons/km² by the time the 2016 Population by-Census was conducted, is one of the most densely-populated areas in the world. Nonetheless, even within such a small territory, Hong Kong's populace is far from evenly distributed. On the one hand, Kowloon Peninsula accommodates an astonishing 47,748 persons/km². And on the other, the New Territories, at only 4,019 persons/km², is much sparsely-populated. Worse, due to the general mountainous landscape, approximately 24% of Hong Kong's land has been developed, of which less than 7% is for residential purposes (Table 1.1).

Class	Approximate area (km²)	Percentage (%)
Residential	77	6.9
Commercial	4	0.4
Industrial	26	2.3
Government, Institution and Community facilities	25	2.3
Transportation	56	5.0
Open Space	25	2.3
Other Urban or Built-up Land	55	5.0
Total Developed Built-Up Area	***268***	***23.9***
Agricultural	68	6.1
Woodland / Shrubland / Grassland / Wetland	737	66.4
Barren Land / Water Bodies	37	3.3
Total Non Built-Up Area	***842***	***75.9***
Total	**1,110**	**100**

Table 1.1: Land use distributions in Hong Kong as in 2015 (Source: Planning Department)

With very limited developable land resources, land development in Hong Kong, inevitably, is subject to very intensive government interventions. Unlike western nations in which either a regulatory planning control system or a discretionary system is deployed, Hong Kong's planning control system, with the expressed goal to achieve a balance between certainty and flexibility, incorporates the elements of both systems (see Chapter 4 for more details). On the one hand, the development of residential buildings is constrained by means of maximum plot ratio, site coverage, and building height[5], in accordance with the *Hong Kong Planning Standards and Guidelines*. This have implications for the financial viabilities of development projects, and thus to developers' demand for residential land. On the other hand, Hong Kong's land use is stipulated by the Outline Zoning Plan (OZP)[6]. Unlike the stringent land-use legislations adopted in foreign countries (for instance, the U.S.), Hong Kong's land-use regulations under the OZP are more flexible by design. For each statutory land-use zone, some land uses are always permitted (i.e. Column 1 uses) while some others are permissible upon the approval of the Town Planning Board (TPB) under Section 16 of the Town Planning Ordinance (Column 2 uses).

However, as uncertainty normally comes along with flexibility, Hong Kong's planning control system unavoidably leads to delays, to varying degrees, in the land development process, and thus the eventual supply of new housing units.

It should be noted that, property developers are not the only ones that are susceptible to delays and uncertainties derived from this system. Another group of peoples who are just as likely to be subject to the TPB's planning controls are the indigenous villagers in the New Territories, when it comes to the construction of small houses (or New Territories Exempted Houses). Since the New Territories, like Hong Kong Island and Kowloon Peninsula, was leased to the British in 1898, the land administration system for land in the New Territories differed from that for land on Hong Kong Island and in Kowloon Peninsula. By the 1970s, due to the need for new town development, the New Territories Small House Policy was launched in order to partially preserve

[5] These development controls differ between the development of land on Hong Kong Island, in Kowloon, and in the New Territories.
[6] Besides OZP, Hong Kong's town planning is also based upon the Development Permission Area (DPA) Plan and the Development Scheme Plan (DSP).

the customary rights of indigenous villagers. Under this policy, a male indigenous villager is allowed to build his small house, subject to the Buildings Ordinance (Application to the New Territories) Ordinance (Cap 121), at his own expenses within areas designated as Village Type Development (V) zone (see Section 5.2.1 for more details about this policy). Nevertheless, as both the indigenous villager population and the general population are expanding consistently, it is inevitable that some indigenous villagers would apply for small house construction either partially or completely outside the V zone. In view of the government's stated priority of releasing more land sites for housing construction, the potential encroachment of land outside the V zone by indigenous villagers indicates that their interests, as guaranteed by the Basic Law, are prioritized at the expense of other Hong Kong residents. By contrast, should the TPB be more stringent in approving small house applications, this means that the indigenous villagers' interests are compromised.

As a result, studies not only on the TPB's planning control decisions on the development of housing units/ordinary houses, but also on those on small house constructions, are important in that the results of the two studies can yield very timely and crucial policy implications not only to land-use in Hong Kong (especially in the New Territories), but also to the eventual supply of housing.

1.1.1.2 Is land sale the only source of land supply?

Another major criticism is that the government has not released enough developable land sites for sale. It has been stated by some that, the government, which owns all land in Hong Kong, has the tendency to sparingly release non-developed land sites in public auctions to maximize revenue (Hui et al., 2006). Such a practice has resulted in higher land prices and the clustering of developable land amongst a few large property developers (Table 1.2), hence providing the conditions for what is perceived by many Hong Kong residents (and the local media) as "Developer Hegemony". Therefore, the general perception shared by members of the public is that the government could help address the housing affordability problem by releasing more developable land sites for sale, with the perception that a higher land supply leads to the construction of more housing units.

Name of Property Developer	**Amount of Land Bank (in million sq. ft)**	**Amount of agricultural land inside the New Territories in possession (in million sq. ft)**
Cheung Kong Group[7]	6.0	Not Available
Sun Hung Kai Group[8]	49.3	More than 30
New World Development[9]	8.2	17.5
Henderson Land[10]	24.1	44.8

Table 1.2: Land banking situations of major Hong Kong property developers by the end of 2016

However, two issues arise. The first issue is that such a perception does not take into consideration the uncertainties in a varitety of aspects, such as property price, construction cost, and interest rate, which determine the viability of a development project. Also, besides land sale, there are other ways in which additional living space can be developed, for instance land exchange (and to a lesser extent, lease modifications, and urban redevelopment)[11]. Land exchange, in particular, has been a

[7] Cheung Kong Property Holdings Limited 2016 Annual Report (http://www.ckph.com.hk/uploaded_files/news/823_e_content.pdf)
[8] http://www.shkp.com/en-US/Pages/land-bank
[9] New World Development Annual Report 2016 (http://cms.nwd.com.hk/downloadIR/report/148/ar2016e_0.pdf)
[10] Henderson Land Interim Report 2013 (http://www.hld.com/en/pdf/investor/annual/2013/InterimReport/hld_interim_2013_E.pdf)
[11] Besides those land-related measures, additional housing space has been provided to Hong Kong residents, since the sale of New Territories Exempted Houses (i.e. small houses) to non-indigenous villagers was declared legal in early 1997.

crucial land-supplying channel in the last 15 years or so (See Appendix B1.1 for information about land exchange and a comparison between land exchange and land sale). As shown in Figure 1.3, the supply of residential land, before 2001, had been pretty much entirely via land sale. Yet, in the aftermath of the late 1990s Asian Financial Crisis, property developers appear to have been more cautious when it comes to land purchase. As a result, the amount of land sold through auction or tender plummeted, despite the introduction of the Application List system in 1999 (see Appendix B1.1). Interestingly, from 2002 to 2011, more residential land had been supplied via land exchange than via land sale, despite that the property market began to recuperate after the 2003 SARS epidemic. It was until 2012 that land sale has become more frequent.

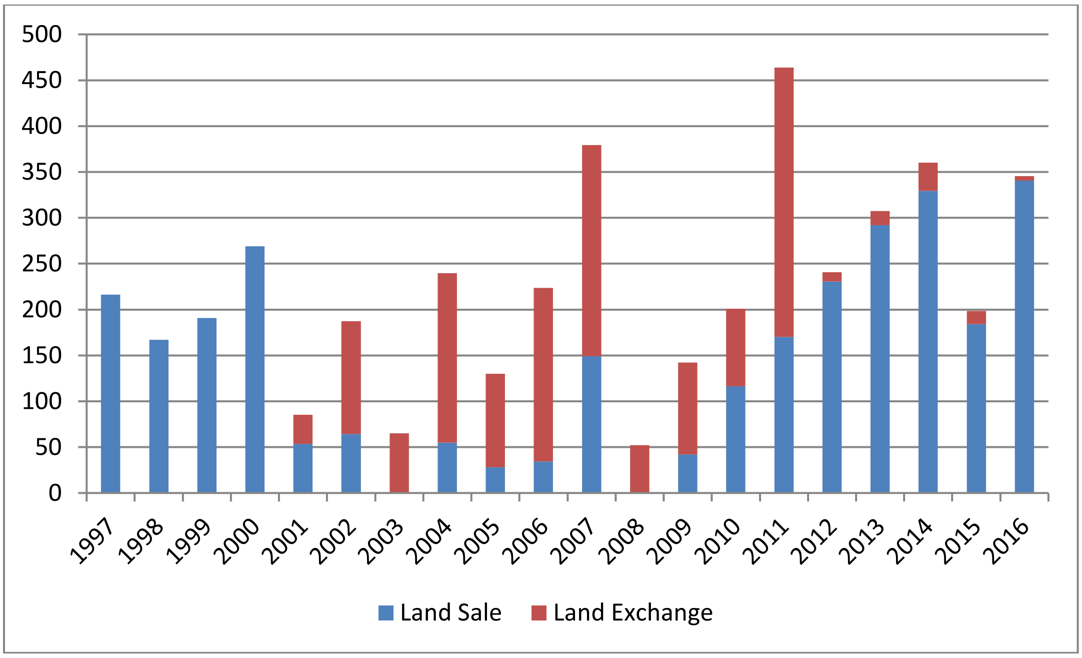

Figure 1.3: Amount of residential land supply via land sale and land exchange (in '000 square metres), 1997-2016
(Source: Lands Department)

1.1.2 Demand-side Factors Overlooked in Housing Debates

In addition to the government's control in the supply of land (via land sale) and in land development, public perceptions towards Hong Kong's (private) housing market have also overlooked the influence of two important demand-side factors. The first of these factors concerns the provision of public housing, especially subsidized homeownership. In addition, even taking these factors into consideration, it is still difficult to fathom how Hong Kong's extremely high housing prices and rents, especially in the last few years, can be sustained without external influences. This is especially important given the introduction of unconventional monetary policy measures, such as Quantitative Easing (QE), in the years following the Global Financial Crisis of 2008. Therefore, a study of the housing price and rental dynamics in Hong Kong cannot be viewed as comprehensive without taking these demand-side factors into account. Some background information of these two components are to be presented in the following sections.

1.1.2.1 The Provision of Subsidized Homeownership

Subsidized housing units, under the Home Ownership Scheme (HOS), have been sold to eligible Hong Kong residents by the Housing Authority (HA) since 1978. It, say La Grange & Pretorius (2000), had been used by the government, since the mid-1980s, to encourage well-off residents in Public Rental Housing (PRH) to become homeowners. This, in turn, allows for PRH flats vacated by these well-off residents to be re-allocated to needy families, hence reducing the waiting time for public housing allocations. This scheme had been rather successful in meeting the government's objectives. By the 1990s, 189,500 PRH flats had already been re-allocated with the assistance of HOS (and other related schemes), and HOS flats had been massively over-subscribed by renters in the private housing sector (La Grange, 1998).

Unlike private housing units, HOS flats are subject to resale alienation restrictions. These flats can be transacted either in the open market or in the HOS Secondary Market which was established in June 1997. For HOS owners who wish to sell (and let or assign) their flats in the open market, a premium which amounts to:

$$Prevailing\ Market\ Value \text{ X } \frac{(Initial\ Market\ Value - Purchase\ Price)}{Initial\ Market\ Value}$$

is payable to the HA *before* the transaction to lift the alienation restrictions. By contrast, HOS owners who intend to sell their flats in the HOS Secondary Market are not required to pay this premium. The original aim of the resale market for assisted homeownership is to facilitate consumers' choices in housing as well as to render the delivery of public housing more efficient by means of market mechanism. Yet, it has also been found, in Singapore, that the resale market for its assisted homeownership flats, called HDB, has become a stepping stone for Singaporean residents in realizing the "Singapore Dream" (Koh and Ling, 1996), by relocating to private housing after selling their HDB flats[12]. In short, should similar mechanisms hold for the HOS scheme, a relationship between housing prices/rents in the private sector and the amount of HOS flats sold should exist. This is the one element in assisted homeownership which has not been explicitly stated in housing-related debates.

1.1.2.2 External Influences

In view of the unconventional monetary policies launched outside Hong Kong in recent years, there are two channels through which extra demand for housing can be

[12] Such upward housing mobility has become so common that about 5% of the existing public housing stock are being transacted in the HDB resale market on a yearly basis (Tu, 2003).

incurred. The first channel is through a pegged exchange rate. Following the 2008 Global Financial Crisis, the Federal Reserve had launched three rounds of asset-purchase programmes, commonly referred to as QE, under which a total of 3.9 trillion U.S. Dollars (USD) worth of U.S. government securities had been bought. In doing so, the same amount of newly-printed money had been injected into the U.S. financial system, giving its money supply an unprecedented boost in the process. Under such circumstances, the USD had become weaker against many other currencies. This, however, does not apply to Hong Kong, as Hong Kong has adopted a Currency Board system, otherwise known as the Linked Exchange Rate system[13], since October 1983. Under this system, the exchange rate between Hong Kong Dollar (HKD) and USD has been officially pegged at 1 USD = 7.8 HKD, with a convertibility zone between 7.75-7.85 HKD to 1 USD[14]. With massive quantities of USD entering the U.S. financial system due to the QEs, the exchange rate between the two currencies should have easily reached the "strong-side Convertibility Undertaking" level (i.e. 1 USD = 7.75 HKD). The Hong Kong Monetary Authority (HKMA), under the Currency Board system, has no choice but to purchase USD from Hong Kong's licensed banks with HKD in order to keep the exchange rate from moving outside the stipulated range[15]. The end-result of this designated response is, thus, a pronounced rise in Hong Kong's monetary base (and money supply [M1]) since the introduction of the QE programmes (Figure 1.4) as well as a weaker HKD against non-USD currencies. This, along with near-zero base interest rate, which also follows the movements in the Federal Funds

[13] This system is considered a 'hard peg' exchange rate regime by the International Monetary Fund (IMF).

[14] According to the HKMA, it "undertakes to buy US dollars from licensed banks at HK$7.75 to one US dollar (strong-side Convertibility Undertaking) and sell US dollars at HK$7.85 to one US dollar (weak-side Convertibility Undertaking)."

[15] Even the HKMA admits that, "the Link ties Hong Kong to US monetary policy at times when the economic cycles of Hong Kong and the US may not necessarily be moving in tandem. A Linked Exchange Rate system leaves little scope for an autonomous interest rate policy to achieve the objectives of price stability or promotion of economic growth."

Rate via the mechanisms of the Linked Exchange Rate system (Figure 1.5), has resulted in much easier access to low-cost credit for potential homebuyers than it otherwise should have been under a floating exchange rate system.

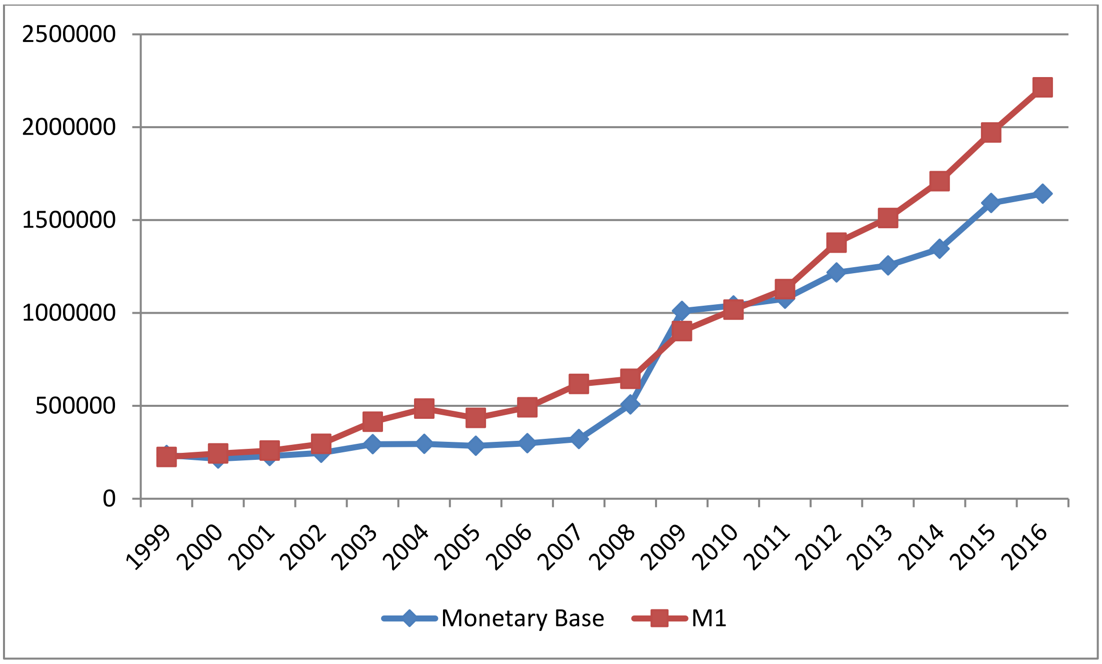

Figure 1.4: Hong Kong's monetary base and money supply (M1), 1999-2016 (Year-end figure; in million HKD)
(Source: The Hong Kong Monetary Authority)

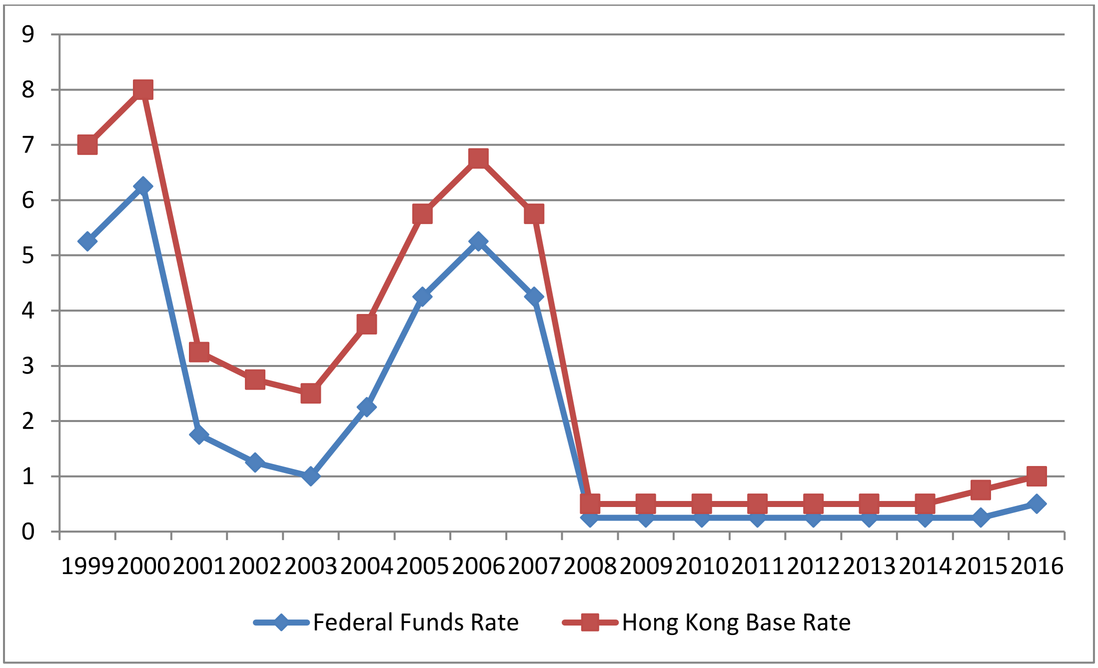

Figure 1.5: The U.S. Federal Funds Rate and the Hong Kong Base Interest Rate, 1999-2016 (Year-end figures; in % per annum)
(Sources: Federal Reserve & Hong Kong Monetary Authority)

Another channel that unconventional monetary policies (and/or other external factors) can influence Hong Kong's housing market is through the stock market. Monetary policies, be they conventional or unconventional, have been found to trigger varying impacts on stock prices, which in turn stimulate macroeconomic activities (both consumption and investment) through the stock market channel (Figure 1.6). Nevertheless, national economies, in an increasingly globalized world, have become more integrated with one another, through either trade or freer movement of human resources and capital resources. With such newly-found interdependence, shocks from one nation are more likely to spillover to other nation(s) than they were before, thus affecting the stock prices of the latter. A rise in stock prices, in turn, could lead to higher demand for housing, whether it is for self-consumption (i.e. the wealth effect) or for investment (i.e. the balance sheet effect), by creating the capital gains necessary for the downpayment, if not for the full amount, of a flat/house.

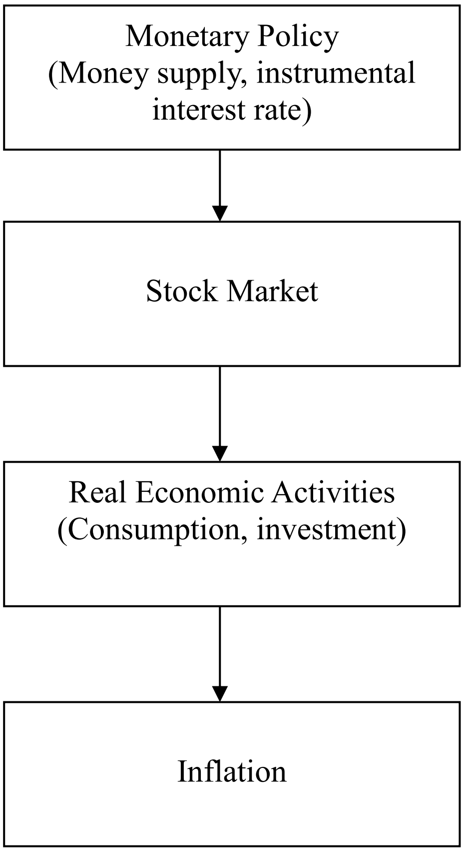

Figure 1.6: The Stock Market Channel (Source: Sellin, 2001, p. 492)

1.2 Research Questions

In view of these unique factors, a number of research questions are raised, based on the research framework presented in Figure 1.7.

First, for the housing market:

- Does a higher supply of housing units help reduce housing prices and rents?;
- Do U.S. monetary policy measures, via the Linked Exchange Rate System, contribute to the soaring housing prices and rents? If so, how?
- Does a bullish stock market drive Hong Kong's housing prices and rents in the private sector?; and

- How does the availability of assisted homeownership influence housing prices and rents?;

Then, for the decisions made by developers:

- Does the sale of more land by the government through auction or tender necessarily lead to more housing constructions?;
- Do developers construct more housing units when property price is soaring?;
- Do uncertainties in housing prices (and in other relevant factors) affect housing constructions? If so, how?;

And finally, for the planning control decisions made by the Town Planning Board:

- Are the TPB's planning control decisions on proposed residential development consistent with the government's stated housing policy objectives (to supply more land sites for housing development through re-zoning non-residential land)?;
- Do the TPB's planning control decisions on proposed residential development respond to soaring housing price? If so, how?
- Are the TPB's planning control decisions on proposed small house constructions consistent with the government's stated housing policy objectives (to supply more land sites for housing development through re-zoning non-residential land)?; and
- Do the TPB's planning control decisions on proposed small house constructions respond to soaring housing price? If so, how?

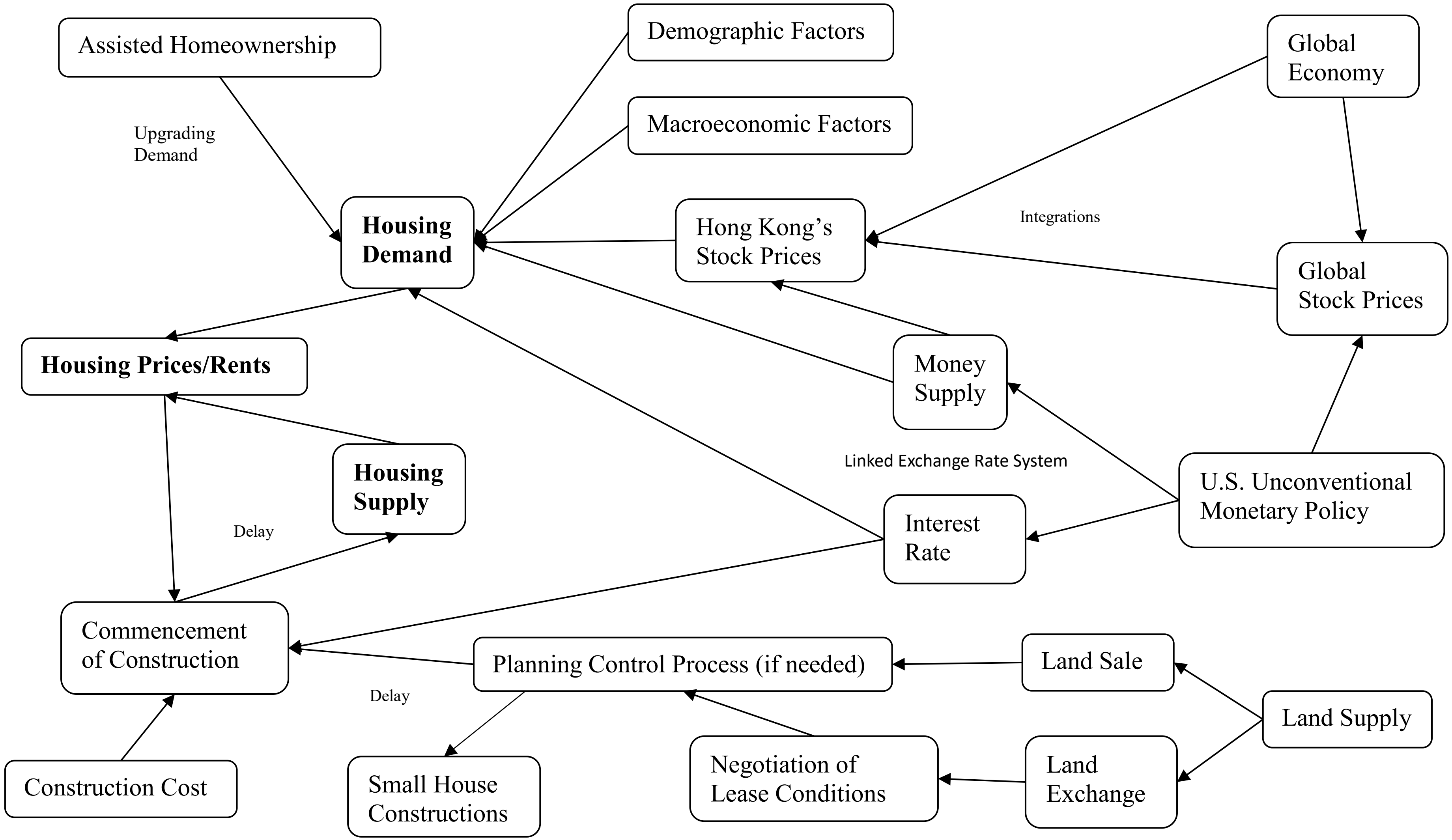

Figure 1.7: Research Framework

1.3 Research Objectives

Grounded on the research questions listed in Section 1.2, the objectives of this research study are as follows:

1. To explore the major determinants of Hong Kong's private property prices and rents;
2. To investigate how different market and land supply-related factors, and their respective uncertainties, affect the amount of housing constructions;
3. To evaluate the Town Planning Board's planning control decisions on applications for residential development; and
4. To evaluate the Town Planning Board's planning control decisions on applications for small house constructions

These objectives are to be addressed in four chapters (Chapters 2-5). To address Objective 1, the major determinents of prices and rents in different housing classes of Hong Kong is first to be conducted (Chapter 2). Then, the relationship between the amount of housing construction and factors relevant to the determination of a project's financial viability is to be studied in Chapter 3, thus meeting Objective 2. It is then followed by two chapters on the planning control decisions made by the Town Planning Board under Section 16 of the Town Planning Ordinance. Chapter 4, first, focuses on residential development applications (i.e. proposed construction of flats and ordinary houses), through which Objective 3 is to be addressed. Meanwhile, Chapter 5 is to investigate applications for small house constructions in the New Territories, which intends to tackle Objective 4. The final chapter of this thesis (Chapter 6) is to summarize the findings obtained in Chapters 2-5 and to discuss the implications of these findings as well as the possible directions for future research.

1.4 Originality of Research

The originality of this research is twofold. The first element which distinguishes this research from others is its broader scope, which not only considers Hong Kong's housing demand/supply dynamics, but also decisions made by participants in the land development process, in response to the rapidly soaring housing prices as well as the government's stated housing policy objectives (to supply more land sites for housing development through re-zoning non-residential land) in recent years. In addition, rather than viewing the housing market as a closed system, this research takes into consideration the influences, if any, of external factors (via the stock market channel)[16], against the backdrop of the Linked Exchange Rate System and intensified integrations among nations under globalization.

1.5 Significance of Research

This research is expected to contribute to knowledge from a theoretical perspective as well as from an empirical perspective. The findings of this research study are expected to shed light on how both domestic factors and global factors are at work in influencing Hong Kong's housing market. The global factors, given the presence of the Linked Exchange Rate System and the introduction of unconventional monetary policy in recent years, are particularly critical. A study in this particular direction not only can provide new insights to the existing academic discussions of housing price and rental

[16] The impact of external factors is not limited to the stock market. However, the stock market responds to shocks in these factors in a much more timelier manner than different aspects of the economy. Also, with the rise of the global debt market, changes in external factors bring about portfolio rebalancing effects as well as changes in the conditions for companies to obtain equity financing. These two outcomes, in turn, trigger varying degrees of responses from stock market(s), which serves as another channel (other than banks) for companies to raise capital for real economic activities (See the stock market channel as depicted in Figure 1.6). Therefore, a supplementary study, specifically to explore how this stock market channel is at work (and thus indirectly influencing housing prices/rents), through an investigation of the interactions between Hong Kong's stock market and different global factors (including international stock market, exchange rate, and global economic factors), is conducted (and included as Appendix A in this thesis).

dynamics in Hong Kong as well as other nations which have adopted a pegged exchange rate arrangement, but also can yield useful policy implications relating to 1) the measures to be utilized to manage the growing property price trend and 2) the re-assessment of the existing currency regime.

In addition, the findings also expected to provide some insights into the discussions as to how property developers respond to soaring property prices as well as the land supply situations. This allows for a better and more comprehensive understanding in the decision-making of property developers when it comes to when to initiate housing construction (and how much), subject to uncertainties in factors relevant to deciding development projects' viability. Policy implications can also be yielded with reference to the existing land sale/land exchange arrangements.

Further, considering the nature of Hong Kong's "hybrid" planning control system, the findings concerning the Town Planning Board's decisions on applications for residential development (i.e. flats and ordinary houses) and for small house construction are expected to shed light on the way the Town Planning Board interprets the guidelines for different statutory land-use zones (and, to a certain extent, the Small House Policy), in light of the current housing affordability issue and the government's expressed objective to increase the supply of housing. The statistical patterns of the TPB's planning control decisions for land sites in different land-use zones can also yield implications that can be beneficial to the formulation of policy responses.

The findings of this research are expected to de-mystify the misperceptions held by members of the public and the media alike, to bridge the knowledge gap regarding Hong

Kong’s housing market dynamics, as well as to provide insights to housing-related policy debates.

CHAPTER 2: HOUSING MARKET DYNAMICS UNDER A PEGGED EXCHANGE RATE -- A STUDY OF HONG KONG

2.1 Introduction

While most of the attentions, concerning Hong Kong's extremely high housing prices/rents in recent years, have been paid towards either property developers or the government (see Chapter 1), several critical elements have usually been overlooked.

Besides market conditions and demographic factors, three elements, in particular, should be highlighted with regard to their latent effects on the demand for housing in Hong Kong. The first element is the provision of subsidized homeownership, known as the Home Ownership Scheme (HOS). As will be discussed in the literature review section, the supply of assisted homeownership has been found to incur significant impacts on the demand for private housing.

The second element concerns the stock market. It has been documented that additional housing demand can be generated, due to capital gains from the stock market. For investors, real estate is also regarded as one of the asset classes in their portfolios. And for users, this new-found capital can be used to settle at least the downpayment for, if not the full amount of, housing units. Regardless of whether housing is being purchased for self-use or for investment, stock market movements could result in profound implications for Hong Kong's housing demand, and by extension, housing prices/rents.

The last element is the influence of U.S. monetary policy through a pegged exchange rate. The Hong Kong Dollar, since October 1983, has been pegged to USD under a “hard peg” currency board arrangement known as the Linked Exchange Rate system. As already shown in Section 1.1.2.2, Hong Kong, under this arrangement, has to follow whatever monetary policy changes initiated by the Federal Reserve. In the context of housing, with the U.S. Federal Funds Rate falling to near-zero levels in the aftermath of the 2008 global financial crisis, this means that prospective homebuyers are able to obtain much cheaper mortgage loans from banks than they otherwise could have under a floating exchange rate system.

These factors give rise to the following questions:

- Does a higher supply of housing units help reduce housing prices and rents?;
- Do U.S. monetary policy measures, via the Linked Exchange Rate System, contribute to the soaring housing prices and rents? If so, how?
- Does a bullish stock market drive Hong Kong’s housing prices and rents?;
- How does the availability of assisted homeownership influence housing prices and rents?;

In response to these questions, this chapter aims to explore the major driving forces behind the dynamics of Hong Kong’s housing market (i.e. both the sale sector sand the rental sector), from 1983Q4 (i.e. when the Linked Exchange Rate system was adopted) to 2016Q4.

The remainder of this chapter is presented as follows: After this introduction section, relevant literature with regard to the demand for housing, as well as how the availability of assisted homeownership affects the private housing market is to be discussed (Section 2.2). Following the literature review is the section in which the methodology and the data necessary for this investigation are to be presented (Section 2.3). Then, the empirical findings are to be presented and discussed in Section 2.4. Prior to the final section which concludes the study, some policy implications based upon the findings are to be discussed in Section 2.5.

2.2 Literature Review

Homeownership in the private sector 1) is regarded as the final step to make on the housing ladder for a household; 2) confers social status; 3) helps create one's sense of belonging to a particular place; and 4) guarantees a shelter for retired persons and keeps the elderly from poverty (Ritakallio, 2003). What distinguishes private properties from those in the public sector is that the quality of the former is generally higher and it reflects a more exclusive lifestyle (Teo and Kong, 1997).

The rationale as to why people own homes rather than rent them has been explained either from a psychological perspective or an economic perspective. From a psychological standpoint, both the psychological meanings and the sociological and cultural meanings of homeownership have been highlighted. A person's emotions towards autonomy, security, or personal identity can be expressed through homeownership, in that homeownership reflects that person's "innate and natural desire" as well as proffers his/her "ontological security". Because of these characteristics associated with homeownership, the sense of security and emotional attachment can be formed among homeowners, but not among renters (Saunders, 1990).

However, this perspective has received its share of criticisms. It is opined by Forrest et al, (1990) that Saunders' notion of homeownership is too generalized, in that people become more eager to own homes only when property prices are soaring. The "innate and natural" desire for homeownership vanishes as property prices drop. As a result, any attempts to explain homeownership decision purely from an ontological perspective, is problematic (La Grange & Pretorius, 2000).

By contrast, from an economic perspective, households are normally assumed as rational, meaning that housing tenure decisions are made in order to maximize their utility, constrained by their budgets (Arnott, 1987). More specifically, a household's utility with reference to housing comprise both consumption demand and investment demand[17] (Henderson and Ioannides, 1983; 1987; Berkovec, 1989; Brueckner, 1997; Lin and Lin, 1999; Arrondela and Lefebvreb, 2001; Cassidy et al., 2008). In accordance with Henderson and Ioannides (1983; 1987), a household is more likely to own homes should its investment demand be higher than its consumption demand, and is more likely to become renters should housing price fluctuate[18]. Yet, according to some researchers (Bruecker, 1997; Lin, 1990; 1994), as tenure choice and housing demand are decided in tandem, an individual's consumption demand and investment demand for housing are thus interrelated. With a binding investment constraint, the investment portfolio of a homeowner, albeit optimal, is not considered efficient, because of overinvestment in housing (Bruecker, 1997; Lin and Lin, 1999). In addition, the latent profits from homeownership could be much less than most people perceive, due to higher transaction cost and information cost for housing (Case and Shiller, 1989; Linneman, 1986). By contrast, even though renters are not bound by the investment

[17] In addition to price appreciations, real estate is also viewed as a hedge against inflation (Sirmans and Sirmans, 1987; Chen and Patel, 2002; Hoesli et al., 2008). In addition, homeownership is closely related to households' retirement strategy even when properties are not deemed very affordable to them (Lee, 1996).

[18] Nevertheless, an investment constraint is assumed for homebuyers in their housing tenure model, as the quantity of housing owned by an individual is, at a minimum, as much as the quantity of housing consumed.

constraint, they are susceptible to the "renter externality", which refers to higher cost due to utilization Henderson and Ioannides (1983; 1987). Renters also are not able to take advantage of tax subsidies exclusive to homeowners, as the imputed rental income is not subject to taxation[19].

In case a household has a higher investment demand for housing than its consumption demand, two factors are critical: housing affordability and mortgage repayments (Ong, 2000). With respect to housing affordability, income has been viewed as a major determinant of housing price (AETM, 1991; Bourassa and Hendershott, 1995; Buckley and Ermisch, 1982; Munro and Tu, 1996; Stern, 1992; Whitehead, 1974). Nevertheless, as many home purchases require mortgage financing, the expected permanent income which is susceptible to economic conditions in general, rather than temporary income changes, determines housing demand (AETM, 1991; Pain and Westaway, 1997). Interestingly, the effect of economic conditions on private residential activities is mixed. Some studies have identified significant relationships between housing prices and GDP (Case et al., 1999; Goodhart and Hofmann, 2008), whereas the study conducted by Bardhan et al. (2003) does not find any significant impacts.

On the other hand, mortgage housing finance shapes the user cost for potential homebuyers (Tu, 2000). It has been found that homeownership rates are higher when the user cost is low (La Grange & Pretorius, 2000)[20]. Also, since mortgage interests are

[19] This argument, however, does not apply to Hong Kong, as homeowners are subject to a type of property tax known as Rates, regardless of whether they lease the property out in exchange of a rental income or occupy it themselves.
[20] Another reason behind higher ownership rates is sufficiently high returns to housing investment, creating wealth for households for additional consumptions (Skinner, 1989; Manchester and Poterba, 1989; Bosworth et al., 1991).

grounded on nominal mortgage rates, this indicates that instead of real interest rate[21], nominal interest rate plays an important role in deciding the user cost of homeownership, as well as housing affordability and housing prices (Drake, 1993; Ling and Narnjo, 1995; Jin and Zeng, 2004; Beltratti and Morana, 2010).

Besides housing affordability and mortgages, there is an extensive literature relating to 1) the risk-return characteristics of housing as opposed to stocks and bonds (Zerbst and Cambon, 1984) and 2) the impact of monetary policies. For the former, real stock returns have been found to contain information concerning real economic activities prior to their actual occurrences (Geske and Roll, 1983; Fama, 1990; Kaul, 1987). Within the context of real estate development, Ito and Iwaisako (1995) find noticeable correlations between Japan's stock price movements and land price movements, as well as correlations between asset prices and market fundamentals.

And for the latter, in addition to interest rate adjustments, money supply adjustments are another form of monetary policy. A higher money supply results in a higher housing price (see Aoki et al., 2004; Ball, 1994; Beltratti and Morana, 2010Breedon and Joyce, 1992; Chen et al., 2007; 2012; Darrat and Glascock, 1989; Elbourne, 2008; Goodhart and Hofmann, 2008; Iacoviello, 2005; Jin and Zeng, 2004; Kim, 1993; Lastrapes, 2002; Maclennan et al., 1998). Rising housing price incurs a wealth effect that encourages further spending, as well as a collateral effect which enhances households' borrowing capacity (Goodhart and Hofmann, 2008). Besides, a higher money supply also makes

[21] Even though previous studies such as Gibson (1972), Schwab (1983), Harris (1989), Hui and Yiu (2003), and Yiu (2009) have found significant negative relationships between real interest rate and property returns, they primarily view real properties as an investment asset, this topic is not the focus of this study, which investigates property (as both a commodity for use as well as an investment asset) price/rental dynamics with reference to the Linked Exchange Rate system.

bank credit more accessible, which attracts a higher demand for credit from potential homeowners that were previously borrowing-constrained. Numerous studies have provided empirical support for the linkages between money supply and housing prices.

One issue with these studies is that, they have not taken into consideration the provision of subsidized homeownership. If government institutions are themselves involved in housing provision (Balchin, 1996; Bacher, 1993; Ching and Tyabji, 1991; Forrest and Murie, 1988; Hays, 1994; Pickvance, 1994), housing decisions made by households change accordingly.

Several studies have, instead, concentrated on the relationship between 1) the public housing sector and the private housing sector; and 2) public housing prices and various economic factors. For the former, the prices of housing in these two sectors have been found to be interrelated (Ong and Sing, 2002; Phang and Wong, 1997), even though the interpretations with regard to the nature of their relationships and the role played by assisted homeownership differ. One particularly interesting mechanism takes the form of the upgrading hypothesis, which states that higher transaction prices for public housing flats are instrumental in assisting homeowners in the public sector to become owners in the private sector (Lum, 1996; Ong, 1999; Hui et al., 2009; Ong, 2000). As a result, public housing prices should have a positive impact on private housing prices (see Phang and Wong, 1997).

Having discussed the relevant literature, the next section describes the research methodology and the data necessary for conducting this study.

2.3 Methodology & Data

Separate housing market models are to be established for both the sale sector and the rental sector. The key variables to be explored with the model are the residential property price index (in natural log; LnPPI) and the residential property rental index (in natural log; LnPRI)[22]. Also, rather than studying the housing market as a whole, separate investigations on different housing sub-classes are to be carried out. The Rating and Valuation Department (RVD) divides all housing units in Hong Kong into five categories based on their size. They are:

- Class A: Less than $40m^2$;
- Class B: $40m^2$-$69.9m^2$;
- Class C: $70m^2$-$99.9m^2$;
- Class D: $100m^2$-$159.9m^2$; and
- Class E: $160m^2$ or above

Of the five housing sub-classes, the first three classes are usually referred to collectively as the mass housing market, and the last two as the luxury housing market. While the mass housing market is to be studied in six separate models (three for sale, three for rental), the luxury housing market is to be explored in two models only (one for sale, one for rental), as much fewer transactions were recorded in the 1980s[23].

As for variables related to the demand for housing, it is said by Malpezzi (1996) that housing demand is a function of housing price, income variables, demographic

[22] An advantage of these property price/rental indices over per unit prices and rents is that, by referencing a property's rateable value, the former measure changes in prices/rents while controlling for any latent changes in terms of the quality of the assessed premises.
[23] It was until 1993 that separate property price indices for Class D flats and Class E housing units were available.

variables, and wealth variables. For the income variable, median household income, ideally, should have been used over Hong Kong's real GDP (in natural long; LnGDP)[24]. However, as the available median household income data for Hong Kong does not cover the whole study period[25], Hong Kong's real GDP is then selected as an alternative in depicting Hong Kong's economic conditions.

Meanwhile, a demographic variable, in the form of the number of households (in natural log; LnHH) in Hong Kong is to be incorporated in the models. The impact of this particular variable, if any, on housing price/rental movements in Hong Kong is worth studying, in light of the publication of the Long-term Housing Strategy (LTHS) document in 2013, which was subsequently adopted by the HKSAR government a year later. In this LTHS, new housing demand is defined as a combination of four factors: 1) Net increase in the number of households; 2) Households displaced by redevelopment; 3) Inadequately-housed households[26]; and 4) Miscellaneous factors[27].

How changes in the number of households, which is the first of the four factors considered in the LTHS, affect housing prices and rents, thus, can shed light into the effectiveness of this Long-term Housing Strategy in addressing the current housing price issue.

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[24] This is defined by Hong Kong's Census and Statistics Department as GDP in chained (2015) dollars (HK$ million).

[25] Only median household income in Hong Kong after 1999 is currently available. In addition, there are some issues concerning the Census & Statistics Department's computation of median wages over the years, as some of the median household income figures for the early 1990s are highly inconsistent.

[26] If the housing unit is (a) made up of temporary structures (e.g. huts, squatters and roof-top structures); (b) located in a non-residential building (e.g. commercial and industrial building); (c) shared with other households (e.g. those living in rooms, cubicles, bedspaces and cocklofts); and (d) subdivided.

[27] Such as non-local students and buyers from outside Hong Kong who may purchase flats and have not channeled them back to the market etc.)

For the wealth variables, should housing demand been subject to rising stock prices, stock market returns and housing prices/rents should have positive relationships. Hence, the stock market variable, represented by the Hang Seng Index (in natural log; LnHSI), is considered. As for the stock market volatility, a proxy variable (SMV) which equals the standard deviation of Hang Seng Index at time t[28] divided by Hang Seng Index at time t-1:

$$\text{SMV} = \frac{\sigma(HSI)_t}{HSI_{t-1}}$$

is to be included, with the aim to explore its impacts, if any, on both property prices and rents.

However, Malpezzi's (1996) housing demand model does not take into account the potential impact of U.S. monetary policy adjustments via the Linked Exchange Rate system and the provision of subsidized homeownership, both of which are unique for the situations in Hong Kong. For the former, Hong Kong is susceptible to U.S. monetary policy changes through adjustments in three factors, namely the Federal Funds Rate (FED), money supply, and Hong Kong Dollar's exchange rate against non-U.S. Dollar currencies. In this light, four different variables are taken into consideration to study their respective impacts, if any, on Hong Kong's housing prices and rents. They are: 1) the Federal Funds Rate (FED), 2) Hong Kong's money supply (M1[29]), 3) Hong Kong's

[28] This figure is computed using daily Hang Seng Index data.
[29] M1 is chosen, rather than M2 and M3, because the HKMA is required to adjust Hong Kong's monetary base, through the U.S. Dollar reserves in its possession, in order to maintain the Hong Kong Dollar-U.S. Dollar exchange rate within the Convertibility Zone. Ideally, monetary base data would be a more preferable choice, since other money supply indicators could change without any changes in monetary base. However, due to insufficient monetary base data (only that after 1999 is available), M1, due to its linkage with monetary base, is thus the second-best alternative (Garfinkel and Thornton,

Narrow Effective Exchange Rate[30] (in natural log; LnNEER), and 4) the Hong Kong-Renminbi Exchange Rate (in natural log; LnRMB).

And for the latter, despite viewed as an alternative to private housing, assisted homeownership has been found in some previous studies in Singapore (Lum, 1996; Ong, 1999; 2000; Hui et al., 2009) to generate extra demand for private housing, as owners of these housing flats manage to obtain profits from selling them in the resale market (i.e. the upgrading hypothesis). Does this hypothesis hold for Hong Kong, in which subsidized homeownership is proffered? To address this question, the total amount of new HOS flats sold (HOS) is thus incorporated in the housing market models for Classes A, B, and C flats[31]. Should the upgrading hypothesis hold, a positive effect on housing prices/rents is expected.

Lastly, in addition to the aforesaid housing demand factors, the supply of private housing (HS), represented by the number of newly-completed housing units in the private sector, is to be included in the models as well. This is to test whether or not the notion of "a higher housing supply reduces housing prices" actually holds.

A description of these variables and the expected relationships between them and PPI/PRI is provided in Table 2.1 below.

1989).

[30] According to the Bank for International Settlements (BIS), the NEER calculates the geometric weighted averages of bilateral exchange rates between 26-27 economies. The Chinese economy is not included. For details regarding the computation of these indices, see Klau and Fung (2006).

[31] This variable is not included in the model for Classes D & E flats, due to the income/asset limit set by the Housing Authority for determining an applicant's eligibility for HOS flats. It is highly unlikely that households who could afford housing in the luxury market are able to meet these requirements, even though there are no restrictions for them to buy resale HOS flats in the open market.

Variable(s)	Description
Dependent Variables (Property Price/Rental Indices)	
LnPPI(A) & LnPRI(A)	Property price index and Property rental index of Class A housing units (in natural log form)
LnPPI(B) & LnPRI(B)	Property price index and Property rental index of Class B housing units (in natural log form)
LnPPI(C) & LnPRI(C)	Property price index and Property rental index of Class C housing units (in natural log form)
LnPPI(D&E) & LnPRI(D)	Property price index and Property rental index of housing units in the luxury market (in natural log form)
Explanatory Variables	
Macroeconomic Variables	
LnHH	Number of households in natural log form
LnGDP	Hong Kong's real GDP (in 2015 chained dollars) in natural log form
U.S. Monetary Policy Variables	
LnM1	Money supply in Hong Kong in natural log form
FED	The Federal Funds interest rate (in %)
LnNEER	Hong Kong's Narrow Effective Exchange Rate in natural log form
LnRMB	The Hong Kong Dollar-Renminbi Exchange Rate
Stock Market Variables	
LnHSI	Hang Seng Index in natural log form in natural log form
SMV	Stock Market volatility (in %)
Housing-related Variables	
LnHS	Amount of newly-completed residential units (in natural log form)
HOS	Amount of HOS units transacted either in the first-hand market or in the resale market

Table 2.1: Description of the selected variables

The data is gathered from a variety of sources. Firstly, the housing price/rental data is collected from RVD. Real GDP and the number of households, meanwhile, are compiled from the Census and Statistics Department (CSD). The Hang Seng Index is collected from the Datastream database, whereas HOS sale data is retrieved from the Housing Authority (HA). Housing supply data is collected from the Buildings Department. Financial data, such as money supply and the Hong Kong Dollar-Renminbi exchange rate, is gathered from the HKMA. And lastly, the narrow effective exchange rate index data is compiled from the Bank for International Settlements (BIS).

Prior to deciding the final model specifications, a number of issues are required to be addressed first. The first issue concerns the integration order (i.e. stationarity) of the variables. This issue arises as spurious regressions, which result in biased estimations, are resulted when non-stationary levels variables (such as those integrated on order 1 [$I(1)$] or order 2 [$I(2)$]) are deployed for model estimations. This is particularly prevalent among macroeconomic and finance time-series. As a result, the Advanced Dickey-Fuller (ADF) tests are first performed to find out whether a unit root exists in the selected variables. The results, as reported in Table 2.2, show that the null hypothesis of the existence of a unit root is rejected at 5% significance level for SMV, HOS, and Federal Funds Rate (with both trend and intercept) on levels, and for all the selected variables after first-differencing. To put it differently, these variables can be said as integrated on order 1 (or $I[1]$).

Variable		ADF Test Statistic (Intercept)	ADF Test Statistic (Trend and Intercept)
LnPPI(A)	Level	-1.128	-1.827
	1st Difference	-5.842*	-5.830*
LnPPI(B)	Level	-1.331	-1.875
	1st Difference	-5.799*	-5.793*
LnPPI(C)	Level	-1.719	-2.057
	1st Difference	-6.125*	-6.280*
LnPPI(D&E)	Level	-1.773	-2.173
	1st Difference	-6.299*	-6.366*
LnPRI(A)	Level	-1.628	-1.871
	1st Difference	-5.968*	-5.979*
LnPRI(B)	Level	-1.768	-2.010
	1st Difference	-6.011*	-6.407*
LnPRI(C)	Level	-2.209	-2.189
	1st Difference	-6.094*	-6.171*
LnPRI(D)	Level	-2.539	-2.308
	1st Difference	-6.083*	-6.259*
LnHH	Level	-2.137	-0.469
	1st Difference	-3.868*	-4.427*
LnGDP	Level	-2.601	-2.819
	1st Difference	-5.112*	-5.558*
LnHS	Level	-1.849	-3.288
	1st Difference	-14.715*	-14.669*
LnHSI	Level	-2.488	-2.536
	1st Difference	-10.986*	-11.173*
SMV	Level	-2.796	-3.776*
	1st Difference	-12.054*	-12.036*
HOS	Level	-2.254	-12.584*
	1st Difference	-13.884*	-13.833*
LnM1	Level	-0.768	-1.975
	1st Difference	-11.120*	-11.082*
FED	Level	-2.622	-4.352*
	1st Difference	-8.449*	-8.444*
LnNEER	Level	-2.420	-1.921
	1st Difference	-9.274*	-8.100*
LnRMB	Level	-4.365*	-2.875
	1st Difference	-10.523*	-11.320*

Table 2.2: The Augmented Dickey-Fuller test results
Note: * denotes significant at 5% level

Nevertheless, as both PPI & PRI are integrated on order 1, a major issue arises as the existence of a unit root alludes to the existence of structural breaks (see Perron, 2006), which, if not taken into account, could lead to systematic forecast failure for models using time-series data (see Clements and Hendry, 1998; 1999; 2002; 2006). Some of the earlier structural break tests, such as the Chow Test and the Quandt-Andrews Tests, allow for either one or two known structural breakpoints to be identified. More recent theoretical development (for instance, Bai, 1997; Bai and Perron, 1998; 2003) allows for multiple unknown structural break points to be found. In this study, the Global Maximizer Tests, which are capable of identifying a multitude of structural breaks that minimize the sums-of-squared residuals of the regression model via global optimization procedures, are used to locate the structural break points, if any, in the four property price indices and the four property rental indices. The determination of the number of structural breaks in these two data series depends on the results obtained from three kinds of Global Maximizer Tests:

- The Bai-Perron tests of 1 to M globally determined breaks;
- The Bai-Perron tests of L+1 vs. L globally determined breaks; and
- The Global Maximizer tests based upon the smallest Schwarz Criterion (see Yao, 1988) and/or the smallest LWZ Criterion (Liu et al., 1997).

The maximum number of structural break points in each of the eight indices is set to be five (5), and the respective structural break points, as identified by the global maximizer tests are reported in Table 2.3 below. Then, all three global maximizer tests are conducted to find out the optimal number of structural breaks to be incorporated into the final models. The detailed results are presented in Appendix B2.1, in which it is shown that five structural break points are present in each of the eight property price/rental indices. As a consequence, to take into consideration the distortions to the estimations these structural breaks would bring about (thus rendering the final models more robust), five exogenous "structural break regime" dummy variables (namely, SBR1, SBR2, SBR3, SBR4, and SBR5), which serve as intercept corrections (see Castle et al., 2010 for example), are introduced for each of the eight models[32], based upon the results as presented in Table 2.3.

<table>
<tr><th>Dependent Variable</th><th colspan="5">Structural Break Points</th></tr>
<tr><td>Property Price Indices</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>LnPPI(A)</td><td rowspan="4">1988Q3</td><td rowspan="4">1993Q2</td><td rowspan="4">2000Q2</td><td rowspan="2">2007Q3</td><td rowspan="2">2012Q2</td></tr>
<tr><td>LnPPI(B)</td></tr>
<tr><td>LnPPI(C)</td><td rowspan="2">2005Q1</td><td>2010Q3</td></tr>
<tr><td>LnPPI(D&E)</td><td>2012Q2</td></tr>
<tr><td>Property Rental Indices</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>LnPRI(A)</td><td>1989Q1</td><td>1993Q4</td><td>2001Q3</td><td>2006Q4</td><td>2011Q3</td></tr>
<tr><td>LnPRI(B)</td><td rowspan="3">1988Q4</td><td rowspan="3">1993Q3</td><td rowspan="3">1998Q4</td><td rowspan="2">2007Q3</td><td rowspan="2">2012Q2</td></tr>
<tr><td>LnPRI(C)</td></tr>
<tr><td>LnPRI(D)</td><td>2007Q1</td><td>2011Q4</td></tr>
</table>

Table 2.3: The structural break points for the four property price indices and the four property rental indices

Having addressed the issue associated with structural breaks, the lag order is then determined by incorporating the selected variables (in levels) into different Vector Autoregression (VAR) models. The results illustrate that the optimal lag terms in the separate Housing Class models, amount to four (4) (Appendix 2.2). These lags are then included in the Johansen Cointegration tests to find out whether or not the integrated time-series variables are themselves cointegrated with one another. The Trace test results, as presented in Tables 2.4a & 2.4b below, show that the integrated time-series variables selected for the study are indeed cointegrated, as cointegrating relations ranging from 7 to 10 (for the property price indices) and from 6 to 8 (for the property rental indices) are identified, subject to a system's deterministic trend assumption.

[32] Using PPI(A) as an example, SBR1 is assigned as "1" between 1988Q3-1993Q1, "0" otherwise. SBR2 is assigned as "1" between 1993Q2-2000Q1, "0" otherwise. SBR3 is assigned as "1" between 2000Q2-2007Q2, "0" otherwise. SBR4 is assigned as "1" between 2007Q3-2012Q1, "0" otherwise. And lastly, SBR5 is assigned as "1" between 2012Q2-2016Q4, "0" otherwise.

Deterministic Trend Assumption		PPI(A)	PPI(B)	PPI(C)	PPI(D&E)
No Trend in Data	No intercept or trend in CE or VAR	8	9	9	7
	Intercept (no trend) in CE – no intercept in VAR	9	10	10	8
Linear Trend in Data	Intercept (no trend) in CE and VAR	8	9	9	7
	Intercept and trend in CE – no trend in VAR	8	8	8	7
Quadratic Trend in Data	Intercept and trend in CE – linear trend in VAR	8	8	9	7

Table 2.4a: The optimal number of Cointegrating Relations (PPI)
Note: Detailed results from the Johansen Cointegration tests are reported in Appendix 2.3

Deterministic Trend Assumption		PRI(A)	PRI(B)	PRI(C)	PRI(D&E)
No Trend in Data	No intercept or trend in CE or VAR	8	7	7	5
	Intercept (no trend) in CE – no intercept in VAR	8	8	8	6
Linear Trend in Data	Intercept (no trend) in CE and VAR	8	8	8	6
	Intercept and trend in CE – no trend in VAR	7	8	7	6
Quadratic Trend in Data	Intercept and trend in CE – linear trend in VAR	7	8	7	6

Table 2.4b: The optimal number of Cointegrating Relations (PRI)
Note: Detailed results from the Johansen Cointegration tests are reported in Appendix 2.3

Given that the selected variables are both integrated (on order 1) and cointegrated, Vector Error Correction Models (VECM) are used for the analysis. This model, grounded on the unrestricted Vector Autogression Model (VAR), treats all variances in the system as potential endogenous to one another, unlike linear regression models that assume exogeneity for the explanatory variables. The VAR is presented in the following form:

$$Az_t = B_1 z_{t-1} + B_2 z_{t-2} + \cdots + B_p z_{t-p} + u_t$$

where z is a vector of explanatory variables. What separates the VECM from the VAR is that the former takes into account the cointegrating relationship(s), if any, between the selected variables within the system of equations. Usually, the long-run equilibrium relationship takes the form of:

$$y_t'\gamma - x_t'\beta = 0$$

whereas, in the short-run, there exists what is known as an equilibrium error, because of which the system deviates from the long-run equilibrium:

$$y_t'\gamma - x_t'\beta = \varepsilon_t$$

Usually, when levels data that is either *I*(1) or *I*(2) is used as regressors, which is common in time-series financial and macroeconomic data, spurious regressions are likely to occur, resulting in biased estimations. Yet, should the variables within the system are cointegrated (i.e. sharing a common trend), the resultant equilibrium error, ε_t, would be stationary. Because of that, the issue of spurious regressions can be addressed.

The error-correction model is basically a first-differenced variation of the long-run model, which takes the following form:

$$\Delta y_t = x_t'\beta + \gamma(\Delta z_t) + \lambda(y_{t-1} - \theta z_{t-1}) + \varepsilon_t$$

where x is a vector of exogenous variables, z is a vector of cointegrated variables, and $y_{t-1} - \theta z_{t-1}$ is the error correction term which measures the speed at which prior deviations from the long-run equilibrium are corrected.

Having obtained the necessary information concerning cointegrating relations and structural breaks, both of these factors are incorporated into the respective VECMs for the property price/rental indices. The resultant VECMs, with varying deterministic trend assumptions, are then compared before deciding the final model(s), based upon the smallest Akaike Information Criterion (AIC) and Schwarz Criterion (SC), not only for the individual property price/rental models themselves, but also for the systems in which these models belong. The results are reported in Table 2.4 below[33]. As for the cointegrating equations and the error correction terms, detailed information can be found in Appendices 2.4a-b (PPI) & 2.5a-b (PRI), respectively.

[33] For more detailed comparisons among the models with different deterministic trend assumptions, see Appendix 2.4.

Variable	Deterministic Trend Assumption	Number of Cointegrating Relations
Property Price Indices		
LnPPI(A)	Linear Trend in Data (Intercept and trend in CE – no trend in VAR)	8
LnPPI(B)	Linear Trend in Data (Intercept and trend in CE – no trend in VAR)	8
LnPPI(C)	Linear Trend in Data (Intercept and trend in CE – no trend in VAR)	8
LnPPI(D&E)	Linear Trend in Data (Intercept and trend in CE – no trend in VAR)	7
Property Rental Indices		
LnPRI(A)	Quadratic Trend in Data (Intercept and trend in CE – linear trend in VAR)	7
LnPRI(B)	Linear Trend in Data (Intercept and trend in CE – no trend in VAR)	8
LnPRI(C)	Quadratic Trend in Data (Intercept and trend in CE – linear trend in VAR)	7
LnPRI(D&E)	Linear Trend in Data (Intercept and trend in CE – no trend in VAR)	6

Table 2.4: Selection of final models with reference to their deterministic trend assumption and number of cointegrating relations

In the next section (Section 2.4), the findings of the eight VECMs, including the impulse response analyses and the variance decomposition analyses, are discussed.

2.4 Research findings

2.4.1 Property Price Indices

The findings (Figure 2.1a) first report significant levels of autocorrelations between current property prices and past property prices, in that the latter plays a critical role in shaping the changes in the former. Of the four sub-classes of residential properties, this factor is able to trigger the largest accumulated responses from the price of Class C housing flats, whereas the smallest accumulated responses are found for luxury housing units (i.e. Classes D & E). Despite the highest level of impulse responses for Class C flats, however, previous housing prices actually help explain the largest amount of variance of the price of housing units within Class B, and the lowest percentage of variance of the price of luxury housing flats (Figure 2.1b).

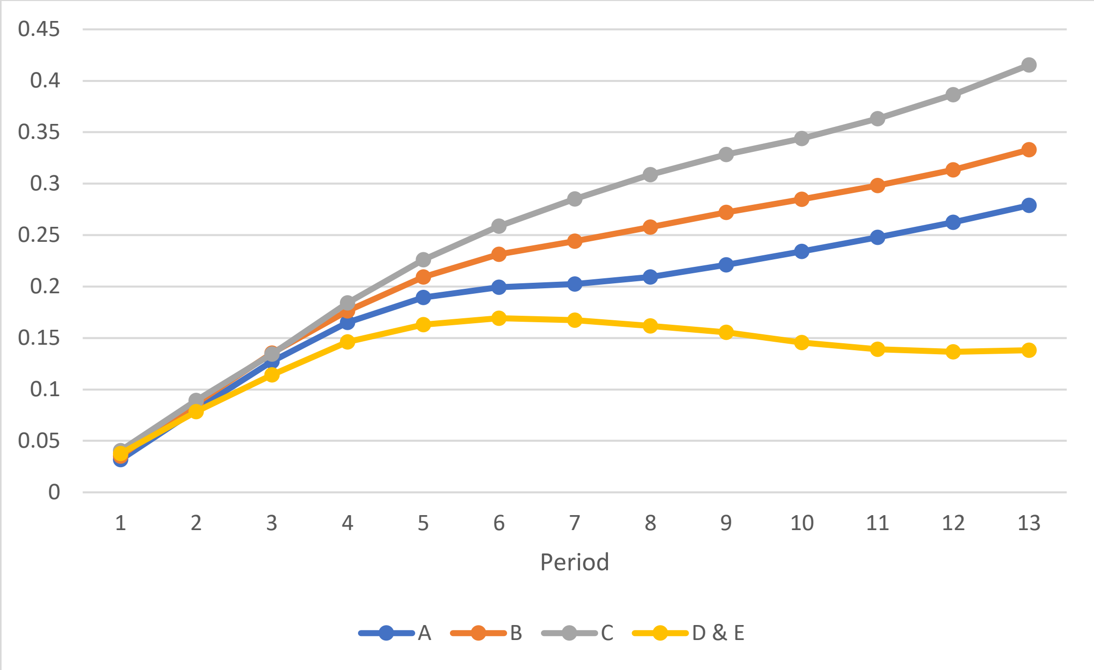

Figure 2.1a: Accumulated responses of PPI to exogenous shocks in PPI

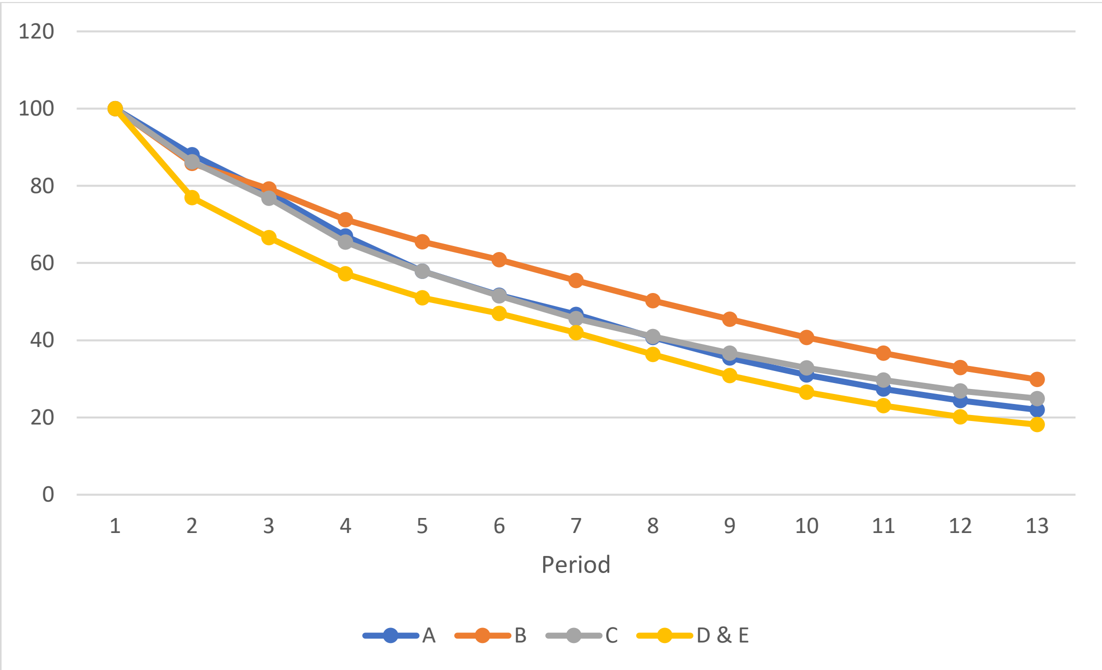

Figure 2.1b: Variance of PPI explained by PPI (in %)

By contrast, previous movements in rental values incur remarkably different responses from property prices (Figure 2.2a). While positive accumulated responses are identified for the PPI(A), negative accumulated responses are found, instead, for the prices in the other three housing sub-classes. The negative responses are much larger for more spacious flats, particularly Class C flats. The variance decomposition analysis (Figure 2.2b) reveals similar patterns, as previous adjustments in PRI explain a much higher percentage of the variance of the PPI(C) (i.e. more than 20% after the 6^{th} period), and to a lesser extent, PPI(D&E) (i.e. more than 10% after the 6^{th} period). The prominence of PRI in influencing the PPI in these two housing classes, but not those in the smaller housing classes, indicate that larger housing flats (i.e. Class C or larger) in the sale market and in the rental market are essentially viewed as substitutes. When a sizable proportion of housing demand for these comparatively spacious flats is being absorbed by the rental sector (as indicated by upward movements in rents), the demand for these flats in the sale sector falls accordingly, thus leading to downward price adjustments. Meanwhile, similar substitution effects are not as prominent among Class A flats and Class B flats.

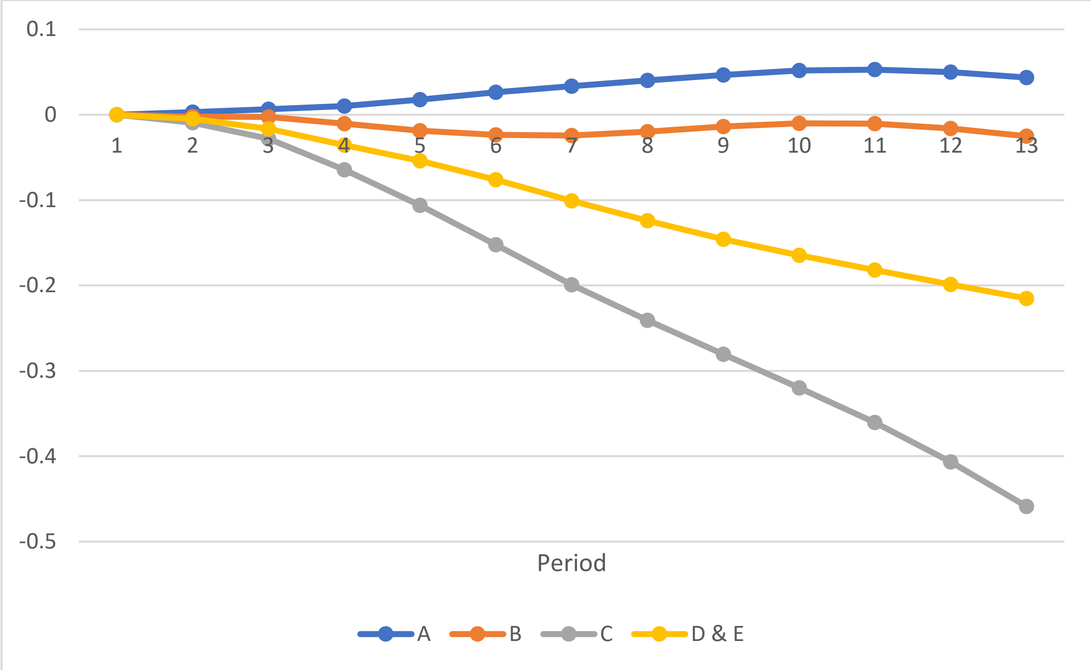

Figure 2.2a: Accumulated responses of PPI to exogenous shocks in PRI (of the same housing sub-class)

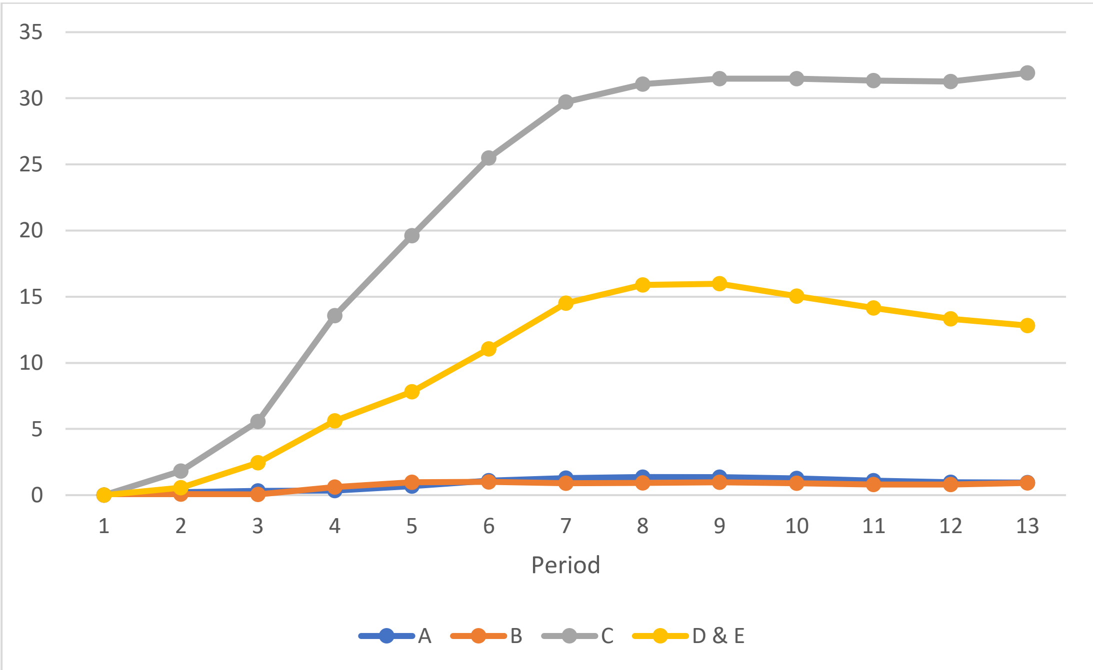

Figure 2.2b: Variance of PPI explained by PRI (in %)

As for the impact of stock market factors, the empirical findings report that shocks from the stock market incur positive responses, in general, from PPI (Figure 2.3a). Of the four housing sub-classes, the (accumulated) response is the largest for the smaller housing classes (Classes A & B), and the smallest for Class C flats. Meanwhile, movements in the Hang Seng Index explain the largest percentage in the variance of PPI(D&E) in the earlier periods (i.e. more than 20% from the 3^{rd}-5^{th} periods), but the largest percentage in the variance of smaller flats (i.e. Class A and Class B) in the latter periods (i.e. from the 9^{th} period onwards) (Figure 2.3b). Surprisingly, this stock market factor has a much smaller impact, in terms of accumulated response and the percentage of variance explained, on prices of Class C flats. This, if anything, further reinforces the notion that price movements of Class C flats are primarily susceptible to changes in user demand, rather than to changes in investment demand. The findings for the other three housing classes, by contrast, confirm the noticeable presence of wealth effect and/or balance sheet effect in the sale sector, as profits obtained from soaring stock prices induce additional demand for housing, whether for consumption or for investment. Stock market volatility, meanwhile, yields negative responses from property prices for Classes A, B, D & E flats, but not for Class C flats in the latter periods as the error correction process manages to restore the relationship to the long-run equilibrium (Figure 2.4a). Volatility in Hang Seng Index contributes more to the variance of the prices of luxury flats in the shorter-run (i.e. until the 6^{th} period), and to the variance of the prices of Class A & Class B housing units in the longer-run (i.e. the 8^{th} period onwards). Its impact on the prices of Class C flats, on the other hand, is negligible. Taking these findings into consideration, it is reasonable to conclude that, while rising stock prices generate additional housing demand for homeownership, the volatilities in the stock market serve as a counterweight for potential buyers of both smaller flats (i.e. Classes A & B) and luxury flats (Figure 2.4b).

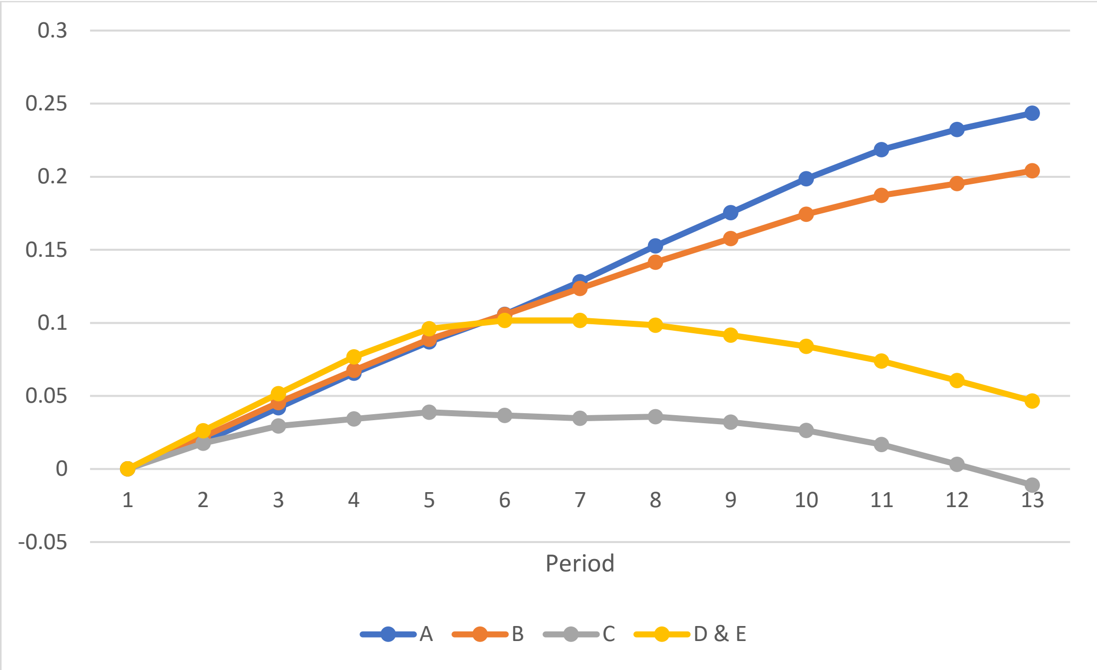

Figure 2.3a: Accumulated responses of PPI to exogenous shocks in Hang Seng Index

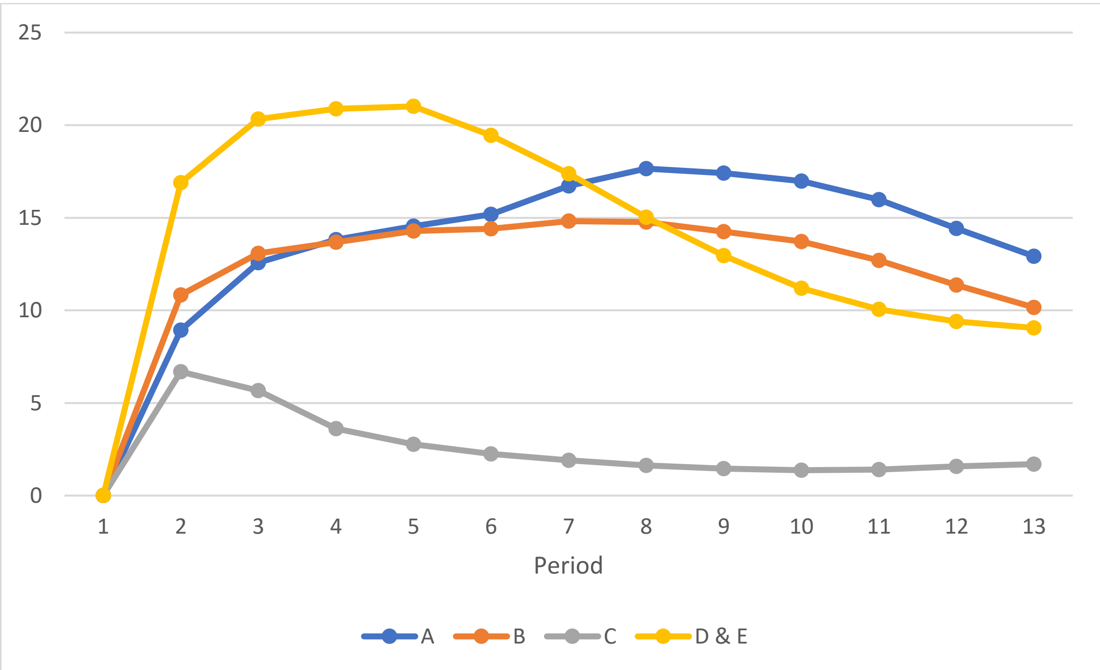

Figure 2.3b: Variance of PPI explained by Hang Seng Index (in %)

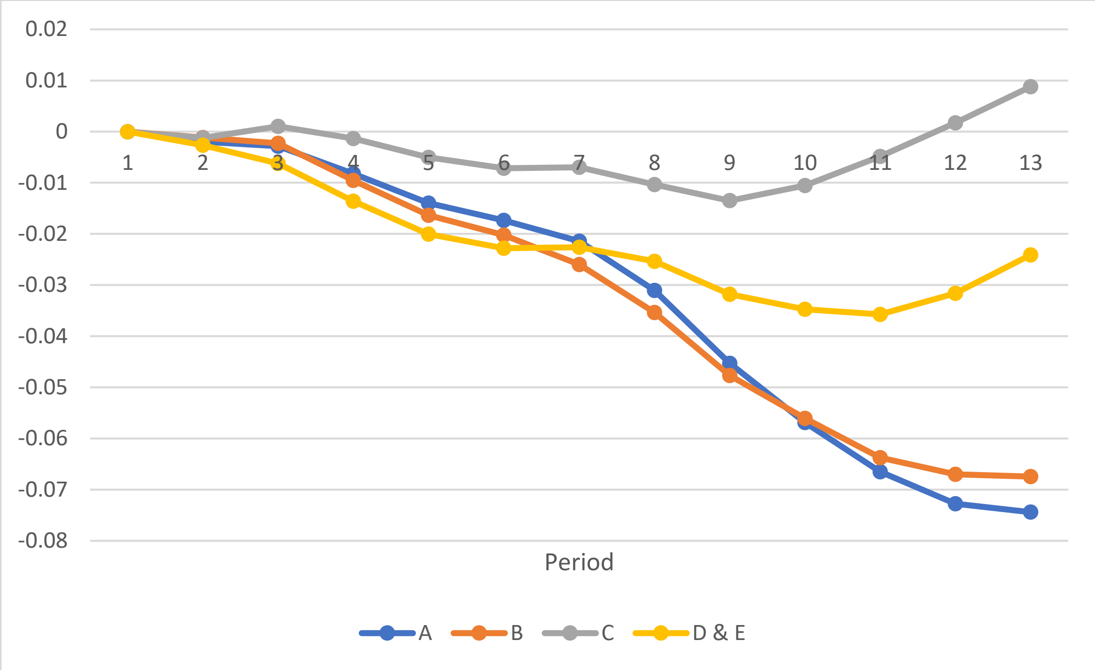

Figure 2.4a: Accumulated responses of PPI to exogenous shocks in stock market volatilities

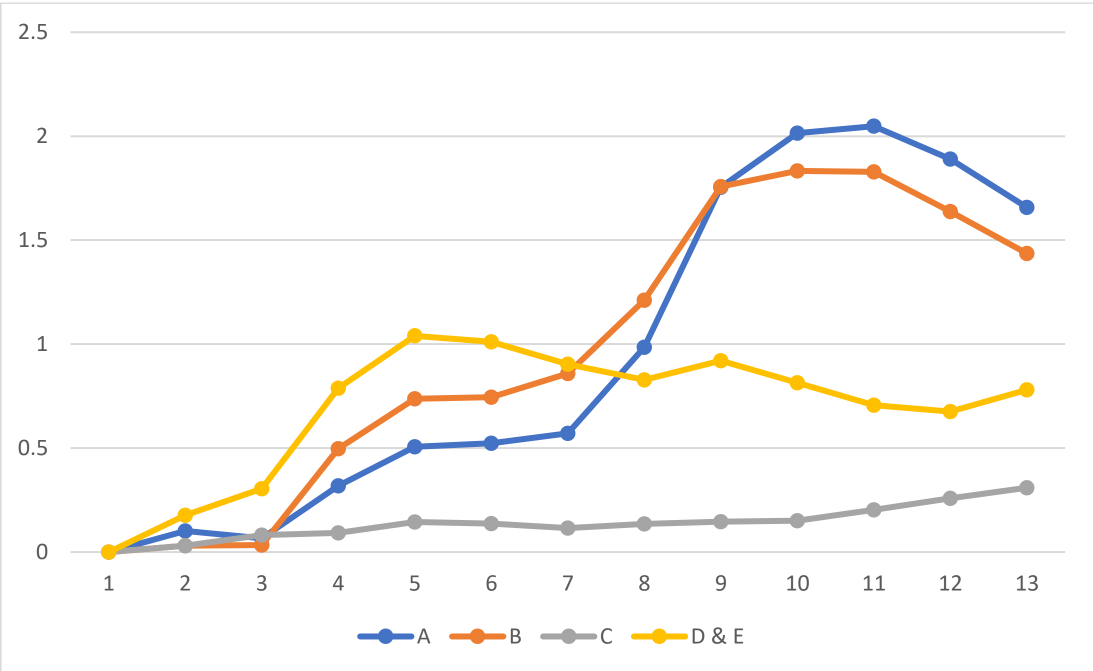

Figure 2.4b: Variance of PPI explained by stock market volatilities (in %)

The effects of the income and demographic variables are somewhat mixed. Firstly, housing prices in Class C & in Classes D & E respond positively to exogenous shocks in Hong Kong's real GDP, whereas the accumulated responses from prices in Class A and Class B are negative after the 6^{th} period (Figure 2.5a). While the positive relationship between economic growth and housing prices is consistent with the literature (see, for instance, Case et al., 1999; Goodhart and Hofmann, 2008), the negative responses by prices of smaller housing flats point to some interesting dynamics across housing sub-markets. A better economy, in general, indicates higher housing affordability among its residents. The improved financial capabilities allow for the purchase of larger flats, other factors being constant. Therefore, rather than higher prices for the smaller flats in Class A and Class B, better economic conditions, somehow, trigger negative movements in housing prices in these two sub-classes. Additionally, movements in Hong Kong's real GDP are able to explain the highest amount of variance of the prices of flats in Class A & Class B from the 6^{th} period onwards, and those in Class C before the 6^{th} period (Figure 2.5b).

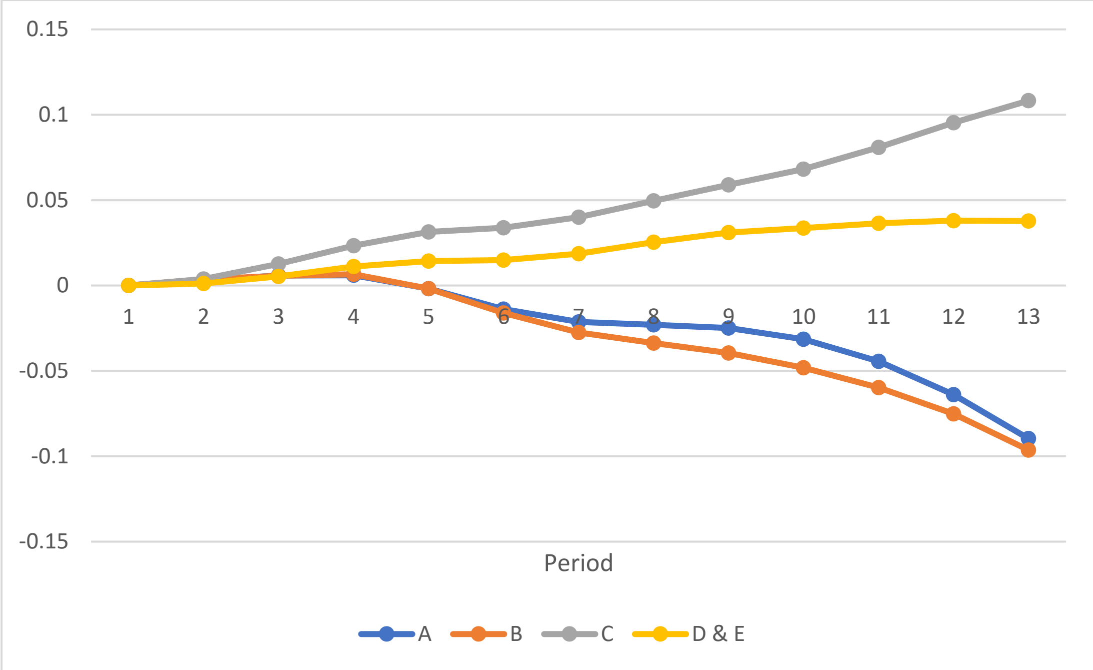

Figure 2.5a: Accumulated responses of PPI to exogenous shocks in real GDP

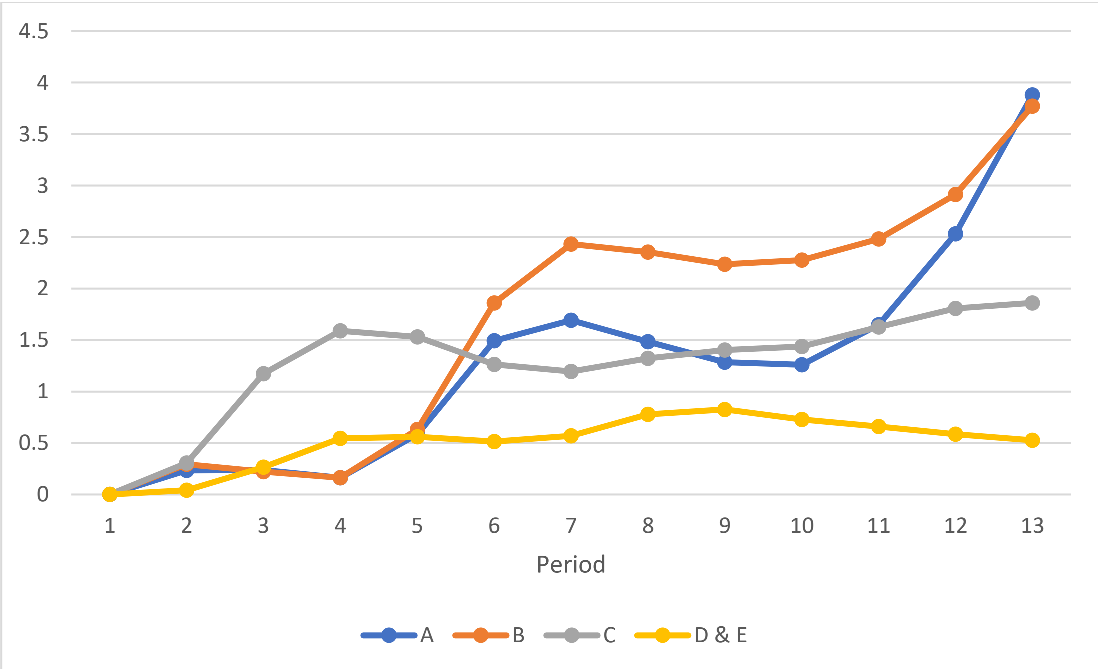

Figure 2.5b: Variance of PPI explained by real GDP (in %)

Yet, household growth in Hong Kong is found to incur negative (accumulated) responses, with the exception of Class A & Class B before the 6th period, from property prices in all four sub-classes (Figures 2.6a-b). This particular finding is in direct contrast to the notion that household formation causes housing demand to rise, which is the foundation of the 2013 Long-term Housing Strategy. Instead, the findings reinforce the idea that other factors, but not household growth, contribute to higher housing prices and rents. The reason behind this odd finding can be attributed to the nature of homeownership as a long-term, capital-intensive commitment. Hence, rather than obtaining homeownership as new households are formed, these new households (many of them single-member) may move to sub-divided housing units which are not officially included in the rental sector, or settle in the public housing sector if they are eligible. Another interpretation of this finding is that some households (or individuals/companies) have been purchasing multiple housing units for investment purpose, without forming new households. Still, this factor manages to explain a much larger amount of variance of property prices than real GDP (i.e. more than 10% in the latter periods), indicating its importance in shaping the prices of housing in Hong Kong.

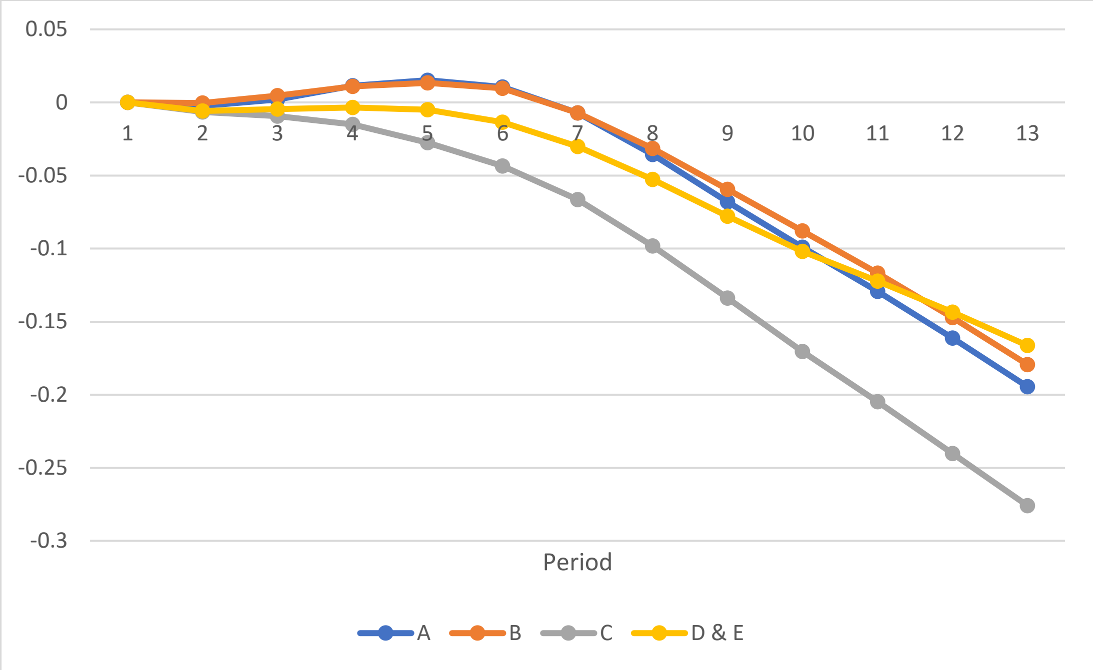

Figure 2.6a: Accumulated responses of PPI to exogenous shocks in the number of households

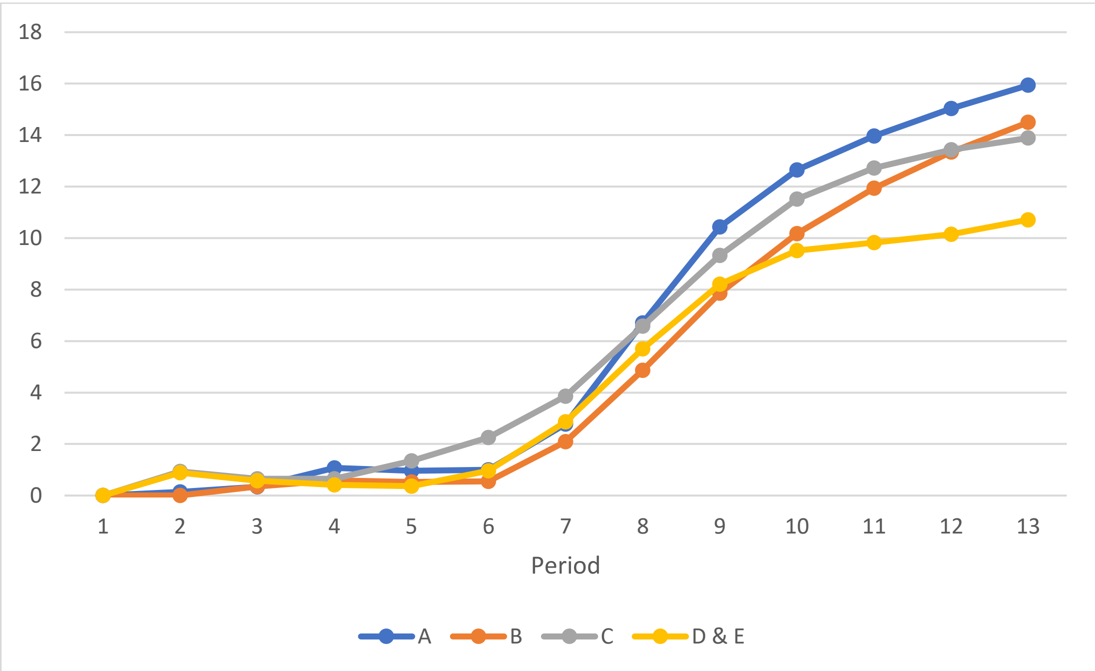

Figure 2.6b: Variance of PPI explained by the number of households (in %)

As for the two housing-related variables, some unique patterns are found. Firstly, exogenous shocks in housing supply (Figure 2.7a-b) yield negative accumulated responses from PPI in the earlier periods (until the 5th period). Then, the accumulated responses become positive for Class B flats and Class C flats, but negative for Class A flats and luxury flats. With reference to the commonly-perceived notion that a higher housing supply reduces housing price, the findings only provide partial support (i.e. it only applies to Class A housing units and luxury housing units), as the prices of medium-sized flats continue to climb under similar circumstances. As for its contribution to housing price variance, housing supply movements explain the highest level of variance of the price of Class A flats and luxury flats in the earlier periods (i.e. until the 6th period) and the last simulation periods (Periods 12-13). In the periods between them (Periods 7-10), however, this factor explains the highest percentage of variance for Class B flats and Class C flats. And secondly, exogenous shocks in the amount of HOS flats sold (Figure 2.8a-b), interestingly, trigger positive responses from prices for Class A flats and Class B flats. The accumulated responses for Class C flats in the sale sector, by contrast, fluctuate over time as the error correction process helps restore the relationship to the long-run equilibrium (in the 6th and the 11th periods). With reference to the upgrading hypothesis (see Lum, 1996; Ong, 1999; Hui et al., 2009; Ong, 2000), it holds for Hong Kong's property market as well, at least for the smaller housing sub-classes.

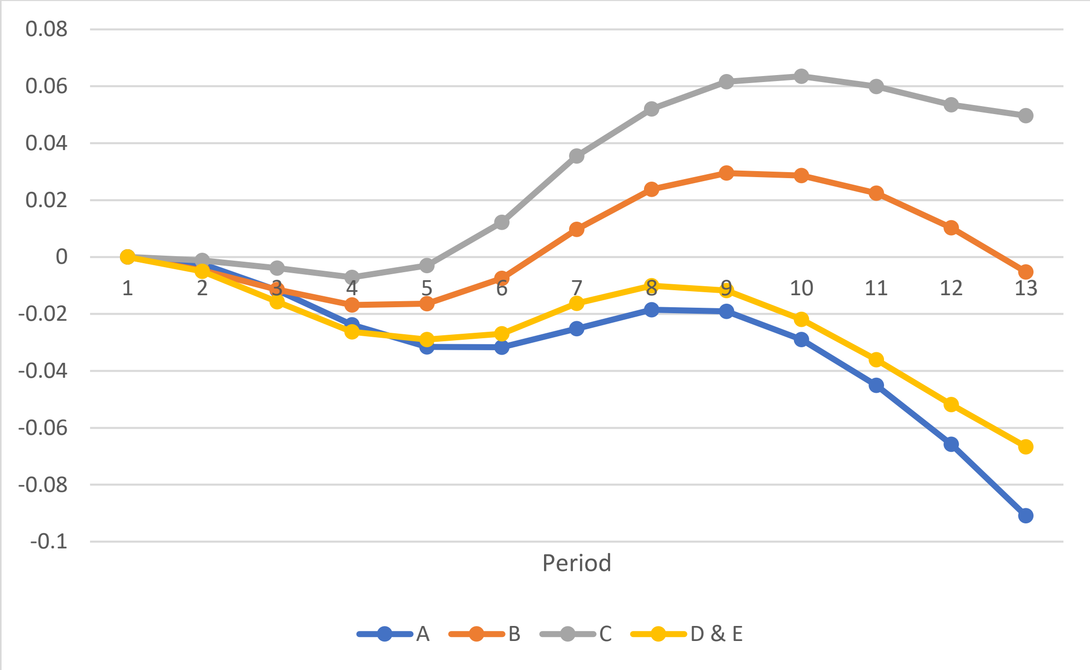

Figure 2.7a: Accumulated responses of PPI to exogenous shocks in housing supply

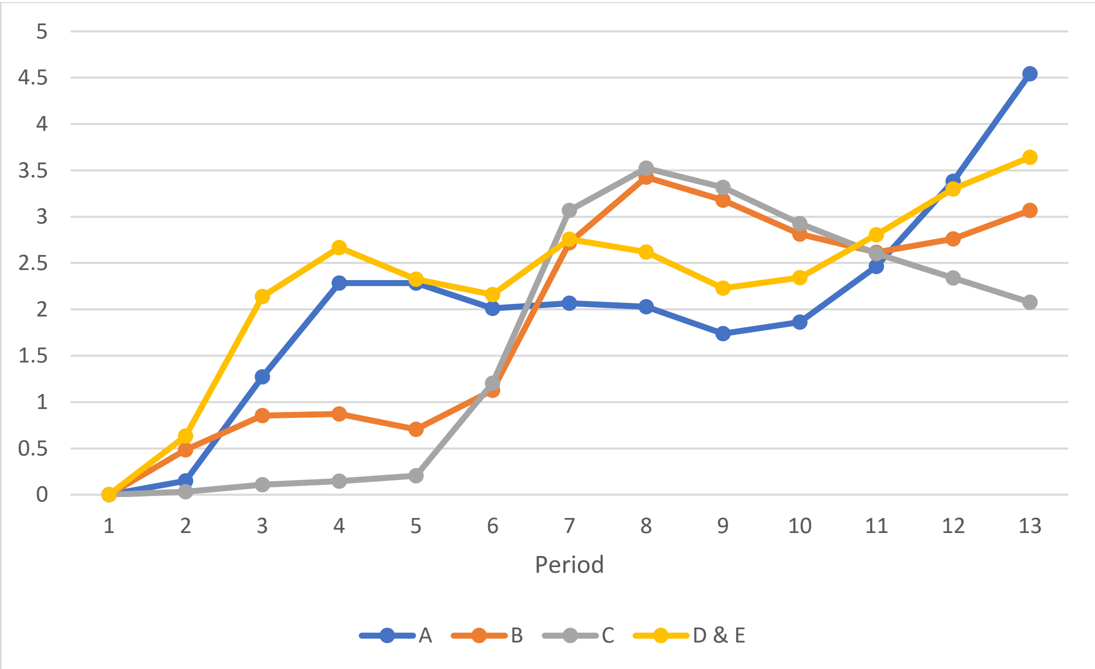

Figure 2.7b: Variance of PPI explained by housing supply (in %)

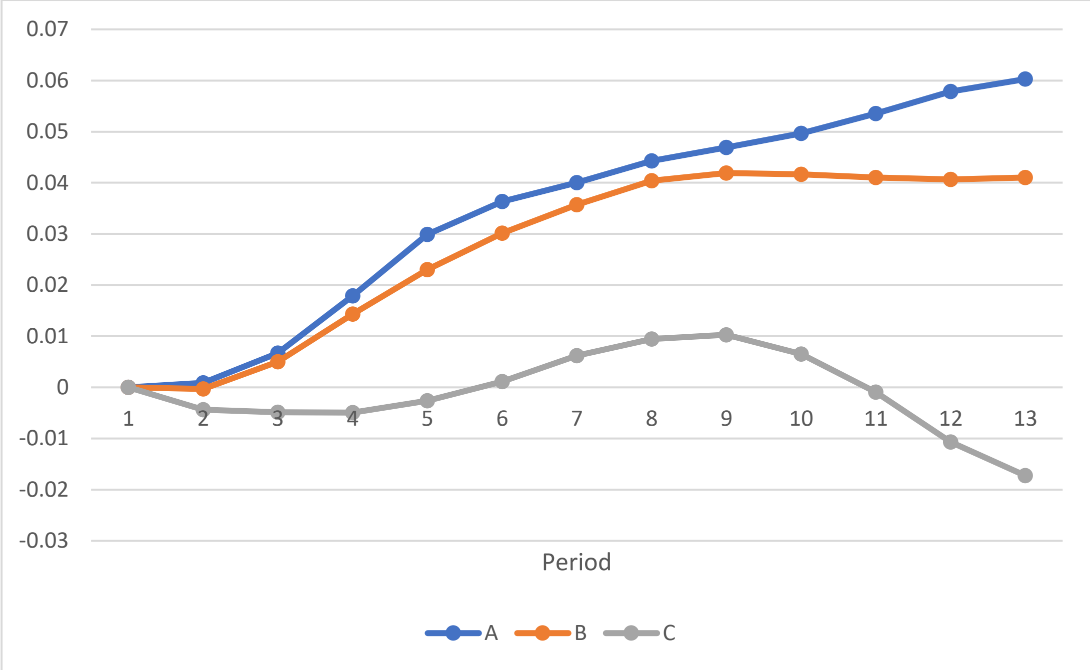

Figure 2.8a: Accumulated responses of PPI to exogenous shocks in the amount of HOS flats sold

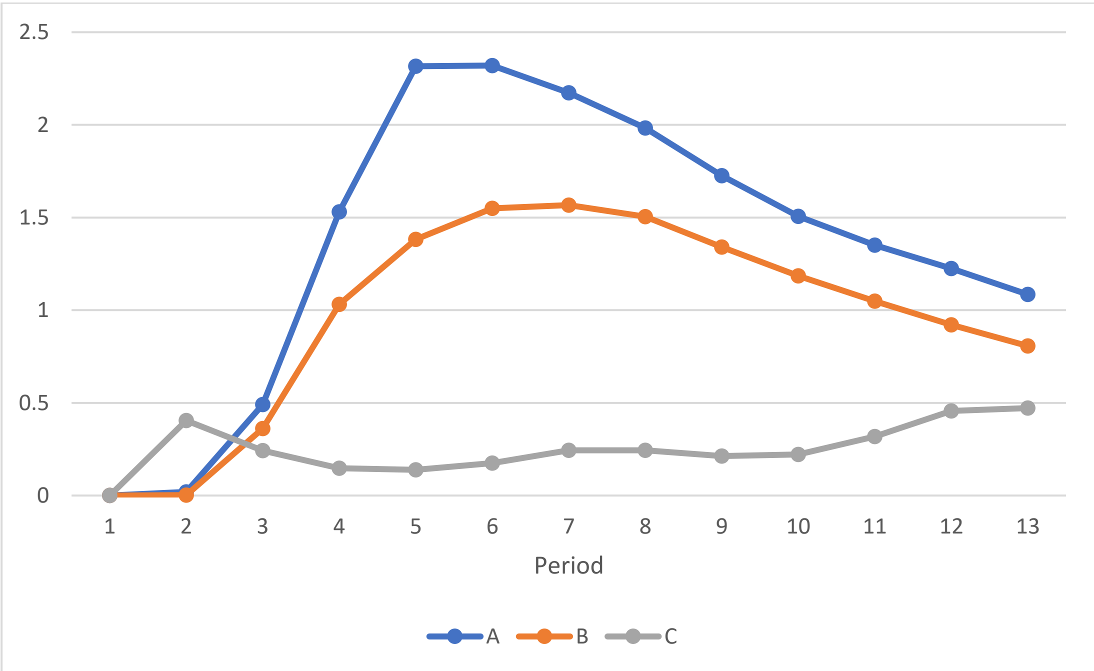

Figure 2.8b: Variance of PPI explained by the amount of HOS flats sold (in %)

Aside from the domestic factors, external shocks are found to have varying impacts on the prices of housing units in the four housing classes under study. Firstly, exogenous shocks in money supply (M1) trigger positive accumulated responses in all four housing classes. This is particularly the case for larger housing flats (Classes C, D & E) (Figure 2.9a-b). The findings show that money supply increases are associated with soaring housing prices, which is in line with the literature (Darrat and Glascock, 1989; Breedon and Joyce, 1992; Kim, 1993; Ball, 1994; Maclennan et al., 1998; Lastrapes, 2002; Aoki et al., 2004; Jin and Zeng, 2004; Iacoviello, 2005; Chen et al., 2007; 2012; Elbourne, 2008; Goodhart and Hofmann, 2008; Beltratti and Morana, 2010). Nevertheless, unlike other nations, Hong Kong, owed to the Linked Exchange Rate System, is not in a position to adjust its own money supply. In light of the numerous Quantitative Easing programmes launched by the Federal Reserve since late 2008, an unprecedented rise in the U.S. money supply has resulted in an equally-unprecedented rise in Hong Kong's own money supply. This, according to the findings, leads to noticeably higher property prices, particularly in Classes D & E. Yet, money supply adjustments actually explain a higher level of price variance for smaller flats (i.e. as much as 20% for Class A flats) than more spacious housing units.

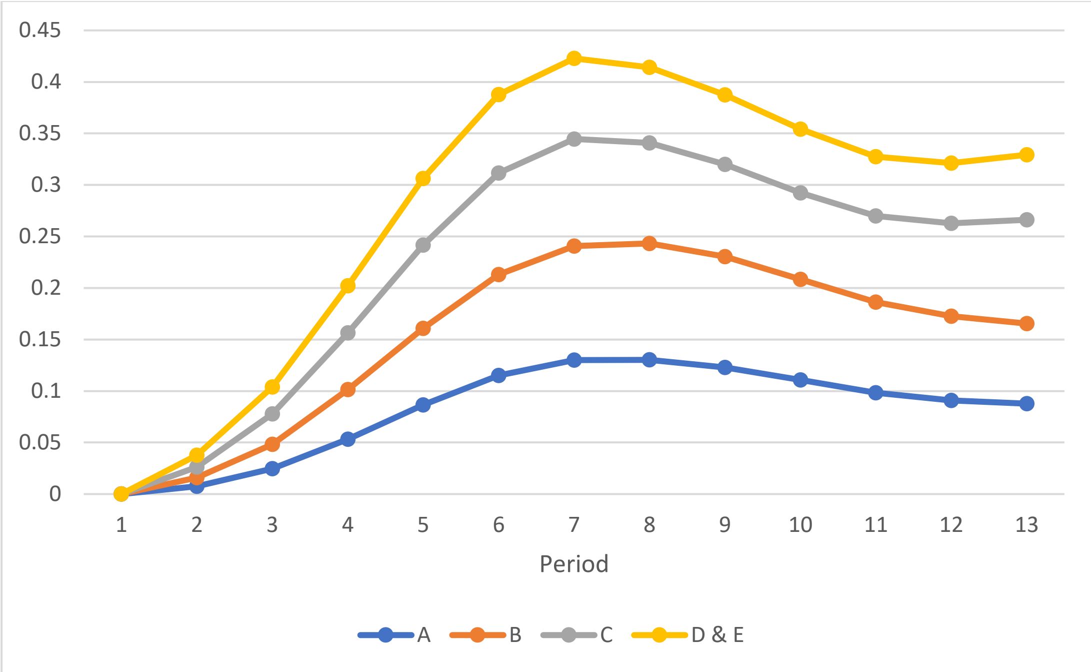

Figure 2.9a: Accumulated responses of PPI to exogenous shocks in M1

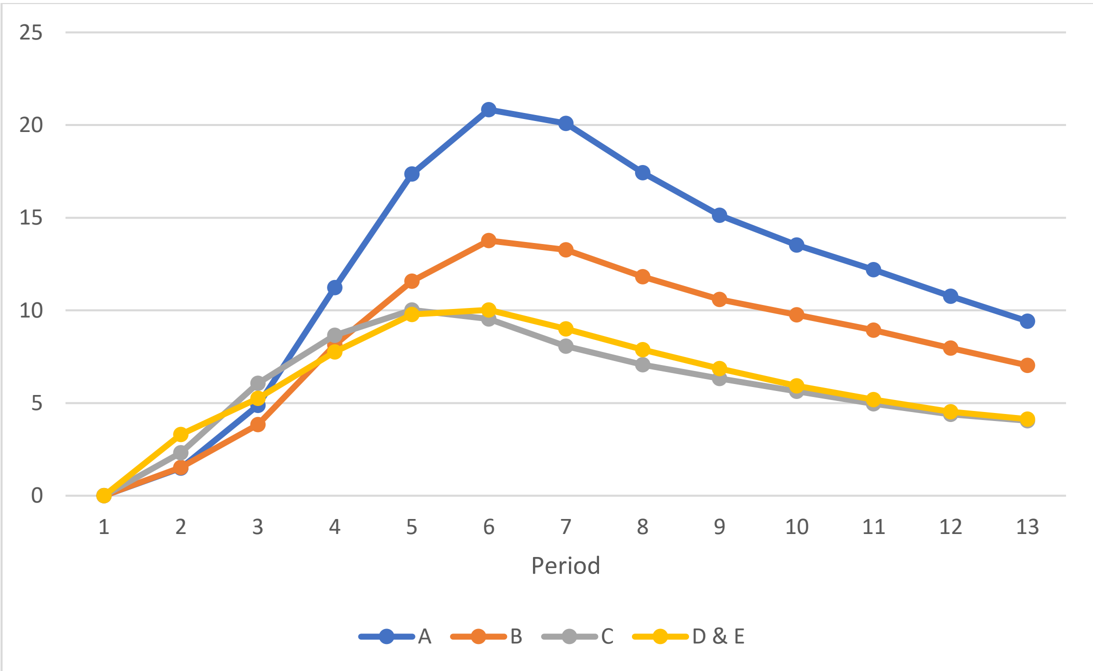

Figure 2.9b: Variance of PPI explained by M1 (in %)

Meanwhile, movements in the Federal Funds Rate are found to trigger negative accumulated property price responses for all four classes of residential properties under study (Figure 2.10a-b). In particular, a rise in FED, usually accompanied by a rise in Hong Kong's interest rate by virtue of the Linked Exchange Rate System, results in lower property prices. Its negative impact is especially noticeable among larger flats within the Mass housing market (Class C), whereas the interest rate effect on the smallest housing class (Class A) is the weakest. With respect to its impact on housing price variance, this factor explains a larger proportion of the price variance for Class C flats and for luxury housing units than those for smaller residential properties.

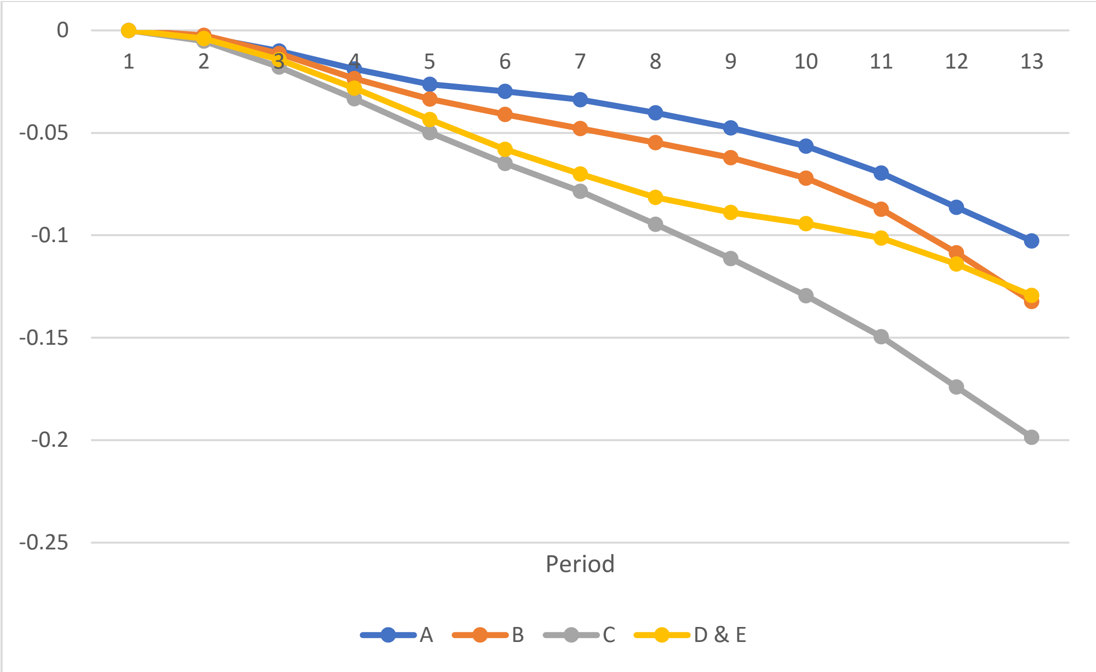

Figure 2.10a: Accumulated responses of PPI to exogenous shocks in Federal Funds Rate

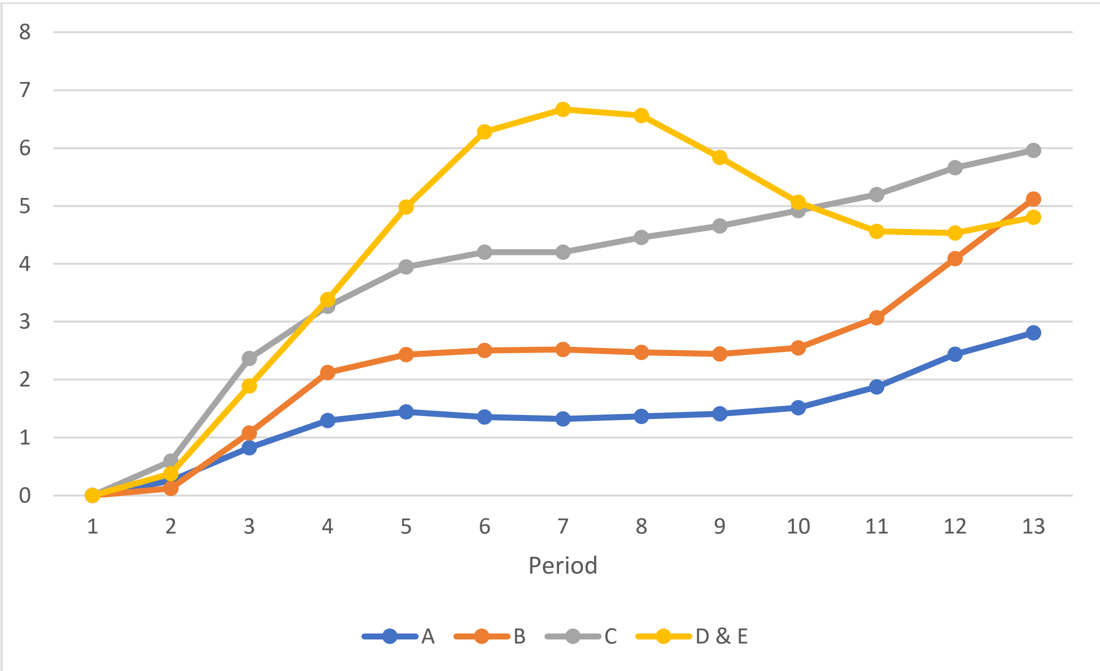

Figure 2.10b: Variance of PPI explained by Federal Funds Rate (in %)

Lastly, the two exchange rate factors, despite the fundamental differences in their respective definitions, trigger noticeably similar housing price responses. The findings first report that exogenous shocks in Hong Kong's Narrow Effective Exchange Rate Index (NEER) trigger negative responses from housing prices from the 7^{th} period onwards (Figure 2.11a-b). However, while the accumulated price responses in Class A, Class B, and Classes D & E are mostly negative, those in Class C, until the 9^{th} period, are positive. As a higher NEER reflects a stronger Hong Kong Dollar, it also means cheaper imports, which is critical considering Hong Kong's status as a net-importer. The findings suggest that, as HKD becomes stronger courtesy of a stronger U.S. Dollar, demand for homeownership in Class A, Class B, and Classes D & E falls as prospective homeowners would spend their financial resources on the consumption of more imported products. This could also explain the remarkably higher amount of price variance explained by NEER adjustments for flats in these three sub-classes, especially Class A & Class B. Nonetheless, the positive responses for Class C flats, at least until the 8^{th} period, might suggest the surge of investment demand from non-local investors, as capital flows into Hong Kong from nations with comparatively weak currencies.

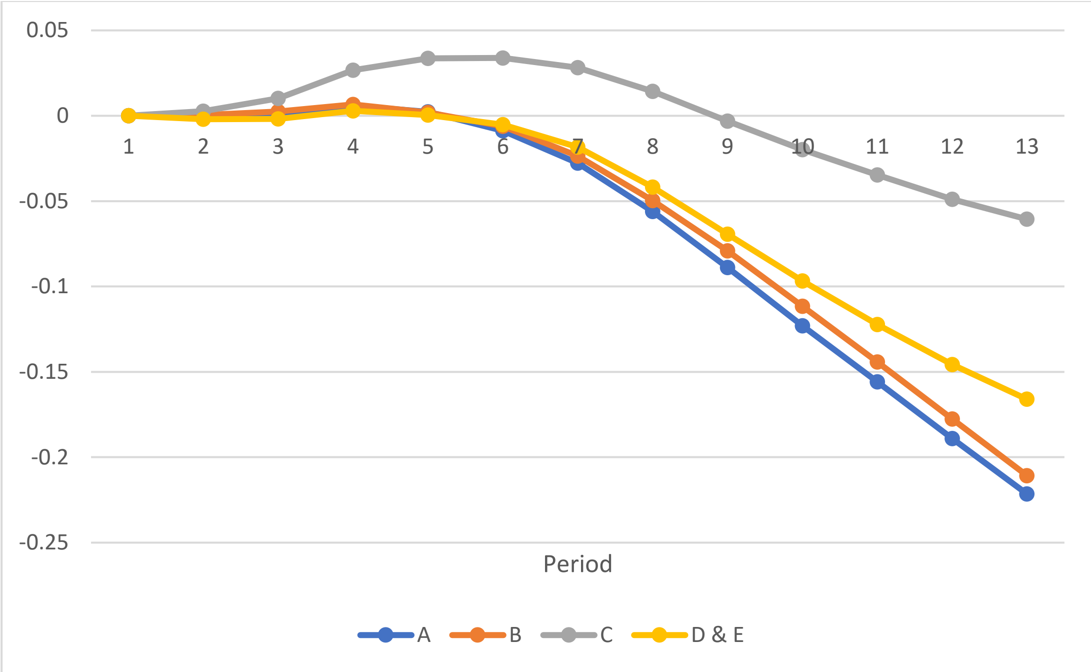

Figure 2.11a: Accumulated responses of PPI to exogenous shocks in Hong Kong's Narrow Effective Exchange Rate

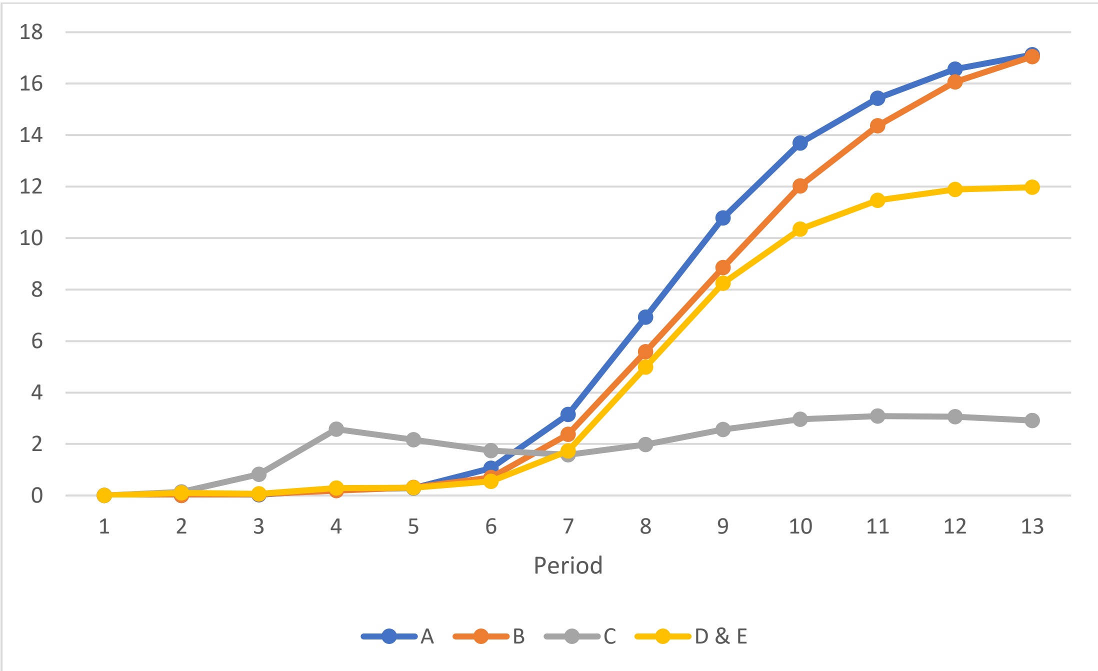

Figure 2.11b: Variance of PPI explained by Hong Kong's Narrow Effective Exchange Rate (in %)

Similar arguments can also be used to explain how Hong Kong's housing prices react to exogenous shocks in the Hong Kong Dollar-Renminbi exchange rate (RMB) (Figure 2.12a-b). The accumulated housing price responses for luxury housing units are consistently negative, whereas those for Class A, Class B, and Class C flats are positive at first, only to become negative in the latter periods (the 11th period for Classes A & B; the 7th period for Class C). A higher RMB means a weaker HKD, and hence more expensive imports from Mainland China, the largest trading partner (and importer) of Hong Kong. Yet, it also means that investment denominated in Hong Kong Dollars becomes less attractive to investors than investment denominated in Renminbi. While the positive price responses for Class A flats and Class B flats until the 10th period (and to a lesser extent, for Class C flats) could point to less consumption of imports from China in the shorter-run but not in the longer-run, the negative accumulated price responses for luxury housing properties signal an outflow of investment capital from luxury real estate in Hong Kong to other Renminbi-denominated investments, from time deposits to Chinese stocks (and/or real estate), therefore a lower demand for/price of luxury housing properties in Hong Kong. This point is further reinforced by the much higher percentage of price variance explained by the RMB variable for Classes D & E flats (over 20% in the latter periods), in comparison with those for Class A, Class B, and Classes C flats (less than 10%).

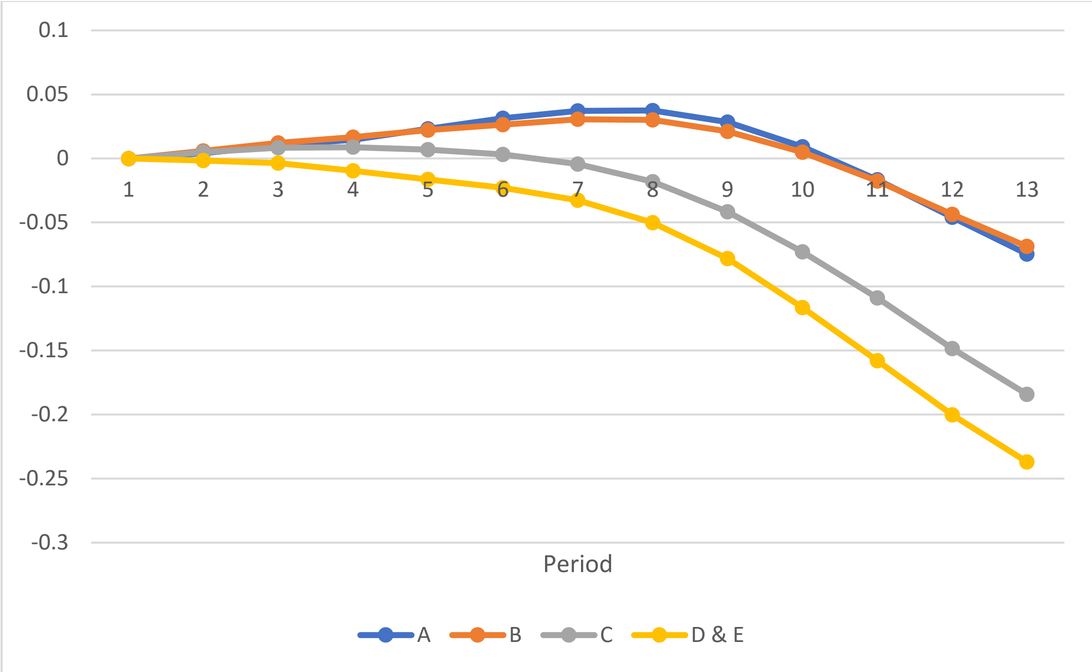

Figure 2.12a: Accumulated responses of PPI to exogenous shocks in the Hong Kong Dollar-Renminbi Exchange Rate

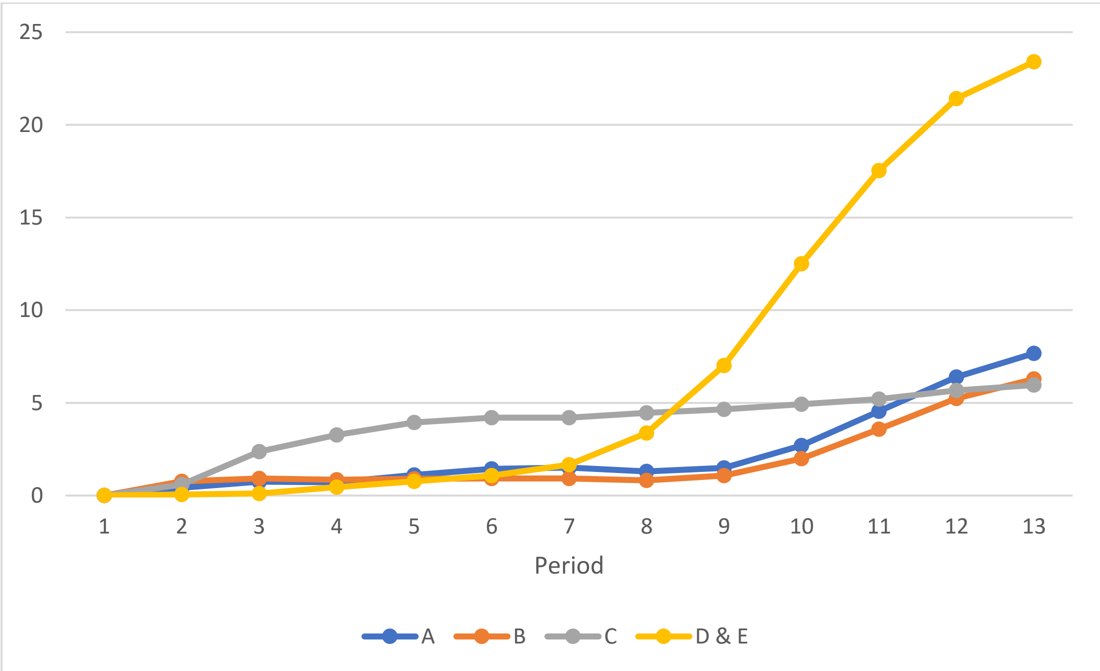

Figure 2.12b: Variance of PPI explained by the Hong Kong Dollar-Renminbi Exchange Rate (in %)

2.4.2 Property Rental Indices

And for the rental sector, the findings obtained from the four VECMs report that, current PRI respond positively to previous rental movements, with the largest accumulated responses for housing flats within Class B (Figure 2.13a-b). Nonetheless, the accumulated responses gradually diminish from the 7th period onwards, so does this factor's role in explaining the variance of the rents of all four classes of housing under study.

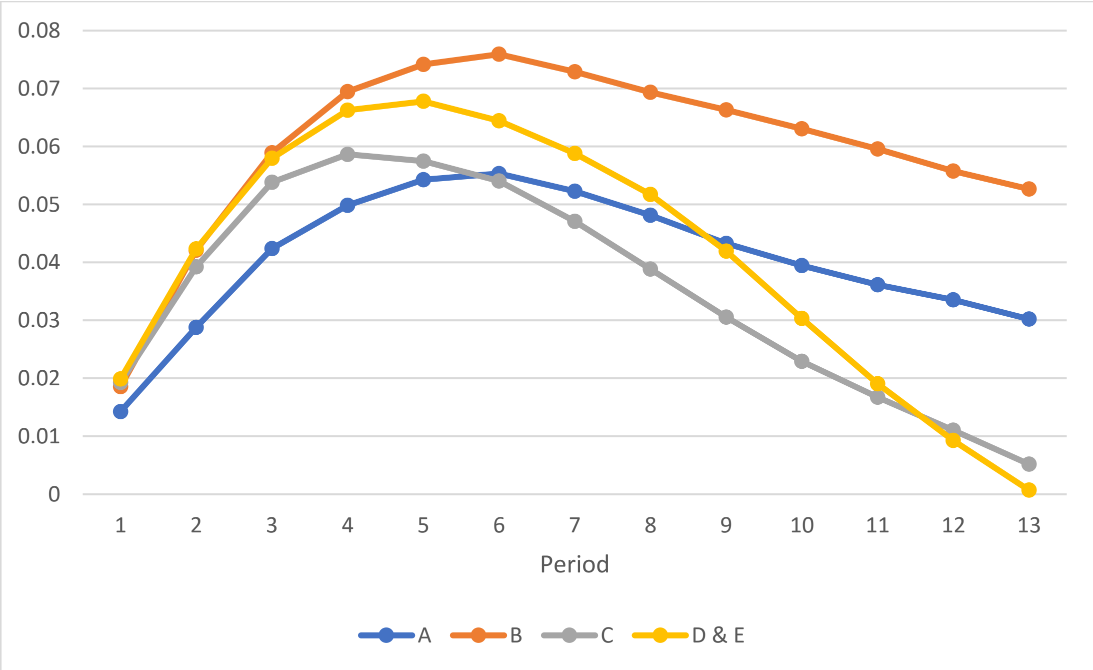

Figure 2.13a: Accumulated responses of PRI to exogenous shocks in previous PRI

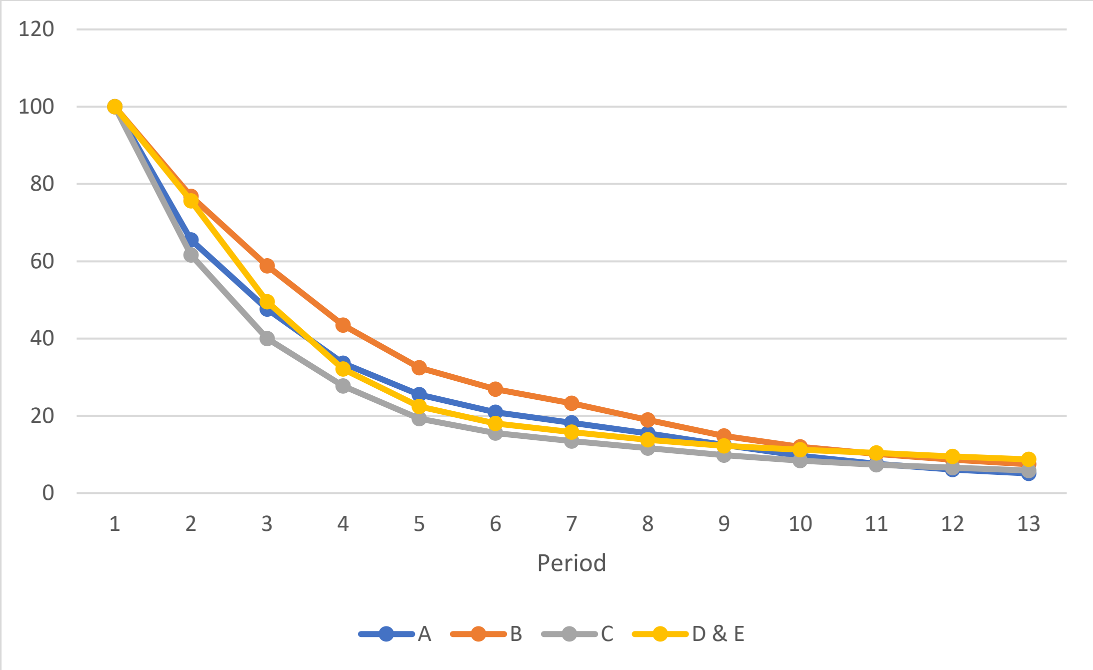

Figure 2.13b: Variance of PPI explained by previous PRI (in %)

Oppositely, housing rental movements are increasingly susceptible to housing price adjustments (Figure 2.14a-b). Rents in all four classes of housing respond positively to exogenous shocks in lagged housing price movements. This is particular the case for Class C housing units. It should also be noted that a notable upward shift in accumulated rental response is observed from Class A flats, compared with the other three housing classes. The variance decomposition analysis further corroborates this finding, as previous housing price adjustments manage to explain approximately 40% of variance of the rents of Class A flats, and over 30% of variance of the rents of Class C flats. Its contributions to the rental variance for Class B flats and luxury flats, on the other hand, are not as prominent.

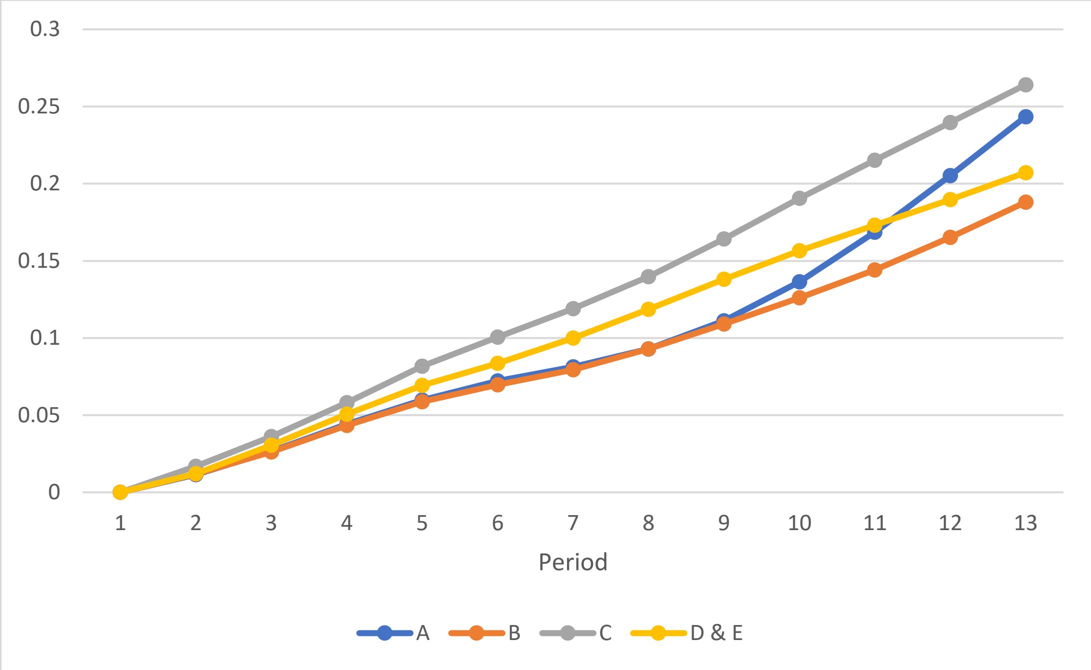

Figure 2.14a: Accumulated responses of PRI to exogenous shocks in PPI

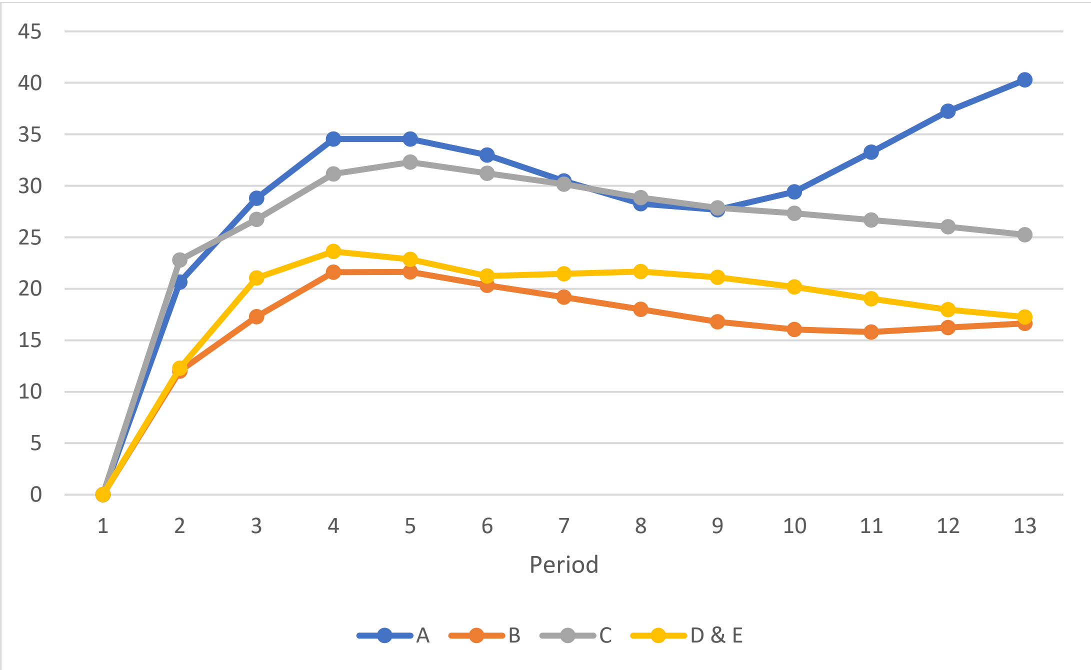

Figure 2.14b: Variance of PPI explained by PPI (in %)

Concerning the impact of the stock market, shocks from the Hang Seng Index induce positive responses in PRI, especially in the shorter-run (i.e. one year) (Figure 2.15a-b). The (accumulated) response is by far the biggest for luxury housing units, and the smallest for Class A flats. Movements in Hang Seng Index are able to explain as much as 24% of the luxury housing units' rental variance, whereas its contributions to the rental variance of the other three housing sub-classes amount to as much as 15%. If anything, these findings provide empirical support for the presence of the wealth effect in the rental sector, as rising stock prices result in higher user demand for housing as well as investment demand for housing (as reported in the previous section). The rental responses to exogenous shocks in stock market volatility, by contrast, are negative overall, with the largest (negative) accumulated responses in Class A, Class B, and Classes D & E (Figure 2.16a-b). Due to the larger responses, stock market volatility contributes to a higher proportion of rental variance for flats within these three housing sub-classes (i.e. as much as 3-4%) than for Class C housing flats (i.e. less than 1%). Albeit not as prominent as its effect on housing prices, a bullish stock market still manages to generate new user demand for housing, whereas uncertainties in the stock market result in lower property rents.

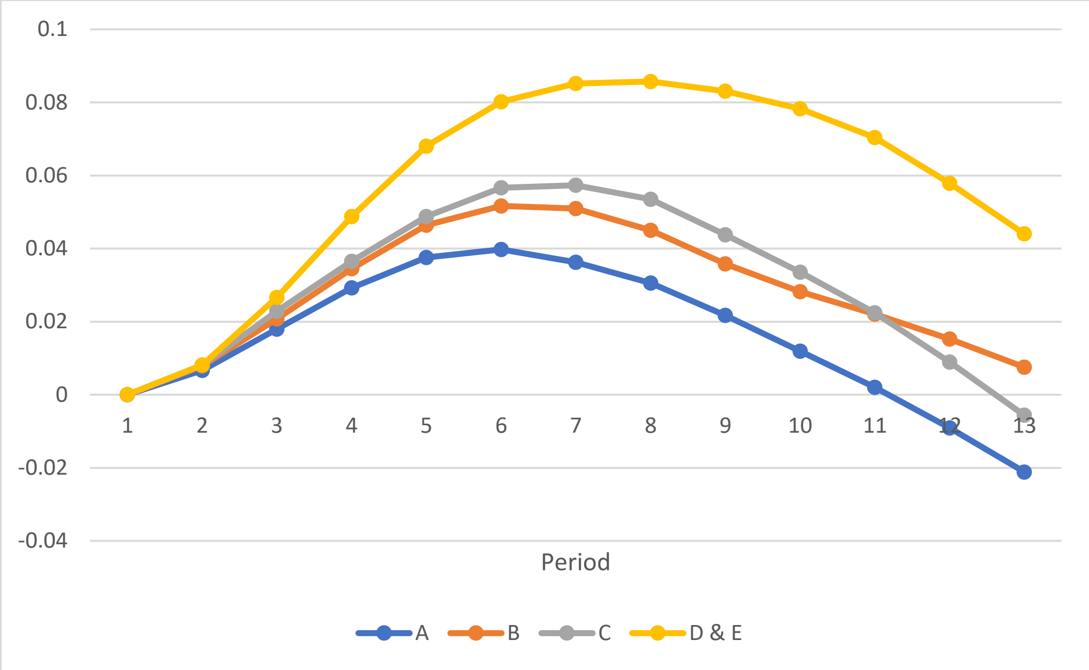

Figure 2.15a: Accumulated responses of PRI to exogenous shocks in Hang Seng Index

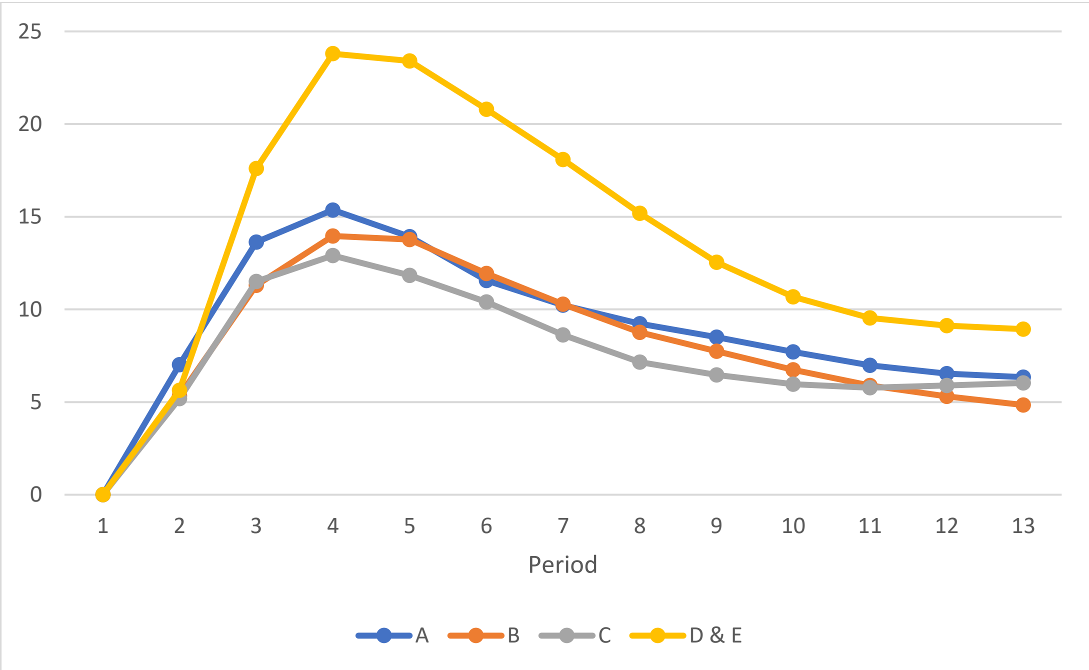

Figure 2.15b: Variance of PPI explained by Hang Seng Index (in %)

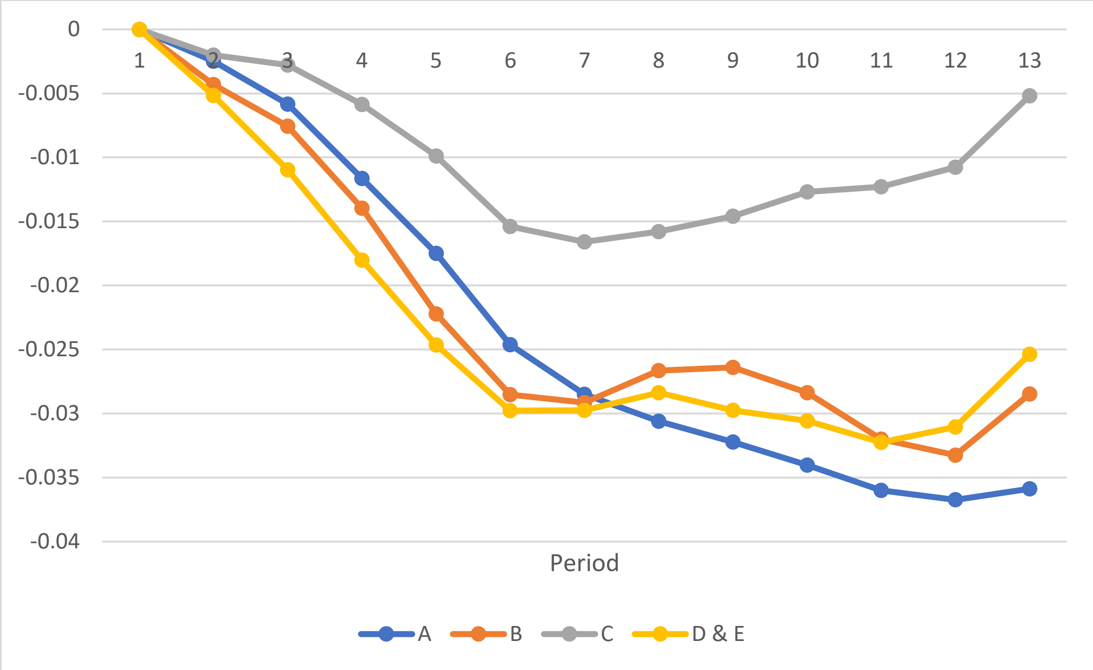

Figure 2.16a: Accumulated responses of PRI to exogenous shocks in stock market volatilities

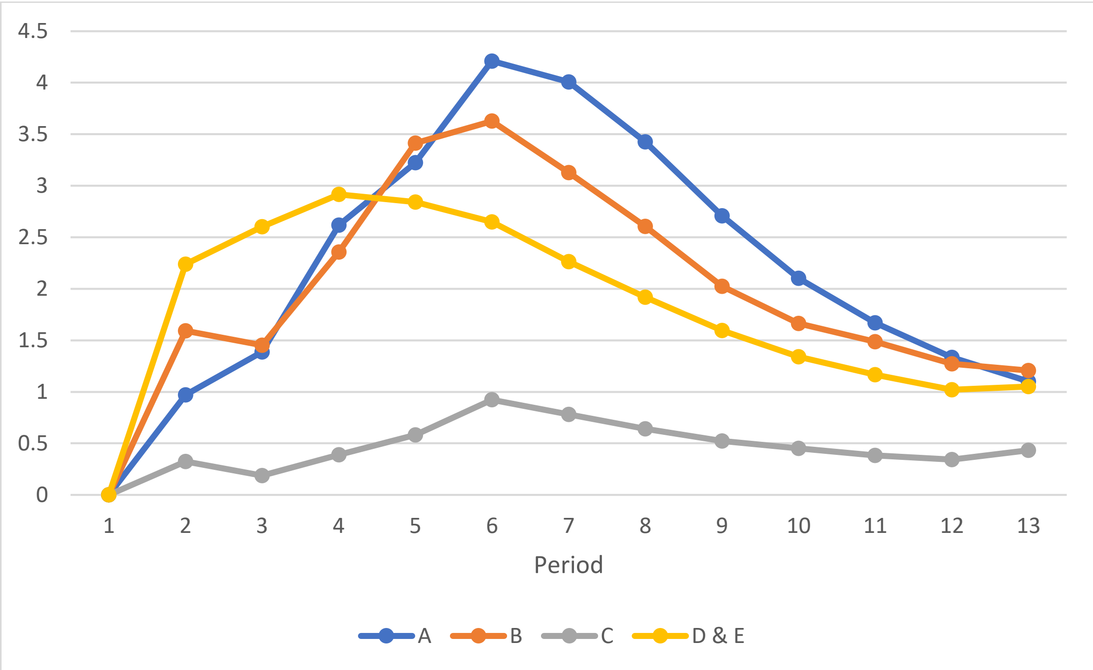

Figure 2.16b: Variance of PPI explained by stock market volatilities (in %)

The effects of income and demographic factors on the rental value of residential properties show remarkable differences. Firstly, exogenous shocks in Hong Kong's real GDP bring about positive rental responses, particularly in Class B, Class C, and Classes D & E (Figure 2.17a-b). Unlike the findings for the sale sector, better economic conditions, in general, lead to higher rents for residential properties, which is consistent with the literature (Case et al., 1999; Goodhart and Hofmann, 2008). Meanwhile, this factor explains the highest amount of rental variance for luxury flats (i.e. as much as 14% after the 9th period), and the lowest amount of rental variance for Class A flats. An interpretation of the findings is that, even as Hong Kong's economy continues to grow, its impact on the housing consumption of lower-income residents in the private housing sector is minimal.

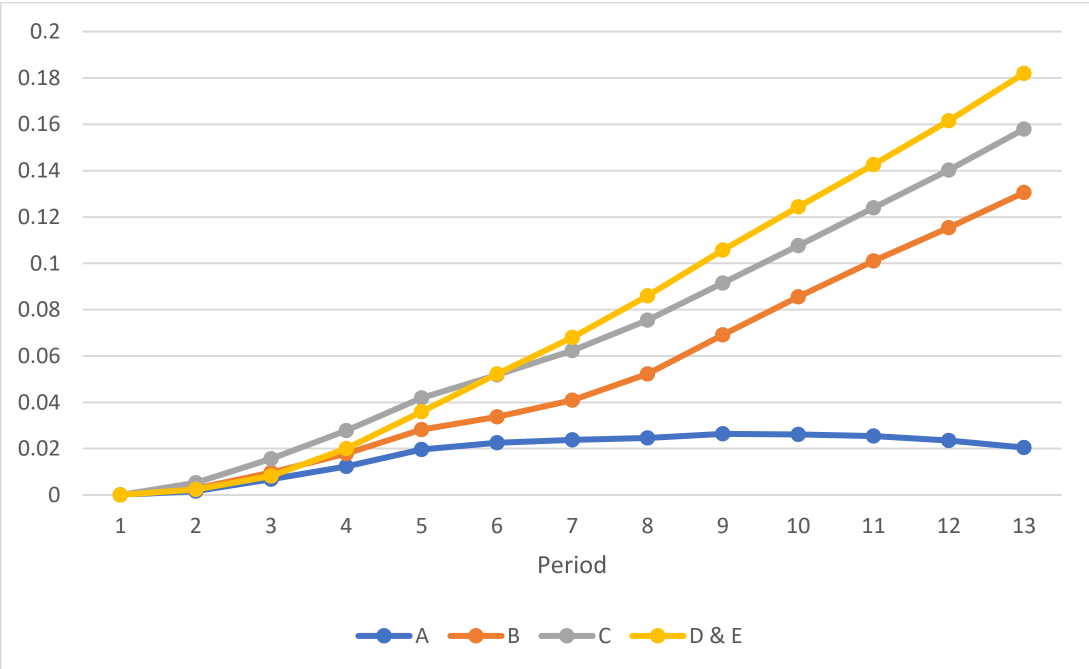

Figure 2.17a: Accumulated responses of PRI to exogenous shocks in real GDP

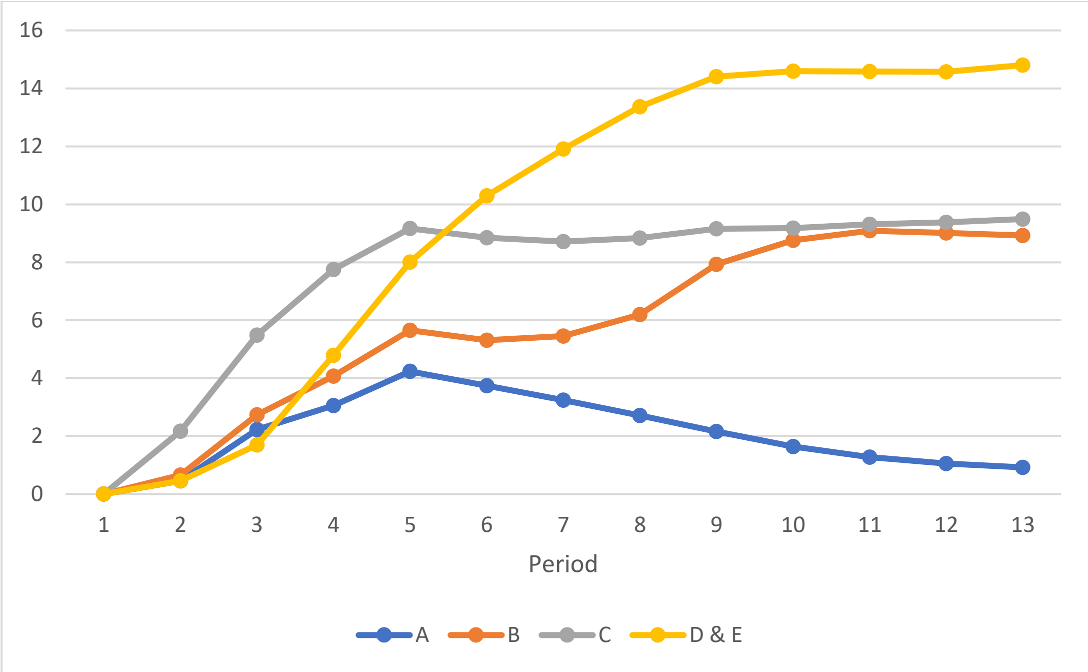

Figure 2.17b: Variance of PPI explained by real GDP (in %)

Similar to the findings for the sale sector, housing rents, other than Class B flats in a number of periods (5-8), is found to respond negatively to exogenous shocks in the amount of households in Hong Kong (Figure 2.18a-b). The negative accumulated responses are the largest for Class C flats. This finding, again, contradicts the notion that household formation is the source of housing demand, as prominently stated in the LTHS (Long Term Housing Strategy Steering Committee, 2013). Even without the long-term financial commitment that obtaining homeownership would lead to, many of these newly-formed households would either live in the unofficial rental sector (i.e. sub-divided housing units) or move to public housing if they are eligible. Yet, unlike the sale sector, this factor explains less rental variance than real GDP.

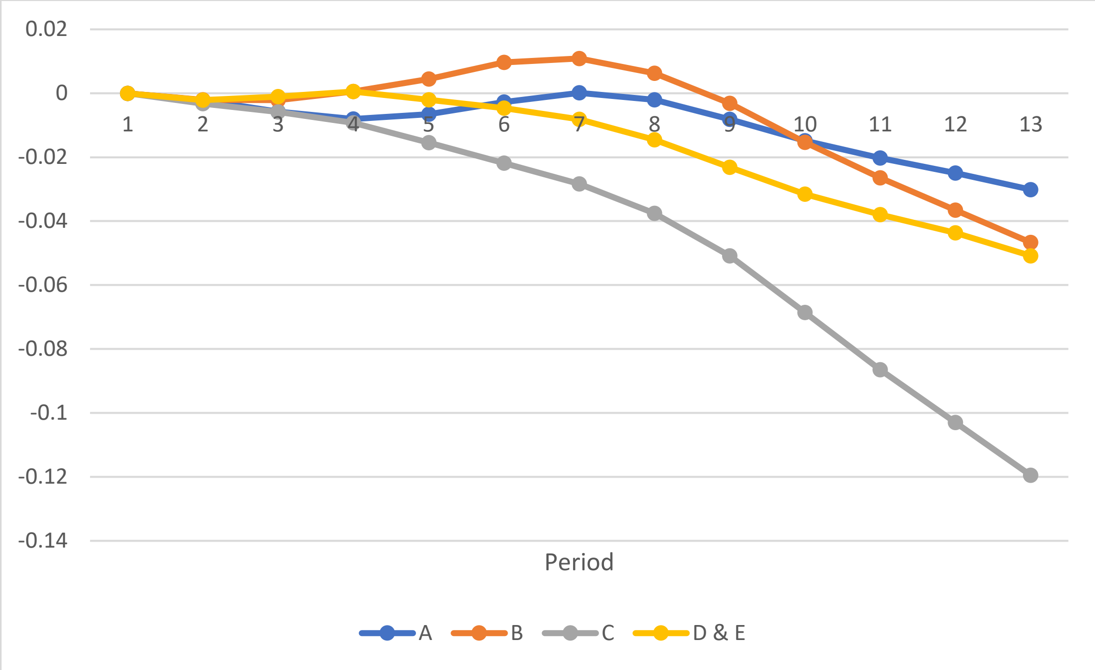

Figure 2.18a: Accumulated responses of PRI to exogenous shocks in the number of households

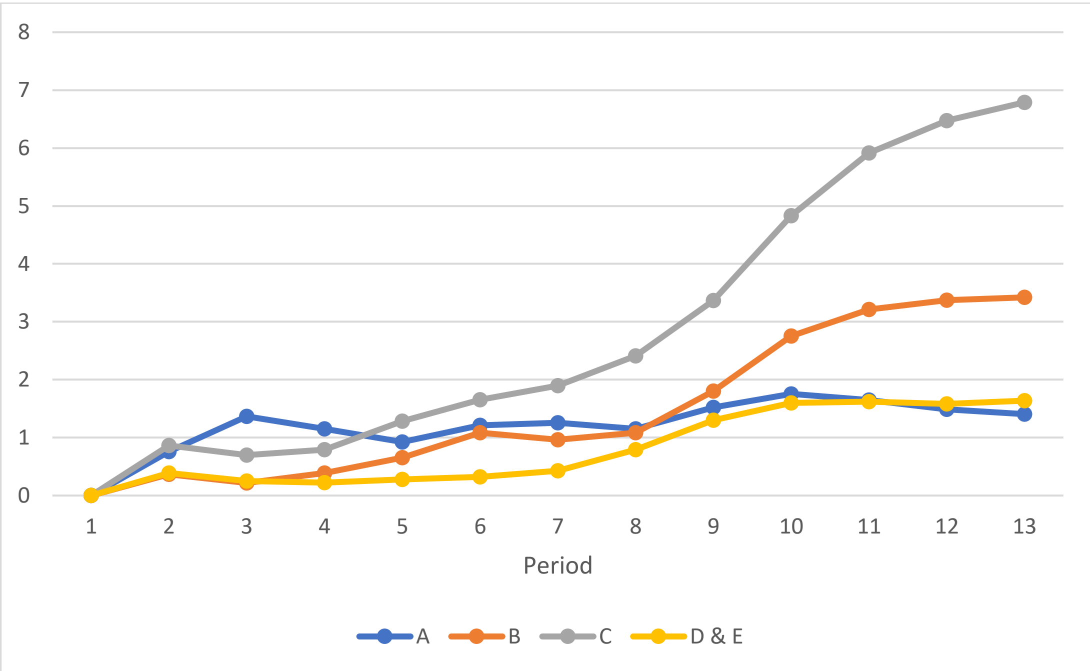

Figure 2.18b: Variance of PPI explained by the number of households (in %)

Concerning the housing-related factors, first, while exogenous shocks in housing supply induce slightly negative rental responses for Class B flats and luxury flats in the shorter-run, the accumulated responses to housing supply adjustments are generally positive, particularly for Class A, Class C, and Classes D & E flats (Figure 2.19a-b). Similar to the findings for the sale sector, a higher housing supply, contrary to public perceptions, is not able to reduce housing-related costs at all. This factor also explains much higher levels of variance of rents in these three housing sub-classes than the rents of Class B flats. And second, the accumulated rental responses to exogenous shocks in the amount of new HOS units sold are negative (Figures 2.20a-b). This illustrates that housing rents would drop should more HOS flats be constructed (and put on sale). The lower resultant rents for the three housing sub-classes point to lower housing demand in the rental sector. This means that the higher availability of assisted homeownership, effectively provides the conditions for renters in the private sector (especially those living in Class A flats or Class C flats) to become homeowners under HOS. According to the variance decomposition analysis, this factor explains the highest price variance for Class C flats in the earlier and final periods, but for Class A flats in the middle simulation periods.

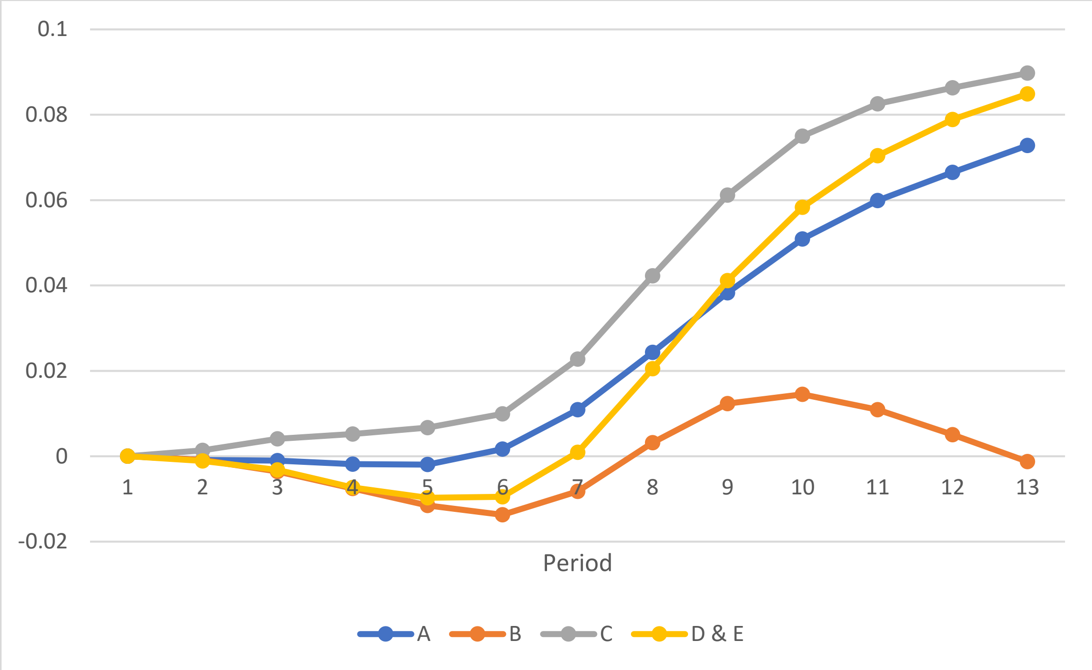

Figure 2.19a: Accumulated responses of PRI to exogenous shocks in housing supply

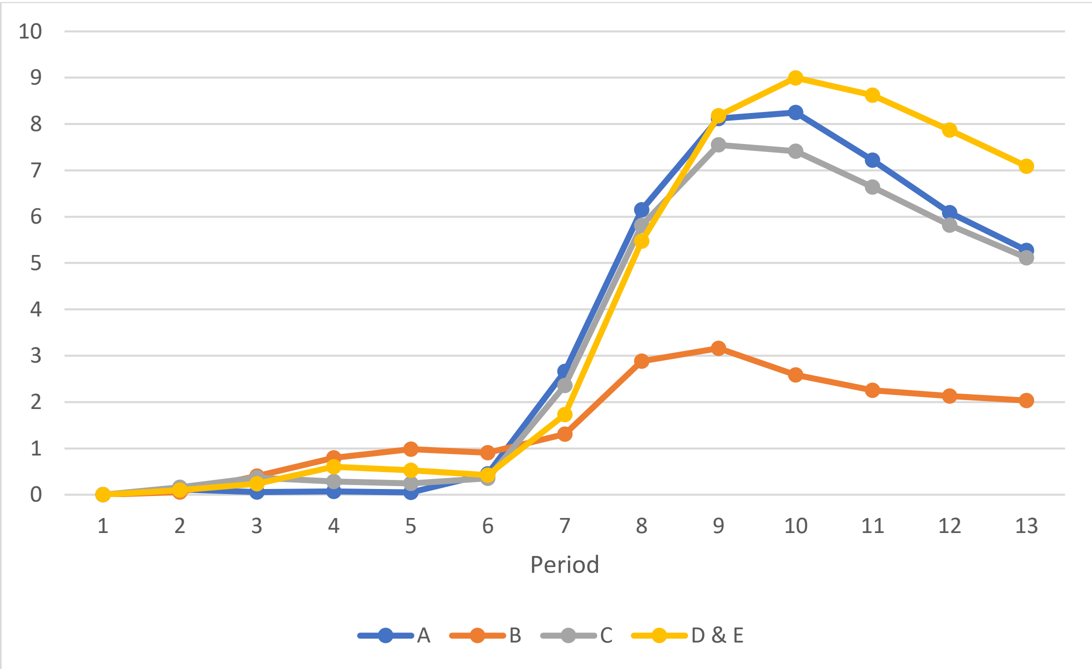

Figure 2.19b: Variance of PPI explained by housing supply (in %)

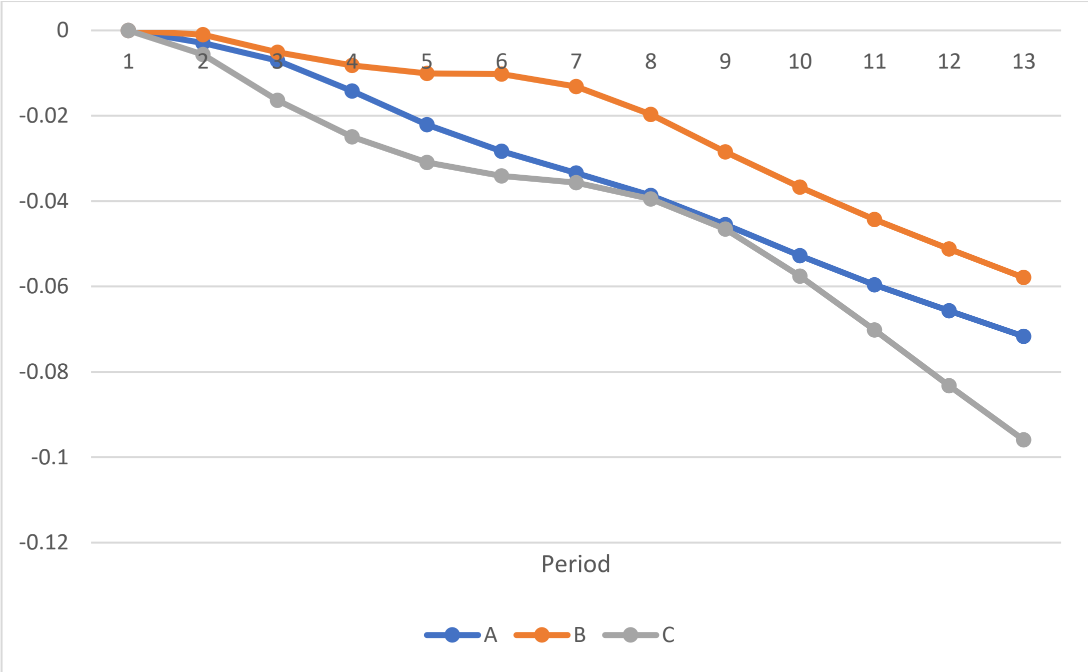

Figure 2.20a: Accumulated responses of PRI to exogenous shocks in the amount of HOS flats sold

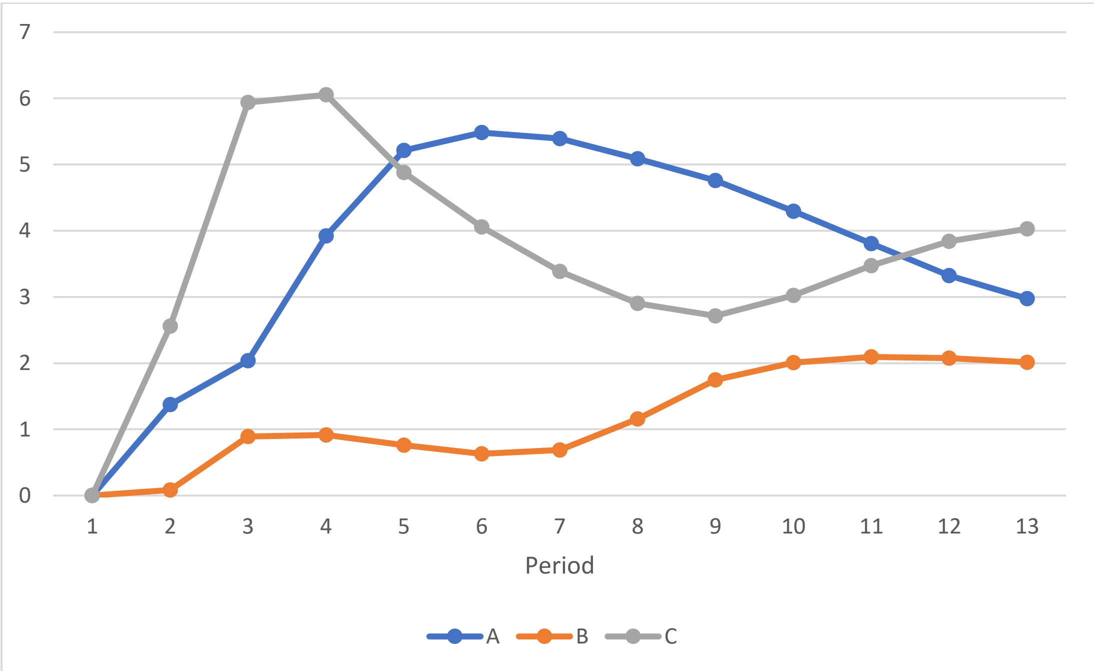

Figure 2.20b: Variance of PPI explained by the amount of HOS flats sold (in %)

As for the external factors, first, similar to its impact on housing prices, exogenous shocks in money supply (M1) trigger positive property rental responses in all four housing sub-classes, especially Class C flats (Figure 2.21a-b). The accumulated rental responses for Class A flats, by contrast, are the smallest. Regardless, the findings confirm that housing demand in the rental sector, similar to that in the sale sector, is essentially driven by the Federal Reserve's asset-purchase programmes via the Linked Exchange Rate System. This factor explains as much as over 20% of the total rental variance for Class B, Class C, and Classes D & E flats, based on the results obtained from the variance decomposition analysis. On the other hand, exogenous shocks in the Federal Funds Rate (Figure 2.22a-b) bring about positive accumulated rental responses (with the exception of Class C flats & luxury flats before the 6^{th} period) in all four housing sub-classes. The impact is particularly large for smaller flats (Classes A & B). The findings indicate that, with the Federal Reserve raising interest rate in the U.S., Hong Kong, via the Linked Exchange Rate System, usually (but not always) follows, thereby resulting in higher user costs for mortgages. As a result, prospective homeowners would rather have their housing needs met in the rental sector, hence resulting in higher property rents. This factor contributes to as much as 3.5% of rental variance for Class A residential units, which is noticeably higher than those for the other three housing sub-classes.

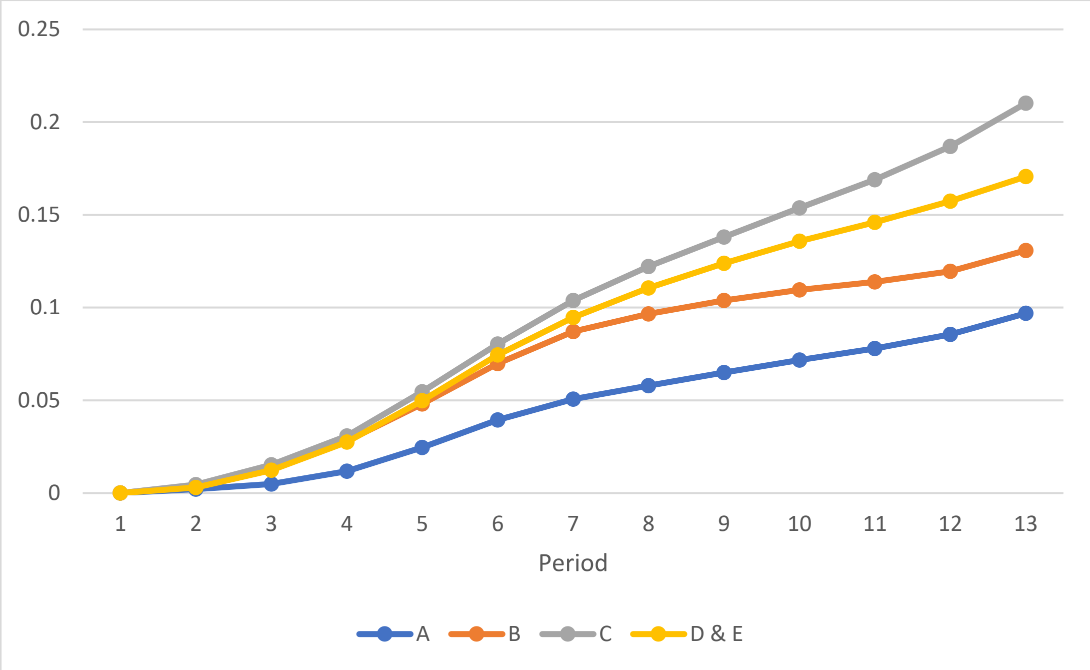

Figure 2.21a: Accumulated responses of PRI to exogenous shocks in M1

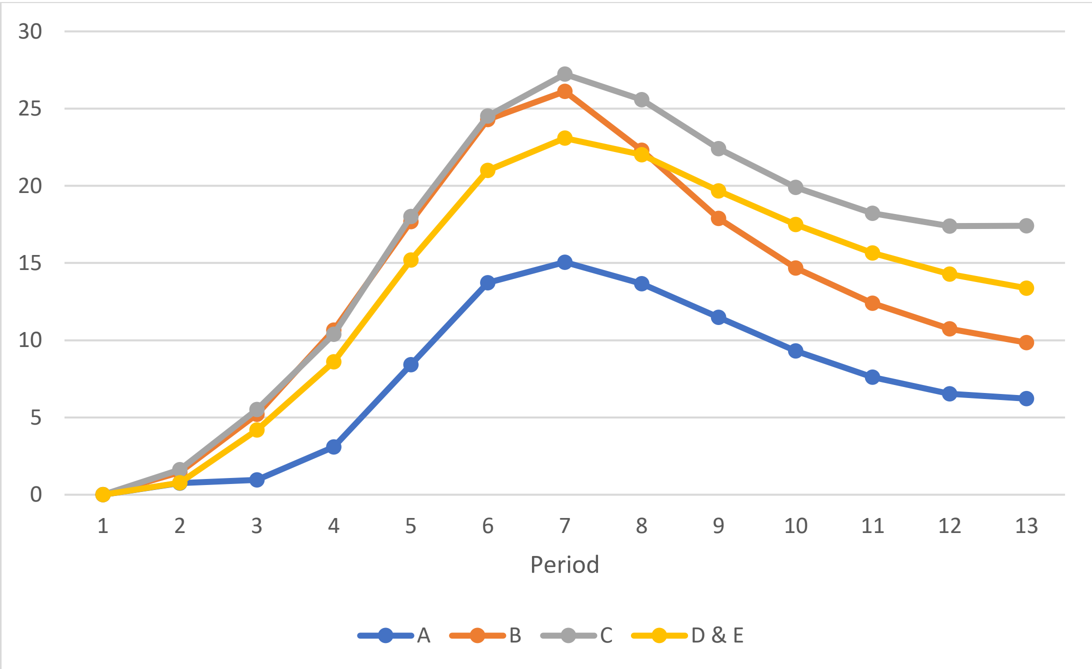

Figure 2.21b: Variance of PPI explained by M1 (in %)

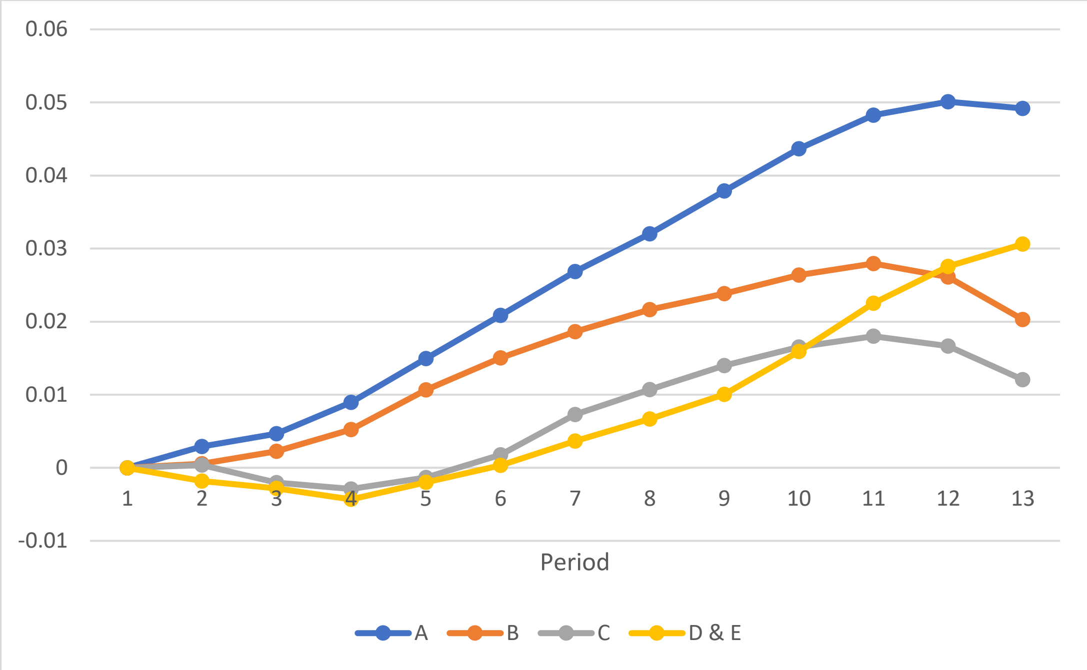

Figure 2.22a: Accumulated responses of PRI to exogenous shocks in Federal Funds Rate

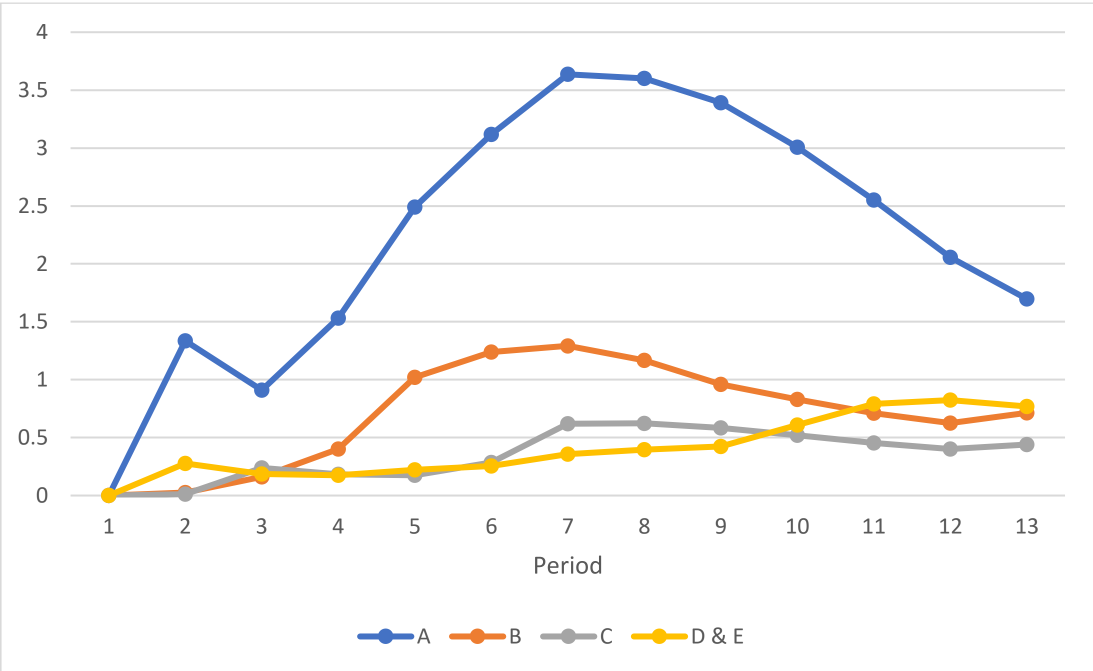

Figure 2.22b: Variance of PPI explained by Federal Funds Rate (in %)

At last, the rental responses to two factors relating to exchange rate are similar to those for the sale sector. First, exogenous shocks in Hong Kong's NEER trigger negative accumulated rental responses for all four housing sub-classes (Figure 2.23a-b), with the exception of luxury flats from periods 5-8. As a higher NEER points to a stronger Hong Kong Dollar and cheaper imports, Hong Kong people tend to take advantage of this exchange rate situation by consuming more non-housing resources with the same amount of budget. As a result, the user demand for housing, especially for Class B flats, falls, thus reducing property rents in the process. In accordance with the variance decomposition analysis results, NEER movements explain the largest amount of rental variance amongst smaller residential properties (Class A & Class B). In the meantime, the rental responses to exogenous shocks in the Hong Kong Dollar-Renminbi exchange rate are also negative for all four housing sub-classes (Figure 2.24a-b), with the responses being the largest for luxury flats. As a rise in RMB indicates a weaker Hong Kong Dollar, Chinese imports, which virtually cover all necessities, become more expensive. Without compromising the basic standard of living, demand for housing resources needs to be reduced in order to compensate for the costlier imports. The reason for the noticeably larger negative rental responses for luxury flats (compared to the other three classes) is that residents would simply reduce their demand for housing resources by renting smaller flats, thus mitigating the impact a stronger RMB would cause to user demand in the mass housing market.

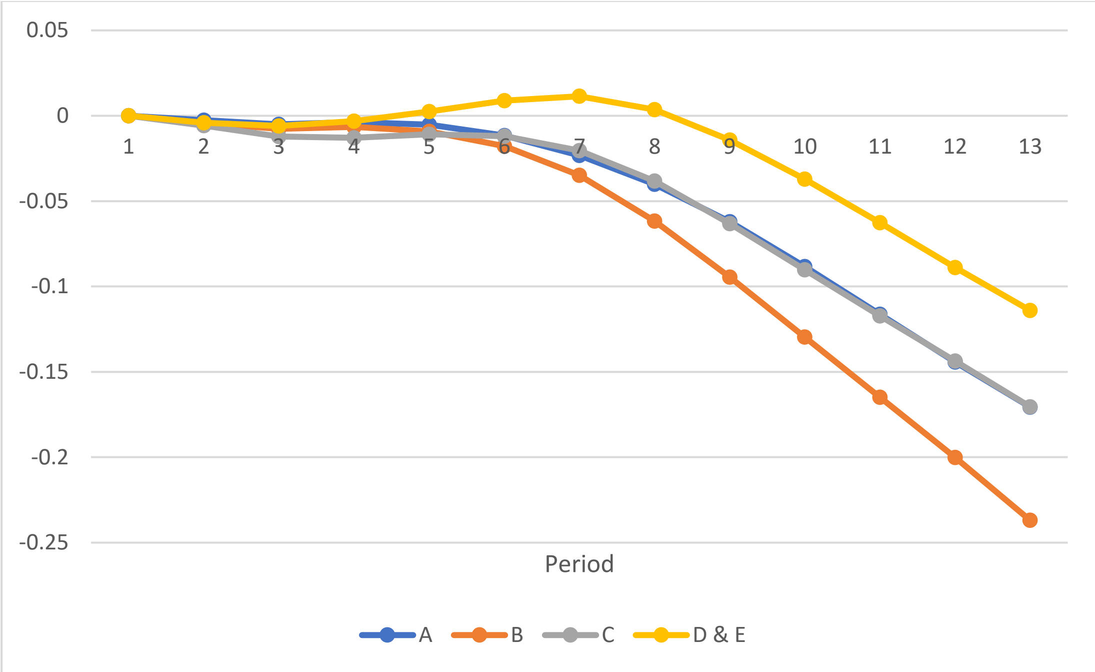

Figure 2.23a: Accumulated responses of PRI to exogenous shocks in Hong Kong's Narrow Effective Exchange Rate

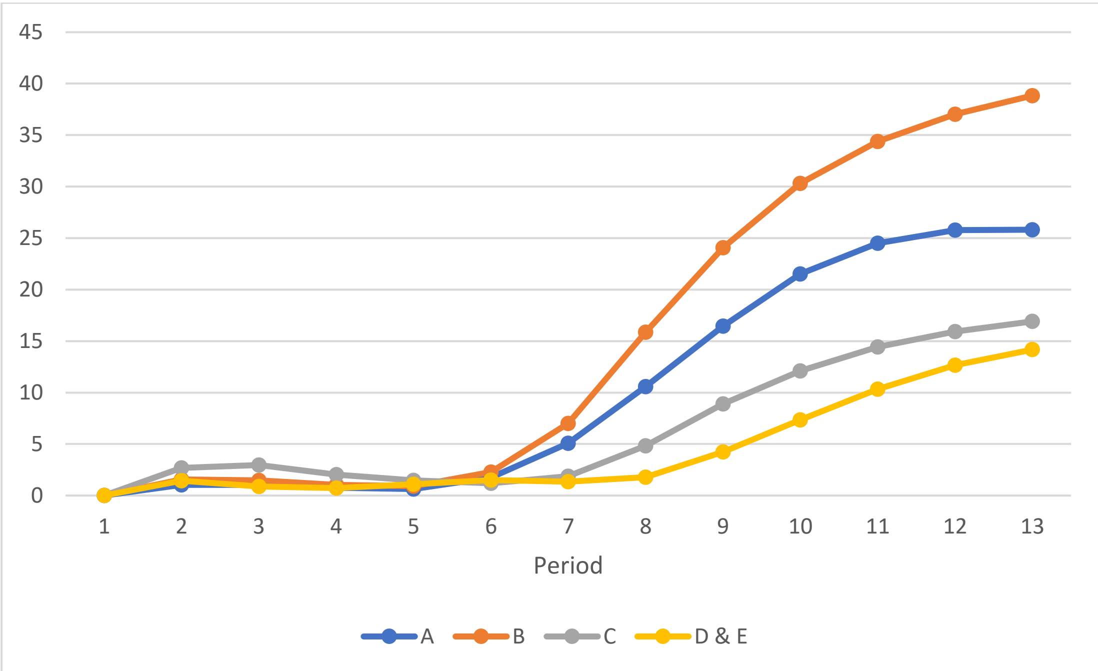

Figure 2.23b: Variance of PPI explained by Hong Kong's Narrow Effective Exchange Rate (in %)

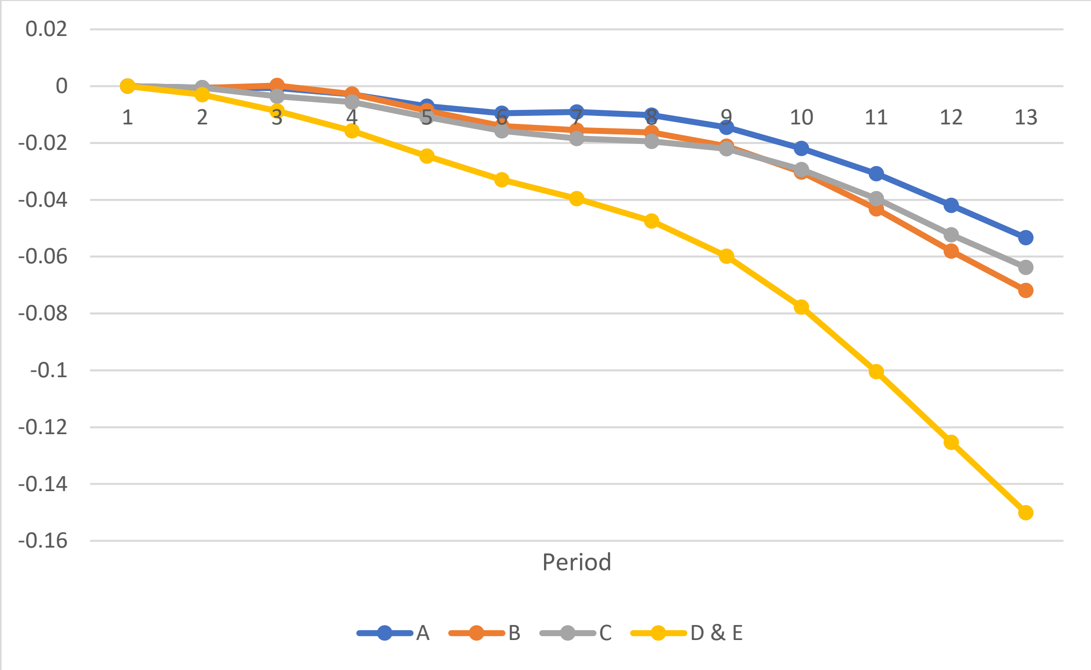

Figure 2.24a: Accumulated responses of PRI to exogenous shocks in the Hong Kong Dollar-Renminbi Exchange Rate

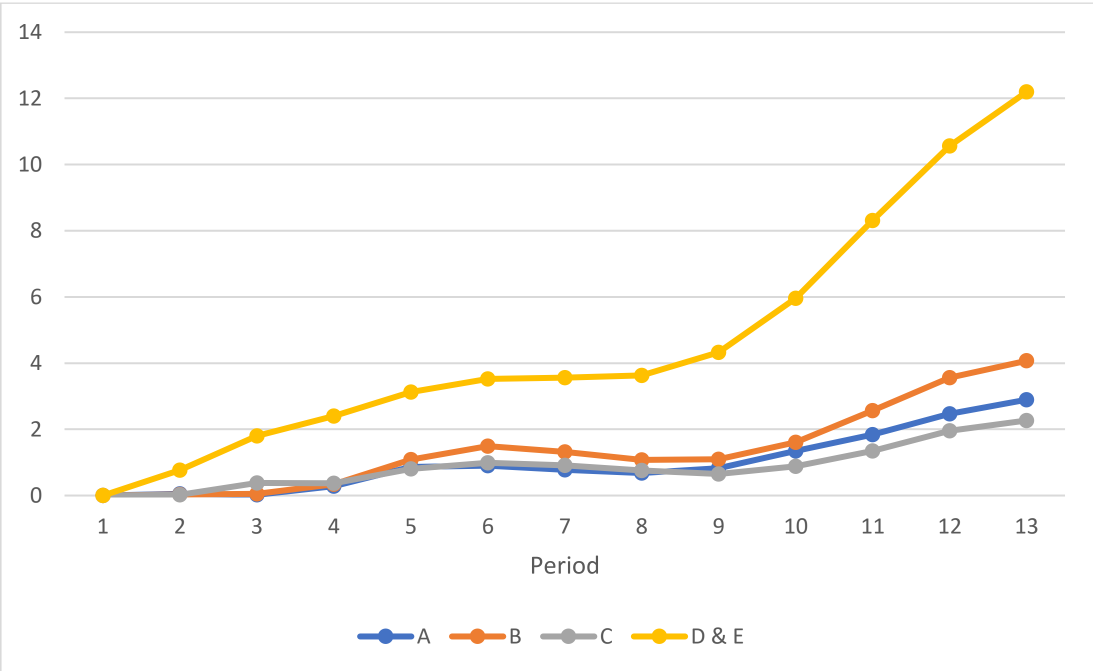

Figure 2.24b: Variance of PPI explained by the Hong Kong Dollar-Renminbi Exchange Rate (in %)

2.5 Conclusion

This chapter, using VECM modeling, has explored how a variety of local and external factors (through the Linked Exchange Rate System) influence Hong Kong's residential property price and rental movements. The findings first show that, though a higher supply of housing does trigger negative adjustments in property prices in the shorter-run, the negative price impact does not last. In fact, in the longer-run, a higher housing supply actually results in higher housing prices in Class B & Class C (and property rents in Class A, Class C, and luxury flats). Instead, the soaring property prices and rents are essentially demand-driven. While a better economic performance (as reflected by a rising real GDP) does influence housing price and rental movements to varying degrees, Hong Kong's housing unaffordability issue in recent years, in both the sale and rental sectors, has essentially been the outcome of U.S. monetary policy measures (and to a lesser extent, latent upgrading demand due to a higher supply of assisted homeownership flats[34]). These measures directly impact housing prices and rents via massive increases in money supply under near-zero interest rates, as well as a weaker Hong Kong Dollar (compared to non-U.S. currencies with the exception of Renminbi) as a result of these policies; and indirectly influence them by means of wealth effect due to soaring stock prices, which in turn has been fuelled by the numerous rounds of Quantitative Easing Programmes (see Appendix A) via the portfolio rebalancing effect (see Tobin, 1969; Joyce et al., 2011; Gagnon et al., 2011; Bernanke, 2012; Hamilton and Wu, 2012) and/or the signaling effect (see Bauer and Rudebusch, 2011).

This chapter, designed to meet Objective 1, has investigated how internal and external

[34] This, however, is only applicable to the sale sector, as the findings suggest that, in the rental sector, the higher availability of assisted homeownership provides the conditions for renters in the private sector (especially within Class A & Class C) to become homeowners under HOS

(via the Linked Exchange Rate System) factors alike affect the movements in both prices and rents in different housing sub-classes in Hong Kong. In the following three chapters, on the other hand, the behaviours of the supply-side actors, namely developers (in Chapter 3) and the Town Planning Board (as the planning authority) (in Chapters 4 & 5) with respect to housing development, in view of soaring housing prices (along with other factors), are to be explored.

CHAPTER 3: LAND SUPPLY AND HOUSING CONSTRUCTION UNDER UNCERTAINTIES IN A HIGH-RISE CITY

3.1 Introduction

In the previous chapter, how Hong Kong's property prices and rents are susceptible to changes in a variety of domestic factors and U.S. monetary policy (via the Linked Exchange Rate System) has been explored. The following three chapters, on the other hand, specifically look at how two vital elements of Hong Kong's residential (and land) development, namely property developers and the Town Planning Board, respond to housing market conditions (and/or the government's housing policy priorities). This chapter, first, focuses on the decisions made by developers as to when to commence housing constructions, in response to housing price movements and land supply situations.

It has usually been argued, especially in the last few years that, property developers are partly to blame for the exorbitant housing prices and rents in the territory, because they have not supplied sufficient housing units. In other words, according to public opinion, housing would become more affordable should 1) developers supply more housing flats and 2) the government sell more land sites specifically for housing development. Yet, these demands, and their implications (as spelt out in Chapter 1), overlook a number of crucial elements, such as the nature of Hong Kong's planning control system, the role played by land exchange in land supply, and the nature of housing as both a consumption good and an investment product. Considering that housing development is a long-term and capital-intensive process, especially in high-rise cities such as Hong Kong, all these elements have profound implications for the future income streams as perceived by developers (and hence, when should development commence), as they tend to withhold land (in the present) for future development should 1) future income streams be stochastic and 2) market information be imperfect (see Section 3.2 for a more detailed discussion).

With reference to all these elements, one might ask whether such desynchronization of housing demand and housing supply is the result of 1) developers not responding to upward housing price movements; 2) market uncertainties rendering present development less-than-optimal; or 3) the innate uncertainties of the development control system. Usually, in many other housing studies, housing supply is seen as one whole process. Yet, with the presence of development controls in housing development (i.e. planning controls and building controls) especially within a high-rise and high-density city, the causes behind the delay from the supply side become rather obscure. Therefore, in addressing this situation before answering the question raised at the beginning of this paragraph, processes under the control of property developers in residential development projects should first be separated from those controlled by government agencies.

Residential development can be divided into four or five phases, depending on how a particular land site is obtained:

1. Negotiation of lease conditions between property developers and the Lands Department (applicable to land exchange only);
2. The planning control process under the jurisdiction of the Town Planning Board (if rezoning and/or development of non-residential use along with housing development is proposed);

3. The building plan approval process under the jurisdiction of the Building Authority[35];
4. The developer's decision to commence construction; and
5. The construction process

Of these phases, property developers have the most control over the fourth phase (as they have already taken into consideration the possible future income streams, construction costs, and uncertainties to be encountered during the construction phase).

This chapter, therefore, intends to explore how property developers' decisions to commence housing construction, from 1995:2 to 2016:4, are influenced by the aforesaid factors. Specifically, this study is designed to address the following research questions:

- Does the sale of more land by the government through auction or tender necessarily lead to more housing constructions?;
- Do developers construct more housing units when property price is soaring?;
- Do uncertainties in housing prices (and in other relevant factors) affect housing constructions? If so, how?;

Following this introduction section, this study is to be divided into four sections. The next section (Section 3.2) reviews the relevant literature with regard to the optimal timing of land development. It is then followed by a section (Section 3.3) in which the research framework, methodology, and data is to be discussed. Section 3.4 presents as well as discusses the findings of the analysis, and Section 3.5 concludes the study.

[35] According to the Buildings Department, the statutory duration for the Building Authority to process building plan submissions (and re-submissions) is 60 days.

3.2 Literature Review

This section is to be divided into two sub-sections. In the first sub-section, the literature with regarded to government interventions in land development is to be reviewed. It is then followed a presentation of previous studies with regard to how landowners decide the optimal timing for development.

3.2.1 Government Interventions in Land Development

Aiming to tackle negative externalities, governments tend to intervene in land development either by using a development plan system or a land-use zoning system. The development plan system is a national "strategic-level structure plan within which are several local/unitary development plans which translate and interpret strategic policy into site-specific allocations for land" (Adams and Watkins. 2002, p. 97; also see Cullingworth, 1997). And the land-use zoning system, usually implemented on a local level, aims to mitigate, if not eliminate, the negative externalities through incompatible land uses (Pogodzinski and Sass, 1991). In accordance with Cullingworth (1997), land-use zoning grants (local) authorities more flexibilities to implement these restrictions. Despite their fundamental differences, planning controls, in accordance with White and Allmendinger (2003), are viewed as one of the ways to preserve the environment as well as to prevent uncontrolled urban development.

These development restrictions are generally believed to result in higher development cost, in turn reducing the supply of housing[36] and raising property prices (Aura and

[36] Interestingly, Peng and Wheaton (1994) argue that, planning restrictions raise housing price but do not reduce housing production. Under these conditions, higher future rents are expected, which in turn are capitalized into higher housing price. According to them, higher housing price then provides the incentive for the production of housing flats in the longer-run, through adjusting the development density.

Davidoff, 2008; Barker, 2008; Costello and Rowley, 2010; Glaeser and Gyourko, 2002; Gyourko et al., 2008; Glaeser and Ward, 2009; Glaeser et al., 2008; Hui and Ho, 2003; Malpezzi and Mayo, 1997; Mayo and Sheppard, 1996; 2001; Pendall et al. 2006). In accordance with Brueckner (1990), the reason price rises is twofold. Firstly, housing price (and land price) soars as a result of lower land supply or regulations that minimize lot size and restrain development density (Barlow, 1993; Brueckner, 1995; Hannah et al. 1993; Katz and Rosen, 1987; Monk and Whitehead, 1996; Peng and Wheaton, 1994; Pollakowski and Wachter, 1990). Second, according to Katz and Rosen (1987), development controls help create an amenity that is costlier to develop, meaning higher prices for the finished product (Brueckner, 1990; Dawkins and Nelson, 2002; Nelson et al., 2002). Nevertheless, it has been commented by some that a more likely result is the development of low-density and costly homes (Ihlanfeldt, 2007; Quigley and Rosenthal, 2005), which poorer households and ethnic minorities simply find unaffordable (Nelson et al., 2002).

If restricted land supply is the reason behind higher housing price, the housing affordability issue can be solved via a higher supply of land. In other words, housing supply should be more elastic if land supply is elastic (Grimes and Aitken, 2006; 2010). While many researchers have reached such a conclusion (see Beer et al., 2007; Demographia, 2007; Moran, 2006, 2008; Nelson et al., 2002; White and Allmendinger, 2003), several other studies have challenged this notion. According to some researchers (Costillo and Rowley, 2010; Evans, 2004; Lai and Wang, 1999; Tse, 1998), higher land supply does not always lower housing price. as a higher supply of land, due to property developers' 'land banking' practices, does not necessarily result in a higher supply of housing.

Land use zoning and planning regulations are believed to dictate the responsiveness of developers to housing price movements (Caldera and Johansson, 2013). In comparatively supply-constrained markets, housing price rises, but not housing supply, as a demand shock emerges (Gyourko, 2009). In other words, these markets have low elasticity of supply (Malpezzi and Mayo, 1997) and highly subject to property price bubbles (Glaeser et al., 2008). By contrast, in markets with higher supply responsiveness, price increases are smaller when demand shock(s) occur (Grimes and Aitken, 2006).

In addition to more stringent controls in land development (Malpezzi and Mayo, 1997) and the resultant delays (Ball, 2011; Ball et al., 2009), risks involved in the regulatory process can be another reason behind a market's low price elasticity of supply. Developers are subject to uncertainties in stochastic development controls, in terms of 1) whether a development project should commence and 2) how a land site should be developed (Mayo and Sheppard, 2001).

3.2.2 Optimal Timing of Land Development

The phenomenon that land sites are being left idle, instead of being developed for alternative uses, gives rise to the study of one of the most discussed topics in land economics, the optimal development timing. That is, whether a piece of land should be developed in the present, or preserved until a later date. Basically, a landlord decides to develop his land (for an alternative land use, for instance residential), when the discounted future income streams (i.e. rental income) exceeds the development cost[37].

[37] Another reason, in accordance with Keuschnigg and Nielson (1996), is attributed to the rapid land prices. They point out that the capital gains resulted from higher land prices could lead to a return (for keeping the land vacant) higher than, or at least as good as, immediate development for alternative use.

In other words, once the development's rate of return is higher than the discount rate, land development is expected to commence in the present. Otherwise, landlords would preserve land sites until such a condition is met. This notion is further extended to consider the likes of property taxes (see Bentick, 1979; Mills, 1981; 1983; Noguchi 1982; Wildasin, 1982; Bentick and Pogue, 1988; Anderson, 1986; Hite et al., 2003; Turnbull, 1988; Arnott and Lewis, 1979), market power (for instance, Markusen and Scheffman, 1978; Mills, 1980; Turnbull, 1988b; Wang et al., 2009; Bulan et al., 2009), as well as income generated from interim land use (such as farming)[38].

In the earlier development of the western literature in optimal development timing, it is usually assumed that perfect information concerning the amount of future land rents receivable is both available and obtainable (see Arnott and Lewis, 1979; Capozza and Helsley; 1989; Markusen and Scheffman, 1978; Mills, 1980). To put it differently, these studies depict the land market as a certain, deterministic environment. This notion, however, has been criticized by others, as unlike the classic scenario in Wicksell (1934) about the optimal time for tree-cutting, certain information as to future rental income streams (and/or future market prices) simply does not exist in the present, rendering the determination of the optimal timing of development very difficult, if not outright impossible. In addition to the widely-perceived nature of land development as both irreversible and indivisible, development in the present may not be optimal. In light of this, numerous studies, based upon the investment under uncertainty literature (Dixit and Pindyck, 1994; Hubbard, 1994; Pindyck, 1991;, have contributed to the land development literature in this regard in both two-period and multi-period models (see

[38] In addition to these factors, Anderson (1986) finds that land development timing is also highly subject to market conditions at the time.

Batabyal, 1996; 1997; Capozza and Helsley, 1990; Capozza and Sick, 1990; Clark and Reed, 1988; Titman, 1985; Bulan et al., 2009**).**

Arguably the most important concept in the study of land development under uncertainty is option value[39], introduced to the land development literature by Arrow and Fisher (1974) and Henry (1974). Generally referred to as the Arrow-Fisher-Henry (AFH) analysis, it indicates that, should land development be both indivisible[40] and irreversible, a landowner, by deciding to develop a piece of land in the present, essentially overlooks the benefits of waiting (such as new information on future rental income). However, it is argued that the decision to leave the land vacant in the present allows for higher degree of flexibility for the landowner in responding to incoming market information, even though it incurs information cost and losses in terms of possible revenue resulted from development (Batabyal, 1996). This decision is perceived to have an economic value, commonly known as option value, which is positively correlated with market volatility. As a result, in a stochastic situation with uncertainty, the optimal timing to develop a particular piece of land is when the rate of return of the investment exceeds the combination of discount rate, property tax rate, and an uncertainty premium. This means that, holding other factors constant, the higher the uncertainty premium (i.e. option value), the less likely and a land site is to be developed in the present. The negative correlation between uncertainty and present investment has been reported in several studies (for instance, Bulan et al., 2009; Cunningham, 2006; 2007; Holland et al., 2000; Quigg, 1993)[41].

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[39] This is also known as the quasi-option value.

[40] Nonetheless, should land development decision be divisible, the pro-development bias under the AFH framework may not arise, only if the development benefit function is of a particular form (Epstein, 1980; Hanemann, 1989; Batabyal, 1999).

[41] The reason, according to Titman (1985), lies in the convexity of the profit function with respect to housing prices and Jensen's Inequality.

Besides the issue regarding uncertainly, another important topic concerns the impact of interest rates. As mentioned in the previous paragraphs, the discount rate, which is usually proxied by the interest rate, is one of the key factors in deciding the present discounted value of future income streams generated from development. In conventional economic theories, it is suggested that an increase in the market rate of interest results in lower investment, as a higher cost of capital is incurred, thereby leading to a higher hurdle internal rate of return (IRR) (Capozza and Li, 2002). However, there have been studies which report a positive relationship between interest rate and investment (such as Amin and Capozza, 1991; Capozza and Li, 1994; 2001; Heaney and Jones, 1986; Ingersoll and Ross, 1992; Williams, 1991). The reason behind this seemingly-abnormal finding, according to Capozza and Li (2001), is because the option value (of awaiting a more "optimal" development opportunity) falls as interest rate rises, thus hasten the development of projects previously deemed not optimal.

Having reviewed the relevant studies in the western literature on the optimal land development timing, it should be noted that, although these previous studies are very valuable in understanding the conditions under which landowners (or developers) decide when to develop their land, they have primarily investigated land development decisions on a micro level. How these factors affect land development as a whole (i.e. from a macro perspective) has been rarely explored. In the light of this, this study aims to contribute to the land development literature through a macro investigation of the relationship between residential development decisions and uncertainties in a variety of aspects. The following section discusses the research framework on which this study is based, as well as the methodology and data.

3.3 Research Framework, Methodology, and Data

The research framework of this study is largely based upon the traditional literature on land development in the stochastic scenario. The only difference is that, unlike the majority of those previous investigations, this study attempts to look at the issue at hand from a macro perspective, rather than on a firm level. In other words, this study intends to find out whether (and how) the amount of housing construction initated within a particular period of time in Hong Kong coincide with housing price movements, in addition to other construction- and land development-related factors.

In the conventional land development literature, a developer commences development of a land site in the present, rather than preserves or withholds it for future development, if the net present value (NPV) of project is positive. Yet, besides the discounted return and cost of capital, the optimal timing for development is also susceptible to uncertainty in future income streams. To put it differently, the financial viability of a residential development project (VIA), in the present, can be described as a function of property price (P), interest rate (I), construction cost (C), and their respective uncertainties (UNC), as follows:

$$VIA = f(P, I, C, UNC)$$

Nonetheless, the land development literature has been founded on studies from a micro perspective (i.e. decisions made by individual landlords and/or developers). Much fewer studies have focused on how the aggregate of these decisions, together, respond to these conditions. Therefore, a macro-level study can shed new lights into the interactions between land development decisions and the whole housing market.

With reference to the land development literature, the decision by a landlord (or developer) to develop a particular land site in a particular period of time (*t*) indicates that, in the stochastic scenario, the present discounted revenue obtained from the development project (or discounted rate of return) is higher than the combination of construction cost (or cost of capital), property taxes (if any), and the uncertainty premium. In other words, the decision itself indicates that all these conditions have already been fulfilled at time *t*. Nevertheless, the situations in a high-rise city like Hong Kong are more complicated. Actual housing constructions are not permitted to begin until a developer 1) has negotiated the lease conditions of a land lot with the Lands Department (applicable to sites which originate from land exchange) and 2) has obtained the Town Planning Board's (TPB) approval for development (if rezoning of the land site in question is required) as well as the consent to commence general building and superstructure work issued by the Building Authority. Yet, even when the Building Authority's consent has already been obtained, it does not necessarily mean that property developers commence housing construction instantly. Instead, the construction phase of a development officially begins when a developer issues a notification to the Building Authorities of its commencement of general building and superstructure work. In other words, the dependent variable in the model, which is the amount of housing Hong Kong's property developers decide to construct in a particular period of time, is represented by the total Gross Floor Area (GFA) to be built as noted in these notifications. In other words, GFA is, thus, a function of property price, interest rate, construction cost (and their respective uncertainties), as well as factors related to residential land supply (such as land sale and land exchange):

$$GFA = f(P, UNC[P], I, UNC[I], C, UNC[C], LS)$$

As for the explanatory variables, a total of eleven factors which correspond to the aforesaid factors are considered. These factors can be categorized into four groups. The first group concerns housing price movements which affect the future income streams of a development project. In this study, in addition to the actual property price index itself (in natural log; LnPPI), the *ex-post* expected growth in PPI (EXPPPI), which is the mean PPI growth rate (in %; as compared to that one year prior) in the previous 4 quarters (i.e. 12 months), is designed as another property price-related variables. The third and final property price variable (VOLPPI) depicts the *ex-post* volatilities in property price movements, which is calculated by means of the standard deviation of the PPI growth rate in the last 4 quarters.

The movements, as well as the uncertainties, of the cost of construction are to be considered as well. Since this study focuses on private housing development, the Rider Levett Bucknall (in natural log; LnRLB) Tender Price Index (which measures tender price movements of builder's works in the private sector of Hong Kong), not only is included in the model, but is also used for the computation of two other explanatory variables as well. The first variable, EXPRLB, denotes the *ex-post* expected growth in RLB, which is the mean RLB growth rate (in %; as compared to that a year before) in the previous 4 quarters. Whereas, the second variable, VOLRLB, indicates the *ex-post* volatilities in RLB movements, as represented by the standard deviation of the RLB growth rate in the past 4 quarters.

The third group is related to movements in interest rate. Likewise, three variables are introduced. Considering the tight relationship between Hong Kong's interest rate and the U.S. interest rate owed to the Linked Exchange Rate System (see Chapter 1), the first variable to be included is the Federal Funds Rate (FED). FED, in turn, is used to establish two other explanatory variables for this study. One of them is the *ex-post* expected change in FED. This rate (EXPFED) is computed as the average change in FED in the previous 4 quarters. And the other is interest rate volatilities (VOLFED), as represented by the standard deviation of FED changes in the last 4 quarters.

The fourth and last group of variables takes into account the land supply situation in Hong Kong (and thus, the extent of land development control a housing development project is subject to). Two variables are selected in this regard. The first variable is the total land supply in Hong Kong in the last 12 months. As pointed out in Chapter 1, the government-initiated land sale is not the only land-supplying channel in Hong Kong. Rather, the developer-initiated land exchange had been a prominent source of residential land supply, especially since 2001. Therefore, instead of using the amount of land sold via auction or tender as the sole indicator of land supply, the combined amount of land transacted by either land sale or land exchange (in m^2) is used as Hong Kong's land supply (in natural log; LnLS). Due to such a specification, the percentage of land transacted via the developer-initiated land exchange in the total land supply (PERLE) is established as another variable, with the aim to gauge how uncertainties in the land development control process influence developers' decisions as to when to commence housing constructions.

The data necessary for this investigation is collected from five different sources. First, information of notifications issued by developers to commence general and superstructure work is obtained from various issues of *Monthly Digest* published by the Buildings Department. Land supply information, including the amount of residential land transactions by land sale (i.e. auction or tender) and by land exchange, is compiled from the Lands Department. Construction cost data (i.e. Tender Price Index) is collected through the *Hong Kong Report: Quarterly Construction Cost Update* published by RLB. Data of the Federal Funds Rate is gathered from the Federal Reserve Bank of St. Louis. And lastly, housing price information (i.e. Property Price Index) is obtained from the Rating and Valuation Department (RVD).

Prior to deciding the final model specifications, a number of issues are required to be addressed first to ensure the most vigorous (and the best possible) model fit.

The first issue concerns the integration order (i.e. stationarity) of the variables. This issue arises as spurious regressions, which result in biased estimations, are resulted when non-stationary levels variables (such as those integrated on order 1 [$I(1)$] or order 2 [$I(2)$]) are deployed for model estimations. This is particularly prevalent among most macroeconomic and finance variables. As a result, the Advanced Dickey-Fuller (ADF) tests are first performed to find out whether a unit root exists in the variables selected for this particular study. The results, as reported in Table 3.1, show that the selected variables, with the exception of GFA itself, are deemed stationary after first-differencing. Yet, as the first-differenced GFA is also stationary, all of the selected variables can be said as integrated on order 1 (or $I[1]$).

Variables	T-statistic (Intercept)	T-statistic (Trend and Intercept)
LnGFA (Levels)	-5.338*	-5.647*
LnGFA (1st Difference)	-13.268*	-13.195*
LnPPI (Levels)	-0.468	-1.287
LnPPI (1st Difference)	-4.360*	-4.469*
EXPPPI (Levels)	-0.713	-4.298*
EXPPPI (1st Difference)	-4.798*	-5.015*
VOLPPI (Levels)	-3.022	-3.166
VOLPPI (1st Difference)	-5.955*	-5.916*
LnLS (Levels)	-2.378	-2.846
LnLS (1st Difference)	-8.408*	-8.376*
PERLE (Levels)	-1.831	-1.679
PERLE (1st Difference)	-6.065*	-6.295*
LnRLB (Levels)	-0.525	-1.122
LnRLB (1st Difference)	-4.222*	-4.844*
EXPRLB (Levels)	-1.700	-2.133
EXPRLB (1st Difference)	-4.720*	-4.712*
VOLRLB (Levels)	-2.942	-2.991
VOLRLB (1st Difference)	-5.261*	-5.235*
FED (Levels)	-1.798	-3.400
FED (1st Difference)	-4.841*	-4.825*
EXPFED (Levels)	-2.471	-2.456
EXPFED (1st Difference)	-7.055*	-7.025*
VOLFED (Levels)	-2.287	-2.501
VOLFED (1st Difference)	-9.431*	-9.369*

Table 3.1: The Advanced Dickey-Fuller Tests Results
Note: * denotes a rejection of the existence of a unit root at 5% significance level

Having identified the order of integration for the selected variables, the lag order is then determined by incorporating these levels variables into different Vector Autoregression (VAR) models. The results illustrate that the optimal lag order amounts to four (4) (Appendix 3.1). Then, the Johansen Cointegration tests are used to find out whether or not the integrated time-series variables are themselves cointegrated with one another. The Trace test results show that the integrated time-series variables selected for the study are indeed cointegrated, as cointegrating relations ranging from 10 to 12, depending on a system's deterministic trend assumption (Table 3.2), are identified.

Deterministic Trend Assumption		Number of Cointegrating Relations
No Trend in Data	No intercept or trend in CE or VAR	10
	Intercept (no trend) in CE – no intercept in VAR	10
Linear Trend in Data	Intercept (no trend) in CE and VAR	10
	Intercept and trend in CE – no trend in VAR	11
Quadratic Trend in Data	Intercept and trend in CE – linear trend in VAR	12

Table 3.2: The number of cointegrating relations identified by the Johansen Cointegration Tests
Note: For more details about the results, see Appendix 3.2

Given that the selected variables are both integrated (on order 1) and cointegrated, Vector Error Correction Models (VECM) are used for the analysis (see Section 2.3 for more details of this model). Based on the lag order and cointegrating relations reported above, five different trial VECMs are conducted in order to find the best model fit. The results are presented in Table 3.3 below. While the VECM with no deterministic trend in data (Intercept [no trend] in CE – no intercept in VAR) yields the lowest Akaike Information Criterion (AIC) and Schwarz Criterion (SC) for the model for GFA, the respective AIC and SC for the whole VECM are much higher than the VECM with a linear trend in data (Intercept and trend in CE – no trend in VAR). Hence, the latter deterministic trend assumption is specified in the final VECM for this study. Appendix 3.3 reports the eleven cointegrating relations whereas Appendix 3.4 presents the resultant error correction terms of the final VECM.

Deterministic Trend Assumption		LnGFA		Whole VECM	
		AIC	SC	AIC	SC
No Trend in Data	No intercept or trend in CE or VAR	2.327	4.029	15.764	39.714
	Intercept (no trend) in CE – no intercept in VAR	2.076*	3.779*	13.019	37.262
Linear Trend in Data	Intercept (no trend) in CE and VAR	2.087	3.819	12.918	37.220
	Intercept and trend in CE – no trend in VAR	2.075	3.836	11.176*	36.505*
Quadratic Trend in Data[42]	Intercept and trend in CE – linear trend in VAR	2.098	3.888	11.199	36.557

Table 3.3: A comparison of model-fit of the five trial VECMs with different deterministic trend assumptions

3.4 Research Findings

In order to gauge the respective impacts of the selected variables on the amount of housing construction to be commenced by developers, the impulse response analysis and the variance decomposition analysis, based upon the results obtained from the VECM, are conducted. Through these two analyses, we are able to obtain information as to 1) how developers' decisions to initiate housing construction in a particular period of time are influenced by exogenous shocks in the other selected variables and 2) the amount of GFA variance to be explained by other variables in the span of 3 years (i.e. 13 quarters, as the first quarter is the base period in which the endogenous variables have no impact on the dependent variable). The results are discussed in the following sections.

[42] With 12 variables included in the system, it is not possible to incorporate 12 cointegrating relations into a VECM. Therefore, only 11 cointegrating relations are included in this particular VECM.

3.4.1 Property Price Movements

The results (Figure 3.1a) show that, while the accumulated responses to exogenous shocks in property price index (PPI) are hovering around the equilibrium over time, GFA responds positively to exogenous shocks in property price volatilities (VOLPPI), yet negatively to exogenous shocks in expected property price growth (EXPPPI). An interpretation for such a finding, with respect to housing development, is that as the expected property price growth rate continues to increase, developers have the tendency to withhold housing development, awaiting further upward movements (in terms of property price growth) in the future in order to maximize their profit margins.

As for the responses to property price volatilities, the findings indicate that, when housing price movements become riskier, the initial reaction from the developers is to take a risk-averse position by commencing development sooner. The positive responses are all the more prominent, should property price volatilities remain consistently high. This finding, interestingly, contrasts with what has been suggested in previous studies concerning the relationship between uncertainty and present investment (Cunningham, 2006; 2007; Holland et al., 2000; Quigg, 1993; Bulan et al., 2009).

Property price-related movements contribute as much as 28% of the overall GFA variance (Figure 3.1b). Of the three property price-related factors, the actual movements in property price (PPI) explain a larger proportion of the variance of GFA in the initial periods, while the contribution of the expected property price growth (EXPPPI) (close to 14% of the overall variance in the final periods) and of uncertainties in property price growth (VOLPPI) (as much as 7.5% of the variance of GFA in the 11th period) to explaining the overall GFA variance become more prominent much later.

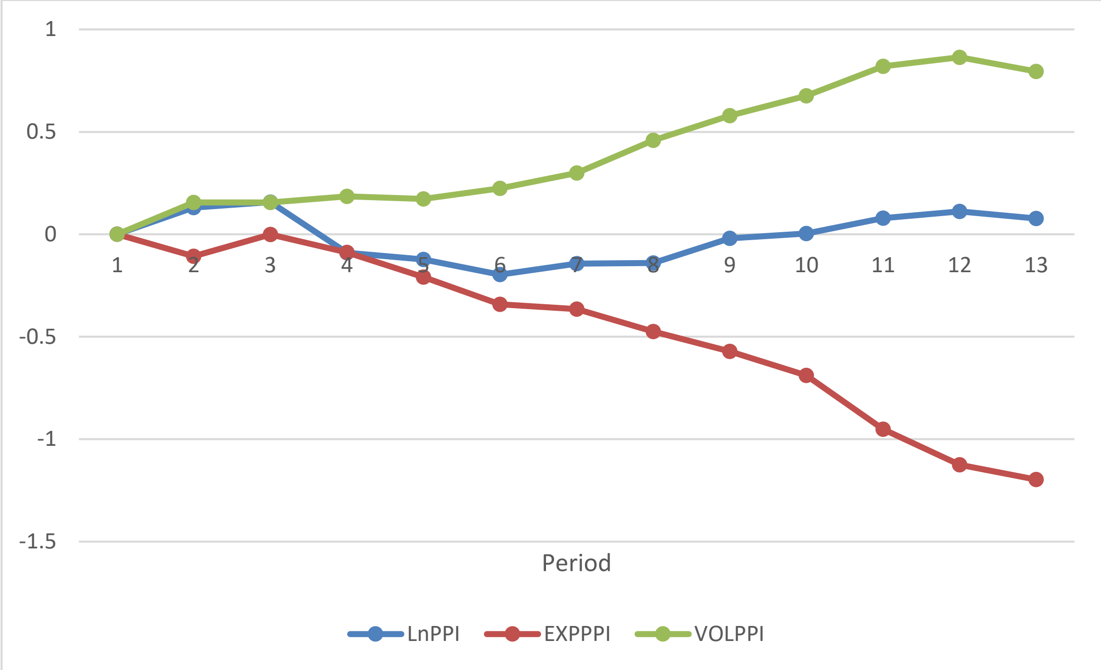

Figure 3.1a: The accumulated responses of GFA to property price-related shocks

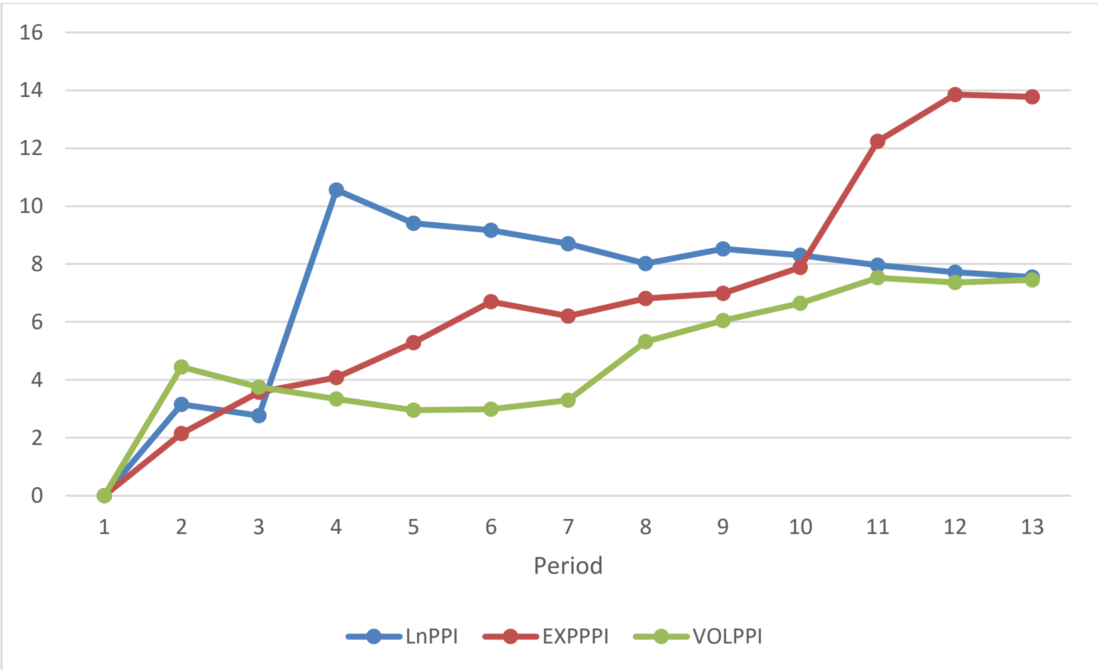

Figure 3.1b: Variance Decomposition analysis (Property price) (in %)

3.4.2 Construction Cost Movements

The accumulated responses to RLB itself, the expected construction cost growth (EXPRLB), and construction cost volatilities (VOLRLB) show significant differences over time (Figure 3.2a). For RLB, the initial response upon a positive shock in construction cost is negative, meaning that developers tend to withhold development. Nevertheless, in the longer-run, the relationship between GFA and RLB is restored to the long-run equilibrium via the error correction process, and subsequently becomes positive. This means that, despite upward movements in construction cost, housing development continues. An explanation for this finding is that Hong Kong's housing development is essentially dominated by a handful of large property developers, many of which are listed in the stock market. Far from a perfectly competitive market, these developers serve as price searchers rather than as price takers. In other words, these developers can simply sell the completed housing units at a higher price to cover the soaring construction costs.

Yet, other than the very small positive response in the 5^{th} period, the accumulated responses to exogenous shocks in EXPRLB are mostly negative. This finding reveals that, as construction cost is expected to rise, property developers would generally withhold development for the time being, until the expected growth decelerates (or if construction cost is expected to fall).

By contrast, exogenous shocks in construction cost volatilities initially bring about positive accumulated responses in the shorter-run, only to return to the long-run equilibrium and then to become negative over time. The results suggest that, in the shorter-run, developers tend to commence construction sooner as construction cost movements become increasingly volatile. Yet, should such volatilities remain, they have the tendency to withhold development. This finding is in line with Cunningham (2006; 2007), Holland et al. (2000), Quigg (1993), and Bulan et al. (2009).

Construction cost movements, in general, explain a smaller amount of the variance of GFA than property price movements (Figure 3.2b). However, unlike the situations of property price, the uncertainties in construction cost movements (VOLRLB), manage to explain a much higher degree of variance than the expected construction cost movements (EXPRLB). Meanwhile, the actual construction cost movements (LnRLB) consistently explains around 2.7-4.3% of the variance in the amount of housing space to be constructed.

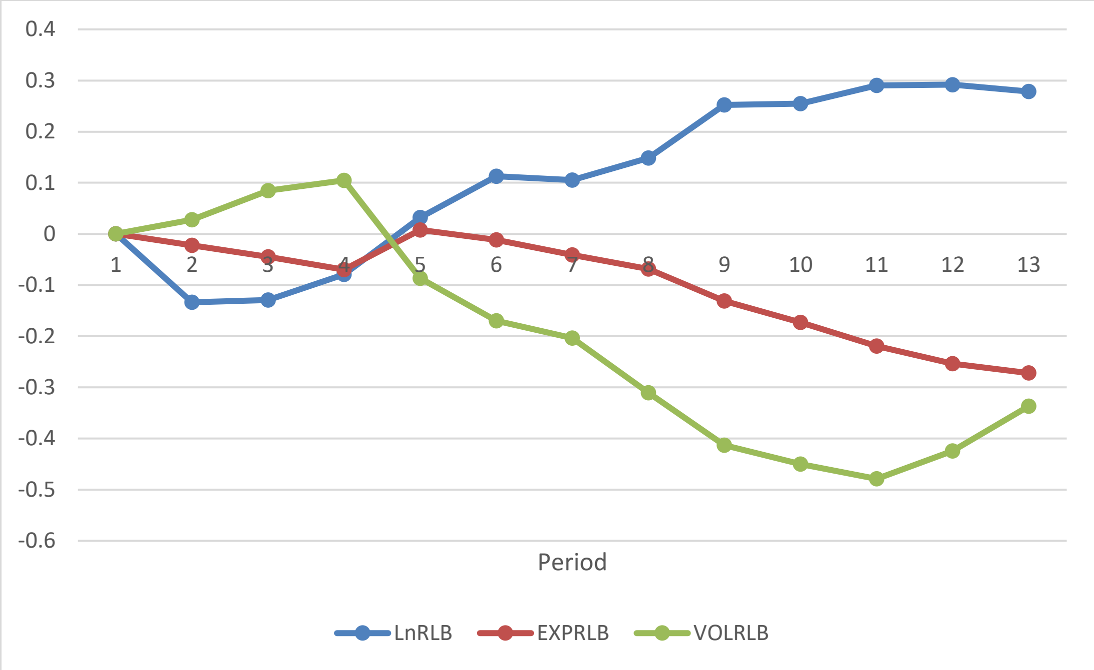

Figure 3.2a: The accumulated responses of GFA to construction cost-related shocks

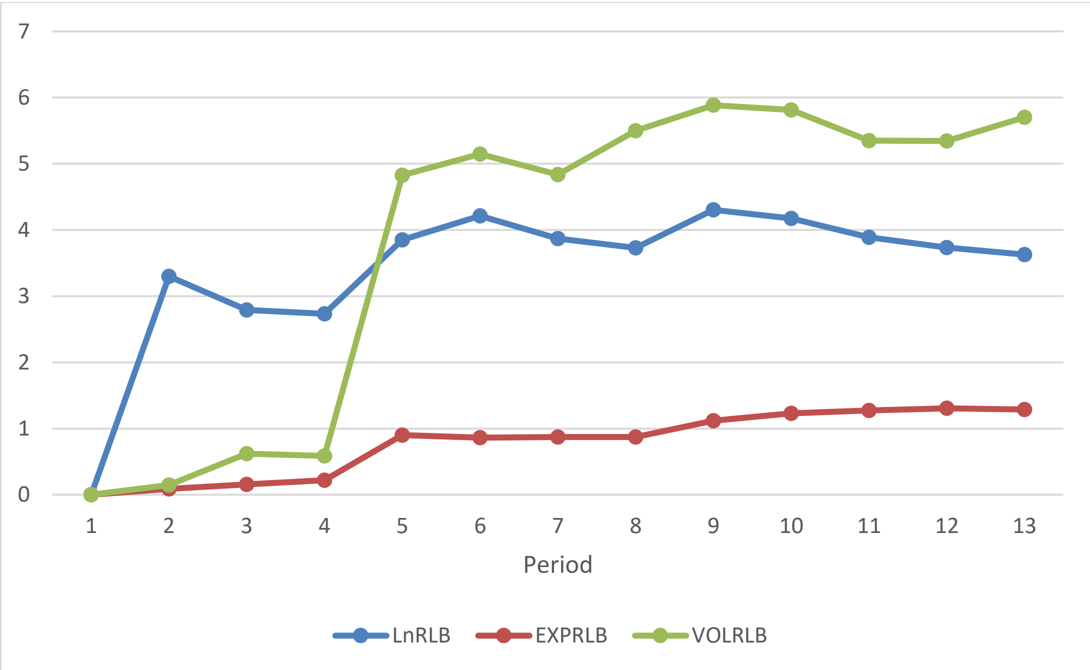

Figure 3.2b: Variance Decomposition analysis (Construction cost) (in %)

3.4.3 Interest Rate Movements

For movements in the Federal Funds Rate (Figure 3.3a), the responses towards its actual movements, its expected growth, and its volatilities differ noticeably. The initial accumulated responses of GFA towards movements in FED itself are negative, suggesting that developers would withhold development as interest rate escalates. But, this lasts for a rather short period of time. As interest rate continues to rise, property developers would commence construction in the medium-run (Periods 5-10), only to withhold development again in the longer-run. In other words, the effect of actual interest rate movements on development timing can be said as far from certain.

The accumulated responses to movements in the expected FED growth are consistently positive, which is consistent with the findings in Amin and Capozza (1991), Capozza and Li (1994; 2001), Heaney and Jones (1986), Ingersoll and Ross (1992), and Williams (1991). By contrast, the accumulated responses to VOLFED are uncertain (i.e. negative in the shorter-run and positive in the longer-run). These findings present some interesting dynamics. First, with the expectation that the Federal Funds Rate (and thus, interest rate owed to the Linked Exchange Rate System) is going to rise, developers would initiate housing construction sooner, despite a higher cost of capital. This is in line with several previous studies (Amin and Capozza, 1991; Capozza and Li, 1994; 2001; Heaney and Jones, 1986; Ingersoll and Ross, 1992; Williams, 1991). Meanwhile, uncertainties in interest rate movements initially lead to the withholding of construction by developers, which is in line with Cunningham (2006; 2007), Holland et al. (2000), Quigg (1993), and Bulan et al. (2009). Considering that real estate development is a lengthy and capital-intensive process, it is almost certain that debt financing (and/or equity financing for listed companies) is involved in raising capital for the projects.

Should developers not be certain as to the changes in interest payment incurred during the construction phase, they are likely to hold off development projects, hence a lower GFA.

Interest rate movements, in general, do not incur impacts as noticeable as movements in property price and in construction cost. Actual adjustments in the Federal Funds Rate are able to explain as much a 3.6% of the variance of GFA. Similar to the findings for construction cost movements, uncertainties in interest rate movements (VOLFED) yield a much higher impact than the expected interest rate changes (Figure 3.3b). While the former can explain as much as 2.6% of the variance of GFA, the latter only manages to contribute to less than 0.6% of GFA's variance.

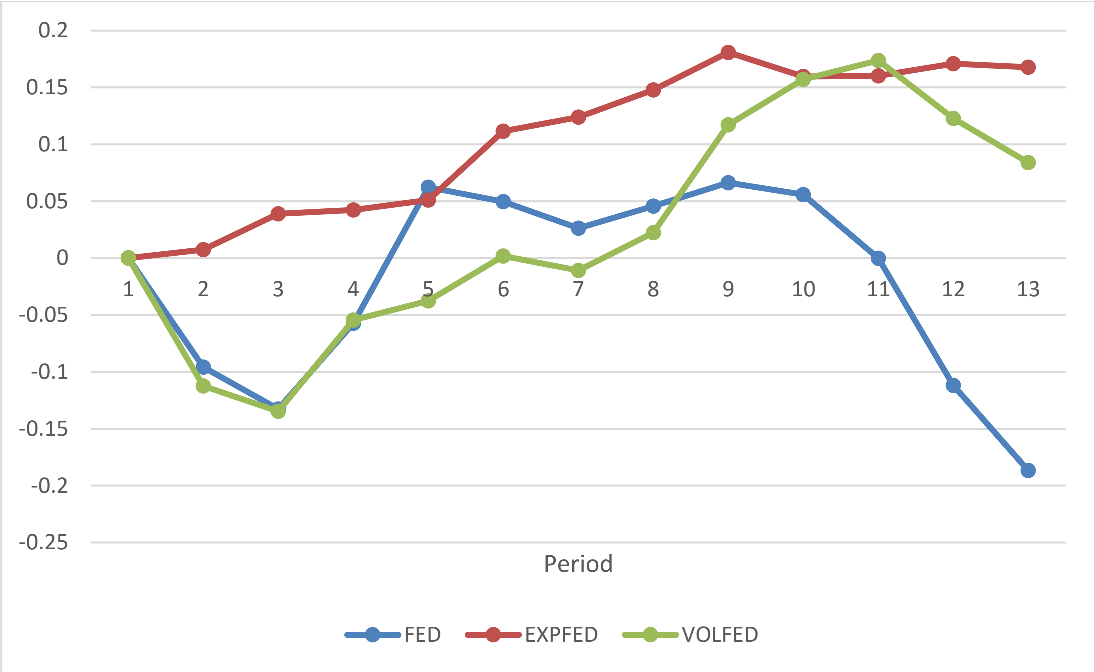

Figure 3.3a: The accumulated responses of GFA to Federal Funds Rate-related shocks

Figure 3.3b: Variance Decomposition analysis (Interest rate) (in %)

3.4.4 Land Supply Factors

Lastly, for the land supply situations (Figure 3.4a), the findings first show that the accumulated responses to exogenous shocks in land supply in the last 12 months (LnLS) are uncertain. Developers tend to initially commence their projects sooner upon the emergence of such shocks (i.e. positive responses), only to withhold development in the longer-run (i.e. negative but unremarkable responses). This finding does appear to support the notion that "higher (residential) land supply causes housing supply to rise", albeit only in the short-run. On the other hand, the fluctuating responses towards land supply movements, if anything, reinforce the notion that the relationship between land supply and housing supply is not as certain as most people perceive (see Lai and Wang, 1999). The reason can be attributed to the concern among developers towards over-construction of housing as a response to the higher land supply in the shorter-run, which exert downward pressure to housing prices when the construction is completed, thereby rendering the projects less attractive than they otherwise should be.

However, the accumulated responses towards exogenous shocks in PERLE are consistently positive. This means that, should a higher proportion of residential land supply comes from the developer-initiated land exchange (rather than from the release of more land sites by the government for sale), the uncertainties in Hong Kong's development control system rise due to delays caused by developers' negotiation with the Lands Department with regard to lease conditions (i.e. the level of development restrictions), in the land exchange process and/or subsequently with the Town Planning Board in the planning control process (rather than the development restrictions themselves as indicated in previous studies; see Aura and Davidoff, 2008; Barlow, 1993; Barker, 2008; Brueckner, 1995; Costello and Rowley, 2010; Glaeser et al., 2008;

Glaeser and Gyourko, 2002; Glaeser and Ward, 2009; Gyourko et al., 2008; Hannah *et al.* 1993; Hui and Ho, 2003; Katz and Rosen, 1987; Malpezzi and Mayo, 1997; Mayo and Sheppard, 1996; 2001; Monk and Whitehead, 1996; Pendall et al. 2006; Peng and Wheaton, 1994; Pollakowski and Wachter, 1990). Nonetheless, even taking these delays and uncertainties into account, the decision for developers to initiate a land exchange application itself indicates that the land site in question is ripe for housing development (see Hui et al., 2014). This is why GFA responds positively to a higher proportion of land supply originated from land exchange.

Viewing the results obtained for these two variables together, it is reasonable to conclude that, should the government sell land at a rate that surpasses the scale of land exchange, LnLS increases yet PERLE (i.e. the percentage of land exchanged in total land supply) falls. Thus, the effects of shocks as a result of the sale of more land by the government will only be positive in the short-run, but not in the longer-run.

Other than the property price-related factors, the two land supply-related variables manage to explain the highest amount of GFA variance (As much as 18% in the early periods; Figure 3.4b). Changes in residential land supply explain a maximum of 11% of the GFA variance, whereas adjustments in the percentage of land exchange in the total residential land supply in the previous 12 months (PERLE) explain around 6.2-8.5% of the variance of GFA after the 3rd period.

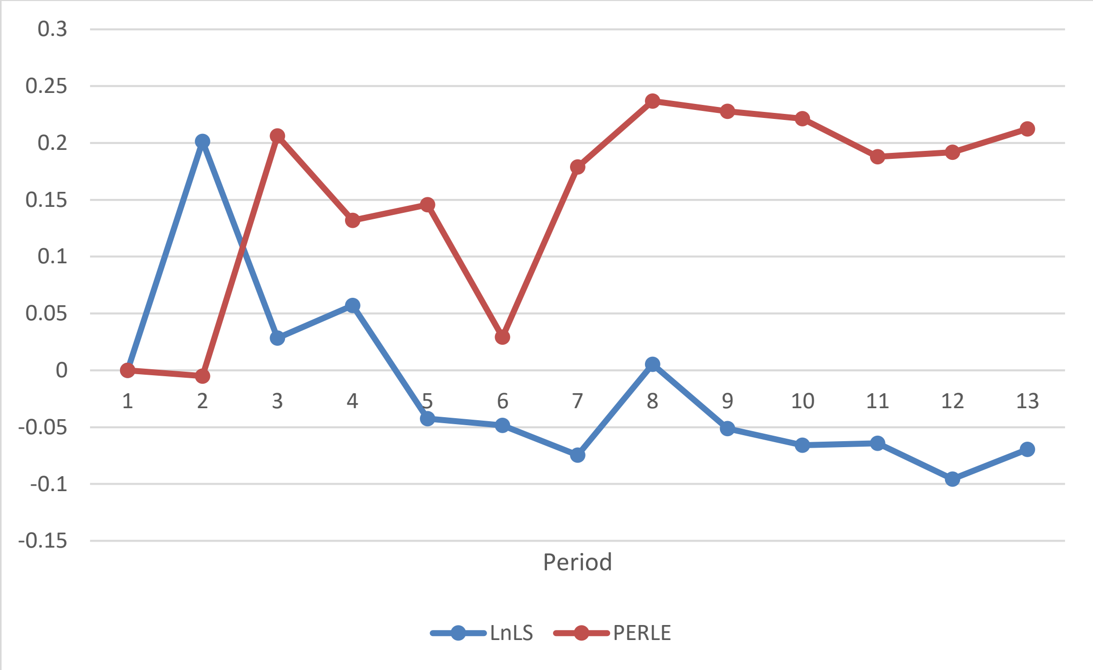

Figure 3.4a: The accumulated responses of GFA to housing supply-related shocks

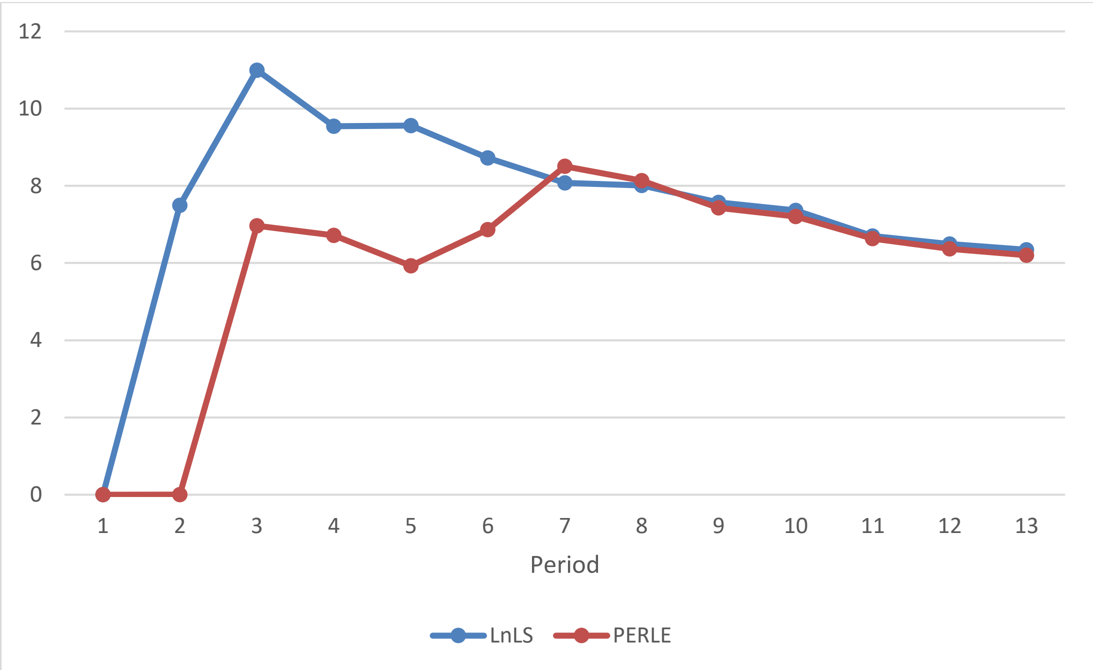

Figure 3.4b: Variance Decomposition analysis (Land supply-related factors) (in %)

To sum up, based upon the findings, it is reasonable to say that the changes in the amount of housing construction to be initiated by property developers in a particular period of time is highly susceptible to 1) actual property price movements, 2) expected property price growth, 3) property price volatilities, 4) total land supply, and 5) the proportion of land exchange in the total residential land supply (i.e. uncertainties of/delays in the development control system); and that the respective impacts of construction cost movements and interest rate movements are at best moderate.

3.5 Conclusion

This chapter has studied how (actual and expected) movements in property price, construction cost, and interest rate (and their corresponding uncertainties), along with Hong Kong's land supply factors, shape developers' decision to initiate housing construction (in terms of GFA). The findings, first, challenge the generally-perceived notion of "higher land supply leads to higher housing supply", in that a higher total residential land supply only triggers housing constructions in the short-run. Interestingly, should a higher proportion of residential land supply be the result of the developer-initiated land exchange rather than the government-initiated land sale, despite the delays (and uncertainties) in the negotiation of lease conditions between property developers and the Lands Department (and in the planning control process if the Town Planning Board's approval is necessary), it results in more housing construction. On the other hand, developers are found to withhold construction as the expected price growth rises, but to begin the construction phase sooner when housing price movements become more volatile. Besides, the findings also illustrate that actual construction cost movements and interest rate movements (and their respective uncertainties) play much bigger roles than their *ex-post* expected movements in explaining the variance of GFA to be constructed.

While this chapter has focused on property developers' decisions as to how much housing space is to be constructed in response to housing market conditions, the next two chapters, instead, are to concentrate on how another major component of the land development process, the Town Planning Board, determines applications submitted by property developers (or individual landowners) for the development of various types of housing, namely:

- Flats and ordinary houses (Chapter 4); and
- New Territories Exempted Houses (more commonly-known as small houses) (Chapter 5)

with reference to soaring housing prices and the government's housing-related policies.

CHAPTER 4: A STUDY OF HONG KONG'S PLANNING CONTROL DECISIONS ON RESIDENTIAL DEVELOPMENT APPLICATIONS

4.1 Introduction

This is the second of the three chapters which focus on how participants in the land development process react to housing market conditions and/or government's housing policy objectives. While how developers decide the amount of housing to be constructed under uncertainties has been studied in Chapter 3, this chapter explores Hong Kong's planning control decision-making for the development of flats and/or ordinary houses.

That an element as crucial as the planning control system is overlooked in housing-related debates can be attributed not only to the technicalities of planning-related legislations (such as the Town Planning Ordinance), but also to a lack of understanding as to how planning control decisions are reached. For the latter, the agency responsible for these decisions, the Town Planning Board (TPB), claims that each application for development is evaluated "via its individual merits". Nevertheless, as how these planning control decisions come about is rather unknown (and thus not necessarily agreeable, as reflected by an increase in the number of judicial review cases filed against the TPB in recent years, concerning the rezoning of greenbelt sites and development restrictions), some researchers (Tang et al., 2000; Tang and Choy, 2000) have even argued that Hong Kong's planning control process resembles a black-box process.

Given Hong Kong's very limited land resources, in order to address the housing needs of Hong Kong residents, land sites in other non-residential land-use zones would inevitably be utilized for housing development, which require the Town Planning Board's permissions. Even though members of the TPB are appointed by the government, the latter of which also acts as the sole owner of all land in Hong Kong, the uncertainties of the planning control system, inevitably, raise some questions with regard to the TPB's planning control decisions (as stated in Section 1.2):

- Are the Town Planning Board's planning control decisions on proposed residential development consistent with the government's stated housing policy objectives (to supply more land sites for housing development through re-zoning non-residential land)?;
- Do the Town Planning Board's planning control decisions on proposed residential development respond to soaring housing price? If so, how?

This chapter, in order to address these questions, intends to examine the planning control decisions made by the TPB on residential development applications (i.e. the construction of housing flats and/or ordinary houses), under Section 16 of the Town Planning Ordinance, in six different statutory land-use zones with the largest amount of planning applications for residential development:

- Residential (Group A) zone [R(A)];
- Residential (Group B) zone [R(B)];
- Residential (Group C) zone [R(C)];
- Government, Institution and Community (GIC) zone;
- Comprehensive Development Area (CDA) zone; and
- Greenbelt (GB) zone

from January 1st 1990 to April 30th 2017.

The findings of this study can contribute to the land-use planning literature, by shedding light on the decision-making of planning authorities concerning residential development in a variety of land-use zones under different conditions, subject to a system that is partly regulatory and partly discretionary, and how they weight between certainty and flexibility in their decisions against the vastly different original objectives of these three zones. To be more specific, which zone's original objectives are more likely to be compromised due to development pressure?

After this introduction section, a description of Hong Kong's development control system (and of the six statutory land-use zones selected for this study) is to be first described (Sections 4.2 & 4.3), followed by a review of relevant literature (Section 4.4). Then, a presentation of the research methodology and data is to be shown in Section 4.5, and the empirical findings are reported in Section 4.6. The final section of this chapter concludes the study and discusses the policy implications.

4.2 Hong Kong's Planning Control System

Hong Kong's planning control system is unique, compared to that of other nations, in that it is a hybrid of a regulatory planning control system and a discretionary planning control system (Booth, 1996).

On the one hand, there are three types of regulatory control in Hong Kong's land development. First, Hong Kong, unlike many other countries, is under a leasehold system, meaning that the government is the sole owner of all land in Hong Kong; and what property developers are able to obtain via public auction or tender in a land sale exercise is only the leasehold rights of land sites, which are decided by the government.

Besides, property developers (or landowners) are required to abide by regulations as set out in the *Hong Kong Planning Standards and Guidelines* with reference to a development's densities (including plot ratio, site coverage, and building height; see Tables 4.1-4.4]). Further, under the Town Planning Ordinance, statutory outline zoning plans (OZP) for different districts across Hong Kong, which dictate how land sites should be used.

<table>
<tr><th>Density Zone</th><th>Type of Area</th><th>Location</th><th>Maximum Plot Ratio</th></tr>
<tr><td rowspan="4">R1</td><td rowspan="3">Existing Development Area</td><td>Hong Kong Island</td><td>8/9/10</td></tr>
<tr><td>Kowloon & New Kowloon</td><td>7.5</td></tr>
<tr><td>Tsuen Wan, Kwai Chung & Tsing Yi</td><td>8</td></tr>
<tr><td colspan="2">New Development Area and Comprehensive Development Area</td><td>6.5</td></tr>
<tr><td colspan="3">R2</td><td>5</td></tr>
<tr><td colspan="3">R3</td><td>3</td></tr>
</table>

Table 4.1: Maximum Domestic Plot Ratios - Metroplan Area
Source: Planning Department

Residential density zone	Maximum domestic plot ratio
R1	8.0
R2	5.0
R3	3.0
R4	0.4

Table 4.2: Maximum Domestic Plot Ratios - New Towns (excluding Tsuen Wan)
Source: Planning Department

Density zone	Maximum domestic plot ratio	Maximum development site ratio	Typical total number of storeys	Locational criteria
RR1	3.6	-	12	Commercial centres of Rural Townships
RR2	2.1	-	6	Areas within Rural Townships lying outside the commercial centre, and in other significant rural development areas served by medium capacity public transport, such as light rail systems.
RR3	-	0.75	3 over car port	Peripheral parts of Rural Townships or other rural development areas, or in locations away from existing settlements but with adequate infrastructure and no major landscape or environmental constraints.
RR4	-	0.4	3 including car port	Similar locations to RR3 but where development intensity is restricted by infrastructure or landscape constraints.
RR5	-	0.2	2 over car port	Replacements for temporary structures in areas requiring upgrading.
Village	3.0	-	3	Within the defined envelope of recognized traditional villages.

Table 4.3: Maximum Domestic Plot Ratios - Rural Areas
Source: Planning Department

Height of building (in metres)	**Maximum site coverage (%)**			**Maximum plot ratio**		
	Class A Site	Class B Site	Class C Site	Class A Site	Class B Site	Class C Site
up to 15	66.6	75	80	3.3	3.75	4.0
up to 18	60	67	72	3.6	4.0	4.3
up to 21	56	62	67	3.9	4.3	4.7
up to 24	52	58	63	4.2	4.6	5.0
up to 27	49	55	59	4.4	4.9	5.3
up to 30	46	52	55	4.6	5.2	5.5
up to 36	42	47.5	50	5.0	5.7	6.0
up to 43	39	44	47	5.4	6.1	6.5
up to 49	37	41	44	5.9	6.5	7.0
up to 55	35	39	42	6.3	7.0	7.5
up to 61	34	38	41	6.8	7.6	8.0
over 61	33.33	37.5	40	8.0	9.0	10.0

Table 4.4: Maximum Permitted Site Coverage and Plot Ratio in Relation to Building Height for Residential Buildings under First Schedule of B(P)R
Source: Planning Department

On the other hand, one critical element in Hong Kong's planning control system resembles a discretionary planning control system. With the expressed intention to accomplish a balance between certainty and flexibility, two columns of land uses are available for each statutory land-use zone in each OZP. Column 1 consists of uses that are always permitted and Column 2 includes uses permissible upon planning applications under Section 16 of the Town Planning Ordinance by property developers/landowners.

Though allowing for a higher degree of flexibility than regulatory-only systems, this "hybrid" development control system unavoidably results in subjective interpretations of planning regulations by the TPB, hence uncertain planning control decisions (see Mayo and Sheppard, 2001). This, in turn, has implications for property developers' development strategies and, thus, to the eventual amount of housing supply.

4.3 Description of the Six Statutory Land-use Zones

4.3.1 R(A), R(B), and R(C) zones

There are a total of five residential statutory zones in Hong Kong: Residential (Group A) [R(A)], Residential (Group B) [R(B)], Residential (Group C) [R(C)], Residential (Group D), and Residential (Group E) zones. This study concentrates on the first three, as 1) flat/house development is not a Column 1 use in R(D) zone and in R(E) zone; and 2) the amount of applications for residential development in these two zones are much fewer than the other three residential zones.

Of the three residential land-use zones in which proposed residential development is always allowed, the R(A) zone is designated for high-density residential developments. Commercial uses, should they be on the lowest three floors of a building or within the non-residential section of an existing building, are always permitted. Otherwise, the owner of the land site in question is required to submit a planning application, under Section 16 of the Town Planning Ordinance, for the approval of the TPB.

Meanwhile, the R(B) zone is designated generally for medium-density housing developments. Unlike the high-density R(A) zone, approval by the TPB is necessary for any proposed commercial uses in this statutory land-use zone.

Lastly, the R(C) zone is designated for housing development which is both low-rise and low-density. Similar to the R(B) zone, any proposed commercial uses also require the submission of a planning application for the permission of the TPB. The respective Column 1 uses and Column 2 uses of these three residential land-use zones are listed in Tables 4.5 & 4.6 below.

<table>
<tr><th colspan="3">Column 1 -- Uses Always Permitted</th></tr>
<tr><th>R(A) Zone</th><th>R(B) Zone</th><th>R(C) Zone</th></tr>
<tr><td>Ambulance Depot</td><td></td><td></td></tr>
<tr><td colspan="3">Flat</td></tr>
<tr><td>Government Use (not elsewhere specified)</td><td colspan="2">Government Use
(Police Reporting Centre, Post Office only)</td></tr>
<tr><td colspan="3">House</td></tr>
<tr><td colspan="2">Library</td><td></td></tr>
<tr><td>Market</td><td></td><td></td></tr>
<tr><td>Place of Recreation, Sports or Culture</td><td></td><td></td></tr>
<tr><td>Public Clinic</td><td></td><td></td></tr>
<tr><td>Public Transport Terminus or Station (excluding open-air terminus or station)</td><td></td><td></td></tr>
<tr><td>Religious Institution</td><td></td><td></td></tr>
<tr><td>Residential Institution (Ancestral Hall only)</td><td>Residential Institution</td><td></td></tr>
<tr><td>Rural Committee/Village Office</td><td></td><td></td></tr>
<tr><td colspan="2">School (in free-standing purpose-designed building only)</td><td></td></tr>
<tr><td>Social Welfare Facility</td><td></td><td></td></tr>
<tr><td colspan="3">Utility Installation for Private Project</td></tr>
</table>

Table 4.5: Column 1 Uses for R(A), R(B), and R(C) zones
Source: Town Planning Board

<table>
<tr><th colspan="3">Column 2 -- Uses that may be permitted with or without conditions on application to the Town Planning Board</th></tr>
<tr><th>R(A) Zone</th><th>R(B) Zone</th><th>R(C) Zone</th></tr>
<tr><td>Commercial Bathhouse/Massage Establishment</td><td></td><td></td></tr>
<tr><td></td><td colspan="2">Ambulance Depot</td></tr>
<tr><td colspan="3">Eating Place</td></tr>
<tr><td colspan="3">Educational Institution</td></tr>
<tr><td colspan="3">Government Refuse Collection</td></tr>
<tr><td>Exhibition or Convention Hall</td><td></td><td></td></tr>
<tr><td></td><td colspan="2">Government Use (not elsewhere specified)</td></tr>
<tr><td colspan="3">Hospital</td></tr>
<tr><td colspan="3">Hotel</td></tr>
<tr><td colspan="3">Institutional Use</td></tr>
<tr><td colspan="3">Mass Transit Railway Vent Shaft and/or Other Structure above Ground Level other than Entrances</td></tr>
<tr><td colspan="2">Office</td><td></td></tr>
<tr><td></td><td></td><td>Library</td></tr>
<tr><td></td><td>Market</td><td></td></tr>
<tr><td></td><td>Off-course Betting Centre</td><td></td></tr>
<tr><td colspan="3">Petrol Filling Station</td></tr>
<tr><td colspan="2">Place of Entertainment</td><td></td></tr>
<tr><td></td><td colspan="2">Place of Recreation, Sports or Culture</td></tr>
<tr><td colspan="3">Private Club</td></tr>
<tr><td colspan="3">Public Convenience</td></tr>
<tr><td></td><td colspan="2">Public Clinic</td></tr>
<tr><td>Public Transport Terminus or Station (not elsewhere specified)</td><td colspan="2">Public Transport Terminus or Station</td></tr>
<tr><td colspan="3">Public Utility Installation</td></tr>
<tr><td colspan="3">Public Vehicle Park</td></tr>
<tr><td></td><td colspan="2">Recyclable Collection Centre</td></tr>
<tr><td>Religious Institution (not elsewhere specified)</td><td colspan="2">Religious Institution</td></tr>
<tr><td></td><td></td><td>Residential Institution</td></tr>
<tr><td></td><td colspan="2">Rural Committee/Village Office</td></tr>
<tr><td colspan="2">School (not elsewhere specified)</td><td>School</td></tr>
<tr><td colspan="3">Shop and Services</td></tr>
<tr><td></td><td colspan="2">Social Welfare Facility</td></tr>
<tr><td colspan="3">Training Centre</td></tr>
</table>

Table 4.6: Column 2 Uses for R(A), R(B), and R(C) zones
Source: Town Planning Board

4.3.2 Government, Institution or Community (GIC) Zones

According to the Town Planning Board (2016a), land sites are designated as GIC sites either to reflect GIC uses that are already in place or to reserve them for the provision of GIC facilities to meet the community needs in the future. Sometimes, land sites are also zoned as GIC for the provision of "breathing space" in a high-rise, high-density environment.

Even though the provision of GIC facilities and/or public open spaces, as a major component of a proposed development, is prioritized by the TPB, it does not mean that GIC sites cannot be developed for primarily non-GIC uses. Rather, unless the proposed development compromises the operation of GIC facilities in the area or postpones the implementation of planned GIC facilities, non-GIC development, for instance residential development, on GIC sites is permissible upon application under Section 16 of the Town Planning Ordinance, given that 1) the site in question is not required for provision of GIC facilities; 2) the provision of GIC facilities in the area is deemed sufficient; and 3) the proposed development does not adversely affect an area's townscape. In fact, in addition to the 30 Column 1 uses (Table 4.7), there are 29 non-GIC land uses that are permissible in GIC zone upon the TPB's approval (Table 4.8).

4.3.3 Comprehensive Development Area (CDA) Zones

Introduced into the OZPs in 1976, the primary objectives for CDA zone are to:

- Facilitate the renewal of older urban areas;
- Restructure old industrial areas;
- Eliminate non-conforming land uses (for instance, open storage use in rural areas); optimize the development potential through the integration of sites

(under different uses and with different road patterns);

- Accomplish coordinated development in areas i) restrained in traffic, environmental, and infrastructure capacity and ii) having incompatible land-use issues;
- Provide sufficient GIC facilities, public transportation facilities, parking facilities, and open space; and
- Control the overall scale and design of development in areas with high landscape/amenity values and in historically significant locations (Town Planning Board, 2016b).

In addition to these objectives, CDA use is also designated for sites intended for development under the Urban Renewal Authority Development Scheme or Hong Kong Housing Society's (HKHS) urban improvement Scheme, with the aim to ensure optimum comprehensive redevelopment and urban restructuring through the prevention of piecemeal development or redevelopment.

Three elements distinguish CDA sites from GIC/GB sites. The first element is the compulsory submission of a Master Layout Plan (MLP), based upon the broad planning parameters and development requirements set out in the Planning Brief for individual sites designated as "CDA", in a development application, as decreed in section 4A(2) of the Town Planning Ordinance. Even though excessive details are not encouraged by the TPB due to lack of flexibility for subsequent minor changes, a MLP (Town Planning Board, 2003) should include information in two major categories, such as:

- The location of the site in question and the development's general layout (in aspects such as number of building blocks, building heights/number of storeys, locations of i) proposed main land-uses, ii) parking facilities, iii) loading/unloading facilities, iv) GIC, recreational, public transport facilities, v) ancillary major utility installations, and vi) open space and pedestrian circulation facilities, layout of internal roads including emergency vehicular access (EVA), allocation of non-building areas, the phasing of development, and a master landscape plan; and

- A development schedule detailing the site area, gross floor area (GFA), residential accommodation (if any), commercial accommodation (if any), provision of GIC, recreation and open space facilities, provision of parking and loading/unloading facilities, provision of public transportation facilities, a development programme with the proposed phasing of the development (and their respective timing), design population and schedule of population intake.

According to the two reviews conducted on CDA sites by the Town Planning Board (2015a; 2015b), by the end of March 2015, there were a total of 132 CDA sites in Hong Kong, including 64 in the Metro Area (i.e. Hong Kong Island and Kowloon Peninsula) and 68 in the New Territories. 50 (or 37.9%) of these sites, however, remained undeveloped as they did not have an approved MLP.

The second element is that, unlike GIC and GB zones, there are no Column 1 uses for CDA zone (see Table 5). Instead, a total of 36 land uses are listed as Column 2 uses for CDA zone, 7 more than the amount of permissible land uses for GIC zone and GB zone (Table 4.8). It should be noted, however, that these Column 2 uses can be added or deleted in accordance with *an individual site's planning intention* determined by the TPB.

Lastly, the third element that separates CDA zone from GIC/GB zones concerns the way in which land sites are obtained. According to Lai et al. (2016), a development project in non-CDA zones normally commences as developers purchase land sites from the government (with pre-determined lease conditions) through public auction or tender. By contrast, a development project in CDA zone begins as developers acquire (and assemble) land parcels from other private landowners. In case the proposed use (in this case, residential) is not permissible under the original government lease(s) of these land parcels, developers are required to apply for lease modification (and pay a premium accordingly).

4.3.4 Greenbelt (GB) Zone

Officially, the aim of GB zone, which generally covers slopes and hillsides, is "primarily to promote the conservation of the natural environment and to safeguard it from encroachment by urban-type developments (Town Planning Board, 1991)." Thus, there is a general presumption against development in areas designated as such.

According to several researchers (see Lai, 1999; Tang et al., 2005; Tang, et al., 2007), the reason greenbelt zone exists in Hong Kong is largely due to the 1948 *Abercrombie Report*, in which the Colonial government was recommended to devise relevant policies to conserve the countryside. The *Talbot Report* (Talbot and Talbot, 1965), which suggests that the classification and conversation of the countryside can be accomplished by means of zoning, reinforces this stance.

Yet, as Hong Kong has very limited (developable) land resources, what actual purpose(s) does GB zone serve in the territory? And are greenbelt policies being implemented as stringently in Hong Kong as they are in other countries? It is reported in Tang et al. (2005) and in Tang et al. (2007) that GB zone was actually incorporated as early as the 1960s, and that the intention for GB zone to be passive recreation outlets has always been stated in the statutory plans. It was until the 1990s that the notion of designating GB zones specifically for conservation purpose came about. This purpose was then officially endorsed in the 1991 Town Planning Ordinance. Nevertheless, unlike South Korea (Gibson, 1999), GB sites in Hong Kong are far from development-free (Home, 1997), given the amount of land uses which are either always permitted (as Column 1 use) or permissible upon the Town Planning Board's approval (Tables 4.7 and 4.8), especially when there exist development pressures. A major reason, according to Tang et al. (2005), is that Hong Kong's GB sites are too scattered and unevenly distributed to serve as an actual spatial "buffer" to curb urban encroachment/sprawl. Also, the greenbelt policy is found to have been carried out differently across districts. In accordance with Tang et al. (2007), this policy has been implemented more leniently in regions such as the Metropolitan Area (i.e. Hong Kong and Kowloon Peninsula) and South West New Territories than in the rest of the New Territories. These findings, if anything, indicate that the greenbelt policy in Hong Kong is both flexible and ambiguous; and that land use in GB zone is highly subject to other policy needs.

Column 1 -- Uses Always Permitted		
GIC	**CDA**	**GB**
Ambulance Depot		Agricultural Use
Animal Quarantine Centre (in Government building only)		Barbecue Spot
Broadcasting, Television and/or Film Studio		Country Park
Cable Car Route and Terminal Building		Government Use (Police Reporting Centre only)
Eating Place (Canteen, Cooked Food Centre only)		Nature Reserve
Educational Institution		Nature Trail
Exhibition or Convention Hall		On-Farm Domestic Structure
Field Study/Education/Visitor Centre		Picnic Area
Government Refuse Collection Point		Public Convenience
Government Use (not elsewhere specified)		Tent Camping Ground
Hospital		Wild Animals Protection Area
Institutional Use		
Library		
Market		
Pier		
Place of Recreation, Sports or Culture		
Public Clinic		
Public Convenience		
Public Transport Terminus or Station		
Public Utility Installation		
Public Vehicle Park		
Recyclable Collection Centre		
Religious Institution		
Research, Design and Development Centre		
Rural Committee/Village Office		
School		
Service Reservoir		
Social Welfare Facility		
Training Centre		
Wholesale Trade		
Total Number of Land Uses Within Column 1		
30	**0**	**11**

Table 4.7: Column 1 Uses for GIC, CDA, and GB zones
Source: Town Planning Board

Column 2 -- Uses that may be permitted with/or without conditions on application to the Town Planning Board			
Land Use/Statutory Zone	**GIC**	**CDA**	**GB**
Ambulance Depot		✓	
Animal Boarding Establishment	✓		✓
Animal Quarantine Centre (not elsewhere specified)	✓		
Broadcasting, Television and/or Film Studio			✓
Burial Ground			✓
Cable Car Route and Terminal Building			✓
Commercial Bathhouse/Massage Establishment		✓	
Columbarium	✓		✓*
Correctional Institution	✓		
Crematorium	✓		✓*
Driving School	✓		
Eating Place	✓	✓	
Educational Institution		✓	
Exhibition of Conventional Hall		✓	
Field Study/Education/Visitor Centre			✓
Firing Range	✓		✓
Flat	✓	✓	✓
Funeral Facility	✓		
Golf Course			✓
Government Refuse Collection Point		✓	✓
Government Use (not elsewhere specified)		✓	✓
Helicopter Landing Pad	✓		✓
Helicopter Fueling Station	✓		
Holiday Camp	✓		✓
Hospital		✓	
Hotel	✓	✓	
House	✓	✓	✓
Information Technology and Telecommunications Industries		✓	
Institutional Use (not elsewhere specified)		✓	
Library		✓	
Market		✓	
Marina			✓
Marine Fueling Station	✓		
Mass Transit Railway Vent Shaft and/or Other Structure above Ground Level other than Entrances	✓	✓	✓
Marine Fueling Station			✓
Off-course Betting Centre	✓	✓	
Office	✓	✓	
Petrol Filling Station	✓	✓	✓

Pier		✓	✓
Place of Entertainment	✓	✓	
Place of Recreation, Sports or Culture		✓	✓
Private Club	✓	✓	
Public Clinic		✓	
Public Convenience		✓	
Public Transport Terminus or Station		✓	✓
Public Utility Installation		✓	✓
Public Vehicle Park		✓	✓
Rader, Telecommunications Electronic Microwave Repeater, Television and/or Radio Transmitter Installation	✓		✓
Refuse Disposal Installation (Refuse Transfer Station only)	✓		
Recyclable Collection Centre		✓	
Religious Institution		✓	✓
Research, Design and Development Centre		✓	
Residential Institution	✓	✓	✓
Rural Committee/Village Office			✓
Sewage Treatment/Screening Plant	✓		
Shop and Services	✓	✓	
School			✓
Social Welfare Facility		✓	
Training Centre		✓	
Utility Installation for Private Project	✓	✓	
Zoo	✓		
Total Number of Uses in Column 2	**29**	**36**	**29**

Table 4.8: Column 2 Uses for GIC, CDA, and GB zones
Note: * within a Religious Institution or extension of existing Columbarium only
Source: Town Planning Board

4.4 Literature Review

4.4.1 Government Controls in Land Development

Owed to (adverse) externalities[43] incurred in the land development process, many governments deploy development controls with the aim to preserve the natural environment and to prevent uncontrolled development, such as urban sprawl (White and Allmendinger, 2003). Planning authorities allocate the rights of

[43] Five types of social costs which, in accordance with Malpezzi (1996), that make it necessary for governments to intervene in order to correct the externalities caused are 1) Congestion, 2) Environmental costs, 3) Infrastructure costs, 4) Fiscal effects, and 5) Neighbourhood composition costs.

development/redevelopment via non-price means (see Fischel, 1985; Lai, 1997; Tang and Tang, 1999), for the promotion of public interests, the redistribution of public costs and benefits, the elimination of negative externalities, and the improvement of the information base for decision making (Klosterman, 1996). Two distinctively different types of planning control systems are usually utilized: 1) A regulatory system and 2) A discretionary system.

The former, by separating incompatible land uses, supposedly minimizes the effect of latent adverse externalities incurred (Pogodzinski and Sass, 1991). Under this system, the approval or rejection of applications for land development is based upon a set of legally-binding land-use zoning regulations. Owed to such stringent attachment to these regulations, development control decisions are therefore perceived as both certain and predictable. However, according to Gielen and Tasan-kok (2010), these decisions do not make room for negotiations with regard to other arrangements involved in proposed developments between planning authorities and developers/landowners.

By contrast, the latter is a "strategic-level structure plan within which are a number of local/unitary development plans which translate and interpret strategic policy into site-specific allocations for land" (Adams and Watkins, 2002, p. 97). Unlike the regulatory system, these development plans, usually implemented on a national level (Cullingworth, 1997), are merely referred to as references and/or guidelines. In other words, the planning permission process is more discretionary and flexible, which makes negotiations between planning authorities and developers/landowners possible. Such flexibility, however, comes at a cost, as subjective interpretations of the guidelines articulated in the development plans result in less certain and less predictable outcomes.

This, in turn, leads to higher development cost and higher transaction cost in the development process (Staley, 1994; Chen et al., 1996; Lai and Ho, 2002; Wong et al., 2011), which has implications for the amount of investment in land development (Cunningham, 2006; 2007; Holland et al., 2000; Quigg, 1993; Bulan et al., 2009). Besides, the planning approval process can also be susceptible to political concerns (Gielen and Tasan-Kok, 2010).

Previous researches have studied planning control decisions from a number of perspectives, such as:

- Assessing how effectiveness development control is at least minimizing negative externalities (Lai, 1994);
- Evaluating the behaviour(s) of those involved in the land market (otherwise known as "development pressures" studies, see Anderson, 1981; Blacksell and Gilg, 1977; Brotherton, 1982; Underwood, 1981);
- The relationship between land-use planning restrictions and transaction costs (Staley, 1994; 2000);
- The relationship between land-use zoning restrictions and property prices (Hui, 2001; 2002; 2003; 2004; Hui and Ho, 2003); and
- Examining these decisions with reference to the consistency in the planning authorities' decision-making and to rent-seeking behaviours by special interest groups (Benson, 1984; Gifford, 1987; Mills, 1989; Tullock, 1993; 1994).

For builders and developers alike, how these planning control decisions are made naturally become the question to ask. In response, many researchers in the Land Economics and Urban Planning disciplines have studied this matter in a variety of perspectives, proffering valuable knowledge in the process.

4.4.2 Research Areas in Planning Control Decisions

The first two primary research areas with respect of planning control are related to the assessment of the effectiveness of planning control on at least reducing negative externalities, if not removing them altogether (Lai, 1994), and the so-called "development pressures" studies in which the behaviour(s) of parties involved in the land market are evaluated (Anderson, 1981; Blacksell and Gilg, 1977; Brotherton, 1982; Underwood, 1981). The third study area concerns either transaction costs (Staley, 1994; 2000) or property prices (Hui, 2001; 2002; 2003; 2004; Hui and Ho, 2003) are affected as a result of land-use planning restrictions. The fourth and last research area focuses on the planning authorities' behaviours in terms of the consistency in their decision making and rent-seeking behaviours (Benson, 1984; Gifford, 1987; Mills, 1989; Tullock, 1993; 1994). For the latter, the political economy theory of development control in Gilg and Kelly (1996) and Kelly and Gilg (2000), points out that societies are developed and structured in a way that only a tiny number of groups, for instance those with more financial resources, have easier access to power than others (Rydin, 1985; 1988; Pacione, 1990; 1991; Short et al., 1986). Such access gives rise to rent-seeking behaviours, due to preferential treatments on the part of the planning authorities. To put it differently, development control decisions, as a result of lobbying efforts by some entities (for instance, by rural land-owners in Gilg and Kelly [1996; 1997]), are found to be inconsistent as they appear to lean towards the interests of these entities. Such inconsistencies, thus, further result in higher uncertainties in the land development process.

4.4.3 Evolvement of Research Methods

In the early days of the research of planning control decision making, qualitative analysis or case studies had usually been depended on (for a more detailed discussion, see Lai and Ho, 2001). Afterwards, the use of aggregate data (i.e. planning statistics) had become commonplace. Nevertheless, some researchers have raised concerns about the limitations of aggregate planning statistics in studying development control decisions. Two particular issues stand out: 1) the research methodology is aggregated in nature and 2) it is difficult to provide interpretations for findings, based upon individual cases (with their own unique elements), that can be generalized enough to be applicable to a wider context (Brotherton, 1984; 1992a; 1992b; Buller and Hoggart, 1985; Kelly & Gilg, 2000; Larkham, 1986; 1988; 1990, McNamara and Healey, 1984; Preece, 1990; Sellgren, 1990). Besides, aggregate planning data does not provide sufficient information to understand the complex decision-making processes and the unique circumstances in these applications (Murray, 1987).

With the development of advanced econometric methods in the 1980s and 1990s, the study of planning control decisions has turned to another direction. Rather than using aggregate planning data, non-aggregate planning data has been used instead with the assistance of statistical analyses (see Brotherton, 1982, 1992a, 1992b; Buller and Hoggart, 1985; Larkham, 1986, 1988; McNamara and Healey, 1984; Sellgren, 1990). The further development of these econometric methods, by the mid-1990s, allows for statistical investigations of development control decisions with discrete choice models (Willis, 1995; Bramley et al., 1995). These two studies, hence, provide the methodological foundations for numerous studies on the Town Planning Board's planning control decisions on various land-uses in different statutory zones.

Of these studies, some do report that political concerns are taken into consideration in the TPB's planning control decisions. Lai and Ho (2001a) study the TPB's decisions for planning applications in three residential zones [R(A), R(B), and R(C)], and find that these decisions (for R(B) and R(C) zones) are sensitive to exogenous government policies that aim to increase housing supply (also see Tang et al., 2005). In the authors' two other studies on greenbelt zone (Lai and Ho, 2001b; 2001c), planning control decisions correspond to the Small House policy, established to cater to the interests of male indigenous villagers in the New Territories, which is currently protected under Article 40 of the Basic Law (also see Tang et al., 2007). On the other hand, the planning authorities tend to discriminate against large-scale developments in both R(A) zone and Greenbelt zone, which suggests that lobbying by prominent property developers does not appear to play a role in influencing the eventual decisions for these zones by the Town Planning Board.

In some other studies, however, it is market conditions, rather than political concerns, which affect the TPB's planning control decisions. Tang and Choy (2000) and Tang et al. (2000) assess applications for commercial-office development on Hong Kong Island and in Kowloon, and find that the TPB also takes market conditions of the office sector (i.e. supply of office space) at the time into account in their planning control decisions, perceived by the authors to regulate the commercial office market. In addition, the rise and fall of the manufacturing sector (in terms of labour share) is also considered by the TPB to evaluate applications for industrial-office use or office-only use in industrial zones (Lai and Ho, 2002a).

However, it is not always the case that political considerations and/or market conditions are being accounted for in the TPB's planning control decisions. In a study of applications for open container storages in Open Storage (OS) zones, Lai and Ho (2002b) report that the Town Planning Board's decisions are subject to the conditions in the container industry. The authors attribute this finding to the lack of a powerful lobby representing the interest of the container industry.

Having discussed the relevant literature, in the following section, the research method used for the analysis of the Town Planning Board's planning control decisions, the variables included in the model(s), and the data sample are to be presented.

4.5 Research Methodology & Data

4.5.1 The Model

A discrete choice model is to be utilized to regress the planning control decisions made by the Town Planning Board on applications for residential development under Section 16 of the Town Planning Ordinance (as the dependent variable, Y) on selected explanatory variables. The dependent variable takes the binary form of either approval with or without conditions ("1") or rejection ("0").

Presenting the above in probabilistic expressions, the probability of a planning application to be approved by the TPB (i.e. Y = 1) is:

$$\text{Prob}(Y = 1|\text{x}) = F(\text{x}, \beta)$$

where β represents the effect of changes in the explanatory variables (x) on the probability. The probability of a planning application to be rejected by the TPB (i.e. Y

= 0), by contrast, is expressed as follows:

$$\text{Prob}(Y = 0|\text{x}) = 1 - F(\text{x}, \beta)$$

As the right-hand size of the formula is essentially a regression model, this means that there is an error term (ε) accompanying the explanatory variables. The next item to be determined is the distribution of this error term. In the econometrics literature (see Greene, 2012), ε is generally under either logistic distribution or normal distribution. Both distributions are believed to be symmetric, in that:

$$\text{Prob}(y^* > 0|\text{x}) = \text{Prob}(\varepsilon < \text{x}'\beta|\text{x}) = F(\text{x}'\beta)$$

where *F(t)* is the cumulative distribution function (cdf) of the random variable ε. Assuming symmetric distributions for the error term, it is expected that:

$$\lim_{\text{x}'\beta \to +\infty} \text{Prob}(\text{Y} = 1|\text{x}) = 1; \text{ and } \lim_{\text{x}'\beta \to -\infty} \text{Prob}(\text{Y} = 1|\text{x}) = 0$$

The probit (logit) model is based upon the normal (logistic) distribution of ε. Both models have been employed in previous studies on development control decisions that rely on non-aggregate planning data. In this study, the probit model, which takes the following form, is to be deployed.

$$\text{Prob}(Y = 1|\text{x}) = \int_{-\infty}^{x'\beta} \Phi(t)dt = \Phi(\text{x}, \beta)$$

in which *Φ(t)* denotes the standard normal distribution function.

From a practical standpoint, a positive coefficient (β) for an explanatory variable indicates that the higher it is, the high probability a planning application is approved, holding other variables constant; whereas a negative coefficient suggests a higher probability for an application to be rejected should the explanatory variable in question be larger.

4.5.2 The Selected Variables

Five groups of variables are to be included in the probit models, including: Site-specific variables (SS); Application-specific variables (APPS); Zoning-specific variables (ZS); Location-specific variables (LS); and Exogenous variables (EXO). In functional form, an application's probability to be approved by the Town Planning Board can be articulated as the following:

$$\mathrm{Y} = f(SS, APPS, ZS, LS, EXO)$$

The following sections provide a description of these explanatory variables.

4.5.1.1 Site-specific variables

Five site-specific variables are introduced in the discrete choice models. In light of the question raised in the beginning of this chapter as to whether or not the TPB's planning control decisions are skewed towards the interests of large property developers (which makes rent-seeking behaviours possible), the scale of the proposed residential development is thus essential. Similar to several previous studies (Lai and Ho, 2001a; Tang et al., 2000), two different sets of indicators that represent the scale of a development are considered in separate models. In Model 1, the Gross Site Area (GSA) (see Tang and Tang, 1999; Tang and Choy, 2000; Lai and Ho, 2002b) and the development's proposed plot ratio (PLOT), are included. Whereas, in Model 2, a single variable, the Gross Floor Area (GFA) (see for instance, Lai and Ho, 2001a; 2001b; 2001c; 2001d; 2002a; Tang and Choy, 2000), which equals GSA times PLOT, is chosen instead.

Besides the scale of the proposed development, another site-specific variable to be included concerns the number of previous applications for development on the same land site (PPA). It is found by Tang and Choy (2000) that, the more often developers (or landowners) submitted applications for development on a particular land site in the past, the current application has a higher probability to be approved by the TPB. In other words, a positive correlation between PPA and the dependent variable is expected, because previous decisions (and comments) made by the TPB provide valuable information to developers (or landowners) concerning its interpretation as to what (and how) a particular land site should be developed.

Further, the leasehold status of the land lot in question is to be taken into consideration as well. A dummy variable, GOVT, is established to evaluate whether a proposed development on a site with both private land and government land ("1") would have a significant difference in terms of approval probability when compared with a similar development on private land only ("0"). A negative correlation is expected between GOVT and the dependent variable, as the government has a higher level of control in deciding how government land designated as either one of these three zones should be utilized according to its policy objectives.

4.5.1.2 Application-specific variables

Six application-specific variables are considered for this study. Three of them are exclusive to the study of R(A), R(B), and R(C) zones, whereas the remaining three variables are applicable to the study of all six statutory land-use zones.

For the application-specific variables exclusive for the three residential land-use zones, even though residential development is always permitted in R(A), R(B), and R(C) zones, a planning application, under Section 16 of the Planning Ordinance, for the TPB's approval is still required should the proposed development seek minor relaxations of restrictions with respect to its plot ratio and/or building height and/or site coverage. Therefore, three dummy variables (PR, SC, and BH) are established to take these conditions into account. For the PR variable, "1" is assigned for an application that seeks minor relaxations of the existing plot ratio restriction; and "0" otherwise). For the SC variable, "1" is assigned for an application which seeks minor relaxations of the existing site coverage restriction; and "0" otherwise. Lastly, for the BH variable, "1" is assigned for an application which seeks minor relaxations of the existing building height restriction; and "0" otherwise.

And for the other three variables that are applicable to all six statutory zones, the first of which is established with reference to the distinction between flat development (i.e. high-rise residential buildings) and (low-rise) ordinary house development under the B(P)R. In order to separate these two types of residential developments, a dummy variable, HOUSE, is incorporated into the discrete choice model(s). "1" refers to an application for a residential development that includes the building of ordinary house(s), and "0" refers to an application for flat-only development.

The other two application-specific variables, by contrast, take into account the inclusion of other non-residential use(s) in a proposed residential development. The first variable is CR, which distinguishes a proposed commercial-residential development ("1") from a proposed residential-only development ("0"). Another variable, GICFAC, separates applications for residential development, in which the provision of GIC facilities (such as recreational facilities, religious institutions, schools, public transportation terminus, public open space, etc.) is explicitly specified ("1"), from others ("0").

4.5.1.3 Zoning-specific variables

As some of the proposed residential development involves land in more than one statutory zone, four zoning-specific variables are hence introduced to control for their latent influences on an application's probability to be approved. Two of these variables are exclusive to R(A), R(B), and R(C) zones whereas the other two are exclusive to GIC, GB, and CDA zones.

For the zoning-specific variables applicable only to R(A), R(B), and R(C) zones, the COL2 dummy variable is introduced, to distinguish a planning application for a site involving other statutory land-use zones in which residential development is regarded as one of the Column 2 uses ("1") from another application on a site which is entirely within the three residential land-use zones ("0"). Another dummy variable, MRES, is also established, as "1" represents proposed residential development on sites in more than one residential statutory zone, and "0" represents proposed residential development on sites within a single residential zone ("0").

And for the zoning-specific variables applicable only to GIC, GB, and CDA zones, the first variable, RESZ, is designed to separate a proposed residential development on a land site which is partly within at least one of the five residential zones (“1”) from a similar development on purely non-residential land (“0”), thus evaluating the differences, if any, in terms of approval probabilities between them.

And the second variable (applicable to GIC and CDA zones only), GBZ, is established with reference to the planning intention of GB zones, which is to “promote the conservation of the natural environment and to safeguard it from encroachment by urban-type developments (Town Planning Board, 1991).” “1” refers to a proposed residential development on a site partially within GB zone, and “0” denotes a proposed development on a land site which does not encroach into GB zone. Should the TPB indeed stick to this planning intention, a negative relationship between GBZ and the dependent variable is expected.

In addition to RESZ and GBZ variables, considering that this study investigates the planning control decisions made by the TPB regarding proposed residential development in GB, CDA, and GIC zones, there are some cases in which the land in question is within any combination of these three statutory zones. In light of this, two zoning-specific dummy variables, GICZ (applicable to CDA/GB only) and CDAZ (applicable to GIC/GB only), are established with the aim to identify the differences, if any, in terms of a proposed residential development’s probability to be approved by the Town Planning Board.

4.5.1.4 Location variables

Given the disparities in development density restrictions in different parts of Hong

Kong under the Building (Planning) Regulations [B(P)R] (Tables 4.1-4.3), two location-specific variables are thus included into the discrete choice models to take into account the geographical differences in terms of the likelihood of approval by the TPB for proposed residential development projects, if any. The first variable, URBAN, separates proposed residential developments either on Hong Kong Island or in Kowloon Peninsula ("1") from those in the New Territories (N.T.). Meanwhile, as the N.T. is divided into newtown areas and non-newtown areas, the NEWTOWNS variable is established, to distinguish applications for residential development in one of the nine new towns in the New Territories (i.e. Tsuen Wan [including Kwai Chung and Tsing Yi Island], Shatin [including Ma On Shan], Tuen Mun, Tai Po, Fanling/Sheung Shui, Yuen Long, Tin Shui Wai, Tseung Kwan O, and Tung Chung) ("1") from the rest of the N.T. ("0"). These two variables are applicable to all six statutory land-use zones.

4.5.1.5 Exogenous variables

In addition to the factors directly related to the proposed development itself, four exogenous variables are considered as well. The first two variables are related to the government's previous housing-related policies. The first variable, similar to the POLICY variable in Lai and Ho (2001a; 2001c), concerns the housing policy announcements made in several *Policy Addresses* since Hong Kong's handover to China (Table 4.9) to rezone previously non-residential sites (for instance Agriculture, Industrial, GIC, and GB sites) for residential development. In order to gauge the impact of these policy announcements, if any, on a proposed residential development's probability to be approved, a dummy variable, REZONE, is thus established. Planning control decisions on small house applications made by the Town Planning Board:

- Between October 8th, 1997 (i.e. the day when the 1997 Policy Address was delivered) and October 6th, 1998 (i.e. the day before the 1998 Policy Address was delivered)

- From October 13th, 2010 onwards (i.e. the day when the 2010-11 Policy Address was delivered)

are designated as “1”, whereas the others are coded as “0”.

Policy Address	**Date of Presentation (YYYY/MM/DD)**	**Announcement to rezone non-residential land for housing construction**
1997	1997/10/08	■
1998	1998/10/07	
1999	1999/10/06	
2000	2000/10/11	
2001	2001/10/10	
2003	2003/01/08	
2004	2004/01/07	
2005	2005/01/12	
2005-06	2005/10/12	
2006-07	2006/10/11	
2007-08	2007/10/10	
2008-09	2008/10/15	
2009-10	2009/10/14	
2010-11	2010/10/13	■
2011-12	2011/10/12	■
2013	2013/01/16	■
2014	2014/01/15	■
2015	2015/01/14	■
2016	2016/01/13	■
2017	2017/01/18	■

Table 4.9: Announcements of rezoning non-residential land for residential use in the *Policy Addresses*, 1997-2017
Source: The Hong Kong SAR Government

By contrast, the second variable aims to capture the possible impact of another housing-related policy under very different conditions. Hong Kong, after the outbreak of the Asian Financial Crisis, had undergone economic downturns since the late 1990s which had lasted several years. By Fall 2002, property prices had dropped by some 60% from their 1997 peak levels. The HKSAR government, having conducted a policy review, had suspended the sale of residential land sites and the application list from 13th November 2002 to 31st December 2003. Did such a short-lived policy, in any way, influence the TPB's decisions with regard to residential development? The dummy variable, SUSPEND, is thus established to address this particular question. "1" denotes applications decided by the TPB within this period, and "0" otherwise. However, it should be noted that, this variable is only applicable to the study of the residential zones, as no applications in GIC, CDA, and GB zones had been decided by the TPB during this period.

The third exogenous variable is related to housing market conditions at the time when planning control decisions are made. Inspired by several previous studies on TPB's planning control decisions on other non-residential development (Tang and Choy, 2000; Tang et al., 2000; Lai and Ho, 2002a), a dummy variable, UPM, is established to explore whether or not the Town Planning Board regulates the housing market. An application is assigned as "1" if the TPB makes the decision when housing price in the previous quarter (which is the most updated housing price information available) is higher than housing price a year (i.e. 4 quarters) before; and as "0" when housing price in the previous quarter is lower than housing price a year before.

The fifth and last exogenous variable takes into account Hong Kong's history as a British colony (before July 1st 1997) and as a Special Administrative Region under Chinese sovereignty (since July 1st 1997). It, COLONIAL, is designed to assess the differences, if any, in the probability for residential development applications to be approved by the TPB in these two eras, as "1" refers to applications which were decided by the TPB before Hong Kong's handover to China, and "0" to those determined after the handover.

A summary of the variables discussed above is provided in Table 4.10 below.

Variable	Description	Type	Expected relationship with the dependent variable
	Site-Specific Variables		
LnGSA	Gross site area (m^2) (in Natural Log form) (Model 1 only)	Numerical	+
PLOT	Plot ratio of the proposed residential development (Model 1 only)	Numerical	/
LnGFA	Gross Floor area (m^2) (in Natural Log form) (Model 2 only)	Numerical	+
PPA	Number of previous planning applications for the same land site	Numerical	+
GOVT	1 denotes an application for residential development on a site with adjoining government land; and 0 otherwise	Dummy	-
	Application-Specific Variables		
HOUSE	1 denotes an application for house development (or a combination of house/flat development); and 0 for flat-only development	Dummy	/
CR	1 denotes an application for commercial/residential development; and 0 for a residential-only development	Dummy	/
GICFAC	1 denotes an application which specifies the provision of Government, Institution and Community (GIC) Facilities (including recreational facilities, religious institutions, schools, public transportation terminus, open space, etc.); 0 otherwise	Dummy	/
PR	1 denotes an application for the relaxation of plot ratio restriction; and 0 otherwise (R[A], R[B], & R[C] zones only)	Dummy	/
SC	1 denotes an application for the relaxation of site coverage restriction; and 0 otherwise (R[A], R[B], & R[C] zones only)	Dummy	/
BH	1 denotes an application for the relaxation of building height restriction; and 0 otherwise (R[A], R[B], & R[C] zones only)	Dummy	/
	Zoning-Specific Variables		

COL2	1 denotes an application for a site involving statutory zones in which residential development is permissible as a Column 2 use; and 0 otherwise (R[A], R[B], & R[C] zones only)	Dummy	-
MRES	1 denotes an application for a site involving more than one residential statutory zones; and 0 otherwise (R[A], R[B], & R[C] zones only)	Dummy	/
RESZ	1 if part of the land site is within a residential zone; and 0 otherwise (CDA, GIC, & GB zones only)	Dummy	+
GBZ	1 if part of the land site is within the greenbelt zone; and 0 otherwise (CDA, GIC, & GB zones only)	Dummy	-
Location-Specific Variables			
URBAN	1 denotes an application for residential development in the urban areas (Hong Kong Island & Kowloon); and 0 otherwise	Dummy	/
NEWTOWNS	1 denotes an application for residential development in one of the nine new towns in Hong Kong; and 0 otherwise	Dummy	/
Exogenous Variables			
REZONE	1 denotes planning control decisions made by the TPB after the announcement by the Chief Executive in the *Policy Addresses* to rezone non-residential land for residential use; and 0 otherwise	Dummy	+
SUSPEND	1 denotes planning control decisions made by the TPB after the announcement to suspend land sale/auctions; and 0 otherwise (R[A], R[B], & R[C] zones only)	Dummy	/
UPM	1 denotes an application with decision made when there is an upward price movement for Hong Kong residential properties; 0 denotes an application with decision made when there is a downward price movement for Hong Kong residential properties	Dummy	/
COLONIAL	1 denotes planning control decisions made by the TPB before Hong Kong's handover to China	Dummy	/

	(i.e. July 1st, 1997); and 0 otherwise.		

Table 4.10: A description of the selected variables

4.5.2 The Data

The data necessary for conducting this empirical analysis comes from two sources. First, planning control data is collected through the Town Planning Board's Statutory Planning Portal (SSP). The SSP is an online database, which contains records of planning applications decided by the Town Planning Board since January 1st 1990, in which information of the proposed development (such as GFA, GSA, number of housing units proposed, building height, site coverage, location, details in terms of provision of open space, GIC facilities, car parking space, loading bay(s) (if any), etc.), as well as the TPB's decision (with reasons), is proffered. And second, the housing price data used for the computation of the UPM dummy variable is compiled from the Rating & Valuation Department (RVD).

Between January 1st, 1990 and April 30th, 2017, a total of 1,721 planning applications for residential development had been decided by the TPB, including 114 cases for R(A) zones, 122 cases for R(B) zones, 296 cases for R(C) zone, 712 cases for CDA zones, 298 cases for GIC zones, and 179 cases for GB zones (for the spatial distribution of these cases, see Appendices 4.1 & 4.2). However, a closer look at these records reveals that they include four types of planning applications, such as:

- Planning applications under Section 16 of the Town Planning Ordinance with the TPB's decision
- Planning applications under Section 16 of the Town Planning Ordinance without the TPB's decision due to deferment on the part of applicants
- Applications for Class B amendment of approved development proposals under

Section 16A(2) of the Town Planning Ordinance

- Planning applications submitted by government agencies (for instance, for development of public housing estates)

Since this investigation only focuses on "fresh" planning applications under Section 16 of the Town Planning Ordinance, only the cases within the first group are included for analysis. This consists of 1,036 cases for residential development (flats and/or houses) in total, of which 80 applications are in R(A) zones, 90 applications in R(B) zones, 252 for R(C) zones[44], 176 applications in GIC zones, 261 applications in CDA zones, and 177 applications in GB zones.

4.6 Research Findings

4.6.1 Descriptive Statistics

4.6.1.1 R(A), R(B), and R(C) zones

The descriptive statistics (Table 4.11), first, reveal that the TPB has been relatively lenient in granting permissions to proposed residential development in R(A) zone, as 55 of 80 applications (or 68.75%) receive the TPB's approval. In comparison, 55.56% and 61.51% of proposed residential development applications are approved in R(B) and R(C) zones, respectively.

As for the site-specific variables, the land sites on which housing is proposed to be developed are much larger in R(C) zone (15,797m²) than those in R(A) and R(B) zones (less than 10,000m²). Meanwhile, the proposed density for housing development in R(A)

[44] There are 21 planning applications in which the land site for development covers more than one residential land-use zones. Of these 21 applications, 8 of them involve both R(A) and R(B) zones and the remaining 13 of them involve both R(A) and R(C) zones.

zone, with an average plot ratio of 7.14, is the highest among the three residential zones, and that in R(C) zone is by far the lowest (at 1.59). In the meantime, developers (or individual landowners) tend to submit numerous planning applications for development on sites within the R(A) zone (i.e. mean value of previous planning applications = 1.38), as compared with the other two residential zones.

Additionally, a much higher proportion of proposed residential development in R(C) zone involves the construction of ordinary houses, whereas only 2 out of 172 planning applications for residential development in R(A) and R(B) zones include ordinary house constructions. The vast majority of land sites involved in the sampled planning applications are located in the urban areas, especially for proposed development in R(A) zone. Yet, a larger proportion of proposed residential developments in R(B) zone are in the new town areas. Also, more than one-fifth of the sampled residential development applications in R(A) zone and in R(B) zone are not completely on private land, while close of 90% of all proposed residential developments in R(C) zone are on private land.

With regard to the application-specific variables, more than one-third of the proposed commercial/residential developments are within R(A) zone, whereas most of proposed developments on sites in the other two zones are residential only. On the other hand, the provision of government, institutional, and community facilities and/or public open space is explicitly stated in more than 10% of applications in R(A) and R(B) zones, compared to 2.4% in R(C) zone.

In addition, a sizeable proportion of proposed housing developments in R(A) and R(B) zones involve land sites which are partly within statutory zones that allow residential development as a Column 2 use. Meanwhile, a noticeably higher percentage of residential development applications within R(A) zone also involve another statutory residential zone than the other two zones.

By contrast, a sizeable amount of planning applications for development in R(C) zone only seek minor relaxations of existing development restrictions in plot ratio, in site coverage, as well as in building height. For applications that request for minor relaxations of development restrictions in R(A) and R(B) zones, most of them concern the existing plot ratio and/or building height restrictions.

Concerning the exogenous variables, while the proportion of proposed residential developments decided after the HKSAR government's announcement to rezone non-residential land sites for housing development are largely similar between the three residential zones (i.e. approximately 13-15%), only 15 planning applications had been determined during the suspension of land sale (and the application list), including 13 applications in R(C) zone and 2 in R(B) zone. At least 60% of the sampled planning applications are decided when housing price is soaring (compared to a year before). Lastly, while more than half of planning applications for housing development in R(A) zone (55.00%) were determined prior to Hong Kong's handover to China, more 60% of applications for residential developments in R(B) and R(C) zones were decided after Hong Kong become a Special Administrative Region.

Statutory Zone	Residential (Group A)		Residential (Group B)		Residential (Group C)	
Approval Rate	**68.8%**		**55.6%**		**61.5%**	
Site-Specific Variables (Numerical)						
Variable	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**
GFA (in m²)	21,645	24,998	29,952	37,808	8,029	23,043
GSA (in m²)	4,151.9	6,087.3	9,432.9	9,928.2	15,797	90,273
PLOT	7.14	2.55	4.12	2.39	1.59	1.97
PPA	1.38	1.65	0.98	1.54	0.61	0.91
Site-Specific Variables (Dummy) (in percentage)						
GOVT	22.50		20.0		11.5	
Application-Specific Variables						
HOUSE	0		2.2		27.8	
CR	33.8		3.3		2.4	
GICFAC	17.5		12.2		1.6	
PR	13.8		24.4		30.6	
SC	1.3		4.4		35.3	
BH	25.0		32.2		41.7	
Zoning-specific Variables (in percentage)						
COL2	63.8		47.8		19.1	
MRES	26.3		8.9		5.95	
Location-specific Variables (in percentage)						
URBAN	90.0		56.7		63.1	
NEWTOWNS	1.3		22.2		13.5	
Exogenous Variables (in percentage)						
REZONE	15.0		15.6		14.3	
SUSPEND	0		2.2		5.16	
PPG	73.8		62.2		63.1	
COLONIAL	55.0		40.0		34.9	

Table 4.11: Descriptive statistics of the data sample by statutory zone

Nevertheless, as there are very few cases for some of the selected variables amongst planning applications for residential development in R(A) (for instance, HOUSE, NEWTOWNS, SC, and SUSPEND) and R(B) (such as SUSPEND and CR) zones, these factors, thus, are not included in their respective final probit models.

4.6.1.2 GIC, CDA, and GB zones

The descriptive statistics of the sampled planning applications are provided in Table 4.12 below. Of these three statutory land-use zones, the Town Planning Board has been noticeably more lenient when it comes to approving planning applications for residential development in CDA zone, as more than three-quarters of applications relating to land sites in these areas have been approved by the TPB. In comparison, the TPB has been more stringent in approving residential development applications in GIC zone (slightly more than half), and especially, in GB zone (approximately three-eighths).

For the site-specific variables, the land sites involved in proposed residential development in CDA zones are by far the largest (Mean=55,103m²), followed by those in GIC zones (26,444m²) and in GB zones (20,400m²). Similarly, the average proposed GFA for the development of residential properties in CDA zones (146,270m²) is more than 3 times as much as that in GIC zone (45,985m²) and more than 11 times as much as that in GB zones (12,870m²). Due to the much larger Gross Site Area and GFA, the mean proposed number of housing units to be constructed on CDA sites (1,793.15) is thus much larger than that on GIC sites (536.10) and on GB sites (approximately 100). Interestingly, the mean proposed plot ratio of residential development applications in GIC zone, at 5.92, is higher than that in CDA zone (4.27). Proposed residential development in GB zone, by virtue of the land-use regulations, inevitably has a much smaller average plot ratio (slightly more than 1). The average number of previous planning applications for the same site is the largest among the sampled planning applications concerning CDA sites (1.77), followed by GIC sites (1.57) and GB sites (1.04).

While more than 35% of planning applications for CDA and GB zones involve government land, the proportion in this regard for residential development applications on GIC sites is much lower (22.7%). By contrast, more than a quarter of all applications for GIC zone and GB zone involve land sites designated for residential use, compared to less than 4% of all applications on CDA sites. The amount of applications for development on sites partly within GB zone (for both GIC and CDA zones) is less than 10%. Further, the number of applications in GB/CDA zones that also involve land designated for GIC use constitute less than 5% of all applications, while 8% of proposed residential developments in GIC zones involve CDA sites and 5.6% of applications in GB zones are partly within CDA zones.

As for the application-specific variables, more than 60% of all residential development applications in GB zone concern the construction of low-rise houses, while less than 10% of those in GIC and CDA zones are for this particular purpose. Meanwhile, more than half of sampled applications in CDA zones propose a commercial-residential development, followed by GIC zone (32%). Only 2.8% of sampled applications in GB zone propose this type of development. Similar statistical patterns are also identified when it comes to the proposed provision of GIC facilities (including recreational facilities, religious institutions, public transport terminus, etc.), as the proportion of planning applications which explicitly state the proffering of GIC facilities in CDA zone (37.5%) is much higher than that in GIC zone (25.6%) and in GB zone (4.5%).

From a geographical perspective, the majority (more than 70%) of sampled planning applications in GIC zone concern land sites located in the urban areas (i.e. Hong Kong Island and Kowloon Peninsula). By contrast, most of the proposed residential developments in CDA zone are clustered either in the urban areas or in one of the nine new towns in Hong Kong (more than 78%); and the overwhelming majority of those in GB zone are concentrated in the New Territories (over 88%).

With regard to other exogenous factors, on the one hand, the percentage of planning control decisions made by the TPB after the announcement by the HKSAR government to rezone non-residential land sites for residential development is the highest for CDA zone (24.5%), compared to that for GIC zone and GB zone (less than 16%). On the other hand, the majority of these planning control decisions have been made by the TPB when housing price is rising (70% for GIC zone; 54% for CDA zone). In fact, all planning applications for residential development in GB zone have been decided by the Town Planning Board when property price is moving upwards. As a result, the UPM variable is not included in the GB zone models. Lastly, while more than half of planning control decisions for residential development on GIC sites had been made when Hong Kong was still under British colonial rule, the majority of decisions for similar development on CDA sites and on GB sites have actually been made after Hong Kong's handover to China.

Statutory Zone	**GIC**		**CDA**		**GB**	
Approval Rate	**55.7%**		**77.4%**		**37.9%**	
Site-specific Variables (Numerical)						
Variable	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**
GSA (in m²)	26444	110164.3	55103	110374	20400	38967.03
GFA (in m²)	45985	84991.81	146270	210866	12870	26805.06
Number of housing units	536.10	916.84	1793.15	2518.31	99.81	275.85
PLOT	5.92	3.29	4.27	2.96	1.09	1.67
PPA	1.57	1.53	1.77	1.88	1.04	1.25
Site-specific Variables (Dummy) (in Percentage)						
GOVT	22.7		40.6		35.6	
Zoning-specific Variables (in Percentage)						
RESZ	26.1		3.8		29.9	
GBZ	7.4		2.7		N.A.	
Application-specific Variables (in Percentage)						
HOUSE	9.7		8.8		62.7	
CR	32.4		54.0		2.8	
GICFAC	25.6		37.5		4.5	
Location-specific Variables (in Percentage)						
URBAN	73.9		32.6		11.9	
NEWTOWNS	17.6		46.0		46.3	
Exogenous Variables (in Percentage)						
REZONE	14.2		24.5		15.3	
UPM	70.5		54.4		100.0	
COLONIAL	64.2		31.8		48.0	
N	**176**		**261**		**177**	

Table 4.12: Descriptive statistics of the data sample by residential zone

Having presented the descriptive statistics of these planning applications by statutory zone, the findings of the probit models are then reported in the next section.

4.6.2 Probit Model Results

4.6.2.1 R(A), R(B), and R(C) zones

Table 4.13 reports the results obtained from the probit models for R(A), R(B), and R(C) zones, which are to be presented in the following paragraphs.

Variable	Residential (Group A)		Residential (Group B)		Residential (Group C)	
Model	**1**	**2**	**1**	**2**	**1**	**2**
Constant	2.934	3.054	-2.661	-3.191	-0.860	0.038
Site-specific Variables						
GSA	-0.150		0.231		0.154	
PLOT	-0.010		0.207*		-0.437**	
GFA		-0.147		0.311*		0.011
PPA	0.197	0.193	0.147	0.197	-0.220*	-0.170
GOVT	0.757	0.744	-0.629	-0.472	-0.282	-0.328
Application-Specific Variables						
HOUSE			0.259	0.356	0.177	0.435
CR	-0.314	-0.313			-0.148	-0.142
GICFAC	-0.445	-0.475	-1.265	-1.286	-0.437	0.034
PR	0.677	0.723	-0.880	-0.884	-0.179	-0.335
SC			0.933	0.902	0.597*	0.788**
BH	-0.613	-0.560	-0.349	-0.444	0.229	0.059
Zoning-specific Variables						
COL2	-0.318	-0.312	0.136	0.088	-0.058	0.056
MRES	-0.430	-0.482	1.015	0.320	4.610**	1.669**
Location-specific Variables						
URBAN	-0.419	-0.361	0.070	0.544	0.534*	0.011
NEWTOWNS			0.728	0.702	1.018***	0.803*
Exogenous Variables						
REZONE	0.278	0.275	0.778	0.763	0.317	0.396
SUSPEND					0.469	0.618
UPM	-1.217*	-1.246*	0.384	0.501	-0.044	-0.192
COLONIAL	0.318	0.370	-0.729	-0.646	-0.596*	-0.347
N	**80**		**88 (Note 2)**		**250**	
Chi-square	89.535	90.723	86.117	82.260	245.936	252.968

Table 4.13: Empirical findings obtained from the Probit models
Notes: 1) ** denotes statistical significance at 1%; and * at 5%; 2) The number of cases included in the Probit model (88) is slightly less than the sample for this land-use zone (90), due to missing information in 2 of the applications in the database.

First and foremost, two of the site-specific variables are found to be statistically significant (at 5% level). The findings first show that, while GSA is significant in neither of the three residential zones (Model 1), GFA is significant (at 5% significance level) in R(B) zone (Model 2). The positive coefficient reveals that a proposed residential development with a larger development potential is more likely to be approved by the TPB, other factors being constant. If anything, this finding proffers some empirical support for the notion that the TPB's decisions lean towards the interests of entities that are financially capable of providing more housing space on sites designated for medium-density residential development, including large property developers or other affluent landowners. By contrast, GFA is not a significant factor in explaining the approval rate of residential development applications in R(A) and R(C) zones. This indicates that no statistically significant differences between the approval probability of proposed residential developments with varying development potential are identified.

The plot ratio (PLOT) of a proposed residential development is also significantly related to an application's likelihood to be approved in R(B) zone and in R(C) zone. What is interesting is that this variable has opposite effects for the two residential zones. While it is positively correlated (significant at 5% level) with an application's approval rate in R(B) zone, it has a negative (significant at 1% level) impact on an application's approval rate in R(C) zone instead. To put it differently, a proposed residential development with a higher density is more likely to be approved in a statutory land-use zone designated for medium-density residential development, yet is more likely to be rejected in a statutory zone designated for low-density development. Grounded on these findings, it can be said that the Town Planning Board is intent on managing the level of development intensity in a low-density residential zone, at the same time welcomes development with higher density in a medium-density residential zone. As for R(A) zone, an application's rate of approval is not statistically related to its proposed development density.

The number of previous planning applications (PPA) is only found to have a statistically significant relationship with an application's likelihood to be approved in R(C) zone when the model controls for its GSA and plot ratio (Model 1), but not its GFA (Model 2). The coefficient is negative (significant at 5% level), which indicates that the probability of an application to be approved is actually lower if a higher number of planning applications have been submitted for the same site. This finding differs from that in Tang and Choy (2000). Given that applicants should be more informed due to the receipt of the (stated) criteria taken into account by the TPB via its decision(s) on previous applications, this finding is rather surprising. Nonetheless, a number of questions are inevitably raised:

- Can those criteria be met in subsequent application(s)?;
- Does the TPB strictly adhere to these criteria all the time in its decision-making process?; and
- Are there any other criteria that were not stated in these decisions?

A higher probability to be rejected for the current application, despite the information advantage obtained through the TPB's decisions on past applications, indicates that either 1) at least some of these stated criteria are not addressable, as a result of the land site's innate characteristics (for instance, issues regarding the landscape in the surrounding areas) or 2) the TPB does not consistently apply these stated criteria, and/or there exist other unspecified criteria (such as the statistical patterns identified in this study). While scenario 1 is predictable, scenario 2 reflects a comparatively flexible but unclear planning control process for low-density residential land. As for R(A) and R(B) zones, this variable is not found to be significant. This suggests that the current application's probability to be approved is not subject to (from a statistical perspective) the number of planning applications submitted previously for the same land site.

Then, only one of the six application-specific variables is found to be significant. The coefficient of the SC dummy variable is positive (significant at 5% level in Model 1; and at 1% level in Model 2) in R(C) zone. This reflects that, on land sites within a low-density residential zone, the TPB is usually more lenient in approving requests for minor relaxations of site coverage restrictions under B(P)R) (or horizontal expansion of building structures) than other kinds of requests for minor relaxations (such as changes in plot ratio and/or building height). On the other hand, the disparities in an application's likelihood to be approved between these three types of minor modifications are not statistically significant for both R(A) and R(B) zones.

As for the pair of zoning-specific variables, one of them is found to be significant in R(C) zone. The coefficient of the MRES variable is positive (significant at 1% level in both Models 1 & 2), indicating that it is much more likely for the Town Planning Board to approve a proposed residential development, should the site in question be within more than one residential statutory zones, than a similar development on a site solely within R(C) zone, even though the development restrictions between these residential zones differ remarkably. Alternatively, this variable is not significant for R(A) and R(B) zones. This means that the likelihood for a proposed residential development on a site within multiple residential zones and that for a similar residential development on a site within a singular residential zone is not statistically different.

Further, the two locational-specific variables are both significant determinants in the TPB's planning control decisions with respect to housing development in R(C) zone. For the URBAN variable, it has a positive relationship (significant at 5% level) in Model 1 (but insignificant in Model 2) with an application's approval probability. This suggests that, when controlling for a development's GSA and proposed plot ratio, an application for housing development in the urban areas are received more favourably by the TPB than another application with similar characteristics in the rural areas of the New Territories. Yet, taking into account the even larger positive coefficients for the NEWTOWNS variable (for both Models 1 & 2), it is reasonable to say that, of the applications for housing development in this low-density residential zone, the TPB is the most stringent when the land site in question is located in the rural areas in the New Territories, but the most lenient when the land site is located in one of the new towns. If anything, such a stance illustrates the TPB's priority to accelerate new town development, and to a lesser extent, urban development. Similar priorities, by contrast, are not applicable to R(A) and R(B) zones, given the statistical insignificance of both locational-specific variables.

Lastly, two of the four exogenous variables are found to be significant in explaining a residential development application's likelihood to be approved. The first significant variable is UPM, which yields a large and negative coefficient (significant at 5% level) for R(A) zone. To put it differently, the TPB is much less likely to approve a proposed residential development when housing price soars[45]. Such a stance taken by the TPB is likely to further postpone a project's development process and drive up development costs (see Wong et al., 2011). The latter, in turn, makes housing development in this zone less viable, from a financial perspective, for developers than it otherwise should, causing even slower response to housing demand. If viewing this from a town planning perspective, however, this finding can be viewed as the TPB's response to objections raised by residents in the surrounding areas during the public consultation phase over

[45] Market factors have also been found to be significant in influencing the TPB's planning control decisions on applications for non-residential development in previous studies as well (see, for instance, Tang and Choy, 2000; Tang et al., 2000; Lai and Ho, 2002a), albeit in very different ways.

the concerns of overdevelopment (and thus, over-concentration of residents) in this high-density residential zone, hence mitigating the latent effect on the living standards of existing residents in these areas due to a lack of supporting infrastructure and facilities.

Another exogenous variable found to be significant is COLONIAL. The coefficient of this variable for R(C) zone is negative (significant at 5% level). It should be noted, however, that this is only the case when the model controls for the proposed development's GSA and plot ratio (Model 1), but not for its GFA (Model 2). The finding means that the TPB was more stringent in approving residential development applications in the low-density residential zone in the Colonial Era than in the HKSAR era. This points to an increasingly pro-development stance taken by the Town Planning Board towards housing development on low-density residential land, with reference to soaring housing demand due to a consistently-rising populace (by either newborns or one-way permit holders from the Chinese Mainland) since Hong Kong's handover to China in the late 1990s. By contrast, there are no significant differences in the probability of housing development applications to be approved in R(A) and R(B) zones between the Colonial Era and the HKSAR Era.

Meanwhile, neither REZONE nor SUSPEND is significant in explaining an application's approval probabilities in these three residential zones. In other words, the notion that planning control decisions made by the TPB on housing development applications in R(A), R(B), and R(C) zones are in line with the government's housing policy objectives is not empirically supported by the findings.

4.6.2.2 GIC, CDA, and GB zones

The results obtained from the discrete choice models for GIC, CDA, and GB zones are shown in Table 4.14 below.

Statutory Zone	**GIC**		**CDA**		**GB**	
Model	**1**	**2**	**1**	**2**	**1**	**2**
Constant	1.706	1.904	-2.629*	-2.644**	-2.429**	-2.324**
Site-specific Variables						
LnGSA	-0.220*		0.313**		0.127	
PLOT	0.065		0.059		0.060	
LnGFA		-0.229*		0.321**		0.124
PPA	0.423**	0.459**	0.109	0.111	0.485**	0.496**
GOVT	0.330	0.184	0.378	0.412	-0.386	-0.378
Application-specific Variables						
HOUSE	-0.321	-0.854	-0.281	0.012	0.553	0.606
CR	0.386	0.588*	-0.312	-0.403	2.926*	3.012*
GICFAC	0.146	0.161	0.384	0.388	-1.816	-1.840
Zoning-specific Variables						
RESZ	0.569	0.681*	0.365	0.199	0.919*	0.905*
GBZ	-0.737	-0.724	-0.675	-0.713	N.A.	
GICZ	N.A.		-0.890	-0.880	0.203	0.215
CDAZ	0.890	0.784	N.A.		0.788	0.760
Location-specific Variables						
URBAN	-0.681	-0.183	0.287	0.116	0.406	0.439
NEWTOWNS	-0.160	0.129	0.179	0.015	0.305	0.322
Exogenous Variables						
REZONE	-1.059*	-0.969*	0.407	0.415	0.150	0.153
UPM	0.625	0.610	-0.684**	-0.723**	N.A.	
COLONIAL	-1.361**	-1.170**	0.037	0.050	-0.717*	-0.715**
N	**176**		**261**		**177**	
Chi-square	161.571	164.230	276.722	266.026	171.558	172.308

Table 4.14: Empirical findings obtained from the Probit models
Note: ** denotes statistical significance at 1%; and * at 5%

It is first reported that three of the five site-specific variables are statistically significant in explaining the TPB’s planning control decisions on proposed residential development in the three statutory land-use zones. Of these significant variables, first, it is found that the Gross Site Area (GSA) of a proposed residential development has positive relationships with an application’s probability to be approved in CDA zone (at 1% significance level), but negative relationships with the likelihood for an application on GIC sites to be approved. Meanwhile, this factor is not significant for GB zones. This finding for CDA zones is in line with Lai and Ho (2001a) whereas the finding for GB zones is consistent with Tang et al. (2007). Meanwhile, the development potential of a land site (i.e. GFA) is another significant factor. A development's proposed plot ratio, however, does not have significant influence on an application's approval probability. Similar to GSA, GFA is positively correlated with an applications probability to be approved in CDA zone (at 1% significance level), similar to the findings in Tang and Choy (2000). This is in line with the findings in the majority of studies on Hong Kong's planning control decisions (i.e. Lai and Ho, 2001a; 2001b; 2001c; 2002a; Chau and Lai, 2004; Tang et al., 2005; 2007). These findings indicate that the TPB is more likely to approve applications for residential development in CDA zone, if either housing units are proposed to be built on larger land sites or the resultant development produces a larger gross floor area. The findings unavoidably lead to the interpretation that larger residential development projects, be they initiated solely by a large developer or jointly by multiple developers, are preferred by the TPB over smaller ones, even though the TPB (Town Planning Board, 2016b) argues that a larger site inside CDA zones proffers a better opportunity "for incorporating public facilities in the development, restructuring of land uses including changes to road patterns, and optimization of development potential". Even if one takes the TPB's argument into consideration, large developers are still the major beneficiaries of such a policy direction, meaning that their interests are catered to by the TPB at the expense of the others. By contrast, GFA is found to be negatively correlated (significant at 5% level) with an application's approval likelihood. This means that, smaller residential development projects (in terms of GFA) in GIC zones receive more preferential treatments by the TPB than larger ones, which is in line with the zone's planning intention.

Then, the number of previous planning applications on the same site (PPA) is positively correlated with an application's likelihood to be approved, in GIC zone and in GB zone (both at 1% significance level). However, this factor only incurs a minimal, and insignificant impact on applications for residential development in CDA zone. The positive relationship between PPA and an application's approval probability lends further support to the findings in Tang and Choy (2000), in that the TPB's decisions in the past (and the stated comments associated with the verdicts) supply useful information to developers (or landowners) as to the thoughts of TPB members with regard to development in GIC zone and in GB zone. In other words, the criteria for approving planning applications on sites in these two zones are comparatively predictable. On the other hand, the reason behind the insignificance of this variable in CDA zones can be attributed to the rather different nature of these repeated applications. A recent study conducted by Lai et al. (2016) does not find significant changes between newer MLPs submitted by developers and the older MLPs which have already been approved by the TPB. The authors suggest the possibility of developers using fresh applications as a means of keeping the permissions alive while making slight adjustments to the projects in response to market changes (as well as buying additional time for assembling land due to the notoriously fragmented ownership in these areas). Since these newer applications do not deviate substantially enough from the older ones, the disparities between the rate of approval of previously-approved applications and newer applications are, thus, not significant. Regardless, further postponements of the development process of a project are inevitable, thus resulting in higher development costs.

Of the three application-specific variables incorporated in the discrete choice models, only one of them, CR, is found to have statistically significant relationship (at least at 5% level) with an application's probability to be approved. For applications relating to GIC sites, this variable is found to be positively correlated with the TPB's planning control decision at 1% level (Model 2). Similar findings are also found for applications concerning GB sites (Models 1 & 2) at 5% significance level. These findings indicate that an application which proposes a commercial/residential development is more likely to be approved than a residential-only development in GB zones. Yet, for GIC zone, similar findings are reached only when a proposed development project's total GFA is controlled for.

As for the other two application-specific variables (HOUSE & GICFAC), their insignificance (within 5% levels) does not provide the empirical evidence to prove that significant differences exist in terms of the likelihood to be approved by the Town Planning Board between 1) a proposed house (or house-flat) development and a proposed flat-only development; and 2) a proposed residential development which explicitly states the provision of GIC facilities and a proposed residential development which does not intend to provide any GIC facilities. The second finding is particularly worth noting, in that, despite the emphasis on the provision of GIC facilities in the TPB guidelines for application for development within GIC and CDA zones, the stated intention to provide these facilities as part of a proposed development does not necessarily improve its chances to be approved. Without the incentives, it is very likely that developers would be discouraged to provide these non-residential facilities in areas in which these facilities are supposedly vital. If anything, this means that the well-being of residents within these areas, especially the needy ones, would be compromised.

Only one of the four proposed zoning-specific variables is found to be significant. The variable of RESZ is found to have positive relationships with the likelihood of approval in GB zone (Models 1 & 2, at 5% significance level). Such relationships indicate that the probability for a proposed residential development on a land site which is partly within a residential statutory zone is higher than a similar development on a land site which is not. By contrast, the GBZ variable is negative, yet insignificant, in either GIC zone or CDA zone, meaning that there is no conclusive statistical evidence to support the notion that residential development applications are more likely to be rejected should the land sites in question are partly within the greenbelt zone. Additionally, both GICZ and CDAZ are not found to be statistically significant, despite rather sizeable positive relationships, in explaining the probability for a proposed residential development project to be approved, suggesting that no conclusive evidence is found to support the idea that the TPB would be more lenient towards these applications should the land site(s) in question are partly within either one of these two statutory land-use zones.

Neither URBAN nor NEWTOWNS is found to be statistically significant (within 5% level) in explaining the Town Planning Board's planning control decisions regarding proposed residential development. To put it differently, the six probit models do not provide sufficient evidence to support the notion that significant differences exist between the probability for proposed residential development applications across different parts of Hong Kong, to be approved by the TPB, despite the differences in terms of development densities in these areas.

All three exogenous variables introduced in this study are found to be significant in explaining the TPB's planning decisions with regard to residential development. Firstly, the housing policy dummy variable, REZONE, is statistically significant (at 5% level) in influencing the likelihood for a proposed residential development in GIC zone to be approved by the authorities. The rather large negative coefficients (Models 1 & 2) indicate that, until the HKSAR government's intention to rezone non-residential land sites for housing development was announced, the Town Planning Board had been more lenient in granting permissions to the construction of housing units on GIC sites.

The second exogenous dummy variable, UPM, is negatively correlated with the dependent variable (at 5% level) in CDA zone. This means that, when housing price soars (compared to that one year before), the Town Planning Board tends to be more stringent in approving applications for housing development on CDA sites than it does when housing price falls. The reason behind such a stance can be attributed to the TPB's attachment to the broad planning parameters and development requirements stipulated in the site's Planning Brief. A look at applications rejected by the TPB when housing price is rising reveals that, other than issues related to the submission of application itself (for instance, the unsatisfactory (or non-)submission of MLP and/or relevant assessments in various aspects) and an application's inconsistency with the planning intention of a particular CDA site, many of the rejected applications have requested for relaxations of the stipulated development restrictions (either in terms of GFA or building height), presumably in response to housing market conditions. Due to the concern towards the potential 1) environmental impact, traffic impact, drainage impact, and sewerage impacts, 2) development mix, 3) over-development, and 4) over-concentration of residents should such relaxations be granted, the TPB has a higher tendency to reject them.

The third and final exogenous variable, COLONIAL, is found to have negative relationships with the dependent variable in both GIC zone and GB zone (at 1% significance levels), but not in CDA zone. These findings illustrate that the Town Planning Board, since Hong Kong's handover to China in July 1997, has taken a more pro-development stance in both GIC and GB zones, in that it has been much more lenient in approving proposed residential development in these two statutory land-use zones than they were in the Colonial Era, other factors being kept constant. By contrast, the findings do not provide sufficient evidence that the TPB has been either more lenient or more stringent when it comes to approving residential development on CDA sites.

Viewing these findings as a whole, it is reasonable to conclude that the TPB, since Hong Kong's handover to China, has taken a more flexible approach in the land-use planning of sites within GB zones as well as GIC zones (i.e. until the government's decision to re-zone other non-residential land sites for housing development). By contrast, the TPB's planning control decisions for CDA zones have been comparatively inflexible, in that it, due to the TPB's attachment to the stipulated broad planning parameters and development requirements, is more difficult for applications to be approved when housing price is rising. Neither are these decisions subject to the government's housing policy objectives (to supply more land sites for housing development through re-zoning non-residential land).

4.7 Conclusion and Policy Implications

This chapter has evaluated the planning control decisions made by the Town Planning

Board concerning residential development in three residential statutory zones (R[A], R[B], and R[C] zones) and three non-residential statutory zones (GIC, CDA, and GB zones), using non-aggregate planning control statistics. With the assistance of probit models, a total of 1,036 applications have been analyzed. Although the TPB claims to assess each application "via its individual merits", the findings do reveal some statistical patterns among these planning control decisions.

For the three residential land-use zones, it is found that the TPB's planning control decisions on housing development applications in R(B) zone have the tendency to cater to the interests of large property developers (or wealthy landowners), considering the positive relationship between a development's GFA and the corresponding application's likelihood to be approved. This, to some extent, proffers some empirical evidence in support of the political economy theory of development control (Gilg and Kelly, 1996; Kelly and Gilg, 2000). By contrast, applications for residential development in R(A) zone are highly susceptible to housing market conditions. Despite a higher rate of approval than R(B) and R(C) zones in general, the TPB is far more likely to reject housing development applications in the high-density residential zone when housing price is soaring. This particular finding alludes to the TPB's conscious decision in response to objections raised by residents in the surrounding areas during the public consultation phase over the concerns of overdevelopment. However, in these three residential zones, no conclusive evidence has been identified in support of the notion that the TPB's decisions on residential development applications, under Section 16 of the Town Planning Ordinance, are in line with the government's housing policy objectives at the time. This differs from the findings in Lai and Ho (2001a).

Additionally, some other interesting statistical patterns have also been identified for R(C) zone. The TPB is found to be more lenient towards residential development applications that 1) propose a lower plot ratio; 2) are not in the rural parts of the New Territories (the new towns are much preferred); 3) have been decided after Hong Kong become a Special Administrative Region under Chinese sovereignty (and hence, showcasing an increasingly pro-development stance since then, in response to development pressure due to a consistently-increasing populace); 4) has had less applications for the same land site in the past[46]; 5) requests for horizontal expansions of building structures than those for higher development density or the construction of taller buildings; and 6) involves more than one residential zones.

And for the three statutory zones in which residential development is permissible as a Column 2 use (i.e. CDA, GIC, and GB zones), the results show that a proposed development's probability to be approved is positively correlated with the development potential (in terms of GFA) in CDA zone, meaning that proposed developments either on a larger site or with a larger development potential are treated more favourably by the TPB than others. Additionally, the number of previous development applications on the same site, as expected, is found to be positively correlated with the current application's likelihood to be approved. This, however, only applies to GIC zone and GB zone, but not to CDA zone.

Besides the number of previous applications, several patterns have also been found to be shared among GIC zone and GB zone. For instance, the TPB is found to be

[46] This finding not only contrasts what is reported in Tang and Choy (2000), but also alludes to a flexible albeit ambiguous planning control process for this zone.

noticeably more lenient in approving an application when it proposes a commercial-residential development, in comparison with a residential-only development. Also, the TPB has been significantly more lenient in allowing the construction of residential units in GIC zone and in GB zone after Hong Kong's handover to China. Paradoxically, the approval rate of residential development applications in GIC zone is much lower after the HKSAR government's decision to rezone non-residential land sites for residential development. For CDA zone, on the other hand, the housing market variable has a negative, rather than positive, correlation with an application's probability to be approved, which suggests a seemingly anti-market stance taken by the TPB. And lastly, despite the emphasis on the provision of GIC facilities (at least in GIC zone and in CDA zone), the proposed provision of these facilities as part of the development does not necessarily enhance an application's likelihood to be approved.

To sum up, it is reasonable to conclude that, given the significance of various variables in explaining the probability for proposed residential development in GIC and GB zones to be approved, the implementation of land-use policies for these two statutory zones is generally more flexible and more responsive to development pressure; whereas for CDA zones, the TPB's planning control decisions have not been as flexible as those on development proposals in GIC and GB zones, in that they are not responsive to the government's priority to supply more housing units, and actually react negatively to upward housing price movements.

Grounded on the research findings, some implications relating to Hong Kong's land use policies, which require the attentions of the likes of government officials, urban planners, and developers, are worth discussing.

Firstly, for R(A) zone, it is revealed that the Town Planning Board's planning control decisions on proposed residential development are more likely to be rejected when housing price is rising. These findings reflect the TPB's stance against housing development in this zone, most of which located in the urban areas, as a result of growing property prices, which is essentially driven by a bullish Hong Kong stock market (which, in turn, has been increasingly susceptible to movements in global stock markets and in the global economy since the introduction of unconventional monetary policy measures such as the Quantiative Easing Programmes; see Appendix A) and the effects of U.S. monetary policy measures owed to the Linked Exchange Rate System (Chapter 2). While this anti-market stance is sound in the sense that the degree of development in these urban areas can be contained, despite the upward housing price adjustments, it is not able to help reduce housing prices. Additionally, as a rather large percentage of poorer people are residing in the high-density urban areas already (Hui and Yu, 2009; Hui et al., 2015), the TPB's tendency to reject applications for residential development in these areas, in view of soaring property price, would further exacerbate the problem of poverty concentrations, especially in some urban districts. This, hence, requires the attentions of different government agencies.

By contrast, the TPB has been more receptive towards proposed residential development with a higher plot ratio (and a higher GFA) in R(B) zones. A more intensified development means the relocation of more residents into these areas in the future. Inevitably, more supporting infrastructure (such as roads) and services (both commercial and community) are needed to meet the needs of a larger population size. Several land use-related implications would emerge. First, unless the encroachment into the surrounding areas which are not designated as residential is allowed, aiming to proffer these infrastructure and services, it is expected that a more intensified R(B) zone would exacerbate the existing problems relating to traffic congestion and noise/air pollution in these areas (also see Hui et al., 2015). Otherwise, the insufficient supporting infrastructure (and services) would only compromise the living standards of the residents.

And for R(C) zone, the TPB is found to be noticeably more lenient towards proposed residential development in areas outside rural New Territories (new towns in particular). In other words, development in low-density residential land in the new town areas (and to a lesser extent, the urban areas) is preferred by the TPB to development in rural New Territories. Considering that approximately 95% of people in Hong Kong live in either the urban areas or the new towns (Census and Statistics Department, 2012), the TPB's decisions would lead to a situation in which some areas become even more densely-populated whereas other areas are still undeveloped. As over 50% of all jobs in Hong Kong are available either on Hong Kong Island or in Kowloon Peninsula (Census and Statistics Department, 2012), the TPB's priority towards the development of residential properties within the low-density areas of new towns, if anything, exacerbates the already serious problems of work-residence mismatch (Hui et al., 2015) and of large-scale intra-regional commuting among Hong Kong residents (Hui and Yu, 2013), both of which discourage people to relocate to these areas despite lower living costs. The government, in this light, could introduce measures to provide additional incentives for businesses to relocate their operations to the new town areas, and thus providing more job opportunities for the residents.

As for property developers, the findings for R(C) zones illustrate the noticeable differences in terms of how applications for minor relaxations of density controls under the B(P)R are being decided. Despite the interrelations between plot ratio, site coverage, and building height (Table 4.4), applications seeking site coverage modifications are encouraged, but not those pursuing further intensifications of residential development and/or modifications of building height. Assuming the same land site, such differences illustrate the TPB's uncompromised stance towards the development of low-rise building structures. Yet, this stance deviates from the generally-praised (by urban planners) idea of a compact and high-density urban environment. In addition, the way "minor" relaxations of development controls are defined could be very interpretive and are subject to change overtime (as new TPB members are appointed in replacement of the incumbent members). These issues could render the planning control process concerning land sites in R(C) zone even less predictable to them (as well as to smaller developers), which in turn have implications as to their development strategies and the eventual supply of housing.

And for the remaining three land-use zones in which housing development is permissible upon the TPB's approval, first, for GIC zone, since the planning intention of these areas is primarily to provide GIC facilities to serve the needs of the community, the higher probability for a proposed commercial/residential development to be approved (as reflected by the positive coefficient for the CR variable), otherwise, suggests a rather flexible, if not obscure, definition of GIC facilities. Rather than the conventional understanding of GIC facilities, such as educational institutions, hospitals, exhibition/convention halls, libraries, public open space, and social welfare facilities, those involving commercial activities such as shops and malls appear to be considered by the TPB as "GIC facilities" as well, as long as they serve the needs of local residents. Nevertheless, the leniency towards approving residential development applications prior to the HKSAR government's policy to rezone non-residential land for residential development (corroborated by the significantly negative coefficients for the REZONE variable) points out that GIC sites, until the government's publicly-announced intention to make use of other non-residential land sites for housing development via re-zoning, had been viewed as an alternative source of land for housing constructions. As more residential development projects, despite comparatively small in scale, are being permitted to proceed, an increase in the number of residents in these areas in the near future is unavoidable. This, hence, leads to a dilemma for government town planners, in that either the living conditions in these areas would be compromised due to insufficient provision of GIC facilities and insufficient "breathing space" within a high-rise, high-density environment (thus deviating from the planning intention of GIC zone) or nearby non-GIC areas would be further encroached in order to compensate for the lack of these facilities.

For GB zones, since residential development, especially the construction of flats, is itself a form of urbanized development, the leniency of the TPB towards approving applications for housing development in GB zones when 1) the land site in question is partly residential (revealed through the positive coefficients of the RESZ variable) and 2) the proposed development is commercial-residential rather than residential-only (as reflected by the positive coefficients of the CR variable) encourages certain degrees of urban encroachment, as this inevitably leads to a larger population (and more vehicles) in greenbelt areas. Inevitably, in order to cater to the needs of the residents, the precedent for further development, be it commercial, residential, or GIC-related, would be set for GB zone, thus fundamentally deviating from the planning intention which is to safeguard the natural environment against urban encroachment.

Lastly, for CDA zones, the findings reveal that, as housing price climbs, the TPB, instead of allowing more housing units to be built, tends to contain the extent of these developments, despite the fact that numerous CDA sites in Hong Kong remain undeveloped (i.e. those without a MLP). Judging from the need for close monitoring of the development progress of these sites as stated in the TPB Guidelines for Designation of CDA Zones (Town Planning Board, 2016b), the stance adopted by the TPB in approving residential development in CDA zones, under these circumstances, could very well be the result of the authorities' concerns towards the potential 1) environmental impact, traffic impact, drainage impact, and sewerage impacts, 2) development mix, 3) over-development, and 4) over-concentration of residents. Taking into account the notoriously lengthy process of residential development inside CDA zones (see Lai et al., 2016), such careful management and planning of these areas, however, leads to continuous vacancy of land sites designated for CDA use despite escalating property prices.

This chapter has investigated the Town Planning Board's planning control decisions on the development of flats and ordinary houses in six different statutory land-use zones. However, as the transaction of the New Territories Exempted Houses (i.e. small houses) was deemed legal in 1997, these houses have since become an alternative source of housing for Hong Kong residents. Yet, the development of these houses, especially outside the Village Type Development zone, serves as a competing land-use against the development of flats and ordinary houses (as well as other types of development). How the TPB evaluates small house applications with reference to 1) soaring housing prices and 2) the government's priority to utilize non-residential land for housing development, thus, becomes an important research topic. In the next chapter, the TPB's planning control decisions on applications for small house constructions are to be studied.

CHAPTER 5: A STUDY OF HONG KONG'S PLANNING CONTROL DECISIONS ON APPLICATIONS FOR SMALL HOUSE CONSTRUCTIONS

5.1 Introduction

This is the second study that focuses on the Town Planning Board's planning control decisions. Unlike Chapter 4, the subject of this chapter, rather than the development of housing flats and/or ordinary houses, is a type of housing with a rich historical background due to Hong Kong's colonial past.

The New Territories Small House Policy, since its inception in December 1972, has been a unique yet controversial land-use policy. It, on the one hand, preserves the rights of (male) indigenous villagers descended through the male line from a resident in 1898 to build their own house on rural land within their village environs. On the other hand, as this policy is only applicable to a small fraction of Hong Kong's populace, it unavoidably becomes controversial, in that it highlights the innate conflict between the interests of these indigenous villagers, and the interests of everyone else's in terms of housing.

The HKSAR government, under the confines of the Small House Policy inherited from the Colonial Era and of the Basic Law (i.e. Article 40), is being put in a difficult situation in that it, through its town planning and land-use policies, has to preserve the indigenous villagers' rights without compromising those of the rest of Hong Kong's populace. Nevertheless, this task has become increasingly difficult due to mounting development pressures in recent years. On the one hand, more land sites are needed for high-rise residential development to address the current housing affordability issue (see

Chapter 1). On the other hand, more indigenous villagers become eligible for small house grants as they reach 18 years of age, meaning that small houses are consistently proposed to be built, many of which outside the village environs, in either Greenbelt zone or Agriculture zone (and to a lesser extent, the Unspecified zone). This prompts a fundamental problem as to how these undeveloped rural land sites should be used. Should they be developed or preserved? If development is the answer, then what should be built on these land sites? The government department responsible for making these decisions is the Town Planning Board (TPB). Nevertheless, as the innate characteristics of Hong Kong's planning control system allow for flexible interpretations of the Town Planning Ordinance (also see Chapter 4), a number of research questions, hence, arise:

- Are the Town Planning Board's planning control decisions on proposed small house (i.e. New Territories Exempted Houses) consistent with the government's stated housing policy objectives (to supply more land sites for housing development through re-zoning non-residential land)?
- Do the Town Planning Board's planning control decisions on proposed small house constructions respond to soaring housing price? If so, how?

This chapter, aiming to answer these questions, is designed to identify the statistical patterns, if any, of the TPB's planning control decisions on applications for small house construction on rural land in three statutory land-use zones under Section 16 of the Town Planning Ordinance:

- "Greenbelt" zone (GB);
- "Agriculture" zone (AGR); and
- "Unspecified" zone (UNSP)

through an econometrical analysis of the planning statistics from January 1st, 1990 to

April 30th, 2017.

The rest of the chapter is presented as follows: The next section (Section 5.2) first provides some background information for both the Small House Policy and the three statutory land-use zones under study. It is followed by a literature review section (Section 5.3) in which previous qualitative and quantitative studies on the Small House Policy is discussed. Then, Section 5.4 details the research methodology and the data necessary for this study. Afterwards, Section 5.5 presents and discusses the empirical findings, and the final section (Section 5.6) concludes the study.

5.2 Background

5.2.1 The Small House Policy

Prior to the discussion of the Small House Policy itself, some historical background regarding rural land in the New Territories should be presented. Before the Second Opium War, the area now referred to as the New Territories was under the governance of Chinese customary law, which was part of the Imperial Chinese Law (Hayes, 1988). Back then, in order to encourage human settlement, as long as a person, who acquired land that was not under the ownership of either the government or the Imperial Court, paid taxes on what was produced on the land, he was permitted to develop that land freely.

However, after Imperial China lost the Second Opium War to Great Britain, the *Convention Between Great Britain and China Respecting an Extension of Hong Kong Territory* (better known as the Conventional of Peking) was signed on June 9, 1898. According to this Convention, the British leased the New Territories for 99 years, effective on July 1, 1898. Under British occupation, the old customary law was replaced by British common law. All land, including those having been privatized (by means of occupation) by villagers prior to the signing of the Convention of Peking, was taken away from them. These land lots were then regranted to them as leasehold interests for 75 years[47] under the Block Crown Lease established in 1905. Under this arrangement, the land-holding villagers were stripped of some of their customary rights, as all new development of their land required permission from the Colonial government (see Lai and Lorne, 2013).

Later, in the 1970s, in response to the rapid growth in Hong Kong's population, the Colonial government commenced the development of new towns in the New Territories. This inevitably compromised the interests of the indigenous villagers even further. According to Lai (2000), in order to appease them, some of their customary rights, with regard to the use of their land currently under the leasehold system, were returned to them, through the introduction of the New Territories Small House Policy in December 1972[48].

Under this policy, male indigenous villagers over the age of 18, who are descended through the male line from a resident in 1898 of a recognized village within one of the nine districts of the New Territories (i.e. Islands, North, Sai Kung, Shatin, Tuen Mun, Tai Po, Tsuen Wan, Kwai Tsing, and Yuen Long)[49], are eligible for the application for a grant to build a small house, at their own expenses, on rural land within the Village

[47] This is renewable for another 24 years minus three days at a reassessed Crown Rent, making the expiry date June 28, 1997 (i.e. 3 days before Hong Kong's handover to China).
[48] Another possible reason for the establishment of the Small House Policy, in accordance with Nissim (1998), is to compensate the villagers for keeping the peace during the 1967 riot.
[49] Currently, 642 villages are recognized under the New Territories Small House Policy.

Type Development Area (V) zone and the environs or the village extension area (VE), up to 300 feet of a recognized village (Lands Department, 2014).

For those who own land within these areas, they can apply for either 1) a building licence at zero premium or 2) a land exchange for a land site owned by the government should the private land in question not be suitable for house construction. By contrast, for those who do not own land in these areas, they can apply for a government land site at a concessionary premium of two-thirds of the full market value. This is known as a private treaty grant (PTG). Regardless of the ownership status of land sites on which small houses are proposed to be built, however, all small house grants are subject to varying degrees of alienation restriction (Table 5.1), with the expressed purpose of preventing indigenous villagers from "cashing in on their eligibility for the small house grants" (Audit Commission, 2002).

<table>
<tr><th rowspan="2">Type of small house grant</th><th rowspan="2">Operative period of restriction</th><th colspan="3">Removal of restriction</th></tr>
<tr><th>Within Years 1-3</th><th>Within Years 4 & 5</th><th>After 5 Years</th></tr>
<tr><td>Building Licence</td><td>5 Years</td><td colspan="2" rowspan="2">Permitted upon the payment of full market value premium (Note)</td><td rowspan="2">No restriction</td></tr>
<tr><td>Land Exchange</td><td>5 Years</td></tr>
<tr><td>Private Treaty Grant (PTG) (VEA Scheme)</td><td>Perpetual</td><td>Not permitted</td><td colspan="2">Permitted upon the payment of full market value premium (Note)</td></tr>
<tr><td>Other PTGs</td><td>Perpetual</td><td colspan="3">Permitted upon the payment of full market value premium (Note)</td></tr>
</table>

Table 5.1: Restriction on alienation for small house grants by type (Source: Audit Commission, 2002)

Note: A discounting factor is applied by the Lands Department in the calculation of the premium.

Officially, a small house is called the New Territories Exempted House (NTEH). The reason a small house is "exempted" is because, unlike other types of residential development (i.e. flats and ordinary houses), the construction of small houses is not subject to the regular Buildings Ordinance (and the Building (Planning) Regulations). Instead, the Buildings Ordinance (Application to the New Territories) Ordinance (Cap 121) provides the blueprint as to how small houses should look like. Under this Ordinance, a small house shall

- have three storeys or less;
- not be higher than 27 feet (or 8.23 metres); and
- not have a roofed-over area of more than 700 sq. ft. (or $65.03m^2$) (Lands Department, 2014).

In other words, under the Small House Policy, an indigenous villager is entitled to the right to build a house with the maximum allowable GFA of 2,100 sq. ft. ($195.09m^2$)[50], which is by no means "small" (Lai, 2000).

Despite its "exempt" status, the construction of small house, like other types of development, is subject to the Town Planning Ordinance. While the development of small houses completely inside the V zone is always permitted (as a Column 1 use), the TPB's approval is necessary when 1) more than 50% of the proposed small house's footprint falls outside the V/VE zone or 2) the land site in question encroaches on conservation-related zones, greenbelt zone, open space zone, water-gathering grounds, and areas shown as "road" (Town Planning Board, 2007).

While a male indigenous villager, under the New Territories Small House Policy, is

[50] According to the definition used by the Rating and Valuation Department, a small house should belong to Group E, which consists of the largest residential properties in Hong Kong.

entitled to one small house grant in his lifetime, the property rights to which he is entitled over his small house had been rather ambiguous since the introduction of the policy. It was until the 1990s that this was legally clarified. In a Court of Appeal verdict made for the case *Sung Wai Kiu and Li Pui Wan vs. Wong Mei Yin* (H.C. No. A 3979/94) on January 17, 1997, it reads "Despite the fact that sale and purchase of small house is in breach of conditions of grant, the government has never taken any positive action against such activities. From the angle of public interest and public policy, it is not really necessary to deem it illegal." If anything, this court decision constitutes an institutional change, in that it both legalizes the resale of small houses (to non-indigenous villagers) and proffers a clearer delineation of indigenous villagers' property rights.

5.2.2 The Statutory Land-use Zones

As mentioned in Section 5.2.1, the Colonial government, upon "leasing" the New Territories from Imperial China in 1898, introduced the Block Crown Lease, under which previously occupied (i.e. privatized) agricultural/village house land was converted to leasehold interests, thereby restraining the landowners' rights to develop. Rural land in the New Territories was divided into different Demarcation District (DD) plans which are still in effect to this day. Under the Block Crown Lease, development of land sites within these DD plans required permission by the Colonial government.

Nevertheless, on paper, the Block Crown Lease appears to have controlled "development" of rural land under its jurisdiction, but not necessarily other types of land-use without the erection of building structures. This issue was highlighted in the Court of Appeal decision, made in March 1983, for *Attorney General vs. Melhado*

Investment Ltd. (CACV79/1982). Better known to the public as the Melhado case, it involved the conversion of agricultural land, under the jurisdiction of the Block Crown Lease, for open storage use. The Court ruled that lessees of agricultural land had the rights to use it for open storage purpose, as long as no building works, subject to the jurisdiction of the Buildings Ordinance, were conducted. In accordance with Lai and Ho (2002), this verdict proffers a legal interpretation as to the property rights possessed by leasehold owners of the New Territories' agricultural land. Though the Court decision for the Melhado case, from an economics standpoint, improved efficiency in land-use, it had given rise to the proliferation of open-storages in previously-abandoned agricultural land in the New Territories, in turn leading to traffic congestions, land degradations, aesthetic concerns, as well as environmental issues.

Aiming to address this particular legal loophole, the Town Planning Ordinance (Cap. 131) was passed in 1991. Under this Ordinance, the rights previously granted to leasehold owners of agricultural land were once again taken away from them without compensations (Fischel, 1995), as the government, with the expressed goal to contain "unauthorized development", first gathered these rural land sites together and placed them into the newly-created Interim Development Permission Area (IDPA) Plan. Any kind of development inside the IDPAs, other than existing uses, requires the TPB's permission. The IDPA plans become the Development Permission Area (DPA) plans after 12 months, and then are incorporated into the rural Outline Zoning Plan (OZP) in approximately 3 years (Lai and Ho, 2002). Rural land within either the IDPA plan or the DPA plan, be it cultivated or abandoned, is categorized as "unspecified" (UNSP) use (Chau and Lai, 2004). It is only after the IDPA/DPA plans are incorporated into the rural OZPs that a more specific land-use is assigned to these land, mostly either

"Agriculture" (AGR) or "Greenbelt" (GB) (Lai and Ho, 2002).

Both AGR and GB zones are designated to have a general presumption against development. While the intention of establishing the Agriculture zone is to conserve farmland, despite the very minor role primary industries have played in Hong Kong's economy in the previous decades, the official aim of the Greenbelt zones is "primarily to promote the conservation of the natural environment and to safeguard it from encroachment by urban-type developments" (Town Planning Board, 1991).

While the Agriculture zone appears self-explanatory, the Greenbelt zone, especially the Hong Kong version of it, is anything but that, based upon the conclusions reached in numerous previous investigations (see for instance, Lai and Ho, 2001a; 2001b; Tang et al., 2005; Tang et al., 2007). The notion of greenbelts as buffers for urban concentrations, in accordance with Home (1997), was largely derived from Colonel William Light's plan for Adelaide, which was then evolved into Ebenezer Howard's concept of garden city (Hall, 1996).

It is believed by several researchers (see Lai, 1999; Tang et al., 2005; Tang, et al., 2007) that the idea of greenbelts was introduced to Hong Kong, in response to the 1948 *Abercrombie Report*. In the report, it was recommended that the Colonial government devise relevant policies to conserve the countryside. This was subsequently substantiated with the release of the *Talbot Report* (Talbot and Talbot, 1965), which suggested that the classification and conversation of the countryside can be accomplished by means of zoning.

However, in view of Hong Kong's very limited (developable) land resources, two questions inevitably arise:

- What are the actual purpose(s) of Hong Kong's GB zones?
- Are Hong Kong's greenbelt policies as stringently applied as they are in other nations, such as Great Britain?

A pair of in-depth studies on Hong Kong's greenbelt policy conducted by Tang et al. (2005) and by Tang et al. (2007) reveal that GB zone was actually incorporated in some of the earliest statutory land-use plans back in the 1960s, and that the use of greenbelts as passive recreation outlets has always been stated as one of the intentions for this zone in the statutory plans. The notion of creating greenbelt zones for conservation purpose did not come about until the 1990s, as it was explicitly stated in the 1991 Town Planning Ordinance. Unlike the practices in other nations such as South Korea (Gibson, 1999), however, greenbelt zones in Hong Kong are far from development-free (Home, 1997), as a variety of land-uses are either always permitted (as Column 1 use) or permissible upon the Town Planning Board's approval[51]. This is particular the case when development pressures call for conversions, rather than conversations, of greenbelt sites. Besides, rather than being universally applied, Hong Kong's greenbelt policy is found to vary geographically. An investigation by Tang et al. (2007) reports that the objective to contain urban sprawl in GB zones in Hong Kong has been much loosely applied to regions such as the Metropolitan Area and South West New Territories, but not the rest of the New Territories. These previous findings, if anything, indicate that greenbelt policies in Hong Kong are noticeably more flexible and ambiguous; and that GB zones in Hong Kong, rather used for definite conservation of the countryside, are transitory

[51] Also, unlike Great Britain and South Korea, Hong Kong's GB zone is too scattered geographically to serve as an actual spatial "buffer" to curb urban encroachment/sprawl (Tang et al., 2005).

in nature, in that the development in which is subject to other policy needs.

5.3 Literature Review

Previous studies about the New Territories Small House Policy have been conducted either qualitatively or quantitatively. On the one hand, the qualitative studies have mostly discussed the controversies surrounding the policy from a variety of aspects. On the other hand, the quantitative studies have primarily focused on the Town Planning Board's planning control decisions on applications for small house construction, usually compared with other competing land-uses, in different statutory zones. This section proffers a review of these studies separately.

5.3.1 Controversies surrounding the Small House Policy

5.3.1.1 Inequality against women and non-villagers

As stated in Section 5.2.1, the small house policy is exclusive to male indigenous villagers over the age of 18, who are descended through the male line from a resident in 1898 of a recognized village. To put it differently, through this policy, the interests of male indigenous villagers from the 642 recognized villages are prioritized over those of two specific groups of people: 1) non-indigenous villagers and 2) female indigenous villagers. It is pointed out by Lai (2000) that the Small House Policy, from which only a fraction of Hong Kong's population benefits by virtue of their gender and birth, is fundamentally at odds with the Hong Kong Bill of Rights Ordinance (Cap. 383), particularly Articles 1 and 22.

To non-indigenous villagers, an indigenous villager's right to build a NTEH as large as 2,100ft^2 is discriminatory, in the sense that the Small House Policy confers a wealth transfer, through resale, that is exclusive to indigenous villagers (Nissim, 1998; Lai, 2000). Nevertheless, it is argued that, despite being granted the exclusive right to build a small house, indigenous villagers are in some ways a disadvantaged population group, as the government has not provided as much subsidies to non-indigenous villagers for building small houses as to non-indigenous villagers (via the development of new towns, public housing, as well as municipal works and infrastructure) (Wong, 1998; Lai, 2000; Hopkinson and Lao, 2003). It is also argued that, as the majority of small houses are built on private land at the indigenous villagers' own expenses, the resale of these houses is simply them exercising their property rights the same way ordinary homeowners sell their flats to others. According to Lai (2000), it is only the transaction of small houses built on government land, under one of the PTGs, that might constitute the problem of unfair wealth transfer.

To female indigenous villagers, the situation is a bit more complicated when other factors are considered. On paper, the right to build a small house being exclusive to male indigenous villagers constitutes gender inequality. This issue has even attracted attentions from outside Hong Kong. According to a report issued by the United Nations Economic and Social Council in December 1994, it reads "The Committee notes with concern that the Government's proposed legislation on sex discrimination includes a number of exclusions and exemptions, in particular the so-called small-house policy, which discriminate against women." The proposed legislation in question is Schedule 5 of the Sex Discrimination Ordinance (SDO) (Cap. 480), in which it is stated that "Any discrimination between men and women arising from that policy of the Government (a) known as the small house policy; and (b) pursuant to which benefits relating to land in the New Territories are granted to indigenous villagers who are men." Even though the government's decision to cater to the male indigenous villagers' interests is undeniable, granting female indigenous villagers the same rights, for the sake of gender equality, is equally problematic as it inevitably leads to an immense increase in the number of small house applications. This in turn has very profound land-use implications, which are to be discussed in the following section.

5.3.1.2 Land-use Implications

Another major criticism towards the Small House Policy concerns its innate unsustainability (see Lai, 1999b; 2000). As the indigenous villager population grows over time, the number of people eligible for small house grants increases. Thus, more land is required to accommodate their interests under the Small House Policy. While this does not pose an issue should these small houses be constructed on private land, this has profound implications for the use of government land in areas surrounding the recognized villages, as they can otherwise be used for the development of medium or high-rise residential buildings to meet the housing needs of Hong Kong residents (including the indigenous villagers themselves) (Nissim, 1998). This, in turn, promotes the interests of indigenous villagers at the expense of everyone else's. Besides, as land resources within the V/VE zone become increasingly scarce due to more intensified small house development, planning problems arise as indigenous villagers request the construction of their small houses outside the V/VE zone (especially Agriculture zone and Greenbelt zone). As there exists no systematic and comprehensive planning for the development of a particular area as a whole (and for controlling the spread of small houses), the Small House Policy gives rise to what Bristow (1984) calls "the gradual growth of incipient suburban sprawl."

5.3.1.3 Property rights issues

Another issue is related to the transaction of these small houses. Despite the inclusion of alienation restrictions in the transaction of small houses, a review of this policy conducted by the Audit Commission in 1987 first reveals that indigenous villagers tended to sell their small houses soon after the certificates of compliances (CCs) were issued, thereby taking advantage of their (exclusive) eligibility for small house grants financially[52]. The Audit Commission's subsequent review of the policy in 2002 (Audit Commission, 2002) reaches similar conclusions. Yet, as mentioned earlier in this literature review section, since the majority of these small houses are built on private land at the villagers' own expenses, albeit officially as leasehold owners under the Block Government Lease (previously known as Block Crown Lease), the resale of small houses that are not built on government land is their way of exercising their property rights. Also, considering that the government had, prior to the *Sung Wai Kiu and Li Pui Wan vs. Wong Mei Yin* case verdict, done virtually nothing to stop these activities, the resale of small houses should not be deemed illegal. Further, from an economics standpoint, transactions of small houses improve land use efficiency (Lai, 2000).

While the transaction of small houses themselves, especially after the Court of Appeal decision on the *Sung Wai Kiu and Li Pui Wan vs. Wong Mei Yin* case, can be said as a legitimate way for indigenous villagers to exercise their property rights on their own land, the Small House Policy presents an exploitable loophole, due to the ambiguity concerning the extent of property rights to which indigenous villagers are entitled.

[52] A 3-year moratorium clause on the removal of the alienation restriction was added, in response to the 1987 Audit Commission Review, to applications for small house construction on government land under the Village Expansion Area Scheme.

Apparently, to some indigenous villagers, having the exclusive right to build (and then sell) a small house on either private land or government land also means that this exclusive right itself can be transacted. The Audit Commission, in its 1987/2002 Reviews of the Small House Policy, identifies cases of indigenous villagers selling this exclusive right to property developers for a windfall profit, which makes large-scale small house development possible. Unlike the transaction of actual small houses, many of which built on private land, the transaction of the right itself constitutes an unfair transfer of wealth to 1) villagers who sell the right; and 2) those who are not supposed to be the beneficiaries of the Small House Policy, such as property developers.

5.3.2 The Town Planning Board's Planning Control Decisions on Small House Applications

Unlike the qualitative studies that have focused on the criticisms towards the Small House Policy, previous quantitative studies on this policy, instead, have concentrated on the planning control decisions made by the TPB, under Section 16 of the Town Planning Ordinance, on applications for small house construction in a variety of statutory land-use zones. In these studies, planning statistics are evaluated with the assistance of econometric modeling, such as discrete choice models, popularized in the 1990s by Willis (1995) and Bramley et al. (1995).

Two of the earlier investigations in this regard are conducted by Lai and Ho (2001a; 2001b). The first study (Lai and Ho, 2001a) concerns the TPB's planning control decisions on proposed small house constructions in GB zone and in UNSP zone. The authors reveal that the TPB has a tendency to approve applications with a lower Gross Floor Area (GFA) in both statutory zones; and that applications for small house construction on land sites included in a DPA plan are more likely to be rejected. On the other hand, the authors' second study (Lai and Ho, 2001b) compares the TPB's decisions on applications for small house construction with applications for ordinary house development in GB zone. Unlike their first study, a proposed development's GFA is not a significant factor in explaining the TPB's decisions. Nonetheless, the TPB appears to find small house constructions in GB zone more preferable than ordinary house constructions. This finding reflects the planning authorities' tendency to protect the rights of indigenous villagers by catering to their interests.

Another study carried out by Chau and Lai (2004), rather than GB zone and UNSP zone, investigates the TPB's planning control decisions on applications for 1) small house construction and 2) open storage use (for containers) in AGR zone instead. The authors first find that the construction of small houses in this statutory zone is preferred by the TPB over open storage use. Then, similar to Lai and Ho (2001a), proposed developments 1) with a lower GFA and 2) in Sheung Shui, Fanling, Tai Po, and Yuen Long have a higher likelihood of being approved. And lastly, the TPB is found to go against the exogenous government housing-related policies when deciding applications for either small house construction or open storage use.

Another group of researchers (Tang et al., 2005; 2007) have also studied the Small House Policy in GB zone. Their first study, on the development of both low-rise housing and small houses, reports that large-scale development of small houses are much more likely to be rejected by the TPB, which concurs with the finding of Lai and Ho (2001a). Also, the authors find that TPB's planning decisions are subject to housing market conditions, in that applications are more likely to be approved when housing supply is high. Similar to Lai and Ho (2001b), there are significant differences in terms of the approval rates of applications for housing development between districts. Specifically, the approval rates of housing development applications in Sheung Shui and in Tai Po are higher than others. Their second investigation, also about GB zone, focuses on four types of proposed land-use, namely small house, ordinary house, residential (i.e. flats), and open storage. Concurring with Lai and Ho (2001b), applications for the construction of small houses (or ordinary houses) have noticeably higher approval rates than those for residential development and for open storage use. The authors also find that small house applications are more likely to be approved if they are proposed to be built on land sites involving GB zone and other development-oriented land-use zonings. By contrast, the size of the land site is not found to be a significant factor in explaining the TPB's decisions.

5.4 Research Methodology & Data

5.4.1 The Model

As the objective of this chapter is to analyze the TPB's planning control decisions on applications for small house constructions, under Section 16 of the Town Planning Ordinance, with non-aggregate planning statistics. Therefore, similar to the study of the TPB's planning control decisions on residential development in the previous chapter, probit models are used as the methodology (see Section 4.5.1 for a description of the model).

The dependent variable of the model (Y) is the TPB's decision, which is either an approval; or a rejection. As such, approved applications are assigned with the number "1" and rejected ones "0". It is to be regressed on a vector of independent variables (x) (to be discussed in the subsequent sections) in order to assess their respective impacts on the likelihood of an application to be approved.

As for the explanatory variables to be included into the probit models, they can be categorized into three groups, consisting of site-specific variables, location variables, and exogenous variables.

5.4.1.1 Site-specific variables

Seven site-specific variables are included in this study. The first, and arguably the most important, factor to be considered is the size of the proposed small house development itself. Based on the previous studies on the TPB's decisions on small house applications, either Gross Floor Area (GFA) (Lai and Ho, 2001a; 2001b; Chau and Lai, 2004; Tang et al., 2005) or Gross Site Area (GSA) (Tang et al., 2007) is used as an indicator, with varying results. However, given that the maximum allowable GFA for a small house is stipulated at 195.09m² according to the Buildings Ordinance (Application to the New Territories) Ordinance (Cap 121), the use of GFA would be problematic as it does not take the size of the land site into account. It would also be equally problematic to use GSA, as it does not take into consideration the number of houses proposed to be built (if the site in question is large enough for multiple small houses to be built on). Therefore, in this study, rather than including either GFA or GSA, four separate variables are introduced. The first variable is a numerical variable that represents the GSA per small house (GSAPH) in the application; and the other three are binary dummy variables which denote the number of houses proposed by the applicant to be constructed on a given site (HOUSES): 1) 2-5 houses; 2) 6-10 houses; and 3) more than 10 houses. Such a selection of variables is believed to lead to a better understanding as to how the TPB views the construction of small houses, with reference to the amount of land resources involved and the number of small houses to be erected.

Then, based upon Tang and Choy's (2000) finding that a higher number of previous applications for the development of a particular land site leads to a higher likelihood of the current application to be approved, a numerical variable, PPA, is introduced, and a positive correlation between this variable and an application's likelihood to be approved is expected. The rationale is that, the TPB's interpretation as to how a land site should be developed is revealed to an applicant through its decisions (and comments provided alongside these decisions). Thus, it becomes more predictable for owner(s) of the land site in question in terms of the criteria the planning authorities would focus on.

Also, as planning permissions by the TPB are only necessary when more than 50% of a proposed small house's footprint falls outside the V/VE zone (Town Planning Board, 2007), it results in two different scenarios: the proposed small house's footprint is either 1) partly within the V/VE zone or 2) completely outside the V/VE zone. In order to find out if there are any statistical differences in the probability of approval for applications between these two scenarios, a dummy variable named VZONE is hence established to distinguish proposed small houses that are partly within the V/VE zone ("1") from those entirely outside the V/VE zone ("0").

Furthermore, with reference to the various small house grants for application depending on the ownership status of a land site, two dummy variables are introduced to assess whether the TPB is more lenient in its decisions towards one over the other. While the first variable is applicable to proposed small house(s) on a site that partly involves government land (PARTGOVT), the second variable applies to proposed small house(s) on government land only (FULLGOVT).

The final site-specific variable is related to the proposed size of the small house(s). Even though the Buildings Ordinance (Application to the New Territories) Ordinance (Cap 121) permits an indigenous villager to build a small house as large as 195.09m², a closer look at the small house applications suggests that some applicants, instead, have proposed a smaller GFA for their NTEHs. Are these applications more likely to be approved by the TPB? To answer this question, a dummy variable, NSH (i.e. Non-standardized House), which refers to a proposed small house smaller than 195.09m², is hence included in the models.

5.4.1.2 Location variables

Considering that there are 642 recognized villages in nine districts under the Small House Policy, several location variables are incorporated into the discrete choice models, with the aim to find out if there are significant differences between the approval rates for small house construction applications between these districts. A closer look at the full data sample, which includes more than 4,000 applications since January 1990, reveals that the vast majority of these small houses are proposed to be constructed in either one of these three districts: 1) Tai Po, 2) North, and 3) Yuen Long (Figure 5.1). In light of this observation, three location dummy variables, TAIPO, NORTH, and YUENLONG, are thus introduced to compare the chance of success for small house construction applications amongst these districts.

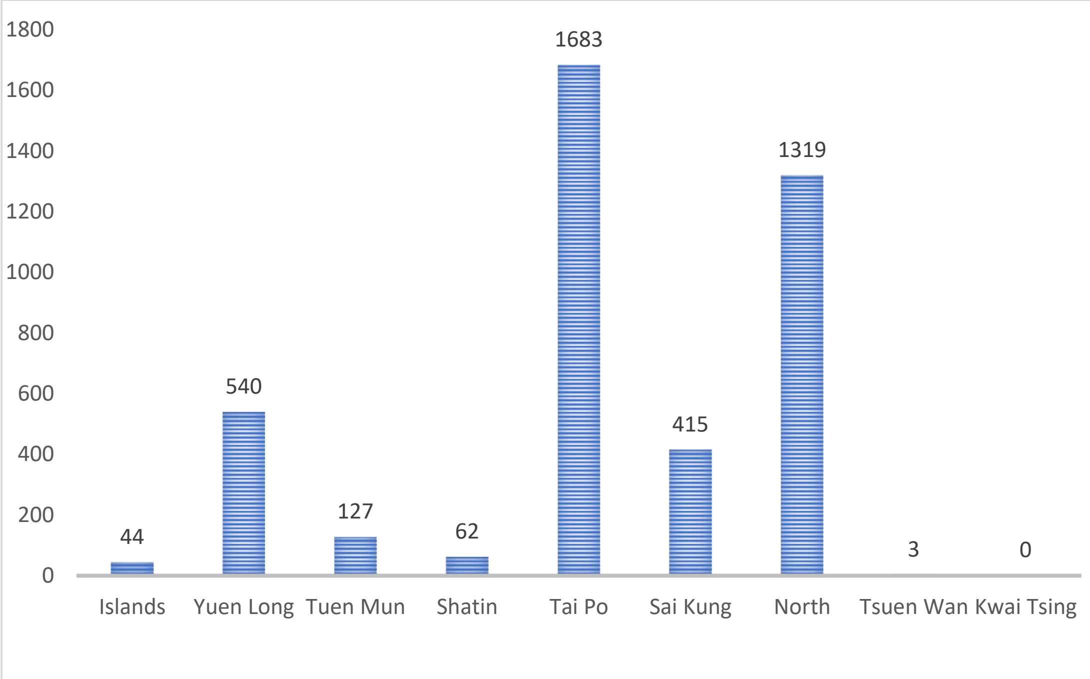

Figure 5.1: Number of small house applications decided by the TPB under Section 16 of the Town Planning Ordinance by District (January 1st, 1990-April 30th, 2017)

5.4.1.3 Exogenous Variables

Besides the factors directly related to the application itself, four exogenous variables are to be considered. The first one is related to the government announcement, in response to mounting development pressure, to supply additional land for residential development by means of rezoning non-residential land sites (such as Agriculture, Industrial, GIC, and GB sites). This has been explicitly stated in seven *Policy Addresses* (i.e. 1997, 2010, 2011, 2013, 2014, 2015, 2016, and 2017) since Hong Kong's handover to China (see Table 4.9). In order to gauge whether this housing policy change yields any impact on the TPB's planning decisions on small house applications, a dummy variable, REZONE, is thus established[53]. Planning control decisions on small house applications made by the Town Planning Board:

[53] This variable is similar to the POLICY variable introduced in Lai and Ho (2001a; 2001b). Nevertheless, in these two studies, the variable represents the government policy to "draw up a package of measures to simplify and streamline various government planning, land and building approval processes for residential development", rather than the decision to rezone non-residential land sites for residential development which was also stated in the *1997 Policy Address*.

- Between October 8th, 1997 (i.e. the day when the 1997 Policy Address was delivered) and October 6th, 1998 (i.e. the day before the 1998 Policy Address was delivered)
- From October 13th, 2010 onwards (i.e. the day when the 2010-11 Policy Address was delivered)

are designated as "1", whereas the others are coded as "0".

By contrast, the second variable depicts another exogenous government housing policy launched under very different circumstances. Housing price had been consistently falling in the years after the Asian Financial Crisis[54], and there was an over-supply of housing flats in the market. In order to rectify this supply-demand imbalance, on 13th November 2002, the suspension of land sale, as well as the application list, was announced by the Secretary for Housing, Planning and Lands. It was eventually lifted by December 2003. How does this policy influence the TPB's decisions to approve planning applications for the building of small houses during this period? The dummy variable of SUSPEND, is established to explore the impact, if any, of this short-lived policy on the TPB's planning control decisions.

Then, in view of the previous findings of the influence of a variety of market factors on the TPB's planning control decisions on different types of proposed development (Tang and Choy, 2000; Tang et al., 2000; Lai and Ho, 2002a; Tang et al., 2005), a variable which depicts the conditions of Hong Kong's housing market is to be taken into account. Unlike Tang et al. (2005) in which housing supply is used as an indicator of housing market conditions, this study uses housing price movements instead. The dummy

[54] By late 2002, housing prices had fallen by some 60% compared to their previous peak levels in 1997.

variable, UPM, is established for this purpose, as “1” is assigned to applications with decision made when housing price in the previous quarter (i.e. the most updated housing price information available) demonstrates a growth compared with housing price a year before; and “0”, by contrast, is assigned to those with decisions made by the time when property price in the previous quarter is lower than property price a year before.

Lastly, the resale of small houses, albeit having been acknowledged as early as the late 1980s in the 1987 Audit Commission Report, was officially permitted with the Court of Appeal verdict on the *Sung Wai Kiu and Li Pui Wan vs. Wong Mei Yin* case, made on January 17th, 1997. This court decision constitutes an institutional change as the indigenous villagers' (property) right to sell their small houses has been clarified. One question arises as how the TPB responds to this institutional change when deciding planning applications for small house constructions. The dummy variable, POSTCAD, is thus created to compare the Town Planning Board's decisions in this regard after the verdict with those made before it.

A summary of these selected variables is provided in Table 5.3 below.

Variable	**Description**	**Type**	**Expected relationship with the dependent variable**
Site-Specific Variables			
GSAPH	Gross site area per small house (m^2) (in Natural Log form)	Numerical	-
HOUSES	The amount of (proposed) small houses to be constructed in the application, in three binary variables: 1) 2-5 houses 2) 6-10 houses 3) more than 10 houses	Dummy	/
PPA	Amount of previous applications for the same site	Numerical	+
VZONE	1 denotes a proposed small house located partly within the Village Type Development Area (V) zone; and 0 otherwise	Dummy	+
PARTGOVT	1 denotes a proposed small house on a site that partly involves government land; 0 otherwise.	Dummy	-
FULLGOVT	1 denotes a proposed small house that is completely on government land; 0 otherwise.	Dummy	-
NSH	1 denotes a proposed small house that is smaller than the maximum allowable size (i.e. a 3-storey house with a total GFA of 195.09 m^2); and 0 otherwise	Dummy	/
Location Variables			
NORTH	1 denotes an application for the construction of a small house on a site located in North District (including Fanling, Sheung Shui, Sha Tau Kok, and Ta Kwu Ling); and 0 otherwise	Dummy	/
TAIPO	1 denotes an application for the construction of a small house on a site located in Tai Po District; and 0 otherwise	Dummy	/
YUENLONG	1 denotes an application for the construction of a small house on a site located in Yuen Long District; and 0 otherwise	Dummy	/
Exogenous Variables			

REZONE	1 denotes planning control decisions made by the TPB after the announcement by the Chief Executive to rezone non-residential land for residential use; and 0 otherwise	Dummy	-
SUSPEND	1 denotes planning control decisions made by the TPB after the announcement to suspend land sale/auctions; and 0 otherwise	Dummy	+
UPM	1 denotes an application with decision made when there is an upward price movement for Hong Kong residential properties; 0 denotes an application with decision made when there is a downward price movement for Hong Kong residential properties	Dummy	/
POSTCAD	1 denotes planning control decisions made by the TPB following the Court of Appeal decision on *Sung Wai Kiu and Li Pui Wan vs. Wong Mei Yin* (i.e. July 17th, 1997); and 0 otherwise.	Dummy	/

Table 5.3: A summary of the selected variables

5.4.2 The Data

In order to evaluate, statistically, the Town Planning Board's planning control decisions on small house construction applications, the planning permissions data, available online at the TPB's Statutory Planning Portal (SPP), is essential. The SSP contains records of planning applications submitted to the Town Planning Board, in which information of the proposed development, as well as the TPB's decision (with reasons), is proffered. Since January 1990, there have been more than 4,000 applications for small house construction under Section 16 of the Town Planning Ordinance. However, as this study focuses upon Greenbelt, Agriculture, and Unspecified zones, only 3,961 cases (approximately 94.5% of all applications seeking permissions from TPB to build small house[s]) are selected for the analysis. In addition, as housing price movements are being considered in this study, property price data is thus needed. It is based upon the Property Price Index (PPI), compiled and published by the Rating & Valuation Department (RVD).

5.5 Research Findings

5.5.1 Descriptive Statistics

The descriptive statistics of planning applications for the building of small house(s) are presented in Table 5.4 below. It is first reported that applications for small house construction, generally, have a higher rate of approval in AGR zone, followed by GB zone which is around 58%. By contrast, close to 48% of all small house applications in UNSP zone are rejected by the TPB.

Of the site-specific characteristics of the sampled small house applications, the mean Gross Site Area of UNSP sites on which small house(s) are proposed to be built is much larger than that of sites in GB zone and in AGR zone. Taking the amount of small houses proposed to be constructed, however, while the mean Gross Site Area per house remains the highest on UNSP sites, the GSA per small house in GB zone is noticeably lower than that on AGR sites. On the other hand, the mean number of previous applications on the same site in GB zone higher, in comparison with that in AGR zone and in UNSP zone, respectively. Also, the number of applications that seek for the construction of more than one small house in a single application in GB zone (more than 20%) is much higher than that in the other two statutory zones under study.

As for the other site-specific variables, the statistics indicate that less than 5% of the proposed small houses in UNSP zone are partly within the V zone, compared to more than 20% in the other two statutory zones. In contrast, approximately 30% of proposed small houses within the GB zone at least partly involve government land, whilst 95% and 90% of small house applications in AGR zone and in UNSP zone, respectively, only involve private land. Also, a slightly higher proportion of small houses proposed to be built on GB sites are smaller than 195.09m^2.

Geographically speaking, the vast majority of proposed small houses in the three statutory land-use zones are located in North, Tai Po, and Yuen Long districts. While the vast majority of proposed small houses in GB zone are within the Tai Po district, most of the small houses are proposed to be built on agricultural land in either North district or Tai Po district. Lastly, approximately 57% of proposed small houses in UNSP zone are located in either North district or Yuen Long district.

With respect to the housing policy variables, more than 37% of small house applications in GB and AGR zones have been decided by the TPB when the government explicitly calls for rezoning non-residential land for residential development. Meanwhile, the proportion of small house applications on UNSP sites is much lower. In fact, no small house applications involving UNSP sites had been decided by the Town Planning Board during the time when the government suspended the supply of land by means of land auction/tender.

Interestingly, close to 95% of small house applications in UNSP zone are determined by the TPB when property price is rising, compared to less than 70% in both GB zone and AGR zone; whereas more than 80% of small house applications in GB zone and in AGR zone have been decided in the aftermath of the Court of Appeal decision on the

Sung Wai Kiu and Li Pui Wan vs. Wong Mei Yin case, in comparison of only 10% in UNSP zone.

Statutory Zone	**GB**		**AGR**		**UNSP**	
Approval Rate	**57.9%**		**72.2%**		**51.9%**	
Site-Specific Variables (Numerical)						
Variable	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**
GSA (in m²)	400.60	1453.9	268.11	553.38	553.42	2219.1
GSA per small house (in m²)	157.63	155.22	180.23	145.53	188.37	171.15
PPA	0.36	0.782	0.32	0.675	0.16	0.404
Site-Specific Variables (Dummy) (in percentage)						
2-5 Houses	15.0		8.7		8.0	
6-10 Houses	4.4		2.1		3.4	
>10 Houses	1.9		0.5		4.2	
VZONE	31.3		21.5		4.4	
PARTGOVT	12.2		2.2		3.1	
FULLGOVT	18.0		2.9		7.3	
NSH	6.8		1.7		3.3	
Location Variables (in percentage)						
NORTH	11.4		42.6		29.9	
TAIPO	53.8		42.3		20.7	
YUENLONG	5.6		10.6		26.9	
Exogenous Variables (in percentage)						
REZONE	37.3		41.6		10.1	
SUSPEND	3.0		3.2		0	
UPM	69.4		62.1		94.6	
POSTCAD	80.8		84.2		10.3	
N	**1,018**		**2,330**		**613**	

Table 5.4: Descriptive statistics of the data sample by statutory zone

It should be noted that, since no small house applications in UNSP zone had been decided by the TPB when land sale was suspended, and since the REZONE and POSTCAD variables for this statutory zone are significantly positively correlated (which could result in multicollinearity issues), both REZONE and SUSPEND dummy variables are therefore not included in the final probit model for UNSP zone.

5.5.2 Probit Model Results

The findings obtained from the three separate Probit models are illustrated in Table 5.5 below, which are to be discussed in separate sections.

Statutory Zone	**GB**	**AGR**	**UNSP**
Site-Specific Variables			
GSAPH	-0.285**	-0.445**	0.135
2-5 Houses	-0.004	-0.019	-0.185
6-10 Houses	-0.516*	-0.457*	-1.222**
>10 Houses	-1.286**	-0.908*	-2.243**
PPA	0.110*	-0.039	-0.204
VZONE	0.591**	0.285**	0.439
PARTGOVT	0.001	-0.046	0.568
FULLGOVT	-0.419**	-0.862**	-0.039
NSH	0.466**	-0.010	0.308
Location Variables			
NORTH	0.709**	0.525**	-0.454**
TAIPO	0.473**	0.102	1.075**
YUENLONG	-0.525**	-0.297	-0.262
Exogenous Variables			
REZONE	-0.262*	-0.472**	N.A.
SUSPEND	-0.609*	-1.132**	
UPM	-0.350**	-0.128	0.044
POSTCAD	-0.313*	-0.028	-1.109**
Constant	1.780**	2.991**	-0.412
N	**1,018**	**2,330**	**613**
Chi-square	1,026.370	2,372.841	637.869

Table 5.5: Empirical findings obtained from the Probit models
Note: ** denotes statistical significance at 1%; and * at 5%

With respect to the selected site-specific variables, it is first revealed that the gross site area per proposed small house (GSAPH) has a significant (at 1% level) and negative relationship with a small house application's likelihood to be approved by the TPB in GB zone and in AGR zone. Such a relationship indicates that the larger site area is proposed for each small house in an application, the more likely it is to be rejected. Considering that the maximum allowable GFA for a small house is the same, regardless of the actual size of the land site on which it is constructed, this finding reveals the TPB's stance towards small house construction, in that the development of small houses should occupy as little land as possible. Nevertheless, as the vast majority of these applications involve private land only (Table 5.4), such a stance is discriminatory against indigenous villagers who have larger land sites in their possessions, as it puts further constraints on how these people should utilize their land when they exercise their rights to build small house(s).

Then, for the three dummy variables with reference to the number of small houses proposed to be built, two of them, namely “6-10 houses” and “>10 houses”, are negatively related with an application’s probability to be approved in all three statutory zones (significant at least at 5% level). This suggests that large-scale development of small houses, which is made possible via the transfer of “ding” rights from indigenous villagers to property developers, is usually not permitted by the Town Planning Board, particularly in UNSP zone. However, the insignificance of the “2-5 houses” dummy variable in all three zones makes for an interesting interpretation. To put it differently, there is no evidence to suggest the notion that the TPB is more stringent in approving applications for the construction of multiple (i.e. 2-5) small houses than those for the construction of a single small house. Yet, the construction of two to five small houses on a particular land site can still be regarded as a smaller-scale (compared to 6-10 houses or >10 houses) small house development. Then, the question becomes whether such an application is initiated by the indigenous villagers themselves (i.e. multiple (male) members of an indigenous villager household exercising their rights at the same time) or by property developers (i.e. as part of a large-scale small house development, which alludes to the illegal transfer of “ding” rights). If it is the latter scenario, this finding does reveal a loophole which requires the attention of the planning authorities, as developers can game the system by simply dividing a large-scale development project into smaller ones which consist of less than six small houses each, and applying for the TPB's permission as separate cases.

Also, the PPA variable is found to be significant in explaining the likelihood of approval for small house applications in GB zone. The positive coefficient (significant at 5% level) means that an application that involves a land site with more previous applications is more likely to be approved by the TPB than others. This, if anything, indicates that the TPB's planning control decisions on small house constructions in this statutory zone are generally predictable, in that applicants, having obtained the TPB's verdict(s) on previous applications (and the reasons behind the decisions), are able to fine-tune their subsequent applications to meet the (stated) requirements by the TPB.

In addition, VZONE is found to be positively correlated (at 1% level) with a small house application's approval probability in GB zone and, to a lesser extent, in AGR zone. This means that a proposed small house on a site which is partly within the Village Type Development zone is more likely to be approved by the TPB, other factors being constant. The results are expected as they are, to some extent, consistent with the original intentions of the Small House Policy, under which a male indigenous villager is entitled to building a small house within the V/VE zone.

Further, the land site's ownership status produces some interesting results. While FULLGOVT is found to be negatively correlated (at 1% significance level) with an application's chance to be approved in both GB and AGR zones, the PARTGOVT variable is not significant in all three zones. The latter reveals that there are no significant differences between the approval rate of proposed small houses partly on government land and that of proposed small houses entirely on private land. The results concerning these two variables have some implications about how different indigenous villagers are being treated under the Small House Policy. As mentioned earlier in this chapter, a variety of small house grants are available depending on the ownership status of the land on which these house(s) are built, namely Building Licence/Land Exchange (private land) and PTGs (government land). It is pointed out by Lai (2000) that it does not constitute an unfair transfer of wealth (to indigenous villagers) should small houses built on private land be sold to non-indigenous villagers. Yet, the TPB is more likely to permit private landowners to build their small house(s) while encroaching on government land (at a premium payable to the government), than to grant government land, in many cases as small as 65.03m², to landless indigenous villagers (also at a premium payable to the government). While the innate discrimination of the Small House Policy against female indigenous villagers and non-indigenous villagers alike has been well-documented (see United Nations Economic and Social Council, 1994; Wong, 1998; Nissim, 1998; Lai, 2000; Hopkinson and Lao, 2003), the findings suggest that the implementation of the Small House Policy has also been discriminatory against landless indigenous villagers as well.

The final site-specific variable, NSH, is positively related with the probability to be approved for small house applications in GB zone, meaning that a proposed small house that is smaller than the maximum allowable GFA under the Buildings Ordinance (Application to the New Territories) Ordinance (Cap 121) is actually treated more favorably by the Town Planning Board. In some ways, this finding concurs with several previous studies which identify negative correlations between the proposed GFA of a small house application and its likelihood to be approved (Lai and Ho, 2001a; Chau and

Lai, 2004; Tang et al., 2005).

Meanwhile, the location variables are also identified as significant factors in explaining the TPB's planning control decisions on small house applications. Nonetheless, some interesting patterns are observed. The findings show that small house applications on GB/AGR sites in the North district, which includes Fanling, Sheung Shui, Sha Tau Kok, and Ta Kwu Ling, are more likely to be approved than other districts, whereas those on UNSP sites in the North district have the lowest probability to be approved. Considering that UNSP zone comes into existence due to the introduction of IDPA/DPA plans in the early 1990s as a response to the 1983 Melhado Case ruling, and that UNSP zone is converted to either GB zone or AGR zone once it is incorporated into the rural OZPs, the complete contrast in the findings could be attributed to the uncertainties in terms of the prospective use of land in the North district. By contrast, the prospective use of land sites, be they in GB zone or UNSP zone, appears much clearer in Tai Po district, as the TPB is more lenient in approving small house applications involving either of these two zones than it is for other districts (with the exception of GB sites in North district), as reflected by their significant (at 1% level) and positive coefficients. In addition, the significantly negative correlations between YUENLONG and an application's likelihood to be approved in GB zones reveal that the greenbelt policy in this district is more stringent than that in other areas included in the Small House Policy. These findings, when viewed together as a whole, confirm (and at the same time extend) the conclusion reached by Tang et al. (2007) that land-use policy in Hong Kong vary geographically, not only in GB zone but also in AGR zone and UNSP zone as well.

Besides, the two exogenous housing policy variables are both found to be significant in explaining the Town Planning Board's decisions on small house applications in GB zone (at 5% level) and in AGR zone (at 1% level). Nevertheless, unlike Chau and Lai (2004) in which the authors conclude that the TPB's decisions go against exogenous government policies[55], the coefficients of both variables are negative. Given the opposite effects these two policies are set out to achieve, a closer scrutiny with regard to how the use of land in GB and AGR zones is determined is needed to determine whether the TPB's planning control decisions go against government policies or not.

The negative coefficient of the REZONE variable, on the one hand, indicates that small house applications in these two zones have a higher possibility to be rejected when the government explicitly expresses its intention to obtain additional land for residential development (in order to increase housing supply), which does not include small houses, through re-zoning non-residential land. In this sense, small houses, which are exclusive to male indigenous villagers, are being viewed as another type of land-use which competes against the development of housing flats, which are available to all Hong Kong residents, for the limited land resources in Hong Kong. On the other hand, the same negative signs identified for the SUSPEND variable in GB zone and AGR zone proffer a vastly different reading as to how small houses are being viewed. A negative correlation between this variable and a small house application's probability of approval means that, the TPB tends to reject small house applications in these two zones more often when the government intends to control the supply of housing through the suspension of land sale. Taking into account the Court of Appeal decision in January 1997 which has since legalized the resale of small houses to non-indigenous villagers,

[55] It is worth noting that Chau and Lai (2004) view small house development as a form of residential development.

small houses are instead regarded as an alternative source of housing supply.

Such interchangeability in the role of small houses leads to two observations. The first observation is that the TPB adjusts its views towards small houses with respect to what the government intends to accomplish with its housing-related policies. This implies that the TPB's decisions are generally in line with government policies. And the second observation is that, since Hong Kong's handover to China, the Small House Policy has been relegated to be a part of Hong Kong's housing policy, rather than a standalone policy which prioritizes the interests of indigenous villagers over those of others.

In addition, the TPB's decisions on applications for small house construction on GB sites are found to be sensitive to housing price movements (at 1% level) as well. The coefficient of the UPM variable is negative, indicating that small house applications involving GB land are more likely to be rejected when the most updated data shows that property price is rising. This finding concurs with Tang et al. (2005) in that the TPB's decisions are highly subject to housing market conditions. Nonetheless, the use of housing price, rather than housing supply, as an indicator of housing market conditions, offers a different interpretation. As the resale of small houses to non-indigenous villagers is deemed legal, a rise in property price provides extra incentives for indigenous villagers (and/or property developers that own land inside the GB zone) to apply for small house grants. This, in the meantime, also suggests the further encroachment of greenbelt areas, should these applications be approved. Therefore, the lower likelihood for applications to be approved, when housing price is rising, points to a consciousness decision by the TPB to contain the "growth of incipient suburban sprawl" (Bristow, 1984), even though Hong Kong's greenbelt policy is found to have been pro-development (see Tang et al., 2005; 2007).

Lastly, the final variable included in the models, POSTCAD, is significant in explaining the TPB's decisions on the applications for small houses in GB zone (at 5% level) and in UNSP zone (at 1% level). The negative coefficient indicates that, had an application for building small house(s) on land sites within these two statutory zones been decided by the TPB after the *Sung Wai Kiu and Li Pui Wan vs. Wong Mei Yin* case verdict, it would have been more likely to be rejected than an identical application determined before the verdict was made. This can be viewed as a response by the planning authorities to the Court of Appeal decision which legally clarifies the property rights of small house owners with regard to resale. As small houses have effectively become yet another type of housing available in the market since this decision was made, the construction of them, especially outside the V/VE zone, can be regarded as a betterment of indigenous villagers' exclusive privileges at the expense of housing/land-use policy needs and public interests, rather than a preservation of their interests. Under these circumstances, the TPB has since been more hesitant when it comes to approving small house applications on GB/UNSP sites.

5.6 Conclusion

The Small House Policy is a colonial era policy, subsequently under the protection of the Basic Law, which grants male indigenous villagers the exclusive right to build small houses on rural land in selected village environs within the New Territories. This exclusive right, however, has given rise to a variety of issues, ranging from its unsustainability to its discriminatory nature. In light of the mounting development pressure in recent years, how the Town Planning Board decides what to be developed on rural land outside the village environs with its planning control decisions, thus becomes, an important research topic. This chapter, in response, has studied these decisions on applications for small house construction in Greenbelt zone (GB), in Agriculture zone (AGR), and in Unspecified zone (UNSP), from January 1st, 1990 to April 30th, 2017, involving a total of 3,961 cases.

Several statistical patterns from the TPB's decisions on small house applications in the three statutory land-use zones have been identified. First, applications which propose a higher gross site area for each small house, in GB and AGR zones, are more likely to be rejected. In other words, indigenous villagers with larger land sites in their disposal are actually facing more resistance from the planning authorities when it comes to exercising their rights to build small house(s). Second, while proposals for large-scale small house development are mostly rejected by the TPB, there exists a possibility that those for smaller-scale small house development (between 2 and 5 small houses) would be approved. The findings also reveal that planning control decisions on small house construction in GB zone are predictable, as information obtained from previous application(s) helps improve the chance of the current application to be approved. As expected, a proposed small house, on either GB/AGR land, with its footprint at least partly within the village environs has a higher chance of approval than a similar small house located completely outside the V/VE zone. Either is it expected that proposed small houses to be constructed on government land only are not as likely to be approved as those on private land. Nevertheless, the lack of statistical difference in approval rates between proposed small houses on private land only and those on private/government land suggests that the TPB's implementation of the Small House Policy has been discriminatory not only against female indigenous villagers and non-indigenous villagers as usually perceived, but also against landless indigenous villagers as well. Another interesting pattern amongst small house applications in GB zone is that the TPB is more lenient in approving applications that propose small houses that are smaller than the maximum allowable GFA.

In addition, the findings indicate that land-use policies concerning the three statutory zones under study do vary geographically, which concur with Tang et al. (2007). It is found that small house applications on GB land in North and Tai Po districts have a much higher probability of approval than other districts, especially Yuen Long district. Proposed small houses in AGR zone within North district also receive much lenient treatment in the planning control process. By contrast, when it comes to UNSP zone, the TPB is much tougher towards small house applications in North district, yet noticeably more lenient towards those in Tai Po district.

Further, the TPB's planning control decisions on small house applications are found to be highly subject to government housing policies and housing market conditions. For the former, despite the two housing-related policies considered in the model(s) aim for polar opposite outcomes, the TPB, under both set of circumstances, has become stricter towards small house applications in both GB and AGR zones. This shows that how small houses are being viewed depends on what a particular government housing policy is set out to accomplish. If the policy goal is to increase housing supply, small houses are being regarded as another land-use that competes against residential development (i.e. high-rise buildings). On the contrary, if the policy goal is instead to control the possible over-supply of housing, small houses are being viewed instead as an alternative source of housing. In short, unlike the findings in Chau and Lai (2004), the TPB's decisions on small house applications are generally in line with government housing policies. The findings also suggest that the Small House Policy has essentially been relegated to be a part of Hong Kong's housing policy, instead of an independent policy which prioritizes the interests of indigenous villagers over the others. Further, the Town Planning Board is less likely to approve small house applications in GB zone when property price is rising, which indicates its consciousness decision to contain the possible overdevelopment of small houses in, and encroachment of, greenbelt areas.

The last finding of this study is that, since the resale of small houses to non-indigenous villagers was deemed legal in early 1997 by the Court of Appeal, the TPB has been comparatively stricter in approving applications for small house construction in GB/UNSP zones. This is believed to be the response to what is regarded as a betterment of indigenous villagers' exclusive privileges at the expense of housing/land-use policy needs and public interests, instead of simply a preservation of their interests.

The last three chapters, specifically, have explored the two critical elements in the housing development process. Chapter 3 has, first, looked at how property developers decide when to commence housing construction in response to housing price movements, land supply conditions, as well as changes in other relevant factors such as construction cost and interest rate (and their corresponding uncertainties); whereas Chapters 4 & 5 have evaluated the Town Planning Board's planning control decisions on proposed residential development and proposed small house constructions, upon changes in housing market conditions and in government housing-related policy objective to supply more housing land via re-zoning non-residential land.

CHAPTER 6: CONCLUSION

This concluding chapter consists of three sections. The major findings of the five chapters, with reference to Hong Kong's contemporary exorbitant housing-related cost problem, are to be summarized in Section 7.1. It is followed by a discussion of the implications of these findings (Section 7.2). In the third and final section of this chapter (Section 7.3), some possible directions for future research, which can complement the findings of this study, are to be presented.

6.1 Summary of Major Findings

A number of major findings have been identified in the studies as presented in Chapters 2-6. The first major finding is that, the exorbitant yet seemingly uncontainable property prices and rents, particularly in the last few years, have essentially been demand-driven. Specifically, housing prices and rents in Hong Kong have been susceptible, both directly and indirectly, to unconventional monetary policy measures launched outside Hong Kong, as shown in Chapter 2. Under the Linked Exchange Rate System, the continuously soaring housing prices and rents, in the aftermath of the 2008 Global Financial Crisis, have been positively related with two factors, namely an unprecedented boost in money supply and capital gains obtained from a bullish Hong Kong stock market.

For the former, the three rounds of Quantitative Easing programmes, between late 2008 and late 2014, had caused Hong Kong's money supply to rise substantially. The much-improved liquidity, along with unusually low interest rates, has created an environment in which obtaining homeownership, be it for self-use or for investment, has become far more financially viable for Hong Kong residents. Besides, with massive amounts of newly-printed HKD flooding the financial system (in exchange for USD in order to maintain the Linked exchange rate between HKD and USD), near-zero base rates payable to them by the Hong Kong Monterary Authority (HKMA), as well as the mortgage insurance protection provided by the Hong Kong Mortgage Corporation (HKMC) for the portion of mortgage loans above the HKMA-recommended LTV ratio, banks are more than encouraged to offer mortgages (as much as 90% of property value should applicants meet certain criteria) to aspiring homeowners. Such a rise in Hong Kong's money supply, thus, has directly led to more expensive housing in the territory.

For the latter, Hong Kong stock market, since the introduction of unconventional monetary policies, has been more integrated with the stock markets of Hong Kong's major trading partners, as well as to global economic conditions (Appendix A). Such intensified integrations are presumably an outcome of a larger non-bank holdings of global debts, which induce upward movements in Hong Kong's stock prices (mainly through co-movements with the Chinese and Singaporean stock markets and a recovering global economy). This has incurred capital gains for many in Hong Kong to at least obtain the necessary downpayment for home purchase. The Quantitatve Easing programmes launched by Japan and by the EU have resulted in a stonger USD (and HKD owed to the Linked Exchange Rate System), following the end of the U.S. QE programmes. A stronger Hong Kong Dollar makes investments in the Hong Kong stock market more attractive to international investors compared to other non-U.S. stock markets, as indicated by the positive response of Hong Kong's stock index to shocks in Hong Kong's Narrow Effective Exchange Rate Index; see Appendix A). Therefore, stock prices have continued to rise, which in turn have further fueled housing demand (as reflected by the positive responses of property prices/rents to rising stock prices; see Chapter 2). Yet, another major finding from this chapter is that, a higher housing supply, contrary to public perceptions, only has a short-run, and not remarkable, negative impact on both housing prices and rents. In other words, the commonly-held view that "a higher supply of housing reduces housing prices" does not always hold.

The third major finding is that, property developers would not necessarily initiate housing constructions shortly as housing prices continue to escalate. This is in stark contrast to what the public usually perceives in this respect. Rather, as shown in Chapter 3, property developers are more likely to withhold (or delay) housing construction, should they expect a higher growth rate in property prices and in construction cost. Developers would also postpone construction as both actual construction cost (in the short-run) and interest rate rise. It is only when volatilities in property price and in interest rate become sufficiently high that developers would initiate the construction phase sooner. Generally speaking, developers' decisions as to whether the construction phase should be postponed (or the amount of housing space to be built in a particular period) are more susceptible to uncertainties than to housing price movements alone.

The fourth major finding of this study is that, the Town Planning Board, due to concerns towards the potential 1) environmental impact, traffic impact, drainage impact, and sewerage impacts, 2) development mix, 3) over-development, and 4) over-concentration of residents, tends to reject applications for housing development in R(A) zone and in CDA zone more often, despite rising property price (or mounting development pressure) (Chapter 4). In addition, there is no evidence suggesting that the TPB's planning control decisions have been in line with the HKSAR government's housing policy objectives (i.e. to supply more land for housing development via rezoning non-residential land sites). The TPB's general irresponsiveness towards the government's housing policy priority, along with its hardened stance towards permitting housing development despite soaring housing price, lead to repeated applications by developers which guarantee a lengthier planning application process. This is very likely to cause further delays in the actual development as the projects' financial viability changes over time.

The fifth, and last, major finding is that, the TPB, despite mounting development pressure (and the government's priority to provide more housing units), has had much tighter control in small house development either partially or completely outside the Village Type Development zone, even though 1) their rights to build small houses under the New Territories Small House Policy has been protected by the Basic Law and 2) the resale of these houses to non-indigenous villagers has been declared legal since 1997 (Chapter 5).

6.2 Implications of the Major Findings

In view of the five major findings presented in the previous section, some implications are worth mentioning. The first implication concerns the general belief that "a higher housing supply is able to lower housing price". As reported in Chapter 2, even though a higher supply of private housing appears to reduce housing prices in two of the four housing sub-classes, it does not result in lower prices in the middle-size housing markets (Classes B & C) in the long-run (and in the rental sector in general). Neither is the sale of more HOS flats help reduce housing price in the private sector, as it proffers an option for residents in the private rental sector to become homeowners (i.e.

upgrading demand), especially those residing in Classes A & B flats, without necessarily lowering the housing demand of smaller housing units in the sale sector.

To make the situations even more complicated, housing development is highly subject to delays on the part of developers and the Town Planning Board. Developers are more likely to postpone housing construction (as long as the existing lease conditions allow them to), due to the expectation of further growth in property price. A likely result is, thus, further delays in the supply of housing (see Gyourko, 2009; Malpessi and Mayo, 1997), until property price volatilities, which indicate fluctuations in the future income streams of a project, are sufficiently high to urge developers to commence construction sooner rather than later. On the other hand, even though a higher land supply, in general, leads to positive responses in the amount of housing construction in the short-run, the developer-initiated land exchange has been shown to yield even more noticeable positive responses in GFA. This is because, in a land sale exercise, the lease conditions for a land site have already been decided unilaterally by the government, before it is put on sale either by auction or tender. By contrast, even though delays are inevitable in a land exchange application as it involves negotiations between developers and the Lands Department concerning the lease conditions as well as the latent uncertainties incurred in the planning control process, the decision to initiate a land exchange application itself indicates that the land site in question is perceived by a developer to be ripe for development (also see Hui et al., 2014).

Even without delays on the part of developers, the Town Planning Board, due to either planning concerns or objections voiced by local residents (and on some occasions, the unsatisfactoriness of development applications submitted by developers), tend to reject residential development applications (hence further delaying the development process) in R(A) zone and in CDA zone, despite rising housing price. There are also no conclusive evidence suggesting that the TPB becomes more lenient towards approving residential development applications, in response to the government's housing policy objectives. In fact, it is even more difficult to obtain an approval from the TPB to build housing units in GIC zone after the government made housing provision a policy priority. And though small houses in the New Territories, after 1997, have become an alternative type of housing for non-indigenous villagers in Hong Kong, the TPB's lack of positive responses to the government's housing-related policy objectives, as well as its hardened stance towards housing development (including small houses) despite soaring property prices, reduce (or at least postpone) the supply of housing. This does not, in any way, help address the housing issues faced by many in this city.

Two other implications are related to the Linked Exchange Rate system. Firstly, the Federal Reserve eventually ended the Zero Interest Rate Policy (ZIRP). The Federal Funds Rate has begun to rise gradually ever since. This was immediately followed by a base rate hike by the same amount in Hong Kong. An immediate effect on the housing market of Hong Kong would be on mortgages, as a rise in interest rates means higher costs for prospective homeowners to obtain mortgage loans under a floating-rate arrangement, given the same property value. Secondly, the Federal Reserve's expectation to implement a balance sheet normalization programme within 2017[56] could have even more serious implications for Hong Kong's housing market than interest rate hikes do. The Federal Reserve, through three rounds of Quantitative Easing programmes, had purchased approximately 3.9 trillion USD worth of U.S. Treasuries.

[56] https://www.federalreserve.gov/newsevents/pressreleases/monetary20170614a.htm

These programmes have been found to cause global asset prices to soar through either the portfolio rebalancing channel or the signaling channel (see Joyce et al., 2011; Gagnon et al., 2011; Bernanke, 2012; Hamilton and Wu, 2012; Bauer and Neely, 2014; Bauer and Rudebusch, 2011; 2014; Neely, 2015; Fratzscher et al., 2016), which in turn has indirectly resulted in rising stock prices in Hong Kong (Appendix A). A bullish stock market fueled by an unprecedented level of liquidity at very low costs, along with the massive increase in Hong Kong's own money supply by virtue of the Linked Exchange Rate System, are the reasons behind the substantial growth in property prices/rents in the last few years (Chapter 2). A rise in the U.S.'s interest rate, however, strengthens the U.S. Dollar (and Hong Kong Dollar) while reducing the level of liquidity in the financial system[57], as the Federal Reserve, in essentially a reverse repo operation, needs to drain billions of U.S. dollars away from the financial system in order to maintain the newly-adjusted Federal Funds Rate. Worse, with the balance sheet normalization programme (i.e. selling the securities the Federal Reserve had obtained through the QE programmes) expected to be launched within 2017, even more U.S. dollars are to be drained from the financial system. These two policy decisions, together, could trigger large-scale capital outflow from outside the U.S., especially among bond investors[58] (and thus falling equity prices on a global scale, as a result of portfolio rebalancing effect or the signaling effect).

Within the context of Hong Kong's housing market, this not only means higher costs

[57] The impact of rising Fed rates on global liquidity, however, would be offset to a certain degree, due to Japan's re-launch of its own Quantitative Easing since April 2013 and of the European Central Bank's introduction of its asset-purchase programme since March 2015.

[58] A stronger U.S. Dollar (and Federal Funds rate hikes) raises the cost of repayment for global debts and bonds denominated in the currency, thus increasing their default risks (and/or incentives to raise capital for investment). According to a recently-published Banks for International Settlements report (McCauley et al., 2015), the outstanding U.S. dollar credit to non-bank borrowers outside the U.S., since the 2008 global financial crisis, has soared from 6 trillion to 9 trillion USD.

to obtain the same amount of mortgage loans and more difficult access to credit, but also plummeting stock prices (as a result of a higher degree of integrations with global markets; See Appendix A). The latter, in turn, results in the dissipation of capital gains (or even in capital losses) from the Hong Kong stock market, all of which have been confirmed in Chapter 2 to lead to falling property prices and rents. This situation can be further exacerbated as property developers have been found to initiate housing development sooner should housing price movements become more volatile (Chapter 3), thereby flooding the housing market with newly-completed housing flats by the time they are completed.

Yet, before that eventually happens, the Linked Exchange Rate System basically guarantees that Hong Kong's housing continues to be expensive, unless a few drastic measures are to be introduced. All these measures, however, would have profound implications for Hong Kong in a variety of aspects. The first measure is the substantial revision, if not the outright abolishment, of the Linked Exchange Rate System itself. Even though this helps Hong Kong regain the autonomy to conduct its own monetary policies to regulate the economy (and the housing market), Hong Kong could then be susceptible to the potential drawbacks of a floating currency regime (for instance, adverse impact on the economy due to currency speculations). Another way to tackle the current housing price issue is to curb speculative activities in the housing market by either substantially increasing the existing stamp duties for housing transactions (i.e. at much higher rates than what has been announced by the government) or barring non-permanent Hong Kong residents to purchase housing in Hong Kong altogether. Yet, these measures, inevitably, would compromise Hong Kong's position as a free market economy.

6.3 Suggested Directions for Future Research

As the housing market involves numerous stakeholders, from prospective homebuyers, property developers, to the government (as the sole owner of land in Hong Kong and as the planning authority), a study of the unprecedentedly high housing prices and rents is required to include different perspectives. Nevertheless, due to time constraints and data limitation, some in-depth studies are not feasible for this research study, which is quantitative by design. In view of this, this section suggests some directions for future research which complements the findings as presented in this thesis.

First, with regard to the study of housing prices, a number of measures have been introduced by the HKSAR government in recent years, with the expressed purpose to curb speculative activities in the housing market. These measures include the Buyer's Stamp Duty (BSD), the Special Stamp Duty (SSD), as well as the upward adjustment of the Ad Valorem Stamp Duty (AVD) and the downward adjustments in the Loan-to-Value (LTV) ratio for mortgages. However, as the introduction of these measures is rather recent, their respective impacts, along with that of the Mortgage Insurance Programme, have yet to be explored in-depth due to insufficient data. As more data becomes available, future research in these areas is expected to complement what has been found in this particular research study, and thus further contributing to real estate literature and facilitating housing-related policy decision-making.

As for the study of the behaviours of the supply-side, this thesis has included a study of the amount of housing construction to be initiated, upon changes in different housing market conditions (and in their corresponding uncertainties), using aggregate data (Chapter 3). As this thesis has argued that land exchange, despite the inevitable delays incurred, is more instrumental in the eventual amount of housing construction than land sale is, a perfect complement to these quantitative studies should comprise a qualitative research as to how the development process, as a whole, can be streamlined. Focus group interviews could be conducted with representatives of Hong Kong's property developers with the aim to solicit their views as to the issues they encounter in the land development process, and their recommendations (if any).

This thesis has also presented the results of two separate investigations concerning the Town Planning Board's planning control decisions on both proposed residential development and proposed small house construction, using non-aggregate planning data. Similarly, focus group interviews could also be conducted the solicit the views of former Town Planning Board members. Their views as to how the planning control decisions are reached should contribute to the existing planning control literature and enhance our understanding towards this process. As the TPB states that each planning application is assessed "via its own merits", an exploration as to the circumstances under which other non-technical aspects of a particular application are valued more heavily than its technical aspects should provide valuable insights into a process which most people are unfamiliar with.

APPENDIX A: INTERACTIONS BETWEEN THE HONG KONG STOCK MARKET AND GLOBAL MARKETS FOLLOWING MAJOR FINANACIAL CRISES

Introduction

It has been concluded in Chapter 2 that, Hong Kong's housing prices and rents have been susceptible to stock market movements. As the world has become more globalized and unconventional monetary policy measures have been launched in different nations, have the nature of such stock market movements change over time? Specifically, are Hong Kong's stock market movements increasingly integrated with foreign stock market movements and the global economy (and hence, more susceptible to spillover effects from international markets)? A study in this regard, which is to be explored in Chapter 6, is expected to shed further light on the changes, if any, in price/rental formation in Hong Kong's housing market via the stock market channel after the introduction of unconventional monetary policies.

Considering the introduction of unconventional monetary policies in the aftermath of the 2008 Financial Crisis, a study in this area could shed light not only in stock market interactions, but also the influence of global factors on Hong Kong's housing market via the stock market channel (as discussed in Chapter 2).

Prior to the age of globalization, the pricing of stocks is perceived to be based upon the present value of listed companies' future dividends. In other words, stock prices are primarily subject to local economic conditions. Yet, as the world has been increasingly globalized, the influence of global economic conditions upon stock markets cannot be overstated. Due to the increasing prominence of international trade, as well as the rapid development of global financial markets, national economies are inevitably more integrated with one another than they were before. Hence, nations are becoming more susceptible to shocks from other nation(s), which is usually reflected in the adjustments in their stock prices (as well as in their exchange rates and current account balances).

An outcome of this development is that stock market movements across nations have become more correlated than they were before globalization. From another perspective, it also means that major shock events from a handful of countries could spread over to nations across the globe, through their connections via trade and investments. Numerous studies in the finance literature have reported that stock markets in general are usually even more integrated in the aftermath of financial crises. Nevertheless, there has been no consensus in these studies as to whether the higher level of linkages between stock markets is the result of co-movements or of spillover effects. The Global Financial Crisis of 2008 has provided a unique opportunity in studying changes in stock market interactions, if any. The reason is that, not only was it a major shock event, it was followed by the introduction of unconventional monetary policy measures which had hitherto never been used on a global scale before.

In view of those recent developments, this chapter intends to explore the interactions, be they co-movements or spillover effects, between the Hong Kong stock market and 1) the stock markets of Hong Kong's major trading partners (namely, China, the United States, Europe, Japan, Singapore, and Taiwan) and 2) other important economic indicators such as money supply, exchange rate, and oil price, from December 1992 to January 2017. The focus of this study is on whether or not such interactions change (and if so, the possible reasons behind these changes) after the outbreak of a major financial crisis (i.e. the Global Financial Crisis of 2008). In view of this focus, two study periods are proposed. The first period (December 1992-October 2008) is that which conventional monetary policy measures (such as adjustments in interest rates and/or in money supply had still be used to regulate global economies. The second period (November 2008-January 2017) is the post-Global Financial Crisis period during which unconventional monetary policy measures were deployed, as trillions of dollars have been injected into the global financial system through Quantitative Easing (QE) programmes in the U.S. (2008-2014), the U.K.[59] (2009-2010), Japan[60] (April 2013-), and more recently, the European Union[61] (March 2015-).

The rest of this chapter is presented as follows: The next section provides a discussion with regard to the co-movements of stock markets, both developed and developing, in different continents and regions. This is then followed by a section in which the methodology deployed for this investigation is articulated. After the methodology section, the empirical findings are to be reported and a discussion grounded on these findings be provided. The final section concludes this study.

Literature Review

Interactions of Stock Markets under Globalization

The process of globalization has added another dimension to the dynamics of financial markets, in that stock markets of different nations have shown increasing

[59] The Bank of England launched its QE programme in March 2009, originally intended to spend £75bn to purchase government gilts in the span of three months. It also cut interest rates to 0.5%. Conditioned by the U.K.'s subsequent economic situations, the programme was furthered expanded as a total of £375bn was injected into the British financial system.
[60] The expected cost of Japan's second QE programme (the first QE was introduced in March 2001), which began in April 2013, is $1.4tn (or £923bn), under which the Bank of Japan (BoJ) plans to purchase ¥7tn yen (£46bn) of government bonds per month using electronically-created money.
[61] It was announced by the European Central Bank (ECB) that it would start purchasing a total of one trillion Euro worth of Eurozone countries' government bonds, at a monthly rate of 60 billion Euro.

interdependence with one another, during the 1980s and early 1990s (Crowder and Wohar, 1998). In other words, the degree of co-movements among various stock markets has been higher than before.

There are numerous reasons attributing to such development. Firstly, economic integrations among nations have intensified, as increases in bilateral trade render the previous geographic divide among these stock markets more obscure than they were, thus resulting in higher correlation in stock returns (Gelos and Sahay, 2000). Secondly, the gradual opening of financial markets has allowed freer flow of foreign capital into these markets, either for portfolio diversifications or for international arbitrage, which links stock markets closer and thus more correlated with respect to stock returns (Tavares, 2009). The third reason is the increasing prominence of multinational corporations. As these corporations essentially transcend national borders, whatever impact they incur would be similarly affecting different economies (and their corresponding stock markets). Some previous studies have found that such global industry effects sometimes even overshadow domestic country effects in explaining stock market variations (see Baca et al., 2000; Cavaglia et al., 2000; L'Her et al., 2002).

The higher co-movements among national stock markets, however, make portfolio diversifications across countries more difficult. From another perspective, this also means that stock markets become more susceptible to shocks originated from other economies/stock markets, regardless of geographical confines. The following sections are to present previous studies relating to stock market co-movements in different geographical regions.

Developed Nations

Many studies in the finance literature have reported the increasing level of integrations (and thus co-movements) between stock markets of developed nations, even more so after the Stock Market Crash of October 1987[62]. One common theme of these studies is how other countries' stock markets are susceptible to shocks from the U.S. stock market. For instance, according to Arshanapalli and Doukas (1993), the U.S. stock market has a remarkable impact on those in France, Germany, and the United Kingdom. Both Hameo et al. (1990) and Becker et al. (1992) find evidence of a spillover effect from the U.S. market to the Japanese market. Meanwhile, similar effects from the U.S. to the U.K., Germany, and Canada[63] are discovered by Theodossiou and Lee (1993). Eun and Shim's (1989) study on the U.S. and eight other stock markets (i.e. Australia, France, Canada, Hong Kong, Japan, Switzerland, Germany, and the U.K.), between 1980 and 1985, reach similar conclusions[64]. Rua and Nunes (2009) discover high level of co-movements between the U.S. market and the U.K. market, as well as between the U.S. market and the German market.

Interestingly, the increasing co-movements with the U.S. stock market in the aftermath of the 1987 Stock Market Crash appears to have reduced the co-movements between European stock markets instead[65], as reported in a number of investigations. For example, Chan et al. (1997) do not find convincing evidence for cointegration among major European stock markets (and among most European Economic Community member states) after the 1987 crash. Weakened cointegrating relationships between

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[62] Increases in stock market correlations in the aftermath of large shocks have also been found in Longing and Solnik (1995) and Karolyi and Stulz (1996).
[63] In addition to the spillover effect from the Japanese stock market to the German stock market.
[64] However, the opposite does not hold true (i.e. from the other markets to the U.S. market).
[65] Long-run co-integrating relationships have been identified among European stock markets years prior to the 1987 crash (Taylor and Tonks, 1989; Corhay et al., 1993).

major European markets between 1990 and 1994 are also reported by Gerrits and Yuce (1999). It is until the establishment of the European Monetary Union (EMU), and more specifically, the creation of the Euro currency, that co-movements between European stock markets once again become significant. For instance, Kim et al. (2005) find that the introduction of the Euro results in higher stock market co-movements within the EU, especially since 1999. Yang et al. (2003a) also report the strengthening of long-run connections among EMU markets after the establishment of the EMU (also see Taylor and Tonks, 1989; Corhay, et al., 1993; Dickson, 2000; Leachman and Francis, 1995).

As for studies specifically on Asian stock markets, the increasing influence of the U.S. stock market on them, in particular after the Asian Financial Crises of the late 1990s, is evident. Earlier studies in this regard in the aftermath of the 1987 Stock Market Crash generate mixed results[66]. For instance, Chan et al. (1992), DeFusco et al. (1996), and Ng (2002) do not identify any cointegrating relationships between US and Asian markets in the 1980s and early 1990s. By contrast, in accordance with Arshanapalli et al. (1995), the stock markets in Hong Kong, Singapore, Thailand, the Philippines, and Malaysia were more susceptible to U.S. stock market exogenous shocks in the post-1987 crash period. Similar cointegrating trends between the U.S. market and Asian markets are also identified in Masih and Masih (1997; 1999; 2001) and in Chung and Liu (1994). However, after the Asian Financial Crisis of the late 1990s, several studies have reported higher levels of cointegrations between the U.S. stock market and various Asian stock markets (see Sheng and Tu, 2000; Yang et al., 2003). Surprisingly, some of these studies have also reported that the Japanese stock market, by contrast, has much

[66] Nevertheless, some researchers have argued that contrasting results in the literature could also be the result of the choice of markets, the frequency of data (and the sample period), as well as the methodologies used (see Crowder and Wohar, 1998; Forbes and Rigobon, 2002).

less impact on other Asian stock markets.

Developing Nations

The situation of Latin American stock markets, by contrast, is a bit different from what have been found in European and Asian stock markets, in that stock markets in the Americas are not only subject to shocks from the U.S. market, but also to shocks from neighboring countries within the Americas, in addition to Eurasian markets. For instance, Johnson and Soenen (2003) report that eight Latin American stock markets (i.e**.** Argentina, Brazil, Chile, Mexico, Canada, Colombia, Peru, and Venezuela) have high levels of contemporaneous correlations with the U.S. stock market, the degree of which is subject to trade (with the U.S.), bilateral exchange rate volatility, and relative stock market capitalization. Meanwhile, some other studies have also reported increasing stock market co-movements amongst these Latin American nations themselves (see Chen et al., 2002; Choudry, 1997; Christofi and Pericli, 1999). Despite being consistently referred to as "America's own backyard", shocks from stock markets outside the American continent (i.e. Eurasian countries) have also been found to be pivotal (Forbes, 2000). For instance, several investigations have identified spillover effects to stock markets in the Americas in the aftermath of the Asian Financial Crisis (Kaminsky and Reinhart, 1998; Edwards, 2000; the United Nations, 1998). In addition, the Russian financial crisis of 1998 is also found to have had a significant effect on these markets (Edwards, 2000; Gelos and Sahay, 2000)

As regards other emerging European countries, studies on stock market co-movements between these countries and the developed stock markets (i.e. the U.S., the U.K., and Germany) have yielded mixed results. Some of these studies do find long-run cointegrating relationships between the stock markets of these European countries and those of the developed nations. Syriopoulos (2004), via the Johansen approach detects one co-integration relationship between four Central/Eastern European nations (Poland, the Czech Republic, Hungary and Slovakia) and the developed markets (U.S. and Germany) between 1997 and 2003. Similar stock market integration among seven nations (i.e. Czech Republic, Hungary, Poland, Britain, France, Germany and the U.S.) has also been reported by Voronkova (2004). Interactions between the capital markets of Poland, Hungary, the Czech Republic, Russia and five developed markets are found in Chelley-Steeley (2005), using orthogonalised variance decomposition of VAR modeling on their respective daily indices. In addition, it is also found that the Polish and Hungarian stock markets are more susceptible to global factors than is the Czech market. In another study of four Eastern European countries (Russia, Poland, Hungary, and the Czech Republic), Yang et al. (2006) find that their short- and long-run relationships with the U.S. and the German stock markets are strengthened from 1999 to 2002, in comparison with those prior to the Russian financial crisis of 1998. Likewise, Syriopoulos (2007) concludes that, following the establishment of the EMU, the linkages between the capital markets of Poland, Czech Republic, Hungary, & Slovakia and the developed markets such as the U.S. and Germany become stronger. Scheicher's (2001) investigation of the Hungarian stock market and MacDonald's (2001) study on the Central European stock market indices (as a group) also reach similar conclusions.

In contrast, other studies have reported either limited linkages or even no long-run relationships between these emerging markets and the developed ones. For the former, Li and Majerowska (2008) study the stock markets in Poland and Hungary and report that they are weakly linked to the developed markets, despite evidence of returns and volatility spillovers from them. Likewise, Gilmore and McManus (2002) are only able to find low short-run correlations between the capital markets of the Czech Republic, Hungary and Poland and that of the U.S. No long-run relationships are identified. Additionally, only weak evidence of increased linkages between the Central/Eastern European markets (Poland, Czech Republic, Hungary, Russia) and the developed European markets (Germany, UK, France, Ireland, Spain, Portugal, Greece) (Serwa and Bohl, 2003). Last but not least, Saleem (2009) reports similarly-weak linkage between the Russian stock market and the world market. For the latter, in a study of the stock markets in the Czech Republic, Hungary, Poland and Russia from 1994 to 1997, only integrations between these countries and the British market are found, but not between them and others such as the U.S. and German markets. Also, the Russian stock market is not as susceptible to U.S. and German stock market shocks towards the end of the study period. A handful of other studies (such as Linne, 1998; Verchenko, 2000; Gilmore and McManus, 2002) simply do not find any long-run cointegrating relationships between the Central European stock markets and the U.S. market.

The Impact of Monetary Policy on Stock Prices

Under normal circumstances (i.e. adjusting interest rates and/or money supply)

It is well-known that a government deploy the following two ways to stimulate macroeconomic activities (such as production and employment) and to manage the level of inflation: 1) adjusting interest rates and 2) adjusting money supply. Not as well-known, however, is how these policies could help achieve the government's objectives. What lies between them is the stock market. To put it differently, monetary policies influence the valuation of financial assets. In conventional finance literature, current stock prices equal the present value of future net cash flows, the latter of which includes two factors, namely 1) future net cash flows and 2) the discount rate. Theoretically, monetary policies, be they expansionary or contractionary, could influence stock markets either by the interest rate channel (i.e. adjusting the discount rate) or by affecting the investors' expectations of future macroeconomic activities as well as the degree of uncertainties they are susceptible to (Thorbecke, 1997; Ioannidis and Kontonikas, 2008; Bjornland and Leitemo, 2009). Usually, when expansionary (contractionary) monetary policies are being launched, the interest (discount) rates are lower (higher) and stock prices are higher (lower). These changes affect not only investors' wealth but also borrowing cost (and access to credit[67]), which through consumption (i.e. the wealth effect channel) or investment (i.e. the balance sheet channel), shape real economic activities (see Gertler and Gilchrist, 1994; Ioannidis and Kontonikas. 2008).

Interestingly, the literature with regard to the relationship between monetary policies and stock prices (returns) is far from conclusive. On the one hand, there have been many studies which support the notion that monetary policies influence stock prices/returns. For instance, a study by Bjornland and Leitemo (2009) reports that real stock prices drop by 7-9% as a result of a 1% upward adjustment in the Federal Funds rate, and that a 1% increase in real stock prices lead to a higher interest rate (by 4 basis points). Another investigation by Rigobon and Sack (2004), based upon the heteroscedasticity of shocks present in high-frequency data, concludes that an increase in the 3-month interest rate (by 0.25%) leads to a 1.7% decrease in the S&P 500 index and a 2.4% decrease in the Nasdaq index. Thorbecke (1997) examines the response of stock returns to monetary policy exogenous shocks (in terms of federal fund rate and non-borrowed reserves), and finds that expansionary monetary policy results in higher ex-post and ex-ante stock returns. Similar results have also been found by many other studies (such as Lastrapes, 1998; Rapach, 2001; Jensen and Johnson, 1995; Rozeff, 1974; Bomfim, 2003; Bernanke and Kuttner, 2005).

In additional to these U.S. studies, a handful of non-U.S. studies appear to reach similar conclusions. An investigation on the stock returns in 13 OECD countries, between 1972 and 2002, reports that stock returns are significantly affected by monetary policy changes (Ioannidis and Kontonikas, 2008). Specifically, a contractionary monetary policy reduces both the nominal and inflation-adjusted stock returns. Conover et al. (1999), in their study of 12 OECD countries from 1956 to 1995, concludes that stock returns in these nations are subjected to not only local monetary policy situations, but also those in the U.S. Another study by Cassola and Morana (2004) on the Euro stock markets finds that a permanent expansionary monetary policy shock yields a temporary positive effect on real stock prices.

On the other hand, there exist other studies which do not find any statistically significant response from the stock market to monetary policy changes (see Geske and Roll, 1983; Kaul, 1987; Lee, 1992; Patelis, 1997; Millard and Wells, 2003; Neri, 2004; Bomfim and Reinhart, 2000; Roley and Sellon, 1996). Nonetheless, it is found by Rigobon and Sack (2004) that most, if not all, of these papers have investigated the matter by means of the event-study approach, which assesses the immediate exogenous impact of monetary policy announcements on current stock prices using daily or weekly data instead of monthly or quarterly data (see Sellin, 2001 for a comprehensive review of this method). Yet, one latent issue with this method is that, while it is able to capture the market response towards these policy announcements within a very short period of time, the impact of such information on macroeconomic indicators could only emerge later, resulting in a delayed albeit persistent change in productivity (hence future cash flows) (Beaudry and Portier, 2006), which is a fundamental element in the determination of stock prices.

Under "Zero lower bound" interest rates (i.e. quantitative easing)

While the studies mentioned in the previous section provide valuable insights with regard to the response of stock prices to monetary policy shocks, primarily adjustments in interest rates, the numerous financial crises in the past 20 years or so (such as the Asian Financial Crisis of the late 1990s and the U.S. Subprime Crisis of late 2008) have proffered new challenges to researchers worldwide. In the aftermath of these crises, the goal of the government of those affected nations, rather than simply to maintain the level of inflation within specific targets, is to stimulate the economy in order for it to rebound from recession. According to Joyce et al. (2012), two problems arise. The first issue is known as the zero bound (nominal) interest rates. If the Taylor rules are to be followed, short-term nominal interest rates could theoretically be negative. Yet, this also means that holding cash is actually preferable to savings. As a result, nominal interest rates are usually either at zero (or slightly higher than zero), rather than negative. The second issue is that, having already incurred massive losses in the aftermath of financial crises, the risk of default becomes much higher than it was pre-crisis. Thus, financial institutions are more reluctant to offer loans to businesses and individuals, regardless of interest rate movements. Under such circumstances, conventional monetary policy via short-term interest rate adjustments no longer applies, and unconventional monetary policy measures are thus needed.

A number of unconventional monetary policy measures have been deployed previously. The first one is to simply follow the Taylor rules and introduce negative nominal interest rates, as adopted in Denmark. A more well-known measure, however, is through the large-scale expansion of central banks' balance sheets by purchasing existing government debts such as bonds and gilts (Joyce et al., 2012), which is more commonly known as Quantitative Easing (QE).

As the government purchases certain financial products (mostly government bonds/gilts) on a massive scale, a few outcomes follow. The first outcome is higher prices (and thus lower yields) for assets brought by the government. And as different financial assets are usually regarded as imperfect substitutes, investors who sell the bonds/gilts to the Central Bank will then use this newly-acquired wealth to purchase assets which are better substitutes than cash (for instance corporate bonds & equities, and foreign assets), hence pushing their prices upwards in the process. This is known as the portfolio rebalancing effect (see Tobin, 1969; Joyce et al., 2010; 2011; 2012; Benford et al., 2009).

In addition to the portfolio rebalancing effect, QE also helps reduce the risk premium required by investors to hold certain financial assets in situations where liquidity is low. As the Central Bank purchases select financial assets from the investors, the amount of short-term risk-free bank reserves held by the private sector increases. As liquidity improves due to the Central Bank's purchases, the liquidity premium required by investors is lower (Joyce et al., 2010; Gagnon et al., 2011). In addition, the improved liquidity following the Central Bank's injection of money into the financial market makes financing much easier (and at lower cost) for the private sector (Benford et al., 2009), which facilitates production and consumption (and thus economic development).

Methodology & Data

This study aims to explore the interactions, be they co-movements or spillover effects, between Hong Kong's stock market and 1) the stock markets of Hong Kong's major trading partners and 2) other important global economic indicators.

For the stock market variables, the capital market capitalization indices (all denominated in U.S. Dollars) of the stock markets in China, the U.S., Europe, Japan, Singapore, and Taiwan, compiled by MSCI, are to be used for analysis. The reason the MSCI indices, rather than their original indices, are used for this study is because of the differences in terms of computation of the individual stock indices. Also, using standardized market cap indices denominated in a single currency minimizes the effect of exchange rate adjustments on the co-movements (and spillover effects, if any) of these stock markets.

Aside from the MSCI stock indices, four more factors are to be included in the model. The first variable is the (Global) Spot Price of West Texas Intermediate Crude Oil (WTI). Oil price, despite being subject to its own supply and demand dynamics in both the spot market and the futures market, is usually referred to as an indicator of global economic development. In other words, the effect of this factor could be interpreted as the impact of global economic conditions on Hong Kong's stock market. The second variable concerns Hong Kong's money supply (M1). Courtesy of the Linked Exchange Rate System, Hong Kong, essentially, has to follow whatever monetary policy measure launched by the Federal Reserve, in order to maintain the HKD-USD exchange rate within the Convertibility zone (i.e. 7.75-7.85 HKD = 1 USD). This mechanism is significant especially since the introduction of QE programmes by the Federal Reserve, which had also resulted in a noticeable higher money supply in Hong Kong. Despite a lack of autonomous monetary policy-making capacity, this variable can be used to investigate the impact of U.S. monetary policy on Hong Kong's stock market. The remaining two variables, partially, are related to the Linked Exchange Rate System as well. With HKD tightly pegged to the USD, Hong Kong's exchange rates with other non-US currencies are also subject to the exchange rates between USD and these currencies. In this light, two different exchange rates are considered. The first one is the exchange rate between HKD and Renminbi (RMB), the currency of Hong Kong's largest trading partner and one of the biggest economies in the world. The second one is related to Hong Kong's (global) exchange rate, on the basis of the Bank for International Settlements' (BIS) Narrow Effective Exchange Rate Index (NEER)[68].

The data necessary for this analysis is gathered from several sources. While the stock price indices are all collected from MSCI's official webpage, WTI monthly spot price data is obtained online from the Federal Reserve Bank of St. Louis webpage. Meanwhile, the HKMA's official webpage provides the data for both money supply and the Hong Kong Dollar-Renminbi exchange rate; and the NEER data is compiled from BIS.

Before conducting the actual analysis, a number of econometrical issues relating to the selected variables are required to be addressed. First and foremost, the stationarity

[68] The NEER includes the currencies of 27 economies, of which China is not included.

(and/or the integration order) of the eleven selected variables are to be ensured. The Augmented Dickey-Fuller tests (ADF) are conducted to test for the existence of a unit root, if any, in these variables. As shown in the table below (Table A1), the null hypothesis of the presence of a unit root cannot be rejected, at 5% significance levels, for all selected variables in levels, with the only exceptions of LnTAIWAN (both intercept/trend and intercept) and LnRMB (trend and intercept). This indicates that the vast majority of these variables are not stationary on levels. It is only after the first-differencing of these variables that the null hypotheses of them containing a unit root are rejected at 5% level of significance, including LnTAIWAN and LnRMB. In other words, all the selected variables are *I*(1) (integrated of order 1).

Variable	ADF Test Statistic (Intercept)	ADF Test Statistic (Trend and Intercept)
LnHK (Level)	-2.203	-3.230
LnHK (1st Difference)	-15.673*	-15.649*
LnCHINA (Level)	-1.832	-1.919
LnCHINA (1st Difference)	-15.342*	-15.380*
LnUS (Level)	-1.495	-1.797
LnUS (1st Difference)	-15.685*	-15.673*
LnEUROPE (Level)	-2.510	-2.248
LnEUROPE (1st Difference)	-15.168*	-15.230*
LnJAPAN (Level)	-2.234	-2.275
LnJAPAN (1st Difference)	-14.582*	-14.556*
LnSINGAPORE (Level)	-1.924	-2.261
LnSINGAPORE (1st Difference)	-15.815*	-15.793*
LnTAIWAN (Level)	-3.461*	-3.447*
LnTAIWAN (1st Difference)	-10.623*	-10.598*
LnWTI (Level)	-1.618	-2.274
LnWTI (1st Difference)	-12.837*	-12.828*
LnM1 (Level)	0.195	-2.370
LnM1 (1st Difference)	-19.219*	-19.215*
LnNEER (Level)	-1.748	-1.821
LnNEER (1st Difference)	-12.066*	-12.052*
LnRMB (Level)	-2.153	-4.002*
LnRMB (1st Difference)	-16.730*	-16.803*

Table A1: The Augmented Dickey-Fuller test (ADF) results
Note: * denotes significance at 5%

Nevertheless, as LnHK is integrated on order 1, a major issue arises as the existence of a unit root insinuates the existence of structural breaks (also see Section 2.3 for a more detailed discussion), which compromise the stability of the model parameters if they are not taken into account. Similar to the study of housing price/rental indices in Chapter 2, the Global Maximizer Tests are used to locate the structural break points, if any, in Hong Kong's MSCI index in the two study periods. The determination of the number of structural breaks in the two data series depends on the results obtained from 1) The Bai-Perron tests of 1 to M globally determined breaks; 2) The Bai-Perron tests of L+1 vs. L globally determined breaks; and 3) The Global Maximizer tests based upon the smallest Schwarz Criterion and/or the smallest LWZ Criterion.

With the maximum number of structural break points in each of the eight indices is set to be five (5), all three global maximizer tests are conducted to find out the optimal number of structural breaks to be incorporated into the final models. The detailed results are presented in Appendix BAA.1, in which it is shown that the optimal number of structural break points in the Conventional Monetary Policy period is four (September 1995, August 2001, January 2004, and July 2006), whereas that in the Unconventional Monetary Policy period is two (January 2010 and November 2012). In order to take the distortions these structural breaks would bring about to the eventual model estimations into account (thus making the final models more robust), four exogenous "structural break regime" dummy variables (coded as SBR1a, SBR2a, SBR3a, SBR4a)[69], served as intercept corrections (see Castle et al., 2010 for example), are introduced for the

[69] SBR1a is assigned as "1" between Sep 1995-July 2001, "0" otherwise. SBR2a is assigned as "1" between Aug 2001-Dec 2003, "0" otherwise. SBR3b is assigned as "1" between Jan 2004-Jun 2006, "0" otherwise. SBR4 is assigned as "1" between Jul 2006-Oct 2008, "0" otherwise.

Conventional Monetary Policy period model, and two "structural break regime" dummy variables (coded as SBR1b and SBR2b)[70] for the Unconventional Monetary Policy period model.

Then, the lag order in the models is then determined by incorporating these variables (in levels) into two separate Vector Autoregression (VAR) models. The results (as shown in Appendix BAA.2) illustrate that the optimal lag order for the model depicting the Conventional Monetary Policy period is one (1). And for the model depicting the Unconventional Monetary Policy, the optimal lag order is found to be six (6). These lags are then included in the Johansen Cointegration tests to find out whether or not the integrated time-series variables are themselves cointegrated with one another. The Trace test results, as presented in Table A2 below, show that the integrated time-series variables selected for the study are indeed cointegrated, as cointegrating relations ranging from 3 to 5 (Conventional Monetary Policy period) and from 8 to 10 (Unconventional Monetary Policy period) are identified, subject to a system's deterministic trend assumption.

[70] SBR1b is assigned as "1" between Jan 2010-Oct 2012, "0" otherwise. SBR2b is assigned as "1" between Nov 2012-Jan 2017, "0" otherwise.

Deterministic Trend Assumption		**Conventional Monetary Policy Period**	**Unconventional Monetary Policy Period**
No Trend in Data	No intercept or trend in CE or VAR	3	9
	Intercept (no trend) in CE – no intercept in VAR	5	10
Linear Trend in Data	Intercept (no trend) in CE and VAR	4	9
	Intercept and trend in CE – no trend in VAR	3	9
Quadratic Trend in Data	Intercept and trend in CE – linear trend in VAR	3	8

Table A2: The optimal number of cointegrating relations based on the Johansen Cointegration tests
Note: For the detailed Johansen Cointegration test results, see Appendix BAA.3

Given that the selected variables are both integrated (on order 1) and cointegrated, Vector Error Correction Models (VECM) are, thus, used for the analysis (see Section 2.3 for more information about the VECM model), in which both cointegrations and structural breaks are incorporated. The resultant VECMs, with varying deterministic trend assumptions, are then compared with one another before deciding the final model(s), based upon the smallest Akaike Information Criterion (AIC) and Schwarz Criterion (SC), not only for the Hong Kong MSCI index, but also for the systems in which these models belong. The results, as reported in Tables A3a & A3b below, illustrate that, for the Conventional Monetary Policy period, the model with the assumption of "No trend in data -- Intercept (no trend) in CE – no intercept in VAR) yields the lowest AIC/SC for the Hong Kong MSCI index, yet the model with the assumption of "Linear trend in data -- Intercept and trend in CE – no trend in VAR" has the smallest AIC/SC for the entire VECM. Nonetheless, as the primary focus of this study is on how the Hong Kong stock market interacts with other stock markets and global market factors, the former specification is thus selected as the final model. And for the Unconventional Monetary Policy period, the model with a quadratic trend in data is chosen as it results in the smallest AIC/SC not only for Hong Kong MSCI index, but also for the whole VECM.

Deterministic Trend Assumption		**LnHK**		**Whole VECM**	
		AIC	**SC**	**AIC**	**SC**
No Trend in Data	No intercept or trend in CE or VAR	-2.213	-1.904	-35.980	-32.017
	Intercept (no trend) in CE – no intercept in VAR	-2.249*	-1.906*	-35.948	-31.145
Linear Trend in Data	Intercept (no trend) in CE and VAR	-2.202	-1.859	-35.980	-31.452
	Intercept and trend in CE – no trend in VAR	-2.181	-1.855	-36.168*	-31.965*
Quadratic Trend in Data	Intercept and trend in CE – linear trend in VAR	-2.179	-1.836	-36.136	-31.797

Table A3a: The Akaike Information Criterion and the Schwarz Criterion for VECMs under different deterministic trend assumptions (Conventional Monetary Policy period)

Deterministic Trend Assumption		**LnHK**		**Whole VECM**	
		AIC	**SC**	**AIC**	**SC**
No Trend in Data	No intercept or trend in CE or VAR	-3.230	-1.212	-54.296	-29.498
	Intercept (no trend) in CE – no intercept in VAR	-3.777	-1.733	-55.824	-30.187
Linear Trend in Data	Intercept (no trend) in CE and VAR	-3.771	-1.726	-56.114	-31.027
	Intercept and trend in CE – no trend in VAR	-3.854	-1.809	-57.540	-32.218
Quadratic Trend in Data	Intercept and trend in CE – linear trend in VAR	-3.854*	-1.810*	-57.900*	-33.102*

Table A3b: The Akaike Information Criterion and the Schwarz Criterion for VECMs under different deterministic trend assumptions (Unconventional Monetary Policy period)

The resultant Cointegrating equations (and error correction terms) of the two VECMs are reported in Appendices BAA4a-b & BAA5a-b. Based on these equations, the impulse response analysis and the variance decomposition analysis are then conducted for the two study periods. The results of these three analyses are reported and discussed in the following sections.

Research Findings

Conventional Monetary Policy Period

During the conventional monetary policy period (Figures A1a & A1b), the stock indices which trigger the largest amount of (positive) accumulated responses from Hong Kong's stock index are the indices of the Japanese stock market, followed by those of the European stock markets, the Chinese stock market, and the U.S. stock market. Meanwhile, the responses to exogenous shocks in both the Singaporean stock index and the Taiwanese stock index are much smaller than the other four stock indices, and fluctuating around zero. This means the error correction process helps offset most of the short-run impacts of the two indices as time passes, and that in the longer-run the interactions between Hong Kong and these markets are much closer to equilibrium, whereas exogenous shocks from the other four stock indices (Japan, China, U.S., and Europe) lead to new equilibriums being reached in the long-run.

And for the other non-stock market variables, the Hong Kong stock index responds positively to exogenous shocks in oil price, in money supply, and in the Hong Kong Dollar-Renminbi exchange rate, but negatively to exogenous shocks in NEER. Unlike the stock indices in Singapore and Taiwan, new equilibrium relations between Hong Kong's stock index and these four factors, over time, are identified.

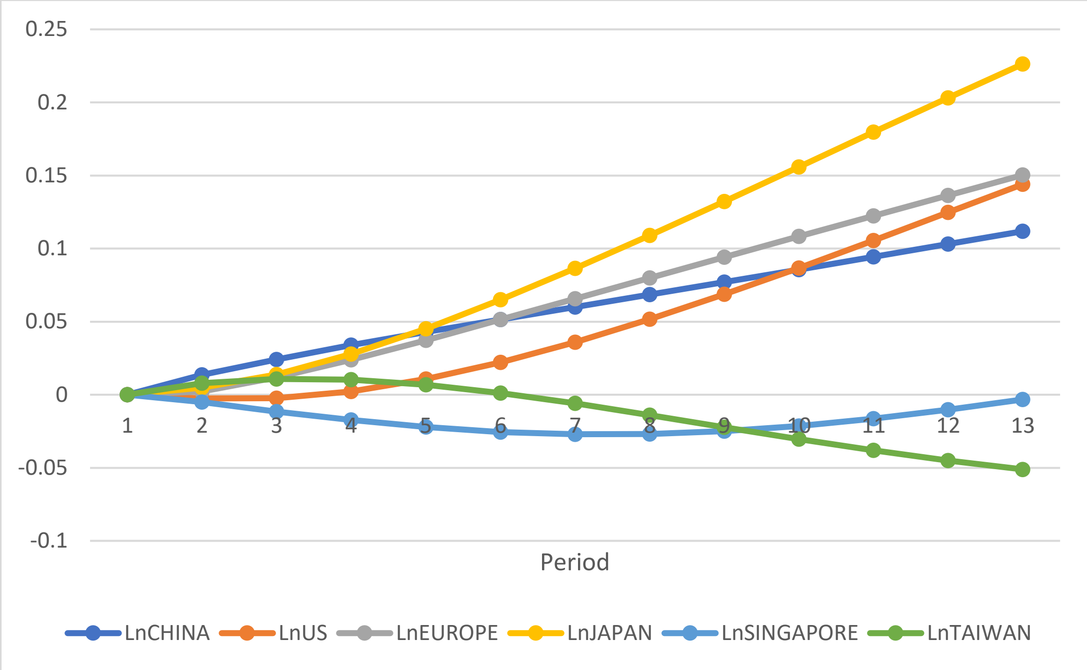

Figure A1a: Accumulated responses of LnHK to exogenous shocks in the selected stock indices

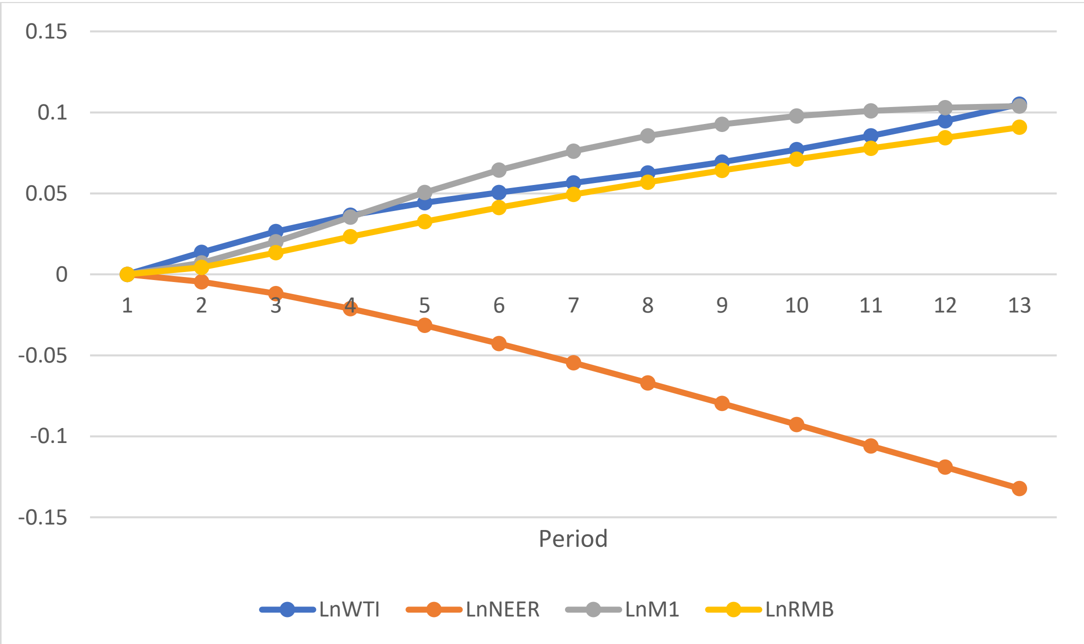

Figure A1b: Accumulated responses of LnHK to exogenous shocks in the selected non-stock market factors

Meanwhile, the largest contributor to the variance of Hong Kong's stock index (Figures A2a & A2b) is by far the previous adjustments in the Hong Kong stock index itself, ranging from 63% to 95.2% of its total variance. Of the selected international stock markets, the three markets which help explain the most of Hong Kong's stock index variance are Japan (as much as 11.3%), U.S. (as much as 5.7%), and Europe (as much as 4.9%). As for the non-stock market factors, exogenous shocks in NEER explains as much as 3.7% of the variations on the Hong Kong stock index, and money supply adjustments explain around 3% of variations. By contrast, exogenous shocks in the Chinese, Singaporean, and Taiwanese stock markets, money supply, as well as oil price and the Hong Kong Dollar-Renminbi exchange rate only result in moderate effects on the variance of Hong Kong's stock index.

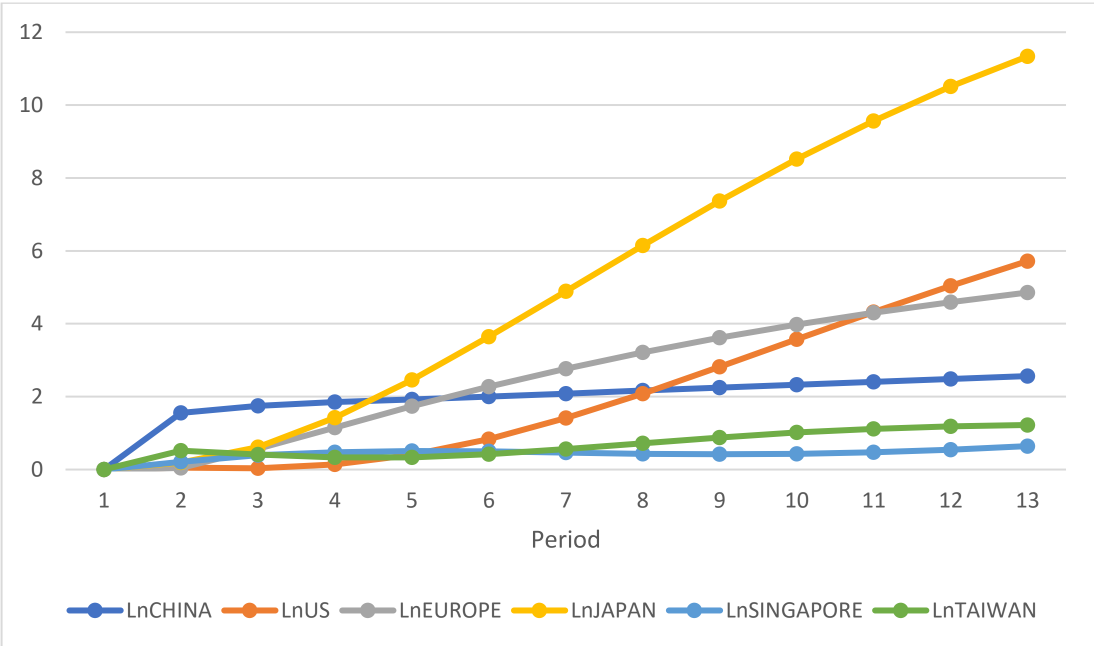

Figure A2a: Variance of LnHK explained by selected stock indices (Conventional Monetary Policy period) (in %)

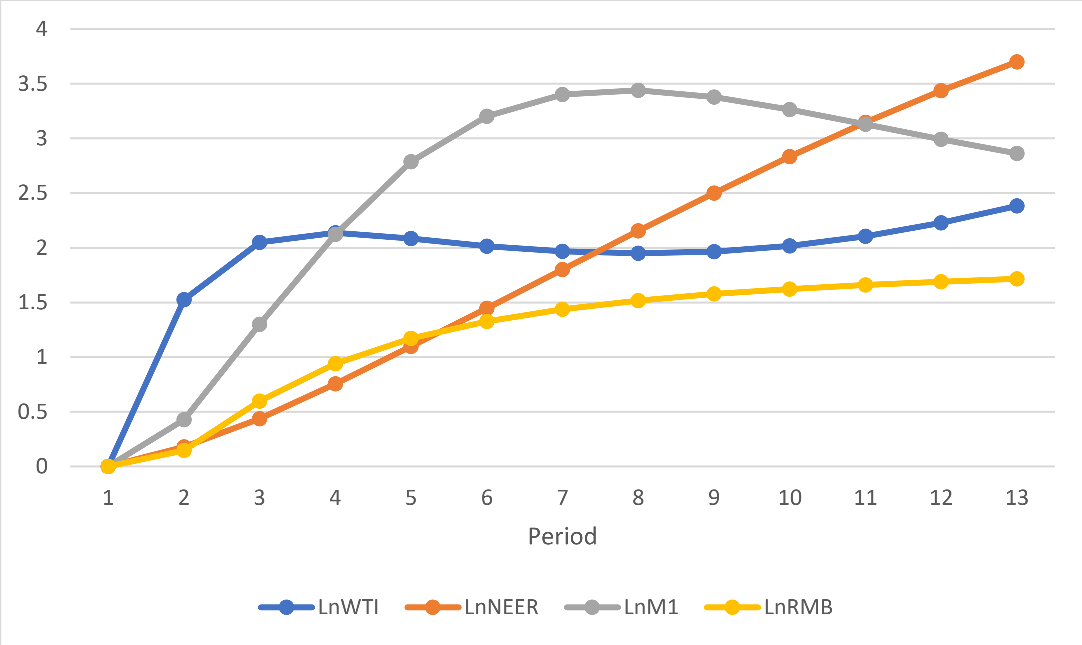

Figure A2b: Variance of LnHK explained by selected non-stock market factors (Conventional Monetary Policy period) (in %)

Implications of the Findings with reference of Global Events

The conventional monetary policy period, which began aftermath few years after the Wall Street Crash of 1987 (as well as the Latin American Debt Crisis of the 1980s), was in a process of recovery in which the US economy gradually recuperated and experienced growth. Interest rates had been falling to further stimulate economic activities (i.e. consumption and investment). Subsequently, global economies in general (with possibly the only exception of Japan due to the burst of its housing bubble), had also experienced a period of stable growth due to easier access to lower-cost credit either from financial institutions (both local and foreign) or from a developing bond market. Following the Wall Street Crash, however, the US Dollar (and by association through the pegged exchange rate, the Hong Kong Dollar) was in a relatively weak position, when compared to other Asian currencies such as the Singapore Dollar[71] and

[71] Unlike the Hong Kong Dollar which is pegged solely to the U.S. Dollar under a "hard peg" Currency board arrangement, the Singapore Dollar is pegged against a basket of currencies (of the nation's primary trading partners and competitors). In accordance with the Monetary Authority of Singapore (2001), the composition of this basket of currencies is revised periodically in response to changes in

the Japanese Yen (until August 1995) (Figure A3). For the former, a weaker Hong Kong Dollar enhances the competitiveness of Hong Kong exports, considering that the export mix of Hong Kong was highly similar to that of Singapore (see Radelet and Sachs, 1998; Corsetti et al., 1999). For the latter, a weaker Hong Kong Dollar indicates more costly imports from Japan, in turn further compromising the growth of the already-stagnating Japanese economy. Yet, the impacts of the stock market movements in these two nations on Hong Kong's stock prices differ. While the rising stock prices in Hong Kong is driven by stronger stock markets in Japan, China, the U.S. and Europe, as well as higher oil price, a higher money supply, and a stronger Renminbi, stock market movements in Singapore and in Taiwan only brought about minimal effect on Hong Kong's stock market in the long-run.

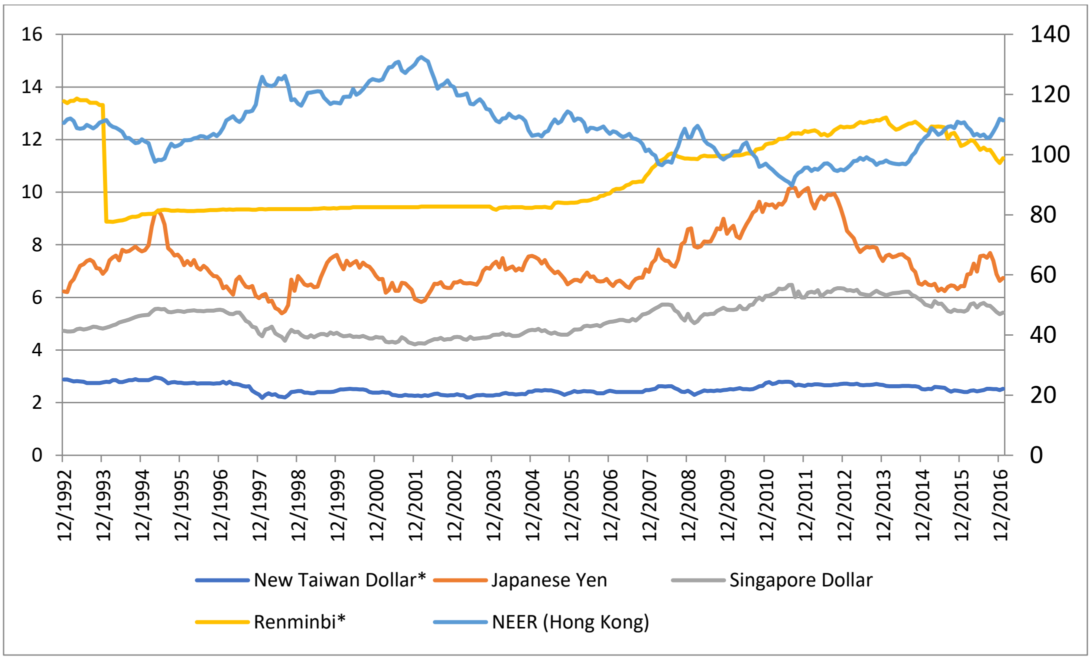

Figure A3: Exchange Rates between Hong Kong Dollar and currencies of East Asian nations and Hong Kong's Narrow Effective Exchange Rate (Sources: The Hong Kong Monetary Authority and The Bank for International Settlements)
Note: * Per 10 units

Interestingly, despite years of minimal economic growth, Japan, with its loose monetary

Singapore's trade patterns. The International Monetary Fund (2014) categorizes the Singapore Dollar as a "Stabilized arrangement" within the "soft peg" category.

policy and low interest rates, had been a major creditor of many emerging Asian countries[72], which helped facilitate the latter's economic growth by intensified trading relationships (mostly exports) with other nations including Hong Kong. The continuously-easy lending by Japanese banks, coupled with the lack of economic growth of its own due to a strong currency[73], eventually sowed the seeds for what became known as the Asian Financial Crisis. The Asian Financial Crisis commenced with the currency crisis in Thailand in July 1997. No longer able to defend the Thai Baht against speculative attacks, the Thai government adopted a floating exchange rate for Baht, which essentially plummeted instantly. This was then followed by the drastic depreciation of other Asian currencies, such as Singapore, Taiwan, South Korea, and Malaysia. Hong Kong was also subject to similar attacks on its currency, but eventually managed to maintain the pegged exchange rate to the US Dollar (Corsetti et al., 1999). Shortly after the Asian Financial Crisis, another wave of financial crises took place, first in Russia in 1998, and then in Brazil and Argentina slightly later, to which these nations responded differently. While Brazil eventually depreciated its currency, the Real, both Russia and Argentina defaulted on their respective debts. An outcome of these financial crises is a stronger Hong Kong Dollar, as reflected by a higher NEER in the late 1990s. Interestingly, a stronger Hong Kong Dollar, at the time, yields negative impacts on Hong Kong's stock prices, as previous shown in the impulse response analysis.

[72] According to statistics provided by the Banks for International Settlements, Japan, in the mid-1990s, was the largest lender of external loans in the world. It was until after the Asian Financial Crisis that its leading role was replaced by the likes of the U.S. and the U.K.

[73] Besides compromising Japan's own export competitiveness, a strong Japanese Yen also rendered repayment of (Yen-denominated) loans by nations that borrowed from Japanese banks costlier. The situation was further exacerbated when the Asian Financial Crisis broke out, as numerous Asian currencies depreciated by large margins upon speculative attacks by hedge funds.

In the aftermath of these financial crises, similar to the years following the 1987 Wall Street Crash, the world again experienced economic recovery (as reflected by the noticeable rise in oil price; see Figure A4 below) in a lower-interest-rates environment (which itself was partly attributed of the burst of the US Dot.com bubble around 2001). Between early 2000 and the outbreak of the Global Financial Crisis of 2008, the Hong Kong Dollar (due to its "hard peg" with the U.S. Dollar) had been comparatively weak (Figure A3), especially against the likes of the British Sterling and the newly-established Euro (Figure A5). During these few years, the biggest beneficiaries appear to have been the developing nations, due to much easier access to credit either through foreign bank loans or through a vigorously-expanding global debt securities market[74] (Figure A6), and improved competitiveness as a result of depreciated currencies (against the US Dollar), especially in Latin America (Ocampo, 2009). As indicated by the findings, a weaker HKD (or a lower NEER), along with escalating oil price, contributed to the rising stock prices in Hong Kong until the emergence of the 2008 Financial Crisis.

[74] At the same time, a rapidly-developing over-the-counter (OTC) derivatives market, which is unregulated, also emerged during this period. With the expansion of the global debt securities market, the notional amount of credit derivatives outstanding, such as Credit Default Swap (CDS), had reached unprecedented heights. According to the Bank for International Settlements (BIS), by June 2008 (just before the burst of the US subprime housing bubble), it amounted to 57.4 trillion USD.

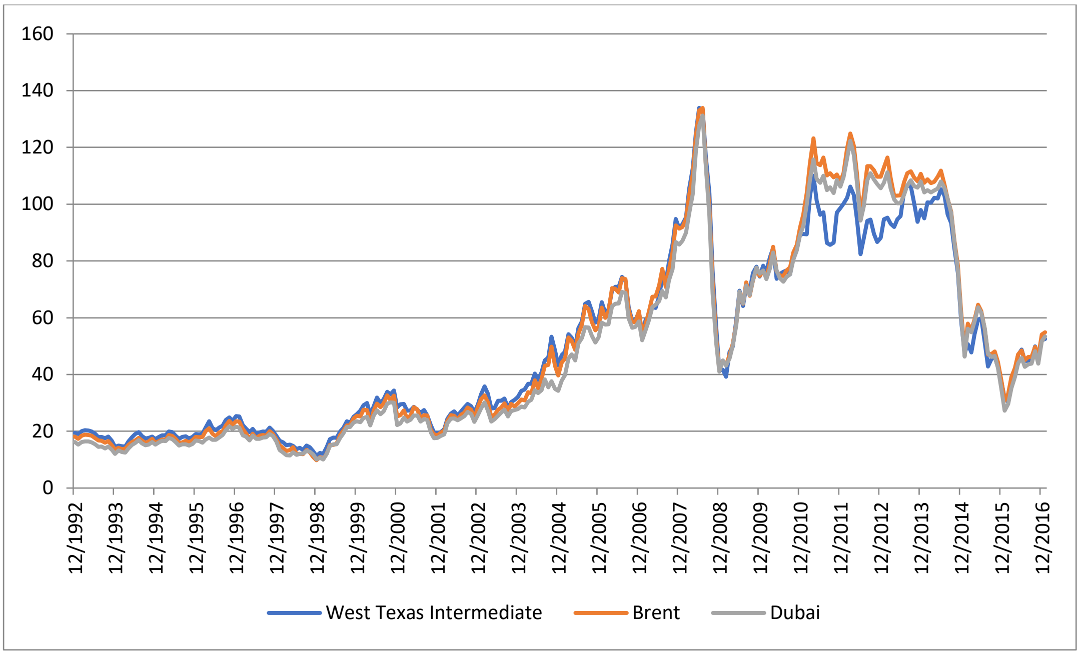

Figure A4: Per barrel spot price of crude oil (West Texas Intermediate, Brent Europe, abd Dubai; in USD) (Source: Federal Reserve Bank of St. Louis)

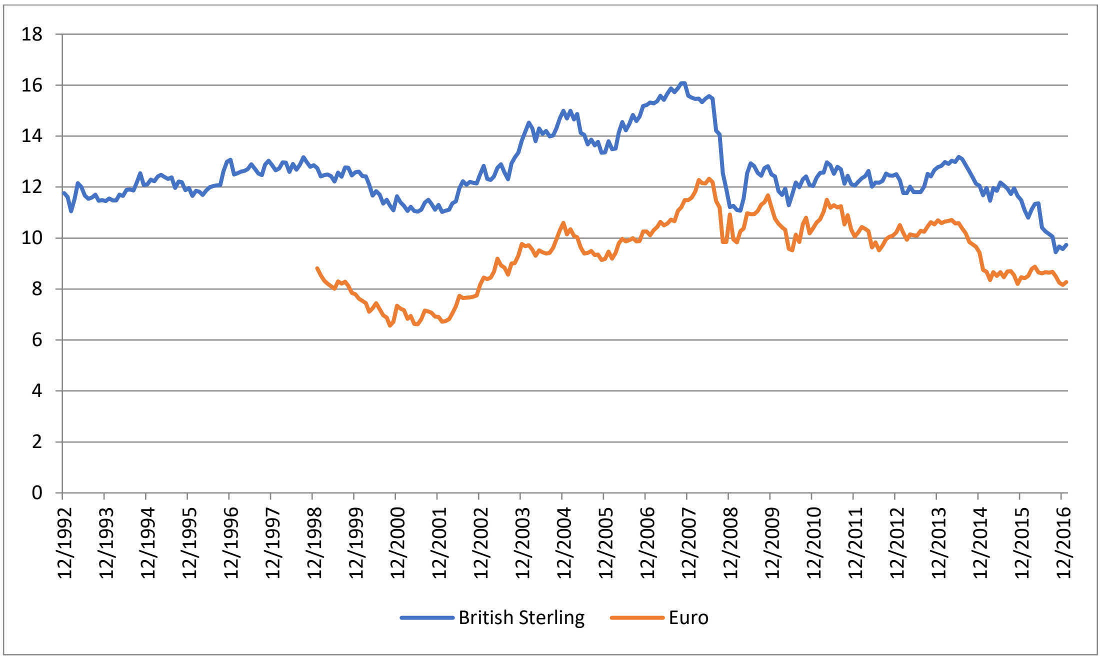

Figure A5: Exchange Rates between Hong Kong Dollar and British Sterling/Euro (Sources: The Hong Kong Monetary Authority & European Central Bank)

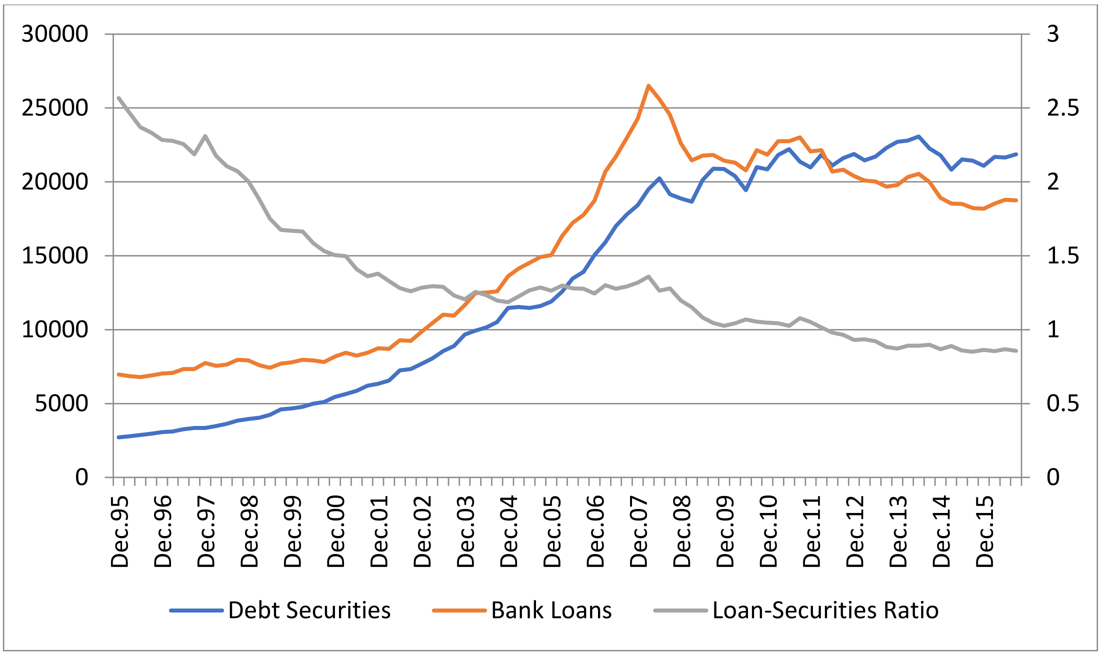

Figure A6: Total outstanding external bank loans (in billion USD), total outstanding international debt securities (in billion USD), and the international loan-debt securities ratio (Source: Bank for International Settlements)

Even though currency depreciations mean cheaper imports (and rising stock prices), Hong Kong, with its currency pegged to the U.S. Dollar under the Linked Exchange Rate system, becomes less competitive with regard to the export of merchandises and services. The result of these circumstances was exacerbated trade deficits (Figure 7) and profound implications for Hong Kong's current account conditions.

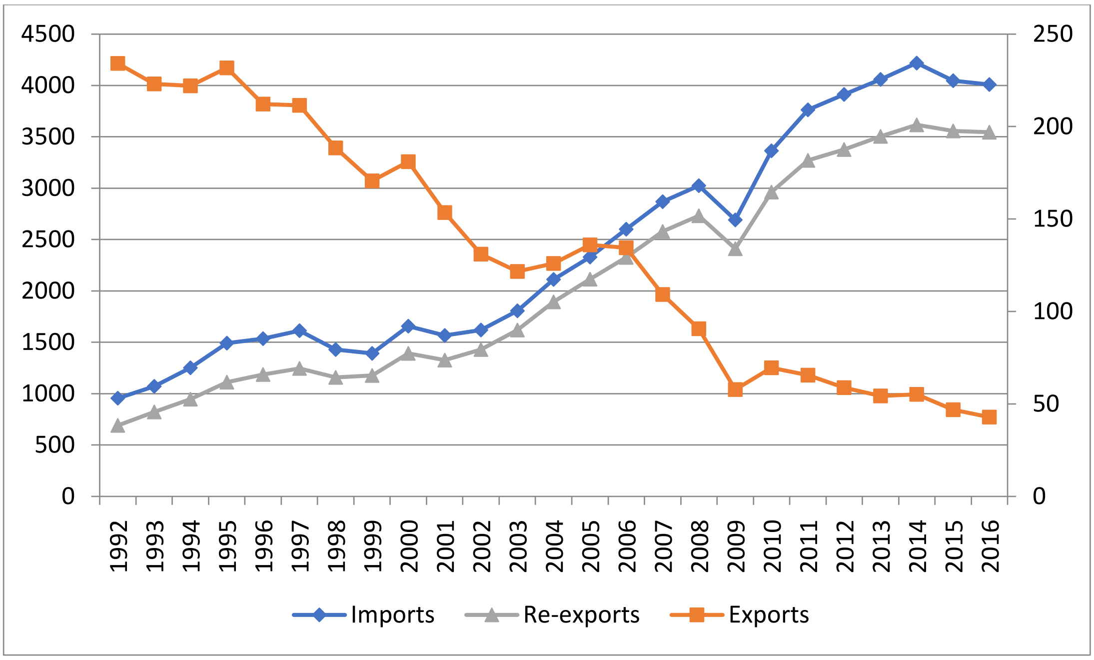

Figure A7: Hong Kong's external trade (in billion HKD), 1992-2016 (Source: Hong Kong Census & Statistics Department)

Unconventional Monetary Policy Period

Then, in the unconventional monetary policy period, it is not hard to discern that the foreign capital markets which yield the highest level of accumulated responses from the Hong Kong stock index are the U.S. stock index, the Japanese stock index, the Singaporean stock index, and the Chinese stock index. While shocks of the other stock indices also trigger certain degrees of responses from the Hong Kong stock index, their respective impacts are not as prominent (Figure A8a).

During this period, the U.S., Japan, and Europe (more specifically, the E.U.) have initiated asset-purchase programmes (i.e. the QEs) in recent years, Nevertheless, despite the similarities in their policy actions, their resultant impacts on Hong Kong's stock market differ substantially. For instance, given similar level of exogenous shocks, the Hong Kong's stock market tends to respond to those from the U.S. much sooner, and much more vigorously, than those from the Japanese stock index and the European stock markets. Also, the accumulated responses to shocks from both Europe and Japan (until the latter periods) are hovering around zero, meaning that the error correction process manages to keep their respective impacts on Hong Kong's stock market near their respective long-run equilibriums. The same, however, cannot be said with reference to shocks from the U.S. stock market. Although the relationship between the Hong Kong stock market and the U.S. stock market is restored to the long-run equilibrium at a later stage, the negative accumulated responses (until Period 11 are far more remarkable than the other stock indices.

And for the other non-stock market factors (Figure A8b), Hong Kong's stock market responds positively (and more vigorously), in general, towards exogenous shocks in Hong Kong's Narrow Effective Exchange Rate Index. This means that a stronger Hong Kong Dollar, reflected by a higher NEER, contributes to soaring stock prices in Hong Kong ever since the launch of these unconventional monetary policy measures outside the U.S. Meanwhile, the initial responses to oil price are positive, suggesting that better global economic conditions lead to higher stock prices in Hong Kong, even though this no longer applies in the longer-run. Interestingly, exogenous shocks in money supply only bring about positive responses in the longer-run, but not in the short-run. This particular finding, with reference to the Linked Exchange Rate system, suggests that the impact on Hong Kong's stock price in light of money supply boosts, as a result of the several QE programmes initiated by the U.S. Federal Reserve, only emerges later. This is remarkably different from its instant effect on housing prices and rents, as shown in Chapter 2. Lastly, exogenous shocks in the Hong Kong Dollar-Renminbi exchange rate trigger negative responses from Hong Kong's stock prices, but only in the longer-run (the initial responses hover around zero as the error correction process consistently restores the relationship back to the equilibrium).

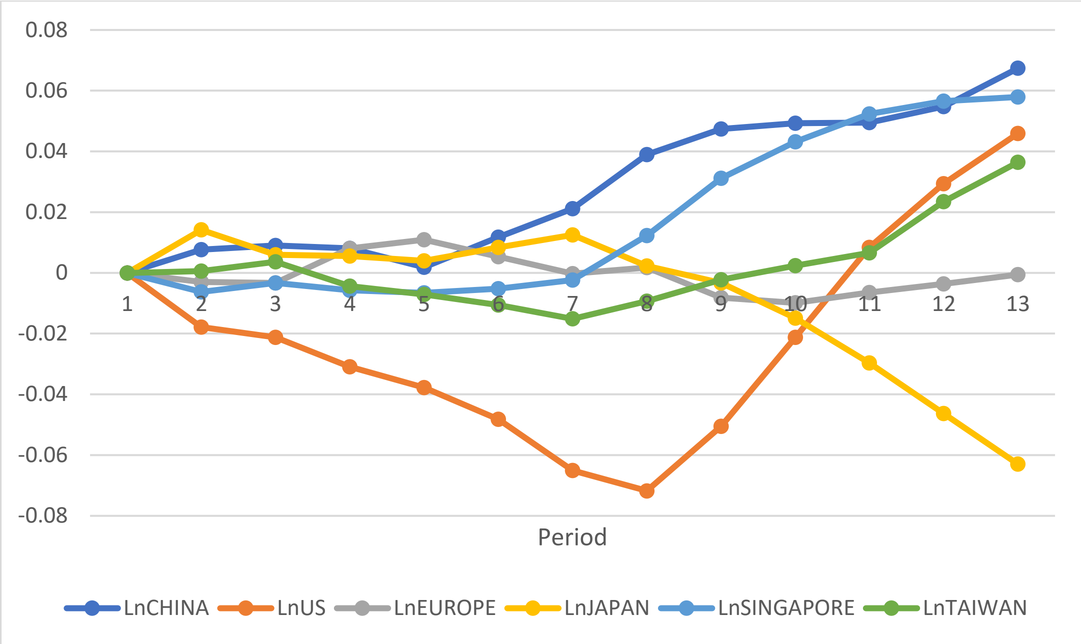

Figure A8a: Accumulated responses of LnHK to exogenous shocks in the selected stock indices

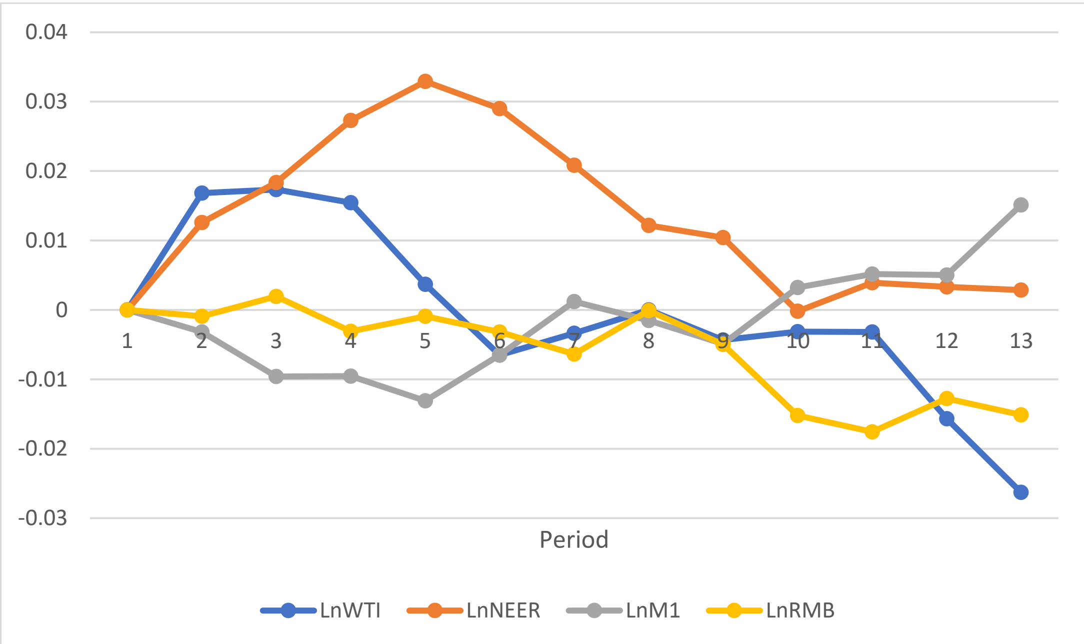

Figure A8b: Accumulated responses of LnHK to exogenous shocks in the selected non-stock market factors

Compared with the unconventional monetary policy period, however, noticeable changes are found concerning the impact of international stock price movements on that of Hong Kong's stock market. Yet, in this period, exogenous shocks in the selected external factors play a much bigger role in explaining Hong Kong's stock price movements. To say that Hong Kong's stock market is highly susceptible to international market conditions now becomes an understatement, as this finding (Figure 9a) indicates that fluctuations in the stock markets, especially in the U.S., contribute to a much larger amount of total variance of the Hong Kong stock index (amounting to almost 50% of the Hong Kong stock index's total variance), whereas past Hong Kong stock index is only able to explain 36-58.3% of its present variance. In addition to the international stock markets, exogenous shocks in global economic conditions (as proxied by oil price) and in Hong Kong effective exchange rate also explain a much larger amount of Hong Kong stock index's variance (Figure A9b). By contrast, while money supply shocks explain a similar amount of the Hong Kong stock index's variance in this period as it did in the conventional monetary policy period, exogenous shocks in RMB-HKD exchange rate are not as prominent in influencing the movements in Hong Kong's stock index in this period as it did in the conventional monetary policy period.

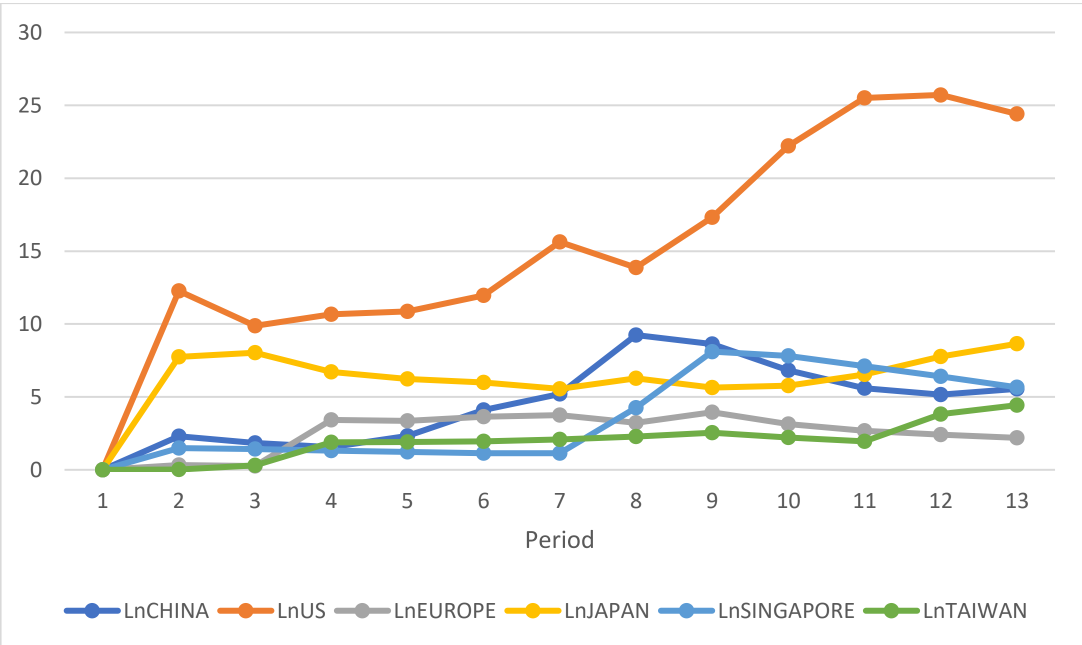

Figure A9a: Variance decompositions of selected stock indices (Unconventional Monetary Policy period) (in %)

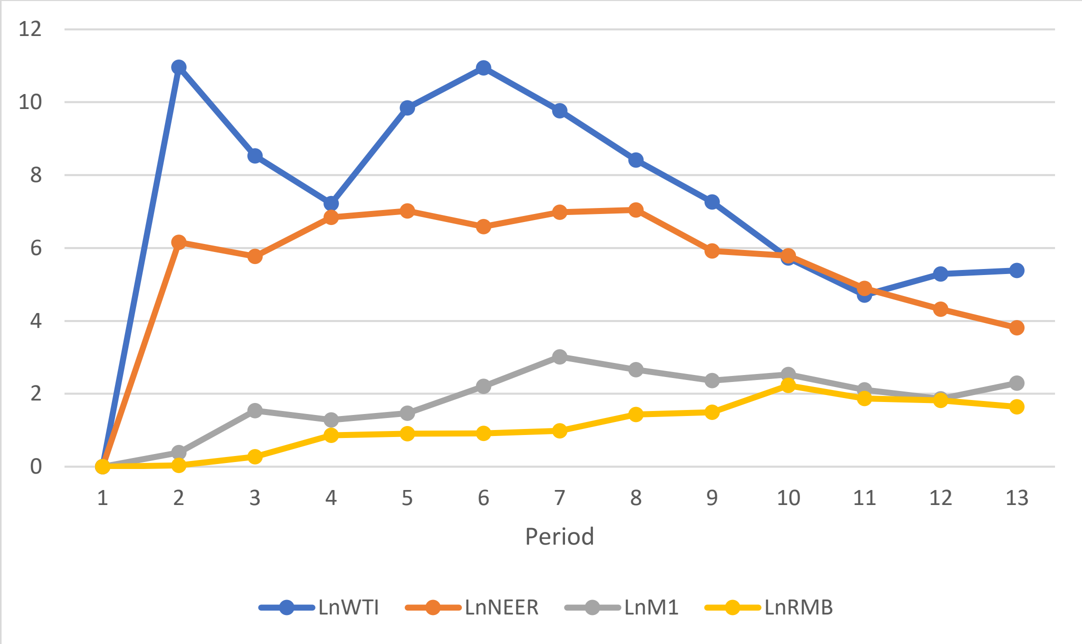

Figure A9b: Variance decompositions of selected non-stock market factors (Unconventional Monetary Policy period) (in %)

Implications of the Findings with reference of Global Events

By the time when the global financial crisis broke out in 2008, following the burst of the US subprime mortgage bubble and the subsequent bankruptcy of Lehman Brothers, it essentially triggered a shockwave across the globe. For a period of time, the world had seen a contraction in demand (as shown by the unprecedented fall in oil prices in Figure 4), thus resulting in stagnating economies, including that of the United States. Unlike the conventional monetary policy period, however, interest rates had already been lowered to the point where nominal rates were practically zero. The same also happened in Japan. Therefore, in order to further encourage spending and investment when the conventional means (i.e. lowering the interest rate) was already exhausted, unconventional monetary policy, in the form of Quantitative Easing, was deployed in the U.S., the U.K., Japan, and later the European Union. These asset-purchase programmes are believed to have impacted global stock market(s) through either the portfolio rebalancing channel or the signaling channel (see Tobin, 1969; Joyce et al., 2011; Gagnon et al., 2011; Bernanke, 2012; Hamilton and Wu, 2012; Bauer and Neely, 2014; Bauer and Rudebusch, 2011; 2014; Neely, 2015; Fratzscher et al., 2016). Since the respective central banks (i.e. the Federal Reserve, the Bank of England, the Bank of Japan, and the European Central Bank) purchased massive amounts of government debts in their financial markets with newly-printed (or electronic) money, international investors, courtesy of this new-found liquidity, invested in other financial assets (as well as tangible assets such as gold[75] and real estate [see Chapter 2]), causing asset prices to rise substantially. Higher asset prices indicate three things. First, capital appreciations in financial assets encourage further consumption or investment, which helps facilitate economic growth. Second, by recycling the profits back to the asset markets, stock prices ascend even further. And third, as higher asset prices suggest lower yields, thus lower cost of borrowing (in the global securities market). This encourages further lending through the issuance of debt securities[76] for investment in production activities.

The QEs by the Federal Reserve and later by the Bank of Japan (and to a lesser extent, by the Bank of England and the European Central Bank), had generated some interesting dynamics for the Hong Kong stock market. Due to the massive injection of newly-printed USD into the financial system, the supply of money in the US remarkably increased, causing the U.S. Dollar to depreciate against currencies which were not in any way pegged to it. The Hong Kong Dollar, owed to the Linked Exchange Rate System, also become weaker against other currencies (as shown in its declining NEER), until Japan and the European Union embarked on their own asset-purchase

[75] According to the World Gold Council, the price of gold (per troy ounce) was USD 729.50 in November 2008. By August 2011, it reached the peak level of USD 1,821.00 (or a rise by 150%).
[76] In fact, it is reported by the BIS that external bank loans had fallen, since the 2008 global financial crisis, whereas the amount of outstanding debt securities had continued to rise.

programmes. This scenario has led to two contrasting outcomes. The first outcome is the rapidly-rising stock prices in Hong Kong, which was primarily caused directly by a strengthened NEER due to the asset-purchase programmes initiated by the Bank of Japan and the European Central Bank, as well as indirectly by the recovering global economy (as shown through the rebounding oil price). Remarkably, the QEs in the U.S., which had caused both U.S. and international asset prices to rise and Hong Kong's money supply to soar under the Linked Exchange Rate System, had not contributed to the rising stock prices in Hong Kong at all. This finding is somehow similar to those reported in numerous studies on the relationship between conventional monetary policies and stock prices (see Geske and Roll, 1983; Kaul, 1987; Lee, 1992; Patelis, 1997; Millard and Wells, 2003; Neri, 2004; Bomfim and Reinhart, 2000; Roley and Sellon, 1996), rather than on the relationship between unconventional monetary policies and stock prices (see Joyce et al., 2012). The second outcome is that imports from nations other than Japan (and recently, the European Union) become costlier than they previously were. Yet, for a net-importer city state such as Hong Kong, higher prices for imports, especially necessities from Mainland China, inevitably result in higher (imported) inflation (but not higher housing prices and rents; see Chapter 2). Worse, cheaper Japanese imports further exacerbate Hong Kong's trade deficit situation.

The Degree of Co-movements and/or Spillover Effects

Comparing the findings obtained for the two periods, it is reasonable to conclude that a higher level of integrations has been identified between the selected factors, as 1) a higher number of cointegrating relations have been identified by means of the Johansen Cointegrating Tests; and 2) the selected stock market and global economic factors manage to explain a much higher level of Hong Kong stock index's variance.

Nevertheless, these analyses do not directly address the question of whether such linkages are merely co-movements or the result of spillover effects. To tackle this issue, the VEC Granger Causality test is thus conducted.

The findings are presented in Table A4[77]. For the conventional monetary policy period, three causal relationships are identified, within 5% level of significance. With reference to the subject of this study, the Hong Kong stock market, Hong Kong's stock index is found to be subject to spillover effects of the Chinese stock index, the Taiwanese stock index, and oil price. In other words, the findings indicate that a significant degree of the interactions between the selected financial markets in this study can be partly attributed to spillover effects between one another, rather than simply co-movements between them.

For the unconventional monetary policy period Hong Kong's stock index is found to be Granger-caused (significant at 5% level) by the European stock index and the Japanese stock index, whereas significant two-way causal relationships are identified between Hong Kong's stock index and global oil price. In addition, the Hong Kong stock index is also found to Granger-cause (i.e. one-way) money supply.

Apart from the direct spillover effects, the Hong Kong stock index is also subject to indirect causal effects via the following channels (see Appendix BAA.6):

1) The Chinese stock index → The Japanese stock index → The Hong Kong stock index

2) The U.S. stock index → The Japanese stock index → The Hong Kong stock index

[77] For the causality relationships between other selected variables in the VECMs, see Appendix 6.6

3) The European stock index → The Japanese stock index → The Hong Kong stock index

4) The Hong Kong Dollar-Renminbi exchange rate → The Japanese stock index → The Hong Kong stock index

Granger Causality	**Chi-square**	
	Conventional Monetary Policy Period	**Unconventional Monetary Policy Period**
CHINA→ HK	4.840*	4.466
US → HK	0.015	10.518
EUROPE → HK	0.002	15.511*
JAPAN → HK	0.655	18.756*
SINGAPORE → HK	1.768	11.098
TAIWAN → HK	4.301*	4.196
WTI → HK	5.064*	19.253*
M1 → HK	0.355	7.856
NEER → HK	0.168	10.581
RMB → HK	0.061	4.356

Table A4: VEC Granger Causality Analyses results
Note: * denotes significance at 5% level.

Implications of findings

The findings illustrate that much higher degrees of spillover effects have been found in the unconventional monetary policy period while much of the interactions between the different global stock market/economic factors in the conventional monetary policy period (other than those found for the Taiwanese stock market and the Chinese stock market) appear to be co-movements. Viewing these findings together, it is reasonable to conclude that the Hong Kong stock market has indeed become increasing integrated with international financial markets and global economic conditions (similar to what Chung and Liu, 1994; Arshanapalli et al., 1995; Sheng and Tu, 2000; Yang et al., 2003.; Masih and Masih, 1997; 1999; 2001 have found in Asian stock markets either after the 1987 Financial Crisis or after the Asian Financial Crisis).

Yet, what are the driving forces behind such intensified integration and how should the differences in terms of spillover impacts (i.e. causal relationships) amongst the two study periods be explained? The answer lies in the relationship between the international loan market and the international debt securities market. As illustrated in Figure 6, until the early 2000s, both the international loan market and the international debt securities market had been growing rather steadily. However, financing for businesses around the world at the time primarily relied on loans proffered by banks. In particular, foreign bank loans, instead of debt securities, appear to have been the primary driver behind global economic development during the mid- and late-1990s. The situation changed drastically in the 21st century, as both the international loan market and the global bond market had expanded drastically, largely owed to low interest costs. This, coupled with the rapid outsourcing of manufacturing jobs (and even IT capacities) from the developed world to the emerging markets to take advantage of the labour cost disparities (see Gomory and Baumol, 2000; Roberts, 2013), resulted in high levels of economic growth in the latter, especially in Latin American nations. By the time global economies suffered the impact of the shocks following the 2008 global financial crisis, the amount of outstanding international bank loans had actually begun to fall yet the international bond market continued to expand. This coincided with the prominent spillover effects between the selected global stock market/economic factors. While the rapid expansions of both the international loan market and the international debt securities market, since the 1990s, contribute to more integrated financial markets, this development alone is not able to explain the changes in the level of spillover effects between international stock markets.

The key to explain this, instead, lies in the degree of expansions of the two markets. To put it differently, the international bank loan-debt securities ratio has implications with respect to the interactions of global stock markets. As shown in Figure 6, it had been noticeably declining since the 1990s, while hovering within a much smaller range in the number of years prior to the 2008 Financial Crisis. Since late 2012, however, the amount of outstanding debt securities was actually higher than that of outstanding international bank loans (i.e. the ratio < 1), which was very likely a direct result of portfolio rebalancing due to the unprecedented boost in liquidity in the financial markets following the launch of various QE programmes. With reference to the movement of this ratio, it can be concluded that the degree of spillover effects between financial markets is subject to the risk-bearing dynamics between commercial banks and international investors. If debt financing is obtained through banks, it is conventionally perceived that the banks themselves bear the risk (of default) of the loans, whereas international investors (amongst them commercial banks and investment banks) share the (both price and default) risk of the bonds sold in financial markets. A falling ratio indicates that the international debt securities market out-grows the international loan market; and that international investors are subject to a higher share of risks from global debts. Meanwhile, a stable ratio suggests that both markets are expanding at a similar pace, and there are no noticeable changes in the risk-taking dynamics between banks and international investors. Should certain debt securities become riskier, risk-averse investors usually would shift their portfolios towards safer assets. This in turn leads to changes in the relative price/yield of these assets[78], thus resulting in spillover effects across global stock markets. The spillover effects would

[78] For instance, higher price of (and lower yield for) safer assets such as U.S. Treasuries and German government bonds. A recent investigation on the latter conducted by Dany et al. (2015) concludes that, due to lower yield rates for German bonds as a result of the so-called "flight to safety" in the aftermath of the Greek Sovereign Debt Crisis, the German government had saved an estimated 100 billion Euros in interest expenses between 2010 and mid-2015.

then become even more pronounced as the proportion of bonds in global debts increases.

Conclusion

This chapter has investigated the interactions between the Hong Kong stock market and the stock markets of Hong Kong's major trading partners (and global economic factors) between December 1992 and January 2017, in two separate periods (i.e. the conventional monetary policy period and the unconventional monetary policy period). Two major findings have been identified.

The first major finding is that, in the conventional monetary policy period, Hong Kong's stock index were driven by a stronger Chinese stock market and a stronger global economy (via causal relations), as well as the result of co-movements with rising stock prices in Singapore, China, the U.S. and Europe, a higher money supply, and a weaker HKD. In the unconventional monetary policy period, however, the escalating Hong Kong stock prices were triggered by a recovering global economy (which in turn was induced by boosts in investment as a result of very low cost of borrowing) and soaring stock prices in China, in Singapore, and in Taiwan, as well as a stronger HKD. Meanwhile, under the Linked Exchange Rate system, negative co-movements (until in the longer-run) are found between Hong Kong's stock market and the U.S. stock market in both study periods. This means that, despite the Federal Reserve's QE programmes, while triggering higher prices for U.S. assets as well as international assets as a result of the portfolio rebalancing effect and/or the signaling effect (see Tobin, 1969; Joyce et al., 2011; Gagnon et al., 2011; Bernanke, 2012; Hamilton and Wu, 2012; Bauer and Neely, 2014; Bauer and Rudebusch, 2011; 2014; Neely, 2015; Fratzscher et al., 2016), were not the reason behind the upward movements in Hong Kong's stock prices, as the

Hong Kong stocks, due to a weaker Hong Kong Dollar, were not as attractive to international investors as assets in other nations with relatively stronger currencies (compared with USD).

This study has also found that Hong Kong's stock market has become more integrated with international stock markets as well as with other global economic-related factors, in that it has been increasingly susceptible to shocks from these global factors in the aftermath of the 2008 Financial Crisis. This is due to the introduction of unconventional monetary policy measures, primarily asset-purchasing programmes, in the U.S., the U.K., Japan, and the European Union, which, to a large extent, shape the relative prices/yields of not only their respectively government bonds/gilts, but also of other global financial assets.

While the higher degree of integrations between international stock markets can be attributed to much easier access to credit as a result of the rapid expansions of the international loan market and the international debt securities market since the beginning of the 21st century, this reason alone is not sufficient in explaining the noticeably prominent spillover effects between the Hong Kong stock market and the stock markets of Hong Kong's major trading partners (along with global economic indicators) in the unconventional monetary policy period. Instead, an exploration of the dynamics between these two markets suggests that a fall in the ratio between the amount of international debts through bank loans and those through the issuance of debt securities results in higher levels of spillover effects between financial markets. In other words, as more risks are shared among international investors through the purchase of bonds (itself a result of portfolio rebalancing as they are looking for other means to invest in light of the immense boost in liquidity in the financial markets), rather than by banks themselves through external loans, the subsequent portfolio re-arrangements, should these debts perform unsatisfactorily (or at worst, default), would re-shape the prices of other financial assets all over the world (including Hong Kong). This, as having been reported in Chapter 2, has profound implications for Hong Kong's housing prices and rents via the stock market channel.

APPENDIX B: SUPPLEMENTARY INFORMATION

Chapter 1

Appendix B1.1: Land Sale and Land Exchange in Hong Kong

Land Sale

As the government is the sole owner of all land in Hong Kong, what is sold via either auction or tender is not the full ownership right of developable land sites. Rather, only these sites' leasehold interests (see Hui, 2001) for a stipulated period (normally 50 years) are transacted[79]. Also, whoever that pays for such leasehold interests of a land site is subject to a rent payable to the government, amounting to 3% of the rateable value on a yearly basis[80]. According to Lai (1998), this leasehold arrangement is "the government's way of allocating private property rights through contracts", which, from a governance standpoint, resembles the freehold land tenure arrangement.

Since Hong Kong's land sites are being transacted under a leasehold arrangement, the government, through the pre-determined lease conditions, is thus able to manage (and adjust) the nature[81] and the intensity of land development alongside statutory controls (Hui, 2001). In addition to the total control of urban development, the sale of leasehold rights also provides a source of revenue for the government by means of land rents and/or land premiums.

Before April 1999, Hong Kong's land supply had generally been initiated by the

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[79] The only exception is the site on which St. John's Cathedral is built (Central). The owner of the site in question possesses its freehold rights, as long as the site is only used for the purpose of a church (Ho, 1999).

[80] This 3% figure is grounded on a speech given by then-Secretary for Planning and Lands, Mr. John C. Tsang on June 6, 2002 (http://www.devb.gov.hk/en/publications_and_press_releases/press/index_id_1711.html)

[81] The recently-introduced HKPHKP is a perfect example of government control over the development of land.

government. Nevertheless, Hong Kong's property prices plummeted (Figure 1.1) as economic depression occurred following the Asian Financial Crisis. Many housing assets became negative-equity overnight. The government, aiming to supplement land sale, launched the Application List system in April 1999, under which a variety of residential land sites were included. Property developers, upon the submission of an application to the Lands Department with a stated price, were entitled to the right to seek for the release of land sites on the application list for sale. Should the government have found the developers' stated price(s) acceptable, these sites were subsequently released for sale via either auction or tender. Despite the seemingly market-oriented approach under this system, it, in reality, was every bit as controlled as regular land sale, given the government's ultimate authority to decide 1) which land sites were included on the list and 2) whether a land site should have been put on sale upon receiving developers' stated prices. Eventually, the application list system turned out to be a rather short-lived experiment, as the government announced on Feb 28, 2013 that it be abolished in the following fiscal year.

Land Exchange

Land exchange, on the other hand, involves one's surrender of 'old' lot(s) in exchange for a 'new' lot. In accordance with Nissim (2008), there are two kinds of land exchange. The first kind is *in-situ*, which refers to a situation in which the original land site at least partly overlaps the new land site. And the second kind of land exchange is non-*in-situ*, as the "old" land site is exchanged for a "new" land site which does not in any way overlap with it.

Land exchange applications, which are under the jurisdiction of the Lands Department[82], normally take place under three conditions. The first condition is when a major readjustment of lot boundaries is involved, whereas the second condition is when different lots are amalgamated. Lastly, the third condition is when the existing (i.e. 'old') lease conditions require major amendments (Nissim, 2008). Normally, the Lands Department adopts a 1:1 ratio in land exchange applications. Yet, if an applicant applies for a land exchange due to the amendment of existing lease conditions, a larger developable floor area (meaning more housing space to be supplied on the same lot) is permissible. On some occasions, developers are even permitted to apply for additional government land in a land exchange application, given that the government land in question 1) is not capable of reasonable separate alienation or development; 2) has no foreseeable public use; and 3) results in a premium payable to the government (Nissim, 2008).

A Comparison between land sale and land exchange

Some noticeable differences can be observed between land sale and land exchange. First, for land sale, the lease conditions for land sites have already been stipulated by the government beforehand. By contrast, in a land exchange application, the lease conditions are negotiable (and constantly subject to revisions) between property developers and the government. Despite a higher degree of flexibility (and arguably more bargaining power) in the determination of lease terms, developers, in land exchange applications, are susceptible to what Mayo and Sheppard (2001) refer to as stochastic development control. Second, with the lease conditions already decided by

[82] In some cases, applications for land exchange and lease modifications require the Town Planning Board's (TPB) permission, should they involve changes related to the Town Planning Ordinance.

the government, a land site obtained via land sale, in theory, could be developed as soon as the transaction is completed. Meanwhile, a land exchange application, while time-consuming, does not guarantee success. According to government sources, it takes 57 weeks for a regular land exchange application to be processed, and twice as much (approximately 114 weeks) should the application request for modifications of the lease conditions relating to the OZP (under the jurisdiction of the Town Planning Board)[83].

In spite of the potential risks and delays, the property market can be influenced by land exchange in two ways. In accordance with Tse (1998), land exchange encourages property developers to utilize their land banks for housing constructions. Also, the modification of lease conditions applicable to the "old" site allows for the creation of land substitutes for the development of more living space, hence more profits for developers.

The fundamental differences between land sale and land exchange, along with Hong Kong's "hybrid" planning control system, make property developers' decisions as to when to initiate housing construction (and how much housing space to be built) more complicated than what a lot of people perceive.

[83] Those figures, however, should be taken with reservation. Ball et al. (2009) and Ball (2011) report that the delay caused by the planning system is usually underestimated.

Chapter 2

Appendix B2.1: Global maximizer tests results

Results of the Bai-Perron tests of 1 to M globally determined breaks

Breaks	**Scaled F-statistic**				**Critical Value**
	LnPPI(A)	LnPPI(B)	LnPPI(C)	LnPPI(D&E)	
1	220.152	309.622	380.507	404.336	8.58
2	418.983*	464.451*	491.471*	556.452*	7.22
3	331.716	385.571	437.573	540.660	5.96
4	298.728	337.988	367.535	502.674	4.99
5	331.577	346.273	382.436	483.329	3.91

Breaks	**Weighted F-statistic**				**Critical Value**
	LnPPI(A)	LnPPI(B)	LnPPI(C)	LnPPI(D&E)	
1	220.152	309.622	380.507	404.336	8.58
2	497.905	551.937	584.047	661.269	7.22
3	477.537	555.067	629.929	778.332	5.96
4	513.644	581.149	631.954	864.318	4.99
5	727.604*	759.853*	839.206*	1060.605*	3.91

Breaks	**Scaled F-statistic**				**Critical Value**
	LnPRI(A)	LnPRI(B)	LnPRI(C)	LnPRI(D)	
1	215.702	250.230	317.783*	316.112	8.58
2	404.942*	352.234*	287.109	290.023	7.22
3	311.509	276.881	242.178	315.997	5.96
4	325.039	331.531	298.034	366.063*	4.99
5	377.349	330.391	284.332	339.384	3.91

Breaks	**Weighted F-statistic**				**Critical Value**
	LnPRI(A)	LnPRI(B)	LnPRI(C)	LnPRI(D)	
1	215.702	250.230	317.783	316.112	8.58
2	481.219	418.583	341.190	344.653	7.22
3	448.447	398.597	348.638	454.909	5.96
4	558.884	570.047	512.452	629.423	4.99
5	828.044*	725.001*	623.930*	744.735*	3.91

Results of the Bai-Perron tests of L+1 vs. L globally determined breaks

Break Test	**Scaled F-statistic**				**Critical Value**
	LnPPI(A)	LnPPI(B)	LnPPI(C)	LnPPI(D&E)	
0 vs. 1	220.152	309.522	380.507	404.336	8.58
1 vs. 2	229.116*	178.354*	152.306*	164.807*	10.13
2 vs. 3	9.210	6.090	10.916	4.584	11.14
3 vs. 4	22.080	19.264	11.375	8.554	11.83
4 vs. 5	22.973	20.083	25.537	24.189	12.25

Break Test	**Scaled F-statistic**				**Critical Value**
	LnPRI(A)	LnPRI(B)	LnPRI(C)	LnPRI(D)	
0 vs. 1	215.702	250.230	317.783	316.112	8.58
1 vs. 2	208.176	154.121	75.561	44.914	10.13
2 vs. 3	13.149	18.796	17.993	68.183	11.14
3 vs. 4	43.251	65.549	64.556	41.720	11.83
4 vs. 5	23.277*	15.179*	14.594*	18.483*	12.25

Global Maximizer tests results based upon information criteria

Breaks (Number of Coefficients)	Schwarz Criterion			
	LnPPI(A)	LnPPI(B)	LnPPI(C)	LnPPI(D&E)
0 (1)	-0.540	-0.492	-0.362	-0.264
1 (3)	-1.452	-1.612	-1.650	-1.598
2 (5)	-2.400	-2.442	-2.362	-2.374
3 (7)	-2.484	-2.570	-2.554	-2.651
4 (9)	-2.581	-2.645	-2.592	-2.786
5 (11)	-2.815*	-2.807*	-2.770*	-2.893*

Breaks (Number of Coefficients)	LWZ Criterion			
	LnPPI(A)	LnPPI(B)	LnPPI(C)	LnPPI(D&E)
0 (1)	-0.506	-0.458	-0.328	-0.230
1 (3)	-1.351	-1.530	-1.549	-1.496
2 (5)	-2.231	-2.273	-2.192	-2.205
3 (7)	-2.246	-2.333	-2.317	-2.414
4 (9)	-2.275	-2.339	-2.286	-2.479
5 (11)	-2.440*	-2.432*	-2.395*	-2.518*

Breaks (Number of Coefficients)	Schwarz Criterion			
	LnPRI(A)	LnPRI(B)	LnPRI(C)	LnPRI(D)
0 (1)	-1.733	-1.785	-1.783	-1.714
1 (3)	-2.633	-2.780	-2.941	-2.868
2 (5)	-3.564	-3.498	-3.326	-3.265
3 (7)	-3.622	-3.572	-3.454	-3.616
4 (9)	-3.851	-3.921	-3.822	-3.941
5 (11)	-4.129*	-4.057*	-3.916*	-4.011*

Breaks (Number of Coefficients)	LWZ Criterion			
	LnPRI(A)	LnPRI(B)	LnPRI(C)	LnPRI(D)
0 (1)	-1.699	-1.752	-1.749	-1.680
1 (3)	-2.531	-2.679	-2.839	-2.767
2 (5)	-3.395	-3.328	-3.156	-3.095
3 (7)	-3.384	-3.334	-3.217	-3.378
4 (9)	-3.545	-3.615	-3.516	-3.635
5 (11)	-3.754*	-3.682*	-3.541*	-3.636*

Appendix B2.2: Lag order

Lag	Sequential Modified LR Test Statistic	Final Prediction Error	Akaike Information Criterion	Schwarz Information Criterion	Hannan-Quinn Information Criterion
0	NA	4.14e-08	17.05403	18.38417	17.59449
1	3180.880	1.82e-19	-9.114127	-4.591633*	-7.276546*
2	308.6756	8.35e-20	-9.968325	-2.253482	-6.833628
3	266.5527	4.51e-20	-10.76477	0.142417	-6.332962
4	196.2929*	4.49e-20*	-11.11502*	2.984522	-5.386089

PPI(A)

Lag	Sequential Modified LR Test Statistic	Final Prediction Error	Akaike Information Criterion	Schwarz Information Criterion	Hannan-Quinn Information Criterion
0	NA	4.86e-08	17.21405	18.54419	17.75451
1	3133.964	3.25e-19	-8.535216	-4.012722*	-6.697636*
2	324.4800	1.27e-19	-9.547459	-1.832616	-6.412762
3	272.6596	6.41e-20	-10.41330	0.493887	-5.981492
4	196.3270*	6.37e-20*	-10.76400*	3.335544	-5.035068

PPI(B)

Lag	Sequential Modified LR Test Statistic	Final Prediction Error	Akaike Information Criterion	Schwarz Information Criterion	Hannan-Quinn Information Criterion
0	NA	7.71e-08	17.67615	19.00630	18.21662
1	3111.022	6.33e-19	-7.868273	-3.345779*	-6.030692*
2	340.4785	2.11e-19	-9.040500	-1.325657	-5.905803
3	284.4888	9.30e-20	-10.04077	0.866423	-5.608956
4	213.3161*	7.40e-20*	-10.61500*	3.484539	-4.886072

PPI(C)

Lag	Sequential Modified LR Test Statistic	Final Prediction Error	Akaike Information Criterion	Schwarz Information Criterion	Hannan-Quinn Information Criterion
0	NA	1.29e-13	1.534620	2.753920	2.030046
1	3327.624	1.38e-25	-26.03741	-22.13565*	-24.45205*
2	290.9093	5.51e-26	-27.01350	-20.42928	-24.33820
3	233.3207	3.15e-26*	-27.70149	-18.43481	-23.93625
4	166.9016*	3.25e-26	-27.91179*	-15.96266	-23.05662

PPI(D&E)

Lag	Sequential Modified LR Test Statistic	Final Prediction Error	Akaike Information Criterion	Schwarz Information Criterion	Hannan-Quinn Information Criterion
0	NA	2.66e-08	16.60995	17.94010	17.15042
1	3142.955	1.64e-19	-9.219587	-4.697093*	-7.382006*
2	336.0849	5.71e-20	-10.34788	-2.633035	-7.213181
3	251.6245	3.66e-20*	-10.97469	-0.067498	-6.542877
4	194.8513*	3.71e-20	-11.30596*	2.793577	-5.577035

PRI(A)

Lag	Sequential Modified LR Test Statistic	Final Prediction Error	Akaike Information Criterion	Schwarz Information Criterion	Hannan-Quinn Information Criterion
0	NA	4.65e-08	17.16930	18.49945	17.70977
1	3126.638	3.32e-19	-8.514551	-3.992057*	-6.676971*
2	334.9721	1.17e-19	-9.631714	-1.916871	-6.497017
3	246.4396	7.93e-20	-10.19961	0.707586	-5.767793
4	218.2809*	5.91e-20*	-10.83916*	3.260375	-5.110236

PRI(B)

Lag	Sequential Modified LR Test Statistic	Final Prediction Error	Akaike Information Criterion	Schwarz Information Criterion	Hannan-Quinn Information Criterion
0	NA	5.73e-08	17.37879	18.70893	17.91925
1	3085.738	5.89e-19	-7.939890	-3.417396*	-6.102309*
2	324.3456	2.31e-19	-8.950787	-1.235944	-5.816090
3	269.7535	1.20e-19	-9.783610	1.123582	-5.351797
4	217.9977*	8.99e-20*	-10.41944*	3.680098	-4.690513

PRI(C)

Lag	Sequential Modified LR Test Statistic	Final Prediction Error	Akaike Information Criterion	Schwarz Information Criterion	Hannan-Quinn Information Criterion
0	NA	1.13e-14	-0.898862	0.320438	-0.403436
1	3076.953	1.12e-25	-26.25256	-22.35080*	-24.66720*
2	279.2810	4.98e-26	-27.11464	-20.53043	-24.43934
3	236.8567	2.74e-26	-27.84150	-18.57482	-24.07626
4	182.6534*	2.32e-26*	-28.24869*	-16.29956	-23.39352

PRI(D)

Appendix B2.3: Johansen Cointegration (Trace) tests results

Property Price Indices (Mass Housing Market):

Number of Cointegrating Relation(s)	LnPPI(A)	LnPPI(B)	LnPPI(C)	5% Critical Value
None	594.319*	600.589*	627.149*	311.129
At most 1	477.337*	478.555*	498.841*	263.260
At most 2	374.939*	377.792*	388.586*	219.402
At most 3	288.690*	298.393*	297.641*	179.510
At most 4	211.513*	223.664*	216.227*	143.669
At most 5	151.718*	155.501*	159.280*	111.781
At most 6	103.571*	106.716*	112.438*	83.937
At most 7	66.901*	68.967*	73.963*	60.061
At most 8	34.408	40.219*	43.629*	40.175
At most 9	13.623	14.070	14.586	24.276
At most 10	2.836	4.447	1.590	12.321
At most 11	0.034	0.150	0.005	4.130

Deterministic Trend Assumption: No trend in data – No intercept or trend in CE or VAR

Number of Cointegrating Relation(s)	LnPPI(A)	LnPPI(B)	LnPPI(C)	5% Critical Value
None	670.312*	685.331*	718.756*	348.978
At most 1	532.685*	539.859*	570.590*	298.159
At most 2	426.054*	437.139*	460.215*	251.265
At most 3	339.538*	357.137*	369.269*	208.437
At most 4	260.375*	281.722*	283.487*	169.599
At most 5	200.575*	213.363*	207.062*	134.678
At most 6	143.255*	148.420*	151.428*	103.847
At most 7	96.865*	101.961*	105.835*	76.973
At most 8	61.140*	65.413*	68.821*	54.079
At most 9	31.347	36.960*	38.684*	35.193
At most 10	12.502	11.931	12.911	20.262
At most 11	2.525	3.610	1.577	9.165

Deterministic Trend Assumption: No trend in data – Intercept in CE – no intercept in VAR

Number of Cointegrating Relation(s)	**LnPPI(A)**	**LnPPI(B)**	**LnPPI(C)**	**5% Critical Value**
None	634.266*	657.274*	685.934*	**334.984**
At most 1	498.166*	512.200*	538.156*	285.143
At most 2	397.231*	412.922*	428.683*	239.235
At most 3	310.715*	333.993*	339.916*	197.371
At most 4	235.023*	259.158*	255.421*	159.530
At most 5	175.409*	192.509*	180.967*	125.615
At most 6	121.630*	129.426*	126.303*	95.754
At most 7	75.646*	83.567*	85.207*	69.819
At most 8	41.394	51.708*	50.992*	47.856
At most 9	17.453	23.538	24.953	29.797
At most 10	7.452	11.133	10.633	15.495
At most 11	2.034	3.025	1.577	3.841

Deterministic Trend Assumption: Linear trend in data – Intercept in CE and VAR

Number of Cointegrating Relation(s)	**LnPPI(A)**	**LnPPI(B)**	**LnPPI(C)**	**5% Critical Value**
None	701.981*	714.132*	744.475*	**374.908**
At most 1	542.759*	555.019*	592.258*	322.069
At most 2	441.824*	454.137*	479.227*	273.189
At most 3	353.923*	370.907*	390.382*	228.298
At most 4	273.533*	292.971*	305.206*	187.470
At most 5	208.059*	224.782*	228.727*	150.559
At most 6	149.123*	160.481*	156.051*	117.708
At most 7	98.533*	103.751*	101.610*	88.804
At most 8	55.011	59.888	61.074	63.876
At most 9	28.952	31.522	33.383	42.915
At most 10	12.421	11.148	11.703	25.872
At most 11	2.624	3.035	2.647	12.518

Deterministic Trend Assumption: Linear trend in data – Intercept and trend in CE – no trend in VAR

Number of Cointegrating Relation(s)	**LnPPI(A)**	**LnPPI(B)**	**LnPPI(C)**	**5% Critical Value**
None	655.854*	657.139*	721.042*	358.718
At most 1	497.227*	499.231*	569.335*	306.894
At most 2	398.175*	405.322*	458.381*	259.029
At most 3	311.709*	324.590*	369.744*	215.123
At most 4	244.744*	251.641*	286.755*	175.172
At most 5	184.743*	187.321*	210.277*	139.275
At most 6	129.960*	130.445*	141.345*	107.347
At most 7	85.928*	81.339*	92.518*	79.341
At most 8	44.785	39.880	57.607*	55.246
At most 9	24.348	19.495	32.578	35.011
At most 10	8.360	7.126	10.992	18.398
At most 11	0.057	0.318	2.063	3.841

Deterministic Trend Assumption: Quadratic trend in data

Property Rental Indices (Mass Housing Market):

Number of Cointegrating Relation(s)	**LnPRI(A)**	**LnPRI(B)**	**LnPRI(C)**	**5% Critical Value**
None	594.739*	607.880*	575.326*	**311.129**
At most 1	450.059*	476.121*	442.526*	263.260
At most 2	343.778*	369.052*	348.346*	219.402
At most 3	272.891*	284.367*	257.441*	179.510
At most 4	212.780*	204.669*	189.391*	143.669
At most 5	157.963*	144.127*	130.797*	111.781
At most 6	108.328*	95.224*	88.466*	83.937
At most 7	66.457*	59.977	56.096	60.061
At most 8	36.979	34.577	32.675	40.175
At most 9	18.034	17.030	15.723	24.276
At most 10	5.393	3.009	3.177	12.321
At most 11	0.712	0.103	0.041	4.130

Deterministic Trend Assumption: No trend in data – No intercept or trend in CE or VAR

Number of Cointegrating Relation(s)	**LnPRI(A)**	**LnPRI(B)**	**LnPRI(C)**	**5% Critical Value**
None	644.740*	675.765*	649.295*	348.978
At most 1	497.403*	536.853*	509.699*	298.159
At most 2	390.850*	427.331*	406.000*	251.265
At most 3	304.004*	337.659*	313.381*	208.437
At most 4	241.855*	257.527*	241.437*	169.599
At most 5	182.719*	194.956*	181.974*	134.678
At most 6	128.501*	136.544*	126.530*	103.847
At most 7	85.204*	87.924*	84.310*	76.973
At most 8	45.475	53.770	52.713	54.079
At most 9	24.122	29.793	29.313	35.193
At most 10	6.783	13.588	12.689	20.262
At most 11	0.721	2.905	2.977	9.165

Deterministic Trend Assumption: No trend in data – Intercept in CE – no intercept in VAR

Number of Cointegrating Relation(s)	**LnPRI(A)**	**LnPRI(B)**	**LnPRI(C)**	**5% Critical Value**
None	608.506*	640.075*	618.867*	334.984
At most 1	468.934*	502.402*	481.347*	285.143
At most 2	365.041*	395.307*	377.713*	239.235
At most 3	283.234*	305.650*	285.133*	197.371
At most 4	223.499*	230.615*	214.889*	159.530
At most 5	166.017*	169.151*	156.736*	125.615
At most 6	116.391*	113.854*	106.458*	95.754
At most 7	76.566*	73.355*	73.555*	69.819
At most 8	43.714	40.811	42.794	47.856
At most 9	22.457	20.068	22.500	29.797
At most 10	5.275	8.646	7.246	15.495
At most 11	0.539	0.315	1.392	3.841

Deterministic Trend Assumption: Linear trend in data – Intercept in CE and VAR

Number of Cointegrating Relation(s)	LnPRI(A)	LnPRI(B)	LnPRI(C)	5% Critical Value
None	677.810*	698.513*	684.744*	374.908
At most 1	538.102*	554.283*	544.999*	322.069
At most 2	420.153*	447.184*	439.638*	273.189
At most 3	331.468*	356.328*	343.552*	228.298
At most 4	249.728*	275.265*	260.967*	187.470
At most 5	191.222*	200.879*	190.949*	150.559
At most 6	133.873*	144.538*	135.070*	117.708
At most 7	88.285	95.192*	86.622	88.804
At most 8	54.090	61.723	55.859	63.876
At most 9	32.663	32.242	34.918	42.915
At most 10	12.724	11.596	15.069	25.872
At most 11	4.496	0.423	1.569	12.518

Deterministic Trend Assumption: Linear trend in data – Intercept and trend in CE – no trend in VAR

Number of Cointegrating Relation(s)	LnPRI(A)	LnPRI(B)	LnPRI(C)	5% Critical Value
None	618.592*	666.969*	658.469*	358.718
At most 1	500.623*	525.795*	520.721*	306.894
At most 2	390.188*	429.078*	417.957*	259.029
At most 3	306.232*	341.015*	322.208*	215.123
At most 4	228.516*	260.218*	241.637*	175.172
At most 5	170.045*	187.816*	171.833*	139.275
At most 6	113.536*	133.645*	117.202*	107.347
At most 7	68.042	85.916*	75.083	79.341
At most 8	35.856	54.026	48.952	55.246
At most 9	15.381	25.555	28.112	35.011
At most 10	7.125	6.525	9.650	18.398
At most 11	1.470	3.28E-05	0.131	3.841

Deterministic Trend Assumption: Quadratic trend in data

Property Price Index & Property Rental Index (Luxury Housing Market)

Number of Cointegrating Relation(s)	**LnPPI(D&E)**	**LnPRI(D)**	**5% Critical Value**
None	465.606*	459.503*	263.260
At most 1	366.844*	361.562*	219.402
At most 2	280.109*	268.289*	179.510
At most 3	218.749*	196.802*	143.669
At most 4	160.460*	132.611*	111.781
At most 5	108.560*	78.091	83.937
At most 6	63.266*	46.626	60.061
At most 7	35.738	26.174	40.175
At most 8	11.235	11.270	24.276
At most 9	2.669	3.097	12.321
At most 10	0.006	0.111	4.130

Deterministic Trend Assumption: No trend in data – No intercept or trend in CE or VAR

Number of Cointegrating Relation(s)	**LnPPI(D&E)**	**LnPRI(D)**	**5% Critical Value**
None	545.549*	518.680*	298.159
At most 1	430.877*	418.188*	251.265
At most 2	338.736*	320.922*	208.437
At most 3	258.853*	247.449*	169.599
At most 4	199.872*	177.106*	134.678
At most 5	144.361*	121.538*	103.847
At most 6	98.551*	73.692	76.973
At most 7	54.825*	42.267	54.079
At most 8	28.306	21.818	35.193
At most 9	5.199	8.021	20.262
At most 10	0.014	2.112	9.165

Deterministic Trend Assumption: No trend in data – Intercept in CE – no intercept in VAR

Number of Cointegrating Relation(s)	LnPPI(D&E)	LnPRI(D)	5% Critical Value
None	517.977*	481.090*	285.143
At most 1	405.259*	383.762*	239.235
At most 2	313.130*	291.926*	197.371
At most 3	240.209*	220.496*	159.530
At most 4	181.716*	156.905*	125.615
At most 5	127.163*	101.979*	95.754
At most 6	83.222*	56.725	69.819
At most 7	42.195	28.459	47.856
At most 8	17.529	14.597	29.797
At most 9	3.435	5.935	15.495
At most 10	0.014	1.242	3.841

Deterministic Trend Assumption: Linear trend in data – Intercept in CE and VAR

Number of Cointegrating Relation(s)	LnPPI(D&E)	LnPRI(D)	5% Critical Value
None	583.641*	564.758*	322.069
At most 1	467.130*	446.058*	273.189
At most 2	368.836*	349.531*	228.298
At most 3	276.856*	258.710*	187.470
At most 4	204.319*	189.284*	150.559
At most 5	149.322*	123.789*	117.708
At most 6	95.212*	73.901	88.804
At most 7	51.832	40.191	63.876
At most 8	24.332	17.874	42.915
At most 9	5.082	5.983	25.872
At most 10	0.963	1.249	12.518

Deterministic Trend Assumption: Linear trend in data – Intercept and trend in CE – no trend in VAR

Number of Cointegrating Relation(s)	LnPPI(D&E)	LnPRI(D)	5% Critical Value
None	559.762*	544.145*	306.894
At most 1	444.089*	426.461*	259.029
At most 2	349.669*	330.802*	215.123
At most 3	261.573*	244.737*	175.172
At most 4	194.679*	173.418*	139.275
At most 5	139.749*	116.046*	107.347
At most 6	85.601*	66.564	79.341
At most 7	47.395	33.260	55.246
At most 8	22.181	14.586	35.011
At most 9	4.330	4.515	18.398
At most 10	0.380	0.366	3.841

Deterministic Trend Assumption: Quadratic trend in data

Appendix B2.4: A comparison of VECMs by their deterministic trend assumptions

Deterministic Trend Assumption		LnPPI(A)		Whole VECM	
		AIC	SC	AIC	SC
No Trend in Data	No intercept or trend in CE or VAR	-3.718	-2.358	-11.325	7.124
	Intercept (no trend) in CE – no intercept in VAR	-3.738	-2.357	-11.472	7.757
Linear Trend in Data	Intercept (no trend) in CE and VAR	-3.757	-2.376	-11.677	7.040
	Intercept and trend in CE – no trend in VAR	-3.757*	-2.376*	-11.974*	6.920*
Quadratic Trend in Data	Intercept and trend in CE – linear trend in VAR	-3.730	-2.327	-11.191	6.992

Deterministic Trend Assumption		LnPPI(B)		Whole VECM	
		AIC	SC	AIC	SC
No Trend in Data	No intercept or trend in CE or VAR	-3.523	-2.142	-10.851	8.133
	Intercept (no trend) in CE – no intercept in VAR	-3.555*	-2.151	-10.998	8.743
Linear Trend in Data	Intercept (no trend) in CE and VAR	-3.535	-2.131	-11.251	8.000
	Intercept and trend in CE – no trend in VAR	-3.540	-2.159*	-11.661	7.233
Quadratic Trend in Data	Intercept and trend in CE – linear trend in VAR	-3.541	-2.138	-11.755*	7.229*

Deterministic Trend Assumption		LnPPI(C)		Whole VECM	
		AIC	**SC**	**AIC**	**SC**
No Trend in Data	No intercept or trend in CE or VAR	-3.154	-1.773	-10.520	8.464
	Intercept (no trend) in CE – no intercept in VAR	-3.262	-1.858	-10.718	9.024
Linear Trend in Data	Intercept (no trend) in CE and VAR	-3.253	-1.850	-10.967	8.284
	Intercept and trend in CE – no trend in VAR	-3.263*	-1.882*	-11.392*	7.502*
Quadratic Trend in Data	Intercept and trend in CE – linear trend in VAR	-3.248	-1.822	-11.178	8.341

Deterministic Trend Assumption		LnPPI(D&E)		Whole VECM	
		AIC	**SC**	**AIC**	**SC**
No Trend in Data	No intercept or trend in CE or VAR	-3.359	-2.111	-28.496	-13.055
	Intercept (no trend) in CE – no intercept in VAR	-3.400	-2.130	-28.710	-12.601
Linear Trend in Data	Intercept (no trend) in CE and VAR	-3.404	-2.134	-28.899	-13.212
	Intercept and trend in CE – no trend in VAR	-3.437*	-2.167*	-29.227*	-13.385*
Quadratic Trend in Data	Intercept and trend in CE – linear trend in VAR	-3.421	-2.129	-29.199	-13.268

Deterministic Trend Assumption		LnPRI(A)		Whole VECM	
		AIC	SC	AIC	SC
No Trend in Data	No intercept or trend in CE or VAR	-5.087	-3.728	-11.437	7.012
	Intercept (no trend) in CE – no intercept in VAR	-5.156	-3.797	-11.636	6.991
Linear Trend in Data	Intercept (no trend) in CE and VAR	-5.141	-3.759	-11.588	7.129
	Intercept and trend in CE – no trend in VAR	-5.332	-3.973	-12.046	6.291*
Quadratic Trend in Data	Intercept and trend in CE – linear trend in VAR	-5.354*	-3.973*	-12.126*	6.323

Deterministic Trend Assumption		LnPRI(B)		Whole VECM	
		AIC	SC	AIC	SC
No Trend in Data	No intercept or trend in CE or VAR	-4.682	-3.345	-11.383	6.531*
	Intercept (no trend) in CE – no intercept in VAR	-4.815	-3.455*	-11.462	7.165
Linear Trend in Data	Intercept (no trend) in CE and VAR	-4.807	-3.425	-11.500	7.216
	Intercept and trend in CE – no trend in VAR	-4.828*	-3.447	-11.668*	7.226
Quadratic Tre-nd in Data	Intercept and trend in CE – linear trend in VAR	-4.781	-3.377	-11.666	7.317

Deterministic Trend Assumption		LnPRI(C)		Whole VECM	
		AIC	SC	AIC	SC
No Trend in Data	No intercept or trend in CE or VAR	-4.686	-3.350	-10.605	7.310
	Intercept (no trend) in CE – no intercept in VAR	-4.784	-3.425*	-10.709	7.918
Linear Trend in Data	Intercept (no trend) in CE and VAR	-4.792*	-3.411	-10.724	7.992
	Intercept and trend in CE – no trend in VAR	-4.705	-3.346	-11.162	7.176*
Quadratic Trend in Data	Intercept and trend in CE – linear trend in VAR	-4.753	-3.372	-11.174*	7.275

Deterministic Trend Assumption		LnPRI(D)		Whole VECM	
		AIC	SC	AIC	SC
No Trend in Data	No intercept or trend in CE or VAR	-4.531	-3.328	-28.936	-14.475*
	Intercept (no trend) in CE – no intercept in VAR	-4.564	-3.339	-28.995	-13.910
Linear Trend in Data	Intercept (no trend) in CE and VAR	-4.546	-3.298	-29.049	-13.853
	Intercept and trend in CE – no trend in VAR	-4.698*	-3.450*	-29.475*	-14.145
Quadratic Trend in Data	Intercept and trend in CE – linear trend in VAR	-4.690	-3.420	-29.454	-14.013

Appendix B2.5a: Cointegrating equations

Class A:

Coint. Eq.	1	2	3	4	5	6	7	8
LnPPI(A)	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LnPRI(A)	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000
LnGDP	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000
LnHH	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000
LnM1	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000
LnHSI	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000
SMV	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000
LnHS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
HOS	-0.0002 (-4.530)	-0.00009 (-2.263)	-0.000002 (0.163)	-0.000002 (-0.480)	-0.00004 (1.544)	-0.0002 (-6.515)	-0.0004 (-3.408)	0.00004 (0.764)
FED	0.072 (2.173)	0.022 (0.699)	-0.006 (-0.488)	-0.0010 (-0.223)	0.021 (0.995)	-0.007 (-0.343)	-0.034 (-0.346)	0.139 (3.127)
LnNEER	4.628 (5.788)	3.569 (4.714)	-0.197 (-0.659)	0.065 (0.610)	0.432 (0.843)	0.243 (0.486)	-4.824 (-2.060)	-3.731 (-3.492)
LnRMB	-0.779 (-2.008)	-1.393 (-3.793)	0.864 (5.974)	-0.162 (-3.130)	0.753 (3.025)	1.843 (7.592)	5.943 (5.230)	0.241 (0.465)
TREND	-0.031 (-5.408)	-0.023 (-4.207)	-0.006 (-2.857)	-0.004 (-5.408)	-0.032 (-8.739)	-0.007 (-1.955)	0.024 (1.408)	-0.008 (-1.018)
C	-23.876	-19.401	-25.352	-14.464	-26.565	-9.785	15.047	8.971

Class B:

Coint. Eq.	1	2	3	4	5	6	7	8
LnPPI(B)	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LnPRI(B)	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000
LnGDP	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000
LnHH	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000
LnM1	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000
LnHSI	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000
SMV	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000
LnHS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
HOS	-0.0002 (-3.850)	-0.00007 (-1.535)	-0.00001 (1.103)	-0.00001 (-2.466)	-0.00009 (2.865)	-0.0002 (-6.317)	-0.0005 (-3.747)	-0.00005 (-0.878)
FED	0.072 (2.587)	0.033 (1.045)	-0.008 (-0.895)	0.0002 (0.054)	0.023 (1.008)	-0.013 (-0.572)	-0.057 (-0.574)	0.143 (3.831)
LnNEER	3.329 (4.882)	2.538 (3.286)	0.377 (1.631)	-0.074 (-0.876)	1.063 (1.880)	0.994 (1.746)	-2.071 (-0.850)	-4.188 (-4.565)
LnRMB	-0.475 (-1.493)	-1.437 (-3.984)	0.574 (5.322)	0.008 (0.205)	-0.092 (-0.347)	2.038 (7.672)	-6.440 (5.664)	1.075 (2.510)
TREND	-0.028 (-5.482)	-0.018 (-3.119)	-0.010 (-5.430)	-0.003 (-4.064)	-0.040 (-9.231)	-0.008 (-1.930)	0.018 (0.980)	0.003 (0.392)
C	-18.054	-14.940	-27.784	-13.932	-28.986	-13.188	2.641	10.419

Class C:

Coint. Eq	1	2	3	4	5	6	7	8
LnPPI(C)	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LnPRI(C)	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000
LnGDP	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000
LnHH	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000
LnM1	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000
LnHSI	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000
SMV	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000
LnHS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
HOS	-0.00009 (-2.219)	0.00006 (1.746)	0.000 (0.782)	0.000 (-1.965)	0.000 (1.925)	0.000 (-7.704)	-0.0007 (-6.260)	-0.00002 (0.326)
FED	0.033 (0.995)	-0.024 (-0.836)	-0.007 (-0.966)	-0.001 (-0.267)	0.009 (0.261)	-0.016 (-1.005)	0.087 (0.936)	0.084 (1.681)
LnNEER	2.267 (3.402)	0.603 (1.063)	0.417 (2.755)	-0.041 (-0.464)	0.923 (1.327)	1.003 (3.109)	1.474 (0.797)	-3.796 (-3.828)
LnRMB	2.062 (6.872)	1.405 (5.496)	0.328 (4.807)	-0.078 (-1.978)	1.074 (3.427)	0.518 (3.567)	-1.986 (-2.383)	2.938 (6.578)
TREND	-0.016 (-2.823)	-0.005 (-1.017)	-0.009 (-6.857)	-0.004 (-4.987)	-0.034 (-5.812)	-0.013 (-4.972)	-0.016 (-1.019)	-0.007 (-0.891)
C	-14.452	-7.391	-27.972	-14.001	-28.893	-12.701	-10.226	8.967

Class D & E:

Coint. Eq.	1	2	3	4	5	6	7
LnPPI(D&E)	1.000	0.000	0.000	0.000	0.000	0.000	0.000
LnPRI(D)	0.000	1.000	0.000	0.000	0.000	0.000	0.000
LnGDP	0.000	0.000	1.000	0.000	0.000	0.000	0.000
LnHH	0.000	0.000	0.000	1.000	0.000	0.000	0.000
LnM1	0.000	0.000	0.000	0.000	1.000	0.000	0.000
LnHSI	0.000	0.000	0.000	0.000	0.000	1.000	0.000
SMV	0.000	0.000	0.000	0.000	0.000	0.000	1.000
LnHS	-1.413 (-5.292)	-0.080 (-1.072)	0.086 (2.334)	0.101 (6.107)	-0.433 (-3.658)	-0.629 (-3.869)	-6.853 (-4.637)
FED	-0.057 (-0.869)	-0.049 (-2.673)	-0.015 (-1.615)	0.008 (2.040)	-0.060 (-2.056)	-0.018 (-0.443)	-0.060 (-0.165)
LnNEER	8.918 (5.640)	2.115 (4.811)	0.199 (0.909)	-0.614 (-6.256)	3.811 (5.438)	3.581 (3.719)	29.674 (3.390)
LnRMB	-1.675 (-2.240)	0.895 (4.304)	0.529 (5.096)	0.145 (3.117)	0.142 (0.428)	-1.103 (-2.421)	-17.269 (-4.172)
TREND	-0.032	-0.004	-0.007	-0.003	-0.030	-0.028	-0.130
C	-31.827	-13.566	-27.787	-12.282	-38.436	-18.517	-75.107

Appendix B2.5b: Cointegrating equations (PRI)

Class A:

Coint. Eq.	1	2	3	4	5	6	7
LnPRI(A)t-1	1.000	0.000	0.000	0.000	0.000	0.000	0.000
LnPPI(A)t-1	0.000	1.000	0.000	0.000	0.000	0.000	0.000
LnGDPt-1	0.000	0.000	1.000	0.000	0.000	0.000	0.000
LnHHt-1	0.000	0.000	0.000	1.000	0.000	0.000	0.000
LnM1t-1	0.000	0.000	0.000	0.000	1.000	0.000	0.000
LnHSIt-1	0.000	0.000	0.000	0.000	0.000	1.000	0.000
SMVt-1	0.000	0.000	0.000	0.000	0.000	0.000	1.000
LnHSt-1	-0.080 (-0.852)	0.280 (1.116)	0.052 (3.160)	0.029 (2.604)	-0.532 (-4.218)	1.168 (3.611)	0.837 (3.382)
HOSt-1	-0.0003 (-7.530)	-0.0006 (-6.514)	-0.00003 (-5.458)	-0.000006 (1.441)	0.0001 (2.507)	-0.0005 (-4.454)	-0.00008 (-0.927)
FEDt-1	-0.027 (-1.120)	-0.023 (-0.355)	-0.006 (-1.402)	0.003 (0.922)	0.001 (0.035)	-0.006 (-0.081)	0.090 (1.421)
LnNEERt-1	1.697 (2.727)	0.420 (0.253)	0.423 (3.869)	-0.263 (-3.558)	3.252 (3.901)	-4.318 (-2.018)	-4.160 (-2.541)
LnRMBt-1	0.055 (0.176)	1.103 (1.312)	0.317 (5.720)	-0.008 (-0.210)	-0.013 (-0.031)	2.421 (2.231)	3.973 (4.785)
TREND	-0.019	-0.033	-0.009	-0.005	-0.024	-0.025	0.006
C	-9.938	-5.395	-28.343	-13.153	-35.833	3.741	5.154

Class B:

Coint. Eq.	1	2	3	4	5	6	7	8
LnPRI(B)t-1	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LnPPI(B)t-1	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000
LnGDPt-1	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000
LnHHt-1	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000
LnM1t-1	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000
LnHSIt-1	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000
SMVt-1	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000
LnHSt-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
HOSt-1	-0.0003 (-5.125)	-0.0005 (-5.938)	-0.0001 (-3.512)	-0.00008 (3.520)	-0.0004 (-3.701)	-0.00009 (-5.280)	-0.0004 (-5.940)	-0.0006 (-3.557)
FEDt-1	0.051 (1.157)	0.099 (1.806)	0.017 (0.714)	-0.013 (-0.821)	0.088 (1.068)	-0.005 (-0.406)	0.003 (0.061)	0.167 (1.404)
LnNEERt-1	-0.138 (-0.119)	-0.031 (-0.021)	-0.779 (-1.253)	0.734 (1.808)	-3.787 (-1.751)	2.050 (6.346)	0.473 (0.418)	-10.456 (-3.335)
LnRMBt-1	-1.329 (2.207)	-0.895 (-1.187)	-0.050 (-0.154)	0.301 (1.426)	-1.205 (-1.072)	1.181 (7.034)	3.228 (5.487)	-0.635 (-0.389)
TREND	-0.022 (-2.448)	-0.038 (-3.383)	-0.018 (-3.779)	0.001 (0.426)	-0.056 (-3.379)	-0.019 (-7.809)	-0.012 (-1.367)	-0.008 (-0.356)
C	-1.603	-0.879	-21.417	-18.227	-3.820	-17.519	-7.220	42.260

Class C:

Coint. Eq.	1	2	3	4	5	6	7
LnPRI(C)t-1	1.000	0.000	0.000	0.000	0.000	0.000	0.000
LnPPI(C)t-1	0.000	1.000	0.000	0.000	0.000	0.000	0.000
LnGDPt-1	0.000	0.000	1.000	0.000	0.000	0.000	0.000
LnHHt-1	0.000	0.000	0.000	1.000	0.000	0.000	0.000
LnM1t-1	0.000	0.000	0.000	0.000	1.000	0.000	0.000
LnHSIt-1	0.000	0.000	0.000	0.000	0.000	1.000	0.000
SMVt-1	0.000	0.000	0.000	0.000	0.000	0.000	1.000
LnHSt-1	-0.317 (-2.493)	-0.185 (-1.555)	0.017 (0.189)	0.020 (0.715)	-0.174 (-1.195)	-0.013 (-0.103)	0.622 (2.625)
HOSt-1	-0.000008 (-0.190)	-0.0001 (-2.727)	0.00005 (1.519)	-0.00001 (-1.564)	0.00006 (1.198)	-0.00002 (-0.380)	-0.0003 (-3.515)
FEDt-1	-0.038 (-1.326)	0.017 (0.650)	-0.024 (-1.210)	0.007 (1.054)	-0.025 (-0.776)	-0.040 (-1.359)	0.0287 (0.539)
LnNEERt-1	3.879 (5.574)	4.108 (6.320)	0.768 (1.569)	-0.267 (-1.705)	1.871 (2.352)	2.606 (3.638)	-1.415 (-1.091)
LnRMBt-1	0.414 (1.138)	0.951 (2.797)	1.068 (4.166)	-0.199 (-2.436)	1.259 (3.025)	1.742 (4.647)	5.090 (7.497)
TREND	-0.005	-0.012	-0.003	-0.006	-0.021	-0.011	0.002
C	-19.733	-21.514	-30.322	-12.941	-32.629	-20.738	-5.209

Class D & E:

Coint. Eq.	1	2	3	4	5	6
LnPRI(D)t-1	1.000	0.000	0.000	0.000	0.000	0.000
LnPRI(D&E)t-1	0.000	1.000	0.000	0.000	0.000	0.000
LnGDPt-1	0.000	0.000	1.000	0.000	0.000	0.000
LnHHt-1	0.000	0.000	0.000	1.000	0.000	0.000
LnM1t-1	0.000	0.000	0.000	0.000	1.000	0.000
LnHSIt-1	0.000	0.000	0.000	0.000	0.000	1.000
SMVt-1	0.076 (1.536)	-0.150 (-2.804)	0.016 (1.164)	-0.013 (-1.944)	0.136 (3.190)	-0.199 (-4.982)
LnHSt-1	-0.218 (-3.724)	-0.163 (-2.586)	0.033 (2.021)	0.010 (1.191)	-0.242 (-4.825)	-0.054 (-1.141)
FEDt-1	-0.001 (-0.060)	0.026 (1.476)	-0.005 (-1.092)	-0.001 (-0.583)	0.023 (1.643)	-0.028 (-2.131)
LnNEERt-1	2.081 (5.480)	2.172 (5.292)	0.456 (4.330)	-0.119 (-2.253)	1.551 (4.770)	1.516 (4.961)
LnRMBt-1	0.734 (3.373)	0.494 (2.100)	0.306 (5.070)	-0.033 (-1.108)	0.383 (2.054)	0.331 (1.890)
TREND	-0.002 (-0.628)	-0.016 (-4.890)	-0.010 (-11.639)	-0.004 (-9.489)	-0.028 (-10.945)	-0.016 (-6.950)
C	-13.001	-11.615	-28.462	-13.652	-30.768	-13.515

Appendix B2.4c: The error correction terms of VECM

Class A:

Error Correction	ΔLnPPI(A)	ΔLnPRI(A)
Coint. Eq. 1	-0.301 (-2.920)	0.024 (0.467)
Coint. Eq. 2	0.248 (1.732)	-0.039 (-1.170)
Coint. Eq. 3	-0.281 (-1.112)	-0.060 (-0.504)
Coint. Eq. 4	0.109 (0.238)	0.813 (4.450)
Coint. Eq. 5	0.197 (2.425)	0.187 (5.023)
Coint. Eq. 6	0.279 (4.122)	0.087 (3.585)
Coint. Eq. 7	-0.024 (-1.491)	-0.006 (-0.839)
Coint. Eq. 8	-0.024 (-1.491)	N.A.
ΔLnPPI(A)t-1	0.715 (5.048)	0.330 (5.271)
ΔLnPPI(A)t-2	-0.123 (-0.768)	0.047 (0.619)
ΔLnPPI(A)t-3	-0.054 (-0.356)	0.087 (1.234)
ΔLnPPI(A)t-4	-0.255 (-1.841)	-0.036 (-0.568)
ΔLnPRI(A)t-1	-0.415 (-1.489)	-0.359 (-2.729)
ΔLnPRI(A)t-2	-0.293 (-1.202)	-0.226 (-1.904)
ΔLnPRI(A)t-3	0.030 (0.122)	-0.298 (2.719)
ΔLnPRI(A)t-4	0.130 (0.635)	-0.079 (-0.801)
ΔLnGDPt-1	0.004 (0.014)	-0.028 (-0.236)
ΔLnGDPt-2	0.074 (0.315)	0.109 (1.114)
ΔLnGDPt-3	-0.185 (-0.915)	0.014 (0.157)
ΔLnGDPt-4	-0.173 (-0.955)	0.088 (1.075)
ΔLnHHt-1	-0.178 (-0.197)	-1.120 (-2.599)
ΔLnHHt-2	1.782 (2.040)	-1.523 (3.597)
ΔLnHHt-3	1.765 (1.848)	-1.191 (-2.695)
ΔLnHHt-4	0.061 (0.066)	-1.126 (-2.503)
ΔLnM1t-1	-0.126 (-1.264)	-0.144 (-2.990)
ΔLnM1t-2	-0.011 (-0.108)	-0.158 (-3.430)
ΔLnM1t-3	0.098 (0.972)	-0.110 (-2.281)
ΔLnM1t-4	0.060 (0.669)	-0.020 (-0.434)
ΔLnHSIt-1	-0.074 (-1.082)	-0.008 (-0.321)
ΔLnHSIt-2	-0.146 (-2.604)	-0.018 (-0.850)
ΔLnHSIt-3	-0.067 (-1.294)	0.034 (1.738)
ΔLnHSIt-4	-0.095 (-2.175)	0.003 (0.167)
ΔLnHSISTDt-1	0.018 (1.362)	0.003 (0.499)
ΔLnHSISTDt-2	0.011 (0.939)	-0.002 (-0.297)
ΔLnHSISTDt-3	-0.008 (-0.828)	-0.005 (-1.216)
ΔLnHSISTDt-4	-0.009 (-1.175)	0.002 (0.671)
ΔLnHSt-1	0.027 (1.516)	-0.006 (-0.906)
ΔLnHSt-2	0.012 (0.858)	-0.005 (-0.824)
ΔLnHSt-3	0.007 (0.691)	-0.007 (-1.508)
ΔLnHSt-4	0.004 (0.558)	-0.006 (-1.713)
ΔLnHOSt-1	-3.29E-06 (0.513)	7.70E-06 (2.688)
ΔLnHOSt-2	-2.19E-06 (-0.424)	6.41E-06 (2.728)
ΔLnHOSt-3	1.31E-06 (0.392)	3.82E-06 (2.470)
ΔLnHOSt-4	1.68E-06 (0.877)	1.76E-06 (2.032)
ΔFEDt-1	0.007 (0.667)	0.008 (1.974)

ΔFEDt-2	0.003 (0.250)	-0.006 (-1.335)
ΔFEDt-3	0.020 (2.125)	0.011 (2.892)
ΔFEDt-4	0.015 (1.556)	0.014 (3.546)
ΔLnNEERt-1	0.013 (0.075)	-0.160 (-1.924)
ΔLnNEERt-2	0.277 (1.517)	-0.013 (-0.148)
ΔLnNEERt-3	0.186 (1.102)	0.103 (1.267)
ΔLnNEERt-4	-0.129 (-0.754)	-0.015 (-0.204)
ΔLnRMBt-1	-0.030 (-0.271)	-0.132 (-2.931)
ΔLnRMBt-2	-0.124 (-1.217)	-0.067 (-1.515)
ΔLnRMBt-3	-0.154 (-1.553)	-0.111 (-2.622)
ΔLnRMBt-4	-0.080 (-0.827)	-0.054 (-1.240)
Constant	0.216 (3.164)	0.075 (3.753)
@Trend (1983Q4)		-0.000597 (-2.156)
SBR1	-0.027 (-0.844)	0.010 (0.906)
SBR2	-0.173 (-2.917)	-0.010 (-0.426)
SBR3	-0.254 (-3.455)	0.003 (0.143)
SBR4	-0.331 (-3.660)	0.042 (1.646)
SBR5	-0.331 (-3.836)	0.048 (1.654)

Class B:

Error Correction	ΔLnPPI(B)	ΔLnPRI(B)
Coint. Eq. 1	-0.352 (-2.965)	-0.071 (-1.162)
Coint. Eq. 2	0.253 (1.744)	-0.012 (-0.224)
Coint. Eq. 3	-0.221 (-0.788)	-0.122 (-0.942)
Coint. Eq. 4	-0.015 (-0.032)	0.347 (1.330)
Coint. Eq. 5	0.217 (2.573)	0.175 (3.220)
Coint. Eq. 6	0.311 (3.873)	0.124 (3.797)
Coint. Eq. 7	-0.018 (-0.983)	-0.017 (-1.619)
Coint. Eq. 8	-0.013 (-0.558)	-0.008 (-0.748)
ΔLnPPI(B)t-1	0.761 (4.540)	-0.310 (3.696)
ΔLnPPI(B)t-2	-0.028 (-0.148)	-0.041 (-0.419)
ΔLnPPI(B)t-3	0.020 (0.126)	-0.200 (2.553)
ΔLnPPI(B)t-4	0.018 (0.123)	-0.146 (-1.994)
ΔLnPRI(B)t-1	-0.681 (-2.375)	-0.056 (-0.383)
ΔLnPRI(B)t-2	-0.041 (-0.152)	-0.353 (2.621)
ΔLnPRI(B)t-3	-0.446 (-1.793)	-0.250 (-1.960)
ΔLnPRI(B)t-4	-0.096 (-0.457)	-0.042 (-0.400)
ΔLnGDPt-1	-0.034 (-0.107)	-0.003 (-0.018)
ΔLnGDPt-2	-0.022 (-0.081)	0.161 (1.175)
ΔLnGDPt-3	-0.170 (-0.704)	0.028 (0.224)
ΔLnGDPt-4	-0.238 (-1.123)	0.124 (1.051)
ΔLnHHt-1	0.288 (0.289)	-0.692 (-1.283)
ΔLnHHt-2	1.337(1.341)	-0.619 (-1.188)
ΔLnHHt-3	1.628 (1.550)	-0.553 (-0.977)
ΔLnHHt-4	0.002 (0.002)	-0.848 (-1.483)
ΔLnM1t-1	-0.203 (-1.761)	-0.111 (-1.841)
ΔLnM1t-2	-0.104 (-0.868)	-0.124 (-2.045)
ΔLnM1t-3	0.015 (0.130)	-0.028 (-0.450)
ΔLnM1t-4	0.013 (0.135)	0.014 (0.268)
ΔLnHSIt-1	-0.041 (-0.521)	-0.033 (-0.984)
ΔLnHSIt-2	-0.144 (2.223)	-0.053 (-1.795)
ΔLnHSIt-3	-0.036 (-0.590)	0.009 (0.340)
ΔLnHSIt-4	-0.075 (-1.489)	-0.030 (-1.151)
ΔLnHSISTDt-1	0.013 (0.865)	0.008 (0.881)
ΔLnHSISTDt-2	0.001 (0.081)	0.008 (1.022)
ΔLnHSISTDt-3	-0.010 (-0.884)	5.36E-05 (0.009)
ΔLnHSISTDt-4	-0.011 (-1.360)	0.001 (0.169)
ΔLnHSt-1	0.003 (0.148)	0.006 (0.590)
ΔLnHSt-2	-0.003 (-0.211)	0.005 (0.587)
ΔLnHSt-3	-0.005 (-0.454)	0.003 (0.477)
ΔLnHSt-4	-0.004 (-0.494)	0.003 (0.699)
ΔLnHOSt-1	4.03E-07 (0.055)	6.14E-06 (1.364)
ΔLnHOSt-2	1.24E-06 (0.212)	4.17E-06 (1.183)
ΔLnHOSt-3	2.78E-06 (0.737)	2.48E-06 (1.091)
ΔLnHOSt-4	1.86E-06 (0.892)	7.66E-07 (0.665)
ΔFEDt-1	0.007 (0.588)	0.002 (0.299)
ΔFEDt-2	-0.010 (-0.868)	-0.005 (-0.820)

ΔFEDt-3	0.023 (2.150)	0.011 (1.991)
ΔFEDt-4	0.017 (1.590)	0.014 (2.565)
ΔLnNEERt-1	-0.034 (-0.172)	-0.226 (-2.206)
ΔLnNEERt-2	0.193 (0.916)	0.022 (0.196)
ΔLnNEERt-3	0.245 (1.230)	0.058 (0.557)
ΔLnNEERt-4	-0.122 (-0.621)	0.001 (0.006)
ΔLnRMBt-1	0.004 (0.0338)	-0.120 (-1.987)
ΔLnRMBt-2	-0.185 (-1.670)	-0.069 (-1.184)
ΔLnRMBt-3	-0.156 (-1.454)	-0.088 (-1.547)
ΔLnRMBt-4	-0.138 (-1.315)	-0.124 (2.249)
Constant	0.168 (2.412)	-0.013 (-0.393)
SBR1	-0.001 (-0.025)	0.037 (1.939)
SBR2	-0.099 (-1.695)	0.029 (0.912)
SBR3	-0.189 (-2.490)	0.043 (1.284)
SBR4	-0.263 (-2.793)	0.067 (1.767)
SBR5	-0.265 (-2.925)	0.073 (1.843)

Class C:

Error Correction	ΔLnPPI(C)	ΔLnPRI(C)
Coint. Eq. 1	-0.064 (-1.119)	-0.160 (-3.093)
Coint. Eq. 2	-0.276 (-2.883)	0.070 (1.548)
Coint. Eq. 3	-0.315 (1.002)	-0.227 (-1.866)
Coint. Eq. 4	-0.915 (-1.248)	0.126 (0.414)
Coint. Eq. 5	0.323 (2.940)	0.086 (1.452)
Coint. Eq. 6	0.267 (2.970)	0.136 (3.633)
Coint. Eq. 7	0.001 (0.036)	0.009 (0.888)
Coint. Eq. 8	-0.010 (-0.361)	
ΔLnPPI(C)t-1	0.346 (2.555)	0.327 (4.486)
ΔLnPPI(C)t-2	0.118 (0.694)	-0.036 (-0.433)
ΔLnPPI(C)t-3	0.254 (1.519)	0.132 (1.718)
ΔLnPPI(C)t-4	0.025 (0.172)	-0.060 (-0.895)
ΔLnPRI(C)t-1	-0.489 (-1.903)	-0.234 (-1.938)
ΔLnPRI(C)t-2	-0.327 (-1.309)	-0.027 (-0.224)
ΔLnPRI(C)t-3	-0.433 (-1.687)	-0.182 (-1.524)
ΔLnPRI(C)t-4	-0.144 (-0.642)	-0.006 (-0.066)
ΔLnGDPt-1	0.082 (0.208)	0.137 (0.901)
ΔLnGDPt-2	0.487 (1.389)	0.227 (1.599)
ΔLnGDPt-3	0.038 (0.127)	0.082 (0.610)
ΔLnGDPt-4	0.164 (0.610)	0.122 (0.931)
ΔLnHHt-1	-0.298 (-0.262)	-0.575 (-1.041)
ΔLnHHt-2	1.324 (1.128)	-0.159 (-0.295)
ΔLnHHt-3	0.389 (0.307)	-0.479 (-0.792)
ΔLnHHt-4	-0.990 (-0.818)	-0.521 (-0.852)
ΔLnM1t-1	-0.214 (--1.646)	-0.077 (-1.257)
ΔLnM1t-2	-0.044 (-0.313)	-0.082 (-1.345)
ΔLnM1t-3	-0.016 (-0.118)	-0.065 (-1.034)
ΔLnM1t-4	-0.028 (-0.245)	0.069 (1.309)
ΔLnHSIt-1	-0.061 (-0.675)	-0.021 (-0.554)
ΔLnHSIt-2	-0.127 (-1.596)	-0.019 (-0.581)
ΔLnHSIt-3	-0.032 (-0.454)	-0.009 (-0.304)
ΔLnHSIt-4	-0.046 (-0.777)	-0.011 (-0.404)
ΔLnHSISTDt-1	-0.008 (-0.471)	-0.008 (-0.934)
ΔLnHSISTDt-2	-0.009 (-0.632)	-0.002 (-0.296)
ΔLnHSISTDt-3	-0.016 (-1.269)	-0.003 (-0.544)
ΔLnHSISTDt-4	-0.018 (-1.947)	0.002 (0.447)
ΔLnHSt-1	0.007 (0.268)	-0.025 (-2.365)
ΔLnHSt-2	-0.006 (-0.306)	-0.019 (-2.095)
ΔLnHSt-3	-0.008 (-0.585)	-0.011 (-1.622)
ΔLnHSt-4	-0.011 (-1.165)	-0.003 (-0.784)
ΔLnHOSt-1	1.38E-05 (1.575)	1.47E-05 (2.853)
ΔLnHOSt-2	1.04E-05 (1.535)	9.99E-06 (2.551)
ΔLnHOSt-3	6.31E-06 (1.489)	5.62E-06 (2.334)
ΔLnHOSt-4	2.34E-06 (1.001)	2.53E-06 (2.111)
ΔFEDt-1	-0.025 (-2.027)	-0.001 (-0.139)
ΔFEDt-2	-0.029 (2.498)	-0.016 (-2.796)

ΔFEDt-3	-0.004 (-0.338)	0.003 (0.576)
ΔFEDt-4	0.009 (0.805)	0.012 (2.159)
ΔLnNEERt-1	-0.132 (-0.622)	-0.230 (-2.224)
ΔLnNEERt-2	0.058 (0.262)	0.004 (0.038)
ΔLnNEERt-3	0.383 (1.776)	0.086 (0.810)
ΔLnNEERt-4	-0.283 (-1.353)	0.121 (1.176)
ΔLnRMBt-1	0.244 (1.663)	-0.139 (-2.080)
ΔLnRMBt-2	0.031 (0.210)	-0.213 (-3.258)
ΔLnRMBt-3	-0.112 (-0.764)	-0.098 (-1.412)
ΔLnRMBt-4	-0.105 (-0.738)	-0.150 (-2.262)
Constant	-0.056 (-0.710)	-0.006 (-0.273)
@Trend (1983Q4)		-0.0002 (-0.389)
SBR1	0.104 (2.656)	0.050 (2.684)
SBR2	0.076 (1.038)	0.031 (0.922)
SBR3	0.016 (0.194)	0.018 (0.453)
SBR4	0.080 (0.811)	0.041 (0.873)
SBR5	0.165 (1.626)	0.047 (0.934)

Classes D & E:

Error Correction	ΔLnPPI(D&E)	ΔLnPRI(D)
Coint. Eq. 1	-0.089 (-1.540)	-0.207 (-3.813)
Coint. Eq. 2	-0.502 (-4.175)	-0.010 (-0.260)
Coint. Eq. 3	0.457 (1.689)	0.205 (1.628)
Coint. Eq. 4	-0.821 (-1.527)	0.348 (1.267)
Coint. Eq. 5	0.231 (2.458)	0.202 (4.041)
Coint. Eq. 6	0.276 (3.674)	0.194 (5.069)
Coint. Eq. 7	-0.018 (-1.380)	
ΔLnPPI(D&E)t-1	0.292 (2.237)	0.358 (4.868)
ΔLnPPI(D&E)t-2	0.013 (0.091)	0.026 (0.343)
ΔLnPPI(D&E)t-3	0.045 (0.352)	0.068 (0.984)
ΔLnPPI(D&E)t-4	-0.058 (-0.541)	-0.090 (-1.611)
ΔLnPRI(D)t-1	-0.229 (-1.045)	-0.027 (-0.242)
ΔLnPRI(D)t-2	0.135 (0.649)	-0.068 (-0.595)
ΔLnPRI(D)t-3	-0.161 (-0.831)	-0.114 (-1.087)
ΔLnPRI(D)t-4	0.090 (0.533)	-0.036 (-0.411)
ΔLnGDPt-1	-0.887 (-2.886)	-0.319 (-1.996)
ΔLnGDPt-2	-0.389 (-1.455)	-0.228 (-1.634)
ΔLnGDPt-3	-0.600 (-2.619)	-0.139 (-1.041)
ΔLnGDPt-4	-0.252 (-1.154)	-0.089 (-0.709)
ΔLnHHt-1	-0.019 (-0.019)	-0.824 (-1.565)
ΔLnHHt-2	2.702 (2.835)	1.002 (2.040)
ΔLnHHt-3	2.644 (2.524)	-0.093 (-0.171)
ΔLnHHt-4	1.320 (1.276)	-1.213 (-2.189)
ΔLnM1t-1	-0.179 (-1.508)	-0.204 (-3.363)
ΔLnM1t-2	-0.135 (-1.117)	-0.164 (-2.688)
ΔLnM1t-3	-0.012 (-0.103)	-0.087 (-1.387)
ΔLnM1t-4	-0.001 (-0.010)	-0.020 (-0.373)
ΔLnHSIt-1	0.005 (0.062)	-0.102 (-2.760)
ΔLnHSIt-2	-0.137 (-1.862)	-0.095 (-2.828)
ΔLnHSIt-3	-0.019 (-0.290)	-0.030 (-0.966)
ΔLnHSIt-4	-0.077 (-1.482)	-0.035 (-1.323)
ΔLnHSISTDt-1	0.010 (0.804)	0.016 (2.531)
ΔLnHSISTDt-2	-0.002 (-0.172)	0.013 (2.122)
ΔLnHSISTDt-3	-0.012 (-1.121)	0.005 (0.842)
ΔLnHSISTDt-4	-0.015 (-1.675)	0.005 (1.012)
ΔLnHSt-1	0.017 (0.747)	-0.002 (-0.210)
ΔLnHSt-2	0.004 (0.237)	0.001 (0.100)
ΔLnHSt-3	-0.004 (-0.339)	-4.17E-05 (-0.007)
ΔLnHSt-4	-0.007 (-0.830)	0.005 (1.061)
ΔFEDt-1	-0.008 (-0.825)	-0.0003 (-0.067)
ΔFEDt-2	-0.021 (-2.337)	0.002 (0.396)
ΔFEDt-3	0.004 (0.424)	0.011 (2.107)
ΔFEDt-4	-0.001 (-0.072)	0.013 (2.641)
ΔLnNEERt-1	-0.164 (-0.841)	-0.383 (-3.671)
ΔLnNEERt-2	-0.028 (-0.136)	-0.095 (-0.861)
ΔLnNEERt-3	0.194 (0.994)	-0.120 (-1.183)

ΔLnNEERt-4	-0.262 (-1.326)	-0.077 (-0.739)
ΔLnRMBt-1	0.096 (0.785)	-0.118 (-1.915)
ΔLnRMBt-2	0.042 (0.363)	-0.121 (-2.024)
ΔLnRMBt-3	-0.077 (-0.655)	-0.117 (-1.904)
ΔLnRMBt-4	-0.089 (-0.809)	-0.158 (-2.732)
Constant	0.015 (0.382)	0.027 (0.822)
@Trend (1983Q4)	0.000126 (0.456)	
SBR1	0.047 (1.758)	0.004 (0.281)
SBR2	0.021 (0.599)	-0.030 (-1.076)
SBR3	-0.044 (-1.598)	-0.007 (-0.195)
SBR4	-0.057 (-2.299)	0.033 (0.835)
SBR5	0.024 (1.011)	0.064 (1.583)

Chapter 3

Appendix B3.1: Lag Order

Lag	Sequential Modified LR Test Statistic	Final Prediction Error	Akaike Information Criterion	Schwarz Information Criterion	Hannan-Quinn Information Criterion
1	NA	1.687010	34.55300	38.74954	36.23893
2	562.7329	0.004674	28.48503	36.87812*	31.85690
3	262.8646	0.000954	26.36205	38.95168	31.41985
4	334.3030*	7.39e-06*	20.28041*	37.06658	27.02416*

Appendix B3.2: Johansen cointegration (Trace) tests results

Number of Cointegrating Relation(s)	Trace Statistic	5% Critical Value
None	1111.591*	311.129
At most 1	865.935*	263.260
At most 2	680.347*	219.402
At most 3	533.422*	179.510
At most 4	402.975*	143.669
At most 5	281.196*	111.781
At most 6	182.966*	83.937
At most 7	108.365*	60.061
At most 8	59.392*	40.175
At most 9	24.478*	24.276
At most 10	7.138	12.321
At most 11	1.141	4.130

Deterministic Trend Assumption: No trend in data – No intercept or trend in CE or VAR

Number of Cointegrating Relation(s)	Trace Statistic	5% Critical Value
None	1369.767*	348.978
At most 1	1047.327*	298.159
At most 2	802.182*	251.265
At most 3	625.948*	208.437
At most 4	485.743*	169.599
At most 5	356.292*	134.678
At most 6	237.039*	103.847
At most 7	161.159*	76.973
At most 8	100.178*	54.079

At most 9	51.411*	35.193
At most 10	20.216	20.262
At most 11	5.493	9.165

Deterministic Trend Assumption: No trend in data – Intercept in CE – no intercept in VAR

Number of Cointegrating Relation(s)	**Trace Statistic**	**5% Critical Value**
None	1346.412*	334.984
At most 1	1024.572*	285.143
At most 2	780.350*	239.235
At most 3	604.425*	197.371
At most 4	464.364*	159.530
At most 5	335.054*	125.615
At most 6	221.721*	95.754
At most 7	147.407*	69.819
At most 8	87.257*	47.856
At most 9	38.975*	29.797
At most 10	7.962	15.495
At most 11	0.963	3.841

Deterministic Trend Assumption: Linear trend in data – Intercept in CE and VAR

Number of Cointegrating Relation(s)	**Trace Statistic**	**5% Critical Value**
None	1557.947*	374.908
At most 1	1234.242*	322.069
At most 2	976.548*	273.189
At most 3	738.397*	228.298
At most 4	565.274*	187.470
At most 5	435.813*	150.559
At most 6	317.479*	117.708
At most 7	209.877*	88.804
At most 8	139.934*	63.876
At most 9	85.161*	42.915
At most 10	37.134*	25.872
At most 11	6.612	12.518

Deterministic Trend Assumption: Linear trend in data – Intercept and trend in CE – no trend in VAR

Number of Cointegrating Relation(s)	**Trace Statistic**	**5% Critical Value**
None	1529.409*	358.718
At most 1	1208.106*	306.894
At most 2	951.857*	259.029
At most 3	715.644*	215.123
At most 4	543.715*	175.172
At most 5	415.149*	139.275
At most 6	298.831*	107.347
At most 7	191.316*	79.341
At most 8	121.850*	55.246
At most 9	69.392*	35.011
At most 10	28.125*	18.398
At most 11	6.490*	3.841

Deterministic Trend Assumption: Quadratic trend in data

Appendix B3.3: The Cointegating Equations

Coint. Eq.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
LnGFAt-1	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LnPPIt-1	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
EXPPPIt-1	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
VOLPPIt-1	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LnLSt-1	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000
PERLEt-1	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000
LnRLBt-1	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000
EXPRLBt-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000
VOLRLBt-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000
FEDt-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000
EXPFEDt-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
VOLFEDt-1	0.286 (0.761)	1.618 (7.454)	52.527 (4.585)	0.339 (0.085)	1.461 (6.421)	-175.900 (-7.049)	0.667 (7.602)	156.1443 (9.250)	-72.427 (-3.338)	-3.577 (-9.870)	-0.035 (-1.216)
@Trend (1995Q2)	0.002 (0.393)	-0.006 (-2.679)	0.154 (1.254)	-0.069 (-1.624)	-0.0001 (-0.057)	-0.336 (-1.254)	-0.005 (-5.607)	0.232 (1.279)	0.280 (1.201)	0.038 (9.708)	-0.0004 (-1.286)
C	-12.539	-5.310	-40.061	-7.524	-12.786	57.473	-7.481	-143.270	-25.912	-2.511	0.301

Appendix B3.4: The error correction terms of the VECM

Error Correction		**ΔLnGFA**
Cointegrating Equation	1	-1.911 (-1.803)
	2	13.762 (2.087)
	3	-0.141 (-1.880)
	4	0.028 (0.481)
	5	1.042 (1.255)
	6	-0.013 (-0.458)
	7	-28.745 (-1.734)
	8	-0.003 (-0.239)
	9	0.001 (0.066)
	10	0.726 (1.357)
	11	-1.701 (-0.611)
ΔLnGFAt-1		0.547 (0.611)
ΔLnGFAt-2		0.364 (0.569)
ΔLnGFAt-3		0.299 (0.650)
ΔLnGFAt-4		0.159 (0.552)
ΔLnPPIt-1		-3.502 (-0.564)
ΔLnPPIt-2		-5.657 (-0.911)
ΔLnPPIt-3		-1.203 (-0.216)
ΔLnPPIt-4		0.288 (0.046)
ΔEXPPPIt-1		0.031 (0.303)
ΔEXPPPIt-2		0.051 (0.484)
ΔEXPPPIt-3		0.150 (1.718)
ΔEXPPPIt-4		0.007 (0.099)
ΔVOLPPPIt-1		0.012 (0.207)
ΔVOLPPPIt-2		-0.028 (-0.495)
ΔVOLPPPIt-3		0.017 (0.428)
ΔVOLPPPIt-4		-0.028 (-0.684)
ΔLnLSt-1		-0.010 (-0.015)
ΔLnLSt-2		-0.823 (-1.312)
ΔLnLSt-3		-0.312 (-0.706)
ΔLnLSt-4		-0.608 (-1.303)
ΔPERLEt-1		0.004 (0.161)
ΔPERLEt-2		0.019 (0.837)
ΔPERLEt-3		0.015 (0.685)
ΔPERLEt-4		0.027 (1.765)
ΔLnRLBt-1		14.547 (1.167)
ΔLnRLBt-2		16.676 (0.968)
ΔLnRLBt-3		18.206 (1.056)
ΔLnRLBt-4		17.619 (0.891)
ΔEXPRLBt-1		-0.013 (-0.616)
ΔEXPRLBt-2		-0.003 (-0.178)
ΔEXPRLBt-3		-0.005 (-0.330)
ΔEXPRLBt-4		0.009 (0.735)
ΔVOLRLBt-1		-0.006 (-0.359)
ΔVOLRLBt-2		0.005 (0.395)
ΔVOLRLBt-3		-0.001 (-0.072)

ΔVOLRLBt-4	-0.009 (-1.136)
ΔFEDt-1	-0.759 (-0.656)
ΔFEDt-2	-0.778 (-0.516)
ΔFEDt-3	-1.189 (-0.621)
ΔFEDt-4	0.649 (0.292)
ΔEXPFEDt-1	-0.481 (-0.163)
ΔEXPFEDt-2	0.830 (0.875)
ΔEXPFEDt-3	2.047 (1.444)
ΔEXPFEDt-4	0.936 (0.557)
ΔVOLFEDt-1	2.306 (1.542)
ΔVOLFEDt-2	1.342 (0.941)
ΔVOLFEDt-3	1.562 (2.060)
ΔVOLFEDt-4	1.136 (1.518)
Constant	-0.486 (-0.877)

Chapter 4

Appendix B4.1: Spatial distributions of planning applications (R[A], R[B], and R[C] zones)

Planning Area[84] (Outline Zoning Plan)	Number of Applications
Hong Kong Island (Total: 216)	
Kennedy Town & Mount Davis	6
Sai Ying Pun & Sheung Wan	22
Wanchai	9
Causeway Bay	7
Wong Nai Chung	18
North Point	5
Shau Kei Wan	1
Pok Fu Lam	6
Mid-levels West	28
Mid-levels East	7
Jardine's Lookout & Wong Nai Chung Gap	1
The Peak Area	17
Aberdeen and Ap Lei Chau	1
Shouson Hill & Repulse Bay	45
Tai Tam & Shek O	22
Stanley	10
Quarry Bay	11
Kowloon Peninsula (Total: 40)	
Tsim Sha Tsui	3
Mongkok	4
Shek Kip Mei	2
Cheung Sha Wan	2
Ho Man Tin	7
Hung Hom	4
Ma Tau Kok	3
Tsz Wan Shan	5
Kowloon Tong	10
The New Territories (Total: 140)	
Fanling/Sheung Shui	4
Ma On Shan	3
Pak Shek Kok	6
Sai Kung*	22
South Lantau Coast	2
Shatin	2
Tseung Kwan O	2
Tuen Mun*	9
Tai Po	11
Tsuen Wan (including Tsuen Wan West)	22
Yuen Long	42
Other Areas in the Rural Outline Zoning Plans	15

* Including areas in the Rural Outline Zoning Plans

84 For areas in which these outline zoning plans cover, see http://www.pland.gov.hk/pland_en/info_serv/tp_plan/images/sta_plan.pdf

Appendix B4.2: Spatial distributions of planning applications (GIC, CDA, and GB zones)

Planning Area[85] (Outline Zoning Plan)	Number of Applications		
	GIC	CDA	GB
Hong Kong Island			
Kennedy Town & Mount Davis	4	6	1
Sai Ying Pun & Sheung Wan	38	7	0
Wanchai	10	0	1
Causeway Bay	0	0	5
Wong Nai Chung	2	0	2
North Point	6	4	0
Shau Kei Wan	4	1	0
Pok Fu Lam	0	0	0
Mid-levels West	9	0	0
Mid-levels East	0	1	0
Jardine's Lookout & Wong Nai Chung Gap	1	0	0
The Peak Area	1	0	6
Aberdeen and Ap Lei Chau	2	0	0
Shouson Hill & Repulse Bay	1	0	0
Tai Tam & Shek O	0	0	1
Stanley	0	1	1
Chai Wan	0	2	0
Quarry Bay	8	0	3
Kowloon			
Tsim Sha Tsui	1	0	0
Yau Ma Tei	3	8	0
Mongkok	5	4	0
Shek Kip Mei	0	1	0
Cheung Sha Wan	2	13	0
Ho Man Tin	6	0	0
Hung Hom	0	11	0
Ma Tau Kok	8	6	0
Tsz Wan Shan, Diamond Hill & San Po Kong	3	0	0
Ngau Chi Wan	5	1	0
Kwun Tong	3	0	0
Cha Kwo Ling, Yau Tong, Lei Yue Mun	3	3	0
Lai Chi Kok	0	4	0
Kowloon Tong	3	2	0
South West Kowloon	0	9	0
Kai Tak	0	1	0
The New Territories			
Fanling/Sheung Shui	3	8	3
Ma On Shan	1	3	1
Sai Kung*	0	10	0
Shatin	4	6	4

[85] See Footnote 108

Tseung Kwan O	2	1	2
Tuen Mun*	18	17	18
Tai Po	0	2	0
Tsuen Wan (including Tsuen Wan West)	0	32	0
Yuen Long	7	44	7
Tin Shui Wai	0	2	0
Kwai Chung	2	7	2
Tsing Yi	3	11	3
Ma Wan	0	4	0
Islands**	1	5	1
Other Areas in the Rural Outline Zoning Plans	7	20	7

* Including areas in the Rural Outline Zoning Plans
** Including Lamma Island, Tung Chung New Town, and Cheung Chau

Appendix A

Appendix BAA.1: Global Maximizer tests results (Structural Breaks Points)

Bai-Perron tests of 1 to M globally determined breaks

Breaks	Conventional Monetary Policy Period		Unconventional Monetary Policy Period		Critical Value
	Scaled F-statistic	Weighted F-statistic	Scaled F-statistic	Weighted F-statistic	
1	142.638*	142.638*	142.057*	142.057	8.58
2	82.752	98.340	137.878	163.850*	7.22
3	75.506	108.698	98.385	141.635	5.96
4	74.443	128.000	79.001	135.837	4.99
5	64.882	142.374	63.959	140.349	3.91

Bai-Perron tests of L+1 vs. L globally determined breaks

Break Test	Scaled F-statistic		Critical Value
	Conventional Monetary Policy Period	Unconventional Monetary Policy Period	
0 vs. 1	142.638*	142.057*	8.58
1 vs. 2	11.765*	43.724*	10.13
2 vs. 3	19.641*	5.539	11.14
3 vs. 4	32.770*	5.833	11.83
4 vs. 5	10.857	1.144	12.25

Global Maximizer tests results based upon information criteria

Breaks	Conventional Monetary Policy Period		Unconventional Monetary Policy Period	
	Schwarz Criterion	LWZ Criterion	Schwarz Criterion	LWZ Criterion
0	-2.662	-2.633	-3.192	-3.154
1	-3.169	-3.083	-4.001	-3.887
2	-3.183	-3.039	-4.360*	-4.169*
3	-3.290	-3.088	-4.326	-4.058
4	-3.397	-3.138*	-4.293	-3.947
5	-3.399*	-3.082	-4.218	-3.794

Appendix BAA.2: Lag Order

Lag	Sequential Modified LR Test Statistic	Final Prediction Error	Akaike Information Criterion	Schwarz Information Criterion	Hannan-Quinn Information Criterion
0	NA	3.11e-19	-11.39766	-10.61417	-11.07996
1	4383.288	2.98e-30*	-36.77308	-33.83498*	-35.58170*
2	181.1116	3.59e-30	-36.60486	-31.51216	-34.53981
3	159.8277	4.71e-30	-36.37845	-29.13115	-33.43973
4	96.88184	9.42e-30	-35.76605	-26.36415	-31.95365
5	140.3823	1.29e-29	-35.58395	-24.02745	-30.89788
6	164.4919*	1.35e-29	-35.74109	-22.02999	-30.18135
7	132.9165	1.80e-29	-35.74543	-19.87972	-29.31201
8	134.8226	2.24e-29	-35.94316	-17.92285	-28.63606
9	96.91845	4.29e-29	-35.86644	-15.69154	-27.68568
10	108.9285	6.82e-29	-36.19031	-13.86080	-27.13587
11	111.0598	1.01e-28	-36.89502	-12.41091	-26.96690
12	144.9873	6.26e-29	-38.91486*	-12.27615	-28.11307

Conventional Monetary Policy Period

Lag	Sequential Modified LR Test Statistic	Final Prediction Error	Akaike Information Criterion	Schwarz Information Criterion	Hannan-Quinn Information Criterion
0	NA	2.38e-24	-23.17889	-22.60220	-22.94556
1	2262.659	1.04e-34	-47.04443	-43.29592*	-45.52778*
2	185.0962	1.12e-34	-47.06794	-40.14762	-44.26796
3	134.9060	1.99e-34	-46.73140	-36.63927	-42.64810
4	133.7521	3.03e-34	-46.81058	-33.54663	-41.44396
5	137.8950	3.28e-34	-47.64935	-31.21359	-40.99941
6	169.3665*	8.32e-35*	-50.66834*	-31.06077	-42.73508

Unconventional Monetary Policy Period

Appendix BAA.3: Johansen Cointegration Tests Results (Trace Statistics)

Number of Cointegrating Relation(s)	**Conventional Monetary Policy Period**	**Unconventional Monetary Policy Period**	**5% Critical Value**
None	297.736*	920.552*	263.260
At most 1	237.191*	685.887*	219.402
At most 2	182.880*	480.358*	179.510
At most 3	136.685	353.057*	143.669
At most 4	99.802	237.419*	111.781
At most 5	71.354	136.898*	83.937
At most 6	46.725	85.659*	60.061
At most 7	30.569	53.097*	40.175
At most 8	17.147	26.011*	24.276
At most 9	5.425	4.119	12.321
At most 10	0.200	0.199	4.130

Deterministic Trend Assumption: No trend in data – No intercept or trend in CE or VAR

Number of Cointegrating Relation(s)	**Conventional Monetary Policy Period**	**Unconventional Monetary Policy Period**	**5% Critical Value**
None	351.563*	1132.707*	298.159
At most 1	289.636*	852.877*	251.265
At most 2	234.067*	633.654*	208.437
At most 3	180.683*	430.926*	169.599
At most 4	134.996*	314.427*	134.678
At most 5	98.533	209.040*	103.847
At most 6	70.707	128.101*	76.973
At most 7	46.125	79.832*	54.079
At most 8	30.000	47.774*	35.193
At most 9	16.578	22.376*	20.262
At most 10	5.218	0.986	9.165

Deterministic Trend Assumption: No trend in data – Intercept in CE – no intercept in VAR

Number of Cointegrating Relation(s)	Conventional Monetary Policy Period	Unconventional Monetary Policy Period	5% Critical Value
None	339.677*	1040.186*	285.143
At most 1	278.218*	760.504*	239.235
At most 2	223.252*	556.863*	197.371
At most 3	169.873*	355.994*	159.530
At most 4	124.469	249.567*	125.615
At most 5	88.417	155.434*	95.754
At most 6	61.034	107.132*	69.819
At most 7	39.394	64.588*	47.856
At most 8	24.468	35.683*	29.797
At most 9	12.335	14.293	15.495
At most 10	4.775	0.630	3.841

Deterministic Trend Assumption: Linear trend in data – Intercept in CE and VAR

Number of Cointegrating Relation(s)	Conventional Monetary Policy Period	Unconventional Monetary Policy Period	5% Critical Value
None	391.191*	1207.102*	322.069
At most 1	293.024*	923.449*	273.189
At most 2	232.003*	663.373*	228.298
At most 3	178.472	460.361*	187.470
At most 4	133.035	320.399*	150.559
At most 5	96.930	214.614*	117.708
At most 6	67.996	135.639*	88.804
At most 7	44.721	90.002*	63.876
At most 8	26.382	50.372*	42.915
At most 9	14.129	21.980	25.872
At most 10	4.991	5.550	12.518

Deterministic Trend Assumption: Linear trend in data – Intercept and trend in CE – no trend in VAR

Number of Cointegrating Relation(s)	Conventional Monetary Policy Period	Unconventional Monetary Policy Period	5% Critical Value
None	380.075*	1137.555*	306.894
At most 1	282.912*	854.016*	259.029
At most 2	221.931*	616.526*	215.123
At most 3	168.400	419.786*	175.172
At most 4	122.965	286.978*	139.275
At most 5	87.068	182.963*	107.347
At most 6	59.946	105.071*	79.341
At most 7	38.155	62.961*	55.246
At most 8	20.526	26.343	35.011
At most 9	9.395	8.322	18.398
At most 10	3.152	1.366	3.841

Deterministic Trend Assumption: Quadratic trend in data

Appendix BAA.4a: Cointegrating equations (Conventional Monetary Policy Period)

Coint. Eq.	**1**	**2**	**3**	**4**	**5**
LnHKt-1	1.000	0.000	0.000	0.000	0.000
LnChinat-1	0.000	1.000	0.000	0.000	0.000
LnUSt-1	0.000	0.000	1.000	0.000	0.000
LnEuropet-1	0.000	0.000	0.000	1.000	0.000
LnJapant-1	0.000	0.000	0.000	0.000	1.000
LnSingaporet-1	1.997 (4.190)	31.894 (5.302)	1.730 (3.754)	17.914 (5.193)	0.031 (0.145)
LnTaiwant-1	-1.484 (-3.431)	-17.461 (-3.200)	-1.775 (-4.244)	-10.533 (-3.366)	-0.711 (-3.654)
LnWTIt-1	-1.558 (-4.926)	-18.825 (-4.715)	-1.197 (-3.912)	-10.918 (-4.769)	-0.603 (-4.238)
LnNEERt-1	5.784 (4.118)	84.514 (4.768)	1.520 (1.119)	43.204 (4.250)	1.686 (2.669)
LnM1t-1	2.214 (3.071)	33.326 (3.663)	0.458 (0.657)	17.276 (3.311)	1.548 (4.773)
LnRMBt-1	2.860 (3.371)	38.568 (3.602)	2.964 (3.613)	23.815 (3.879)	0.827 (2.167)
C	-95.275 (-4.630)	-1355.132 (-5.219)	-25.110 (-1.262)	-702.886 (-4.720)	-50.476 (-5.455)

Appendix BAA.4b: The error correction terms of the VECM (Conventional Monetary Policy Period)

Error Correction	ΔLnHK
Coint. Eq. 1	-0.210 (-2.274)
Coint. Eq. 2	-0.015 (-0.395)
Coint. Eq. 3	-0.005 (-0.048)
Coint. Eq. 4	0.050 (0.667)
Coint. Eq. 5	0.161 (2.682)
ΔLnHKt-1	0.058 (0.435)
ΔLnChinat-1	0.166 (2.200)
ΔLnUSt-1	-0.030 (-0.122)
ΔLnEuropet-1	0.009 (0.040)
ΔLnJapant-1	-0.100 (-0.809)
ΔLnSingaporet-1	-0.175 (-1.330)
ΔLnTaiwant-1	0.175 (2.074)
ΔLnWTIt-1	0.189 (2.250)
ΔLnNEERt-1	-0.201 (-0.410)
ΔLnM1t-1	-0.041 (-0.596)
ΔLnRMBt-1	0.049 (0.247)
SBR1	0.030 (1.709)
SBR2	-0.028 (-1.380)
SBR3	-0.053 (-1.826)
SBR4	-0.038 (-1.226)

Appendix BAA.5a: Cointegrating equations (Unconventional Monetary Policy Period)

Coint. Eq.	1	2	3	4	5	6	7	8
LnHKt-1	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LnChinat-1	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000
LnUSt-1	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000
LnEuropet-1	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000
LnJapant-1	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000
LnSingaporet-1	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000
LnTaiwant-1	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000
LnWTIt-1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
LnNEERt-1	1.275 (4.882)	0.142 (0.510)	1.333 (3.678)	2.204 (6.138)	2.042 (3.605)	2.384 (4.906)	1.910 (5.757)	11.184 (5.441)
LnM1t-1	-1.632 (-8.100)	-2.505 (-11.67)	-0.677 (-2.420)	-2.344 (-8.456)	-1.473 (-3.369)	-1.112 (-2.965)	-2.154 (-8.415)	0.996 (0.628)
LnRMBt-1	0.075 (0.236)	-0.821 (-2.423)	0.654 (1.482)	-0.148 (-0.338)	1.069 (1.550)	0.517 (0.873)	0.169 (0.418)	5.912 (2.362)
TREND	0.009	0.023	-0.005	0.018	0.009	0.007	0.016	-0.018
C	27.773	58.779	6.225	42.692	21.021	9.758	41.149	-80.165

Appendix BAA.5b: The error correction terms of the VECM (Unconventional Monetary Policy Period)

Error Correction	ΔLnHK
Coint. Eq. 1	-1.402 (-0.913)
Coint. Eq. 2	-0.203 (-0.210)
Coint. Eq. 3	-3.077 (-3.171)
Coint. Eq. 4	1.904 (2.692)
Coint. Eq. 5	-0.753 (-1.043)
Coint. Eq. 6	1.360 (2.211)
Coint. Eq. 7	0.621 (0.546)
Coint. Eq. 8	0.307 (1.364)
ΔLnHKt-1	0.924 (0.607)
ΔLnHKt-2	0.845 (0.701)
ΔLnHKt-3	1.051 (1.134)
ΔLnHKt-4	0.223 (0.359)
ΔLnHKt-5	0.064 (0.133)
ΔLnHKt-6	0.219 (0.511)
ΔLnChinat-1	0.359 (0.390)
ΔLnChinat-2	0.382 (0.473)
ΔLnChinat-3	0.117 (0.162)
ΔLnChinat-4	0.398 (0.715)
ΔLnChinat-5	0.351 (1.014)
ΔLnChinat-6	0.403 (1.073)
ΔLnUSt-1	1.934 (1.835)
ΔLnUSt-2	1.890 (1.667)
ΔLnUSt-3	1.131 (0.979)
ΔLnUSt-4	1.975 (1.813)
ΔLnUSt-5	2.061 (2.430)
ΔLnUSt-6	0.797 (1.456)
ΔLnEuropet-1	-1.505 (-2.373)
ΔLnEuropet-2	-1.210 (-2.168)
ΔLnEuropet-3	-0.106 (-0.150)
ΔLnEuropet-4	-0.664 (-0.908)
ΔLnEuropet-5	-1.274 (-2.013)
ΔLnEuropet-6	-0.593 (-1.343)
ΔLnJapant-1	1.174 (1.522)
ΔLnJapant-2	0.401 (0.554)
ΔLnJapant-3	-0.030 (-0.041)
ΔLnJapant-4	0.062 (0.101)
ΔLnJapant-5	0.395 (0.474)
ΔLnJapant-6	0.090 (0.233)
ΔLnSingaporet-1	-1.917 (-3.071)
ΔLnSingaporet-2	-1.344 (-2.667)
ΔLnSingaporet-3	-1.298 (-2.290)
ΔLnSingaporet-4	-1.078 (-1.987)
ΔLnSingaporet-5	-0.710 (-1.506)
ΔLnSingaporet-6	-0.548 (-1.669)
ΔLnTaiwant-1	-0.347 (-0.352)

ΔLnTaiwant-2	-0.087 (-0.098)
ΔLnTaiwant-3	-0.304 (-0.463)
ΔLnTaiwant-4	-0.281 (-0.482)
ΔLnTaiwant-5	0.082 (0.170)
ΔLnTaiwant-6	-0.030 (-0.097)
ΔLnWTIt-1	0.011 (0.053)
ΔLnWTIt-2	-0.238 (-1.278)
ΔLnWTIt-3	-0.238 (-1.433)
ΔLnWTIt-4	0.072 (0.372)
ΔLnWTIt-5	-0.218 (-1.713)
ΔLnWTIt-6	-0.347 (-2.406)
ΔLnNEERt-1	-1.618 (-0.715)
ΔLnNEERt-2	-2.285 (-0.896)
ΔLnNEERt-3	-3.235 (-1.589)
ΔLnNEERt-4	-2.014 (-1.102)
ΔLnNEERt-5	-2.188 (-1.583)
ΔLnNEERt-6	-2.242 (-2.626)
ΔLnM1t-1	0.803 (0.966)
ΔLnM1t-2	0.530 (0.755)
ΔLnM1t-3	0.084 (0.169)
ΔLnM1t-4	-0.055 (-0.142)
ΔLnM1t-5	-0.326 (-1.116)
ΔLnM1t-6	-0.238 (-1.006)
ΔLnRMBt-1	0.168 (0.113)
ΔLnRMBt-2	1.050 (0.716)
ΔLnRMBt-3	-1.049 (-0.745)
ΔLnRMBt-4	-1.282 (-0.828)
ΔLnRMBt-5	0.250 (0.182)
ΔLnRMBt-6	0.480 (0.411)
Constant	0.001 (0.004)
@Trend (1992M12)	0.000115 (0.064)
SBR1	-0.072 (-0.888)
SBR2	-0.156 (-1.293)

Appendix BAA.6: VEC Granger Causality Analyses results for other selected variables within the VECMs

Granger Causality	Chi-square	
	Conventional Monetary Policy Period	Unconventional Monetary Policy Period
CHINA		
HK → CHINA	0.304	2.227
US → CHINA	0.011	2.779
EUROPE → CHINA	0.336	7.387
JAPAN → CHINA	0.307	17.725*
SINGAPORE → CHINA	0.686	7.009
TAIWAN → CHINA	0.003	4.180
WTI → CHINA	1.884	9.036
M1 → CHINA	0.150	3.155
NEER → CHINA	0.129	9.195
RMB → CHINA	0.013	2.219
US		
HK → US	1.590	1.879
CHINA → US	1.405	6.832
EUROPE → US	6.728*	6.532
JAPAN → US	1.270	12.831*
SINGAPORE → US	0.477	6.338
TAIWAN → US	0.019	3.720
WTI → US	0.155	13.244*
M1 → US	0.014	3.714
NEER → US	0.023	6.052
RMB → US	0.019	4.308
EUROPE		
HK → EUROPE	0.279	5.312
CHINA → EUROPE	1.628	2.567
US → EUROPE	0.434	10.668
JAPAN → EUROPE	0.142	6.137
SINGAPORE → EUROPE	0.749	12.587
TAIWAN → EUROPE	1.414	4.496
WTI → EUROPE	0.370	8.611
M1 → EUROPE	0.200	8.407
NEER → EUROPE	0.281	5.171
RMB → EUROPE	0.506	2.164
JAPAN		
HK → JAPAN	1.367	11.803
CHINA → JAPAN	1.521	27.109*
US → JAPAN	0.008	31.984*
EUROPE → JAPAN	0.109	20.155*
SINGAPORE → JAPAN	6.893*	10.133
TAIWAN → JAPAN	4.210*	9.575
WTI → JAPAN	0.335	9.864
M1 → JAPAN	7.56E-06	10.403

NEER → JAPAN	0.580	11.913
RMB → JAPAN	0.875	18.189*
SINGAPORE		
HK → SINGAPORE	0.001	11.280
CHINA → SINGAPORE	4.909*	12.142
US → SINGAPORE	0.414	47.192*
EUROPE → SINGAPORE	0.085	38.681*
JAPAN → SINGAPORE	0.005	50.726*
TAIWAN → SINGAPORE	3.312	12.113
WTI → SINGAPORE	3.099	63.825*
M1 → SINGAPORE	0.020	36.451*
NEER → SINGAPORE	0.101	29.751*
RMB → SINGAPORE	0.001	9.297
TAIWAN		
HK → TAIWAN	1.685	5.815
CHINA → TAIWAN	0.008	7.588
US → TAIWAN	0.011	3.288
EUROPE → TAIWAN	0.561	5.254
JAPAN → TAIWAN	2.477	10.485
SINGAPORE → TAIWAN	2.410	4.614
WTI → TAIWAN	0.035	19.575*
M1 → TAIWAN	0.134	3.062
NEER → TAIWAN	0.085	6.118
RMB → TAIWAN	1.349	5.032
WTI		
HK → WTI	0.905	15.769*
CHINA → WTI	0.911	11.253
US → WTI	0.353	13.087*
EUROPE → WTI	1.266	12.020
JAPAN → WTI	2.466	10.255
SINGAPORE → WTI	0.325	12.471
TAIWAN → WTI	0.126	22.209*
M1 → WTI	0.033	4.542
NEER → WTI	0.171	6.311
RMB → WTI	1.148	3.685
M1		
HK → M1	0.129	25.798*
CHINA → M1	1.921	19.255*
US → M1	3.832	17.419*
EUROPE → M1	5.552*	19.411*
JAPAN → M1	0.137	28.959*
SINGAPORE → M1	0.031	41.598*
TAIWAN → M1	0.658	10.207
WTI → M1	1.007	28.461*
NEER → M1	0.131	15.234*
RMB → M1	0.200	4.100
NEER		
HK → NEER	1.092	6.767

CHINA → NEER	1.093	32.721*
US → NEER	4.358*	17.077*
EUROPE → NEER	7.810*	19.781*
JAPAN → NEER	2.237	15.192*
SINGAPORE → NEER	2.551	9.676
TAIWAN → NEER	0.109	27.463*
WTI → NEER	0.669	16.869*
M1 → NEER	2.679	27.273*
RMB → NEER	0.571	2.452
RMB		
HK → RMB	0.004	7.280
CHINA → RMB	0.212	17.147*
US → RMB	3.049	21.086*
EUROPE → RMB	0.152	9.579
JAPAN → RMB	0.883	7.265
SINGAPORE → RMB	0.165	14.701*
TAIWAN → RMB	3.474	17.271*
WTI → RMB	4.940*	11.807
NEER → RMB	0.325	23.431*
M1 → RMB	0.494	15.742*

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