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THREE ESSAYS ON HOUSING MARKET IN HONG KONG:  
IMPLICATIONS FOR PUBLIC POLICY AND MACRO ECONOMY

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THREE ESSAYS ON HOUSING MARKET IN HONG KONG:  
IMPLICATIONS FOR PUBLIC POLICY AND MACRO ECONOMY

by

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A thesis  
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## **ABSTRACT**

Three Essays on Housing Market in Hong Kong:  
Implications for Public Policy and Macro Economy

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Doctor of Philosophy

The thesis contains three papers on different areas of housing study in Hong Kong. The first paper focuses on government policy in public housing privatization on housing market and its effect on the overall economy. By comparing the negative impacts of two financial crises in 1997 and 2008 on housing market, the paper tries to offer explanation for the property downturn during 1997-2003. It aims to study how a public housing privatization program would produce adverse effects on housing transactions and the economy. The second one links up the housing market and macro economy. It is found that housing sector appears to serve as a link between exports and domestic expenditures. Housing prices are found to be driven by exports and interest rates over a long period, while housing prices in turn drive domestic expenditures. The last one attempts to investigate the dynamics of private housing market in Hong Kong. Using the cointegarting approach, the paper identifies two cointegrating relations, ie. a long run demand side relation between property price, prime rate, housing price expectation and GDP per capita, and supply side relation between private housing completion, property price, prime rate and land cost, which show a short run disequilibrium dynamics in demand and supply of private housing during 1985 – 2008.

## DECLARATION

I declare that this is an original work based primarily on my own research, and I warrant that all citations of previous research, published or unpublished, have been duly acknowledged.

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(Wong Wai Chung Gary)  
24th September 2010

CERTIFICATE OF APPROVAL OF THESIS

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## CONTENTS

<b>LIST OF TABLES</b>	iv
<b>LIST OF FIGURES</b>	vi
<b>ACKNOWLEDGEMENTS</b>	vii
<b>I. INTRODUCTION</b>	1
<b>II. ESSAY ONE</b>	3
<b>Comparing the Effects of the Asian Financial Crisis, Financial Tsunami and the Tenants Purchase Scheme: A Study of External and Policy Shocks on the Hong Kong Housing Market</b>	
1. Introduction	4
2. The Public Housing Privatization Program	9
3. The Data and Statistical Tests	14
4. Empirical Findings	18
4.1 The Relative Effects of TPS and the Two Financial Crises on Transactions and Prices	18
4.2 Structural Break and Simulation of Housing Price	24
5. Conclusions	30
List of variables and their definitions	33
<b>III. ESSAY TWO</b>	34
<b>The Nexus between Housing and the Marco Economy: The HK Case</b>	
1. Introduction	35
2. Theory	38
3. Hong Kong's Housing Market and Policies	42

4. Housing Price Determination in a Small Open Economy and the Exports	
Multiplier on Domestic Economy	45
4.1 Economy Base Theory	45
4.2 Empirical Results	47
a. Test Results for Units Roots	47
b. Test Results for Cointegration	48
c. Granger Causality between Housing Price and Domestic Demand	52
d. Results of Variance Decompositions and Impulse Responses	53
5. Conclusions	57
List of variables and their definitions	59
<b>IV. ESSAY THREE</b>	60
<b>Supply and Demand Dynamics of Private Housing Market</b>	
<b>in Hong Kong</b>	
1. Introduction	61
2. Costly Search, Reservation Demand, Inelastic Supply and Adjustment	62
3. Theoretical Considerations	65
4. Data and Methodology	70
5. Empirical Results	74
4.1 Supply and Demand Dynamics of Private Housing Market	74
a. Test Results for Units Roots	74
b. Test Results for Cointegration	75
c. Identifying Long Run Relation	78
d. Impulse Responses	81
e. Price Expectation and Supply Dynamics	83
f. Granger Causality between Property Price and Land Price	86
4.2 Supply of Subsidized Sale Unit (HOS): Does it Affect Private	
Housing Market?	88
6. Conclusions	93



List of variables and their definitions	95
<b>REFERENCES</b>	96

## LIST OF TABLES

### ESSAY ONE:

#### **Comparing the Effects of the Asian Financial Crisis, Financial Tsunami and the Tenants Purchase Scheme: A Study of External and Policy Shocks on the Hong Kong Housing Market**

Table 1	Hong Kong's Economic Growth 1961-2008 (GDP % change)	4
Table 2	Indicator of Changes of Confidence/External Shocks	6
Table 3	Indicator of External Shocks	6
Table 4.1	Augmented Dickey-Fuller Test of Unit Root	19
Table 4.2	Testing Cointegration Using the Johansen Procedure	20
Table 4.3	Normalized Cointegrating Coefficients Using the Johansen Procedure	20
Table 4.4	Error Correction Model	22
Table 5.1	Augmented Dickey-Fuller Test of Unit Root	25
Table 5.2	Testing Cointegration between LnPPI, LnEx MR and LnCPI Using the Johansen Procedure with Dummy Variables	26
Table 5.3	Normalized Cointegrating Coefficients Using the Johansen Procedure	26
Table 5.4	Error Correction Representation of Johansen Model	27
Table 5.5	A Timing Test by Switching Dummy Variables to Unity in Different Quarters	28
Table 6	Monthly Transactions of Private Homes	31
Table 7	List of Variables and their Definitions	33

### ESSAY TWO:

#### **The Nexus between Housing and the Marco Economy: The HK Case**

Table 1	Private Consumption during Two Crises	36
Table 2	Gross Domestic Fixed Capital Formation during Two Crises	36
Table 3	Augmented Dickey-Fuller Test of Unit Root	49
Table 4	Johansen Cointegrating Test Result	49
Table 5	Normalized Long-run Cointegrating Coefficients & Test of Restrictions	50
Table 6	Vector Error Correction Model Estimation	51
Table 7	Temporal Granger Causality Test Result	52
Table 8	Variance Decomposition Analysis	56
Table 9	List of Variables and their Definitions	59

## **LIST OF TABLES**

### **ESSAY THREE:**

#### **Demand and Supply Dynamics of Private Housing Market in Hong Kong**

Table 1	Augmented Dickey-Fuller Test of Unit Root	75
Table 2	Johansen Cointegrating Test Result	76
Table 3	Normalized Long-run Cointegrating Coefficients & Test of Restrictions	77
Table 4	Johansen Cointegrating Test Result (Period 1986o 2008)	84
Table 5	Normalized Cointegrating Coefficients Using the Johansen Procedure	84
Table 6	Temporal Granger Causality Test Result	87
Table 7	Actual Transactions of HOS Units in the Secondary Market	90
Table 8	Johansen Cointegrating Test Result (Period 1985 to 2009Q4)	92
Table 9	Normalized Cointegrating Coefficients Using the Johansen Procedure	92
Table 10	List of Variables and their Definitions	95

## LIST OF FIGURES

### ESSAY ONE :

#### **Comparing the Effects of the Asian Financial Crisis, Financial Tsunami and the Tenants Purchase Scheme: A Study of External and Policy Shocks on the Hong Kong Housing Market**

Figure 1	Total Second Hand Residential Housing Transactions	13
Figure 2	Completion of Private Residential Units, Subsidized Sale Flats and Tenants Purchase Scheme Units, 1980-2008	14
Figure 3	12-Month Forward Rate Premium/Discount of the US Dollar on the HK Dollar	15
Figure 4	Ted Spread - Difference between 3 Month Treasury Bill Rate and the 3-Month Eurodollar Rate	16
Figure 5	Residuals from the Long Run Cointegrating Relation for LTRAN, LPPI and MR	23
Figure 6	Predicted Log of Property Price Using JH Model Incorporating Dummy Variables Switched to Unity from 1998: quarter 1	29

### ESSAY TWO :

#### **The Nexus between Housing and the Marco Economy: The HK Case**

Figure 1	Impulse Response of LnPPI to One Standard Deviation Shocks	54
Figure 2	Impulse Response of LnDD to One Standard Deviation Shocks	55
Figure 3	Variance Decomposition of LnPPI	55
Figure 4	Variance Decomposition of LnDD	56

### ESSAY THREE :

#### **Demand and Supply Dynamics of Private Housing Market in Hong Kong**

Figure 1	Turnover Demand, Reservation Demand and Supply	67
Figure 2	Price Expectation Proxied by the Gross "PE" Ratio of Homes	71
Figure 3	Price Expectation Proxied by the Net Rental Yields	71
Figure 4	Estimated Land Price per GFA sq. m. (1984-2008Q4)	72
Figure 5	Private Housing Completions (1984-2010Q1)	72
Figure 6	Residuals from CointEq1 (Demand Side) & CointEq2 (Supple Side)	79
Figure 7	Impulse responses of LnPPI to one standard shocks	82
Figure 8	Impulse responses of LnCOMP to one standard shocks	82
Figure 9	Number of Domestic Households ('000) and Owner-occupiers % 1982-2009	85
Figure 10	Completion of HOS housing 1983Q4-2010Q1 (average of 4 quarters)	89

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Wong Wai Chung, Gary

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## I. INTRODUCTION

The thesis contains three papers on different areas of housing study in Hong Kong. Expenditures on housing represent the single largest item of expenditures for most households in Hong Kong. Expenditures on housing purchases, in particular, amount to many years of income (around 8.7 years of median household income in 2009, research report, Bank of East Asia). Undoubtedly, housing is very important element in the macro economy. This thesis focus on few important issues in housing economics including demand and supply, privatization of public housing, and the relation between housing and marco economy. .

By comparing the housing market reactions to Asian Financial Crisis, Financial Tsunami, the first paper offers alternative explanation for the housing market downtown during 1998-2003. It is evidenced that a public housing privatization program produced adverse effects on housing transactions and prices in Hong Kong. A scheme announced in December 1997, offering tenants an opportunity to buy their units at deeply discounted prices, reduced public housing tenants' bids for private homes and adversely affected home transactions. This effect is more pronounced than the effects of the Asian Financial Crisis. An effect on housing prices is also indirectly demonstrated through a demonstration that a structural break in the housing price relationship occurred at the time the privatization program is introduced.

The second paper shows that, consistent with the "economic base" theory, exports drive domestic consumption and domestic investment, but housing appears to serve as an important link between exports and domestic expenditures. Focusing on

the Hong Kong economy, which is a small open economy with a big population, I found that exports and interest rates drive housing prices over a long period, while housing prices in turn drive domestic expenditures.

The last one attempts to investigate the disequilibrium dynamics of private housing market in Hong Kong. Many empirical researches on housing market are traditionally based on the assumption that market is almost in equilibrium status. Nevertheless, we can observed that housing market is more often in disequilibrium as reflected by cost search, reservation demand and slow response of supply during excess demand. Using the cointegarting approach, the paper identifies two cointegrating relations, ie. a long run demand side relation between housing property price, prime rate, price expectation and income, and supply side relation between private housing completion, property price, and land cost, which shows a short run disequilibrium dynamics in demand and supply of private housing during 1984 – 2008. Impulse response and variance decomposition are employed to shed light on the dynamics structure in the VECM model.

## **II. ESSAY ONE**

### **Comparing the Effects of the Asian Financial Crisis, Financial Tsunami and the Tenants Purchase Scheme: A Study of External and Policy Shocks on the Hong Kong Housing Market**



## 1. Introduction

The Hong Kong economy had been well known for its legendary resilience. Despite a number of momentous setbacks, which included the Great Proletariat Cultural Revolution in 1966 through 1976, two major oil crises that plunged most countries of the world into recession during the 1970s, and several episodes of financial and banking crises, not a single year since 1961 was there recorded negative economic growth (see Table 1). Indeed the Hang Seng Index plunged from over 1,700 in 1973 to little more than 150 in 1975 without causing an economic decline in any of these years. The banking crises of 1965-66 “at a point posed a threat to the entire banking system in Hong Kong,” (Jao, 1993, p. 242), while those of 1982 to 1986 “were even bigger in scale and produced more far-reaching repercussions.” (Jao, *op.cit.*).

**Table 1. Hong Kong’s Economic Growth 1961-2008 (GDP % change)**

Year	%	Year	%	Year	%	Year	%	Year	%
	change		change		change		change		change
1961	N.A.	1971	7.2	1981	9.4	1991	5.7	2001	0.5
1962	14.2	1972	10.5	1982	3.0	1992	6.1	2002	1.8
1963	15.7	1973	12.3	1983	5.9	1993	6.0	2003	3.0
1964	8.6	1974	2.3	1984	9.9	1994	6.0	2004	8.5
1965	14.5	1975	0.4	1985	0.7	1995	2.3	2005	7.1
1966	1.7	1976	16.2	1986	11.0	1996	4.2	2006	7.0
1967	1.7	1977	11.8	1987	13.4	1997	5.1	2007	6.4
1968	3.4	1978	8.4	1988	8.4	1998	-6.0	2008	2.1
1969	11.3	1979	11.6	1989	2.2	1999	2.6	2009	-2.7
1970	9.2	1980	10.3	1990	3.9	2000	8.0		

Source: *Gross Domestic Product 1961-2008*, Government of HKSAR, plus updates from: <http://www.info.gov.hk/hkecon/gdp/index.htm>

The Hong Kong economy had suffered under both the Asian Financial Crisis in 1997 and the Global Financial Tsunami in 2008. But the behaviours of the housing market during the two crises were very different. Comparing the property price movements one year after the outbreak of each financial crisis, property prices fell much more dramatically after the outbreak of the AFC, The decline amounted to 45% from the pre-crisis peak by October 1998 and a further 39% between 1998 and 2003. One year after the outbreak of the Global Financial Tsunami, housing prices were almost at the same level in October 2009 as in September 2008 and even reached a new height in 2010 first quarter (Hong Kong Property Review 2008, Rating and Valuation Department of HKSAR). Yet the financial tsunami in 2008 is a global crisis, and was even said to be the most serious in a century. Indeed, Hong Kong's exports fell much more in the wake of the global financial tsunami.(Table 3) The Hang Seng Index in Oct 2008 was 65% lower than its pre-crisis peak as compared to the 60% drop in Aug 1998 during the Asian Financial Crisis (see Table 2).

The years during and following the Asian Financial Crisis were far less tumultuous. Hong Kong's major trading partners, the US and Mainland China, continued to grow rapidly during the time, while stock market declines were far milder than what happened from 1973 to 1975. Moreover, not a single bank failed. Yet the Hong Kong economy shrank by 6 per cent in 1998. This turnout deviated so much from predictions that Jao referred to it as "one of the most bizarre and egregious failures in the history of economic forecasting." (Jao, 2001, p.140). Table 1 also shows that the rebound in 1999 is extremely weak, quite unlike the rebounds that followed earlier recessions.

**Table 2. Indicator of Changes of Confidence/External Shocks**

HSI performance during Asian Financial Crisis			HSI performance during Global Financial Tsunami		
Quarter or Month	Hang Seng Index At End of Period	Year on year % Change (month/ Quarterly)	Quarter or Month	Hang Seng Index At End of Period	Year on year % Change (month/ Quarterly)
<b>97 Aug</b>	16673*		07 Oct	31638*	
<b>98 Aug</b>	6660#	<b>-60.00%</b>	08 Oct	11015#	<b>-65.18%</b>
<b>98 Q3</b>	7883		08 Q4	14387	
<b>98 Q4</b>	10049	27.48%	09 Q1	13576	-5.64%
<b>99 Q1</b>	10942	8.89%	09 Q2	18378	35.38%
<b>99 Q2</b>	13532	23.67%	09 Q3	20955	14.02%

Source: <http://finance.yahoo.com/q/hp?s=^HSI> \* = pre-crisis peak # = bottom

**Table 3. Indicator of External Shocks**

Exports Sector performance during Asian Financial Crisis			Exports Sector performance during Global Financial Tsunami		
Quarter	HK\$ million	Year on year % Change	Quarter	HK\$ million	Year on year % Change
<b>98 Q1</b>	295,463	1.0	<b>08 Q3</b>	755,018	1.3
<b>98 Q2</b>	332,348	-0.6	<b>08 Q4</b>	712,987	-4.9
<b>98 Q3</b>	339,062	-7.3	<b>09 Q1</b>	513,309	-22.7
<b>98 Q4</b>	331,053	-9.9	<b>09 Q2</b>	621,064	-12.8
<b>99 Q1</b>	281,301	-4.8	<b>09 Q3</b>	655,043	-13.2
<b>99 Q2</b>	325,517	-2.1	<b>09 Q4</b>	692,651	-2.9

Note: HK\$ chained (2008)

Source: *Hong Kong Monthly Digest of Statistics*, Census & Statistics Dept of HKSAR, various years.

The often-cited explanation for Hong Kong's deep recession, that the AFC burst the property price bubble and thus produced a gigantic negative wealth effect, is

simply unconvincing (Jao, 2001, p.140). The transmission mechanism whereby the AFC burst the property price bubble is not clear. First, although foreign participation in the office building sector was indeed quite significant, foreign participation in the housing market has never been significant. There is no evidence that a big withdrawal of foreign capital from the housing market produced a collapse. Second, although inter-bank interest rates went up in the wake of the currency troubles in South East Asia, mortgage rates had been relatively stable. Hong Kong had seen bigger mortgage rate hikes before but had never encountered such serious depression in the housing market.<sup>1</sup> Third, it is not true that confidence collapsed overnight. Indicators suggest that people had regained confidence not long after the Asian Financial Crisis (Table 2).

It is sometimes thought that with the opening up of China Hong Kong's middleman role, which had been important in supporting the entire economy, was diminished. But China did not start opening up in 1997 or 1998. The *suddenness* of the reversal suggests that there may be other reasons. Moreover, an examination of trade data, including service trade and merchandise trade, suggests that Hong Kong's decline in exports in the period after 1997 was in line with decline in global trade, and was actually smaller relative to Korea, Taiwan, the UK, or the US.

This paper offers an alternative explanation to Hong Kong's housing market downturn during 1998-2003. The hypothesis is that a public housing privatization scheme introduced by the government played an important role in reducing existing home transactions and home prices. This hypothesis will be substantiated both by

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<sup>1</sup> Some commentators cited high real interest rates as the culprit, but the deflation that caused

theory and by statistical evidence.

Privatization is often believed to be conducive to economic efficiency. Even though this effect is still controversial, any suggestion that privatization could lead to the erosion of wealth and economic inefficiency would seem ludicrous to economists.

This paper presents evidence that suggests such a possibility. A privatization scheme, if managed poorly, could lead to counter-intuitive results. Working through the “housing ladder effect,” or otherwise called the equity effect or the down payment effect, such as described by Stein (1995), Bardhan, Datta, Edelstein, and Kim (2003), Ortalo-Magne and Rady (2006), Ho & Wong (2009), privatizing public housing cheaply could lead to the erosion of equity values among homeowners, which could spread throughout the housing market through the housing market quality continuum. The erosion of wealth works dynamically, and wipes out any static efficiency gains that could result from the privatization.

The housing market is a continuum with a full range of qualities and prices and that homeowners trade up to a better quality when they have accumulated sufficient equity in their current homes. The ability to trade up depends crucially on the prices of existing homes. When prices collapse at the lower end of the market, they transmit readily to higher quality homes with a noticeable shrinkage in transaction volumes. I hypothesize that the very attractive prices offered by the Housing Authority for sitting tenants to buy their own units under the “Tenants Purchase Scheme,” (TPS)

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high real interest rates did not occur until late 1998, AFTER the major collapse of housing prices.

offering up to 88% discount on the estimated market price for buyers making a quick decision to buy, made it unattractive for them to buy other kinds of homes. Given their earlier documented significant participation in the housing market this unavoidably caused home prices to decline.

This paper introduces a new methodology that throws light on the relative influence of the public housing privatization program, the Asian Financial Crisis and the Financial Tsunami on housing transactions in Hong Kong. I present evidence that the housing privatization program also adversely and significantly affected home prices—and for a much longer time—by demonstrating that a structural break in the housing price relationship occurred at exactly the time the TPS policy took effect.

Section II presents a review of Hong Kong's housing market and the public housing privatization program. Section III provides the data description and outlines the statistical tests to be conducted. Empirical evidence is presented in Section IV. The final section presents the conclusions.

## **2. The Public Housing Privatization Program**

Economists normally expect that a privatization program would make the economy more efficient. The experience in Hong Kong shows that this cannot be taken for granted. The circumstances, in which a privatization program is conducted, as well as how the privatization takes place, play an important role in determining the outcome.

On December 8, 1997, the Housing Authority in Hong Kong announced that

sitting tenants in designated public housing estates could buy their own flats at up to 88% discount off the estimated market price. The move was cheered by the local press and thought to engender a large positive wealth effect that would boost consumption and give Hong Kong's economic growth a big push. However, what transpired was a big and immediate economic slump. In the first quarter of 1998, the Hong Kong economy declined sharply by an unprecedented 12 per cent on a quarter-to-quarter basis (not seasonally adjusted).

The first quarter GDP decline was puzzling not only because of its magnitude but also because of the apparent favorable circumstances of the economy at the same time. The currency turmoil had shown signs of stabilizing, to the extent that it actually allowed one interest rate drop. The HK Policy Research Institute's housing property confidence index shot up from 35.5 in January to 94.2 in March 1998. The Heng Seng index rose 7.4 per cent in the quarter.

What explained this sudden and dramatic reversal amid signs of revival of investor confidence? The hypothesis that I advance in this paper, to be tested using various statistical tests, is that the public housing privatization scheme actually severed the housing ladder that had been in effect for years prior to the announcement of the TPS. There was evidence that public housing tenants had been important players in the housing market. In a survey in 1992, which was conducted by the Housing Authority, it was found that 24 percent of all housing transactions were due to public housing tenants and that 13 per cent of all public housing tenants already owned at least one residential property. Starting in April 1987, the Housing Authority had been implementing a policy to make the richer tenants with at least 10

year residence in the public rent housing estate to pay higher rent.<sup>2</sup> This provided a big incentive for the better-off tenants to buy homes as a back-up in the event they were asked to pay higher rent. The TPS effectively reversed this policy, for from now on rich tenants needed not leave. They were offered an opportunity to capitalize all their future rental subsidies through a purchase decision.

As expected, the demand for Home Ownership Scheme (HOS) housing—a government subsidized homeownership scheme—suddenly collapsed. HOS housing used to attract many public housing tenants to buy. Indeed they were always many times oversubscribed ever since the scheme started in 1978. Disappointed buyers would have to buy in the open market, where HOS units fetched very high prices, reflecting again the strong buying power enjoyed by the richer tenants. Starting in June 1997, the Housing Authority allowed HOS owners to resell, after two years from their dates of original purchase, their units to public housing tenants and other Green Form Applicants without having to repay the land premium. Records of such transactions indicate that public housing tenant buyers were paying very high prices for these flats, indicating their strong purchasing power.<sup>3</sup>

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<sup>2</sup> In essence, the policy requires that tenants who have been accommodated for over ten years be subjected to a means test. If the household income exceeds three times that of the maximum eligibility limit, it will have to pay double the standard rent. Those who have breached stipulated income and asset thresholds are required to pay market rent. See “Safeguarding Rational Allocation of Public Housing Resources: A Consultation Document” published by the Hong Kong Housing Authority in December 1995.

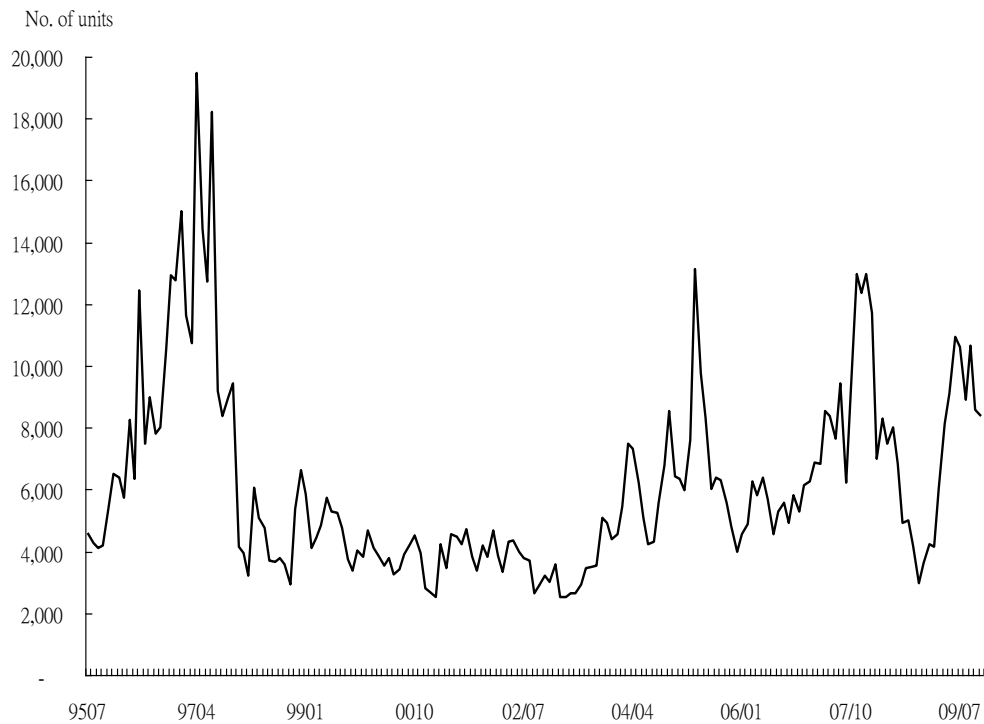
<sup>3</sup> Transactions with prices were downloadable from the Housing Authority webpage but the information is all in Chinese. Starting in 2003 data earlier than 2002 were no longer downloadable. However, I had examined the earlier records and found one transaction at 3.95 million Hong Kong dollars for a 644 square feet flat in Kowloon in September 1997. This was not an exceptional case in 1997. Watanabe (1998) provided figures showing that public housing tenants generally saved much more than either HOS or private housing owners as well as private housing tenants, particularly in 1994/95.



With the announcement of the TPS, HOS units suddenly lost their appeal, because in comparison they were ridiculously expensive. Some 250,000 HOS owners suddenly found that their units could hardly find buyers. Immediately they found difficulty trading up to better homes in the private housing market. Transactions in the existing home market plunged, in turn freezing transactions in the new homes market, which at the time almost exclusively depended on buyers trading up (see Figure 1). Some commentators argued that the increase in supply of housing, in particular, the HOS housing would also produce negative impacts on housing price and transaction. In fact, HOS housing is not a new thing to the public and it has long been an important part of housing market during the 1980s and 1990s (see Figure 2). Also, the production of housing excluding the TPS units during 1998-2003 did not show an obvious jump as compared to its production during the past 2 decades. On the other hand, the TPS units became available overnight. The response to the TPS was enthusiastic. While only 19,807 units were sold by the end of March 1999 (Annual Report 00/01, Hong Kong Housing Authority of HKSAR), many public housing tenants were looking forward to the day when they could buy their units.

Since public housing tenants were the primary source of buyers for HOS housing, the effect of TPS on HOS housing market was immediate. HOS housing owners found that buyers had suddenly disappeared and were no longer able to trade up. Similarly, other homeowners who depended on HOS buyers as their principal buyers also could not trade up because they also could not find buyers.

**Figure 1. Total Second Hand Residential Housing Transactions  
(07/1995 - 09/2009 Monthly Data)**



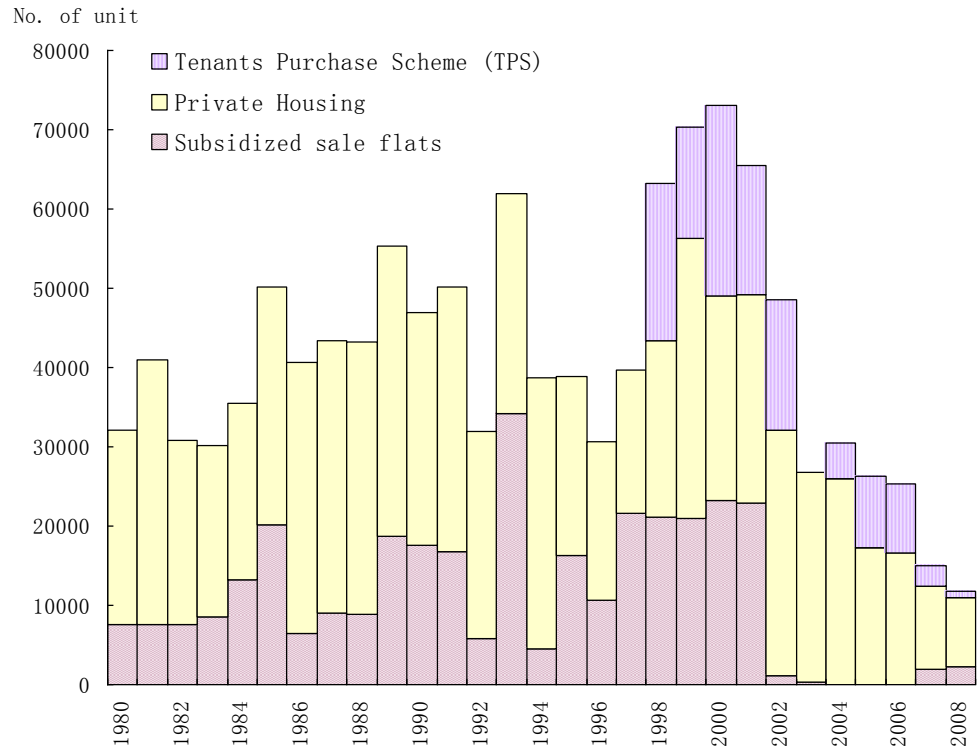
Source: Data provided by Research Dept, Centraline Property Agency Ltd.

Notwithstanding a highly stimulative budget in 1998 providing generous tax relief, generous home starter loans, and an unprecedented tax allowance given to homeowners for the mortgage interest payments, the housing market continued to fall. By 1999 the Asian Financial Crisis was over. There was no longer any premium on Hong Kong dollar's forward exchange rates, and real estate prices had risen markedly in Singapore.<sup>4</sup> Hong Kong's housing prices, however, continued to decline. Even the 10.2 per cent growth in 2000 failed to lift prices, as home prices continued to slip by another 14 to 15 per cent. By September 2001 they had fallen back to levels reached 10 years ago. By 2003 housing prices generally had lost over 65 per cent or more of their 1997 values.

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<sup>4</sup> Singapore housing prices fell again subsequent to the bursting of the IT bubble.

**Figure 2. Completion of Private Residential Units, Subsidized Sale Flats and Tenants Purchase Scheme Units, 1980-2008**



Sources: *Hong Kong Monthly Digest of Statistics*, various issues, Censuses & Statistics Dept of HKSAR, and *Hong Kong Property Review*, various years, Rating & Valuation Dept of HKSAR.

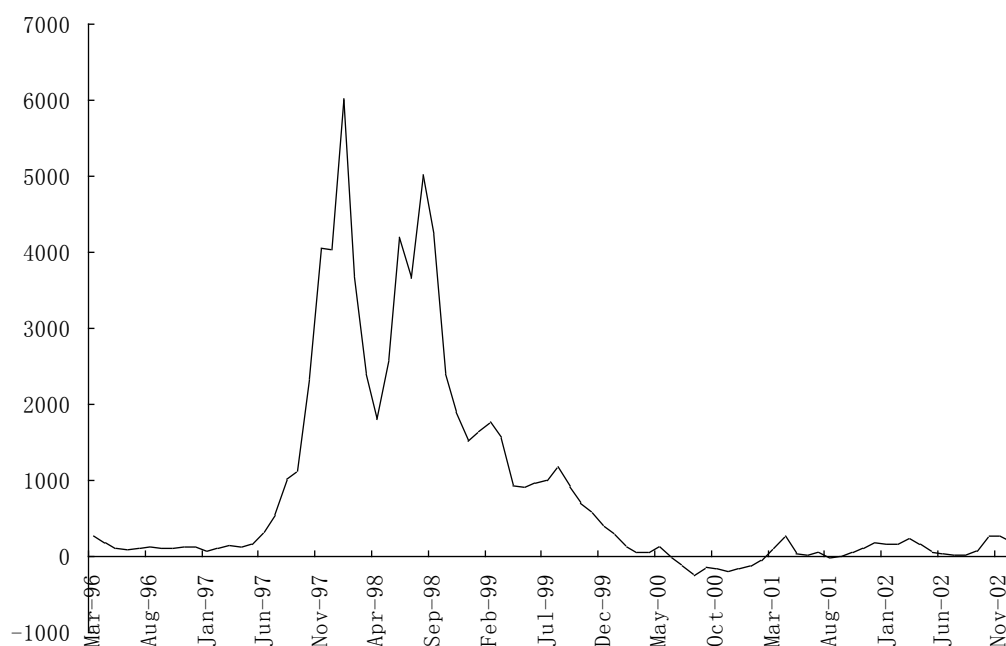
### 3. The Data and Statistical Tests

Two statistical tests provide support to our theory. The first one (the “effect on transactions” test) is to show that TPS was the key factor behind the big drop in existing home transactions. In a multivariate regression controlling the effects of various factors on existing home transactions, the TPS dummy was found to explain the decline in home transactions far better than the Asian Financial Crisis. The second test (the “timing test”) shows that, while exports, mortgage rate and consumer price had been the driving factor behind housing prices this relationship showed a structural change after 1997. Using the Johansen co-integration model with both an intercept and an interactive TPS/exports dummy, I found a structural break at the

time of the announcement of the TPS. This suggests that housing probably serve as a transmission mechanism between the external (the exports) sector and the domestic sector, but this mechanism appears to have been severed by the TPS policy.

In the first test, the focus of analysis is second-hand transaction volume for private sector residential properties. This variable is of great interest because normally when a homeowner sells his property he would buy another. In contrast, to the extent that new housing has already been produced and a new home purchase represents only a transfer from the developer's inventory to the homebuyer, buying an existing home generates more additional economic activities than when a household buys a new unit from the developer.<sup>5</sup>

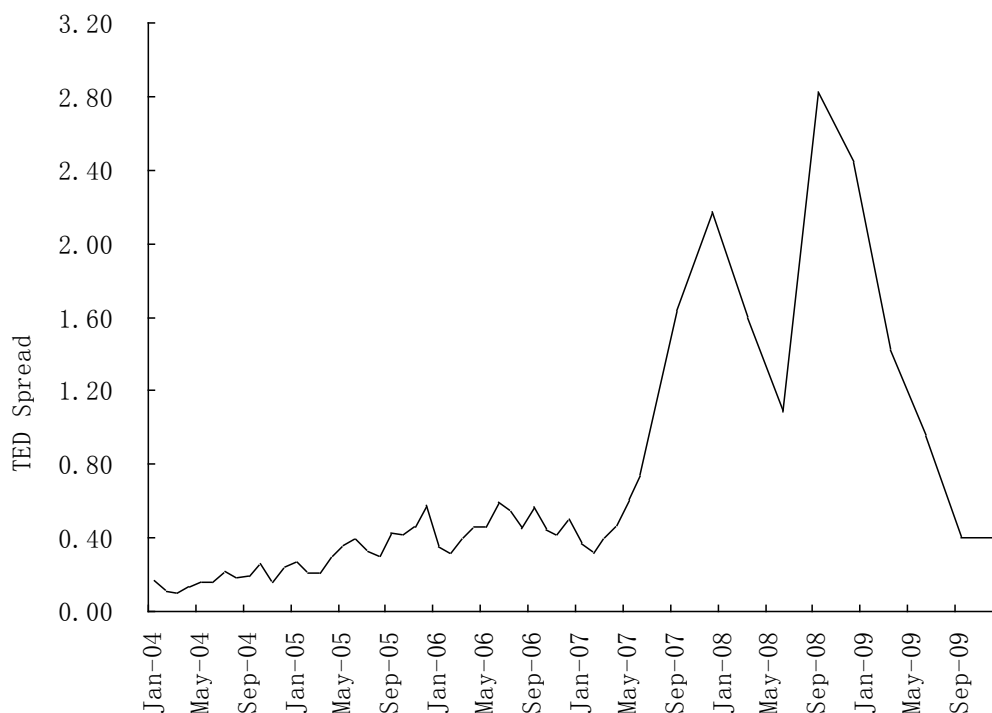
**Figure 3. 12-Month Forward Rate Premium/Discount of the US Dollar on the HK Dollar**



Source: *Monthly Statistical Bulletin*, various issues, Hong Kong Monetary Authority.

<sup>5</sup> A "tree" of second hand transactions usually ends up in a first hand high end property. On the other hand, if a first time buyer buys a new home the economic stimulation is more limited.

**Figure 4. Ted Spread - Difference between 3 Month Treasury Bill Rate and the 3-Month Eurodollar Rate**



Source: Data are obtained from Datastream

The housing price of private domestic flats is treated as a variable to explain second-hand transactions. The data on this variable is the monthly housing price index of private domestic units, which is supplied by the Rating and Valuation Department of the Government. The period covered in this study is from July 1995 to March 2004. Second-hand transaction data is not available before July 1995. The period covered both the Asian Financial Crisis and the Tenants Purchase Scheme (TPS)—the public housing privatization program of the Housing Authority.

Besides, dummy variables are used to capture the effects of key changes in the environment, namely the Asian Financial Crisis Dummy (AFC), Global Financial Crisis Dummy (GFA) and the Tenants Purchase Scheme (TPS) - as well as a dummy to control the first quarter effect of home purchase pattern (FQR) which may affect

transaction volume.<sup>6</sup> During times of acute loss of confidence such as resulting from the Asian Financial Crisis, the local currency is subjected to tremendous pressures to depreciate. While the spot exchange rate holds its place a considerable discount in the value of the local currency appears in the forward market. I therefore find it convenient to use the forward market premium of the US dollar over the spot market exchange rate as an instrument to measure the degree of the financial crisis (see Figure 3.). The Global Financial Crisis in 2008 is proxied by the TED spread - the price difference between three-month futures contracts for U.S. Treasuries and three-month contracts for Eurodollars (see Figure 4). Yields on US Treasuries can be taken as a risk-free rate of return. When banks charge one another for short term lending at a higher rate, the premium reflects compensation for perceived risk. An important advantage of using such “non-binary dummies” is that there is no need to make the necessarily arbitrary judgment as to when the financial crisis is “switched on” and when it is “switched off.” In order to facilitate interpretation, I normalize these variables to set *the maximum value of this dummy within the observation period* to unity.<sup>7</sup>

Since the TPS was announced by the Hong Kong Housing Authority on December 8 1997 we assign the value of ‘0’ to months prior to December 1997 and assigned the value of unity for the months from December 1997 onwards. The policy is “switched off” by an announcement made in November 2002. The data for mortgage rate is obtained from Hong Kong Monetary Authority. CPI and total exports statistics are obtained from officially released statistics. For the list and definition of variables that are analyzed, please refer to Table 9.

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<sup>6</sup> This effect has to do with the fact that Chinese New Year falls in the first quarter.

<sup>7</sup> The value of this dummy is therefore 1 at the point of most intensive pressure for the currency

## 4. Empirical Findings

### *4.1 The Relative Effects of TPS and the Two Financial Crises on Transactions and Prices*

In this test I attempt to assess the relative impacts of the introduction of the TPS, the Asian Financial Crisis and the Global Financial Crisis on second-hand transaction volume. The length of the time series allows us to use the Johansen cointegration method to test the long term relationships of the key variables. The dependent variable for the first test is the logarithm (log) of the second-hand home transaction volume (LTRAN). The explanatory variables include the log of the housing price index (LPPI), mortgage rate (MR), the Asian financial crisis dummy (AFC), Global financial crisis dummy (GFC), and binary dummy variables TPS (unity from 1997:12, 0 prior to this<sup>8</sup>), and FQR (1 for first 3 months every year). It is expected that any increase in housing prices will allow homeowners to trade theirs for better ones and thus tends to drive up transactions. On the other hand an increase in interest rates will dampen transactions because this will increase the costs of owning a new home or a better home.

I begin the analysis by examining the stationarity properties of the variables using the Augmented Dickey-Fuller (ADF) Test (Dickey and Fuller, 1981). The optimal lag in the test is chosen by the Akaike Information Criterion (AIC). Table 4.1 shows that the test statistics for all the series in level form and in their first differences, respectively. The null hypothesis of unit root cannot be rejected when the series are in level but can be rejected when the series are in first differences, showing

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to devalue and 0 when there were no such pressures.

<sup>8</sup> In November 2002 the Government announced a plan to terminate the TPS, but termination

that all the series are integrated of order one.

**Table 4.1 Augmented Dickey-Fuller Test of Unit Root (Period: 1995M7 to 2009M11 )**

Variable name	Test on	No Trend	Trend	Conclusion
LnTRAN	Level	-0.8498	-2.9550	I(1)
	1st diff	-12.1277***	-12.0611***	
LnLPPI	Level	-1.4716	-1.1844	I(1)
	1st diff	-4.3952***	-4.4779***	
MR	Level	-1.1855	-1.5717	I(1)
	1st diff	-6.6066***	-6.5854***	

Note: 1. 5% critical value for the augmented Dickey-Fuller tests that include constant; and constant plus trend = 2.87 and -3.43 respectively.

2. The numbers of lags in the two unit root tests are determined by the AIC.

3. \*\*\* indicate 1% significance levels.

Since the variables are integrated of the same order I(1), I can use the well-known Johansen and Juselius procedure (1990). Under this procedure, I first identify the long-run relationship among LTRAN, LPPI, and MR. Following the common practice, the dummy variables AFC, GFC, TPS and FQR are all treated as exogenous I(0) variables in the VAR and the error-correction model.

The co-integration test results are presented in the Table 4.2. The number of co-integrating vectors  $r$  is determined by reference to the  $\lambda_{max}$  and trace statistics. The lag specification for the Johansen test is determined by Akaike's Information Criterion (AIC). The results show that TRAN, LPPI and MR are cointegrated with only one cointegrating vector.

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was not effective until after 2004, when the last batch of TPS units were sold.



**Table 4.2 Testing Cointegration Using the Johansen Procedure**

Cointegrating Relation	Hypothesized No. of CE(s)	Test Statistics	Probability
TRAN		Trace Value	
= $f$ (LPPI, MR)	None	104.30***	0.0000
With exogenous dummy variables AFC, GFC, TPS and FQR	At most 1	10.40	0.2513
		$\lambda$ max Value	
	None	93.91***	0.0000
	At most 1	9.45	0.2500

Note: \*\*\* denotes significance at 1% level.

**Table 4.3 Normalized Cointegrating Coefficients Using the Johansen Procedure**

Variables	Coefficient	t-statistic
LTRAN	1	
LPPI	-1.0035	-7.3766***
MR	0.0153	1.3543

Note: \*\*\* denote 1% significant level

Table 4.3 reports the normalized cointegrating coefficients that will be interpreted as long run equilibrium coefficients. Coefficients on both LPPI and MR are shown with the expected signs. In general, price appreciation provides an incentive and a greater ability for homeowners to trade up, thus pushing up second hand transaction. The interest rate, on the other hand, discourages home purchases and tends to dampen transactions. In addition, given that the variables are cointegrated, I then estimate the error correction model as shown in Table 4.4. The ECM coefficient enters significantly with negative sign. The significant negative ECM coefficient confirms our earlier findings that cointegration exists between them. It is noteworthy that the dampening effect of the Tenants Purchase Scheme (TPS

dummy) is greater than that of the Asian Financial Crisis (AFC dummy) and Global Financial Crisis (GFC dummy). Also it is statistically much more significant. (See Table 4.4 coefficients of the TPS, AFC and GFC dummy). Because both the TPS dummy and the two financial crisis dummies have values between 0 and 1 their coefficients can be directly compared with each other. We can see that the effect of the TPS on second hand transition (coefficient= -0.1348,  $t=-3.11$ ) is much bigger than the Asian financial crisis dummy which even does not show a significant coefficient (coefficient= -0.0519,  $t=-0.55$ ). The Global financial crisis in 2008 shows a strongest negative impact on second hand transaction. While if we compare the effects of the two financial crises and TPS on housing price, the Asian financial crisis had produced the largest negative impact. To sum up, TPS had a larger impact on transaction than on price compared to that of the Asian financial crisis. This is in line with my argument that after the announcement of TPS, HOS units suddenly lost a lot of potential housing buyer and so they found immediately difficulty trading up to better homes in the private housing market. Transactions in the overall second home market and even first hand market therefore would be remained at a low level for longer period.

Figure 5 shows the residuals from long run cointegrating relation among LTRAN, LPPI and MR which is mean-reverting over the long run. It is worthy to note that the second hand transaction had dropped dramatically for several months both after the outbreak each of two financial crises. Nevertheless, we can see that the second hand transaction had shown a quick and strong rebound after the Global financial crisis while the transaction had remained below the long run equilibrium level for over 5 years after the Asian financial crisis. In view of the different housing market reactions to the financial crises, obviously, the 1998-2003 experience could

not be purely explained by the Asian financial crisis and the TPS should play an important role for explaining the housing market downturn during that period. Note that over an extended period after the TPS announcement in December 1997 the residuals remained negative. This is quite unusual. Transactions did not come back to normal levels until shortly after the announcement of the termination of the TPS policy in November 2002.

**Table 4.4 Error Correction Model**

<b>Regressors</b>	<b><math>\Delta</math> TRAN</b>	<b><math>\Delta</math> LPPI</b>
$\Delta$ TRAN(-1)	-0.1213(-1.64)*	0.0133(1.43)
$\Delta$ TRAN(-2)	-0.0615(-0.87)	-0.0127(-1.43)
$\Delta$ LPPI(-1)	4.1747(6.47)***	0.2463(3.04)**
$\Delta$ LPPI(-2)	1.4070(2.06)**	-0.2262(-2.63)**
$\Delta$ MR(-1)	-0.1069(-1.23)	-0.0104(-0.95)
$\Delta$ MR(-2)	-0.0079(-0.09)	-0.0017(-0.16)
<b>Constant</b>	0.0828(3.48)***	0.0050(1.66)*
<b>TPS</b>	-0.1348(-3.11)***	-0.0107(-1.97)**
<b>AFC</b>	-0.0519(-0.55)	-0.0471(-3.97)***
<b>GFC</b>	-0.2904(-2.87)**	-0.0196(-1.54)
<b>FQR</b>	-0.0859(-2.47)**	-0.0107(-1.97)**
<b>ECM<sub>t-1</sub></b>	-0.5972(-7.84)***	0.0293(3.06)***
<b>R-squared:</b>	0.4188	0.4824

Note: 1. \*, \*\* and \*\*\* denote 10%, 5% and 1% significance levels respectively.

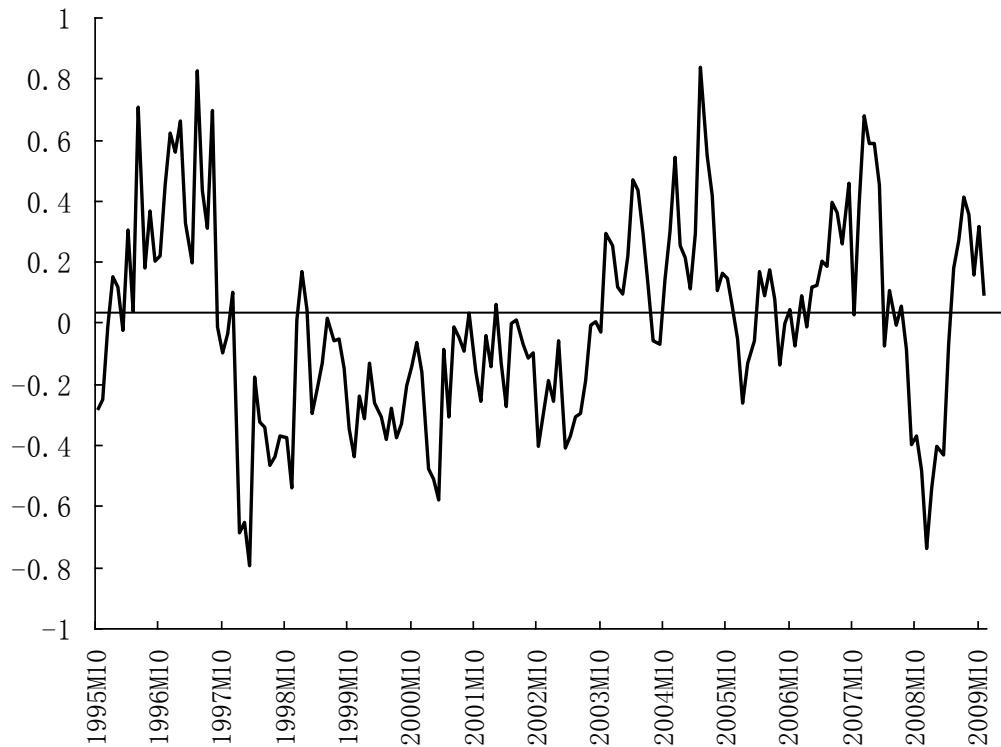
2. Numbers in parentheses are t-statistics

3. Optimal lags are determined by AIC criterion

Even though the dummies variables in Table 4.4 indicates that TPS had lesser direct impact on price compared to that of the Asian Financial dummy, however, if there exists a positive relation between LnTRAN and LnPPI, I can still conclude that TPS had indirectly pushed down the housing price through its impact on reducing existing home transaction. Leung, Lau and Leong (2002) found that there is a robust

positive correlation between price and volume while there is no clear causal relation. The vector error correction model (VECM) is also appropriate for examining their long run causal relationships. The coefficients of the error correction terms (ECM) and their t-statistics are shown in Table 4.4. The ECM coefficients turn out to be significant with positive sign when LnPPI is treated as dependent variable which indicates that there is a positive relation between LnPPI and LnTRAN. Given that both ECM coefficients are significant when either LnPPI or LnTRAN is treated as dependent variable, I can conclude that there exists a bi-directional positive causality between second hand transaction and property price.

**Figure 5: Residuals from the Long Run Cointegrating Relation for LTRAN, LPPI and MR**



#### ***4.2 Structural Break and Simulation of Housing Price***

As explained above, we would expect that a structural change had occurred in the first quarter of 1998, since the Tenants Purchase Scheme (TPS) that allowed sitting tenants to buy their units at deep discounts was announced on 8 December 1997. I use a timing test to determine whether a structural change indeed took place right after the announcement of the policy. In this test I identify the timing and the magnitude of a structural break in the housing price equation. The housing price equation is based on the assumption that the housing market was essentially in equilibrium over the test period. When the housing market was in equilibrium, housing prices reflect the bids from buyers which increase when their incomes rise. I write a housing price equation with three explanatory variables: exports of goods and services which represents the key exogenous determinant of incomes for a small open economy, mortgage rates and consumer price.

Following Pinon-Farah (1998), and Bardhan et. al. (2003), the significance of the key t statistic in the relevant test testifies to the existence of a structural change. For this purpose, I now incorporate a “timing test switching dummy variable”(Dum) into the model (all values being equal to zero prior quarter Q and switching to unity for all quarters from Q is incorporated in our system. Under this test, I switch the dummy variable (we can call this a regime shift dummy if the timing is proven correct) from zero to unity in different quarters, and observe the changes in the coefficients estimates and the t statistics. The intercept dummy variable “Dum” would capture any shift in the relationship.

Two kinds of dummy variables—one for the intercept and one “interactive dummy”—are used to capture any shift and change in the magnitudes of key

coefficients in the relationship. I found that a structural break occurred in the first quarter of 1998. Interestingly, this coincides with our priors, since the Tenants Purchase Scheme—which I have reasoned will have significant structural changes on the housing market, was announced on December 8 1997.

**Table 5.1 Augmented Dickey-Fuller Test of Unit Root (Period: 1981Q1 to 2009Q3)**

Variable name	Test on	No Trend	Trend	Conclusion
LnPPI	Level	-1.2199	-1.4714	I(1)
	1st diff	-6.4370***	-6.4301***	
MR	Level	-1.9481	-2.9910	I(1)
	1st diff	-3.4775***	-3.5392**	
LnEX	Level	-1.9732	-0.8138	I(1)
	1st diff	-4.5706***	-4.9606***	
LnCPI	Level	-0.5238	-1.6929	I(1)
	1st diff	-2.7463*	-1.7524	

Note: 1. 5% critical value for the augmented Dickey-Fuller tests that include constant; and constant plus trend = 2.88 and -3.45 respectively.  
 2. The numbers of lags in the two unit root tests are determined by the AIC.  
 3. \*\*\* indicate 1% significance levels.

The ADF test results show that the null hypothesis of the relationship containing a unit root can only be rejected when the series are first differenced. Thus the series are all integrated of order one I(1) (see Table 5.1). Since the variables are integrated of the same order I(1), I then employ the Johansen and Juselius procedure (1990). The lag length of the VAR is determined by Akaike's Information Criterion (AIC). As is standard, both the slope and the intercept dummy variables are treated as exogenous I(0) variables in the co-integrating equation and the error correction model.

**Table 5.2**  
**Testing Cointegration between LnPPI, LnEx MR and LnCPI Using the Johansen Procedure with Dummy Variables, 1980Q1 to 2009Q3**

Explanatory Variables	Null Hypothesis	Alternative Hypothesis	Test Statistics
LnPPI = $f$ (LnEx, MR, LnCPI)	Trace tests:		Trace Value
	$r = 0$	$r > 0$	99.33***
	$r \leq 1$	$r > 1$	25.46
	$\lambda$ max tests:		$\lambda$ max Value
	$r = 0$	$r = 1$	73.87***
	$r = 1$	$r = 2$	15.00

Notes: 1. \*\*\* denotes significance at 1% level  
2.  $r$  indicates the number of cointegrating vectors.  
3. VAR = 2 is determined by AIC criterion

**Table 5.3**  
**Normalized Cointegrating Coefficients Using the Johansen Procedure**

Cointegrating equation:	Coefficient	t-statistic
LnPPI = $f$ (LnEX, MR, LnCPI)		
LnPPI	1.0000	
LnEx	-0.2220	-1.0416
MR	0.0861	4.2026***
LnCPI	-1.4860	-3.8454***

Notes: 1. \*\* and \* denote significance at 5% and 10% level respectively.  
2. optimal lags are determined by AIC criterion.  
3. D98 and interactive dummies are treated as exogenous I(0) variables in the cointegrating equation.

The cointegration test results for the model incorporating the most significant dummy variables—switching to unity in the first quarter of 1998—are presented in Table 5.2 through Table 5.5. Table 5.2 presents evidence that *LnPPI* is cointegrated with the *LnEX*, MR and *LnCPI*. Table 5.3 shows that the normalized cointegrating coefficients on LnCPI and MR carry the expected signs and are statistically significant. The error correction model, reported in Table 5.4, showing a statistically significant negative coefficient on the ECM term, confirms the earlier findings that

cointegration exists between the variables.

Table 5.5 shows that the key coefficients and t statistics for models with dummies switched on in different quarters. Readers can testify that there is an obvious jump in the t statistic when the switch occurred in 98Q1 rather than 97Q4. Since TPS was announced on December 8 this result is just right. The negative coefficient on the interactive term for exports shows that exports growth no longer provided the housing market the kind of support it used to; the positive coefficient on the interactive term for the interest rate and consumer price show that a decline in interest rates and increase in inflation would not provide much stimulation either.

**Table 5.4 Error Correction Representation of Johansen Model  
(Dependent variable:  $\Delta \text{LnPPI}_t$ )**

Regressors	Coefficient (t-ratio)
Intercept	0.0087 (1.0519)
$\Delta \text{LnPPI}_{t-1}$	0.2875 (3.2681)***
$\Delta \text{LnEX}_{t-1}$	-0.1430 (-1.0225)
$\Delta \text{MR}_{t-1}$	-0.0016 (-0.3104)
$\Delta \text{LnCPI}_{t-1}$	1.4217 (2.2867)**
$\text{ECM}_{t-1}$	-0.0476 (-3.328)***
$\text{LnEX} * \text{D98Q1}$	-0.6473 (-1.9818)**
$\text{MR} * \text{D98Q1}$	0.0169 (1.1147)
$\text{LnCPI} * \text{D98Q1}$	-1.8558 (-1.2015)
D98Q1	16.9556 (1.5736)
R-squared: 0.4137	

Note: 1. Optimal lags are determined by AIC criterion.

2. \*, \*\* and \*\*\* denote 10%, 5% and 1% significance levels respectively

3.  $\Delta$  denotes first difference.



**Table 5.5**  
**A Timing Test by Switching Dummy Variables to Unity in Different Quarters**

Quarter with Value of Dummy Switched to Unity	LnEX * DQ	MR * DQ	LnCPI*DQ	Intercept Dummy DQ
1997 Q2	-0.5366 (-1.6951)	0.0127 (0.8137)	-1.2146 (-0.7161)	12.5513 (1.1140)
1997 Q3	-0.5632 (-1.6437)	0.1144 (0.8120)	-1.4568 (0.7168)	14.0150 (1.0615)
<b>1998 Q1</b>	<b>-0.6474</b> <b>(-1.9818)**</b>	<b>0.0169</b> <b>(1.1147)</b>	<b>-1.8556</b> <b>(-1.2015)</b>	<b>16.9556</b> <b>(1.5736)</b>
1998 Q2	-0.6061 (-1.8533)*	0.0156 (1.0368)	-1.5447 (-1.0100)	14.9773 (1.3966)
1998 Q3	-0.3134 (-0.8588)	0.0050 (0.3193)	0.1277 (0.0761)	3.4326 (0.2859)

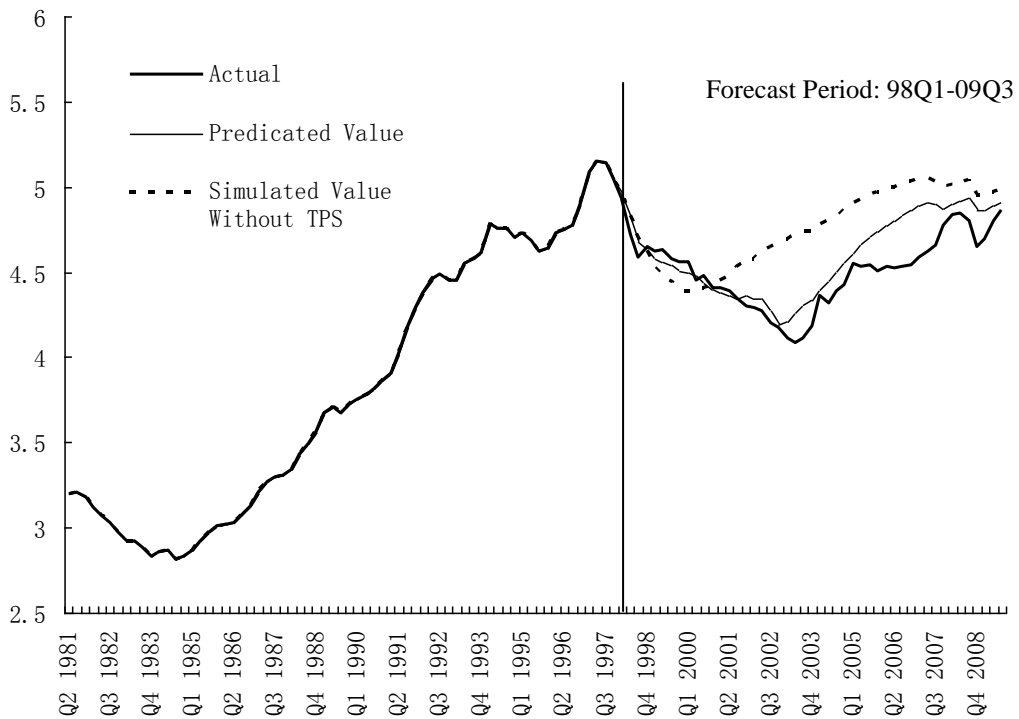
Note: Figures are estimated coefficients for the error correction models. t-statistics are in brackets. DQ is a dummy variable that switches to unity in the quarter on the left column. The t statistics indicates a structural break in 1998:Q1. The TPS was announced on December 8 1997.

As Table 5.5 shows that Dum is indeed largest and statistically most significant when Dum=Dum98Q1, i.e., when it is switched to unity in the first quarter of 1998, suggesting a possible structural shift in 1998 Q1. It is noteworthy that Bardhan et. al.(2003), using a similar methodology, found no evidence that the Asian financial crisis(AFC) had produced a structural shift in Singapore, as all timing test switch dummy variables regardless of the quarter they are switched to unity(from 1997Q2 up to 1998Q1) were insignificant. This lends support to our argument that the structural shift we found in Hong Kong is mainly attributed to the policy change – viz. the TPS and not the AFC.

To further confirm the presence of a structural break in the first quarter of 1998 I conducted a Chow Test. To do this I first re-estimate the relation using the sub-sample data before and then after(and inclusive of) the first quarter of 1998. I

report two test statistics for the Chow Forecast test. Both the F-statistic (1.6760 with p-value of 0.029) and log likelihood ratio (94.52 with p-value of 0.0000) rejected the null hypothesis of no structural change in the equation before and after 1998Q1. Therefore, I conclude that both the timing test and Chow Test provide strong support for the hypothesis that the Tenants Purchase Scheme produced a “regime shift” that affected the housing price relationship.

**Figure 6**  
**Predicted Log of Property Price Using JH Model Incorporating Dummy Variables Switched to Unity from 1998:quarter 1. (1998Q1-2009Q3)**



To conclude, I found a structural break that occurred in the first quarter of 1998, which is consistent with the hypothesis that TPS caused the structural break. The stimulative effects of exports on Hong Kong’s housing prices were reduced significantly from the first quarter of 1998.

Based on the estimated error correction model reported in Table 5.4, I conduct a dynamic forecast starting from 1998Q1 to 2009Q3. The forecasted values of LnPPI are based on previous predicted values given the actual exports, consumer price and mortgage rate. I have plotted the predicted values against the actual ones in the Figure 6. Even the period of forecast values are over ten years, surprisingly, the model tracks the actual data very well indeed. It would be interesting to find out what might have happened to Hong Kong's economy if there had been no Tenants Purchase Scheme. To do so, I set the dummy D98Q1 equals to zero, we can see that the property price should be bottomed out in year 2000 instead of experiencing a over seven year property downturn.

## **5. Conclusions**

Our empirical findings have shown that residential property price, mortgage rates, the Asian Financial Crisis, and the implementation of the Tenants Purchase Scheme are important determinants of the second-hand home transaction volume. Price appreciation allows existing homeowners to trade up for better homes and boosts confidence. Mortgage rate increases are found to have clearly dampening effects on housing market transactions. Of particular interest is the finding that the Tenants Purchase Scheme is found to have a significant and a greater negative effect on the housing transactions than the Asian Financial Crisis.

During the mid-1990s, Hong Kong house prices appreciated rapidly as funds poured in from among the richer public housing tenants. After the Asian Financial Crisis, housing transactions had eased and house prices had slipped. At the eve of the announcement of the TPS on 8 December 1997, home transactions in Dec

unexpectedly plunged to new lows, and home prices began their dramatic downturn (see Table 6).

**Table 6 Monthly Transactions of Private Homes**

Year/Month	First Hand Homes	Second Hand Homes
97/07	2,147	17,227
97/08	2,044	8,595
97/09	1,396	7,800
97/10	2,174	8,315
97/11	1,343	8,653
<b>97/12</b>	<b>364</b>	<b>3,804</b>
<b>97/01-97/12</b>	<b>20,380</b>	<b>133,555</b>
98/01	2,334	3,598
98/02	868	2,883
98/03	2,636	5,501
98/04	649	4,683
98/05	2,429	4,364
98/06	3,871	3,413
98/07	1,880	3,337
<b>98/01-98/12</b>	<b>31,599</b>	<b>48,110</b>
99/01	1,999	5,012
99/07	1,394	4,317
<b>9901-9912</b>	<b>21,557</b>	<b>46,565</b>
00/01	695	4,000
00/07	2,400	2,929
<b>00/01-00/12</b>	<b>17,830</b>	<b>39,089</b>

Source: Data provided by Centaline Property Agency Ltd.

Notwithstanding Hong Kong's rapid economic growth in 2000 at 10.2 per cent home prices continued to fall, losing over 14 per cent in the year. My theory is that this has to do with the immobilization of the existing homeowners as a result of TPS. Because land developers from now on could only depend on first-time buyers to buy their homes, they needed to keep reducing their asking prices in order to reach potential buyers with a lower purchasing power. This inevitably worsened the negative equity problem, both by dragging more homeowners into the trap and deepening the trap. Given the huge linkage effect on the economy of the housing

market (Case, 2000), governments pondering privatization schemes need to learn from the experience in Hong Kong.

**Table 7. List of Variables and their Definitions**

<b>Short Form</b>	<b>Explanatory Variables</b>	<b>Sources and Definition of Variables</b>
<b>TRAN</b>	Second hand home transaction volume (dependent variable)	Monthly volume figures are no. of registration of transactions in private residential properties in the second hand market and provided by Centaline Ltd.
<b>PPI</b>	Property Price Index 1989=100	Property price index
<b>AFC</b>	Asian Financial Crisis Dummy	This is a non-binary dummy variable derived from the 12-month forward rate premium of the US dollar on the HK dollar. It is normalized to have a maximum value of unity .
<b>GFC</b>	Global Financial Crisis Dummy	This is a non-binary dummy variable derived from 3 month Treasury bill rate and the 3-month Eurodollar rate It is normalized to have a maximum value of unity .
<b>TPS</b>	Tenants Purchase Scheme	1 starting from the announcement of the scheme in December 1997, 0 before that month (Monthly Data).
<b>D98Q1</b>	Dummy Variable	1 starting from the 1998 1 <sup>st</sup> quarter, 0 before that quarter (Quarterly Data)
<b>FQR</b>	First Quarter Effect	1 for months in the first quarter of the year, 0 otherwise
<b>MR</b>	Mortgage Rate(%)	Prime rate plus 0.5% prior to 1997. Starting from 1997 Jan, weighted average mortgage rate from 1997 to 2009 was provided by Hong Kong Monetary Authority.
<b>EX</b>	Total Exports of Goods and Services	In million HKD (current price), seasonally adjusted
<b>DQ</b>	Timing Test Dummy	1 starting from the quarter tested, 0 prior to that quarter

### **III. ESSAY TWO**

**The Nexus between Housing and the Macro Economy:**

**The Hong Kong Case**

## **1. Introduction**

Expenditures on housing represent the single largest item of expenditures for most households in any economy and a purchase that normally requires financing. It is widely believed that housing plays an important role in the macroeconomy (Case, 2000, Goodhart and Hofmann, 2003, Cutler, 2005, Leung, 2004, Gerlach and Peng, 2005). The US subprime crisis and financial tsunami, in fact, are an outcome of the fall in US housing price and so understanding the relation between housing market and “domestic consumption and investment” is of particular importance nowadays. This paper considers this subject from the perspective of economic base theory and presents some evidence for this relationship, focusing on the Hong Kong case.

Hong Kong presents a very interesting case for our investigation of the relation between the housing market and the macro economy, both because it is a small open economy and because it is rated as the world’s freest economy. In 2010 Hong Kong has been the number 1 free economy in the world for the 15th consecutive year according to the Heritage Foundation. It is known to be a very dynamic economy, with a big population living in a small area, so that housing represents a significant and rapidly growing component of wealth for its homeowners. Yet shortly after the Asian Financial Crisis, the Hong Kong economy shrank by 5.5 per cent in 1998. In Hong Kong’s history negative economic growth for the entire year is unprecedented. With many economies around the world still enjoying and apparently benefiting from a housing boom, there is a need for greater understanding of the relation between housing and the macro economy.



**Table 1. Private Consumption during Two Crises**

Asian Financial Crisis			Global Financial Tsunami		
Quarter	HK\$ million	% Change (year on year)	Quarter	HK\$ million	% Change (year on year)
<b>97 Q4</b>	205,555	2.3	<b>08 Q3</b>	252,033	0.7
<b>98 Q1</b>	184,847	-1.9	<b>08 Q4</b>	256,996	-3.2
<b>98 Q2</b>	186,143	-4.0	<b>09 Q1</b>	238,438	-6.2
<b>98 Q3</b>	184,073	-8.2	<b>09 Q2</b>	257,936	-0.6
<b>98 Q4</b>	189,678	-7.7	<b>09 Q3</b>	253,433	0.6
<b>99 Q1</b>	177,669	-3.9	<b>09 Q4</b>	269,261	4.8
<b>99 Q2</b>	188,476	1.3	<b>10 Q1</b>	253,886	6.5

Source: *Hong Kong Monthly Digest of Statistics*, Census & Statistics Dept of HKSAR, various years.

**Table 2. Gross Domestic Fixed Capital Formation during Two Crises**

Asian Financial Crisis			Global Financial Tsunami		
Quarter	HK\$ million	% Change (year on year)	Quarter	HK\$ million	% Change (year on year)
<b>98 Q1</b>	80,864	-1.0	<b>08 Q3</b>	85,871	4.1
<b>98 Q2</b>	87,439	1.9	<b>08 Q4</b>	74,029	-16.7
<b>98 Q3</b>	74,339	-11.7	<b>09 Q1</b>	76,948	-10.3
<b>98 Q4</b>	73,756	-18.8	<b>09 Q2</b>	78,012	-11.8
<b>99 Q1</b>	65,774	-18.7	<b>09 Q3</b>	88,585	3.2
<b>99 Q2</b>	66,085	-24.4	<b>99 Q4</b>	84,470	14.1
<b>99 Q3</b>	65,536	-11.8	<b>10 Q1</b>	85,054	10.5
<b>99 Q4</b>	65,993	-10.5			
<b>00 Q1</b>	66,809	1.6			

Source: *Hong Kong Monthly Digest of Statistics*, Census & Statistics Dept of HKSAR, various years.

As mentioned in the first paper, the Hong Kong economy had suffered under both the Asian Financial Crisis in 1997 and the Global Financial Tsunami in 2008. In the exports sector and stock market which are both more sensitive to external shocks, Hong Kong's exports and stock market fell much more in the wake of the global financial tsunami. However, the declines in domestic sector including private consumption and gross investment had lessened in 2008 financial tsunami and the rebounds have appeared to be much stronger after the crisis (see Table 1 and 2). I argued that a much better performance in property market in 2008/09 should play a significant role in making the domestic sector more stable and enhancing the rebounds.

In comparing the performance of domestic sectors under the two crises, there are some interesting questions that deserve study. What accounts for the strength in the Hong Kong housing market ahead of 1997, and what accounts for the major decline after? If recessions would cause a fall in property market, why we did not see a more dramatic drop in property price in 2008 crisis? Does it imply that the housing market should drive domestic private expenditures (defined as domestic private consumption plus domestic fixed capital formation)? Or do domestic private expenditures drive housing prices? What are the causal directions? I will attempt to answer these questions, presenting statistical evidence to support my arguments.

Many commentators attributed the housing price surge ahead of the handover of sovereignty to a provision in the Annex to the Sino-British Joint Declaration, which restricted the annual land grant to no more than 50 hectares (excluding land granted to the Hong Kong Housing Authority for the construction of public rental housing) unless a relaxation to the limit is approved by the Land Commission consisting of

equal number of members from the British and Chinese sides<sup>9</sup> (Peng & Wheaton, 1994). Yet a comparison of the number of households and the number of dwelling units indicates that the housing market was essentially in balance during the run-up to the handover: housing prices appeared to be rising in a moving equilibrium—with supply and demand being equalized even as price change. This is much like the rising wages and salaries witnessed in a growing economy.

## 2. Theory

I will follow the tradition of viewing a small open economy as comprising a basic sector that is trade-oriented, and a non-basic sector that owes its existence to and services the basic sector. A small open economy has to export in order to finance its imports, which are necessary for its survival. The exports sector, then, is the driver of the economy, while the “non-basic” or domestic sector spins off economic benefits throughout the economy. It is, however, typical that the basic sector can only provide a limited number of employment opportunities. The majority of workers have to work in the non-basic sector. Thus, earnings from the basic sector must be spent in the economy in order to create additional jobs. Housing happens to be the largest single item of expenditures that employers and employees in the basic sector can spend on. What is more important, housing as an industry also has much greater domestic value added content than many other industries. Even though modern housing construction may rely increasingly on imported prefabricated components the construction has to take place on a plot of land. It is largely through the building

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<sup>9</sup> See <http://www.hkbu.edu.hk/~pchksar/JD/jd-full1.htm> In practice Hong Kong had released more than 50 hectares per year every year since the Sino-British Joint Declaration took effect in 1984.

erected on a plot of land that the latter can realize its locational rent. In a sense, then it is housing that confers a plot of land its rent. When housing prices rise, small and medium businesses will also become better able to obtain loans to finance their business operations (Chen, 2001). Thus it is postulated that for a small open economy housing serves as the principal transmission mechanism and the linkage between the basic sector and the non-basic sector, or perhaps more accurately between the basic sector and the rest of non-basic sector other than housing, since housing is certainly an important component in the non-basic sector. It is, of course, also possible that instead of, or in addition to trade, capital inflows, particularly FDI, may also provide the non-basic sector the “fuel” for growth, even though much of FDI may target at the exports markets<sup>10</sup>. But these capital inflows would also benefit the housing sector before it benefits the rest of the non-basic sector.

In comparison, for a large, relatively closed economy the role of housing is expected to be smaller. There is hardly a distinction between the basic sector and the non-basic sector, as the economy is relatively self-sufficient. In addition to housing, there are also many other forms of assets that can serve as a store of value for income earners—with the result that housing becomes relatively less important.

Under this hypothesis, the run-up in housing prices in Hong Kong before 1997 is very much a result of strong exports, although it is also pushed up by speculative activities and by a deliberate policy to drive out richer public housing tenants onto the private market. Following the Asian Financial Crisis, Hong Kong’s exports suffered a decline. According to the same logic as described this would have led to a

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<sup>10</sup> Chou and Wong (2002) found that trade and foreign direct investment effects account for

decline in housing prices any way. But the decline has been further aggravated by two other policies: a policy to lure sitting tenants, including the richer ones, to buy their own units rather than from the private market, which severed the “housing ladder” of households trading up to better and more costly homes, and a policy to increase housing supply to a target of 85,000 units a year. This part’s focus is however NOT about this story, but about the effects of the housing market collapse on the macro economy, and about the macroeconomic effect of exports growth on housing prices in a small open economy.

In this paper, I hypothesize that housing plays the unique role of a bridge between the basic sector and the non-basic sector. In particular, I hypothesize that exports, apart from providing employment and incomes, will push up housing prices. As housing prices move up, a range of other activities will benefit. Expenditures on housing represent the single largest item of expenditures for most households in any economy. Expenditures on housing purchases, in particular, amount to many years of income. That is why financing is very important. Few individuals or households would commit years of incomes to servicing the loan for acquiring any asset other than housing. Because of the leverage involved, capital gains from housing potentially generate sizable returns to the initial investment. On the basis of such capital gains, an entrepreneur can usually refinance the home and obtain a much larger loan to support his business project. So residential housing also indirectly allows many potential entrepreneurs realize their dreams. Increases in house prices enhance the collateral available to homeowners in form of equity withdrawal by remortgage their unit and thereby facilitating higher consumption or investment

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approximately 44% of the growth in Hong Kong.

(Aoki et al., 2001)

Yet the view that housing prices would boost consumption and domestic demand has not been unchallenged. For example, it is argued that heavier mortgage payments resulting from higher housing prices may displace consumption expenditures (Glaeser, 2000). Miles (1994) argues that increases in house price would hurt those existing owners who want to trade up and also the first time buyers (existing renters) as increase in home prices would lead to increase their saving for down payment and thereby reducing their consumption. (Campbell and Cocco, 2007). Therefore, the positive wealth effect on consumption could be offset by increase in saving by those owners who want to trade up and first time buyers.

In Hong Kong, 53.1% of total number of domestic households in 2010 own their homes (including private housing, subsidized sales flats and TPS units), and this figure has remained very stable from 1999 to 2010—representing a change from the previous increasing trend, and the household formation is around 30,000 each year sharing just about 1 % of the total number of households in Hong Kong (General Household Survey, various years, Censes & Statistics Dept of HKSAR). Also, 30.1% of households who reside in public rental housing receiving heavy subsidy form the government are not affected by the increase in housing price. Only 13.1% of households are tenants of private housing. The net impacts on domestic demand arising from the wealth effect and saving effect from renters as a result of the increase in housing price remains an empirical question and the results would vary across countries with different demographic profiles, saving and consumption patterns.

An important and extremely robust result of the current paper is that domestic private sector expenditures is always driven by the housing price index and not vice versa. The dramatic decline in housing prices appears to be a major reason behind the sharp decline of the economy and the deflation that began in August 1998(cf. Cutler, 2005).

Section 2 will provide some background to the Hong Kong housing market and highlight some key policy changes that happened in the 1990s. Section 3 will present the results of empirical tests under a VAR framework. I identified two cointegrating relations among the variables Housing Price Index(LnPPI), Total Exports(LnEX), Mortgage Rate(MR), and Private Domestic Demand(LnDD),and found that restrictions consistent with our prior assumptions cannot be rejected. Variance decomposition and impulse response functions indicate that indeed exports is the key driving variable for housing price, while housing price is the key driving variable for private domestic demand. Section 4 will provide the conclusions.

## **2. Hong Kong's Housing Market and Policies**

Public housing has traditionally played a key role in Hong Kong's housing market. To deal with the rapidly expanding population, Governor MacLehose announced in October 1972 an unprecedented public housing programme. Seventy-two public housing estates were to be constructed, to provide decent housing to a total of 1.8 million people. These estates offered cheap rents to qualified means-tested households. Then in 1978, the Home Ownership Scheme (HOS) was launched, offering an opportunity for those who were not qualified for low cost rental housing to buy their own flats at prices much lower than private flats. Most

buyers of HOS housing were public rental tenants, who were given a more favorable quota than other eligible buyers over the limited supply of new HOS flats.

Hong Kong's housing prices slumped following the dramatic interest rate spike of 1980-81 and in the face of political uncertainty over Hong Kong's future. With the signing of the Sino-British Joint Declaration in 1984 removing much of the political uncertainty, Hong Kong's housing prices began to climb spectacularly. Particularly after 1987, following the implementation of a policy to make the richer public housing tenants pay higher rent, participation among public housing tenants in the housing market rose. A priori, one would predict that this inflow of cash into the housing market would drive housing prices as well as housing transactions up. By 1992/93, it was found that 13 per cent of public housing tenants owned a flat and as much as 24 per cent of housing transactions were due to purchase by public housing tenants(Hong Kong Housing Authority,1993).

With housing prices surging ahead, a Task Force on Land Supply and Property Prices was set up in 1994. Finding that 10% of sale and purchase agreements presented for stamping between February 1992 and March 1994 involved short-term re-sales—which was considered prima facie evidence for speculative activities, the Task Force recommended a series of anti-speculation measures in June. Among such measures, the initial deposit was to be fixed at 10% of the purchase price and 5% would be forfeited if the purchaser fails to sign the formal sale and purchase agreement or enters into a Cancellation Agreement with the developer. Stamp duties were also made payable at the time a provisional sale and purchase agreement was signed and not at the time the transaction was completed.



Apart from worrying about speculation, the government also had worried over the homeownership rate. In 1987, The Long Term Housing Strategy: A Policy Statement already made it clear that the government wanted to encourage home ownership. The Tenants Purchase Scheme(TPS), announced in December 1997, was a way to boost the homeownership rate. Offering tenants as much as 88 % off the estimated market values and allowing them to resell after two years, the TPS was attractive and was to play a strategic role in Mr. Tung Chee-hwa's vision of increasing homeownership from 50% to 70% in ten years, as announced in his first policy address of October 1997.

Unfortunately, the scheme's success meant a sudden loss of attractiveness of Home Ownership Scheme flats, which suddenly looked ridiculously expensive in comparison<sup>11</sup>. For the first time ever, HOS homeowners found a dearth of buyers. Turnover in the second-hand market dropped precipitously, and developers had to by-pass existing homeowners in order to find buyers (Ho, et.al. 2005). After they have exhausted one "crop" of buyers, they must further cut prices in order to reach buyers with lower purchasing power.

In an attempt to boost homeownership Mr.Tung in 1997 announced a new policy of increasing the supply of homes to 85000 units a year (from an average of about 53,000 units a year over the 1987-1997 period). From 1998 on through late

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<sup>11</sup> For this hypothesis to carry weight, public housing tenants have to be active in the housing market prior to the announcement of the TPS. This was vindicated as a survey by the Housing Authority in 1992/93 found that public housing tenants were responsible for 24 per cent of housing transactions. Watanabe(1998) found public housing tenants had huge savings compared to private housing tenants or owners.

1999 the government used every means within its control to boost housing supply<sup>12</sup>. The increased supply began to hit the market around late 2000. In late 2002, in order to stabilize the housing market, new measures were implemented including cessation of the production and sale of HOS, PSPS flats as well as the sale of PRH flats under the TPS after phase 6 will cease from 2003 onwards

#### **4. Housing Price Determination in a Small Open Economy and the Exports**

##### **Multiplier on Domestic Economy**

##### **4.1 Economic Base Theory**

In principle, many factors determine housing prices, and they include both demand side and supply side factors. These factors include demographic variables, incomes, interest rates, mortgage loan ratios, and expectations about inflation, expectations about supply and income trends, and the completion rate, etc. If supply and all other factors are given, however, housing prices will simply rise with incomes and decline with the interest rate. In general, when the policy environment is stable, and when the housing market is more or less in equilibrium, incomes and interest rates would be the predominant factors driving housing prices.

Following the economic base theory, in a small open economy incomes are closely tied to exports. Exports, apart from interest rates, is then a key factor driving housing prices. If exports are the main driving force behind a small open economy's incomes, and if this initial income increase translates into demand for housing, then

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<sup>12</sup> Mr. Tung in an interview with reporters in June 2000 unexpectedly made the statement that the 85000 a year production target was no longer government policy. Earlier on, a story in Apple Daily (July 6, 1999) reported that land lease conversions and land exchange in the first half of the year would provide 16785 housing units, a new record in recent history. Plot ratios were also increased

there are three effects on domestic consumption and domestic investment. There is first the direct multiplier effect working through developers' construction expenditures and payments of land premiums to the government (the "basic sector" O'Sullivan, 2003, pp.120-122.). There is also a second order effect working through the wealth effect as the prices of housing rise (Cutler, 2005). The third effect is through the credit channel. Many small and medium enterprises obtain their financing of their business activities through borrowing, and the rise in the collateral value of housing boosts borrowing.(Gerlach and Peng, 2005)

Thus, I have a recursive model with an "exports multiplier" linking exports to domestic demand. The housing market provides a "transmission mechanism" whereby the "growth engine" of the economy, i.e., exports, gives rise to the secondary effects of "non-basic" sector activities through various input-output relationships.

These relations can be summarized by the following equations:

$$\text{LnPPI} = \alpha_1 + \beta_1 \text{LnEX} + \gamma \text{MR} + \varepsilon_t \quad \text{----- [1]}$$

( $\beta_1 > 0$ ,  $\gamma < 0$  and  $\lambda > 0$ )

$$\text{LnDD} = \alpha_2 + \beta_2 \text{LnPPI} + \varepsilon_t \quad \text{-----[2]}$$

( $\beta_2 > 0$ )

where PPI is the property(housing) price index, EX is total exports, DD is domestic demand and MR is mortgage rate.

[1] is a reduced form equation collapsing the effects of supply and demand

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over the years.

assuming the housing market is in moving equilibrium over time. While most authors use income--in particular GDP--growth as the key driving variable for housing prices (Tsatsaronis, Kostas and Haibin Zhu, 2004, Phillips and Goodstein, 2000) I prefer to focus only on exports because exports is exogenous. In contrast, measures such as the GDP include consumption and will be affected by housing prices.<sup>13</sup>

Equation [2] depicts private domestic demand as solely dependent on home prices, which is obviously too simplistic to be a theory to explain private domestic demand. The simplified specification, however, is intended to highlight the recursive nature of the key variables, and does not portend that variables such as government expenditures, interest rates, and current incomes do not play a role in determining private domestic demand.

This study employs quarterly data from 1984 to 2004. This is a period with a stable monetary regime as well as a period of relative political stability after the signing of the Sino-British Joint Declaration removing much of the uncertainty about Hong Kong future. Figure 1 – 4 show the movements of the four key variables. For the source and definition of variables that are analyzed, see Appendix 1.

## **4.2 Empirical Results**

### ***a. Test Results for Unit Roots***

I begin the estimation by testing the stationary properties of the variables using

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<sup>13</sup> Tsatsaronis and Zhu(2004) used the structural vector autoregression approach and regressed each variable on a number of lags of all endogenous variables, which include: house price inflation, the growth rate of GDP, the real short-term interest rate, the term spread, inflation and the growth rate of real bank credit to the private sector. Ours is a simpler approach but essentially capture similar

the Augmented Dickey-Fuller (ADF). The following equation is estimated for each of the time series:

$$\Delta X_t = \alpha_0 + \alpha_1 t + \beta X_{t-1} + \sum_{i=1}^k \delta_i \Delta X_{t-i} + \eta_t$$

where  $\Delta$  is the first difference operator,  $t$  is the time trend,  $k$  denotes the number of lags used and  $\varepsilon$  is the error term. The null hypothesis that series  $X$  is non-stationary can be rejected if  $\beta$  is statistically significant with negative sign. The optimal lag  $k$ , is chosen by the Akaike Information Criterion (AIC). Table 3 shows that the test statistics for all the series in level form and in their first differences, respectively. The fact that the null hypothesis of unit root cannot be rejected when the series are in level but can be rejected when the series are in first differences clearly indicates that all the series in the system are integrated of order one, and therefore no further unit root tests are performed.

### ***b. Test Results for Cointegration***

Since the variables are integrated of order one  $I(1)$ , the next step is to carry out co-integration analyses of the variables. I first identify the long-run relationship among our variables by using the Johansen procedure. I chose the lag structure by using the Akaike's Information Criterion (AIC), which determines VAR=2. The cointegration test results are presented in Table 4. The number of co-integrating vectors  $r$  is determined by reference to the  $\lambda_{max}$  and the trace statistics. As can be seen, the trace value indicate that there are two cointegrating vectors ( $r = 2$ ) among the four variables at 5% significant level while  $\lambda_{max}$  indicates only one cointegrating relation. Based on the results,  $r=2$  was chosen for the VECM model.

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variables, except that we used exports rather than GDP.

**Table 3. Augmented Dickey-Fuller Test of Unit Root (1984Q1 to 2009Q4)**

Variable name	Test on	No Trend	Trend	Conclusion
LnPPI	Level	-1.2218	-1.5239	I(1)
	1st diff	-6.2372***	-6.2302***	
LnEX	Level	-2.7314*	-1.0878	I(1)
	1st diff	-5.2713***	-5.9228***	
LnDD	Level	-2.3716	-1.0059	I(1)
	1st diff	-3.4821***	-4.9843***	
MR	Level	-1.9483	-2.9910	I(1)
	1st diff	-10.9872***	-10.946***	

Note:

1. 5% critical value for the augmented Dickey-Fuller tests that include constant; and constant plus trend = -2.8861. and -3.4480 respectively.
2. The numbers of lags in the two unit root tests are determined by the AIC
3. \*\*\* and \* indicates 1% and 10% significance level respectively.

**Table 4. Johansen Cointegrating Test Result (1984Q1 to 2009Q4)**

Variables	Null Hypothesis	Alternative Hypothesis	Test Statistics	0.05 Critical Value
LnPPI, LnEX, LnDD, MR	Trace tests:		Trace Value	Trace Value
	$r = 0$	$r > 0$	58.55****	47.86
	$r \leq 1$	$r > 1$	31.17**	29.79
	$r \leq 2$	$r > 2$	14.78*	15.49
	$\lambda$ max tests:		$\lambda$ max Value	$\lambda$ max Value
	$r = 0$	$r = 1$	27.38*	27.58
$r = 1$	$r = 2$	16.39	21.13	
$r = 2$	$r = 3$	11.32	14.26	

Notes:

1. \*\*\* and \*\* denotes significance at 1% and 5% level respectively
2. Test assumption: No linear deterministic trend in the data
3. r indicates the number of cointegrating vectors.
4. VAR = 2 is determined by AIC criterion.

Having determined that the number of cointegrating vectors  $r = 2$ , the next step is to identify the cointegrating vectors and to test if the restrictions suggested by our theoretical model(i.e. excluding domestic demand from the first cointegrating

equation, and the total exports and prime rate from the second cointegrating equation) are statistically acceptable.

**Table 5. Normalized Long-run Cointegrating Coefficients & Test of Restrictions**

	LnPPI	LnEX	LnDD	MR
<b>Relation 1</b>	1	-1.9004*** (-7.4452)	0	0.0461** (2.0272)
<b>Relation 2</b>	-0.7561*** (-16.4560)	0	1	0
<i>Test of cointegration restrictions:</i>				
$H_0 = \beta_{13} = 0, \text{ and } \beta_{22} = \beta_{24} = 0$				
LR Test: $\chi^2 = 1.25637, \text{ p-value} = 0.2623$				

Notes: 1. \*\*\* denotes significance at 1% level.  
2. Numbers in parentheses are t-statistics.

The estimated cointegrating equations and the results on test of restrictions are reported in the Table 5. The test on cointegration restrictions, as explained in Boswijk (1996), is a log-likelihood ratio (LR) test with a chi-squared distribution. If the test statistics is high (i.e.  $p < 0.05$ ), then the LR test rejects the imposed restrictions. The LR static to our restrictions (i.e.  $H_0: \beta_{13} = 0, \text{ and } \beta_{22} = \beta_{24} = 0$ ) is 1.0747 with a P-value of 0.2999. Therefore, our restrictions are accepted and so our prior hypotheses are not rejected.

The first cointegrating vector suggests there is a positive relation between property price and exports, and a negative relation between property price and mortgage rate. The second vector suggests a positive relationship between property price and private domestic demand. As Table 5 shows, all the variables carry the expected signs and in particular the coefficients for LnPPI (in CoinEq 2) and LnEX (in CoinEq 1) are significant at 1% level. The above estimation implies the following VEC model:

$$\Delta \text{LnPPI}_t = \alpha_1 + \beta_1 \Delta \text{LnPPI}_{t-1} + \beta_2 \Delta \text{LnDD}_{t-1} + \beta_3 \Delta \text{LnEX}_{t-1} + \beta_4 \Delta \text{MR}_{t-1} + \theta_{1,1} \gamma_{1,t-1} + \theta_{1,2} \gamma_{2,t-1} + \varepsilon_{1,t} \quad \text{-----(3)}$$

$$\Delta \text{LnDD}_t = \alpha_2 + \sigma_1 \Delta \text{LnPPI}_{t-1} + \sigma_2 \Delta \text{LnDD}_{t-1} + \sigma_3 \Delta \text{LnEX}_{t-1} + \sigma_4 \Delta \text{MR}_{t-1} + \theta_{2,1} \gamma_{1,t-1} + \theta_{2,2} \gamma_{2,t-1} + \varepsilon_{2,t} \quad \text{-----(4)}$$

$$\Delta \text{LnEX}_t = \alpha_3 + \phi_1 \Delta \text{LnPPI}_{t-1} + \phi_2 \Delta \text{LnDD}_{t-1} + \phi_3 \Delta \text{LnEX}_{t-1} + \phi_4 \Delta \text{MR}_{t-1} + \theta_{3,1} \gamma_{1,t-1} + \theta_{3,2} \gamma_{2,t-1} + \varepsilon_{3,t} \quad \text{-----(5)}$$

$$\Delta \text{PR}_t = \alpha_4 + \delta_1 \Delta \text{LnPPI}_{t-1} + \delta_2 \Delta \text{LnDD}_{t-1} + \delta_3 \Delta \text{LnEX}_{t-1} + \delta_4 \Delta \text{MR}_{t-1} + \theta_{4,1} \gamma_{1,t-1} + \theta_{4,2} \gamma_{2,t-1} + \varepsilon_{4,t} \quad \text{-----(6)}$$

**Table 6. Vector Error Correction Model Estimation**  
Dependent Variable:

	D(LnPPI)	D(LnDD)
<b>ECM 1 (-1)</b>	-0.0855 (-2.7659)**	-0.0331 (-2.7221)**
<b>ECM 2 (-1)</b>	0.0113 (0.1648)	-0.0751 (-2.7759)**
<b>D(LnPPI(-1))</b>	0.3703 (3.3620)**	0.1268 (2.9232)**
<b>D(LnEX(-1))</b>	-0.3175 (-1.6668)*	0.0302 (0.4025)
<b>D(LnDD(-1))</b>	0.3553 (1.1946)	-0.0008 (-0.0074)
<b>D(MR(-1))</b>	-0.0020 (-0.3274)	0.0031 (1.2803)
<b>Constant</b>	0.1774 (3.3957)***	0.0689 (3.3476)***

Notes:

1. \*\*\*, \*\* and \* denotes significance at 1%, 5% and 10% level respectively.
2. Numbers in parentheses are t-statistics.



where  $\gamma_1$  and  $\gamma_2$  are the error correction term (cointegrating vectors estimated in the Table 5), and  $\theta_1$  and  $\theta_2$  are the adjustment coefficients. The VEC model is reported in Table 6. The cointegrating vectors indicate a stable long-run relationship among the variables and the coefficients associated with the error correction term indicate the direction and speed of adjustment of each variable in the system towards its long-run equilibrium.

***c. Granger Causality between Housing Price and Domestic Private Demand***

I now test the direction of causality between domestic private demand and housing prices. Based on the equations (3) and (4), the short-run causal relation between the variables can be investigated by applying a Wald  $\times 2$ -test of the joint significance of the lags of other explanatory variables in the equation. As far as our focus is concerned, the null hypotheses being tested are:  $H_0: \sigma_1 = 0$  and  $H_0: \beta_2 = 0$ . The results of temporal Granger causality test is shown in the Table 7<sup>14</sup>. Clearly, only the null hypothesis of LnPPI does not Granger-cause LnDD is rejected at 5% significance level. Therefore, based on the result, I conclude that the direction of causality only runs from LnPPI to LnDD but not the other way round.<sup>15</sup>

**Table 7. Temporal Granger Causality Test Result**

Dep. Variable	Null Hypothesis	Chi-sq	Prob
DLnDD	LnPPI <i>does not cause</i> LnDD	8.5448	0.0035***
DLnPPI	LnDD <i>does not cause</i> LnPPI	1.4271	0.2322

Notes: 1. \*\*\* denotes significance at 1%. 2. D denotes first difference

<sup>14</sup> Diagnostic tests (test on serial correlation and normality) indicate well-behaved residuals. For space consideration, the results are not reported here but are available upon request.

<sup>15</sup> It should be noted that the Granger causality test does not by itself establish any causal relationship. It does, however, provide a test to falsify any hypothesized causal relationship. Our test results are

#### *d. Results of Variance Decompositions and Impulse Responses*

The above analysis provides evidence on the existence of long-run cointegrating relations among the variables and also of a short-run casual relation between the property price and domestic demand. To provide a more comprehensive analysis of causal relationship (both in short run and long run) and dynamic properties of the model, the variance decomposition and impulse response analysis will be conducted in this section.

Impulse response functions show the response paths of each endogenous variable to a one-time shock (=one standard deviation) to other variables in the system. As far as our research focus is concerned, I am interested in the response of housing price and domestic demand to shocks in other variables. Figure 1 shows the response of housing price to one standard deviation shocks in LnEX, MR, LnDD and the housing price itself.<sup>16</sup> It indicates that there is a positive effect of LnEX on the LnPPI and a negative effect of MR on LnPPI. Figure 2 plots the response of domestic demand to various shocks. As can be seen, domestic demand increases sharply during the first three quarters following a shock in the housing price and this impact will then weaken over a longer time horizon. The figure also confirms that the domestic demand responds positively to a shock in exports and negatively to a shock in interest rate.

To assess the relative importance of these shocks, I then carry the variance decomposition analysis. This shows the proportion of the variance of the forecast error for each variable that is attributed to shocks (one standard deviation innovation)

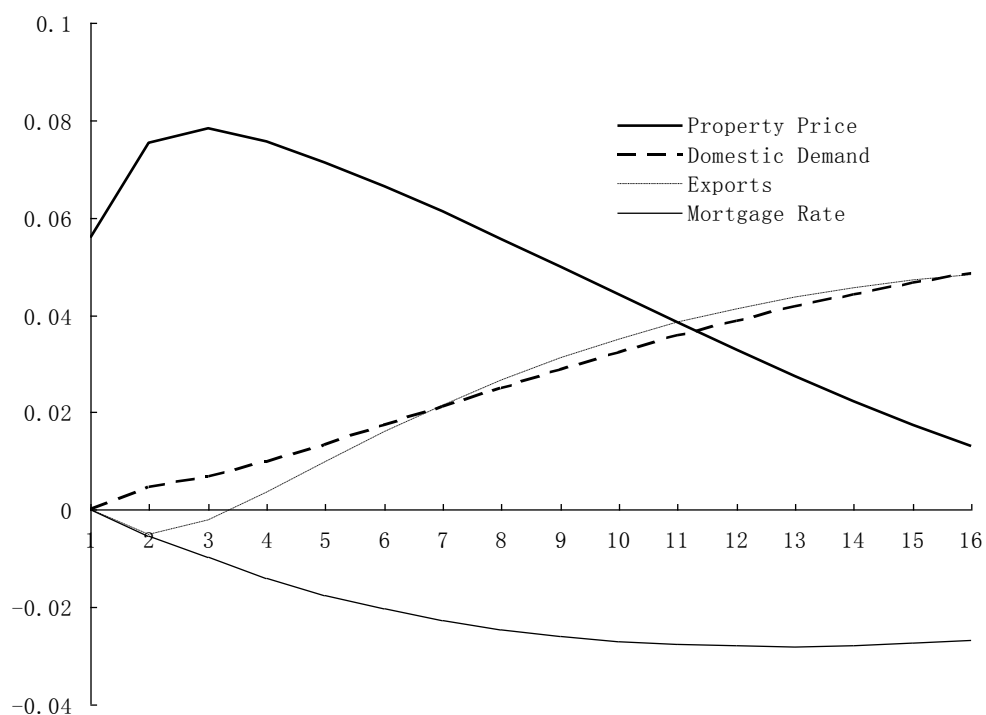
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consistent with the hypothesized causal directions.

to each endogenous variable in the system including its own. Table 8 reports the results of variance decompositions for LnDD and LnPPI with a 16 quarter (4 years) horizon (also see Figure 3 and 4). I do not report the results for LnEX and PR as the variations in these two variables are largely explained by their own innovations (more than 70 percent).

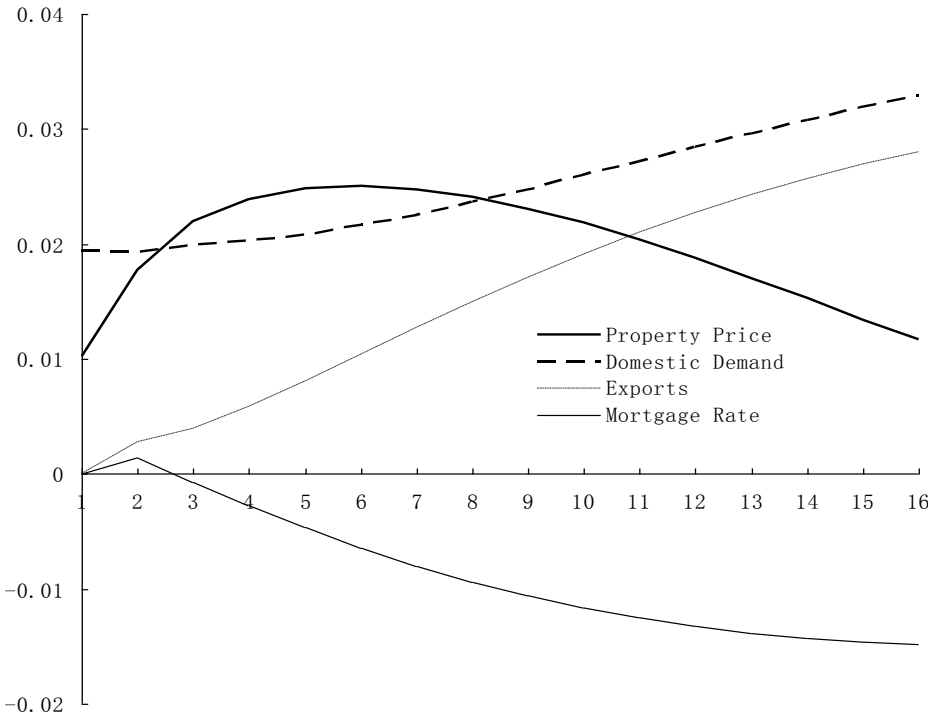
As can be seen in the Table 8(A) and Figure 3, the LnPPI forecast error variance (FEV) is dominated by movement in itself in the short run (about 90%), while it declines over a longer horizon. In the long run (about 4 years), about 18 percent of the forecast error variance of LnPPI can be explained by shocks in LnEX and LnDD respectively.

**Figure 1. Impulse Response of LnPPI to One Standard Deviation Shocks**

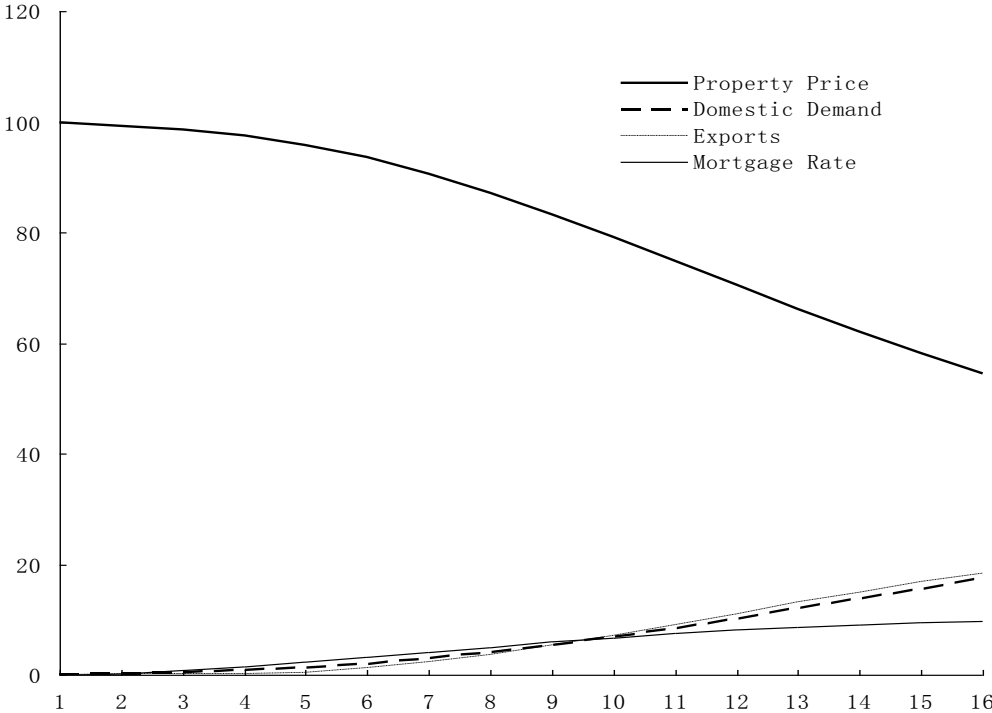


<sup>16</sup> The results are insensitive to different ordering of the variables.

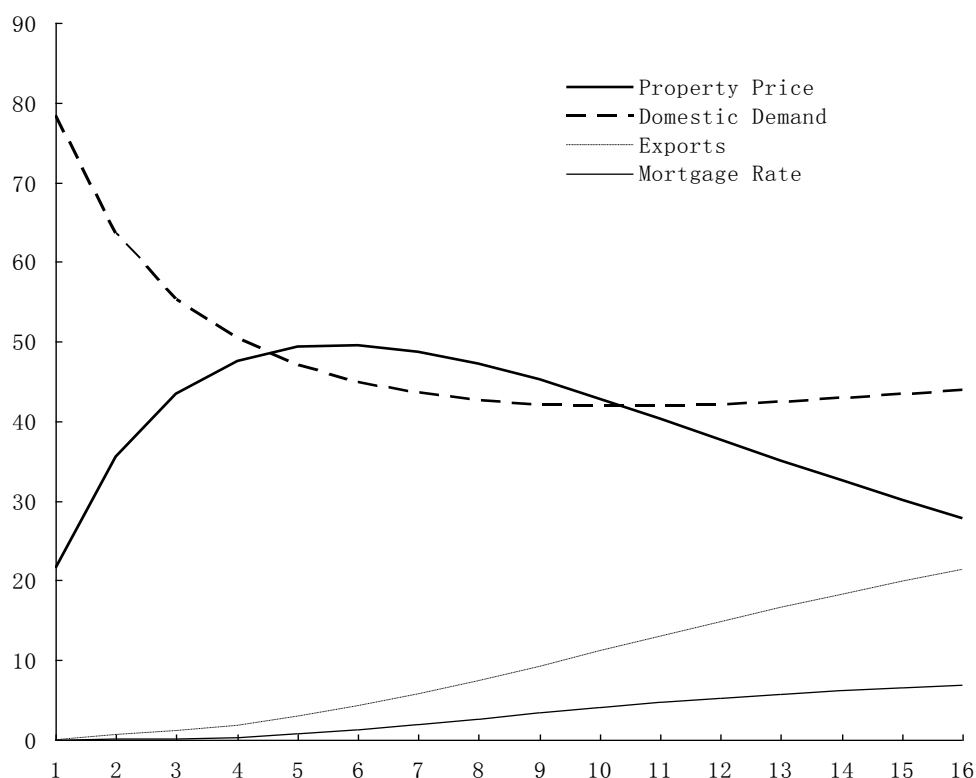
**Figure 2. Impulse Response of LnDD to One Standard Deviation Shocks**



**Figure 3. Variance Decomposition of LnPPI**



**Figure 4. Variance Decomposition of LnDD**



**Table 8. Variance Decomposition Analysis**

Period	LnPPI	LnDD	LnEX	MR
<i>A) Variance decomposition of LnPPI (%)</i>				
1	100.00	0.00	0.00	0.00
4	97.53	0.76	0.20	1.49
8	87.16	4.07	3.70	5.06
12	70.47	10.25	11.13	8.15
16	54.44	17.43	18.48	9.65
<i>B) Variance Decomposition of LnDD(%)</i>				
1	21.62	78.38	0.00	0.00
4	47.53	50.30	1.85	0.32
8	47.20	42.65	7.45	2.70
12	37.66	42.20	14.83	5.32
16	27.81	43.91	21.34	6.94

For the LnDD (see Table 8(B) and Figure 84, interestingly, the proportion of variance explained by the LnPPI increases sharply during the 1-5 quarters from about

20% to 50% and then declines gradually afterward but still remains at around 30% in the long run. The MR shock is almost no effect on explaining the FEV of LnDD in the short run while it gains importance in longer time horizon. After 20 quarters later, it can explain about 7% of the FEV of the LnDD. Exports also explains a large proportion of FEV of LnDD (from below 10 percent in the short term and then up to above 20 percent after 16 quarters).

These results indicates that property price has a strong and immediate impact on domestic demand in short run and it also supports our earlier findings that there is a short term unidirectional causality from property price to domestic demand. Besides, Hong Kong as a small and open economy, our analysis supports the argument that external sector - export in Hong Kong has generated significant positive impacts on property price and domestic demand in both the medium and the longer run.

#### **4. Conclusions**

This paper has thrown light on an interesting role of the housing market in the economic base model. In a small open economy exports serves as the “economic base” so that when exports grow the simulative effects are transmitted to the domestic economy and then generate second and higher order spending effect. In this process the housing market appears to play a crucial role. If the housing market for some reason suddenly fails to draw capital or to retain capital in the domestic economy, it is difficult to think of a substitute that could play a similar role.

Using Hong Kong data I have presented a statistical model that clearly indicates the effects of exports on housing prices and the crucial effects of housing prices on

domestic private spending. In Hong Kong, roughly 50-55% of all households living in private flats or subsidized sales flats own their homes, and this figure has remained very stable from 1999 to 2009. This is not a particularly high figure in the developed world, suggesting that the effects of housing on domestic private spending are likely to be quite significant in countries like the US or the UK.

I have presented evidence that housing prices are one of the driving forces behind growth in domestic consumption and spending in the non-basic sectors in general, including gross fixed capital investment. This does not, however, imply that the government should try to manipulate housing prices. When housing prices surge and there is worry about the formation of a bubble, it is important not to be tempted to artificially boost supply and thus cool down the market. If people pay too high a price and if prices subsequently decline, they will only have themselves to blame. Governments should always aim only at keeping supply close to the long run level of demand

**Table 9. List of Variables and their Definitions**

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<b>Short form</b>	<b>Description</b>	<b>Data Sources</b>
LnDD	Log of domestic private spending = Log of (Private Consumption + Private construction + Machinery & Equipment (Private)), current price, seasonally adjusted using X11 from Eview Programme	Hong Kong Census and Statistics Dept
LnEX	Log total exports of goods and services , current price, seasonally adjusted using X11 from Eview Programme	Hong Kong Census and Statistics Dept
LnPPI	Log property price index (overall private domestic housing market) 1989=100	Hong Kong Monthly Digest of Statistics, Hong Kong Census and Statistics Dept
MR	Mortgage Rate(%)	Prime rate plus 0.5% prior to 1997. Starting from 1997 Jan, weighted average mortgage rate from 1997 to 2009 was provided by Hong Kong Monetary Authority.

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## **IV. ESSAY THREE**

### **Supply and Demand Dynamics of Private Housing Market in Hong Kong**

## 1. Introduction

This paper attempts to investigate the supply and demand dynamics of private housing market in Hong Kong. Many empirical researches on housing market are traditionally based on the assumption that market is almost in equilibrium status. Nevertheless, we can observed that housing market is more often in disequilibrium as reflected by asymmetric price movement where owners tend to hold a reservation price during the cold market and slow response of supply during excess demand. Using the cointegarting approach, the paper identifies two cointegrating relations, ie. a long run demand side relation between property price, prime rate, per capita GDP, expectation and private housing stock, and supply side relation between private housing completion, property price, and land cost, which shows a short run disequilibrium dynamics in demand and supply of private housing during 1984 – 2008. Private housing price and supply adjust slowly to shocks would produce disequilibrium effects. Impulse response and variance decomposition are employed to shed light on the dynamics structure in the VECM model. The finding also indicates that the foreseeable supply level of private housing would have a positive impact on current price expectation. A predictable future housing supply would therefore help to stabilize potential home buyer's price expectation. The paper is divided into five sections. Section two discusses the sources of inefficiency in the private housing market and reviews literature. Section three develops the model used in this paper to explain the demand and supply adjustments of private housing market in Hong Kong. The empirical findings and policy recommendations on implementing a production target and subsidized sales flats are reported on Section four. Finally, Section five offers conclusions.

## **2. Costly Search, Reservation Demand, Inelastic Supply and Adjustment**

In many empirical studies of the housing market, the model assumes that supply and demand factors would interact simultaneously to determine the price level that clears the market. However, the spontaneous market clearing that equilibrates “turnover supply” with “turnover demand” does not imply equilibrium in terms of longer term demand and longer term supply responses. The market price typically informs, along with earlier market prices and other market information, both the supply and the demand side and generally triggers further adjustments. First, there are several features of housing market which leads to delayed responses from both supply side and demand side. In particular, quality heterogeneity compounds the imperfect information problem to cause potential buyers to spend time in searching for a unit and owners are also subject to time cost for searching a buyer who may offer a higher price. Typically search characterize both buyers and sellers, as a result of which vacant homes waiting for buyers may exist even though the price “clears the market” in some sense. At the market price some home sellers may decide to keep their homes and continue to look for better offers. In other words there is a “reservation demand” from the owners themselves that balances out with the apparent excess supply in the form of vacancy.

Every housing unit in the market is unique in terms of quality, decoration, high/low floor, views, developers, location, etc. Given the uniqueness of each housing unit, price discovery is not as efficient as might be thought. In other words it is very difficult and time consuming for owners to obtain an accurate fair market price for their property. Sellers want to get the best price and search for the highest bidder, and the amount of time of this search is a key decision variable that is related

to the perceived marginal cost of search and the expected marginal benefit. Property developers have lots of units to be sold in the market and therefore they soon notice any difference in the speed at which the units are selling, and thus can respond with a price change quickly. Unlike a property developer, most sellers would only have one or two units to sell and they are also relatively inexperienced. If the market slows down, they may not be aware of it, and thus tends to be slow in revising the asking price. Leung (2006) recognized that fact that the uniqueness of housing unit and little experience selling for most home owners would produce price dispersion in the residential property market. The same is true for buyers who may have little experience buying, especially for first time buyers. They want to look for the better deal, and tend to extend their search time as long as the perceived benefit of search is higher than the cost. Different perceptions of these costs and benefits lead to divergent search time and possibly divergent offering prices. A higher price dispersion would induce owners and potential buyers to search further thereby increasing the natural vacancy rates.

Home owners who want to sell a unit face a trade-off between higher expected price offer and longer expected time to sell. The owner may hold a unit vacant in search for a buyer who is willing to pay a higher price. While buyers also take time to compare the price and quality of all available units for sale in the market. Both sides do not have perfect information of all available potential buyers and all available units for sale. The owners may be able to gain information by searching the market or depending on property agents. If the reservation price is set at a relative high level, the search time for a buyer would increase significantly in terms of longer expected time to sale. Novy-Marx (2009) pointed out that in the markets characterized by costly search, price is not the only variable that adjusts to clear

markets. A positive demand shock will bring more buyers to the markets, improving the relative position of sellers, who then can meet potential buyers more frequently, reducing the expected time to sale.

In the supply side, it is commonly believed that housing supply is fixed (or very inelastic) in short run. When there is a sudden increase in demand, the price will go up to clear the excess demand. The higher price for housing will then induce property developers to supply more housing units to the market as it becomes more profitable (long run supply is more elastic). However, developers production decision is not only based on current housing price level and current production costs but also on expected future price at which a flat will be sold, land availability for housing development and ability to expand production. It may take several years for the supply to adjust adequately to the price changes.

Under these conditions, it is possible for housing prices to overshoot upward in the short run (deviated from its long run equilibrium path) when there is a sudden increase in housing demand. In the longer term, property developers gradually react to the increase in profitability and therefore a much greater supply of housing units is forthcoming, it is therefore entirely possible that housing price will overshoot (downward) again at the time when the new supply flows into the market in the longer term. The end result is that housing market is often characterized by sustained periods of disequilibrium. Although price ups and downs guide the market toward new equilibrium, the failure of supply to adjust efficiently to price changes seems to be an important source of disequilibrium thereby generating boom and bust cycle in the housing market. In case of Hong Kong where land is scarce and residential units are largely produced in form of high-rise building, the time lag for supply to catch up

with demand appears to be very difficult.

### 3. Theoretical Considerations

The housing market has both a flow dimension and a stock dimension. New investment, the flow dimension, is the sum of construction of new housing units and depreciation of existing units. The long-run supply, or stock of housing, is the accumulation of the new investment. DiPasquale and Wheaton (1994, 1996) develop a stock-flow model and define the long-run equilibrium stock to be a function of price and a vector of cost-shifting variables (e.g. construction cost, land prices, interest rate). Housing demand theory defines the equilibrium demand for the current stock of housing as a function of price and a set of demand variables such as income, interest rate. The traditional assumption in the stock-flow model is that markets clear quickly and that prices adjust instantaneously to equate the demand for housing with the existing stock (see equation [1]). Where  $P$  is the housing price and  $X_1$  is the demand side variables such as interest rate, tax, income.  $P^*$  in equation [1] is the equilibrium prices that bring supply and demand in equilibrium. Equation [2] indicates a price adjustment mechanism where  $\sigma$  is the adjustment coefficient. If  $\sigma = 1$ , equilibrium price  $P^*$  at time  $t$  equals to actual price  $P$ . When  $\sigma < 1$ , it indicates the percentage at which actual prices would move to an equilibrium price (DiPasquale and Wheaton, 1994).

$$D_t(P^*, X_1) = S_t(P^*, X_2) \quad [1]$$

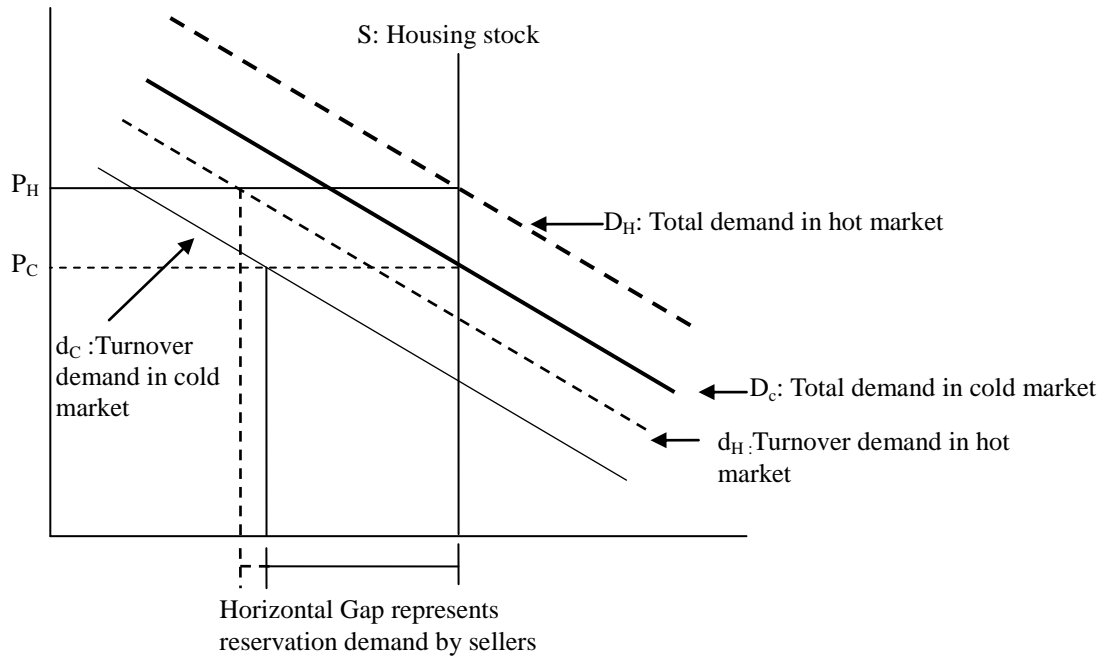
$$P_t = \sigma P_t^* + (1 - \sigma) P_{t-1} \quad [2]$$

In this study, I try to identify both the demand and supply side relations of private housing market in Hong Kong. The housing demand depends on the housing price (LnPPI) and a vector of demand-side variables  $X_1$ , ie. interest rate (PR) and income (LnGDP) and price expectation (EXP). This relation can be summarized by the equation [3].  $D$  is the total demand including turnover demand and potential sellers' reservation demand for total private housing stock. The housing stock was computed by using data on housing completions. Theoretically, quantity demand theory suggests that the housing demand is negatively related to housing price and so we will face a downward sloping demand curve. Conversely, the demand for housing is a negative function of the interest rate because higher interest rate increases the cost of consuming housing services (mortgage interest cost rise). In addition, income level would have a positive effect on housing demand. In housing economic literature, it is believed that price expectation is a key explanatory variable for housing demand. When people expect price will continue to go up further, end-user will enter the market to hedge for rising rental cost or mortgage payment and the price expectation will encourage investor to enter the market for short term profit or inflation protection. Given demand for housing is unobservable (actual transactions data may overstate the demand as housing units can be changed hands few times within a short period), a reduced form equation [ 5 ] is obtained by bring the equation [ 3 ] into [ 1 ].  $S$  is measured by the total stock of private housing units which is negatively related to housing price.

$$D_t = \alpha_0 + \alpha_1 P_t + \alpha_2 GDP_t + \alpha_3 PR_t + \alpha_4 EXP_t \quad [ 3 ]$$

$$( \alpha_1 < 0, \alpha_2 > 0, \alpha_3 < 0 \text{ and } \alpha_4 < 0 )$$

Figure 1. Turnover Demand, Reservation Demand and Supply



Note: Reservation demand is expected to fall with a higher price, given the same demand curve. In a hot market, however, potential sellers will search longer looking for a better price believing they can afford to wait. This translates to a higher reservation demand. This is as shown in the above diagram. However, the decline in reservation demand with a higher price for the same demand curve has not been shown for simplicity.)

$$S_t = \alpha_0 + \alpha_1 P_t + \alpha_2 PGDP_t + \alpha_3 PR_t + \alpha_4 EXP_t \quad [4]$$

$$P_t = \frac{\alpha_0}{\alpha_1} + \frac{\alpha_2}{\alpha_1} PGDP_t + \frac{\alpha_3}{\alpha_1} PR_t + \frac{\alpha_4}{\alpha_1} EXP_t - \frac{1}{\alpha_1} S_t \quad [5]$$

$$\Delta P_t = \frac{\sigma \alpha_0}{\alpha_1} + \frac{\sigma \alpha_2}{\alpha_1} \Delta PGDP_t + \frac{\sigma \alpha_3}{\alpha_1} \Delta PR_t + \frac{\sigma \alpha_4}{\alpha_1} \Delta EXP_t - \frac{\sigma}{\alpha_1} \Delta S_t + \sigma ECM_{t-1} \quad [6]$$

The estimated equation [5] is the long run housing price level given the demand side variables including per capita GDP, prime rate, expectation and stock of housing. As discussed in the last section, market clearing that equilibrates “turnover supply”



with “turnover demand” does not imply equilibrium in terms of longer term demand and longer term supply responses. Costly search (both buyers and sellers) and reservation demand from the home owners would fluctuate in the short term thereby contributing to a short term fluctuation in “turnover supply”, leading to a deviation of actual price from its long term value. Figure 1 illustrates that the turnover demand plus the reservation demand equal to the total demand or the total supply of housing stock. A rise in turnover demand to the right (from  $d_c$  to  $d_H$ ) may arise from buyers cutting down the time of their search or an increase in the number of buyers. This will trigger a rise in the price prompting home sellers to lengthen their time of search for higher bids as the marginal cost of searching a higher bidder is lower when there are more potential buyers in the market. This will immediately translate into higher reservation demand and reduce “turnover supply.” The total demand curve would shift from  $D_C$  to  $D_H$  and so the price level would be driven up in the short term to  $P_C$  from  $P_H$ . If the reservation demand drops when transactions increase, the price would be lie between the  $P_H$  and  $P_C$  depending on the changes in the level of reservation demand which depends on the marginal benefits and costs of searching faced both by the sellers and the potential buyers. While actual prices may deviate from their long run values temporarily but it should covert to its long run values in longer time horizon. The vector error correction model would help to investigate such adjustment. Let  $\Delta P_t$  denote the change in housing price at time t, and  $\Delta P = \sigma(P^e - P)$ , where  $\sigma$  capture the adjustment percentage at each period toward “the long run equilibrium”—which is the state consistent with “normal search” on the part of buyers as well as “on the part of sellers.” Any deviation from “normal” or “natural” search will trigger a momentary change in “turnover demand” or “turnover

supply.”<sup>17</sup> In the error correction model [ 6], ECM is the error correction term which equals to  $P_{t-1} - P^e_{t-1}$ , where  $P^e$  is the long run prices given the demand-side variables  $X_1$  and  $\sigma$  capture the adjustment percentage at each period toward the long run values.

The supply of housing follows a differential equation (see equation [ 7] ) where the stock slowly depreciates at a rate  $\delta$  and expands gradually with new construction,  $C$ , which depends on housing price,  $P$ , and other cost variables  $X_2$  such as land, interest, and building material cost. On the supply side, given that the demolition rate in Hong Kong during the last decade is just around 0.5% (Hong Kong Property Review, various years) and so I simply assume  $\theta$  equal to zero. Therefore, supply of private housing at any time equal to the new housing completion, i.e.  $\Delta S = C(P, X_2)$ . The supply side relations can be summarized by the equation [8]. The supply of housing as measured by the private housing completion (LnCOMP) is positively related to price so that the supply curve is upward sloping and the LnCOMP is negatively related to other cost variables  $X_2$ . In the study, costs are proxied by the land cost and interest rate. Given that the current price level and cost variables should not have any influences on current housing completion,  $C_t$  in equation [8] is defined to lead 4 quarters (t+4) ahead of the supply side determinants at time t. The  $C_t$  is a 4 quarter moving average data (average of current period and its past three quarters), therefore, any change in the independent variables will affect the future housing completion (around 1.5-2 years).

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<sup>17</sup> Some “norm” is implicit in the “long run.”

$$\Delta S_t = C_t - \delta S_t = \partial(S_t^*(P, X_2) - S_t) - \delta S_t \quad [ 7 ]$$

$$C_t = \beta_0 + \beta_1 P_t + \beta_2 PR_t + \beta_3 LAND_t \quad [ 8 ]$$

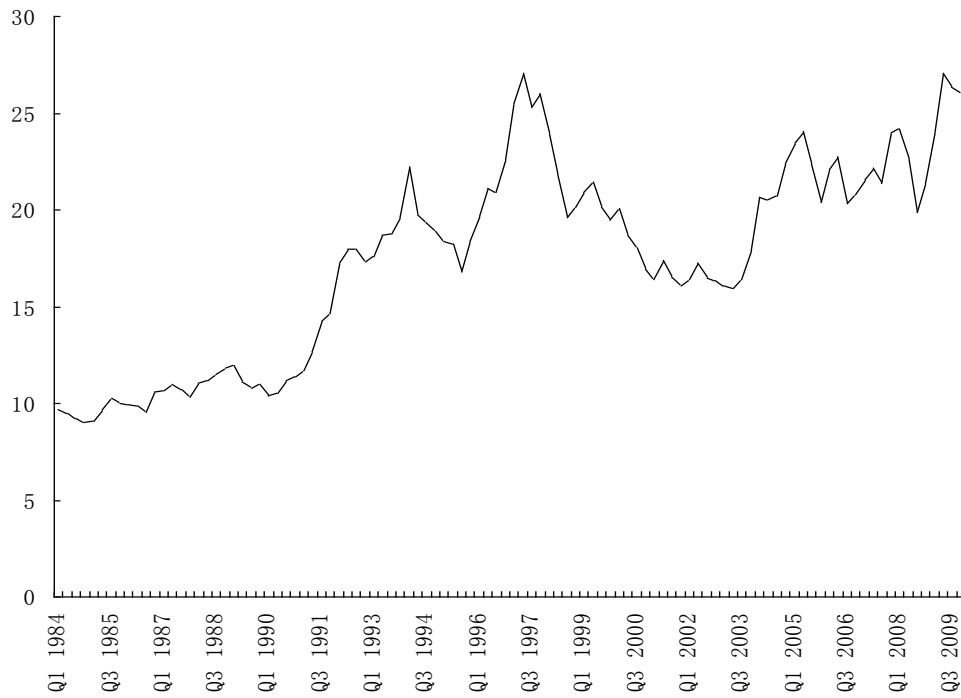
$$(\beta_1 > 0, \beta_2 < 0, \beta_3 < 0)$$

#### 4. Data and Methodology

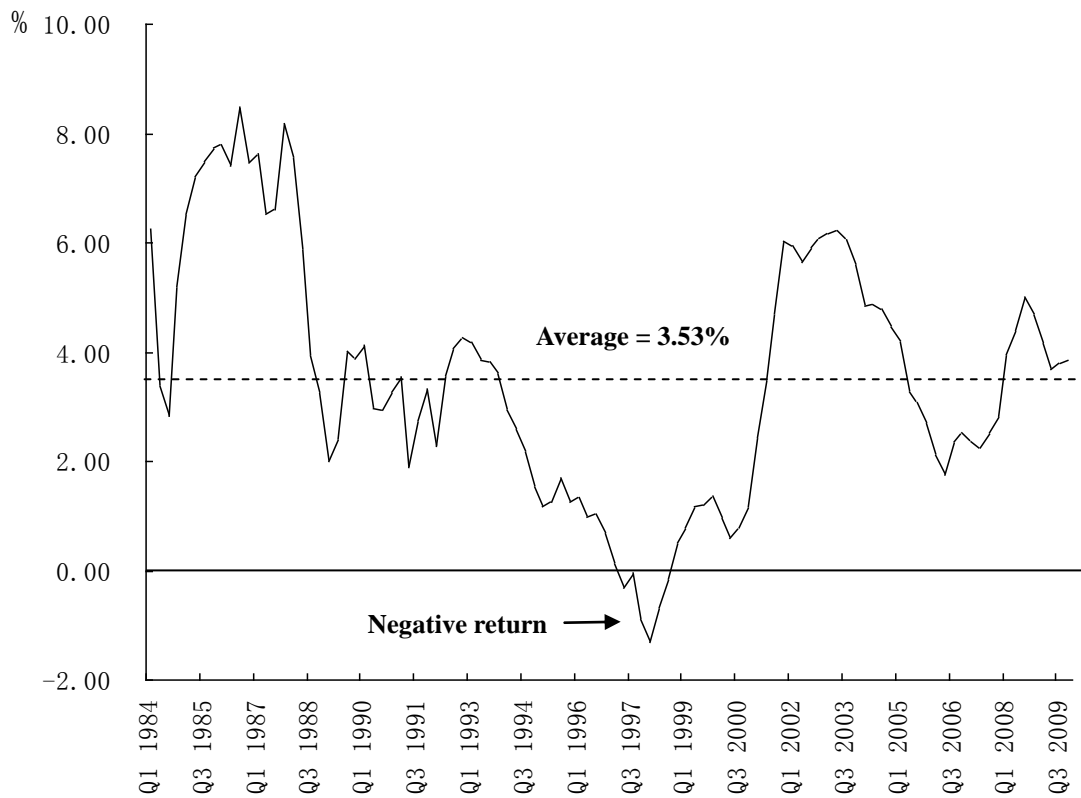
The land cost variable is an unpublished statistics conducted by the Censes and Statistics Department. All property developers (excluding those very small ones) in Hong Kong report an estimated land values for the first and fourth quarters including projects under construction and land reserve. It is believed that the land price is quite stable in short term so the data for second and third quarters are an average value of the first and fourth quarters ( $Q2 = Q1 + (Q4-Q1)/3$ , and  $Q3=Q2 + (Q4-Q1)/3$ ). It is noted that the data on land price is only available starting from 1985 to 2008Q4.

Many past studies indicate that price expectation play an important role in explaining housing price movements. Once prices have increased for a period of time, people would tend to believe that the upward trend will continue in foreseeable future (backward looking approach). Philips (1988) and Brown et al (1994) studies assumed that price expectations were formed by observing past and current values of different variables including inflation rate, interest rate. DiPasquale and Wheaton (1994) observed that using recent past prices data as a proxy for future price expectation would be problematic as they are highly correlated with the current price and therefore would lead to serial price correlation.

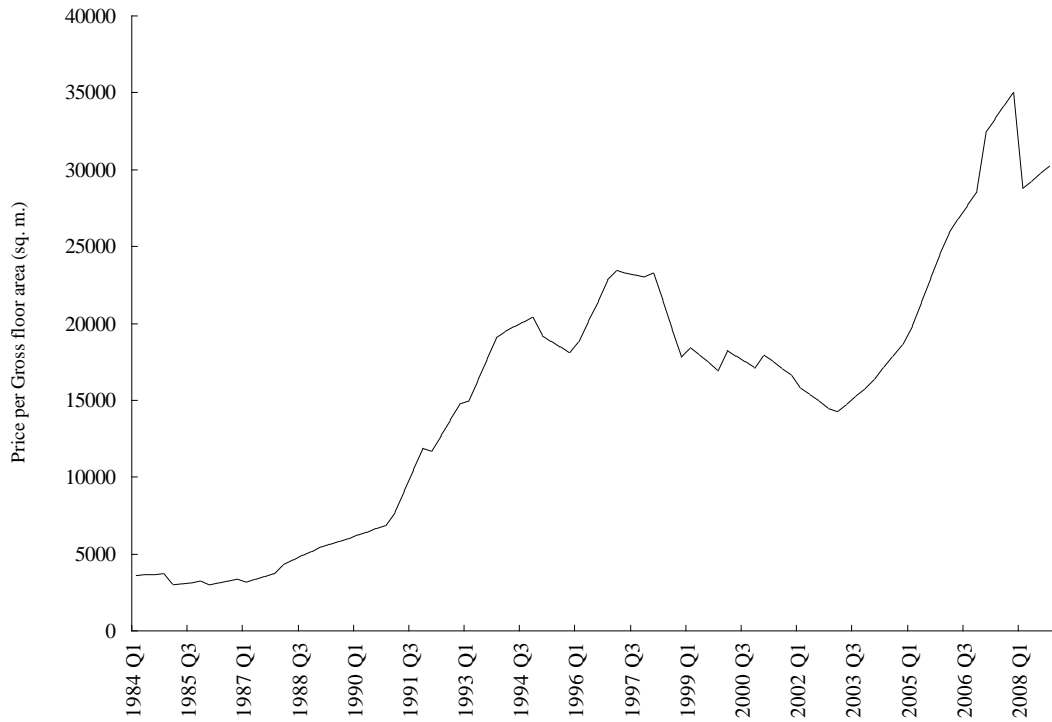
**Figure 2. Price Expectation Proxied by the Gross “PE” Ratio of Homes (1984-2009Q4)**



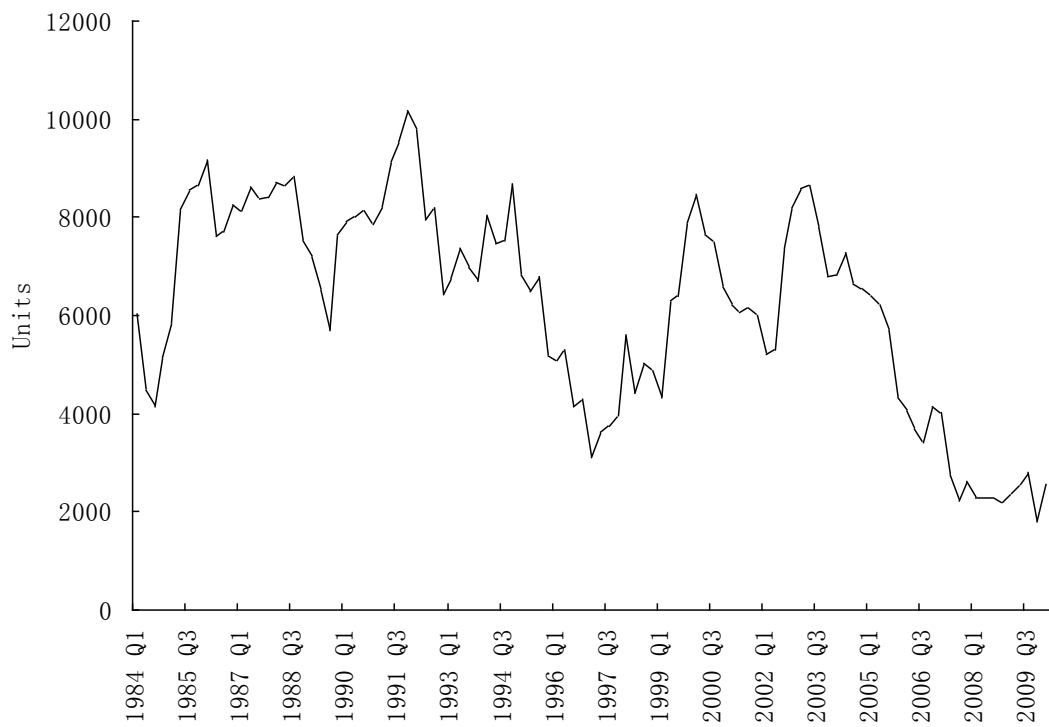
**Figure 3. Price Expectation Proxied by the Net Rental Yields (1984-2009Q4)**



**Figure 4. Estimated Land Price per GFA sq. m.  
(1984-2008Q4)**



**Figure 5. Private Housing Completions  
(1984-2010Q1)**



In this study, I borrow the concept of PE ratio in stock analysis to analysis the housing market. When a company with a higher PE ratio, investor would expect that the future profit growth rate (e.g. IT or new technology companies during IT bubbles) would be much faster than those company with low PE (e.g. public utilities companies). The “PE ratios” in housing market are calculated as follows: average property price/m<sup>2</sup> (P) to average rental income/m<sup>2</sup> per month X 12 (E) (data obtained from Hong Kong Property Review, various years). Figure 2 shows that PE ratio of Hong Kong housing market. As can be seen, the PE ratio peaked at 27 in 1997 and then dropped to about 16 in 2003. In recent months, the PE ratio appears to be approaching the peak in 1997 again. The willingness of people to accept a lower rental return in the property market in recent years could be a result of very low deposit rate. Instead of the gross rental yield, I shall consider the premium of the rental yield over the 3-months Hong Kong deposit rate. Based on this alternative measure, Figure 3 indicates a different pattern on picturing the housing price expectation. We can see that the yield (net return) equals to -1.3% in 1997 which means that people were willing to accept a negative return from rental income, indicating they should be very optimistic on the future price appreciation. The short term negative rental return was immaterial compared to the possible capital gain. In fact, housing unit as an illiquid asset should enjoy a higher return than holding cash. When people were willing to accept a negative net return, as in 1997, their expectation about price appreciation must be very optimistic. In 2009, even though the Hong Kong property price had risen over 30% from the bottom at the Financial Tsunami in late 2008, the net yield was still a positive 3.84% in 2009Q4 which is still higher the 25 years average (3.53%). The net yield variable is employed in this study as a proxy of price expectation. Given that the more negative net yield reflects higher price expectation, therefore, it is expected that the net yield and property

prices are negatively related.

For the source and definition of other variables that are analyzed, please see Appendix 1. Figure 4 – 5 show the movements of the key variables. This study employs quarterly data from 1984 to 2008. This is a period with a stable monetary regime as well as a period of relative political stability after the signing of the Sino-British Joint Declaration removing much of the uncertainty about Hong Kong future. This study basically follows the work of DiPasquale and Wheaton (1994) and Yong (2004) by using a cointegration approach which can help to identify any short-run and long run relations among variables and investigate the disequilibrium structure.

## 5. Empirical Results

### 4.1. Supply and Demand Dynamics of Housing Market

#### *a. Test Results for Unit Roots*

We begin the estimation by testing the stationary properties of the variables using the Augmented Dickey-Fuller (ADF) Test (Dickey and Fuller, 1981). The following equation is estimated for each of the time series:

$$\Delta X_t = \alpha_0 + \alpha_1 t + \beta X_{t-1} + \sum_{i=1}^k \delta_i \Delta X_{t-i} + \eta_t$$

where  $\Delta$  is the first difference operator,  $t$  is the time trend,  $k$  denotes the number of lags used and  $\varepsilon$  is the error term. The null hypothesis that series  $X$  is non-stationary can be rejected if  $\beta$  is statistically significant with negative sign. The

optimal lag  $k$ , is chosen by the Akaike Information Criterion (AIC). Table 1 shows that the test statistics for all the series in level form and in their first differences, respectively. The fact that the null hypothesis of unit root cannot be rejected when the series are in level but can be rejected when the series are in first differences clearly indicates that all the series in the system are integrated of order one, and therefore no further unit root tests are performed.

**Table 1. Augmented Dickey-Fuller Test of Unit Root (Period: 1984 to 2008 )**

Variable name	Test on	No Trend	Trend	Conclusion
LnLAND	Level	-2.3755	-1.2543	I(1)
	1st diff	-3.1851**	-3.8325**	
LnPGDP	Level	-2.4056	-1.2939	I(1)
	1st diff	-4.1315***	-5.0592***	
PR	Level	-2.6159*	-3.2236*	I(1)
	1st diff	-3.6437***	-3.8136**	
LnCOMP	Level	-1.5716	-2.2882	I(1)
	1st diff	-7.6831***	-7.8391***	
EXPIinverse	Level	-2.7600*	-2.9722	I(1)
	1st diff	-3.2357**	-3.2613*	
LnGSTOCK	Level	-1.9437	-2.3584	I(1)
	1st diff	-5.5817***	-5.6519***	
LnSTOCK	Level	-2.7057	-0.2987	I(1)
	1st diff	-2.8813**	-3.57014**	

Note:

1. 5% critical value for the augmented Dickey-Fuller tests that include constant; and constant plus trend = -2.8892 and -3.4500 respectively.
2. The numbers of lags in the two unit root tests are determined by the AIC
3. \*, \*\* and \*\*\* indicates 10, 5% and 1% significance level respectively.

#### ***b. Test Results for Cointegration***

The variables were largely confirmed by ADF test as in order one I(1), the next step is to carry out co-integration analyses of the variables. The cointegration analysis is applied to equation (5) and (9). I chose the lag structure by using the Akaike's



Information Criterion (AIC), which determines 3 lags in VECM.

The cointegration test results are presented in Table 2. The number of co-integrating vectors  $r$  is determined by reference to the  $\lambda_{\max}$  and the trace statistics. As can be seen,  $\lambda_{\max}$  statistics indicate that there are two cointegrating vectors ( $r = 2$ ) among the six variables at 5% significant level while the trace statistic indicate that  $r=3$ . The results are generally consistent with the previous discussion and I will proceed on the analysis with two cointegrating vectors.

**Table 2. Johansen Cointegrating Test Result (Period 1986 to 2008)**

Variables	Null Hypothesis	Alternative Hypothesis	Test Statistics
LnPPI, LnPGDP, PR, LnCOMP, LnLAND, EXPInverse, LnPSTOCK	Trace tests:		Trace Value
	$r = 0$	$r > 0$	178.88***
	$r \leq 1$	$r > 1$	112.68***
	$r \leq 2$	$r > 2$	74.01**
	$\lambda_{\max}$ tests:		$\lambda_{\max}$ Value
$r = 0$	$r = 1$	66.14***	
$r = 1$	$r = 2$	38.67**	
$r = 2$	$r = 3$	30.96	

Notes:

1. \*\*\* and \*\* denote 1% and 5% significant level respectively
2. Test assumption: Linear deterministic trend in the data
3.  $r$  indicates the number of cointegrating vectors.
4. Lags interval = 3 is determined by AIC criterion.
5. 98Q1 dummy is treated as exogenous variable

Having determined that the number of cointegrating vectors  $r = 2$ , the next step is to identify the cointegrating vectors and to test if the restrictions suggested by our theoretical model(i.e. including the demand side variables in the first cointegrating equation, and the supply side variables in the second cointegrating equation) are

statistically acceptable. The estimated cointegrating equations and the results on test of restrictions are reported in the Table 3. The LR static to the restrictions (i.e.  $H_0 = \beta_{14} = \beta_{15} = 0$  and  $\beta_{22} = \beta_{26} = \beta_{27} = 0$ ) is 6.7243 with a P-value of 0.081. Therefore, the restrictions are accepted and so our prior hypotheses are not rejected at 5% significant level.

**Table 3. Normalized Long-run Cointegrating Coefficients & Test of restrictions**

Variables	CointEq 2 (Demand Model) LnPPI	CointEq 2 (Supply Model) LnCOMP
LnPPI	1	-1.2609 (-4.1209)***
LnPGDP	-1.6797 (-15.2892)***	0.00
PR	0.0821 (6.9910)***	0.1549 (5.0685)***
LnCOMP	0	1
LnLAND	0	1.0793 (3.2102)***
EXPInverse	0.1106 (9.3099)***	0
LnPSTOCK	1.4478 (10.2283)***	0
Constant	-19.0037	-14.6363

Test of cointegration restrictions:

$$H_0 = \beta_{14} = \beta_{15} = 0 \text{ and } \beta_{22} = \beta_{26} = \beta_{27} = 0$$

LR Test:  $\chi^2 = 6.7243$ , p-value = 0.0768

- Notes:
1. \*\* and \*\*\* denotes significance at 5% and 1% level respectively.
  2. Numbers in parentheses are t-statistics.

All variables in cointegrating equation 1 and 2 carry with a significant expected signs. The first cointegrating vector (demand side) suggests there is a negative relation between prime rate, private housing stock, expectation (more negative = higher expectation) and property price. The housing demand is positively related to the PGDP. The second vector (supply side) suggests the private housing completion is positively related to the property price, and negatively related to the cost variables: prime rate and land Price.

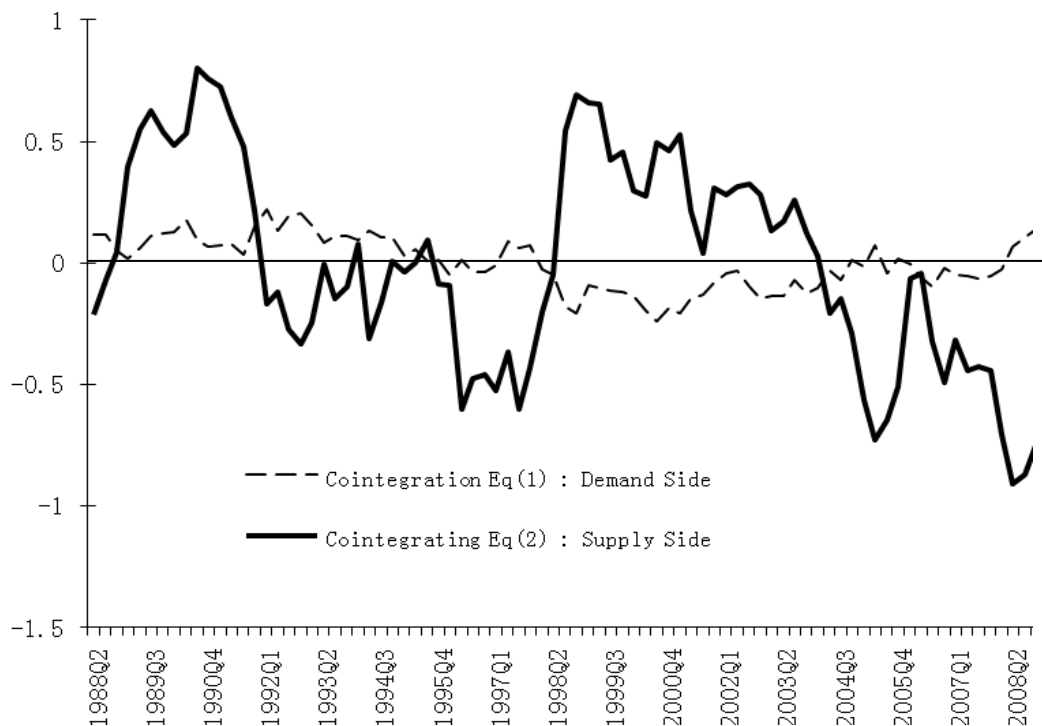
### *c. Identifying Long Run Relation*

The above modeling identifies two long run relations among the six variables i.e. for the 1) demand side:  $\text{LnPPI} = 1.6797 \cdot \text{LnPGDP} - 0.0821 \cdot \text{PR} - 0.1106 \cdot \text{EXPInverse} - 1.4478 \cdot \text{LnPSTOCK} + 19.0037$  and for the 2) supply side:  $\text{LnCOMP} = 1.2610 \cdot \text{LnPPI} - 0.1549 \cdot \text{PR} - 1.0793 \cdot \text{LnLAND} + 14.6363$ . Figure 5 shows the two restricted cointegrating vectors. Both vectors appear to be stationary throughout the study period and mean reverting. The deviations of the vectors to its long run value can be regards as short term disequilibrium or shocks in the housing demand and supply.

As can be seen in the Figure 6, the demand of the stock of housing in general appears to be quite stable between 1985 and 1997 given the prevailing level of income, housing price and interest rate. The demand of the stock of housing had experienced an obvious decline from 1997 to 2003. The period covered both the Asian Financial Crisis and the Tenants Purchase Scheme (TPS)—the public housing privatization program of the Housing Authority. The first paper provided strong evidence that the effect of TPS on the demand for housing was significantly larger than that of the Asian Financial Crisis. In 1996 and 1997 close to 10,000 households

gave up their units each year, after 1997 the flow out of public rental housing fell suddenly. The immediate effect of the TPS is that buyers almost disappeared completely from the HOS market. The prices of private housing units, which had all along depended on HOS owners to trade up, also plummeted. We should therefore expect that the housing price should decrease in order to ensure the housing demand would adjust upward to its long run level. The adjustment took few years and until 2004, we could see there was a strong rebound in the demand for housing.

**Figure 6. Residuals from CointEq1 (Demand Side) & CointEq2 (Supply Side)**



Note:

Cointegrating Eq(1):  $\text{LnPPI} = 1.6797 \cdot \text{LnPGDP} - 0.0821 \cdot \text{PR} - 0.1106 \cdot \text{EXPInverse} - 1.4478 \cdot \text{LnPSTOCK} + 19.0037$

Cointegrating Eq (2):  $\text{LnCOMP} = 1.2610 \cdot \text{LnPPI} - 0.1549 \cdot \text{PR} - 1.0793 \cdot \text{LnLAND} + 14.6363$

On the supply side, as can be seen in the Figure 6, the supply of private housing in general appears to have been quite fluctuated between during the study period given the prevailing level of housing price, land cost and interest rate. In 1996,

LnCOMP obviously had been below its desired level significantly. This could be the outcome of the anti-speculation measures announced in June 1994. The property price had been dropped nearly 2 years afterward. Since the building of new units needs to take few years to complete, the response of supply would be very slow (inelastic) in the short run. Therefore, the supply gap was occurred 2 years later in response to the introduction of anti-speculation measures and policy uncertainty.

On the other hand, during 2000 and 2003, we can see the supply of housing returned to above its long run desired level. This could be the result of the slow supply response to the high level of housing price during 1996-1997, contributing to an overshooting in supply in 2000 to 2003. The increase in supply during this period was also attributed to the 85,000 announced in 1997. For the vector to return to its long run level, either the supply of housing or housing price (or both) must adjust downward. Therefore, unless the supply of housing contracted significantly, it is expected that the housing prices should decrease. This is also consistent with the evidence of the housing price downward trend during the 2000 and 2003.

In view of the continuing weakness of the housing market—amounting to close to 70% of decline since the peak in 1997, the government essentially reversed its earlier policy of increasing supply and selling public housing cheaply. Housing Secretary Michael Suen announced “Nine measures” to stabilize the market in late 2002.

From then on the government began to control the land supply through the *land application list system*. Since then, the supply of private housing has dropped below the equilibrium for a few years and we can see the disequilibrium was relatively

large in 2008. In retrospect, the Hong Kong government intervened the housing supply three times, i.e. in 1994, 1997 and 2002. Intervention each time, however, would only end up with either a surplus or a shortage in supply a few years after policies were implemented, undermining the market forces to restore equilibrium. This time around, however, reversing the TPS program has been seen as fundamental to the long term recovery of the Hong Kong housing market (Ho and Wong, 2005).

#### *d. Impulse Responses*

The above analysis provides evidence on the existence of long-run cointegrating relations among the variables. To provide a more comprehensive analysis of short term dynamic properties of the model, the impulse response analysis will be conducted in this section.

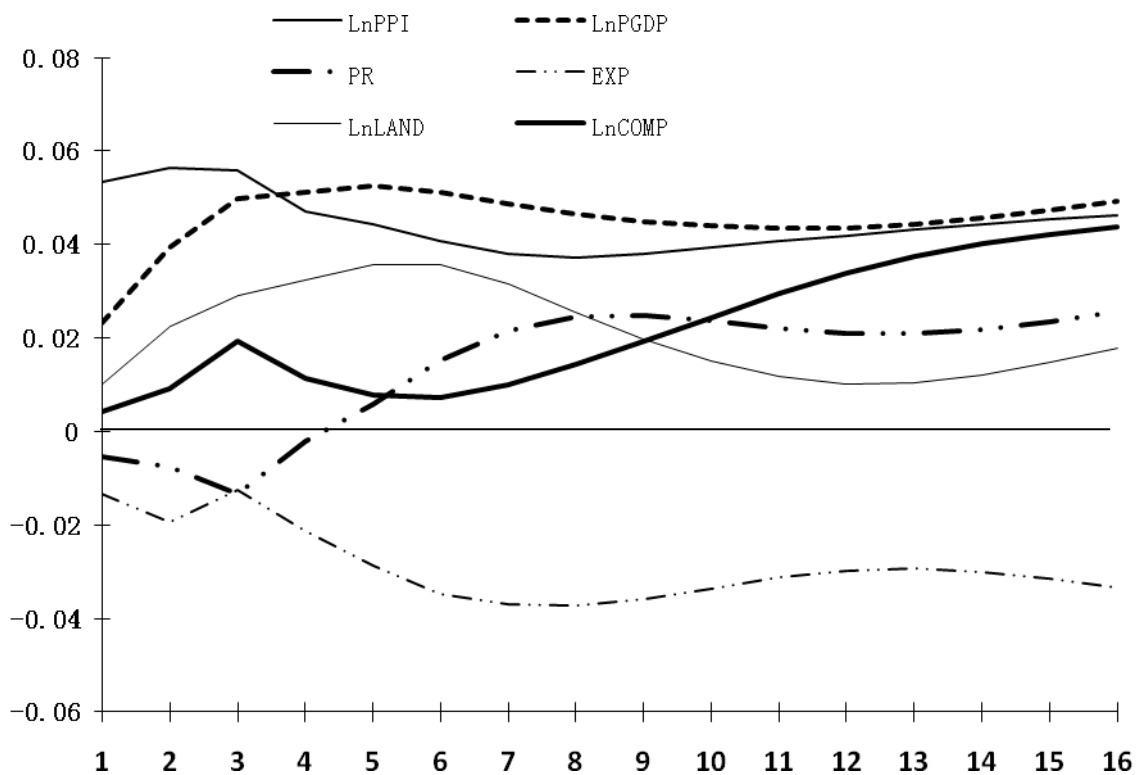
Impulse response functions show the response paths of each endogenous variable to a one-time shock (=one standard deviation) to other variables in the system. As far as the research focus is concerned, I am interested in the responses of LnCOMP and LnPPI to shocks in other variables<sup>18</sup>. Figure 7 plots the response of LnPPI to various shocks. As can be seen, the negative effects of PR and LnCOMP on LnPPI are strong in the short term and these impacts are weakened in the long run and the impacts of interest rate is even positive in longer time horizon. A shock to LnLAND and LnPGDP induce strong positive impacts on LnPPI, in particular, the impact of shock in LnPGDP on LnPPI is very significant in short run and this effect will remain over time. As expected, the EXP has a negative impact on the LnPPI and the impact will remain over a longer time horizon.

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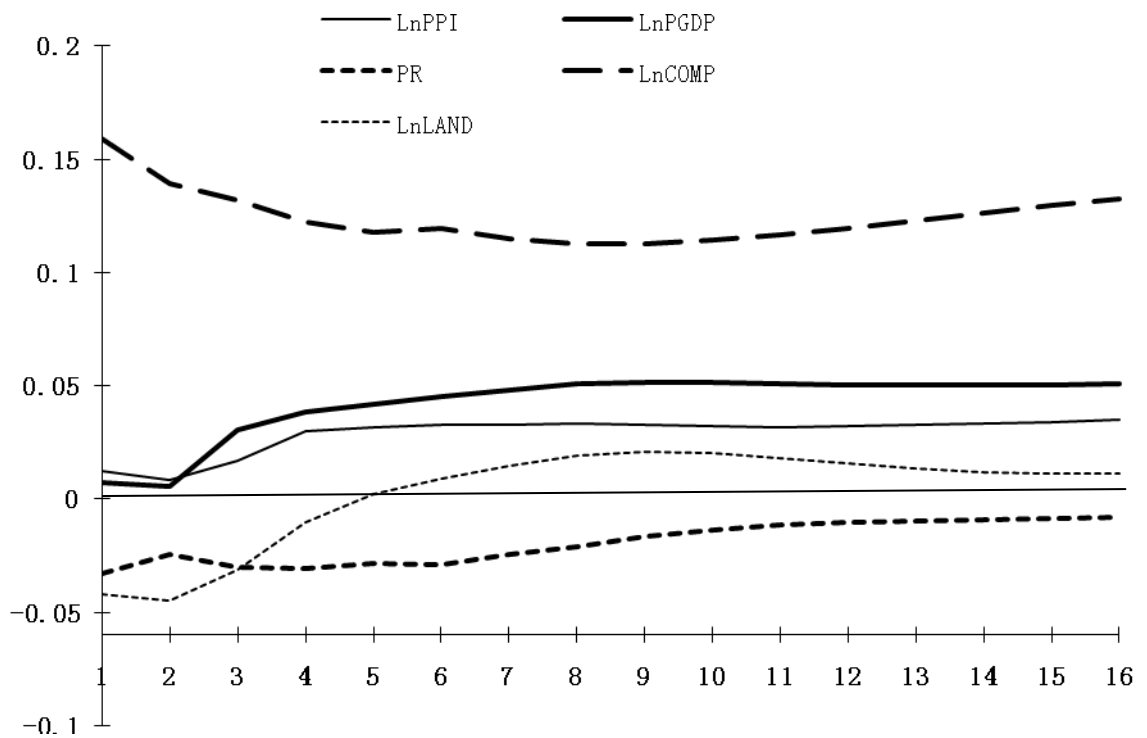
<sup>18</sup> The results are insensitive to different ordering of the variables.

Figure 8 shows the responses of LnCOMP to one standard deviation shocks in LnPPI, LnPGDP, PR, LnLAND, EXP. The negative effect of LnLAND on LnCOMP is quite substantially negative in the short term and its effect remains stable in the long run. A shock to housing price (LnPPI) has no impacts on completion for the first two quarters and it induces only a moderate increase in LnCOMP after four quarters and then the positive effect remains stable up to 20 quarters. A shock to LnPGDP on LnCOMP is also positive in short run only (up to 2 quarters) and diminishes eventually. Interest rate only generates a short term impacts on LnCOMP. Overall, the supply of housing are not responsive to housing price in short run supporting the views that there is a large constraints on the supply side of the market.

**Figure 7. Impulse Responses of LnPPI to One Standard Shocks**



**Figure 8. Impulse Responses of LnCOMP to One Standard Shocks**



***e. Price Expectation and Supply Dynamics***

As mentioned, government intervention often ends up with either a surplus or a shortage in supply. Given that any plan to increase supply will not affect actual supply after at least three or four years, trying to adjust the supply to demand appears to be out of the question. In recent months, there is a widespread belief that with the supply of housing remaining at historical low levels for the coming few years, housing price should continue to go up further in foreseeable future. Instead of trying to adjust supply to a fluctuating demand, should the government set up an annual production target, such as one based on a 10 year average of housing units taken up , or one based on household formation or other demographic data? In this section, I will investigate the relation between the future private housing production (actual total completion for coming two year) and price expectation.



The cointegration test results are presented in Table 4. The number of co-integrating vectors  $r$  is determined by reference to the  $\lambda_{\max}$  and the trace statistics. As can be seen,  $\lambda_{\max}$  statistic indicates that there is one cointegrating vectors among between the two variables at 10% significant level while the Trace statistic indicates that there is no cointegration. I will proceed on the analysis with one cointegrating vector.

**Table 4. Johansen Cointegrating Test Result (Period 1986o 2008)**

Variables	Null Hypothesis	Alternative Hypothesis	Test Statistics
EXP and lnFCOMP	Trace tests:		Trace Value
	$r = 0$	$r > 0$	12.56
	$r \leq 1$	$r > 1$	0.18
	$\lambda$ max tests:		$\lambda$ max Value
	$r = 0$	$r = 1$	12.38*
	$r = 1$	$r = 2$	0.18

Notes:

1. \* denotes 10 % significant level
2. Test assumption: Linear deterministic trend in the data
3.  $r$  indicates the number of cointegrating vectors.
4. Lags interval = 2 is determined by AIC criterion.
5. 98Q1 dummy is treated as exogenous variable

**Table 5. Normalized Cointegrating Coefficients Using the Johansen Procedure**

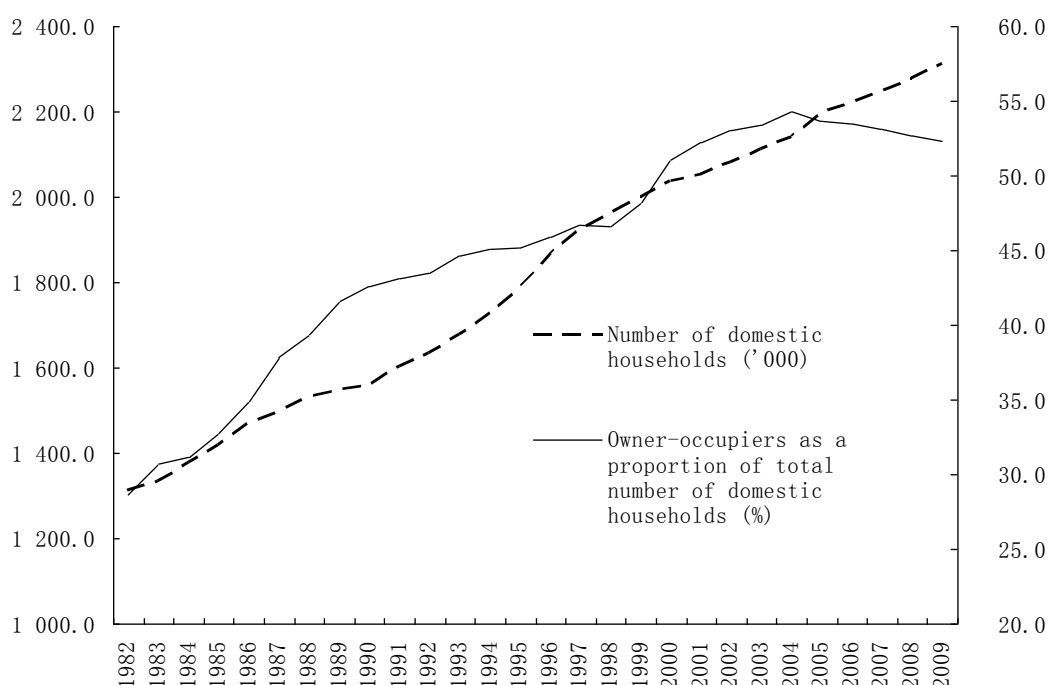
Cointegrating equation:	Coefficient	t-statistic
EXP = $f$ (LnFCOMP)		
EXP	1	
LnFCOMP	-4.5894	2.4882**

- Notes:
1. \*\* denotes significance at 5% level
  2. optimal lags are determined by AIC criterion.
  3. D98 and interactive dummies are treated as exogenous I(0) variables in the cointegrating equation.

The estimated cointegrating equation is reported in the Table 5. The completion of private housing units for  $t + 8$  (2 years) is positively related to the EXP at time  $t$ .

The coefficient is significant with the expected sign. That is: the lower the completion of private units for the coming two years, the higher will be the expectation for a price increase today and therefore affect the current housing price level. Hong Kong's experiences tell us that the government intervened the market when it almost at the peak or bottom of the cycle while the economic cycle could change much faster than the changes in supply as it is very inelastic in the short run.

**Figure 9. Number of Domestic Households ('000) and Owner-occupiers % 1982-2009**



Notes: Owner occupies including private housing and subsidized sales flats.

Source: Quarterly Report on General Household Survey, Censuses and Statistics Department of HKSAR

Just as William Poole (2001) observed, it is very important that the central bank not take a position on the level of prices in asset markets. "It is very easy to be wrong about the appropriate level; the judgment ought to be left to the market." For a small open economy blessed with low tax rates, respect for the rule of law, excellent infrastructure and market institutions, a well educated labor force, an efficient civil

service, and laissez faire policy, housing and office prices are likely to be high because these favorable factors tend to attract capital. But this is in itself not a cause for concern. If the importance of the housing sector in the economy is a natural outcome of market forces and the natural development of the economy, there must be a good reason for it. On the other hand, it will not be desirable to artificially boost housing prices by limiting supply or cool down the market by boosting supply. The supply should be set at levels commensurate with the needs of the community as suggested by such factors as household formation and general economic conditions. In fact, the demand for housing are relatively stable, the government can set up a production target using the past 5 or 10 years housing unit take up or household formation data as a reference (Figure 9). Potential home buyer's price expectation would be more stable if the future supply is certain.

***f. Causality between Property Price and Land Price***

This section attempts to test the direction of causality between LnLAND and LnPPI. The short-run causal relation between the variables can be investigated by applying a Wald  $\times 2$ -test of the joint significance of the lags of other explanatory variables based on the equations [9] and [10],. As far as the focus is concerned, the null hypothesis being tested are:  $H_0 : \beta_4 = 0$  (eq 9) and  $H_0 : \beta_1 = 0$  (eq 10). The results of temporal Granger causality test is shown in the Table 6. Clearly, only the null hypothesis of LnLAND does not Granger-cause LnPPI is rejected at 10% significance level. Therefore, based on the result, we can conclude that the direction of causality only runs from LnLAND to LnPPI but not the other way round.<sup>19</sup>

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<sup>19</sup> It should be noted that the Granger causality test does not by itself establish any causal relationship. It does, however, provide a test to falsify any hypothesized causal relationship.

$$\begin{aligned}
\Delta \text{LnPPI}_t = & \alpha_1 + \sum_{i=1}^k \beta_1 \Delta \text{LnPPI}_{t-i} + \sum_{i=1}^k \beta_2 \Delta \text{LnPGDP}_{t-i} + \sum_{i=1}^k \beta_3 \Delta \text{LnPR}_{t-i} \\
& + \sum_{i=1}^k \beta_4 \Delta \text{LnCOMP}_{t-i} + \sum_{i=1}^k \beta_5 \Delta \text{LnLAND}_{t-i} + \sum_{i=1}^k \beta_6 \Delta \text{EXP}_{t-i} \\
& + \sum_{i=1}^k \beta_7 \Delta \text{PSTOCK}_{t-i} + \theta_{1,1} \gamma_{1,t-1} + \theta_{1,2} \gamma_{2,t-1} + \varepsilon_{1,y}
\end{aligned}$$

[ 9 ]

$$\begin{aligned}
\Delta \text{LnLAND}_t = & \alpha_1 + \sum_{i=1}^k \beta_1 \Delta \text{LnPPI}_{t-i} + \sum_{i=1}^k \beta_2 \Delta \text{LnPGDP}_{t-i} + \sum_{i=1}^k \beta_3 \Delta \text{LnPR}_{t-i} \\
& + \sum_{i=1}^k \beta_4 \Delta \text{LnCOMP}_{t-i} + \sum_{i=1}^k \beta_5 \Delta \text{LnLAND}_{t-i} + \sum_{i=1}^k \beta_6 \Delta \text{EXP}_{t-i} \\
& + \sum_{i=1}^k \beta_7 \Delta \text{PSTOCK}_{t-i} + \theta_{1,1} \gamma_{1,t-1} + \theta_{1,2} \gamma_{2,t-1} + \varepsilon_{1,y}
\end{aligned}$$

[10]

**Table 6. Temporal Granger Causality Test Result**

Dep.Variable	Null Hypothesis	Chi-sq	Prob
DLnLAND	LnPPI does not cause LnLAND	1.3547	0.7162
DLnPPI	LnLAND does not cause LnPPI	6.7039	0.0820*

Notes:

1. \* denotes significance at 10%.
2. D denotes first difference

The result appears opposite to what economic theory would predict. As the land input is a derived demand of housing production which is driven by housing price, the direction of causality should run from land price to housing price. Nevertheless, every housing unit in the market is unique in terms of quality, decoration, high/low floor, views, developers, location, etc. Given the uniqueness of each housing unit, price discovery is not as efficient as might be thought, in other words it is therefore very difficult and time consuming for owners to obtain an accurate fair market price for their property. Perhaps, people may have to check recent property transactions with similar characteristics and then compare with their one, and even different

banks or property appraisers would provide different price estimations to a flat. These indicate an accurate estimated price of property involves a high information cost.

On the other hand, the result of land auction is dispatched quickly and understood easily. The land auction results also reflect the expectation of future housing price estimated by property developers. In this sense, it is entirely possible for the causality to run from the land price to housing price. Having said this, it remains true that past land prices do not imply today's housing prices, for housing prices tend to be forward looking and not backward looking.

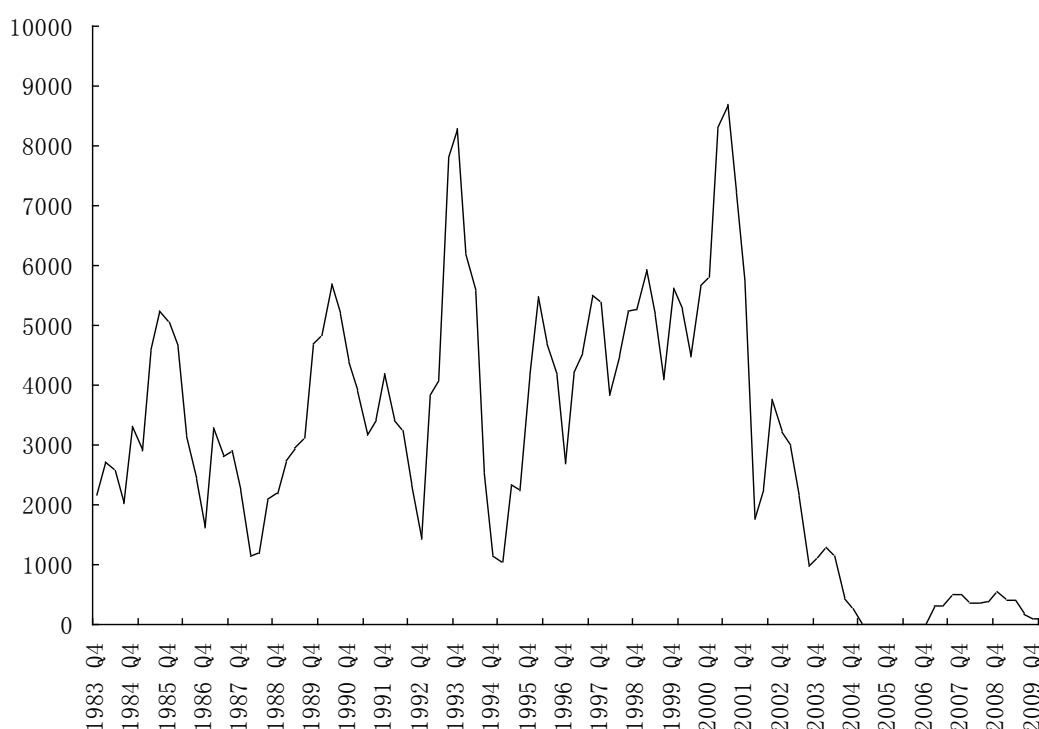
#### **4.2 Supply of Subsidized Sale Unit (HOS): Does it Affect Private Housing Market?**

In recent years, some commentators argued that the increase in supply of housing, in particular, the HOS housing would produce negative impacts on housing price and transaction. In fact, HOS housing is not a new thing to the public and it has long been an important part of housing market during the 1980s and 1990s.

I argued that the HOS housing unit provided public housing tenants with the first step in the home ownership ladder so that they could begin to move up to higher quality housing. HOS housing is in the middle of the homeownership ladder between public housing and private housing. The homeownership ladder refers to the tendency for homeowners to trade their existing homes for more expensive, better homes when they have accumulated sufficient equity in their homes and other savings, and when their ability to service larger loans has gone up. Both

Ortalo-Magne and Rady (2006) as well as Ho, Ma, and Haurin (2008) provided theoretical frameworks explaining the working of the homeownership ladder. For a tenant to become a homeowner, he will need to have accumulated enough savings for the down-payment, which is not only always required in Hong Kong<sup>20</sup> but will help reduce the mortgage payments down the road.

**Figure 10. Completion of HOS housing 1983Q4-2010Q1 (average of 4 quarters)**



Source: Hong Kong Monthly Digest of Statistics, various years, Censuses and Statistics Dept of HKSAR government

Prior to 1998, HOS homeowners always made a handsome profit when they eventually sold their units, notwithstanding the repayment of the implicit land cost subsidy. They could sell their units in the open market after having lived in their units for over 10 years upon repaying such premium subsidies. Starting in June

<sup>20</sup> Banks are not permitted to lend more than 60% or 70% of their appraised values, depending on the value of the homes. In recent years, this was relaxed but only if the borrower pays an extra premium and gets coverage for default insurance.

1997, there was a new arrangement called the HOS Secondary Market, which is a market with buyers restricted to “Green Form Applicants,”<sup>21</sup> who are predominantly public rental housing tenants. HOS owners were allowed to sell from the fourth year after purchase provided that they sold to such Green Form Applicants, and as long as they sell to such applicants, they would not need to repay the implicit land cost subsidy.<sup>22</sup> The fact that such transactions in the “secondary market” in 1997 were at very high prices (see Table 7) suggest that many public housing tenants were really cash-rich and that they had indeed played an important part in the very strong housing market in 1996 and 1997 at the time.

**Table 7. Actual Transactions of HOS Units in the Secondary Market, Fu Keung Court\***

<b>Usable floor area</b>	<b>High, Middle, or Low Floor</b>	<b>Date of Agreement to Purchase</b>	<b>Price US\$,000</b>	<b>Land Premium Discount Rate(%)</b>
644	Middle	09/1997	506.4	29
644	High	11/1997	461.2	29
645	Middle	04/1998	328.2	29
645	Middle	10/1998	253.8	35

\* Fu Keung Court in Wang Tau Hom. An exchange rate of HK\$7.8 to 1 US dollar is assumed. Sellers do not have to pay the land premium discount when they sell in the secondary market that is restricted to public housing tenants. The buyer will however have to repay the land premium discount upon resale in the future. The land premium discount is calculated from the formula (Market Price – Sale Price)/Market Price at the time of original purchase. Source: Downloaded from Housing Authority website at the time of writing from: [http://www.housingauthority.gov.hk/chi/hd/hos/s\\_market/index.htm](http://www.housingauthority.gov.hk/chi/hd/hos/s_market/index.htm)

<sup>21</sup> Other “Green Form Applicants” include: Authorized occupants of Interim Housing (IH) of the HA, Allowance recipients of the HA's Rent Allowance for Elderly Scheme (RAES); Applicants on the Waiting List, Junior civil servants applying for the HALS under the Civil Service Public Housing Quota, Clearerees and victims affected by clearance and natural disaster respectively, or Domestic tenants affected by Urban Renewal Authority's redevelopment programme. or Divorcees / splitting households of the HA estates who are issued with Green Form Certificates.

<sup>22</sup> From June 1999, HOS owners can sell after two years from the date of purchase in the secondary market without repayment of the land premium subsidy. The open market resale date was also reduced from 10 years to 5 years.

The policy to deny well-off tenants the benefits of housing subsidies was further stepped up in June 1996. Tenants paying double rent were required to declare their assets and would be required to pay market rent if the values of these assets exceeded specified limits. This policy provided a big incentive for the well-off tenants to buy in the private market or HOS housing and gave much impetus to housing prices through 1997. It is not surprising that 1996 and 1997 were the years with the greatest number of public housing units returned to the Housing Authority on record.

A number of studies lend support to the ladder effect hypothesis. Stein(1995) suggests that transactions at the lower tiers of the housing ladder, which may be triggered by price increases, will lead to more transactions up the ladder. Ho, Ma, and Haurin (2008) further shows that housing prices of lower-tier housing lead housing prices in higher tiers, and that lower-tier housing transactions lead higher-tier housing transactions. In this section, I will investigate the relation between the actual completion of HOS housing and housing price by using the cointegration method. As the HOS housing served as the second step for public housing tenants to trade up in the ownership ladder, and part of the HOS owners will trade up for more expensive private housing after they have accumulated sufficient equity (through increase in price and increase in their ability to service larger loans), the completion of HOS unit should be positively related to the housing price in the long run. The dependent variable for the test is LnPPI. The explanatory variables include the log of the exports (LnTX), mortgage rate (MR), price expectation (EXP) and the log of the completion of HOS unit (LnGCOMP).



**Table 8. Johansen Cointegrating Test Result (Period 1985 to 2009Q4)**

Variables	Null Hypothesis	Alternative Hypothesis	Test Statistics
LnPPI, LnEX, MR, EXP, LnGCOMP	Trace tests:		Trace Value
	$r = 0$	$r > 0$	84.83***
	$r \leq 1$	$r > 1$	51.96**
	$\lambda$ max tests:		$\lambda$ max Value
	$r = 0$	$r = 1$	32.88*
	$r = 1$	$r = 2$	23.51

Notes:

1. \* denotes 10% level
2. Test assumption: Linear deterministic trend in the data
3. r indicates the number of cointegrating vectors.
4. Lags interval = 3 is determined by AIC criterion.
5. 98Q1 dummy is treated as exogenous variable

**Table 9. Normalized Cointegrating Coefficients Using the Johansen Procedure**

Cointegrating equation:	Coefficient	t-statistic
LnPPI = $f$ (LnEX, MR, EXP, LnGCOMP)		
LnPPI	1.0000	
LnPGDP	-0.7756	-2.8178**
MR	0.0727	1.7209*
EXP	0.1663	2.8791**
LnGCOMP	-0.0235	-4.5799***

Notes:

1. \*\* and \*\*\* denote significance at 5% and 1% level respectively.
2. optimal lags are determined by AIC criterion.
3. D98 and interactive dummies are treated as exogenous I(0) variables in the cointegrating equation.

The cointegration test results are presented in Table 8. The number of co-integrating vectors  $r$  is determined by reference to the  $\lambda$ max and the trace statistics. As can be seen, the Trace statistics indicate that there are two cointegrating vectors among the four variables at 5% significant level while the  $\lambda$ max statistic indicates that there is only one cointegration among the variables. I will proceed on the analysis with one cointegrating vector.

The next step is to identify the cointegrating vectors. The estimated cointegrating equation is reported in the Table 9. All variables in cointegrating equation carry the expected signs. The completion of HOS housing unit (LnGCOMP) is positively related to the LnPPI. The coefficient is very significant, while the positive effect is modest compared to that of LnPGDP on the housing price. In contrast to the widely held view that the supply of HOS housing would generate negative impact on the prices of private housing market, the findings indicate that HOS housing is an important part in the Hong Kong housing ecology and it is beneficial to both the public housing tenants and private housing owners in the long run.

## **6. Conclusions**

This study attempts to investigate the disequilibrium dynamics of private housing market in Hong Kong. By using the cointegration approach, the paper identifies two stable cointegrating relations, ie. a long run demand side relation between property price, prime rate, income, price expectation and stock of private housing, and supply side relation between private housing completion, property price, prime rate and land cost, which shows a short run disequilibrium dynamics in demand and supply of private housing during 1988 – 2008. Between 1985 and 1997, the demand of the stock of housing in general appears to have been above its long run desired level while the supply of housing has been relative stable, moving around its long run desired level. There had been a positive supply shock and negative demand shock from 1998 to 2003. Impulse response and variance decomposition indicate that private housing completion responses very slowly to shock in housing price indicating a main source of inefficiency in the housing market. The findings

also indicate that the supply of HOS housing will not produce negative impacts on the price housing sector.

**Table 10. List of Variables and their Definitions**

<b>Short form</b>	<b>Description</b>	<b>Data Sources</b>
LnPPI	Log property price index (overall private domestic housing market 1999=100)	Hong Kong Property Review, Rating and Valuation Dept HKSAR Government
LnCOMP	Log Private Residential Completion Unit (average of current period and its past three quarters)	Hong Kong Monthly Digest of Statistics, Hong Kong Census and Statistics Dept, HKSAR Government
LnFCOMP	Log Private Residential Completion Unit (2 years total completion)	Hong Kong Monthly Digest of Statistics, Hong Kong Census and Statistics Dept, HKSAR Government
LnGCOMP	Log Subsidized sales Residential Completion Unit (No. of HOS housing unit completed by HA and HS)	Hong Kong Monthly Digest of Statistics, Hong Kong Census and Statistics Dept, HKSAR Government
LnPSTOCK	Log Private Housing Stock (No. of unit)	Hong Kong Monthly Digest of Statistics, Hong Kong Census and Statistics Dept, HKSAR Government
LnPGDP	Log Gross Domestic Product, Per capita (Current price, seasonal adjusted)	Hong Kong Census and Statistics Dept, HKSAR Government
LnLAND	Log Estimated Land Price per GFA sq. m (Current Price)	Unpublished Statistics conducted by the Censes and Statistics Dept, HKSAR Government
EXPIinverse	Inverse of Housing price expectation: The property market yields: $E / P * 100$ mins the 3-months Hong Kong deposit rate (in percentage)	Hong Kong Property Review, various years, Rating and Valuation Dept and Monthly Statistical Bulletin, various issues, HKMA
PR	Prime Rate (in percentage)	Monthly Statistical Bulletin, various issues, HKMA

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