Current Issues on Housing Prices in Korea

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This study analyzes certain aspects of the housing price in Korea, utilizing quarterly data for 1987:Q1 – 2003: Q2. The results indicate that interest rate and *chonsei* price are important factors affecting housing price. The expected growth rate of housing price is a crucial determinant of housing price in certain areas such as *Gangnam*, while the same phenomena is not found for *Gangnam* area. Seoul. Further, the changes in housing price in *Gangnam* area is found to affect that in *Gangbuk* area, while the same effect is not significantly found when the roles are reversed. Government policies to encourage the housing market in general did not achieve the aims until 2003.

Key Words: Housing market, Interest rates, The expected growth rate of price, Government policy

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1. Introduction

The housing market and related issues have strong implications for the Korean economy. As of the end of 2003, the market value of houses and residential land in Korea exceeded 781 trillion won, which was larger than Korea's nominal GDP for the same year. Also, it is believed in Korea that the real estate market is closely linked to the national economy, in particular, business cycles. At the same time, the right to reside in a 'humanistic' environment is regarded as one of the most basic rights.

The housing market in Korea has heated up dramatically at least three times during the past 30 years: the late 1970s, early 1990s and early 2000s. It is argued that the rapid increase in house prices magnifies the sense of alienation among people who feel relatively deprived, and brings along with it the risk of inflation. In addition, a sudden bursting of a bubble in the real estate market, if there is any, can cause serious problems such as deflation and instability in the financial market. The real estate market, in particular the housing market, is of tremendous importance for countries like Korea, which has a very limited amount of area for residential dwelling combined with a high population density. This paper empirically analyzes the effects on housing prices of variables such as real GDP, interest rates and government policies. It also investigates related issues such as the transmission of house price fluctuations in different sub-markets.

This paper consists of six chapters. Chapter 2 briefly reviews previous literature analyzing housing related issues in Korea, and Chapter 3 investigates changes in the pattern of housing prices and relevant variables. The model is developed and the empirical results are discussed in Chapter 4, which is followed by additional discussions on the findings in Chapter 5. Lastly, Chapter 6 concludes the paper with policy implications.

2. Brief Review of Previous Studies and Korea's Housing Market

The housing market and related issues have been one of the most popular research topics in the field of urban economics in Korea.

Hur (1991) argues that the increase in housing prices in the late 1980s was brought about by strong demand in the housing market. The paper concludes that variations in housing prices are caused by government policies, the level of urbanization, investment in housing, inflation, land prices and construction business cycle. On the contrary, the quantity of money was not found to be a critical element. A subsequent

study by Kim (1996) analyzes determinants of housing prices using structural equations that take into account demand and supply in the housing market, and reports that the surge in housing prices in Korea was mainly due to a shortage in land supply.

Lee (1992), Yoon (2001) and Kim (2004) are some of those who use a VAR model to investigate determinants of housing (purchase) and *chonsei* prices. Lee (1992) generates somewhat different results from Hur (1991). Using a VAR model, and employing such variables as housing price, M2, CPI, GDP, housing investment, Lee (1992) finds that the quantity of money is crucial in the short-run, whereas CPI is important in the medium to long-run. He also demonstrates that the effects of demand-side variables, such as household income and inflation, on housing prices are larger than that of supply-side variables such as housing investment.

A more recent study by Kim (2004) investigates a sudden jump in apartment prices in select areas in Seoul including *Gangnam* and some parts of *Gangbuk*, as well as, areas in the *South Chungchong* Province. The author concludes that the rise in apartment prices was not caused by a shortage of houses but rather by an increase in floating funds, as well as, a sharp drop in interest rates.

A brief review of some previous studies indicates that results differ depending on the period or area reported. This study analyzes the effects of important variables acknowledged in previous literatures, and examines various issues regarding the housing market in Korea, in particular about housing price. This study also looks at *chonsei* prices[1] and land prices for the entire nation, as well as sub-markets such as *Gangnam* and *Gangbuk* areas.

While this paper takes a conventional empirical approach in examining the Korean housing market by employing the VEC model, the study contains unique features; it analyzes the effect of expected growth rate of housing prices, it uses the latest data, and the impact from price changes between *Gangnam* and *Gangbuk* areas, which has substantial implications in Korea, is also analyzed. This study also investigates empirical relationship between housing price and government policies. Previous researches on the determinants of housing prices demonstrate that government policies are important determinants on the level of prices (for example, Malpezzi, 1996; 1998). Nevertheless, as Abraham and Hendershott (1996) point out, there is little explicit empirical work examining the effects of regulation on the behavior of housing prices.

3. The Housing Price Movement Patterns in Korea

3.1 Data

This study uses quarterly data for the period of 1986:Q1-2004:Q2 (1987:Q1-2003:Q2 for regression). The definitions and data sources of all variables initially included in this study are summarized in Table 1.

Macroeconomic data such as GDP, CPI, housing investment, quantity of money, and corporate bond yield were compiled from the Bank of Korea and KOSIS database of the National Office of Korea. Housing price data were collected from a survey, 'Urban Housing Price Movement,' which was conducted by *Kookmin* (Korea Housing) Bank. Since 1986, the bank has been publishing various housing price indices including purchase price indices and *chonsei* price indices for major cities by dwelling type. As the data are made available on a monthly base, for this study, the data is converted into a quarterly basis. Land price indices are published on a quarterly basis by the Ministry of Construction and Transportation (MOCT) for different regions, which are further categorized by land use and zoning status. The indices of residential zones for entire nation and Seoul are used.

The expected growth rate of housing prices (SV1F) was estimated based on the time varying parameter model using Kalman-filtering. In a simple world, in which arbitrage conditions are simple, the intrinsic value (P) and the real (market) value (P^*) of houses can be different, and the following equation is provided:

$$1-\frac{q_t}{P_t^*}=1-\frac{q_t}{P_t}+u_t=\Pi_t\frac{1}{r_t}+u_t,$$

where q is the *chonsei* price, Π is the expected growth rate of the house, and r is the interest rate. Defining $Y_t=1-\frac{q_t}{P_t^*}$ and $X_t=\frac{1}{r_t}$, the equation can be rewritten as $Y_t=\Pi_t X_t+u_t$ where X and Y are observable, but Π is not and time variant. This study first estimates the expected growth rate of housing prices using the above equation.

The expected growth rate of housing prices is regarded to have a property of random walk process, and is estimated to be about 2.7 percent in 2004.[2]

Table 1. Definitions and Sources of Variables

Raw Data	Variable Name	Seasonal Adjustment	Source	Unit
Corporate bond yield	CR	×	The Bank of Korea	3 year corporate bond, %
Stock price index	SPI	○	Korea Stock Exchange Market	2003:Q3 as 100
Gross domestic product	GDP	s.a	The Bank of Korea	One billion won, nominal/real
Housing investment	ICH	s.a	The Bank of Korea	One billion won, nominal/real
Consumer price index	CPI	○	KOSIS	2000:Q3 as 100
M2(quantity of money)	M2	s.a	The Bank of Korea	One billion won
M3(quantity of money)	M3	s.a	The Bank of Korea	One billion won
Building permit area	ACH	○	MOCT	Building Area, 1,000 ㎡
Housing price indices	HP	○	The Korea Housing Bank	2003:Q3 as 100
Chonsei price indices	HR	○	The Korea Housing Bank	2003:Q3 as 100
Land price index	LP	○	Korea Land Corporation	2003:Q3 as 100
Expected growth rate of housing price	SV1F	×	Estimated value	%

Note: "s.a" denotes that the data is already seasonal adjusted

"○" denotes that the data need seasonal adjustment

"×" denotes that the data need not seasonal adjustment.

3.2 Trend in Housing Price Movements in Korea

Figure 1 illustrates the trend in average purchase prices of houses and apartments from 1986:Q1 to 2004:Q2 for various regions including the, entire nation, Seoul, *Gangnam* area, and *Gangbuk* area. Each series was made into an index with 2003:Q3 as 100. Housing prices by different regions (entire nation, Seoul, *Gangnam* area, *Gangbuk* area) and by different types (Apartment, Detached House, Row Houses) show similar fluctuation patterns. As shown, prices increased most rapidly in *Gangnam* in terms of region, while apartments increased in terms of housing type during the period. It is worthwhile to point out that, contrary to the general perception in Korea that housing prices increased consistently and rapidly until mid 2004, in actuality the increase in housing prices was rather mild. This may be an indication that the rapid increase in prices

occurs in select areas or periods only. This argument is confirmed in Table 2.

As shown in Figure 1, housing and apartment prices soared from 1988, peaking in early 1991, and then, falling in mid 1991, after which a stable movement was maintained for the next five years. Just before the outbreak of the economic crisis in late 1997, prices seemed to be on the verge of rising. However, prices slipped sharply amid the economic turmoil, before taking about four years to recover to pre-crisis levels. Prices kept increasing rapidly since 2001, until strict government regulations to curb property speculation were announced in October 2003.[3]

Table 2 and Figure 1 indicate the possible presence of 'speculative frenzy' on real estate in particular regions, such as areas south of the Han River (*Gangnam*), the premier residential area in Seoul. Over the period of 2001 – 2003, apartment prices in the *Gangman* area registered an average growth of 24.3% per annum. This implies that housing prices increased by two-fold in about three years. If we consider apartment prices in the two most popular areas in *Gangnam* - *Gangnam-Gu* and *Sheocho-Gu* - the increase rate of prices should be even higher.

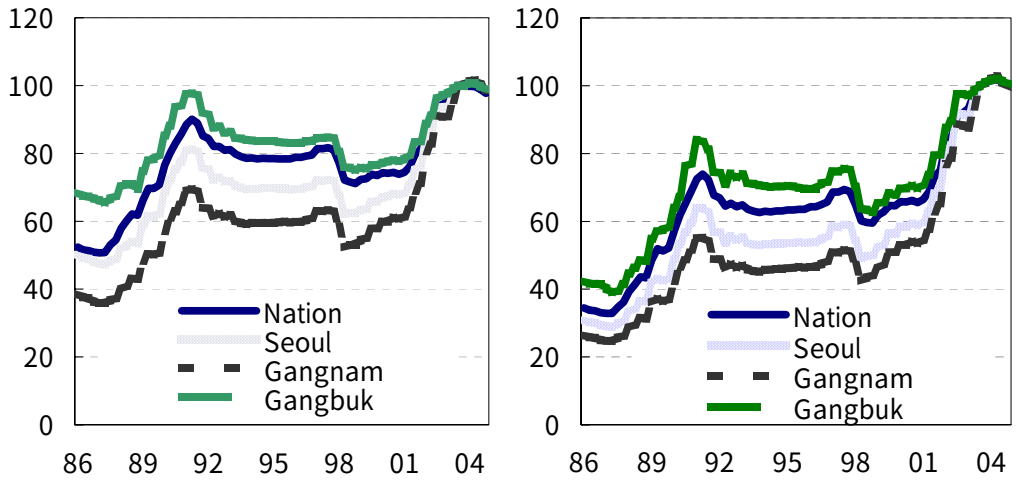
Table 2. Average Annual Growth Rate in Housing Price - by Period and Region

		Nation	Seoul		
				Gangnam	*Gangbuk*
1986~1991	Total	10.8	9.5	12.0	6.7
	Apartments	15.4	14.1	14.4	12.4
	Detached House	8.7	6.9	8.8	5.8
	Row Houses	11.2	10.8	13.4	7.4
1992~1997	Total	0.0	0.0	0.5	-0.4
	Apartments	1.4	1.5	2.0	0.7
	Detached House	-1.1	-1.1	-1.6	-0.9
	Row Houses	-0.3	0.0	0.5	-0.6
1998~2000	Total	1.9	4.3	6.7	1.7
	Apartments	4.9	8.3	10.0	5.4
	Detached House	-1.4	1.1	2.5	0.3
	Row Houses	-0.6	0.9	3.1	-1.5
2001~2003	Total	11.0	14.4	18.7	9.4
	Apartments	16.0	20.0	24.3	12.6
	Detached House	4.2	10.0	11.7	8.9
	Row Houses	6.4	6.8	9.0	4.4

Note: The number in table indicates % change

Figure 1. The Trend of Housing Price (2003.9 = 100)

<Housing Price-Total> <Housing Price-Apartments>



While some economic factors must have been behind the movement in house prices, it is controversial whether government policies somehow have been a major factor in determining housing prices in Korea. The government has used a variety of instruments to intervene in the housing market. For example, since housing prices began increasing rapidly from 1989, the government suppressed speculative demand for land through punitive taxation and restrictions to transactions to keep demand within the supply limit. This policy is based on the philosophy that the holding and trading of land can be restricted and benefits from real estate transaction can be collected by government in the interest of the public. Another example of active intervention in the market is the government's policy on supply side to construct two million new dwellings since 1990, which contributed to stabilizing the housing market in the early to mid 1990s.

While not apparent in Table 1 and Figure 2, *chonsei* prices kept increasing (with some fluctuation) until the economic crisis. *Chonsei* prices in 1991:Q1 jumped by 20 percent compared to 1989:Q4.[4] *Chonsei* prices also experienced structural changes around 1997 and 1998, which reflects exogenous shocks from the economic crisis.

After a sharp drop, *chonsei* prices went through a period of adjustment for one year, before beginning to increase rapidly in 1999. Chang and Sim (2004), using a unit root test by Zivot and Andrews (1992) and Leybourne and Newbold (2001), confirmed that housing prices together with the interest rate and business cycle index went through structural changes around the period of the economic crisis in late 1997. In particular, structural changes were obvious in *chonsei* prices both in the metro-area and medium-

small towns during the boom period after the 1988 Seoul Olympic Games and around the economic crisis.

4. Empirical Analyses of Market Price Issues

4.1 Construction of the Model

4.1.1 Unit Root Test

The augmented Dickey-Fuller (ADF) unit root test, which examines the stationarity of individual time series, was carried out on all variables. While Dickey and Fuller (1979) suggested three models, the model including time, trend, and intercept was used: $\Delta y_t = \mu + \beta t + \delta y_{t-1} + u_t$, where y_t is a scalar time series, t is a time trend, Δ is a difference operator, μ is an intercept, and u_t is an error term.

Table 3 presents the results of the ADF unit root test for individual variables. All variables used in this study are based on seasonally-adjusted series by x-12-ARIMA after the natural logarithmic values were derived. Most price variables related to the real estate market such as housing prices, *chonsei* prices and macroeconomic variables appear to be integrated of order one, or *I(1)*, except land price. On the other hand, all the variables in first difference are stationary.

Table 3. ADF Unit Root Test of Variables

variable	level	1st difference	Variable	level	1st difference
CR	-0.93	-6.15***	HP – Nation	-2.05	-3.91**
SPI	-2.67	-4.56***	HR – Nation	-2.82	-5.08***
GDP	-1.30	-3.90***	HP – *Gangnam*	-1.43	-3.75**
ICH	-2.99	-3.62**	HR – *Gangnam*	-2.26	-4.74***
CPI	-1.44	-3.85***	HP - *Gangbuk*	-2.30	-3.72**
M2	-2.23	-5.09***	HR - *Gangbuk*	-2.31	-5.09***
M3	-2.88	-3.63**	LP - Nation	-4.07**	-3.65**
ACH	-2.89	-4.91***	LP - Seoul	-3.95**	-4.43***

Note: Figures are ADF test statistics. *, ** and *** denotes that the level of significance is 10%, 5% and 1% respectively.

4.1.2 Granger Causality Test

A careful examination of the results utilizing relevant empirical tests such as the Granger causality test (by Granger, 1969; Sims, 1972) and cross tabulation test, help in selecting the set of variables to be included in the reduced form of the VAR model and in ordering the variables.

The first difference of the logarithmic value of variables was used for the Granger causality test. Table 4 shows a feedback causality between housing prices and land prices in the long run. *Chonsei* prices do Granger cause strongly land prices. In contrast, land prices Granger cause *chonsei* prices with time lag. Housing prices fail to Granger cause *chonsei* prices.

Table 5 presents the results of the Granger causality test between housing prices and economic variables. Housing prices Granger cause GDP, but GDP does not Granger cause housing prices. Bilateral causality relationships are found between housing prices and corporate bond yields, and housing prices and the expected growth rate of housing prices. Considering the causality between land prices and macroeconomic variables, GDP and corporate bond yields Granger cause land prices with time lags. Stock price index Granger causes land prices, and land prices Granger causes housing investment.

Table 6 summarizes the results of the Granger causality test between *chonsei* prices and economic variables. Bilateral causality relationships are found between *chonsei* prices and stock price index (for certain periods) and, *chonsei* prices and CPI. Corporate bond yields and GDP Granger strongly cause *chonsei* prices.

Table 4. Granger Causality between Real Estate Variables – Nation

	lag1	Lag2	lag3	lag4	lag5
HP → LP	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
LP → HP	**0.63**	**0.07**	**0.06**	**0.00**	**0.02**
HR → LP	0.00	0.00	0.00	0.00	0.00
LP → HR	0.90	0.99	0.27	0.00	0.00
HR → HP	0.09	0.31	0.34	0.38	0.24
HP → HR	0.89	0.18	0.22	0.17	0.30

Note: The numbers are p-values.

Table 5. Granger Causality between Housing Price and Economic Variables

	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5
GDP → HP	0.94	0.66	0.23	0.65	0.61
HP → GDP	0.02	0.06	0.24	0.16	0.06
SPI→ HP	0.46	0.61	0.65	0.92	0.97
HP → SPI	0.35	0.01	0.00	0.03	0.01
CR → HP	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
HP → CR	**0.01**	**0.08**	**0.08**	**0.17**	**0.07**
ICH → HP	0.91	0.51	0.29	0.22	0.19
HP → ICH	0.00	0.01	0.03	0.14	0.30
m3 → HP	0.43	0.13	0.18	0.38	0.38
HP → m3	0.73	0.92	0.92	0.89	0.96
ACH → HP	0.12	0.50	0.69	0.77	0.80
HP → ACH	0.42	0.67	0.82	0.29	0.26
CPI → HP	0.52	0.18	0.22	0.34	0.30
HP → CPI	0.02	0.04	0.07	0.12	0.17
SV1F → HP	**0.05**	**0.03**	**0.11**	**0.07**	**0.23**
HP → SV1F	**0.00**	**0.05**	**0.02**	**0.01**	**0.02**
GDP → LP	0.22	0.01	0.08	0.05	0.09
LP → GDP	0.18	0.55	0.90	0.92	0.86
SPI → LP	0.00	0.00	0.00	0.00	0.02
LP → SPI	0.09	0.18	0.25	0.57	0.67
CR → LP	0.43	0.05	0.02	0.01	0.01
LP → CR	0.16	0.28	0.37	0.27	0.53
ICH → LP	0.26	0.43	0.48	0.00	0.00
LP → ICH	0.00	0.00	0.00	0.08	0.04
m3 → LP	0.03	0.24	0.49	0.70	0.74
LP → m3	0.12	0.61	0.36	0.49	0.48
ACH → LP	0.22	0.24	0.44	0.62	0.72
LP → ACH	0.30	0.46	0.43	0.72	0.78
CPI → LP	0.82	0.08	0.03	0.04	0.06
LP → CPI	0.02	0.06	0.08	0.14	0.25

Note: The numbers are p-values.

Table 6. Granger Causality between *Chonsei* Price and Economic Variables

	lag1	lag2	lag3	lag4	lag5
GDP → HR	**0.09**	**0.03**	**0.02**	**0.01**	**0.01**
HR → GDP	0.02	0.12	0.17	0.25	0.12
SPI → HR	**0.13**	**0.03**	**0.05**	**0.21**	**0.26**
HR → SPI	**0.15**	**0.00**	**0.00**	**0.04**	**0.05**
CR → HR	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
HR → CR	0.01	0.10	0.18	0.37	0.61
ICH → HR	0.40	0.57	0.22	0.04	0.03
HR → ICH	0.00	0.03	0.05	0.04	0.35
m3 → HR	0.33	0.85	0.85	0.84	0.92
HR →m3	0.66	0.91	0.78	0.90	0.91
ACH → HR	0.66	0.67	0.90	0.96	0.93
HR → ICH	0.01	0.01	0.02	0.01	0.06
CPI→ HR	**0.05**	**0.02**	**0.02**	**0.05**	**0.11**
HR → CPI	**0.03**	**0.03**	**0.06**	**0.06**	**0.09**

Note: The numbers are p-values.

4.1.3 Lag Length and Co-integration

Five variables are selected to be included in the model, together with a constant and government policy variables (to be discussed), and the ordering of these endogenous variables in the VAR model is finalized as [corporate bond yield - GDP - c*honsei* Price - land price - expected growth rate of housing price - housing price], considering the magnitude of exogeneity by a cross tabulation analysis and the Granger causality test.

In general, the selection of lag length (p) is determined based on Akaike Information Criterion (AIC), Schwartz Bayesian Criterion (SC) or Hannan-Quinn Information Criterion (HQ). If p is too small, the model can be mis-specified; if p is too large, the degree of freedom can be made futile. It is crucial to have a parsimonious model which includes a proper number of variables, an optimal lag length and the right ordering.

Table. 7 presents the test results of AIC, SC and HQ regarding a set of variables. The results from SC and HQ show that [lag length=2] appears to be the most proper length of lag while the AIC test reports it to be 4. This study follows the suggestion from SC and HQ.

This study proceeds by conducting Johanson's co-intergation test in order to, investigate the long run relationship among the variables. If a co-intergation relationship among several variables exists, it is possible to construct a Vector Error Correction (VEC) Model in which error correction terms are included. As Table 8 indicates, when a time trend and intercept are allowed, two co-integration relationships are found for the whole nation, *Gangbuk* and *Gangnam* respectively.

Table 7. The Results of Lag Length Tests

lag	AIC	SC	HQ
0	-30.38268	-29.74323	-30.13360
1	-37.40442	-35.48607*	-36.65718*
2	-37.40148	-34.20424	-36.15609
3	-37.36323	-32.88709	-35.61968
4	-37.71168*	-31.95665	-35.46997

Note: * stands for selected lag length

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Table 8. The Results of Co-integration Test

Case	Time Trend	Co-integration Equation	Cointegration Number		
			Nation	*Gangnam*	*Gangbuk*
1	No	Intercept term: Yes	4	1	1
2	Yes	Intercept term: No	2	2	2
3	Yes	Intercept term: Yes	2	2	2

4.1.4. Policy Variable

To stabilize the housing market (or prices), the Korea government has been using a variety of measures to, directly or indirectly, intervene in the housing market. While a

large number of research analyzes the effectiveness of the government's policies, controversy stirs whether the government's policies are achieving its aims.

This paper categorizes the government's policy into two groups: those that discourage the market and those that encourage the market. The model used in this study therefore includes two policy dummy variables:

$DD_t = 1$ if government implements the policy to discourage the housing market at period t,
$DD_t = 0$ otherwise, and
$DE_t = 1$ if government implements the policy to encourage the housing market at period t,
$DE_t = 0$ otherwise.

Table 9 represents the definition of the dummy variables, showing when the policies that encourage (DE) and discourage (DD) were implemented on a quarterly basis.

Table 9. Definition of Government Policy Variables

Variables	Values	Quarters
DD	1	1988:Q1~1992:Q4, 1995:Q1, 2000:Q4, 2002:Q1, 2002:Q3, 2003:Q2, (2003:Q3, 2003:Q4, 2004:Q1)
	0	Otherwise
DE	1	1995:Q4, 1998:Q1, 1998:Q3, 1999:Q1, 2000:Q1
	0	Otherwise

4.2 Results of Estimation

The results of the estimation using the VEC model for the duration of 1987:Q1 – 2003: Q2 are presented in Table 10.[5] The model consists of six endogenous variables ordered by [CR (corporate bond yield) – GDP – HR (c*honsei* price) – LP (land price) - SV1F (expected growth rate of housing price) – HP (housing price)] and two exogenous policy variables including DD and DE. The appendix shows the results of the VEC Model on c*honsei* prices in the three regions.

During the period, the *Gangnam* area was the epicenter of surging housing prices[6], and this area was the government's prime concern in trying to curb soaring

apartment prices. This is why the model aims to investigate housing prices and *chonsei* prices for the *Gangnam* and *Gangbuk* areas, as well as, the whole nation.

While the coefficients in the VAR model do not offer economic interpretations as they are coefficients in a reduced form of the equations, it is possible to derive the meaning from the error correction terms and for policy variables. The estimated coefficients in the error correction terms have the expected signs for most regions and are statistically significant. The estimates of the first error correction term are significant and negative in all three cases (the entire nation, *Gangnam* and *Gangbuk*), whereas the coefficients in the second error correction term are statistically significant only for the *Gangnam* area. The first normalized co-integrating equation does not contain GDP, while the second normalized co-integrating equation does not contain interest rates. The signs for the expected growth rates in *Gangnam* and *Gangbuk* show unexpected results, however, they are not statistically significant.

Table 10. The Results of Estimation for Housing Price

Period: 1987: Q1 ~ 2003: Q2

< Normalized Cointegration Vector >

Housing Price - Entire Nation

$$z_{1t} = CR_t - 0.184HR_t - 0.062LP_t - 1.542SV1F_t + 0.302HP_t - 0.326$$
(0.033) (0.020) (0.132) (0.041)

$$z_{2t} = GDP_t - 1.272HR_t - 0.142LP_t - 1.477SV1F_t + 1.502HP_t - 11.656$$
(0.199) (0.118) (0.777) (0.244)

Housing Price – *Gangnam* Area

$$z_{1t} = CR_t - 0.064HR_t - 0.032LP_t - 1.525SV1F_t + 0.097HP_t - 0.013$$
(0.014) (0.007) (0.088) (0.016)

$$z_{2t} = GDP_t - 2.795HR_t - 0.07LP_t + 9.347SV1F_t + 3.418HP_t - 14.171$$
(1.295) (0.671) (7.687) (1.435)

Housing Price – *Gangbuk* Area

$$z_{1t} = CR_t - 0.091HR_t - 1.166LP_t + 0.310SV1F_t + 0.097HP_t - 0.749$$
(0.037) (0.020) (0.220) (0.055)

$$z_{2t} = GDP_t - 0.533HR_t - 0.341P_t + 2.113SV1F_t + 1.522HP_t - 14.194$$
(0.226) (0.123) (1.345) (0.336)

* The number in parentheses indicates the standard error

variable	Nation	*Gangnam*	*Gangbuk*
	D(HP)	D(HP)	D(HP)

ECM1(z_{1t-1})	-1.744656***	-1.693768*	-0.790541*
	(0.48025)	(0.96708)	(0.40290)
ECM2(z_{2t-1})	-0.002264	-0.049694***	-0.028864
	(0.07031)	(0.01192)	(0.05844)
D(CR(-1))	1.266282	0.418266	0.050456
	(0.90413)	(1.22591)	(0.58796)
D(CR(-2))	1.478971*	1.239373	1.497331**
	(0.80798)	(1.08933)	(0.62388)
D(GDP(-1))	0.061216	0.034890	0.085845
	(0.07058)	(0.07714)	(0.05794)
D(GDP(-2))	0.071286	0.015204	0.019318
	(0.06521)	(0.07498)	(0.04893)
D(HR(-1))	-0.344018	-0.217810	-0.246840**
	(0.21929)	(0.19924)	(0.10020)
D(HR(-2))	-0.296529	-0.110497	-0.129170
	(0.17856)	(0.17622)	(0.09850)
D(LP(-1))	-0.048421	-0.022237	-0.132221
	(0.16666)	(0.13952)	(0.08286)
D(LP(-2))	0.129681	0.173375	0.200791**
	(0.13906)	(0.13433)	(0.07881)
D(SV1F(-1))	-2.754743*	-1.901066	-0.589832
	(1.66230)	(2.17667)	(1.05458)
D(SV1F(-2))	-2.435663	-1.795890	-2.576666**
	(1.39642)	(1.87645)	(1.05824)
D(HP(-1))	0.709582***	0.612693	0.695668***
	(0.23317)	(0.20083)	(0.13832)
D(HP(-2))	0.266328	0.186519	0.358466***
	(0.24475)	(0.20973)	(0.14266)
C	-0.000394	-0.005292	-0.003795
	(0.00370)	(0.00426)	(0.00287)
DE	-0.000367	0.005988	-0.003929
	(0.00834)	(0.01105)	(0.00642)
DD	0.019840***	0.026615***	0.017058***
	(0.00655)	(0.00859)	(0.00511)
R-squared	0.700818	0.734506	0.782685
Adj. R-squared	0.596755	0.642161	0.707097

The coefficient for the error correction term is interpreted as the widely known speed of adjustment parameter. In other words, the coefficient explains how rapidly the model regains equilibrium, when the variables included in an error correction term change and the long-run equilibrium relationship among variables breaks down.

The coefficients of the individual variables in the first normalizing co-integrating vector are statistically significant, with the expected signs. This implies that average housing prices are negatively affected by interest rates, while positively affected by *chonsei* prices, land prices and the expected growth rate of housing prices. The second normalized co-integrating vector included GDP, which is significant only in the *Gangnam* area, with the unexpected sign. This means that housing prices in the *Gangnam* area are negatively affected by GDP, which goes contrary to our intuition. This finding needs further investigation.

The effects from policies that encourage the market (DE) do not appear to be significant. However, policies that discourage the market (DD) have positive effects on housing prices for the entire nation, *Gangnam* and *Gangbuk* areas. This finding may be due to the fact that most government policies in Korea were aimed to discourage the market, and they were implemented after policy makers had diagnosed certain symptoms signaling that the market was heating up. Alternatively, this finding may be due to the time lag in practically implementing market discouraging policies or the time it took for the market to respond to the policies after they are implemented. In addition, if market participants anticipate that the discouraging policies will not last long and the policies will create a housing shortage due to a drop in future supply, the discouraging policies may fail to curb the upward trend of prices. Any of these may contribute to the outcomes of the VEC estimation.[7] The argument by Ha (1997) may be implicative in this regard. He asserts that it was the 'land for public' policy alone until 2003:Q3 that influenced and stabilized the real estate prices.

4.3 Impulse-Response Analyses

As discussed, the coefficients estimated in the VEC model do not offer economic meanings. The impact of the fluction in one variable to another is better understood by way of impulse response analyse, with identification restriction using the Choleski decomposition. Figures 2 to 4 show the impulse response of housing prices and *chonsei* prices to one standard deviation shock in the error terms of each variable.

Several features are found from the figures. First, the responses of housing prices and *chonsei* prices to their own shocks are, in general, substantial in Seoul. Comparing housing price in *Gangnam* and *Gangbuk*, the effect disappears in *Gangnam* in after seven quarters while it persists in *Gangnam* longer.

Figure 2. Impulse Response – Entire Nation

- Housing Price - - *Chonsei* Price -

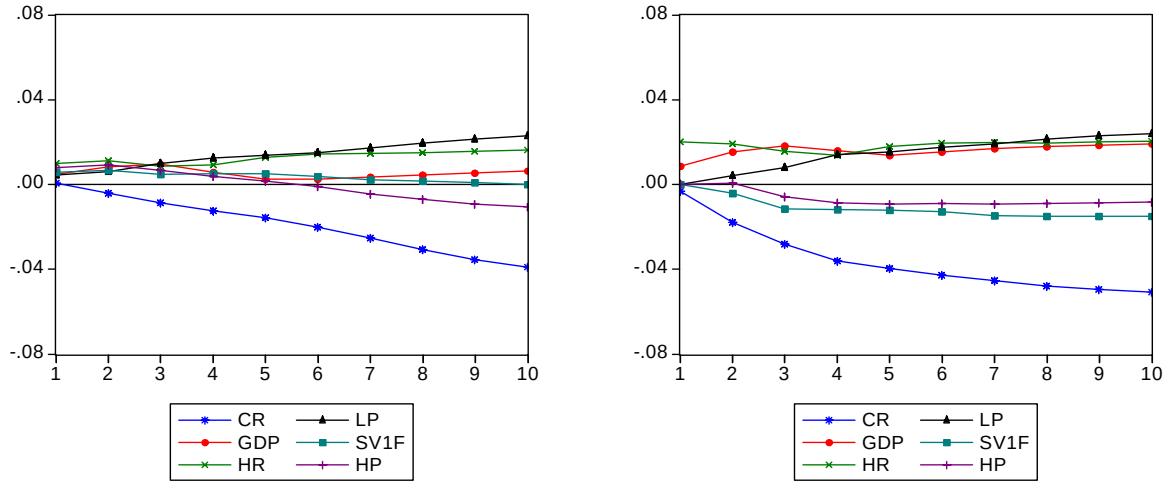


Figure 3. Impulse Response – *Gangnam* Area

- Housing Price - - *Chonsei* Price -

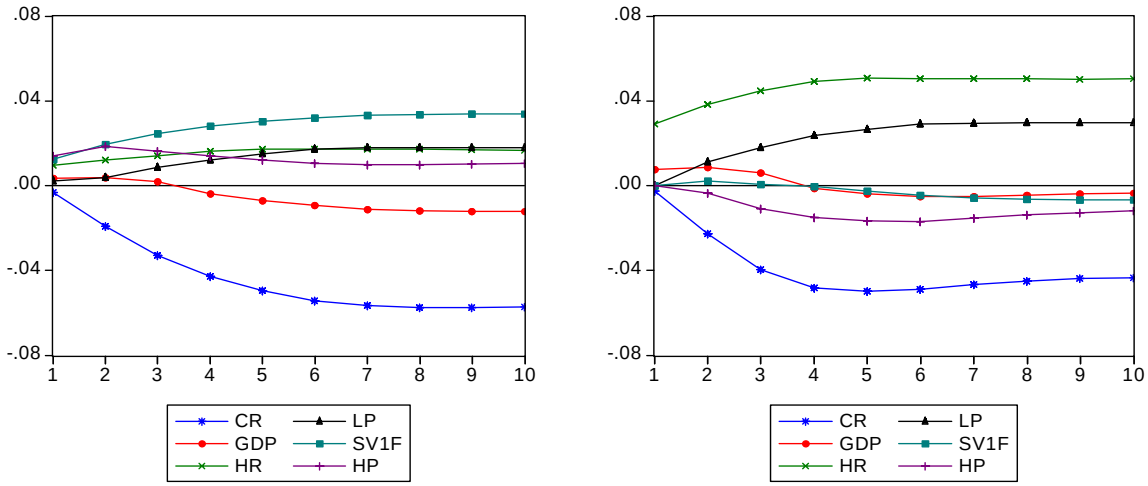
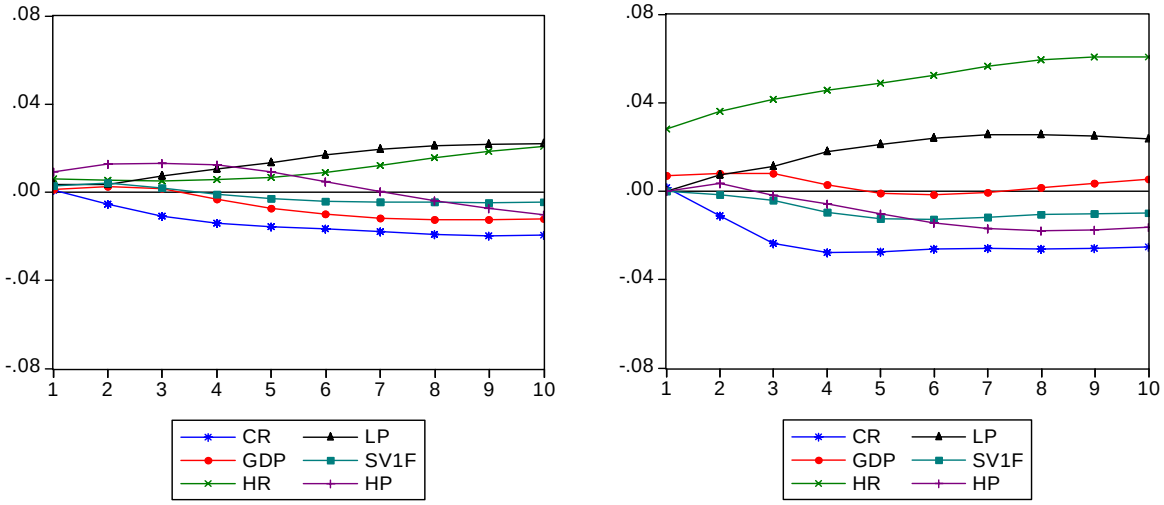


Figure 4. Impulse Response – *Gangbuk* Area

- Housing Price - - *Chonsei* Price –



Second, the shock from the interest rate has negative effects on both housing prices and *chonsei* prices for all three cases. The response is stronger in *Ganagnam* than *Gangbuk*, indicating greater changes in housing and *chonsei* prices in *Gananam* when interest rates change. For all three cases, the effects seem substantially strong, and do not fade even after several quarters have passed by.

Third, the shock in land prices and *chonsei* prices are also vey strong and persistent for all three cases. For both *Ganagnam* and *Gangbuk* areas, *chonsei* prices have the strongest effect on itself, which is followed by land prices. For housing prices, shocks in the two prices – land and *chonsei* – show about the same effects, however, in the long run, the land price shock appears to be more substantial.

Fourth, the shock from the expected growth rate of housing prices affects *Gangnam* housing price positively and the effect is persistent for more than 30 months. However, it affects *chonsei* prices negatively, implying that when participants anticipate an increase in housing prices, housing price increases, however, *chonsei* prices fall. From this, we can reasonablely consider that *chonsei* can be a substitutive residential tenure choice for owning a house. It may be concluded that the anticipation of future increases in housing prices accelerates the rise in housing prices in the *Gangnam* area, as usually argued in Korea.

4.4. Forecasting Errors and Fitness of the Model

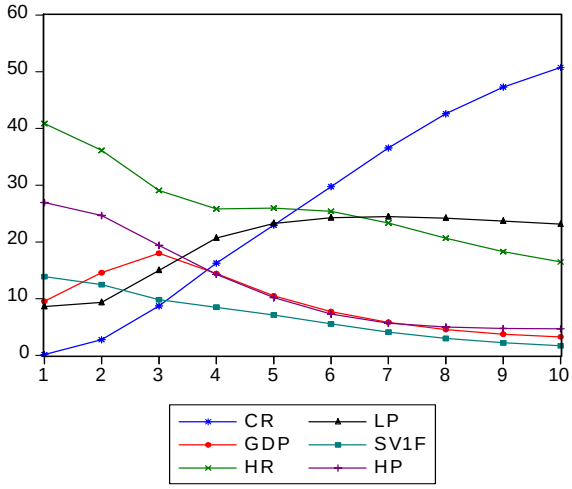
4.4.1. Variance Decomposition

While the unrestricted VAR is overparameterized and not particularly useful for short-term forecasting, understanding the properties of the forecasting errors is helpful in finding interrelationshps among the variables in the system. The forecasting error variance decomposition shows the proportion of movements in one variable due to its "own" shock versus shocks to other variables (Enders, 1995). If shocks in the error sequence of one variable (say x) cannot explain any of the forecasting error variances of another variable (say y) at all forecast horizons, we can say that the $\{y\}$ sequence is exogenous. In this case, the variable y is deemed to evolve independently of the shocks and innovation in the other variable x.

Utilzing a 10 quarter forecasting horizon, the variance decompositions are reported in Figures 5 to 7. Each figure shows the percentage of forecasting error variance attributable to each of the other variables. The results indicate that while there are

Figure 5. Variance Decomposition – Entire Nation

- Housing Price -



- *Chonsei* Price -

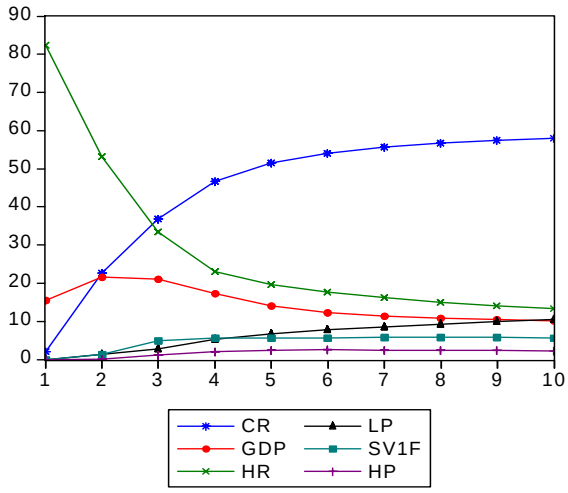
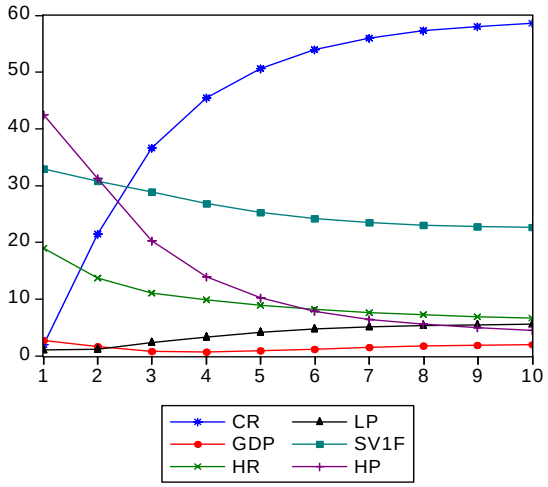
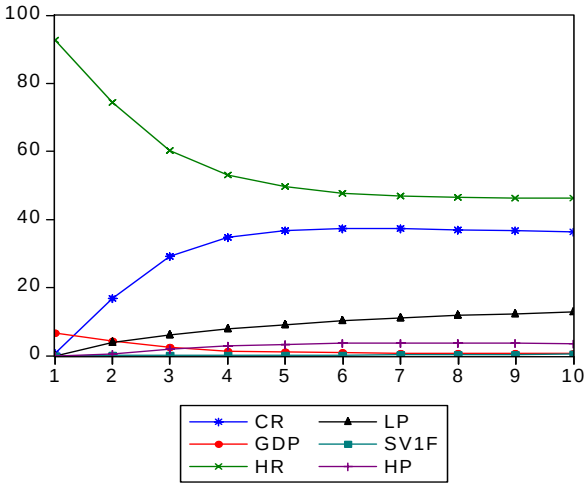


Figure 6. Variance Decomposition – *Gangnam* Area

- Housing Price -

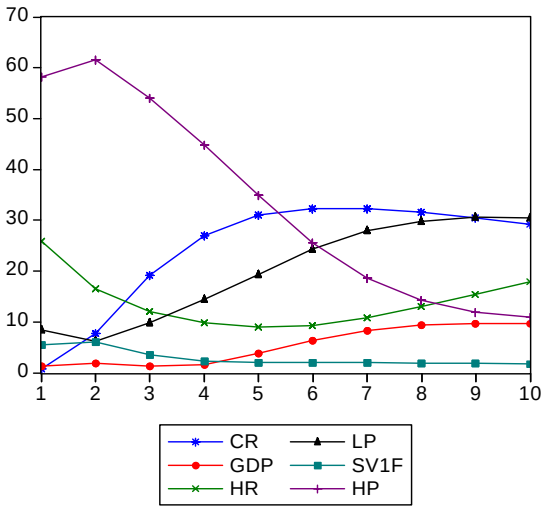


- *Chonsei* Price –

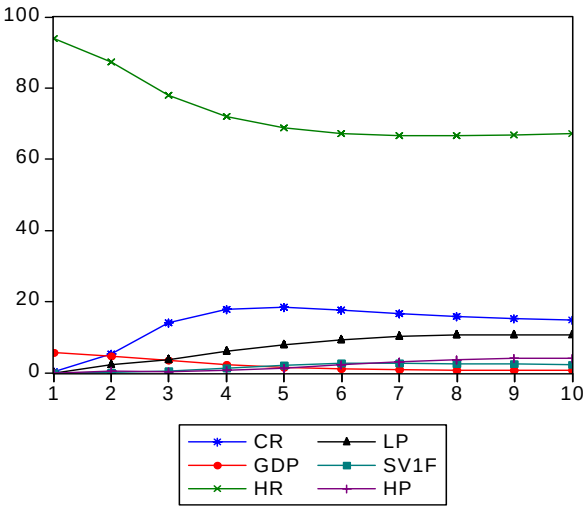


p

- Housing Price -



- *Chonsei* Price –



housing prices and *chonsei* prices in one nation, the contribution from each of the other variables to their forecsting error variances are considerably different.

For the entire nation, housing prices and *chonsei* prices are found to be the most significant variables for housing prices in the short and mid run, however, in the long run, the interest rate becomes the most important variable contributing to the forecasting error of housing prices. In fact, the interest rate is either the most important or the second most important factor in purchasing and *chonsei* prices for *Gangnam*, *Gangbuk* and the entire nation, in the long run. For most cases, while the importance of other variables decreases, that of interest rates increases with a forecast horizon of 30 months. In other words, the importance of housing prices and *chonsei* prices in comprising their forecasting error variance diminishes over time, while the more significant portion of the forecasting errors becomes attributable to interest rates. It is noteworthy that while the decomposition of forecasting error indicates that the contribution of most variables converge, interest rates do not show any evidence of converging with other variables.

It is noteworthy that the expected growth rate of housing prices is important in explaining the forecasting error of housing prices in the *Gangnam* area. In contrast, it is not as important in terms of *chonsei* prices in the same region or housing price.

4.4.2. The Fitness of the Model Forecast

To put it simply, forecasting errors are the difference between the actual and forecasted values. There are many useful tools to access the forecasting ability of a model according to that criterion. The most recognized statistical methods are probably scale invariant RMSE(Root means squared error, or PRMSE: percentage RMSE) and Theil' U. PRMSE is computed as follows.

$$PRMSE = 100 \times \sqrt{\frac{1}{h}} \sqrt{\sum_{t=1}^{h} \left(\frac{y_t^e - y_t}{y_t} \right)^2}$$

where *y* is a random variable, *e* denotes a predicted value.

A dynamic forecast for three variables, housing prices, *chonsei* prices and land prices over the period 2003:Q3 to 2004:Q2 is constructed by using our estimated VEC model. Forecasting errors measured by (PRMSE) for the two VEC used in this study are reported in Table 11.

Table 11. PRMSE for the Three Variables

ECM Model 1	Korea	*Gangnam*	*Gangbuk*
	1-step ahead PRMSE		
Housing Price	2.325	4.25813	2.26426
Chonsei Price	2.6623	3.92591	3.67235
Land Price	1.21269	1.7071	1.45397
	2-step ahead PRMSE		
Housing Price	3.4006	6.92585	3.63763
Chonsei Price	4.84258	6.37401	6.54367
Land Price	1.82083	3.07455	2.48302
	3-step ahead PRMSE		
Housing Price	4.0591	10.77358	6.32837
Chonsei Price	6.25671	9.9775	8.97709
Land Price	3.17413	3.86272	2.6838
	4-step ahead PRMSE		
Housing Price	4.88009	16.16768	9.95069
Chonsei Price	8.87606	14.61637	12.24535
Land Price	4.75909	5.54007	4.62377

ECM Model 2	Korea	*Gangnam*	*Gangbuk*
	1-step ahead PRMSE		
Housing Price	2.40181	4.48975	2.56669
Chonsei Price	2.82984	3.83381	3.76721
Land Price	1.05541	1.70811	1.5006
	2-step ahead PRMSE		
Housing Price	3.6192	6.79867	3.93111
Chonsei Price	5.59453	6.29838	6.79698
Land Price	1.5779	3.15728	2.46445
	3-step ahead PRMSE		
Housing Price	3.92438	9.33862	5.50543
Chonsei Price	7.10164	9.64635	9.32281
Land Price	2.74603	4.01348	2.70049
	4-step ahead PRMSE		
Housing Price	4.71858	11.35485	6.48618
Chonsei Price	10.09323	13.85285	12.79696
Land Price	4.03923	5.69811	4.5364

The results show that the model used to the make the forecast is the most fit for the entire nation, and then the *Gangbuk* area for both ECM1 and ECM2, while, the *Gangnam* area shows the worst performance. This finding implies that it is not easy to model housing prices and *chonsei* prices (and land prices as well) accurately, in particular for the *Gangnam* area and forecast them. As easily predicted, the longer the period, the greater the forecasting errors. After three quarters, forecasting ability for housing prices drops sharply. 3 quarter ahead forecast represents 2004:Q1. From 2004:Q1, PRMSE in the *Gangnam* area fell sharply, which might reflect that the real estate market, especially in the *Gangnam* area, faced different situations from the past, due to the firm government policies announced in October 2003. While the government's intervention in the real estate market has been frequently observed in Korea, the government policy announced in October 2003 is regarded as the most resolute in terms of its intention and intensity. Accumulating more observations will enable a more accurate means to test the structural changes in the market.

4.5. Inter-regional Effects Revisited

One of the most implicative topics in regards to the real estate market (or housing market) in Korea is the mutual effects of real estate prices across regions. Certain regions are blamed as the source of instability in housing prices. This section investigates this topic by revisiting the results of the Granger causality test. Discussions in this section are confined to housing prices and *chonsei* prices in the two areas, *Gangnam* and *Gangbuk*, and the whole nation.

Table 12 shows that changes in housing prices and *chonsei* prices in the *Gangnam* area affect those in *Gangbuk* and the whole nation. In particular, the changes in housing prices *Gangnam* area affect those in *Gangbuk* in the first quarter and then sixth quarter onward, and those in the rest of Korea after three quarters. The effects from *chonsei* prices in *Gangnam* on *Gangbuk* and the rest of Korea, also persist for a long duration, for 10 quarters with some interruptions.

In contrast, the effects of price fluctuations in the *Gangbuk* area are not as clear. Changes in housing prices in *Gangbuk* do not affect prices in *Gangnam* or the whole nation for more than two years of time horizon provided in Table 12. Changes in *chonsei* prices in *Gangbuk* affect those in *Gangnam* after four quarters, however, the effects dissipate quickly. A similar pattern is found for the whole nation.

Table 12. Inter-regional Effects of Housing and *Chonsei* Prices - Granger Causality Tests

	lag1	lag2	lag3	lag4	lag5	lag6	lag7	lag8	lag9	lag10
HP(*Gangnam*)→HP(*Gangbuk*)	0.05	0.16	0.29	0.45	0.21	0.09	0.04	0.07	0.01	0.03
HP(*Gangbuk*)→ HP(*Gangnam*)	0.96	0.97	0.96	0.72	0.74	0.25	0.16	0.30	0.19	0.07
HP(*Gangnam*)→HP(Nation)	0.12	0.33	0.48	0.09	0.01	0.01	0.02	0.15	0.03	0.15
HP(Nation)→ HP(*Gangnam*)	0.55	0.62	0.37	0.09	0.08	0.20	0.25	0.55	0.73	0.56
HP(*Gangbuk*)→ HP(Nation)	0.30	0.63	0.93	0.68	0.64	0.77	0.82	0.94	0.87	0.76
HP(Nation))→ HP(*Gangbuk*)	0.95	0.82	0.74	0.46	0.43	0.55	0.39	0.57	0.97	0.47
HR(*Gangnam*)→HR(*Gangbuk*)	0.02	0.07	0.07	0.03	0.04	0.33	0.36	0.15	0.03	0.07
HR(*Gangbuk*)→ HR(*Gangnam*)	0.47	0.20	0.17	0.05	0.05	0.24	0.49	0.41	0.16	0.20
HR(*Gangnam*)→ HR(Nation)	0.04	0.08	0.05	0.02	0.06	0.03	0.07	0.14	0.08	0.13
HR(Nation)→ HR(*Gangnam*)	0.19	0.36	0.14	0.09	0.17	0.24	0.25	0.43	0.42	0.47
HR(*Gangbuk*)→ HR(Nation)	0.10	0.11	0.21	0.08	0.07	0.10	0.20	0.40	0.09	0.17
HR(Nation)→ HR(*Gangbuk*)	0.85	0.89	0.90	0.39	0.40	0.47	0.55	0.52	0.33	0.41

Changes in housing prices and *chonsei* prices for the whole nation also do not seem to affect those in *Gangnam* or *Gangbuk*. Therefore, it can be concluded that price fluctuations in *Gangnam* significantly affect those in other areas in Seoul and the whole nation, sometimes with lags. In general, this effect is persistent. However, the effects from *Gangbuk* or the whole nation are not found to affect other areas significantly.

5. Conclusion

The issue of housing has been at the center of public interest, as well as, academia and policy makers. This paper investigates the housing market in Korea, and presents some findings through quantitative analyses.

While the housing market has been experiencing some dramatic fluctuations due to a variety of reasons, the VECs applied in this study indicate that the long run equilibrium relationship among crucial variables is confirmed, for housing prices and *chonsei* prices in the *Gangnam* and *Gangbuk* areas, as well as, the whole nation. The variables considered in this relationship include interest rate, GDP, land price and expected growth rate of housing prices, as well as, housing and *chonsei* prices themselves. The coefficients of all of these variables possessed the expected signs.

One of the most controversial topics regarding the housing market in Korea is the role of the expected growth rate of housing prices. While the role of this variable is

neither confirmed for *chonsei* prices, nor for housing prices in the *Gangbuk* area, the impulse response analyses show that it is one of the major determinants that affect housing prices in *Gangnam* area. In relation to housing prices in the *Gangnam* area, it is confirmed that the prices in the *Gangnam* area affect those in the *Gangbuk* area and the entire nation. However, the same effect is not found when the roles are reversed.

Policy variables do not seem to be very effective in encouraging or discouraging the market, at least for the period under investigation. Although the effects of the gover policy to discourage the market are found to be related to increases in prices, the magnitude of the coefficient is quite small. These results in regards to the unexpected effects from discouraging policies may be obtained as the government policy to discourage the real estate market is often announed in series when the market is heating up, and frequently the effects are visible with lags. Considering that the study only considers the quarters when the policy is announed, the results may vary as dummy variables are defined in different ways. In addition, while this study investigates the period up to 2003:Q2, an analysis using different periods may provide different results, as the real estate market in Korea to policies may sometimes respond in a sensitive manner.

ENDNOTES

1. In Korea, *chonsei*s are used as a housing financing method, in which a lump-sum deposit is given up-front to the owner of the property by the tenant. Therefore, tenants that use the property are not required to make additional periodic rent payments.

2. Lee (2002) uses the same method and shows that the expected growth rates are very similar regardless of whether they are estimated by assuming the properties of random walk or AR(1). Nevertheless, as the coefficient for AR(1) term is approximately one, he concludes that the expected growth rate of housing prices do not follow the stable process of AR(1), but the random walk process.

3. The government announced a set of measures to curb real estate speculation in the areas, including levy of heavy taxes for home traders. 10.29 measures have brought about many aftermaths. For example, the construction business cooled down and trade of houses froze, which might have worsen the national economy, which was suffering from sluggish domestic consumption and a high unemployment rate.

4. Yoon (2001) using BOK-X-12-ARIMA found structural change during same period.

5. For simplicity, this paper presents the results for housing prices only. The results for *chonsei* price is in Appendix without discussion. More discussion is formed in Tcha (2004).

6. The appendix shows that the fluctuation in housing prices in the *Gangnam* area affects prices in other areas while there is no strong indication of a reverse relationship.

7. It may be due to how dummy variables are defined. Estimations were performed with some variations in dummy variables, but the results were either insignificant or had unexpected signs.

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Appendix

Table A1. The Results of Estimation for Housing *Chonsei* Price

Period: 1987: Q1 ~ 2003: Q2

< Normalized Cointergating Vector >

Housing *Chonsei* Price - Entire Nation

$$z_{1t} = CR_t - 0.184HR_t - 0.062LP_t - 1.542SV1F_t + 0.302HP_t - 0.326$$
(0.033) (0.020) (0.132) (0.041)

$$z_{2t} = GDP_t - 1.272HR_t - 0.142LP_t - 1.477SV1F_t + 1.502HP_t - 11.656$$
(0.199) (0.118) (0777) (0.244)

Housing *Chonsei* Price – *Gangnam* Area

$$z_{1t} = CR_t - 0.064HR_t - 0.032LP_t - 1.525SV1F_t + 0.097HP_t - 0.013$$
(0.014) (0.007) (0.088) (0.016)

$$z_{2t} = GDP_t - 2.795HR_t - 0.07LP_t + 9.347SV1F_t + 3.418HP_t - 14.171$$
(1.295) (0.671) (7.687) (1.435)

Housing *Chonsei* Price – *Gangbuk* Area

$$z_{1t} = CR_t - 0.091HR_t - 1.166LP_t + 0.310SV1F_t + 0.097HP_t - 0.749$$
(0.037) (0.020) (0.220) (0.055)

$$z_{2t} = GDP_t - 0.533HR_t - 0.341P_t + 2.113SV1F_t + 1.522HP_t - 14.194$$
(0.226) (0.123) (1.345) (0.336)

* The number in parentheses indicates the standard error

Variable	Nation	*Gangnam*	*Gangbuk*
	D(HR)	D(HR)	D(HR)
ECM1(z_{1t-1})	-0.580419	-2.808196	-2.997171
	(1.26290)	(1.76504)	(1.57694)
ECM2(z_{2t-1})	-0.020729	0.010052	0.588303
	(0.07397)	(0.05211)	(0.44520)
D(CR(-1))	-0.210258	1.180204	1.626581
	(1.23167)	(1.69405)	(1.52519)
D(CR(-2))	-0.172125	0.665481	0.845920
	(0.41283)	(0.66331)	(0.66626)
D(GDP(-1))	0.300093	0.069968	-0.319839
	(0.22015)	(0.27047)	(0.41327)
D(GDP(-2))	0.086915	-0.299134	-0.222645
	(0.23125)	(0.28335)	(0.30822)

D(HR(-1))	-0.411894	-0.586609	-0.820956
	(0.29343)	(0.30539)	(0.22640)
D(HR(-2))	0.088808	-0.322951	-0.440235
	(0.23941)	(0.23603)	(0.22968)
D(LP(-1))	0.107115	0.294067	0.124820
	(0.30216)	(0.35686)	(0.30173)
D(LP(-2))	-0.282395	-0.246942	-0.340325
	(0.21079)	(0.19082)	(0.16812)
D(SV1F(-1))	-0.063849	0.578849	0.576631
	(2.02909)	(2.39931)	(2.12936)
D(SV1F(-2))	-0.050396	1.175369	1.245912
	(0.48951)	(0.76894)	(0.78077)
D(HP(-1))	-0.434989	-0.190427	0.059087
	(0.56802)	(0.38468)	(0.38042)
D(HP(-2))	-0.848951	-0.317682	-0.255426
	(0.38594)	(0.26589)	(0.30662)
C	-0.001275	-0.002946	-0.001378
	(0.00442)	(0.00530)	(0.00476)
DE	-0.003759	0.011456	0.001144
	(0.01352)	(0.01589)	(0.01443)
DD	-0.001680	0.003387	-0.005379
	(0.01008)	(0.01257)	(0.01106)
R-squared	0.535553	0.549448	0.574374
Adj. R-squared	0.358621	0.377809	0.412231