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Asset Prices and Monetary Liquidity in Korea

Abstract

This paper examines the relationship between asset prices and liquidity in Korea. A theoretical model is derived using Lastrapes's (2002) dynamic equilibrium model. The theoretical model indicates that house price is positively correlated with GDP, liquidity, and future house price, and negatively associated with equity price. I find empirical evidence supporting the model's prediction: in the long-run, house price and equity price move together with liquidity; in the short-run, house price and liquidity interact positively with each other and this mutual dependence has been enforced in recent years; on the other hand, equity price and liquidity do not show any significant short-run relationship. The empirical results suggest that it is essential to break the strong link between the house price and the liquidity, and keep the liquidity at the optimum level in order to stabilize the asset prices.

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Keywords: asset prices, monetary liquidity

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Ⅰ. Introduction

During the early 2000s, house price which was falling sharply during the financial crisis rose rapidly and recovered the pre-financial crisis level in 2002. It peaked in 2003 and has stayed around the same level since then. Equity price which showed relatively stable movements in the early 2000s started to rise from 2005.

Among many reasons for the hikes of asset prices, the ample monetary liquidity[1] (liquidity here after) which was supplied during the financial crisis to boost the economic activity has increasingly getting academia's attention. It is because the excess liquidity which has not been used for the real economic activity might flow into asset markets and push the asset prices high. This paper explores the relationship between asset prices and liquidity in Korean.

Many economists have studied the role of liquidity in asset market. Hofmann (2001) and Goodhart and Hofmann (2004) show that a close correlation internationally exists between house price and credit by using VAR analysis.[2] McCarthy and Peach (2004) provide an evidence that a financial asset has a positive effect on U.S. house price by building a structural Error-Correction Model (ECM). Lastrapes (2002) displays a simulation, under a dynamic

[1] The growth rates of M3 (average, year-to-year) during 2000-2004 are 5.6%, 9.6%, 12.9%, 8.8%, and 5.8%.
[2] Davis and Zhu (2004) also find that commercial property price is positively related with bank loan using a VECM.

equilibrium model setting, that a negative interest rate shock causes the rise of U.S. house price.

Though previous studies provide us with insightful results, they also have their own limitations: either lack of micro foundation such as Hofmann (2001), Goodhart and Hofmann (2004), and McCarthy and Peach (2004) or narrow scope of analysis – consideration of only two variables – such as Lastrapes (2002). Here I combine Lastrapes (2002)'s and McCarthy and Peach's (2004) methodologies. To enhance the micro foundation, I build a theoretical model for housing market following Lastrapes (2002) and choose the relevant variables used for an empirical analysis according to the indication of the theoretical model. I also analyze a long-run relationship and a short-run adjustment process between asset prices and liquidity simultaneously, considering the fact that housing market resolves its disequilibrium in a very sluggish manner.

The main results of this paper can be summarized as follows: in the long-run, asset prices and liquidity move together;[3] in the short-run, house price and liquidity are also positively correlated, thus the interaction between housing market and credit market may push the house value very rapidly in a boom period, or cause an abrupt burst when the economic condition changes. It appears that this mutual dependence has been enforced in recent years; on the

[3] More specifically, a 1% increase of liquidity pushes house (equity) price by 0.3 (0.7) %, whereas the increase of 1% house (equity) price results in a 3.4 (1.4) % rise of liquidity.

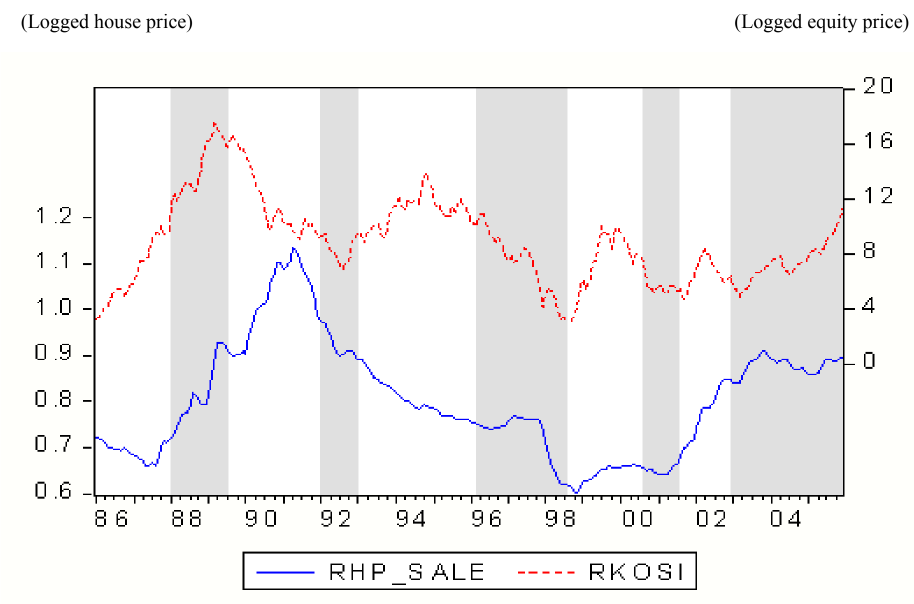
other hand, any significant short-run relationship between equity price and liquidity has not been found. These empirical results imply that it is essential to break a strong link between house price and liquidity to prevent volatile movements of house price. It is also desirable to keep the liquidity at the optimum level which does not accelerate or decelerate real economic activity in order to stabilize asset prices.

The rest of this paper is organized as follows: Section 2 briefly sketches the developments of asset prices and liquidity. Section 3 builds a theoretical model used for the empirical analysis. Section 4 presents empirical results classified as long-run relationships and short-run adjustments. Finally section 5 closes this paper.

Ⅱ. The Development of Asset Prices and Liquidity

House price[4] has shown two booms and one burst since 1986. The first boom started in 1988 and ended in 1990. The second boom began in 2001 following the burst period from 1991 to 2000. At this point, it is unclear whether the second boom has ended or is still going on because the house price has stayed within a narrow band since 2004. As suggested in figure 1, house price (solid line) recorded the highest point in 1990 when economic activity was expanding whereas it reached a peak in 2003 when the economy was cooling down.

Figure 1 **House Price and Equity Price**



Note: shaded area represents a recession period.

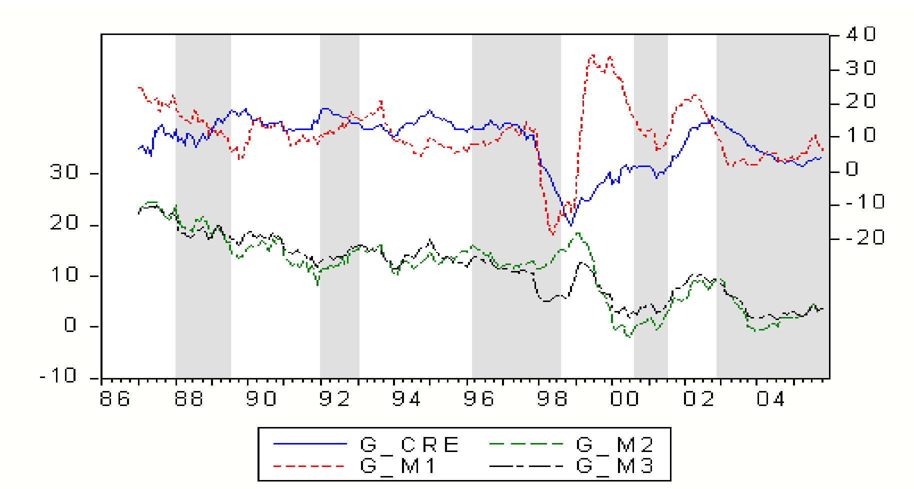
[4] This is a real apartment purchasing index (national) transformed by using CPI.

Equity price[5], on the other hand, has repeated a rise and fall in a relatively shorter period, a typical random walk. The equity price (dashed line) moves ahead of business cycles, implying that it is one of the leading indicators.

Figure 2 shows the movements of liquidities. Liquidities here are classified as M1, M2, M3, and private sector credit. M1, M2, and M3 represent the liability side of banks' balance sheet while credit captures the behavior of asset side of balance sheet.

Figure 2 **Monetary Liquidity Growth**

(M2, M3, %) (M1, Credit, %)



Note: Percentage changes are over the same period of previous year.

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[5] This is a real KOSPI transformed by using CPI.

M1 growth rate (small dashed line) moves along the average level, around 10%. It becomes very volatile after the financial crisis reflecting the rapid movement of short-term funds.

M2 (dashed line) and M3 (dashed-dotted line) growth rates had been gradually falling before 1997 because monetary target, M2 growth rate, had been continuously lowered reflecting the low economic growth rates during that period.[6] In 1998, Korea abandoned the monetary targeting and adopted inflation targeting, and the M2 and M3 growth rates have shown a similar pattern to M1 growth rate – moving along the average line.

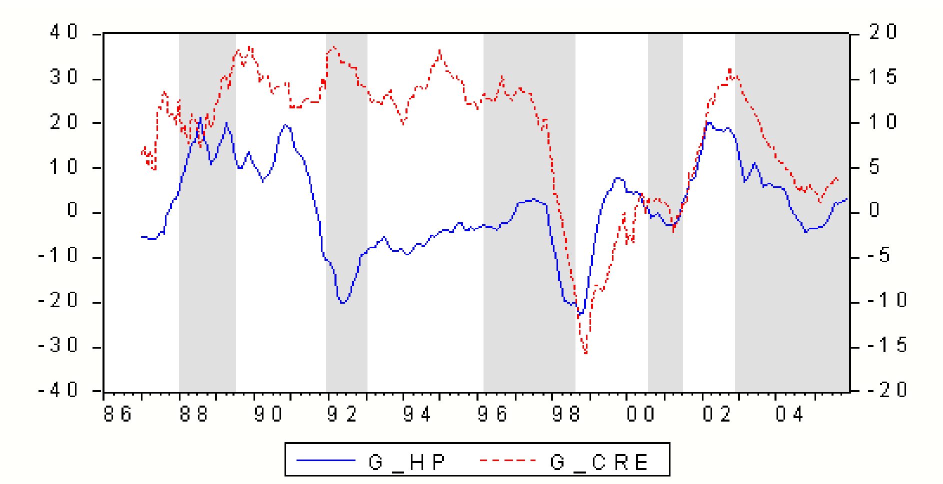
Credit growth rates were falling during the financial crisis, but recovered soon and passed the pre-crisis level in 2002. It has been falling again since 2003. The credit growth appears to be concurrent with business cycles.

Among various liquidity measures, credit has a unique characteristic different from M1, M2, and M3. When the asset prices rise, the value of collateral such as house also goes up, and let the borrower to get a new loan. Therefore, the asset market boom usually causes an expansion of credit. In order to check the possibility of this correlation, I compare asset price inflation and credit growth. Figure 3 demonstrates the development of house price inflation (solid line) and credit growth (dashed line). We can find some noteworthy similarities in both graphs since 1998. We can confirm these from

[6] The target rate of M2 growth was 15-19% annually in 1990, but it was lowered to 11.5-15.5% in 1996 (Monetary Policy in Korea, the Bank of Korea, 2005).

Figure 3 **House Price Inflation and Credit Growth**

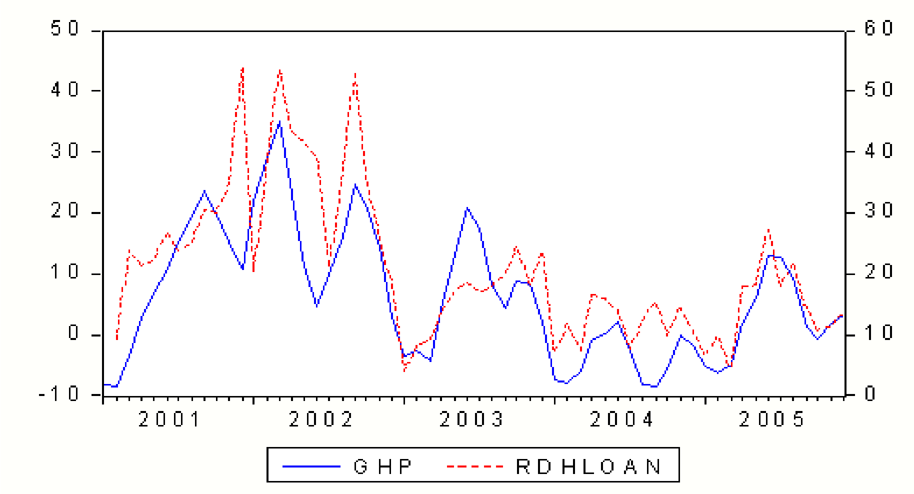
(House Price Inflation, %) (Credit Growth, %)



Note: Percentage changes are over the same period of previous year.

Figure 4 **House Price Inflation and Changes in Home Equity Loan**

(House Price Inflation, %) (Changes in Home Equity Loan, Bil. Won)



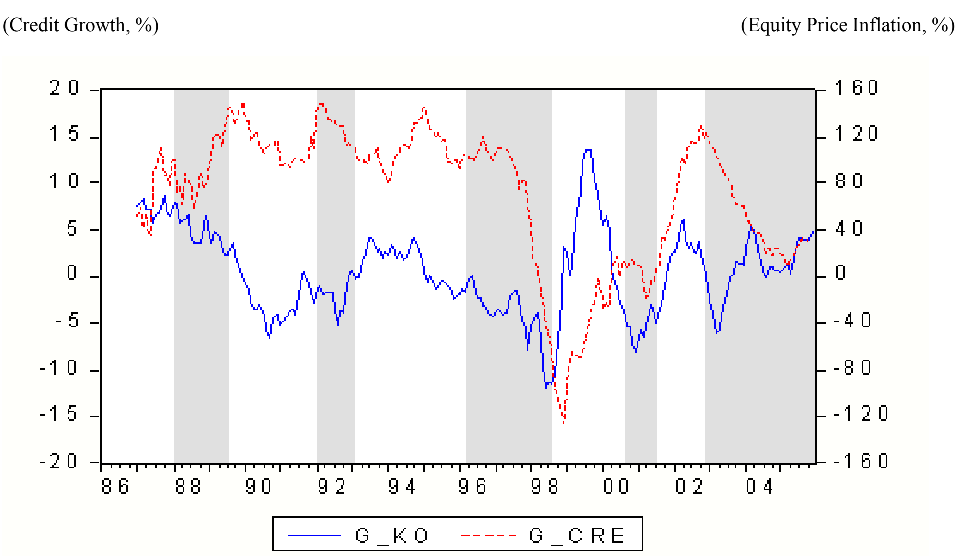
Note: Percentage changes are over the same period of previous month.

a different angle.

Figure 4 illustrates the movements of house price inflation (solid line) and changes in home equity loan (dashed line). Two graphs show almost identical pattern despite the high frequency data – monthly.

As regards equity price inflation (solid line) and credit growth (dashed line), they appear to be largely uncorrelated as displayed in figure 5. The equity price inflation reveals a typical random walk pattern and this high volatility of equity price movements makes it impossible to identify any significant relationship between those two variables.

Figure 5 **Equity Price Inflation and Credit Growth**



Note: Percentage changes are over the same period of previous year.

Ⅲ. Model

To build a theoretical model, I adopt a traditional asset view of housing which is asserted in Obstfeld and Rogoff (1996) and Porterba (1984), etc. According to the asset view of housing, housing is considered as a durable good, the demand for which reflects both the service flow and the asset value of housing units. Lastrapes (2002) also follows the same view and develops a dynamic equilibrium model of the housing market. Here I adopt Lastrapes's (2002) model and modify it. As he does, I also assume perfect foresight.[7]

Let the representative household maximize his/her life time utility:

$$V_0 = \sum_{t=0}^{\infty} \beta^t U(H_t, c_t) \tag{1}$$

here, β is the time preference rate, H_t is the number of housing units (of standardized size and quality), and c_t is the quantity of nondurable goods consumption. The following budget constraint shows the household's flow of funds:

$$\begin{aligned} & z_{t-1}(q_t + y_t) + p_t(1-\delta)H_{t-1} + L_t \\ & \geq c_t + z_t q_t + p_t H_t (1+\mu) + (1+R_{lt})L_{t-1} \end{aligned} \tag{2}$$

where z_{t-1} is the real value of equity purchased at t-1 period, q_t is the real price of equity, y_t is the real dividend for the equity, p_t is the real price of the

[7] Poterba (1984) also follows this line.

standard unit of housing in terms of nondurables, δ is the depreciation rate, L_t is real mortgage debt, μ measures maintenance cost as a fixed proportion of current house value, and R_{lt} is the real yield on mortgage-secured loans.

The left-hand side of the budget constraint (2) defines the sources of funds: the value of the equity stock carried over from the previous period, the value of the housing stock purchased at last period net of depreciation, and new mortgage borrowing. The right-hand side defines the uses of funds: current consumption, current purchases of equity stock and housing stock, housing maintenance cost, and real expenditure on mortgage repayment. I impose an additional constraint on mortgage borrowing:

$$L_t = \psi p_t H_t \tag{3}$$

here ψ is the loan-to-value ratio and lies between zero and one. This mortgage borrowing constraint implies that the household is required to finance a given percentage of his house purchase by issuing mortgage debt.

The household's optimal choice of c_t, z_t, and H_t must satisfy the following first order conditions:

$$\beta^t U_c(H_t, c_t) = \lambda_t,\ \forall t \tag{4}$$

$$\frac{\lambda_{t+1}}{\lambda_t} = \frac{q_t}{(q_{t+1} + y_{t+1})},\ \forall t \tag{5}$$

$$\beta^t U_H(H_t, c_t) = \lambda_t p_t (1 + \mu - \psi) + \lambda_{t+1}[(1 + R_{l,t+1})\psi p_t - p_{t+1}(1-\delta)], \quad \forall t \tag{6}$$

where λ_t is the multiplier associated with (2) at t period and $U_x(\bullet)$ is the partial derivative with respect to x. By substituting (4) and (5) into (6), we can get the following tangency condition:

$$\frac{U_H(H_t, c_t)}{U_c(H_t, c_t)} = p_t[(1-\psi) + [\frac{1 + R_{l,t+1}}{1 + R_{s,t+1}}]\psi + \mu - (\frac{1-\delta}{1 + R_{s,t+1}})(1 + \dot{p}_{t+1})] \tag{7}$$

where $R_{s,t+1} \equiv (\frac{q_{t+1} + y_{t+1}}{q_t})$ and $\dot{p}_{t+1} \equiv (\frac{p_{t+1} - p_t}{p_t})$. Equation (7) implies the marginal rate of substitution between consumption and housing equals the user cost of housing. The first term of the bracket in the right-hand side – the proportion of the house value not financed by the mortgage borrowing – is the direct resource cost of buying a house. The second term reflects the opportunity cost of mortgage borrowing. The third term is the maintenance cost. Finally, the last term shows the real future value of the undepreciated portion of housing, discounted to the current period. Equation (7) expresses the tangency condition for the demand for housing.

At this point, we need to specify preferences. Here I assume a Cobb-Douglas utility function ($U(H_t, c_t) = \gamma \log(c_t) + (1-\gamma)\log(H_t)$). After plugging this utility function into equation (7), I log-linearize the equation[8]. Then we can get the inverse function of housing demand like below:

$$\log(p_t^d) = K + \alpha_1 \log(c_t) - \alpha_2 \log(H_t) + \alpha_3 \log(p_{t+1}^d) + \alpha_4 \psi(R_{s,t+1} - R_{l,t+1}) - \alpha_5 R_{s,t+1} \quad (8)$$

To complete the model, I need to add another equation representing housing supply:

$$\log(p_t^s) = \zeta \log(\frac{I_t}{H_t}) \quad (9)$$

where I_t is housing investment and so $(\frac{I_t}{H_t})$ is housing investment rate. Equation (9) implies that the supply price of housing is positively associated with the housing investment rate. If I additionally assume $I_t = \eta p_t$, then I can express equation (9) as $\log(H_t) = \log(\eta) + (1 - \frac{1}{\zeta})\log(p_t)$. By substituting this into equation (8) , I can get the equilibrium price of housing:

$$\log(p_t) = \frac{1}{\xi}[K^{'} + \alpha_1 \log(c_t) + \alpha_2 \log(p_{t+1}) + \alpha_3 \psi(R_{s,t+1} - R_{l,t+1}) - \alpha_4 R_{s,t+1}] \quad (10)$$

According to equation (10), the equilibrium housing price is positively related with nondurable consumption[9], future price of housing, and the degree of

[8] Refer to Lastrapes (2002) for a detailed explanation.
[9] Like Lastrapes (2002), nondurable consumption here represents the household's permanent income.

mortgage borrowing availability, and negatively associated with the future rate of return to equity. Equation (10) is the main workhorse for the empirical analysis explained in next section. Based on this equation, I do the cointegration test and the ECM estimation.

Ⅳ. Empirical Results

This section analyzes the relationship between asset prices and liquidity. As summarized in table 1, all data are taken from the Bank of Korea Economic Statistics System (BOK ECOS) database and Kookmin Bank's House Price Survey, and are seasonally adjusted. Nominal aggregates are transformed into real terms by using the consumer price index. All data are also transformed into natural logs. The sample is quarterly data from 1986. 1/4 ~ 2005. 3/4.

1. Long-run Relationships

Before estimating the long-run relationships between asset prices and liquidity, we should check the non-stationarity of the relevant variables. Based on equation (10), I choose house price, GDP as a proxy for the household's permanent income, equity price, and liquidities (M1, M2, M3, and credit) used for proxies for the degree of mortgage borrowing availability. Table 2 reports the standard augmented Dickey-Fuller test results: all variables are integrated

Table 1 **Summary of the Data**

	Variable Name	Description	Sources
LHP	House Price	Real Apartments Purchase Price Index (all cities)	Kookmin Bank, House Price Survey
LKO	Equity Price	Real KOSPI	BOK, ECOS
LGDP	GDP	Real GDP	BOK, ECOS
LCRE	Credit	Loans & Discounts on Private Sector	BOK, ECOS
LM1	M1	Short-term Liquidity	BOK, ECOS
LM2	M2	Long-term Liquidity	BOK, ECOS
LM3	M3	Long-term Liquidity	BOK, ECOS
DLHP	House Price Inflation	LHP/LHP(-1)	Kookmin Bank, House Price Survey
DLKO	Equity Price Inflation	LKO/LKO(-1)	BOK, ECOS
DLGDP	GDP Growth Rate	LGDP/LGDP(-1)	BOK, ECOS
DLCRE	Credit Growth Rate	LCRE/LCRE(-1)	BOK, ECOS
DLM1	M1 Growth Rate	LM1/LM1(-1)	BOK, ECOS
DLM2	M2 Growth Rate	LM2/LM2(-1)	BOK, ECOS
DLM3	M3 Growth Rate	LM3/LM3(-1)	BOK, ECOS

Table 2 **ADF Unit Root Test Results**

Variables (level)	t-value	p- value	Variables (change)	t- value	p- value
LHP(C)	-1.86	0.35	DLHP(N)	-4.51****	0.00
LGDP (C)	-2.34	0.16	DLGDP(N)	-5.06***	0.00
LKO(N)	0.03	0.69	DLKO(N)	-6.15***	0.00
LCRE(C)	-2.27	0.18	DLCRE(N)	-2.34**	0.02
LM1(C)	-1.06	0.73	DLM1(N)	-4.07***	0.00
LM2(T)	-0.85	0.96	DLM2(C)	-3.82***	0.00
LM3(T)	-1.23	0.90	DLM3(C)	-3.81***	0.00

Notes 1) ***, **, *: Statistically significant at the 10%, 5%, and 1% levels, respectively.
2) T, C, and N indicate whether the test regression includes a time trend (T), only a constant (C), or neither a trend nor a constant (N).

of order one over the sample period. Therefore I can analyze the long-run relationships between asset prices and liquidity based on the multivariate approach.

As shown in table 3, the Johansen cointegration test suggests that a single long-run relationship exist between house price, equity price, and liquidities. When I alternate M1, M2, M3, and credit for the proxies for liquidity, I can always find the single long-run relationship. According to the cointegration equations, house price is positively related to liquidity except one case explained right after, but negatively correlated to equity price, which is consistent with the theoretical model, equation (10).

When M1 is used for the liquidity, house price is positively associated with equity price, contradicting to the model's prediction. This implies that M1 is not an appropriate gauge for liquidity in this analysis. When M2 and M3 are used for liquidity proxies, the coefficients of equity prices are so big that I cannot interpret the long-run relationship appropriately. This is because the gradual diminishing pattern of M2 or M3 growth rates are too deviant from the house price or equity price inflation which demonstrates random walk behaviors along the average level. In this regard, credit is the best measure to show the long-run relationship between asset prices and liquidity. Credit also captures the fact that changes in house price affect the value of collateral, and leads to the changes in the household's borrowing ability.

Table 3 **Johansen Cointegration Test Analysis**

Liquidity	Trace Test			Long-run Relationship
	r=0	r≤1	r≤2	
LCRE	42.9***	11.0	1.1	LHP = 0.3LCRE - 0.4LKO (0.04)2) (0.2)
LM1	33.9***	11.0	1.1	LHP = 0.1LM1 + 0.9LKO (0.07) (0.2)
LM2	31.3***	9.0	0.8	LHP = 1.3LM2 - 6.7LKO (0.4) (1.8)
LM3	39.1***	9.5	0.8	LHP = 0.4LM3 - 1.5LKO (0.08) (0.4)

Notes 1) ***, **, *: Statistically significant at the 10%, 5%, and 1% levels, respectively.
2) Numbers in ( ) represent standard errors.

According to equation (11), house price goes up by 0.3% in response to a 1% increase of credit, while it decreases by 0.4% in response to a 1% increase of equity price.

$$LHP = 0.3LCRE - 0.4LKO \tag{11}$$

When I rewrite equation (11) in order to set the equity price and the credit as dependent variables, I can get different types of long-run relationships:

$$LKO = 0.7LCRE - 2.4LHP \tag{12}$$

$$LCRE = 3.4LHP + 1.4LKO \tag{13}$$

The existence of a stable long-run relationship between asset prices and liquidity enables me to model an error correction models for house price, equity price, and credit. The reason for using ECM is to capture the long-run relationship and the short-run adjustment simultaneously, and this is especially important to analyze housing market in which the adjustment process is very sluggish.

2. Short-run Adjustments

A. The Effect of Credit on House Price

To analyze the effect of credit on house price, I build an ECM for house price like below:

$$\Delta LHP_t = \nu_1 EC_{t-1} + \nu_2 \Delta LHP_{t-1} + \nu_3 \Delta LCRE_t + \nu_4 \Delta LGDP_t + \nu_5 \Delta LHP_{t+1} + \nu_6 \Delta LKO_t + \varepsilon_t \quad (14)$$

Explanatory variables are chosen according to the indication of the theoretical model, equation (10).[10] As suggested in table 4, regression 1 including the equity price inflation shows a poorer estimation result compared to regression 2 excluding the equity price inflation. More specifically, the coefficients of GDP growth rate and equity price inflation are not significant in regression 1, whereas the GDP growth coefficient turns significant in regression 2.

[10] The future house price, ΔLHP_{t+1}, is calculated following Lee (2002).

Therefore, I can conclude that equity price inflation is not appropriate in explaining the movement of house price inflation. According to the estimation result, the house price inflation jumps by 0.38% in response to a 1% increase in credit growth. Considering the fact that the regression equation contains GDP growth rate which reflects the economic condition, we can induce that the 1% increase of credit growth which has nothing to do with economic activity pushes the house price inflation by 0.38% in the short-run.

The sign of error correction term is negative as expected, and the coefficient, -0.13, implies that 12% of disequilibrium in housing market is resolved within one year.

Table 4 **ECM for House Price Inflation**

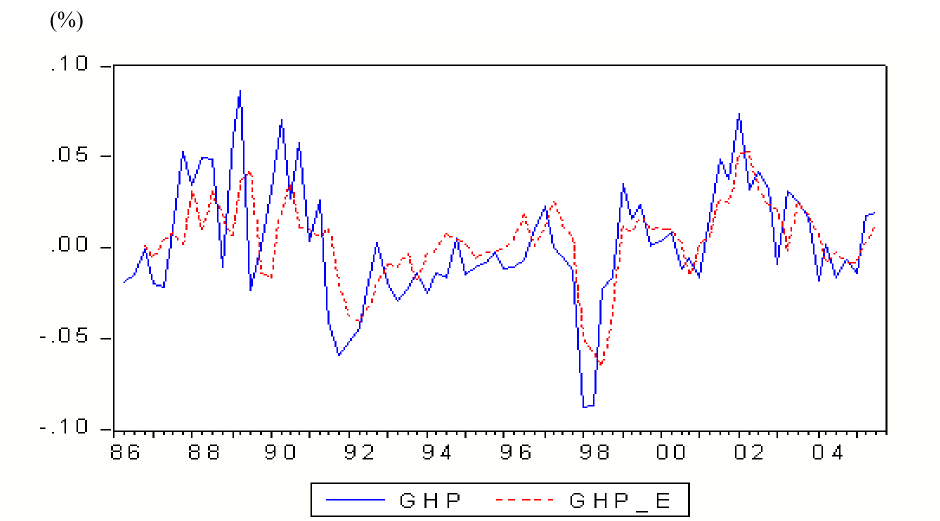
Variable Name	Regression 1			Regression 2		
	Coefficient	Standard-error	t-value	Coefficient	Standard-error	t-value
EC (t-1)	-0.03**	0.01	-2.6	-0.03***	0.01	-2.8
House Price Inflation (t-1)	0.40***	0.12	3.0	0.40***	0.12	3.4
Credit Growth Rate	0.40**	0.14	2.5	0.38**	0.14	2.7
GDP Growth Rate	0.20	0.19	1.3	0.30*	0.19	1.6
House Price Inflation (t+1)	0.10*	0.05	1.9	0.09*	0.05	1.6
Equity Price Inflation	0.03	0.02	1.1			
R^2 (adjusted)	0.41			0.41		
LM test (p-value)2)				0.45		

Notes 1) ***, **, *: Statistically significant at the 10%, 5%, and 1% levels, respectively.
2) Breusch-Godfrey LM test is used for a serial correlation check instead of D/W ratio because the lagged term of dependent variable (House Price Inflation (t-1)) is one of explanatory variables.

The effect of GDP growth on house price inflation, 0.3, is smaller than that of credit growth, 0.38, indicating the importance of credit growth in determining the short-run movement of house price inflation. Though the future house price inflation appears to be significant, the magnitude of it does not seem to be big. Figure 6 compares the true house price inflation and the estimated one. They are broadly quite similar.

Table 6 reveals that the effect of credit growth on house price inflation has been enhanced in the second-half sample period, 1996. 1/4 ~ 2005. 3/4. The model's explanatory power, R^2, also increases from 0.45 to 0.72. This suggest that credit growth has been the main factor to determine the house price inflation in recent years.

Figure 6 **House Price Inflation Estimation**



Note: Percentage changes are from preceding quarter.

Table 6 **Estimation of House Price Inflation by Sample Periods**

Variable Name	Estimation Results		
	Coefficient	Standard-error	t-value
86. 1/4 - 05. 3/4			
EC (t-1)	-0.03***	0.01	-2.8
House Price Inflation (t-1)	0.40***	0.12	3.4
Credit Growth Rate	0.38**	0.14	2.7
GDP Growth Rate	0.30*	0.19	1.6
House Price Inflation (t+1)	0.09*	0.05	1.6
R^2 (adjusted)	0.41		
LM test (p-value)	0.45		
96. 1/4 - 05. 3/4			
EC (t-1)	-0.04*	0.02	-1.8
House Price Inflation (t-1)	0.38***	0.12	3.2
Credit Growth Rate	0.60***	0.13	4.6
GDP Growth Rate	0.37**	0.17	2.3
House Price Inflation (t+1)	-0.04	0.06	-0.6
R^2 (adjusted)	0.72		
96. 1/4 - 05. 3/4			
EC (t-1)	-0.05***	0.02	-3.3
House Price Inflation (t-1)	0.34***	0.10	3.5
Credit Growth Rate	0.60***	0.12	4.7
GDP Growth Rate	0.40**	0.15	2.7
R^2 (adjusted)	0.72		
LM test (p-value)	0.18		

Notes 1) ***, **, *: Statistically significant at the 10%, 5%, and 1% levels, respectively.

B. The Effect of Credit on Equity Price

The ECM for equity price is set-up like below:

$$\Delta LKO_t = \iota_1 EC_{t-1} + \iota_2 \Delta LKO_{t-1} + \iota_3 \Delta LCRE_t + \iota_4 \Delta LGDP_t + \iota_5 \Delta LHP_t + \varepsilon_t \qquad (15)$$

All the explanatory variables are again chosen according to the theoretical model, equation (10). As shown in table 6, credit growth and house price inflation appear insignificant in explaining the equity price inflation. Instead, GDP growth has a very strong effect on the equity price inflation. This is because equity price is basically a mirror of economic fundamentals. Also,

Table 6 **ECM for Equity Price Inflation**

Variable Name	Regression 1			Regression 2		
	Coefficient	Standard-error	t-value	Coefficient	Standard-error	t-value
EC (t-1)	-0.03	0.02	-1.3	-0.03*	0.02	-1.3
Equity Price Inflation (t-1)	0.23**	0.12	2.0	0.24**	0.11	2.0
Credit Growth Rate	-0.29	0.74	-0.4			-0.4
GDP Growth Rate	2.33**	0.90	2.6	2.43***	0.89	2.6
House Price Inflation	0.41	0.48	0.9			0.9
R^2 (adjusted)	0.17			0.19		
LM test (p-value) 2)				0.27		

Notes 1) ***, **, *: Statistically significant at the 10%, 5%, and 1% levels, respectively.
2) Breusch-Godfrey LM test is used for a serial correlation check instead of D/W ratio because the lagged term of dependent variable (House Price Inflation (t-1)) is one of explanatory variables.

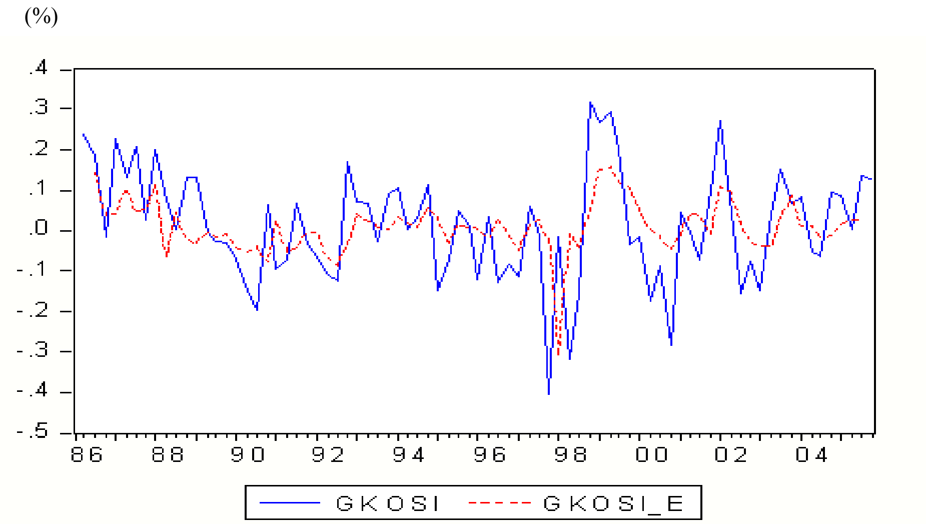
equity price is so volatile in the short-run that it is very hard to capture any significant relationship between the equity price inflation and the credit growth. This point is also mentioned in Ferguson (2005) and Goodhart and Hofmann (2004). Figure 7 shows the comparison of the true equity price inflation and the estimated one gotten from regression 2. Even though the estimated equity price inflation is less volatile than the true one, the former traces the latter quite well.

To check whether the effect of GDP on equity price has changed in recent period, I try to estimate the same equation using the second-half period sample, 1996. 1/4 ~ 2005. 3/4. However, as revealed in table 7, I can not find any significant coefficients except the error-correction term. This may be the result of too short sample period, which is not long enough to capture the relationship between equity price inflation and other variables. This makes me ensure that *credit growth* and *house price inflation* have no significant effect on *equity price inflation* in the short-run, whereas *house price* and *credit* have long-run linear relationships with *equity price*.

C. The Effect of Asset Prices on Credit

Finally, I construct the ECM for credit growth following the previous two models. In this case, however, I add interest rate because it is one of the key variables to determine the behavior of credit growth.

Figure 7 **Equity Price Inflation Estimation**



Note: Percentage changes are from preceding quarter.

Table 7 **Estimation of Equity Price Inflation by Sample Periods**

Variable Name	Estimation Results		
	Coefficient	Standard-error	t-value
86. 1/4 - 05. 3/4			
EC (t-1)	-0.03*	0.02	-1.8
Equity Price Inflation (t-1)	0.24**	0.11	2.2
GDP Growth Rate	2.43***	0.89	2.7
R^2 (adjusted)	0.19		
LM test (p-value)	0.27		
96. 1/4 - 05. 3/4			
EC (t-1)	-0.12**	0.06	-2.1
Equity Price Inflation (t-1)	0.25	0.17	1.4
GDP Growth Rate	2.20	1.42	1.5
R^2 (adjusted)	0.21		
LM test (p-value)	0.36		

Note: ***, **, *: Statistically significant at the 10%, 5%, and 1% levels, respectively.

The regression equation is as follows:

$$\Delta LCRE_t = \upsilon_1 EC_{t-1} + \upsilon_2 \Delta LCRE_{t-1} + \upsilon_3 \Delta LHP_t + \upsilon_4 \Delta LKO_{t-1} + \upsilon_5 \Delta LGDP_{t-1} + \upsilon_6 R_{t-1} + \varepsilon_t \quad (16)$$

As table 8 suggests, the equity price inflation does not show any significant relationship with the credit growth. The coefficients of GDP growth and house price inflation appear insignificant when I include the equity price inflation in the regression, whereas the GDP growth turns significant when I exclude the equity price inflation. Figure 8 shows the comparison of the true credit growth (solid line) and the estimated one (dashed line) gotten from regression 2. Both graphs broadly exhibit very similar patterns.

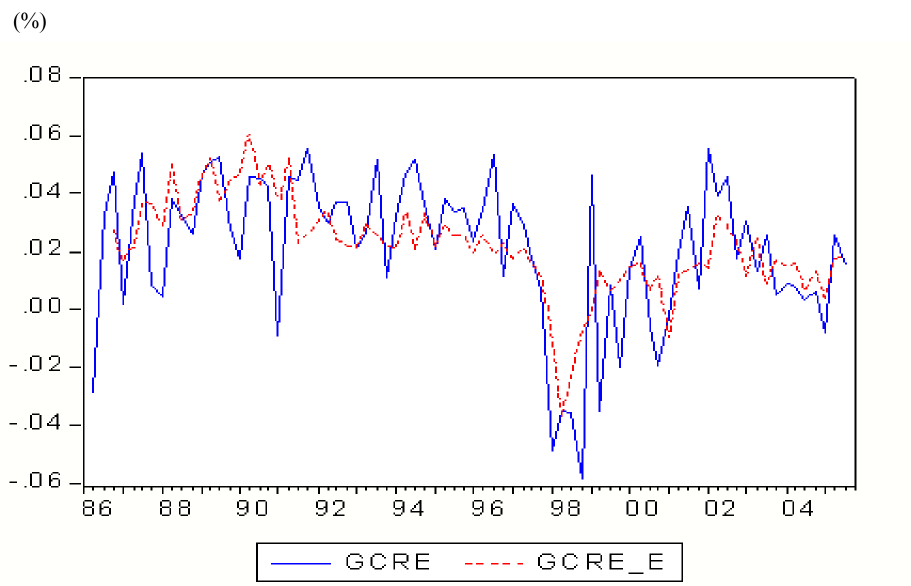
Next question is if there is any change in the coefficients' magnitudes when I consider the second-half sample period. As shown in table 9, only the error correction term and the house price inflation appear as significant variables in explaining the credit growth during the second-half period. Note that despite the smaller number of significant variables, the model's explanatory power, R^2 , goes up from 0.39 in the full sample period to 0.59 in the half sample period. On the other hand, the magnitude of the house price inflation coefficient increases three times from 0.2 to 0.66. This implies that the link between the credit growth and house price inflation has become much tighter in recent years.

Table 8 **ECM for Credit Growth Inflation**

Variable Name	Regression 1			Regression 2		
	Coefficient	Standard-error	t-value	Coefficient	Standard-error	t-value
EC (t-1)	-0.01***	0.00	-3.3	-0.01***	0.00	-3.4
Credit Growth Rate (t-1)	0.20*	0.12	1.7	0.20*	0.12	1.7
House Price Inflation	0.20***	0.07	2.7	0.20***	0.07	2.7
GDP Growth Rate (t-1)	0.23	0.14	1.5	0.22*	0.14	1.6
Interest Rate (t-1)	-0.41*	0.22	-1.9	-0.40*	0.20	-1.9
Equity Price Inflation (t-1)	-0.001	0.02	-0.03			
R^2 (adjusted)	0.38			0.39		
LM test (p-value)				0.17		

Note: ***, **, *: Statistically significant at the 10%, 5%, and 1% levels, respectively.

Figure 8 **Credit Growth Estimation**



Note: Percentage changes are from preceding quarter.

Table 9 **Estimation of Credit Growth Inflation by Sample Periods**

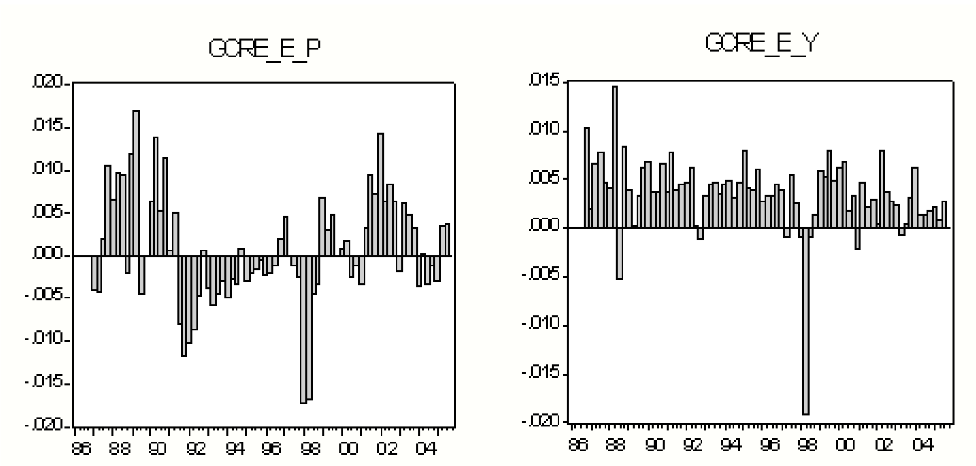
Variable Name	Estimation Results		
	Coefficient	Standard-error	t-value
86. 1/4 - 05. 3/4			
EC (t-1)	-0.01***	0.00	-3.4
Credit Growth Rate (t-1)	0.20*	0.12	1.7
House Price Inflation	0.20***	0.07	2.7
GDP Growth Rate (t-1)	0.22*	0.14	1.6
Interest Rate (t-1)	-0.40*	0.20	-1.9
R^2 (adjusted)	0.39		
LM test (p-value)	0.17		
96. 1/4 - 05. 3/4			
EC (t-1)	-0.02***	0.01	-4.2
Credit Growth Rate (t-1)	-0.16	0.14	-1.1
House Price Inflation	0.75***	0.12	6.2
GDP Growth Rate (t-1)	-0.05	0.18	-0.3
Interest Rate (t-1)	-0.32	0.27	-1.2
R^2 (adjusted)	0.59		
96. 1/4 - 05. 3/4			
EC (t-1)	-0.02***	0.01	-4.1
House Price Inflation	0.66***	0.10	7.0
R^2 (adjusted)	0.59		
LM test (p-value)	0.11		

Note: ***, **, *: Statistically significant at the 10%, 5%, and 1% levels, respectively.

Finally, I check the time-varying effect of house price inflation and GDP growth on credit growth over the full sample period. This is done by illustrating the difference between the original estimation and the restricted estimation setting the coefficients of each variable zero.

Figure 9 depicts the effect of house price inflation (left panel) and GDP growth (right panel) on the credit growth over the last 20 years. The influences of house price inflation on credit growth were big during the late 1980s and the early 2000s when the house price increased quite rapidly. On the other hand, the GDP growth has a consistent positive effect on the credit growth over the whole period.

Figure 9 **<u>The Effects of House Price Inflation and GDP Growth on Credit Growth</u>**



Ⅴ. Conclusions

This paper investigates the relationship between asset prices and liquidity in Korea. By using a dynamic equilibrium model, I derive a housing market model showing which variables determine house price. According to the model's indication, house price is positively correlated with GDP, liquidity, and future house price, and negatively associated with equity price.

I find empirical evidence supporting the theoretical model's prediction: in the long-run, house price and equity price move together with liquidity, and the rise of house price has a negative effect on equity price; in the shot-run, house price also strongly interact with liquidity and this mutual dependence has been enforced in recent years. This implies the possibility of house price-liquidity spiral; equity price, on the other hand, does not show any short-run relationship with liquidity.

Based on the empirical results, two policy implications can be suggested. First, to mitigate a boom-burst cycle in housing market caused by liquidity, it is essential to break the strong link between house price and liquidity. Macro supervision policy such as adjustments of loan to value ratio or qualification requirements for home equity loan in accordance with the market condition might be effective tools for preventing the acceleration or decoration of house price.

Second, maintaining the liquidity at the optimum level is indispensable to stabilize asset prices in the long-run. The optimum amount of liquidity can be measured in various ways. The most important point is that it should not exceed the level which is enough to support the real economic activity. Otherwise, the excess liquidity flows into asset markets and push asset prices up. Therefore, maintaining the liquidity at the optimum level is a priori condition for the asset market stabilization.

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