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House Price and Bank Lending in a Premium Submarket in Korea

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This paper studies the abnormal price behavior of Kangnam, a premium (high price) housing submarket in Seoul, Korea, which addresses the correlation between house prices, bank lending, and other factors, including income. Kangnam experienced the most dramatic price escalation during the study period (1999-2009) despite Korean government policies to stabilize house prices in 2005 and the U.S. subprime crisis in 2008. The empirical result shows that even though the house price in a premium market is, to some degree, positively influenced by income, it is not affected by bank lending in the short-run while negatively affected in the long-run. This suggests that a premium housing submarket has a peculiar price dynamics of its own unlike the other submarkets which seem to comply more or less with our notion of a general economic theory, especially in terms of house prices and bank lending.

Keywords

Kangnam; Premium Housing Submarket; House Prices; Bank Lending

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1. Introduction

The issues on the linkage between house price and bank lending which are closely correlated in most countries have drawn special attention throughout the world since the outburst of the U.S. subprime crisis in 2008.[1]Since the crisis primarily stemmed from excessive bank lending with far-reaching consequences for the world economy particularly in the housing sector, our attention is also focused on the widely discussed relationship between house price and bank lending.

This paper will give an account of the Korean case, where there was not such a house price reduction as seen in the U.S. and other countries, but rather a price rise in certain areas even in the aftermath of the U.S. subprime crisis. This is especially the case for Kangnam, the most expensive housing submarket in Seoul, Korea, which experienced a dramatic price upheaval during the study period (1999-2009). To stabilize the soaring house price in the market, the Korean government implemented a number of policies, including tax and bank lending regulations. Yet, these measures did not seem to work in controlling the price in Kangnam, until there were bubble concerns in this area.

While the nationwide house price has steadily increased, or in some submarkets become somewhat stagnant since the sudden fall in 1998 given the Asian financial crisis in 1997, the house price of Kangnam has witnessed a sharp increase ever since, especially from 2001 to early 2007. The house price of Kangnam showed temporarily, only an insignificant amount of decrease in 2007, which can be interpreted as a slight effect of government restrictions aimed at this submarket beginning in August 2005.

The housing affordability in Kangnam is unusually low with a price to income ratio (PIR) of 12, which means that the housing is far beyond the reach of the average income household (note that the nationwide PIR is 5). Hence, we refer to this eccentric housing submarket with incomparably high prices as a premium housing submarket and focus on the factors that affect the prices in an effort to explain its price behavior. In doing so, we have used comparative analyses throughout this paper.

Clearly, this paper builds on some of the literature on house prices and bank lending, such as Hofman (2003), Gerlach and Peng (2005), Oikarinen (2009) and Brissimis and Vlassopoulos (2009), Park et al. (2010), and Gimeno and Martinez-Carrascal (2010). Although we use the same econometric methodology as they do, there are some significant differences in this paper. Previous studies on this topic are mostly based on the units of nations, but to

[1] Financial crises that result from excessive mortgage loans have been repeated occurrences worldwide. For example, there were financial distresses in Norway in 1987, and Sweden and Finland in 1991.

the best of our knowledge, there have been few studies based on regional units within a nation or a metropolitan city so far. Although one can find a study that employs units of cities (Oikarinen 2009), studies based on more specifically subdivided units like those of in-city regions are non-existent except for the research work by Park et al. (2010). In fact, the housing market is, by nature, regional rather than national, where other assets or stock markets belong. Even if they belong to the same country or city, units in a regional housing market may have substantial differences in household wealth, income levels, residential conditions, and government controls, which may affect house prices and influence bank lending in turn. So it seems feasible that we may have aggregation bias if we examine the relationship on a national or city basis regardless of the obvious regional differences that affect those variables.

However, there is growing empirical literature on the regional differences of housing markets depending on income, monetary policy, and elasticity of supply. For instance, Hwang and Quigley (2006) show that by using a sample of U.S. metropolitan areas, the real prices of housing in three Californian housing markets had more than tripled during the period of 1975-2000, while the real housing prices in three other metropolitan statistical areas (MSAs, Houston, Albany, and Oklahoma City) were stagnant. What accounts for such cross sectional diversity becomes an important research topic. Leung and Teo (2011) show that differences in the price elasticity of housing supply can be related to stylized facts on regional differences in (1) house price level, (2) house price volatility, (3) monetary policy propagation mechanism, and (4) household asset portfolio, by a multi-region, dynamic stochastic general equilibrium model. Fratantoni and Schuh (2003) have noted that the impact of a national monetary policy is different and depends on the regions because monetary transmission depends on the extent and nature of regional heterogeneity.

Following these insights, we therefore first survey the house price growth rates of our subject areas to determine the potential number of unit categories that we can possibly adopt in this paper. The result shows that the yearly growth rates of real house prices on average are 4.78% nationwide, 12.19% in Kangnam, 5.95% in Kangbuk, 1.44% in Daegu, -0.74% in Gwangju and 2.11% in Pusan.[2] The figure for Kangbuk proves to be a little higher than those for nationwide cities, which means that Kangbuk has a moderate and near equilibrium housing market. Thus, we have decided to break down our subject into three categorical units (submarkets) accordingly, which comprise a premium housing submarket (Kangnam) that shows a substantial price rise, a moderate market (Kangbuk), and a stagnant market (Pusan, Daegu, and Gwangju, for which the growth rates are far lower than those nationwide).

[2] Pusan, Daegu and Gwangju are metropolitan cities which are located 323 km, 236 km, and 266 km from Seoul, the capital city of Korea, respectively.

This paper is organized into 6 sections of which the remaining 5 are as follows. In Section 2, we review the literature. Section 3 contains the stylized facts and data. This is followed by a long-run analysis in Section 4 and the short-run relationship in Section 5. Finally, in Section 6, we put forth the conclusion on this research with some future recommendations.

2. Literature Review

The relationship between bank lending and house prices has been widely tackled in the literature. Among others, Hofman (2003), Davis and Zhu (2004), Kim (2004), Oikarinen (2009), Brissimis and Vlassopoulos (2009), and Gimeno and Martinez-Carrascal (2010) argue that there is a significant bilateral dynamic interplay between bank lending and house prices. Aoki et al.(2004) and Iacovielleo (2004, 2005) show that house prices may affect the availability of bank lending by the wealth effect[3]. Gerlarch and Peng (2005) find a one-way causality from house prices to bank lending. These studies suggest that house prices influence bank lending rather than the other way around.

On the other hand, the opposite of unilateral causality can also be assumed. Bank lending may affect house prices with increased credit availability, possibly expanding the demand for a contemporaneously fixed supply of housing stock. Kindleberger (1978) and Minsky (1982), for example, have developed models that exhibit the role of credit in asset valuations, particularly when it increases available liquidity.

Collyns and Senhadji (2001) find that credit growth has a significant effect on house prices in a number of Asian countries. Koh et al. (2005) look into the Asian house price run-up and collapse in the 1990s and suggest that the cause of a housing market bubble may be excessive bank lending. They also argue that under-pricing by financial institutions of the put option imbedded in non-recourse mortgage loans is a potential cause for the observed price behavior. Liang and Cao (2007) find a unidirectional causality from bank lending to house prices in China. Allen and Gale (1999) find that massive credit expansion induced by an expansionary budget policy in 1987 caused the housing price appreciation in Finland from 1988 to 1989. Ahearneet et al. (2005) argue that the period during a monetary appeasement policy is typically followed by an appreciation of house prices. Wheaton and Nechayev (2006) and Mian and Sufi (2008) show that the booming price of the US housing market is caused in part by the emergence of an active sub-prime mortgage market.

[3] Wealth effect means that an increase in house prices enhances the borrowing capacity of households. Besides that, the rise in house prices improves the capital position of banks and thus their lending capacity through increased valuations of their real estate and mortgage assets.

According to Park et al. (2010), house prices in Kangnam are not affected by bank lending in the short-run, while positively affected in the long-run. However, their study seems to be carried out for only a short period of time (1999 - 2006). This kind of study may be very time-sensitive. Therefore, it may not fully reflect the attributes and the long term influences of bank lending on house prices. Thus, with this limitation in mind, we extend the dates in the literature on the linkage between bank lending and house prices with a longer period of time (1999–2009).

As in any other market, the prices in the housing market are also subject to the economic principle of demand and supply. Typically, the demand for housing is modeled as a function of household income, mortgage interest rates, availability of credit and other demographic factors while the supply of housing is modeled as a function of land cost, construction cost and new construction. For example, Hendry (1984) expresses real house price in terms of household income, housing stock, construction costs and money supply.

3. Apartment Prices and Bank Lending: Facts and Data

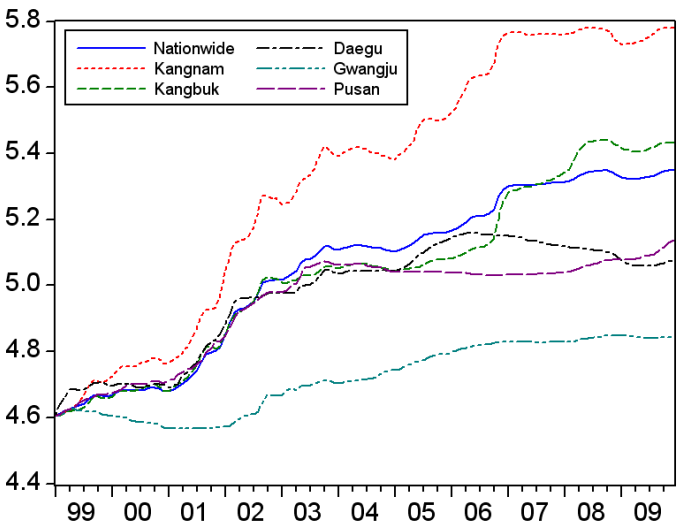
Seoul is divided into two areas by the Han River which runs through the middle of the city, Kangnam (the southern part) and Kangbuk (the northern part). Although they are in the same metropolitan city, Kangbuk is older with a moderate house price pattern while Kangnam is a relatively newer region which consists of 11districts characterized by a good living environment that includes decent housing, amenities and good educational opportunities in particular, thus rendering itself as the most expensive housing area in Korea.
Of all the housing types, we have taken apartments into consideration, for they are data affluent as well as the most popular housing type in Korea. We employ the apartment price indexes (from January 1999 to December 2009) from the Kookmin Bank[4], not based on actual transaction prices, but on a survey of local brokers taken on a regular basis. Figures 1 and 2 show the apartment price indexes in nominal and real terms, respectively. The indexes are set to 100 in January 1999, and then, their natural log is used for the graphs.

As seen in Figures 1 and 2, Kangnam has experienced the most dramatic house price appreciation in recent years (1999-2009).It was not until 1999 that the mortgage market began to prosper in Korea.[5] Prior to the Asian financial crisis in1997, the housing finance system had been underdeveloped partly because government policies on bank lending were in favor of industrial development, concentrating limited capital on the industry and thus sacrificing

[4] The price index of Kookmin Bank is authorized by government authorities.
[5] For a brief review of the history of the Korean mortgage market, see Kim (2004) and Zhu (2006).

the housing sector. The underlying assumption behind such control was that the housing sector yields lower returns compared with manufacturing and export industries. However, after a decade of rapid growth, commercial banks have emerged as the major mortgage providers. Consumer credit offered by commercial banks, however, was very limited until after the Asian financial crisis, when consumer credit accounted for only 26.4% of the loan portfolio of the banks while the remaining 73.6% were loans to corporations. Yet, the share of consumer credit increased to 30.5% in 1999, 34.5% in 2000, 43.8% in 2001, and all the way to 49.5% in 2006. There were only slight decreases in 2007, 2008 and 2009, to 45.2%, 42.3%, and 42.9%, respectively, which imply that the importance of mortgage loans grew in the bank's consumer loan portfolio[6]. According to a survey by the Bank of Korea, 64.5% of the consumer loans were collateralized by houses in 2009.

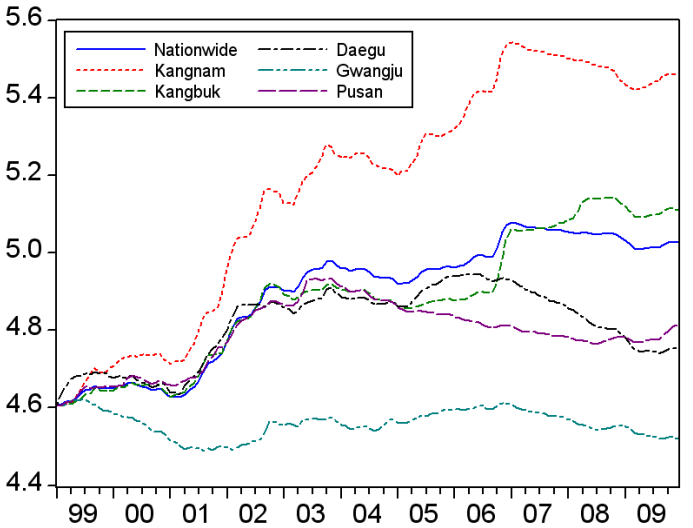
Figure 1 Nominal Apartment Prices in Major Submarkets



Notes:* All time series data are set to 100 in 1999:1. Their log values are shown on the graph.

[6] The data are from the Statistical Survey of the Bank of Korea. The main reasons for the shift from the corporate sector to households are that the corporations had to substantially cut the demand for funds to improve their previously heavily leveraged financial structure and that banks became more reluctant to make loans to corporations since they suffered heavy losses from the corporate loan portfolio during the Asian financial crisis.

Figure 2 Real Apartment Prices in Major Submarkets



Notes:* All time series data are set to 100 in 1999:1. Their log values are shown on the graph.

As bank lending has become a significant factor for financing house purchases since 1999 as evidenced above, we use a bank lending time series from 1999 accordingly. To empirically certify that there is a real structural change in 1999, we conduct the Chow's breakpoint test for Kangnam apartment prices as a function of bank lending and GDP. As a result, we find that there is a structural break around December 1998 at the 5 percent significance level, which is consistent with the notion that the relationship between bank lending and apartment prices may have changed since 1999.

The distinctive features of the Korean mortgage market can be depicted as follows. Loan to value (LTV) in the Korean mortgage market is relatively low compared with that in other countries. Furthermore, there is no put option imbedded in mortgage loans which is common in the U.S and other countries. The effect of mortgage loans on house prices may vary depending on the level of the LTV and the existence of a put option. The feasibility of such a low LTV in Korea is, for the most part, due to an informal housing finance scheme known as chonsei. Under a chonsei arrangement, the tenant gives the landlord a lump-sum deposit (about 50 per cent of the house value) in lieu of monthly rental payments. The landlord is expected to generate a stream of income from this deposit, for instance, to buy a second house. The deposit is fully refunded at the end of the lease.[7]

[7] For a more comprehensive discussion, refer to Ambrose and Kim (2003) and Hwang, Quigley and Son (2006).

To testify our initial assumption that Kangnam is a differentiated premium housing market, we have also examined and compared housing prices and affordability under the study period, although it was not possible to obtain the exact standards for comparison of the prices, namely, the height, age, location, geographic and meteorological conditions and so on, except for the size. As seen in Table 1, the average apartment price in Kangnam is $564,000, $352,000 in Kangbuk, and $127,000 in other cities in 2009, which suggest the house price in Kangnam is still higher than or presumably the highest in Korea.[8] The reasons for this high price in the Kangnam housing market are attributed to the high quality of schools and amenities including easy access to public transportation along with restrictions on land supply and construction. For instance, the green belt in Seoul occupies 50 per cent of its developable land. At the same time, controlling the growth in the capital region, which amounts to 11 per cent of the nation's territory and is home to 46 per cent of its population, remains a top government priority (Xiao, 2010: Xiao and Park, 2010)

Table 1 Apartment Price and Yearly Growth Rate
(unit: thousand US dollars)

	Nationwide	Kangnam	Kangbuk	Other provincial cities
Mean*	218	564	352	127
Median*	202	529	333	115
growth rate**	4.78%	12.19%	5.95%	0.46%***

Notes: *indicates the apartment price at the end of 2009.
** indicates the average growth rate from 1999 to 2009.
*** indicates the average growth rates of Daegu, Gwangju and Pusan.
***Source*:** Kookmin Bank

To assess affordability in the housing market, we used three conventional metrics, that is, the housing affordability index (HAI), price-to-income (PIR) ratio and price-to-rent (P/R) ratio. If the HAI is below 100 with an excessively high PIR, it could be an indication of poor affordability, which implies that the house price is far beyond the reach of an average income household. As evident in Table 2, the HAI of Korea is 117.3 nationwide, 44.7 in Kangnam and 71.0 in Kangbuk in 2009. Moreover, the PIR is 5.1 nationwide and 11.9 in Seoul in 2009.

It can be well inferred from the above results that the PIR of Kangnam would be even higher than that of Seoul.

[8] Park et al. (2010) state that the apartment price in Kangnam is incomparably high. Moreover, Xiao and Park (2010) find that the apartment price in Seoul is relatively high.

Table 2 Measures of Housing Affordability: Housing Affordability Index and Price–to-income Ratio

	Housing Affordability Index			PIR	
	Nationwide	Kangnam	Kangbuk	Nationwide	Seoul
2008	108.1	43.0	64.8	5.3	12.0
2009	117.3	44.7	71.0	5.1	11.9

Notes: The HAI measures the ability of a median income family to pay back a mortgage loan with its current income when buying a median priced house with a mortgage loan. A HAI greater than 100 means that a median income family can afford to buy a median priced house without difficulty.
Source: Kookmin Bank

Another measure used to assess the housing affordability is the P/R ratio which is calculated as the proportion of the house price to the yearly rental. In Table 3, we show the house P/R ratios in Kangnam and elsewhere from 1999 to 2009. In Korea, monthly rentals are not as popular as chonsei. In fact, under the chonsei system, the tenant can be said to pay an implicit rent, which we estimate by multiplying chonsei with the opportunity cost of chonsei, that is, an interest rate applied specifically to chonsei.

Since there are no published yearly rent statistics from reliable sources in Korea, we estimate apartment P/R ratios as (apartment price/chonsei) (1/prevailing chonsei equivalent annual interest rate). [9] We obtain chonsei-to-apartment price ratios and the equivalent monthly interest rates of chonsei from the Kookmin Bank, which maintains the monthly time series of those figures.

For this table, we use the apartment price index for Kangnam provided by the Kookmin Bank. For the second last column, we calculate the difference in the average P/R ratios between Kangnam and the other four regions during the study period. The last column shows the t-statistics of the difference in means. The difference in the average P/R ratios between Kangnam and the other regions except for Kangbuk is statistically significant at the 1% significance level. There is no significant difference between Kangnam and Kangbuk.

[9] Since P/R ratio = (house price)/(yearly rent), by expressing yearly rental as (chonsei) times (prevailing chonsei equivalent annual interest rate), we have P/R ratio= (house price/chonsei) (1/prevailing chonsei equivalent annual interest rate).

Table 3 Measures of Housing Affordability: Apartment Price–to-rent Ratio

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Kangnam minus other markets	t-test statistics
Nationwide	8.9	9.1	9.1	10	12.9	14.2	14.4	15.4	15.5	16.1	16.3		
Kangnam	9.8	10.2	10.5	12.9	20.9	21.8	22.3	26.1	25.9	26.2	26.2		
Kangbuk	8.8	9.2	9.1	10.3	15.9	17.1	17.2	18	18.8	21.4	22.2	4.1	1.56
Daegu	8.5	8.5	8.7	8.4	12.7	13.7	13.8	13.9	10.4	10.6	10.8	8.4	3.79**
Gwangju	8.2	8.5	8.8	9.1	8.7	9.5	10.2	10.5	13.1	12.9	13.2	9.1	4.14**
Pusan	8.2	8.4	8.6	8.9	11.7	12.9	13.5	13.4	13.8	13.6	14.5	7.8	3.44**

Notes: ** denotes significance at the 1% level.

The apartment price-to-rent (P/R) ratio is the ratio between the apartment price and the yearly rent. We estimate the P/R ratios as (apartment price/chonsei) (1/prevailing chonsei equivalent annual interest rate). The Kookmin Bank publishes apartment price-to-chonsei ratios and chonsei-equivalent annual interest rates.

We obtain bank lending data from the Bank of Korea and then measure the bank lending by using the bank lending outstanding in a given market, rather than using the total mortgage loans that were underwritten.[10] There are several considerations behind doing so. First, the Bank of Korea does not publish regional residential mortgage loan data, although it does so with regional bank lending data. On top of that, it began to publish nationwide residential mortgage loan data only from October 2003[11] which we find improper for our regional and time-sensitive analysis. Second, bank lending tends to co-move with residential mortgage loans of which the regional data are not available in Korea. Thus, we use bank lending as surrogate variables of mortgage loans by focusing on the identification of potential deviations of these variables from their long-run or equilibrium levels and the manner that these variables are adjusted.

GDP is also used in our analysis. The quarterly GDP data, which are adjusted for seasonal factors by the Korea National Statistical Office, are converted into monthly data by using linear interpolation. The interest rate that we use is the composite lending rate published by the Bank of Korea. The real term used in this paper is adjusted to the consumer price index (CPI) over the past 12 months released by the Korea National Statistical Office. The regional house construction permit unit data are from the South Korea Ministry of Land, Transport and Maritime Affairs. The construction cost index is from the Construction Economy Research Institute of Korea. However, due to the lack of regionally separate data on this, we use the house construction permit units of Seoul instead of those of Kangnam and Kangbuk separately. GDP and the construction cost index are also nationally based rather than regional.

In Table 4, the descriptive statistics of the variables in all the regions are reported. The variables are real apartment price, real bank lending and house construction permit unit as well as real GDP and real interest rate. Logarithms are taken in all variables except for real interest rate. They are normalized to 100 in January 1999 before the log transformation. The mortgage loan data are set to 100 in October 2003.

[10] For both Kangnam and Kangbuk, we use total bank lending in Seoul rather than that in Kangnam or Kangbuk since separate bank lending in Kangnam or Kangbuk is not available and also because it is possible that households that move into Kangnam or Kangbuk may apply for house purchase loans elsewhere in Seoul.

[11] We estimate the augmented vector error correction model for the apartment price by using mortgage loans and report the results in Table 14.

Table 4 Descriptive Statistics (1999:01 - 2009:12)

Variable	OBS	Mean	Median	Max	Min	SD
Panel A. Nationwide						
real apartment price	132	4.89	4.95	5.08	4.61	0.16
real bank lending	132	5.38	5.46	5.85	4.61	0.35
construction permit	132	5.19	5.12	6.65	3.89	0.55
Panel B. Kangnam						
real apartment price	132	5.16	5.24	5.54	4.60	0.30
real bank lending	132	5.34	5.41	5.80	4.60	0.32
construction permit	132	5.13	5.31	7.64	2.63	0.98
Panel C. Kangbuk						
real apartment price	132	4.88	4.88	5.14	4.60	0.17
real bank lending	132	5.34	5.41	5.80	4.60	0.32
construction permit	132	5.13	5.31	7.64	2.63	0.98
Panel D. Daegu						
real apartment price	132	4.81	4.86	4.95	4.61	0.10
real bank lending	132	5.15	5.22	5.50	4.60	0.28
construction permit	132	5.13	5.39	7.34	1.27	1.40
Panel E. Gwangju						
real apartment price	132	4.56	4.56	4.62	4.49	0.03
real bank lending	132	5.30	5.37	5.70	4.61	0.30
construction permit	132	4.31	4.68	7.25	0.00	1.46
Panel F. Pusan						
real apartment price	132	4.79	4.79	4.93	4.61	0.09
real bank lending	132	5.37	5.49	5.78	4.61	0.35
construction permit	132	6.05	6.22	8.09	2.42	1.18
Panel G. for all regions						
real interest rates (%)	132	4.08	3.56	9.27	0.86	2.10
real construction cost index	132	4.19	4.18	5.13	2.75	0.51
real mortgage loan	75	4.83	4.87	5.00	4.61	0.11
real GDP	132	4.93	4.94	5.13	4.61	0.14

Notes: All variables except for real interest rates are transformed by taking their natural logarithms and they have been normalized to 100 in 1999:1 prior to the log transformation while mortgage loans have been normalized to 100 in 2003:10. Bank lending and construction permits for Seoul are used instead of those for Kangnam and Kangbuk.

4. Long-run Analysis

In this section, we turn to the econometric work. To examine the stationarity of the time-series data, we apply Phillips-Perron's (Phillips and Perron, 1988) unit root test. The results are shown in Table 5. The inferred order of integration is found in the last column. The inferred order of integration of all variables is 1 except for construction permit. Next, we analyze the long-run relationship between apartment prices and bank lending for each region.

The analysis of the long-run relationship between real regional apartment prices, regional bank lending, GDP and interest rate is based on a multivariable approach to cointegration tests proposed by Johansen (1988, 1991, 1995). The cointegrating vector autoregression (VAR) model is given by:

$$x_t = \beta_1 x_{t-1} + ... + \beta_k x_{t-k} + \mu + \delta\tau_t + \varepsilon_t \quad (1)$$

where x is a vector of endogenous variables that comprise real interest rates, the log of real bank lending, real apartment prices and real GDP. $\mu$is a vector of constants, τ is a deterministic time trend and ε is a vector of white noise error terms. We use this specification as the sequential testing procedure.[12]

To proceed, the VAR model can be reformulated into a vector error correction form:

$$\Delta x_t = C_1 \Delta x_{t-1} + ... + C_{k-1} \Delta x_{t-k+1} + C_0 x_{t-1} + \mu + \varepsilon_t \quad (2)$$

The Johansen methodology is based on the maximum likelihood estimation and aims to test the rank of the matrix C_0, which indicates the number of long-run relationships between the endogenous variables in a system. Table 6 shows that the trace statistics point toward the existence of one or two cointegrations. After performing an unrestricted cointegration test (Model 1), we find that the sign of the coefficients of interest does not come out as expected for some regions. Thus, in Model 2, we impose a zero coefficient on interest rate, as bank lending is the variable that captures the impact of financing costs on apartment prices. The results of Models 1 and 2 show that the speed of the adjustment parameter of GDP is near zero which means that the GDP is weakly exogenous. So in Model 3, we conduct a restricted cointegration test again, this time imposing zero on the α value of GDP.

[12] Akaike information criterion (AIC), Schwarz information criterion (SIC) and Hannan-Quinn information criterion (HQ) are used for model selection, such as determining the lag length of VAR.

Table 5 Phillips-Perron Unit Root Test Results (1999:01 - 2009:12)

Variable	Levels		First Difference		Inferred order of integration
Panel A. Nationwide					
real apartment price	-0.83	(T)	-5.26	(C)**	I(1)
real bank lending	-1.96	(T)	-9.23	(C) **	I(1)
construction permit	-8.47	(C)**			I(0)
Panel B. Kangnam					
real apartment price	-0.60	(T)	-5.39	(C)**	I(1)
real bank lending	-2.22	(T)	-11.16	(C) **	I(1)
construction permit	-8.14	(C)**			I(0)
Panel C. Kangbuk					
real apartment price	-1.84	(T)	-4.72	(C)**	I(1)
real bank lending	-2.22	(T)	-11.16	(C)**	I(1)
construction permit	-8.14	(C)**			I(0)
Panel D. Daegu					
real apartment price	-0.85	(T)	-5.82	(C)**	I(1)
real bank lending	-0.89	(T)	-9.82	(C)**	I(1)
construction permit	-9.69	(C)**			I(0)
Panel E. Gwangju					
real apartment price	-1.57	(T)	-7.19	(C)**	I(1)
real bank lending	-1.72	(T)	-9.47	(C)**	I(1)
construction permit	-9.76	(C)**			I(0)
Panel F. Pusan					
real apartment price	-1.47	(T)	-5.77	(C)**	I(1)
real bank lending	-0.76	(T)	-6.92	(C)**	I(1)
construction permit	-6.95	(C)**			I(0)
Panel G. for all regions					
real interest rate	-1.93	(T)	-4.62	(C)**	I(1)
real construction cost index	-2.28	(T)	-5.45	(C)**	I(1)
real mortgage loan	-1.90	(T)	-5.89	(C)**	I(1)
real GDP	-3.01	(T)	-4.08	(C)*	I(1)

Notes: * denotes significance at the 5% level. ** denotes significance at the 1% level. The Phillips-Perron test statistics are shown in the table where the null hypothesis of the series is not stationary. T indicates that the test regression includes a time trend and a constant, and C indicates that the test regression includes only a constant. The sample period for these series typically starts in January 1999 and ends in December 2009. The lag length is chosen by using the Newey-West (1992) bandwidth selection method for kernel based estimators.

Table 6 Johansen Cointegration Tests(1999.01-2009.12)

Panel A. Nationwide			Trace test	
real apartment price	Null hypothesis	r=0	r≤1	r≤2
real bank lending	Trace statistics	53.73	21.63	11.11
real GDP	p-value	0.013	0.320	0.205
real interest rate				
*Panel B.*Kangnam			Trace test	
real apartment price	Null hypothesis	r=0	r≤1	r≤2
real bank lending	Trace statistics	52.41	25.77	12.16
real GDP	p-value	0.018	0.059	0.149
real interest rate				
*Panel C.*Kangbuk			Trace test	
real apartment price	Null hypothesis	r=0	r≤1	r≤2
real bank lending	Trace statistics	64.25	35.75	11.35
real GDP	p-value	0.001	0.001	0.191
real interest rate				
*Panel D.*Daegu			Trace test	
real apartment price	Null hypothesis	r=0	r≤1	r≤2
real bank lending	Trace statistics	57.62	31.35	7.11
real GDP	p-value	0.005	0.033	0.564
real interest rate				
*Panel E.*Gwangju			Trace test	
real apartment price	Null hypothesis	r=0	r≤1	r≤2
real bank lending	Trace statistics	57.35	30.49	15.49
real GDP	p-value	0.005	0.042	0.064
real interest rate				
*Panel F.*Pusan			Trace test	
real apartment price	Null hypothesis	r=0	r≤1	r≤2
real bank lending	Trace statistics	52.35	20.40	6.70
real GDP	p-value	0.018	0.396	0.613
real interest rate				

Table 7 Unrestricted and Restricted Cointegration Tests (1999:01-2009:12)

	Model 1 Unrestricted		Model 2 Restricted		Model 3 Weak exogenous	
	β	α	β	α	β	α
Panel A. Nationwide						
real apartment price	1	-0.0054	1	0.0033	1	0.003
real bank lending	-0.17	0.0018	-2.496**	0.0150*	-2.551**	0.0157*
real GDP	-1.067	-0.0005	3.660**	0.0014	3.902**	0
real interest rate	0.170**	-0.3059**	0	-0.2915**	0	-0.2877**
Panel B.: Kangnam						
real apartment price	1	-0.0089*	1	-0.0011	1	-0.0035
real bank lending	1.249	0.0002	17.001**	-0.0012	4.783**	-0.0049
real GDP	-3.283	-0.0001	-24.88	-0.0003	-9.352*	0
real interest rate	0.270**	-0.1909**	0	0.0253**	0	0.0945**
Panel C. Kangbuk						
real apartment price	1	0.0201	1	-0.0032	1	-0.0038
real bank lending	-1.204**	0.0935**	-0.975**	0.1028**	-0.960**	0.1079**
real GDP	1.207*	0.0024	0.701	0.0043	0.716*	0
real interest rate	-0.042**	0.9348**	0	-0.3751	0	-0.3068

(Continued…)

(Table 7 Continued)

	Model 1 Unrestricted		Model 2 Restricted		Model 3 Weak exogenous	
	β	α	β	α	β	α
Panel D. Daegu						
real apartment price	1	0.0134**	1	0.014	1	0.0135
real bank lending	-4.783**	0.019**	-2.192**	0.0413**	-2.189**	0.0401**
real GDP	6.389**	-0.0009	3.132**	-0.0013	3.078**	0
real interest rate	-0.179**	0.136	0	-0.491**	0	-0.4922**
Panel E. Gwangju						
real apartment price	1	0.0095**	1	-0.0195	1	-0.0206
real bank lending	-0.677	0.0095	-0.648**	0.0574	-0.711**	0.0632
real GDP	0.505	0.0016	0.99	0.0081	1.199*	0
real interest rate	-0.157**	0.2786**	0	-.06524*	0	-0.5685
Panel F. Pusan						
real apartment price	1	-0.026	1	-0.00028	1	-0.0037
real bank lending	-0.775**	0.0191	-1.147**	0.0512*	-1.136**	0.0533*
real GDP	1.614**	-0.0032	2.175**	0.002	2.169**	0
real interest rate	0.022**	-1.9826**	0	-1.5243**	0	-1.5813**

Notes: * denotes significance at the 5% level. ** denotes significance at the 1% level.
The null hypothesis is that the number of cointegration vectors is r. Standard errors for α are in parentheses.

As seen in Table 7, an unrestricted model has less significant β coefficients than the restricted models. Moreover, we note that the restricted model which is weakly exogenous is better than that without exogenous variables as the former has more significant variables. So, we choose to explain the relationships with this model.

In the fifth column of Table 7, we show the cointegration results of the apartment prices, bank lending and GDP. The coefficient on nationwide real bank lending is - 2.551, which implies that real apartment prices and bank lending grow proportionately over time. However, the coefficient in Kangnam is 4.783, which means that real apartment price and bank lending grow negatively, and imply that about a 1% increase in bank lending is associated with about a 4.78% decrease in apartment prices in the long run. The coefficient on real income is -9.352 which indicates that real apartment price and real income also grow together over time. Overall, these results suggest that along-run relationship between apartment prices and GDP goes in the same direction during the sample period but the movement goes conversely between apartment prices and bank lending. This finding is different from that of the existing literature on the long-run relationship between house price movements and bank lending in most of the OECD economies, and in Hong Kong.[13] Moreover, our result is quite the opposite of that found by Park et al. (2010) in a previous study on similar regions.

The apartment price and bank lending in the regions other than Kangnam grow proportionately. The elasticities of apartment price on bank lending are-0.960,-2.189,-0.711, and -1.136, respectively, and real GDP has a negative influence on the apartment prices in these regions. This seems to reflect the fact that while GDP has steadily increased, the apartment prices in these regions have remained stagnant.

5. Short-run Relationship

In this section, we examine the short-term dynamic relationships between real bank lending, apartment prices, GDP and interest rate. The above cointegrating results imply that the relationship has an error correction term, represented by the once-lagged cointegrating vector, which should enter the equation for real bank lending and real apartment prices. We consider other possible variables as well as those that do not enter the cointegration relationship, but may contribute to short-term movements in bank lending and apartment prices, such as changes in the house construction permit unit and real construction cost index. We use the Newey-West procedure (Newey and West, 1987) to control for the heteroskedasticity and/or the autocorrelation of

[13] See Goodhart and Hofmann (2003), Gerlach and Peng (2005).

the error terms which may frequently occur in an ordinary least square (OLS) regression.

We follow a general-to-specific approach in which insignificant variables are removed step by step to obtain parsimonious equations for the changes in real bank lending and real apartment prices, respectively.

First, we will describe the bank lending equation. The dependent variable is the change in real bank lending in each region. The explanatory variables are the four lags of the dependent variable, current and four lags of the changes in real apartment price, real GDP, real interest rate, regional house construction permit unit and real house construction cost index, and one lag of the cointegrating vector.

Table 8 shows the coefficient estimates of the bank lending equations nationwide, and for Kangnam, Kangbuk and three provincial cities. The second column of Table 8 shows the parsimonious bank lending equation for Kangnam. Several observations are worth noting. First, the error correction term proves to be significant which suggests that excessive bank lending may reduce bank lending growth in the next period. Secondly, the combined coefficient of the current Kangnam apartment price and that of the three lags are positive. In other words, movement in apartment prices seems to have played a role in driving the credit growth in Kangnam. More specifically, a 10% change in the apartment price in the previous month causes a 1.72% change in bank lending in Kangnam.

Columns 3 through 6 of Table 8 show the ultimate equations obtained for real bank lending growth in regions other than Kangnam. Our results show that bank lending in Kangbuk is influenced by past bank lending, current/past apartment prices and past house construction permit units. Bank lending in Daegu is influenced by past bank lending, past income, current apartment prices, past construction permits, current/past construction cost indexes and past interest rates. Bank lending in Gwangju is influenced by current apartment prices, past bank lending, past income, current and past construction indexes and past interest rates. Bank lending in Pusan is influenced by past bank lending, current apartment prices, past construction cost indexes and past interest rates. We note that bank lending in all of the regions is influenced by current apartment prices.

Next, we estimate the apartment price equation. In doing so, we use the change in real apartment price as a dependent variable. The explanatory variables are the four lags of the dependent variable; the current and four lags of the changes in real bank lending, real GDP, real interest rate, house construction permit unit and real house construction cost index; and one lag of the cointegrating vector. The changes in the house construction permit unit and house construction cost index are intended to capture the influence of

supply on apartment prices. Table 9 shows the final apartment price equations obtained nationwide, and for Kangnam, Kangbuk and three other cities.

The second column of Table 9 shows the coefficient estimates of the apartment price equation for Kangnam. The coefficients of bank lending are statistically significant, but the combined effect of bank lending is -0.02. This implies that in a premium market, bank lending has little ability to cause changes in apartment prices. As expected, income proves to have influence on the apartment prices in Kangnam. The coefficient of past house construction permit units is statistically significant which implies that construction permit units influence apartment prices over time. This may be due to the fact that construction companies as a whole try to increase the housing supply when the apartment prices are rising or a rise is anticipated.

We find that the interest rate does not have a significant short-term influence on the apartment price in Kangnam. In a related study, Cho and Ma (2006) have shown that there is a long-term negative equilibrium relationship between housing values and interest rates for twelve years in Korea from 1991 to 2002. Ahearne et al. (2005) have shown that the early stages of increase in real house prices are related to the declines in nominal policy interest rates. The difference between our results and those of Cho and Ma, and Ahearne et al., may be due to the fact that house prices continued to increase so incessantly with such a low LTV as previously described that interest rate may have been of little concern during the study period. Another reason could be that the house prices during their study periods were relatively stable and low while the prices continued to rise during our period of study.

Apartment prices in Kangnam were heavily influenced by the apartment prices in the previous period. The coefficient of lag one of the apartment prices is 0.554 and that of lag three is -0.151.The combined effect of the previous three months of apartment prices is 0.403,which indicates that a 1% increase in the apartment price in the previous three months leads to an increase of 0.403% in the current month.

Columns 3 through 6 of Table 9 show the apartment price equations obtained for Kangbuk and three cities. The combined coefficient of the bank lending in Kangbuk is 0.103, which indicates that there is an apartment price response of 0.103% for a 1% change in the bank lending in Kangbuk. The combined coefficients of the bank lending in Daegu, Gwangju and Pusan are 0.27, 0.161 and 0.394, respectively, which indicate a likewise apartment price response.

The apartment prices in Kangbuk are also influenced by past apartment prices. In Daegu, they are influenced by past apartment prices, construction permits, construction cost indexes and current and past interest rates. They are also influenced by current income, past apartment prices and past interest rates in Gwangju. However, in Pusan, they are influenced by past apartment prices, income, construction costs and interest rates.

Table 8 Bank Lending Equations Nationwide, and for Kangnam, Kangbuk and Three Provincial Cities (1999:01 - 2009:12)

	Nationwide	Kangnam	Kangbuk	Daegu	Gwangju	Pusan
bank lending (t-2)		0.197**	0.230**			
		-3.169	-3.069			
bank lending(t-3)	0.323**	0.302**	0.226**		0.336**	0.178*
	-5.614	-6.022	-4.116		-4.31	-2.6
bank lending(t-4)	0.196**			0.110*		
	-2.725			-2.258		
GDP(t-2)				0.576*	1.405**	
				-2.163	-6.716	
GDP (t-4)		0.682**				
		-2.859				
apartment price(t)	0.647**	0.340**	0.477*	0.734**	1.150**	0.989**
	-5.657	-2.661	-2.548	-5.721	-3.934	-7.278
apartment price(t-2)			-0.357**			
			(-3.026)			
apartment price(t-3)		-0.168**				
		(-2.639)				
construction permit(t-1)			0.001**	-0.001*		
			-4.248	(-2.037)		
construction permit(t-2)	-0.005**					0.001**
	(-4.117)					-5.651
construction cost index (t)				-0.039**	-0.036**	-0.011**
				(-4.670)	(-4.633)	(-2.651)
construction cost index (t-1)				-0.050**		
				(-2.708)		
construction cost index (t-2)				0.081**		
				-3.439		

(Continued…)

(Table 8 Continued)

	Nationwide	Kangnam	Kangbuk	Daegu	Gwangju	Pusan
construction cost index (t-3)		-0.032**		-0.140**		-0.023**
		(-3.015)		(-4.864)		(-3.345)
construction cost index (t-4)					-0.072**	-0.036*
					(-2.792)	(-2.538)
interest rates (t-1)				0.032**		
				-3.502		
interest rates (t-2)	-0.006*			-0.032**	-0.017**	
	(-2.346)			-2.676	(-3.098)	
interest rates (t-3)				0.045**		
				-3.924		
interest rates (t-4)					0.027*	0.014*
					-2.334	-2.312
cointegration vector(t-1)	-0.052**	-0.043**	0.072**	-0.058*	-0.091**	-0.125**
	(-3.221)	(-3.108)	(-5.207)	(-2.078)	(-2.568)	(-6.223)
constant	0.026**			0.010**		
	-4.471			-3.825		
adjusted R-squared	0.477	0.295	0.306	0.5	0.444	0.58

Notes:*** denotes significance at the 5%. ** denotes significance at the 1% level.

The dependent variable is the change in real bank lending in each region. The explanatory variables are the four lags of a dependent variable; current and four lags of the changes in real apartment price, GDP, interest rate, regional house construction permit unit, and house construction cost index; and one lag of the cointegrating vector. Following a general-to-specific approach, the parsimonious models are obtained by removing insignificant variables. T-statistics are shown in parentheses by using Newey-West heteroskedasticity and autocorrelation consistent standard errors.

Table 9 Apartment Price Equations Nationwide, and for Kangnam, Kangbuk and Three Provincial Cities (1999:01-2009:12)

	Nationwide	Kangnam	Kangbuk	Daegu	Gwangju	Pusan
bank lending(t)	0.337**	0.208*	0.245**	0.371**	0.161**	0.394**
	-6.07	-2.208	-6.084	-8.904	-8.048	-6.664
bank lending(t-2)			-0.142**		-0.059**	
			(-3.742)		(-2.629)	
bank lending(t-3)	-0.124*	-0.137*				
	(-2.459)	(-2.100)				
bank lending(t-4)	-0.157**	-0.091*		-0.101*		
	(-3.634)	(-2.000)		(-2.192)		
GDP(t)	0.213*	0.630**	0.212*		-0.273**	
	-2.338	-4.324	-2.083		(-3.557)	
GDP (t-1)						0.340**
						-50.71
GDP (t-3)						-0.236**
						(-3.558)
GDP (t-4)						0.169*
						-2.319
apartment price(t-1)	0.582**	0.554**	0.734**		0.416**	
	-11.353	-10.262	-8.075		-5.702	
apartment price(t-2)						
apartment price(t-3)	-0.184*	-0.151**	-0.120*	0.459**		
	(-2.619)	(-3.163)	(-2.306)	-6.829		

(Continued…)

(Table 9 Continued)

	Nationwide	Kangnam	Kangbuk	Daegu	Gwangju	Pusan
apartment price(t-4)	0.175*					
	-2.356					
construction permit(t-1)			-0.002**			
			(-2.712)			
construction permit(t-2)	0.004**					
	-3.864					
construction permit(t-3)				0.001*		
				-2.424		
construction permit(t-4)	0.002*	0.003**	0.002*	0.001*		
	-2.186	-3.688	2.556	-2.447		
construction cost index (t)	0.121*					
	-2.355					
construction cost index (t-1)				0.027**		
				-2.864		
construction cost index (t-2)				-0.035*		0.012**
				(-2.465)		-3.536
construction cost index (t-3)				0.077**		
				-4.518		
construction cost index (t-4)				-0.014**		0.026*
				(-3.658)		-2.499
interest rates (t)				0.007**		
				-2.643		

(Continued…)

(Table 9 Continued)

	Nationwide	Kangnam	Kangbuk	Daegu	Gwangju	Pusan
interest rates (t-2)				0.016*	0.005**	
				-2.124	-2.675	
interest rates (t-3)				-0.026**		
				(-3.548)		
interest rates (t-4)						-0.011**
						(-2.701)
cointegration vector(t-1)	-0.036**		-0.035*	-0.023*	-0.041**	-0.070**
	(-4.260)		(-2.118)	(-2.211)	(-2.726)	(-3.667)
constant	-0.028**			-0.012**		-0.002**
	(-4.251)			(-3.729)		(-3.771)
adjusted R-squared	0.646	0.499	0.608	0.647	0.403	0.634

Notes: * denotes significance at the 5% level. ** denotes significance at the 1% level.
The dependent variable is the change in the real apartment price in each region. The explanatory variables are the four lags of the dependent variable; the current and four lags of the changes in real bank lending, GDP, interest rate, house construction permit unit, and house construction cost index, and one lag of the cointegrating vector. Following a general-to-specific approach, parsimonious models are obtained by removing insignificant variables. T-statistics are shown in parentheses by using Newey-West heteroskedasticity and autocorrelation consistent standard errors.

In comparing the regression results for Kangnam, Kangbuk and three cities, we find that the apartment prices in Kangnam are not influenced by bank lending, but this is not the case elsewhere. As evidenced, bank lending does not explain the apartment prices in a premium market in both the long-run and the short-run.

We can infer some reasons for this phenomenon. First, there is the possibility of speculative activity in a price booming market like Kangnam as Xiao and Park (2010) have noted. Secondly, the purchasers of apartments in Kangnam may not primarily rely on bank lending as is common in other regions. This can be illustrated by the lower LTV in Kangnam in comparison to the other regions. The average LTV in September 2009 as reported by the Kookm in Bank is 39.3% in Seoul, 49.3% in Pusan, 54.1% in Daegu, and 52.1% in Gwangju. By our best guess, this figure will probably be much lower in Kangnam. At the same time, Kangnam is heavily under control of debt to income (DTI) restrictions by the government since 2003. According to Lamont and Stein (1999), house prices react more sensitively to city-specific shocks in cities where households are highly leveraged. This suggests that changes in LTV ratios may affect house price dynamics and price volatility in particular. Consequently, Kangnam which has a low LTV does not sensitively react to bank lending. The number of unsold new apartments can, to some degree, indicate the extent of financial constraint. As shown in Table10, the number of unsold new apartments in Seoul is much smaller. Finally, most of the purchasers of Kangnam apartments are reportedly non-Kangnam residents, which imply that the real owners of Kangnam apartments are a limited number of the nationwide wealthy who have abundant liquidity and thus may not need to primarily rely on bank lending. According to a research by a mainstream daily newspaper[14] in Korea, for instance, more than 50% of the purchasers of newly constructed Kangnam apartments were non-Kangnam residents while in Kangbuk, only 20% were non-residents in 2006.These figures can account for the minimal influence of bank lending on house prices in this market. Gyourko, Mayer and Sinai (2006) argue that an increasing number of high-income households is the main cause of growing spatial skewness in house price in the U.S. In Korea, there has been an ever widening gap in household income since the Asian financial crisis in 1997.[15]

Apart from the demand driven factors that we have addressed so far, there can also be detected supply driven factors. The housing supply in Kangnam was limited due to the low price elasticity of housing supply and government restrictions for controlling the growth of the capital region in Korea.[16] Leung

[14] The Chosunilbo (June 23, 2006)

[15] Interquintile share ratio as income distribution indicator increased from 5.00 in 2003 to 6.16 in 2009 in Korea (Household income and expenditure survey of Korean National Statistical Office).

[16] The authors estimate the coefficient of the supply elasticity of Seoul apartments with data from Jan. 2000 to Mar. 2011. The result was 0.06. This figure appears to be

and Teo (2011) find that both the level and volatility of the house price will be higher with lower elasticity of housing supply. Saiz (2010) also finds that highly regulated metropolitan areas typically have low estimates of supply elasticity.

Table 10 Measures of income/wealth constraints: unsold new apartments (in units)

Year total	Seoul	Pusan	Daegu	Gwangju
1999	2,795	0	3,357	4,015
2000	3,037	6,046	2,944	2,704
2001	1,771	3,797	1,198	564
2002	52	1,936	2,250	868
2003	735	3,657	4,159	1,870
2004	612	6,895	3,250	5,609
2005	574	5,295	3,274	2,156
2006	529	9,009	8,732	6,506
2007	454	11,502	12,199	7,940
2008	2,486	13,997	21,379	12,384
2009	1,803	9,200	16,009	4,678

Source: the 2009 Construction and Transportation Annual Statistical Report by the Korean Ministry of Land, Transport and Maritime

In deriving the dynamic equations, one special concern is the potential simultaneity bias, given that apartment prices and bank lending are highly positively correlated. To tackle this issue, we perform the Hausman test as follows. For the bank lending equation for all regions, we perform an auxiliary regression of real apartment price changes on a set of instrumental variables that are likely correlated with the real apartment price changes, but not with the error term of the changes in real bank lending. Next, we re-estimate the equation for the changes in real bank lending, adding the residuals from the auxiliary regression. If the OLS estimates of the real bank lending equation are consistent, the coefficient on the first-stage residuals should not be significantly different from zero. We also apply the Hausman test to the apartment price equations. We find that the coefficients reported in the study for all regions are consistent in both the bank lending and apartment price equations. Then, we conduct the Ramsey reset tests on the regression equations. The results indicate that all the regression results are stable.

To check the robustness of the test result, we examine the breakpoint of the apartment price equation by using the Quandt-Andrews breakpoint test (Andrews, 1993 and Andrews and Ploberger, 1994).The result shows that there is no breakpoint in Kangnam and nationwide, while it appears in

very low compared to that of MSAs (with populations over 0.5 million in the U.S.) which are 0.60 to 1.70 as estimated by Saiz (2010).

Kangbuk in October 2006, and somewhere in 2002~2003 in a stagnated market as seen in Table 11.

Following the breakpoint test results, we conduct a sub-period analysis on the regions where a breakpoint is apparent. As reported in Tables 12 and 13, the same relationship qualitatively holds for both sub-periods as for the entire sample period.

Table 11 Quandt-Andrews Breakpoint Tests

	Breakpoint	Maximum LR F-statistic Value	Prob.
Nationwide	2003.4	2.494	0.056
Kangnam	2002.1	1.481	0.785
Kangbuk	2006.10	4.280	0.001
Daegu	2002.8	2.358	0.045
Gwangju	2003.5	3.549	0.032
Pusan	2002.1	3.510	0.006

Table 12 Apartment Price Equations in Subperiods1

region	Kangbuk	Daegu	Gwangju	Pusan
period	1999.1-2006.9	1999.1-2002.7	1999.1-2003.4	1999.1-2001.12
bank lending(t)	0.219**	0.310**	0.184**	0.481**
	-7.609	-4.82	-5.698	-4.896
bank lending(t-1)		0.290**		
		-4.732		
bank lending(t-2)	-0.149**			
	(-4.345)			
bank lending(t-4)		-0.248**	0.056**	
		(-6.235)	-3.941	
GDP(t)			-0.545**	
			(-5.151)	
GDP(t-3)				-0.440**
				(-3.077)
GDP (t-4)		-0.729**		
		(-3.304)		
apartment price(t-1)	0.612**		0.264*	
	-6.932		-2.459	
apartment price(t-3)				-0.435**
				(-3.686)
construction permit(t-2)			-0.001**	
			(-3.645)	
construction permit(t-4)		0.001**		
		-2.548		
construction cost index (t)				-0.235**
				(-3.311)
construction cost index (t-1)		-0.158**		
		(-5.09)		

(Continued…)

(Table 12 Continued)

region	Kangbuk	Daegu	Gwangju	Pusan
period	1999.1-2006.9	1999.1-2002.7	1999.1-2003.4	1999.1-2001.12
construction cost index (t-2)		0.094** -3.131		
construction cost index (t-3)		-0.096** (-4.328)		
interest rates (t)		0.015** -3.633		0.039** -3.045
interest rates (t-2)			0.011** -3.477	
cointegration vector (t-1)			-0.111** (-4.419)	
adjusted R-squared	0.515	0.759	0.567	0.664

Notes:* denotes significance at the 5% level. ** denotes significance at the 1% level. The dependent variable is the change in the real apartment price in each region. The explanatory variables are the four lags of the dependent variable; the current and four lags of the changes in real bank lending, GDP, interest rate, house construction permit unit, and house construction cost index, and one lag of the cointegrating vector. Following a general-to-specific approach, parsimonious models are obtained by removing insignificant variables. T-statistics are shown in parentheses by using Newey-West heteroskedasticity and autocorrelation consistent standard errors.

Table 13 Apartment Price Equations in Subperiods 2

region	Kangbuk	Daegu	Gwangju	Pusan
period	2006.10-2009.12	2002.8-2009.12	2003.5-2009.12	2002.1 2009.12
bank lending(t)	0.700** -3.901	0.432** -7.865	0.207** -4.994	0.375** -6.644
bank lending(t-1)			0.126** -3.539	
bank lending(t-4)		-0.099** (-2.878)	-0.099** (-3.032)	
GDP(t)	1.254** -3.418		-0.242** (-3.272)	
GDP(t-1)	-1.096* (-2.428)			
GDP(t-3)	1.082* -2.623			
apartment price (t-1)	0.836** -8.695	0.483** -6.454	0.276** -2.807	0.517** -4.943

(Continued…)

(Table 13 Continued)

region	Kangbuk	Daegu	Gwangju	Pusan
period	2006.10-2009.12	2002.8-2009.12	2003.5-2009.12	2002.1 2009.12
apartment price(t-2)				-0.204*
				(-2.601)
apartment price(t-4)		0.177*	0.279**	
		-2.384	-2.818	
construction permit(t-1)	-0.006**		-0.0004*	
	(-3.267)		(-2.229)	
construction permit(t-2)			0.0004*	
			-2.139	
construction cost index (t)		0.016**		0.007**
		-5.207		-3.038
construction cost index (t-1)		0.029*	0.005*	
		-2.528	-2.286	
construction cost index (t-2)	-0.049*	-0.013**		
	(-2.338)	(-4.278)		
construction cost index (t-3)		0.058**		
		-4.792		
construction cost index (t-4)				-0.023**
				(-4.182)
interest rates (t-1)		-0.017*		
		(-2.632)		
interest rates (t-3)	0.014*	-0.015**	0.003*	
	-2.061	(-2.863)	-2.533	
interest rates (t-4)		-0.005**		
		(-3.276)		
cointegration vector(t-1)	-0.048*		-0.058**	-0.084**
	(-2.097)		(-2.760)	(-6.447)
constant	0.018*	-0.002**		-0.003**
	-2.352	(-3.225)		(-6.286)
adjusted R-squared	0.679	0.669	0.471	0.697

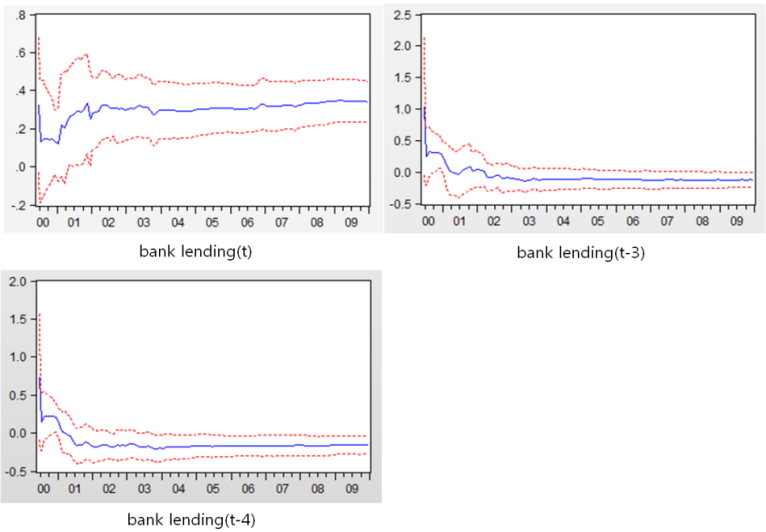
Notes: * denotes significance at the 5% level. ** denotes significance at the 1% level. The dependent variable is the change in the real apartment price in each region. The explanatory variables are the four lags of the dependent variable; the current and four lags of the changes in real bank lending, GDP, interest rate, house construction permit unit, and house construction cost index, and one lag of the cointegrating vector. Following a general-to-specific approach, parsimonious models are obtained by removing insignificant variables. T-statistics are shown in parentheses by using Newey-West heteroskedasticity and autocorrelation consistent standard errors.

We use the mortgage loan data from the Bank of Korea from 2003:10. To isolate the mortgage loans from other non-housing loans, we estimate the augmented vector error correction models (VECMs) of the apartment prices and the mortgage loans for the 2003:10-2009:12 period. In Table 14, we report the regression results of the apartment price equations for Kangnam, Kangbuk

and three other cities. We find a significant short-term effect of bank lending on the apartment prices in areas other than Kangnam except nationwide and in Pusan, but not in the premium market even when we use mortgage loans as the bank lending variable.

To examine whether the response of apartment price to bank lending has changed over time, we also recursively conduct augmented VECMs for all regions. Once the first estimation window is set, the estimation window is increased by one period at a time in subsequent estimations as shown in Figures 3 through8. We find that the coefficients in all variables are generally stable except for some volatility in the early period of the sample. However, we representatively present here, only the figures for the coefficients on bank lending.

Figure 3 Recursive Estimates of Nationwide Bank Lending in Apartment Price Equation



Notes: Solid lines show recursive estimates, dotted lines show ±2.S.E.

Table 14 Apartment Price Equations Nationwide, and for Kangnam, Kangbuk and Three Provincial Cities by Only Using Mortgage Loans (2003:10-2009:12)

	Nationwide	Kangnam	Kangbuk	Daegu	Gwangju	Pusan
mortgage loans(t)			0.270*		0.147*	
			-2.037		-2.473	
mortgage loans(t-2)				0.124*		
				-2.029		
GDP(t)		0.706**			-0.325**	
		-3.975			(-5.061)	
GDP(t-2)				0.287**		
				-4.959		
GDP(t-4)		-0.360*				
		(-2.299)				
apartment price(t-1)	0.747**	0.696**	0.924**	0.635**	0.470**	0.578**
	-6.24	-7.041	-5.201	-7.048	-4.762	-9.723
apartment price(t-2)			-0.300*			
			(-2.405)			
apartment price(t-3)	-0.223*	0.232**			-0.352**	
	(-2.086)	(-4.539)			(-3.484)	
apartment price(t-4)	0.225*				0.290*	
	-2.147				-2.642	
construction permit(t-2)					0.001*	-0.001*
					-2.023	(-2.177)

(Continued…)

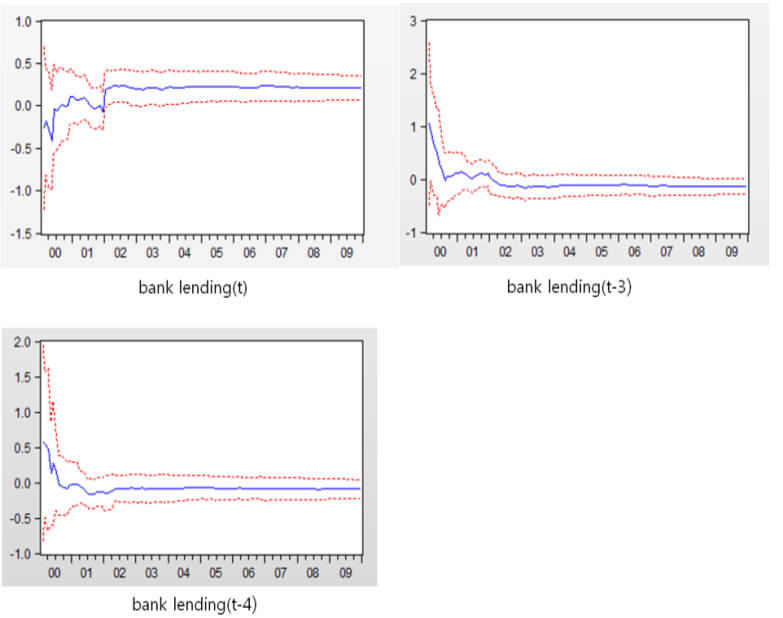
(Table 14 Continued)

	Nationwide	Kangnam	Kangbuk	Daegu	Gwangju	Pusan
construction permit(t-3)		-0.003*	-0.002*			
		(-2.244)	(-2.164)			
construction cost index (t)	0.206*		0.342**		0.230*	
	-2.118		-3.965		-2.091	
construction cost index (t-2)					-0.183*	
					(-2.143)	
construction cost index (t-3)	-0.210*		-0.265*			
	(-2.377)		(-2.550)			
interest rates(t-1)					0.006**	
					-3.381	
interest rates(t-3)		0.012*				0.004*
		-2.626				-2.453
cointegration vector(t-1)	-0.063**					
	(-3.791)					
constant				-0.002**		
				(-2.932)		
adjusted R-squared	0.56	0.54	0.672	0.543	0.339	0.354

Notes:*** denotes significance at the 5% level. ** denotes significance at the 1% level.

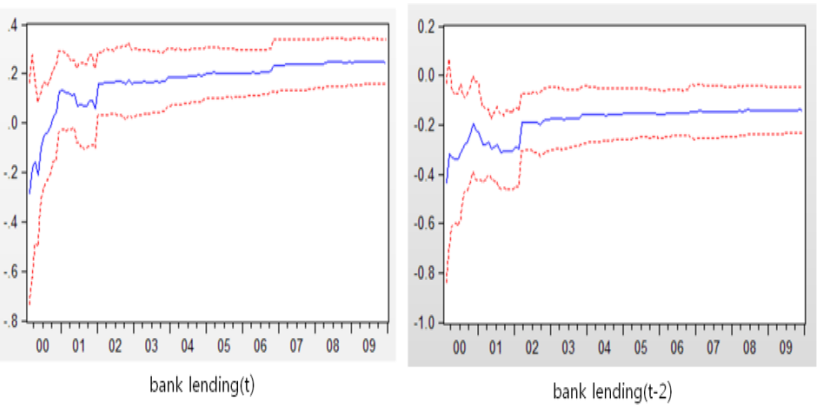
The dependent variable is the change in the real apartment price in each region. The explanatory variables are the four lags of the dependent variable; the current and four lags of the changes in real bank lending, GDP, interest rate, house construction permit unit, and house construction cost index, and one lag of the cointegrating vector. Following a general-to-specific approach, parsimonious models are obtained by removing insignificant variables. T-statistics are shown in parentheses by using Newey-West heteroskedasticity and autocorrelation consistent standard errors.

Figure 4 Recursive Estimates of Bank Lending in Apartment Price Equation for Kangnam



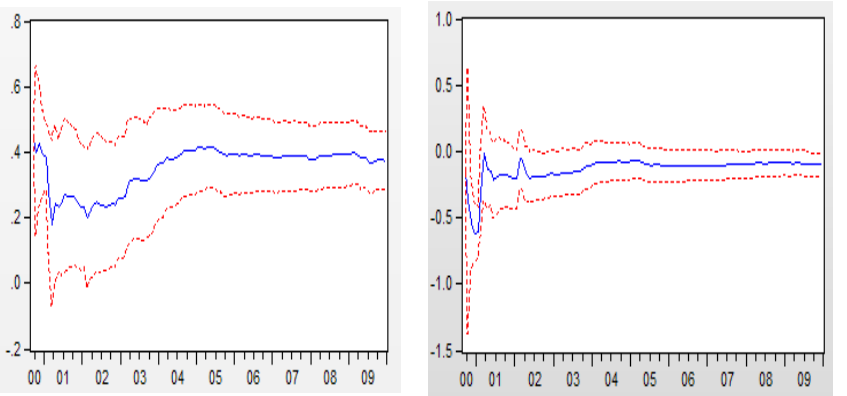
Notes: Solid lines show recursive estimates, dotted lines show ±2.S.E.

Figure 5 Recursive Estimates of Bank Lending in Apartment Price Equation for Kangbuk



Notes: Solid lines show recursive estimates, dotted lines show ±2.S.E.

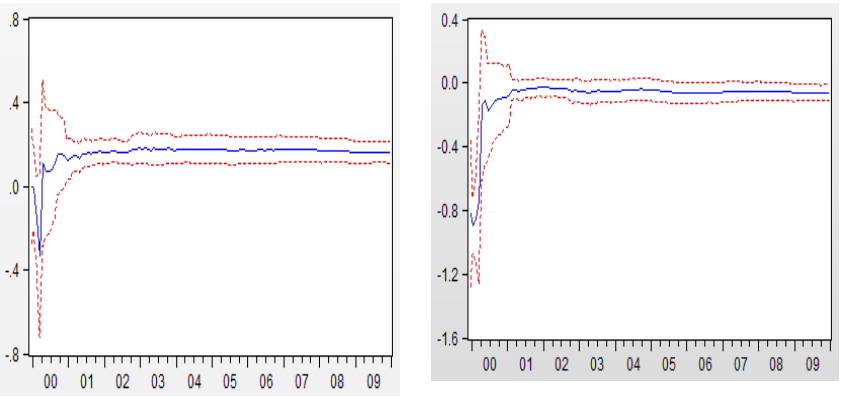
Figure 6 Recursive Estimates of Bank Lending in Apartment Price Equation for Daegu



bank lending(t) bank lending(t-4)

Notes: Solid lines show recursive estimates, dotted lines show ±2.S.E.

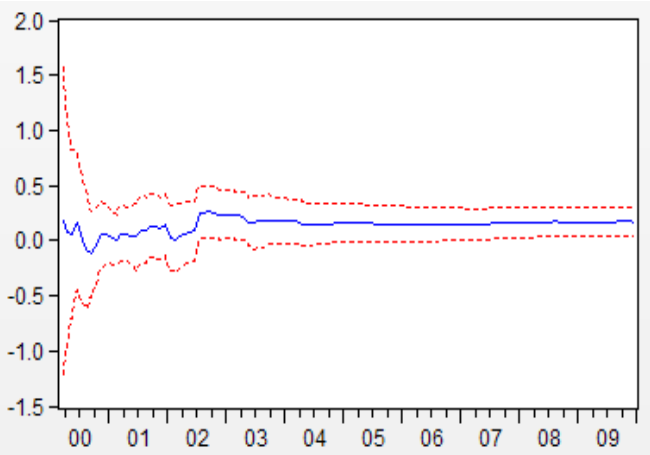
Figure 7 Recursive Estimates of Bank Lending in Apartment Price Equation for Gwangju



bank lending(t) bank lending(t-2)

Notes: Solid lines show recursive estimates, dotted lines show ±2.S.E.

Figure 8 Recursive Estimates of Bank Lending in Apartment Price Equation for Pusan



bank lending(t)

Notes: Solid lines show recursive estimates, dotted lines show ±2.S.E.

6. Conclusion

This paper starts with an assumption that a peculiar housing submarket in Kangnam may exist within a metropolitan city in which regulatory measures related to bank lending may not have such an effect as expected by the government. Unlike another submarket (Kangbuk) in the same metropolitan city, and other submarkets, the specific submarket of our interest is not affected by governmental regulations which had been, ironically designed and implemented for this specific submarket. To confirm the existence of the specific market of our notion and isolate it from the other submarkets, we first examine and compare the price related variables. As expected, the house price in our interest market is beyond comparison and its price dynamics also proves to be unaccountable with our general economic theory, particularly in terms of house prices and bank lending. For these reasons, we designate this particular submarket as a premium market and focus on detecting the factors that influence its odd price behavior.

The empirical result shows that unlike other factors which have proven to be more or less consistent with general economic principles, the relationship between house prices and bank lending in Kangnam do not comply with that in the other submarkets. In other words, bank lending alone may not be sufficient for explaining the peculiarity of price dynamics of a premium market, which implies that there might have been some other factors which affect the house price in Kangnam. Accordingly, we came to take into

consideration the factors on the supply side. As in any other major city in the world, the land available for housing in Kangnam, Seoul, is extremely limited and rigidly regulated by the government through green belt zoning and some construction restrictions. As a result, there is an insufficient housing supply especially for such a bustling area as Kangnam, which also contributes to increasing the price.

From an economic perspective, house prices can also be determined by housing demand and supply. Housing demand may be determined by the composition of population, income and availability of credit while supply will be determined by house construction cost, land cost and construction regulations. Among these factors, we particularly investigate the effect of the availability of credit on house prices in a premium market. By following the related steps, we have conducted a cointegration test to derive long-run relationships among house prices, bank lending, income and interest rate, and then estimated augmented VECM to analyze short-run relationships among house prices, bank lending, income, interest rate as well as house construction permit unit and house construction cost index.

The results of our empirical study are as follows.

The reaction of house prices to bank lending is markedly different among all the submarkets. In a moderate market (Kangbuk) which shows the most complying results with our concept, house prices are affected by bank lending and income in the short run while in the long-run, they are also affected by bank lending. These results are similar to those of a stagnant market except for the fact that a stagnant market shows relatively little or sometimes converse response to our tests because it is a dull or cold market. However, in a premium market, the house prices appear to be unaffected by bank lending in the short-run while in the long-run, they are negatively affected with some influence by income.

From these results, we can safely conclude that contrary to our general notion of an economic principle in which increased bank lending may raise house prices through increased demand for housing, the premium market does not respond as much to the availability of credit as the other submarkets. There could be several reasons to account for this conclusion.

First, the premium market in Korea has an extraordinarily lower LTV and lower financial constraint than other regional markets, which can be illustrated by the smaller number of unsold apartments in this area. Second, a certain portion of the apartments in the premium market are purchased not by Kangnam residents but by the nationwide rich who have plentiful liquidity and thus may not need to primarily rely on bank lending for house purchasing as much as those shown in other regions. Third, while the demand for housing in Kangnam has dramatically increased due to its good quality living conditions and amenities including educational opportunities, its supply is

limited due to the low price elasticity of housing supply and governmental restrictions that control the growth of the capital region in Korea.

What makes our study unique and interesting is that while most previous studies on the interdependence between bank lending and house prices generally employ national or regional units, we have subdivided the housing market into more specific units, like a premium, moderate and stagnant submarket, even within the same metropolitan city. This is due to the notion that housing markets have region-specific features and thus show different price dynamics depending on the region rather than on a national or city level. Moreover, we have employed a more extended sample period (1999:1-2009:12) than that in a related study as a time series analysis of the effect of bank lending on house prices is, most of all, sensitive to the length of the time period. These are the distinct features of our study which may make it unique, interesting, and worthy of attention.

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Appendix 1 Data Descriptions and Sources

Variables	Explanations	Sources	Adjustments
apartment price index	apartment price index for various regions	Kookmin Bank website (est.kbstar.com)	
bank lending	loans of all deposit-taking banks for various regions	Bank of Korea website (www.bok.or.kr)	
mortgage loan	mortgage loan of all deposit-taking banks	Bank of Korea website (www.bok.or.kr)	
GDP	gross domestic product	Korea National Statistical Office website (www.nso.go.kr)	quarterly series converted to monthly series by using interpolation
construction permit unit	house construction permit units for various regions	Korea Ministry of Land, Transport and Maritime Affairs website (www.mtlm.go.kr)	
construction cost index	house construction cost index	Construction Economy Research Institute of Korea (www.cerik.re.kr)	
interest rate	annual composite lending rate	Bank of Korea website (www.bok.or.kr)	