주택가격과 거시경제변수의 순환변동에 대한 연구: 외환위기 전·후기간의 비교분석

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House Price and Macroeconomic Cycles : A Comparative Analysis of Pre- and Post Economic Crisis Periods

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국문 요약: 본 연구는 외환위기 전·후 기간동안 주택가격과 경제변수들의 순환변동에 어떤 변화가 나타났는지를 분석하였다. 외환위기 전에는 물가와 이자율을 제외한 거시경제변수들의 순환과 주택가격 순환변동 간에 인과관계가 발견되지 않았다. 그러나 외환위기 이후 기간에서는 경제변수들의 순환과 주택가격의 순환변동 사이에 강한 인과관계가 발견되었는데, 분산분해분석의 결과도 이를 뒷받침하고 있다. 즉, 외환위기 이후 주택가격 순환변동에 대한 거시경제변수들의 순환변동 설명력이 크게 증가하였다. 특히 주택순환에 대하여 가계대출과 가계소비지출 순환변동의 설명력이 가장 크게 나타났다. 이는 최근 수년 동안 주택가격 급등이 가계대출의 증가와 이에 따른 주택에 대한 가계소비지출과 크게 관련되었음을 함의한다. 한편 충격반응분석결과, 외환위기 이후에는 이자율의 순환변동 충격에 대하여 주택가격 변동이 부(negative)의 반응을 보여주며 이자율이 주택가격의 순환에 인과하고 있다. 이러한 결과는 낮은 이자율이 주택가격 급상승에 있어서 하나의 중요한 원인으로 작용했음을 시사하고 있다.

중요어: HP filter, VAR, 주택가격, 이자율, 가계소비지출, GDP
HP filter, VAR, house price, interest rate, household credit, GDP

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I. Introduction

In many countries' housing markets, the house price cycles are generally believed to be the product of the short-run deviations from the long-run upward trends. The long-run growth in house price is accompanied by the short-run fluctuations around the growth path. The short-run and long-run movements in house prices have been largely related to the fluctuations in the macroeconomic variables such as GDP, inflation, money supply, interest rate and household consumption, etc. over the past decades in many countries. These features are also observed in Korean housing market. An inspection of graphics shown in <Figure 1> in section III gives a upward trend, cyclical pattern and irregularity in the pattern as important features of the house price series. Furthermore, the house price cycle appears to move together with the macroeconomic cycles as in <Figure 2>. Korea has experienced fast economic growth during the past few decades, resulting in growth in macroeconomic sector. This rapid economic growth, in turn, has boosted wealth and pushed up house prices, gearing with higher demand for house. Therefore, it is the economic condition behind the fluctuations in the housing markets in Korea, and thus the house price cycle should be considered together with the cyclical patterns of macroeconomic variables.

In this context, Sim (2005) investigated the cyclical relationship between house price and macroeconomic variables during 1986Q1~2005Q1 in Korea. In the study, however, he did not consider a possible structural break around the Korean economic crisis in 1997. In fact, the economic crisis has brought about structural changes through macroeconomic sectors and specially in real estate markets, followed by financial liberalization and the deregulation associated with real estate. Considering this feature, the present study gives special attention to the empirical findings before and after the economic crisis.

On the other hand, a number of house price studies focus on the lead-lag or casual relationships between the house price cycle and the cyclical movements of macroeconomic variables. The studies that use Hodrick-Prescott filtering method to extract the cyclical components include followings. Brooks and Lee (2000) find that the cycles of U.K. macroeconomic variables such as GDP, interest rate, inflation and consumer expenditure are positively or inversely correlated with the property stock prices. Further, they stress these variables can be used leading indicators of property stock prices. Witkiewicz (2002) shows that Swedish real estate cycle is in large dependent on the real business cycle. Matysiak and Tsolacos (2003) examine the cyclical relations between the retail, office and industrial rent series and the macroeconomic variables in U.K. McGough and Tsolacos (1995)'s Granger causality test, based on a VAR model, provides empirical evidence of no relationship between cyclical activity of office property and interest rate or employment in U.K. Meanwhile, Kang and Cho (2005) document that housing rental price, housing construction permit area, and housing construction order lead housing sale price and that land price lags housing sale price in Korea.[1)]

The purpose of this paper is to investigate whether the characteristics of cyclical relationship between house price and macroeconomic variables have changed during the periods before and after the Korean economic crisis. A meaningful analysis of the cyclical properties of the house price in relation to the cycle of the macroeconomic time-series requires that variables are appropriately detrended in order to extract a relevant cyclical component from the raw data. For this, we adopt a filtering method proposed by Hodirck and Prescott (1997). Then, using a vector autoregressive (VAR) model, we analyze several issues for the cyclical patterns of variables.

The remainder of this study is organized as follows. A discussion of methodology and data is made in the next section. Section III describes the characteristics of cyclical components, and section IV explores the empirical results. The final section presents summary and conclusions.

II. Methodology and Data

1. Methodology

Several methods have been used to detrend the original time series data and to obtain its stationary component. These methods include first differencing, the use of deterministic polynomial functions of time (e.g., quadratic trends), ARIMA models fitted to each individual series, exponential smoothing (ES) filter, and low-pass (LP) filters (Baxter and King, 1999), etc.

We adopt a method proposed by Hodrick and Prescott (1997).[2] The Hodrick-Prescott (HP) filter decomposes the original series, y_t, into a growth (or trend), y_t^g, and cyclical components, y_t^c, by minimizing the following expression.

$$\min_{\{y^g\}_{t=1}^{T}} \{\sum_{t=1}^{T}(y_t - y_t^g)^2 + \lambda \sum_{t=2}^{T}[(y_{t+1}^g - y_t^g) - (y_t^g - y_{t-1}^g)]^2\} \; ; \quad \lambda > 0 \;, \tag{1}$$

where T is the sample size. The parameter λ controls the smoothness of series y_t^g. The larger the value of λ, the smoother the trend path, and when $\lambda = 0$, a linear trend results. In this

1) There have been a number of researches that analyze the relationship between real estates and macroeconomic variables in Korea. These studies use the raw data series and include Chang and Sim (2004, 2005), Kim (2004), Lee (2004), Shon *et al.* (2003), Park and Park (2001), Seo and Kim (2000), and Chi (1998), etc.

2) This filtering method has been used extensively in the literature on real economic cycles in spite of its shortage. For example, Harvey and Jaeger (1993) and Cogley and Nason (1995)) showed some problem with HP filter as well as Baxter-King (BK) (1999) filter because the filters may produce spurious cycles when filtering near-integrated time series (so-called Slutzky effect). It is, however, not possible to construct an ideal business cycle filter (high-pass filter or band-pass filter) in the time domain with only a finite number of observations so all filters are distorting.

study, we use $\lambda = 1600$, as suggested by Hodrick and Prescott (1997) for quarterly data.

With an assumption of stationarity in the HP-filtered data series (i.e., in HP cycle), the usual Granger causality test and variance decomposition analysis are performed with following VAR model. [3)]

$$Y_t = \alpha_1 + \sum_{i=1}^{n} \beta_{1i}\, Y_{t-i} + \sum_{j=1}^{n} \gamma_{1j}\, X_{t-j} + \epsilon_{1t}, \quad (2)$$

$$X_t = \alpha_2 + \sum_{i=1}^{n} \beta_{2i}\, X_{t-i} + \sum_{j=1}^{n} \gamma_{2j}\, Y_{t-j} + \epsilon_{2t}, \quad (3)$$

where Y and X represent two endogenous variable series, house price cycle and the cyclical component of each economic variable, respectively. The disturbances ϵ_{1t} and ϵ_{2t} are assumed to be uncorrelated. The restricted version of each equation includes appropriately selected lagged values of the variables, based on the Akaike Information Criterion and Schwartz Criterion.

The dynamic interactions between the house price cycle and the cycles of other variables are also estimated by using equation (2) and (3). For this, a generalized impulse response function proposed by Pesaran and Shin (1998) is employed in the present study. The results from traditional impulse response analysis (e.g., Sims (1980)) may be sensitive to the ordering of the variables particularly when contemporaneous correlations of error terms in the VAR are high. However, the generalized impulse responses are unique and invariant to alternative orderings of the variables in the system.

3) We provide the results of unit root test for each HP cycle series in next section.

2. Data

The VAR model of equation (2) and (3) is estimated using quarterly data ranging from 1986Q1 through 2005Q3 for all variables since house price is available only from 1986Q1. Exception comes from the household credit which is available only from the 1995Q4.[4)] The house price index is obtained from the Kookmin Bank, and the data for other variables are taken from the Bulletin of the Bank of Korea.[5)] The set of variables comprises both macroeconomic and financial time-series that are expected to track the movement of economic condition which reflects housing market. That is, the selected variables are considered to contain information on economic and housing market trends and consist of the following time series: gross domestic product, household income, household consumption expenditure, consumer price level, the yield rate of 3 year maturity corporate

4) We, therefore, use this series as a supplementary data only in the second sample period. The data used for household credit do not include the portion credited by individual card. In general, the credit card loans are not related with purchasing house.

5) Housing data are reported in monthly basis. We transformed the data to quarterly series by averaging of three monthly values. The other time series can be available on the quarterly basis.

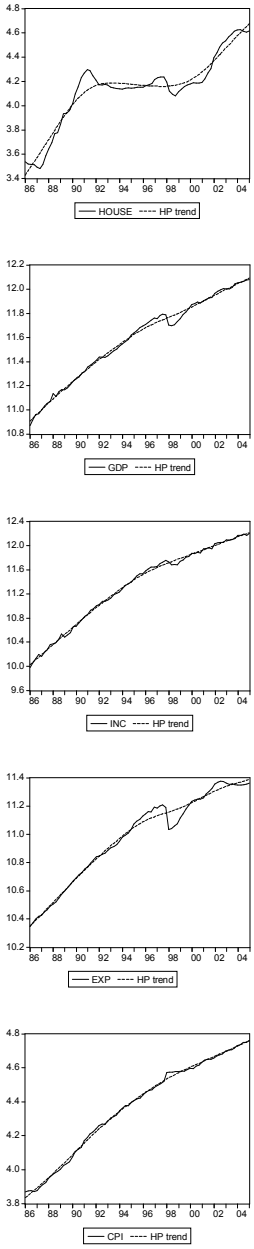
bond (used as a proxy for interest rate), money supply (M2), and household credit. Since the seasonal fluctuations in the data might yield spurious problems in business cycle analysis as in the present study, all variables except for interest rate are seasonally adjusted. All time series data, but interest rates, are also defined as the natural logarithm.

The Korean economy was drastically deflated due to the impact of Korean financial crisis in the end of 1997, and thus most economic variables moved downwards during 1998.[6] To avoid the effect of this same-directional movements of variables on regression results, the second sample period is selected from the first quarter of 1999.

III. The Characteristics of Cyclical Components

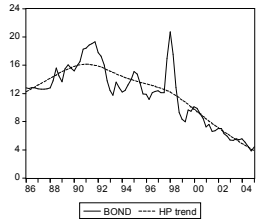
<Figure 1> plots the evolutions of the logarithm of original series and the trend components of series produced by the HP filter.[7] All variables with exception of interest rate have increasing trends, and they oscillate around the period of the 1997 economic crisis.

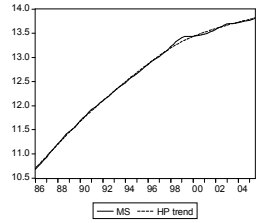
<Figure 1> Variables and HP Trends

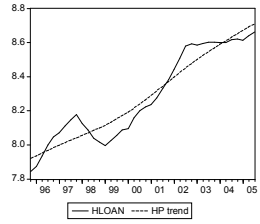


6) Previous studies empirically showed that most of the structural break in Korean time-series data occur during 1997~1998. See Chang and Sim (2004, 2005) and Lee (2004) for more detail.

7) The cyclical component of each series is illustrated in <Figure 2>.







Note: HOUSE: house sale price index, GDP: gross domestic product, INC: household income, EXP: household consumption expenditure, CPI: consumer price index, BOND: yield rate of 3 year maturity corporate bond, MS: money supply (M2), and HLOAN: household credit.

The proper interpretation of the HP filter's effects depends on the nature of original data. The HP filter was designed to decompose a nonstationary series into a stochastic component, and a serially correlated deviation from trend or cyclical component that was stationary. Many previous studies on the HP filter, however, rely on theorems which assume that the original data are stationary. This assumption is problematic since the filter is typically applied to nonstationary data. That is, when applied to stationary series, the HP filter operates like a high pass filter, damping fluctuations which last longer than eight years per cycle (in quarterly data) and passing shorter cycles without change.[8] Furthermore, the Granger causality test based on the VAR model requires the variables to be stationary in order to avoid the problem of spurious regression.

<Table 1> Unit-Root Test

	Period I (1986Q1~ 1997Q4)		Period II (1999Q1~ 2005Q3)	
	Original Series	Cyclical Component	Original Series	Cyclical Component
HOUSE	-2.517	-3.292**	-3.428*	-3.400*
GDP	-2.519	-2.747*	-3.724**	-3.994**
INC	-1.448	-2.805*	-3.078	-3.516*
EXP	-2.463	-3.121**	-1.677	-2.673*
CPI	1.412	-2.941**	-4.241**	-4.258**
BOND	-1.843	2.800*	-2.718	-4.222**
MS	-2.237	-2.621*	-3.647**	-4.106**
HLOAN	--	--	-1.254	-1.325*

Note: Null hypothesis: a variable has a unit root;
* significant at 10% level,
** significant at 5% level.

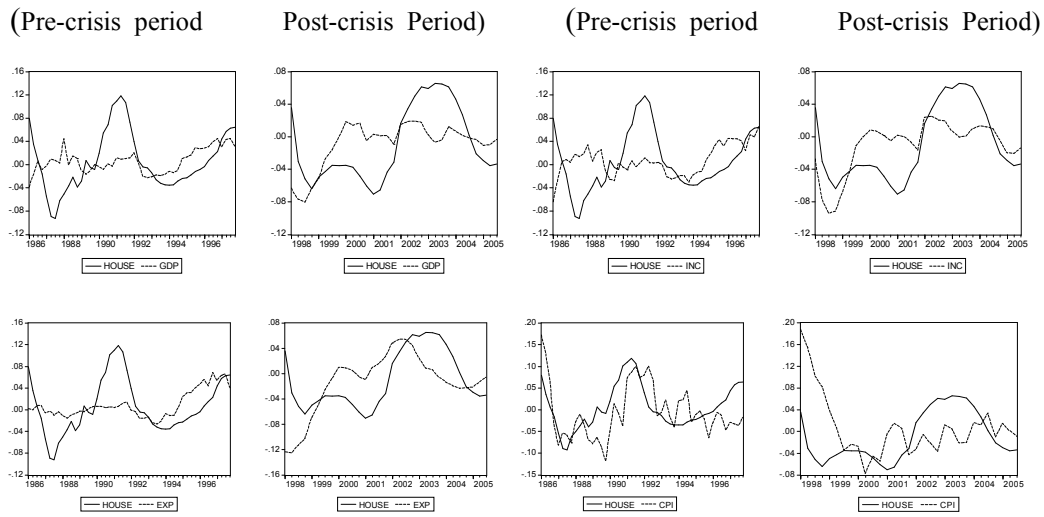
In this respect, we perform tests on stationarity of the variables. For each time series, augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1981) test is used to determine the existence of unit roots, and the

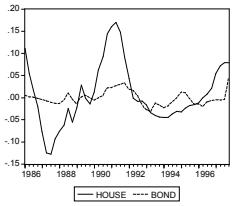
8) See Cogley and Nason (1995) for details on this issue.

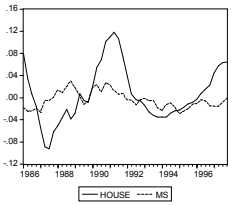
series tested include both a constant and a trend. The choice of lag length is carried by the Schwartz Criterion (SC) and Akaike Information Criterion (AIC). The results reported in <Table 1> show that all original data series are not stationary in Period I, whereas some of the original series are stationary in Period II. However, the results suggest that all of the cyclical components (the HP cycles) are stationary both Period I and II. Therefore, we begin a VAR estimation with all stationary data series (i.e., HP cycles).

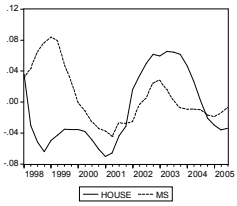
It is customary to define the cyclical component of each series as a deviation of actual values from the HP trend fitted to the series. That is, the cycle is defined as actual value minus the HP trend. <Figure 2> depicts the cyclical patterns of the variables along with the house price cycle. The first and third columns indicate the pre-crisis period (1986Q1~1997Q4), and the second and fourth columns of the <Figure 2> represent the post-crisis period (1998Q1~2005Q3). <Figure 2> does not provide obvious lead-lag relationships between the cyclical movements of the economic series and house price cycle. Although the lead-lag relations are found in a certain short time period in some series, it could not be said that a house price cycle clearly leads other series or vice versa. However, interest rate cycle remains stable even when the house price cycle has sharply fluctuated since 2000. The house price cycle is more synchronized with the household credit cycle than with the other cycles. Moreover, the house price cycle appears to lag the cycle of household credit during the recent few years.

<Figure 2> Cycle Comparison









IV. Empirical Results

1. Causality Tests

The empirical results showing the differences of the pre- and post-crisis periods are summarized in <Table 2> and <Table 3>. In the first sample period, there do not exist any causal relations from four cyclical components of economic variables (i.e., GDP, disposable income, household expenditure, and money supply) to the house price cycle. The reverse hypothesis that house price cycle Granger-causes the cycles of the four economic time series is also rejected. However, there is a bi-directional causality between house price cycle and the CPI cycle, whereas house price cycle Granger-causes the cycle of interest rate. The finding that any causal relationship between house price cycle and the GDP cycle is not found before the Korean economic crisis is in line with the result of Seo (1994).

Meanwhile, <Table 3> shows the causality result in the second sample period. <Table 3> indicates that housing is a follower of fluctuation of the GDP cycle, which is consistent with the conventional conception that GDP cycle leads house price cycle. Our result shows a bi-directional causality between household income cycle and the house price cycle in Period II. This indicates that the house price cycle appears to be more closely related to the movements of both national and household income variables during the Period II, compared with the Period I.

<Table 2> Causality Test : Period I
(1986Q1~1997Q4)

Variables	F-statistics		Opt. lag
	HOUSE→ Variables	HOUSE← Variables	
GDP	1.108	0.955	2
INC	0.339	0.642	2
EXP	1.069	0.801	2
CPI	6.336***	16.884***	1
BOND	3.651**	1.682	2
MS	0.225	0.331	2

Note: 1. *, ** and *** indicate significant at the 10%, 5%, and 1% level, respectively.
2. Optimal lag is selected by Akaike

Information Criterion and Schwartz Criterion.

As shown in <Table 3>, there exists a bi-directional causality relation between house price and consumption expenditure cycles. The causal relationship from consumption expenditure to house price cycle after the economic crisis can be explained, along with the rapid credit expansion, as following. The household consumption expenditure on the housing has been traditionally considered as a main fraction of total consumption expenditure in Korea. This feature is distinct especially when soaring house prices in Korea has been observed during the last few years. This rapid expansion of consumer credit is thought to have been a major contributing factor to the sharp increase in house prices. Thus, the consumption expenditure followed by this rapid expansion of consumer credit is likely to have had a strong impact on the housing market because a large portion of this credit expansion is considered to flow into the Korean housing market.[9)]

The finding in <Table 3> corroborates this feature because the cycle of household credit expansion Granger-causes the house price cycle. In addition, the results show that the causality also runs from the house price cycle to the household credit cycle and to the cycle of household consumption expenditure as well. This finding suggests that an increase in the collateral value stemming from a rise of house price enables the households to have easier access to financing and to induce reinvestment in housing sector, resulting in spiraling upturns in both cycles during the recent few years.

Korean government maintained tight monetary stance right after the 1997 currency crisis in order to cope with the collapse of the exchange rate system. However, domestic credit was allowed to be overly expanded to recover the Korean economic crisis since 2000.[10)] Recent sharp increase in the housing credit expansion is rooted in this continuously expanded monetary stance, generating a speculative investment in housing sector over the last few years. Therefore, the fluctuation in domestic credit could be regarded as a main reason of causal relationship from the cyclical component of money supply to house price cycle after the economic crisis. As shown in <Figure 2>, the house price cycle appears to be synchronized with the money supply in Period II.

9) The balance of consumer loans was 192 trillion won at the end of 1999. The balance drastically increased up to 391 trillion won in 2002, to 421 trillion won in 2003, and stood at 437 trillion won at the end of 2004. According to the survey by the Bank of Korea, 68% of consumer loans were collateralized by houses and about 56% of the loans were used to finance home purchases in 2002.

10) The growth rates of money supply moved stably before 1997. However, the rates sharply dropped from 23.6% in 1997 to 5.1% in 1999 whereas the rates went up to 8.1% in 2000 and 14% in 2002.

<Table 3> Causality Test : Period II
(1999Q1~2005Q3)

Variables	F-statistics		Opt. lag
	HOUSE→ Variables	HOUSE← Variables	
GDP	1.782	3.475**	3
INC	5.168***	3.535**	3
EXP	2.891**	3.829**	3
CPI	0.941	1.361	3
BOND	0.664	3.397**	3
MS	1.648	8.404***	4
HLOAN	6.144***	4.903**	3

Note: 1. *, ** and *** indicate significant at the 10%, 5%, and 1% level, respectively.
2. Optimal lag is selected by Akaike Information Criterion and Schwartz Criterion.

<Table 2> shows that there exists a bi-directional causality relation between CPI and house price cycles. This might be explained by a general view as followings. Inflationary expectation can have an effect on the demand for real assets like housing and hence housing price. This increase in housing price often makes inflationary expectation result in actual inflation due to the higher demand for housing. A change in housing price can be also influenced by a change in the consumer price level. For instance, inflation affects the financial costs and expected capital gain, which in turn decreases user cost that is negatively related with demand for housing and thus increases in demand for housing. Hence, inflation would lead to a rise in housing price as well. In fact, the first sample period experienced high inflation, and relatively larger increases in the values were also observed in housing market than in other asset markets. Therefore, a bi-directional causality relation between CPI and house price cycles seems to be found in Period I.

In Period II, however, there is no causal relationship between CPI cycle and house price cycle. Even a sharp increase in house price since 2000 does not have an impact on the CPI inflation as in our finding. This appears to be because the CPI inflation has been stably maintained at a low level on account of an inflation-targeting policy by the Korean monetary authority in spite of over-liquidity in domestic credit markets.

Meanwhile, findings in <Table 2> and <Table 3> show that while there is a causal relationship from house price to interest rate before the Korean economic crisis, the causality direction is reversed after the economic crisis. Coupled with increasing the opportunity cost of bank deposits, the low interest rate during the last few years is likely to make easy access to financing and then induce capital flow into the housing markets. Thus, a sharp rise in recent house price could be rooted in the low interest rate. This finding also suggests that market fundamental like interest rate plays more important role on determining the change in house price cycle after the Korean economic crisis, compared with the pre-crisis period.

2. A Generalized Impulse Response Analysis

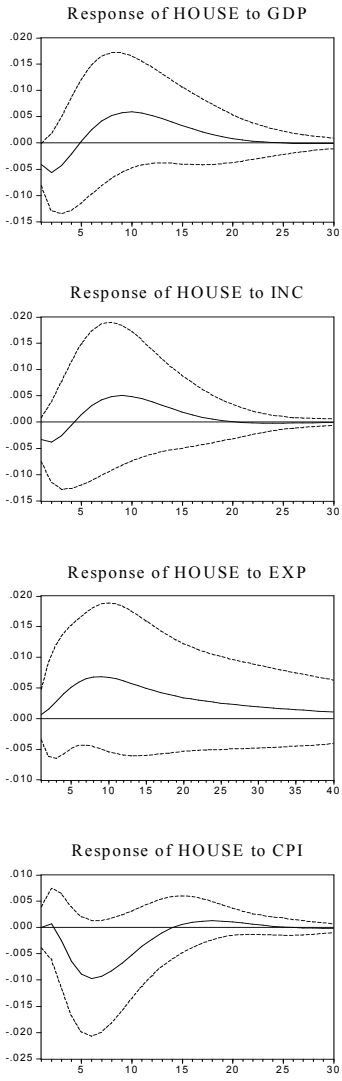
<Figure 3> and <Figure 4> depict a generalized impulse responses of house price cycle to one standard deviation shocks in the

cyclical components of macroeconomic variables.[11] The figures include two standard error (SE) confidence bands.

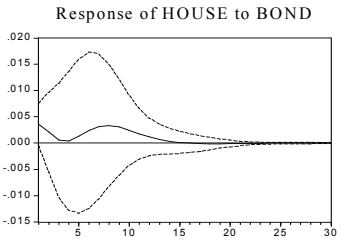
The innovations in house price cycles generate similar dynamic responses to the cyclical component shocks of GDP and household income in Period I. Although the response of house price cycles to both GDP and household income is rather muted in Period II compared with Period I, the results are consistent with the economic theory suggesting the positive relations between house price and GDP (or household income).

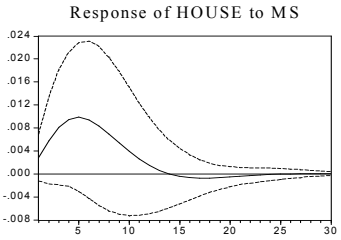
The cyclical component of household consumption expenditure has initial positive impacts on house price cycles. Even though the responses die down after the twelfth quarter in period II, the magnitude of reactions in house price cycle around the peak is double in Period II compared with Period I. To some degree, this finding is consistent with the causality result and reflects the sharp increase in consumer expenditure followed by a rapid expansion of consumer credit since 2000. The responses of house price cycle to the household credit cycle again support this feature as in the figure of second sample period in which the innovations in house price cycle are greater than those to other cycle shocks. It is also worth stating that the responses of house price cycle to the cyclical components of household expenditure and household credit are significantly different from zero up to fifth and eighth quarters, respectively.

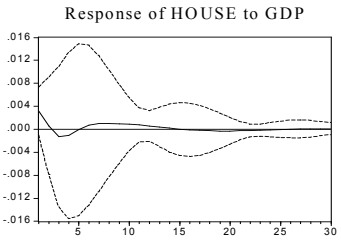
<Figure 3> Generalized Impulse Responses : Period I (1986Q1~1997Q4)

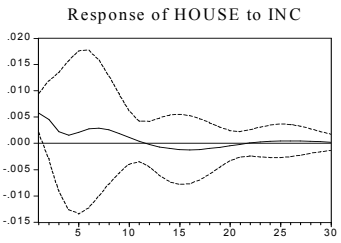


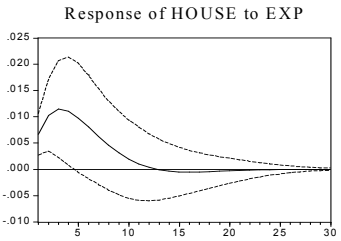
11) We do not provide the cyclical responses of economic variables to shock in house price cycle because the main focus of this study is to analyze the impact of economic variable cycles on the house price cycle, following partly the results of causality test in the previous section.

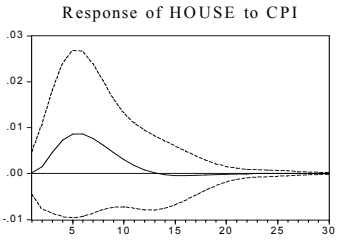


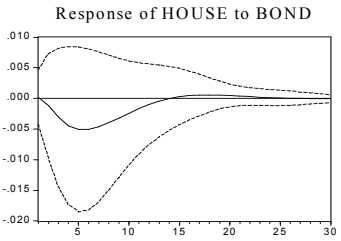


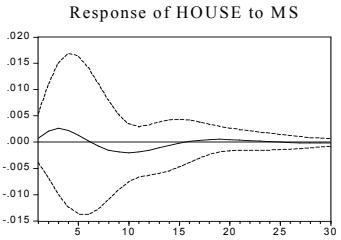


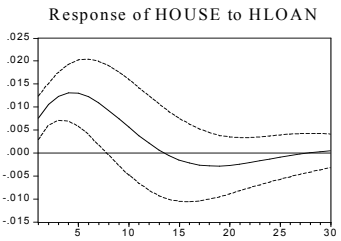












<Figure 4> Generalized Impulse Responses : Period II (1999Q1~2005Q3)

The cyclical component of money supply has initial positive impacts on house price

cycle and the impacts hold steady until they converge at their original steady states in Period I, whereas the responses of the house price cycle begin to fall below zero around eighth quarter in Period II. The magnitude of responses in house price cycle at the peak is greater in the first sample period compared with that in the second sample period. On the other hand, the result of positive relationship between house price and CPI cycles is consistent with the conventional viewpoint in Period II but the inverse relation found in Period I is not. In fact, the empirical evidence of showing the relationship between house price and CPI is inconclusive in academic literature.[12] Moreover, as a possible explanation on this inverse relation, the following caveats could be alluded: first, the growth rate of house price is much larger in Period II than in Period I; and second, unlike Period I, the growth rate of house price is much greater than that of CPI in Period II.[13]

In period I, the responses in house price cycle to interest rate cycle hold positive values until reaching their original steady states. In contrast, the cyclical component of house price reacts negatively to the shocks of interest rate cycle up to fifteenth quarter of the cycle and then approaches their steady-state level in the second sample period. Chang and Sim (2004, 2005) also document the empirical evidence of showing significant inverse relationship between house price and interest rate after the Korean economic crisis.

3. Variance Decomposition Analysis

Variance decomposition of the forecast errors for house price cycle is required in order to represent the relative importance of the shocks in the cyclical components of economic time series. The variance decomposition shows the portion of variance in the prediction for each variable in the system, due to its own shocks versus shocks to the other variables. Given that the main focus of this study is to analyze the impact of economic variable cycles on the house price cycle, we only report the variations in house price cycle that are explained by shocks in the economic series.

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12) A negative relation between two variables is often explained in terms of stock return-inflation puzzle: empirical findings showing that asset return such as stock (or property) is inversely related with inflation. For example, in the study of Sim (2005) using quarterly data (1986Q1~2005Q1), the house price cycle is found to inversely react to the shocks in CPI cycle in Korea. Lee (2004) using Korean monthly data (1991:1~2003:12) also shows that the CPI inflation has negative impacts on house sale and rental prices.

13) For more tangible explanation on this issue, further empirical study is required, for instance, by dividing the sample period into more specific ranges that reflect the variations in CPI and house price.

<Table 4> Variance Decomposition: Portion of Variance of Change in House Explained by Shocks to Economic Variables (Period I)

Quarter	GDP	INC	EXP	CPI	BOND	MONEY
1	0.00	5.48	0.21	0.49	6.57	4.23
2	0.04	3.95	0.43	4.70	2.55	6.46
3	0.49	2.70	0.90	11.46	1.35	8.96
4	1.47	1.92	1.64	17.61	0.94	11.50
5	2.96	1.65	2.68	22.53	0.83	13.90
6	4.83	1.86	4.01	26.31	0.97	16.01
7	6.91	2.44	5.60	29.18	1.29	17.70
8	8.98	3.24	7.33	31.33	1.66	18.94
9	10.86	4.11	9.08	32.93	1.97	19.75
10	12.44	4.92	10.71	34.13	2.17	20.20

For Period I, the results as presented in <Table 4> show that larger portions of the variance in house price cycle are explained by shock in GDP than shocks in the cyclical components of other economic variables except for money supply and CPI cycles. In Period I, CPI cycle is the largest contributor (up to 34%) to the variation in house price cycle whilst the house price cycle is hardly influenced by interest rate cycle. The cyclical components of GDP, household expenditure, income, and interest rate explain much more the variation in house price cycle in Period II, which indicates our earlier assertion that the variables are exogenous in Period I. The CPI cycle explains less in the second sample period, whereas the contribution of money supply shock has changed little in Period II.

Meanwhile, the fact that much larger variations in house price cycle are explained by the cyclical components of GDP and interest rate in Period II than Period I implies that the explanatory power of market fundamentals on the change in house price cycle has increased after the Korean economic crisis.[14] Especially, low interest rate during the last few years induces, to a large degree, the capital flow into the real estate market and thus affects the fluctuation in house price cycle. This finding is obviously reconfirmed by the contributions of household credit and expenditure cycles to the variation

<Table 5> Variance Decomposition: Portion of Variance of Change in House Explained by Shocks to Economic Variables (Period II)

Quarter	GDP	INC	EXP	CPI	BOND	MONEY	HLOAN
1	0.00	0.00	44.16	0.00	0.00	0.00	0.00
2	8.11	6.34	59.30	1.68	2.19	26.02	0.01
3	15.43	14.08	50.28	7.19	12.62	14.80	0.22
4	19.12	18.20	49.05	11.03	19.82	9.90	1.93
5	20.03	19.31	47.49	14.37	26.10	12.18	10.47
6	19.55	19.07	47.62	16.83	28.21	17.87	24.95
7	18.81	18.88	48.24	18.65	29.12	20.48	37.29
8	18.33	18.82	48.75	19.88	28.86	21.67	44.53
9	18.19	18.86	48.74	20.56	28.64	21.61	47.20
10	18.30	18.96	48.14	20.79	28.64	22.26	46.88

in house price cycle as in <Table 5>. Namely, the cyclical components of household credit and expenditure account for most and the second largest variations in house price cycle up to 60% and 47%, respectively. Again, this finding corroborates the strong nexus among house price, interest rate, household loans, and household expenditure, especially in Period II. The overall results of variance decomposition confirm the results of causality test found in <Table 2> and <Table 3>.

VI. Summary and Conclusion

The purpose of this study is to examine the cyclical relationship between house price and macroeconomic time series over a 20-year period with regard to Korean market, based on a VAR model. Especially, the present study focuses the impact of the Korean economic crisis on the change in cyclical patterns among the variables. Overall, the empirical results point to several conclusions as follows.

The causal relationships between house price cycle and the cyclical components of macroeconomic variables are weak before the Korean economic crisis. After the economic crisis, however, there exits stronger causality from the cyclical components of economic variables to house price cycle. That is, there exits one-sided causality from the macroeconomic cycles such as GDP, interest rate, and money supply to house price cycle, corroborating a conventional viewpoint that macroeconomic cycle leads the house price cycle. Meanwhile, a reversal casuality relationship from interest rate cycle to the cycle of house price after the economic crisis could be inferred in terms of asset reallocation due to low interest rate and raised house price. The results of generalized impulse responses of house price cycle to the shocks in other variables are generally consistent with the economic theory with exception in CPI case in Period I.

Along with the causality result, the fact that much larger variations in house price cycle are explained by the cyclical components of macroeconomic variables such as GDP and interest rate in Period II implies that market fundamentals play more important role on determining the change in house price cycle after the Korean economic crisis. Especially, the record-low interest rate during the last few years induces, to a large degree, the capital flow into the real estate markets and thus affects the fluctuation in house price cycle. This finding is reconfirmed by the great contributions of household credit and expenditure to the variation in house price cycle in Period II.

Based on our empirical results, this study gives some policy implications for the housing market. The effect of macroeconomic cycles on the housing price cycle becomes larger after the economic crisis. This indicates that

14) The term, market fundamentals, is based on a 'theoretical model of market fundamental value' in explaining the price of real estates. In the model, the price (P) of real estate can be shortly expressed as follow; $P = R / i$, where R is a profit by the use of real estate and i is interest rate. GDP growth also has an impact on the real estate price by affecting the structure of profit (R).

housing policy to control housing markets should be considered in line with the long-run movements of macroeconomic variables as well as with the condition of demand and supply in housing market itself. Furthermore, the interest rate cycle has increased in its explanatory power on the house price cycle after the economic crisis as well. This implies that the monetary policy through interest rate (and/or money supply) could be flexibly taken as necessary measures for the housing market, together with other demand-side polices associated with taxation and housing collateral loan.

Although this study has investigated the relationship between house price cycle and the cyclical components of other economic variables and found some potential reasons of a sharp increase in recent house price, it has some limitations. First, this study is based on VAR model with relatively small sample data especially in second sample period. A VAR model with a small sample size might generate an estimation bias due to the loss of degree of freedom. Thus, a future research with the larger sample size is required in order to confirm the results of this study. Second, this study has looked at the relationship between the housing price and economic variables by focusing only on the demand side (i.e., households). However, changes in the factors like interest rates and money supply also affect an investment circumstance in favor of housing suppliers and thus do both housing supply and price. Therefore, future study also needs to analyze the impacts of economic variables on the housing markets by considering the supply side factors as well.

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