Preliminary

Housing Prices and Monetary Policy when Interest Rates Decline

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Abstract

This paper discusses the relationship between interest rates and inflation rates on one part and the house prices (typical real asset prices) relative to *chonsei* prices (typical nominal asset prices) on the other. The key point of the paper is that the relative price of sales to *chonsei* depends on the ratio of inflation to real interest rates, and thus even when the monetary authority maintains a pre-announced target level of inflation rate, the relative price of sales to *chonsei* rises if the real interest rate is lowered. Recognizing this relationship, it would make sense to lower the target inflation rate in an economy where the efficiency growth and real interest rate decline, as far as the society wishes to minimize the fluctuation of the relative housing prices (or the relative values between real and financial assets). Over the short-run business cycle horizon, it is argued that there might be a rationale for the conduct of interest rate policy in a less aggressive manner than would recommended by a standard Taylor rule.

1. Introduction

Since the IT bubble burst in 2000, interest rates have fallen and housing prices have risen in the global economy. According to Case and Shiller(2003), for example, the ratio of house prices to per capita income soared from around 6.5 in 2000 to around 8.5 in 2003 in California. Along with the soaring house prices, investment on house construction also increased at a substantial pace. For example, the residential investment in the U.S. increased by 4.9% in 2002 and 7.5% in 2003, while GDP grew at the rate of 2.2% in 2002 and 3.1% in 2003.

Korea was no exception in this global trend. During the period from 2001 to 2003, the general house price index rose by more than 30%. However, the prices of apartments --- the most preferred housing type in recent years --- rose by more than 50% nation-wide, and by almost 100% in the Kangnam area (south of Han River) of Seoul. Along with the rise in house prices, construction industries enjoyed a boom. The average annual growth rate of building construction investment during the period of 2001-2003 reached at 13.3%, while the average GDP growth rate remained only at 4.6%. This boom increased the portion of building construction relative to GDP from 8.4% in 2000 to 11.3% in 2003.

Regarding the housing market, Korea has a unique *chonsei* system, in which the renter pays a lump-sum amount of deposit money to the owner for typically two-year lease contract. The interest earned on this lump-sum deposit provides income to the owner for two years, at which point the lump sum is returned to the renter. This system is so prevalent in Korea that 25 to 40% of dwelling is under the *chonsei* contract.[1] Given the high housing prices relative to income flow in Korea, this implies that a substantial amount of assets are held in the form of *chonsei* deposit. A back-of-the-envelop calculation, for example, yields 200 to 250 trillion won, approximately 40 percent of GDP or 80 percent of the total stock value, as the

[1] According to the *Population and Housing Census Report* (2000), the total number of households is 14.31 million, out of which 7.75 million (54%) are homeowners and 4.04 million (28%) are under *chonsei* contracts. The ratio of *chonsei* increases in metropolitan areas, where housing prices are high. Out of 3.09 million households in Seoul, for example, 1.26 million (40%) are homeowners, while 1.27 million (40%) are under *chonsei* contracts.

amount of total *chonsei* deposit.[2]

While *chonsei* prices, as well as sales prices, should reflect demand and supply in the housing market, the two prices have shown sharply different trends since the second half of 2002 (see [Figure 1]). Until the first half of 2002, both prices had rapidly recovered from the collapse after the 1997 crisis. Since then, however, only the sales prices have kept rising while the *chonsei* prices have stagnated, which has sharply raised the ratio of sales to *chonsei* price or lowered the real value of *chonsei* deposit (deflated by the sales price). This phenomenon can, in a sense, be interpreted as a transfer of wealth from *chonsei* renters to house owners.

Motivated by this observation, this paper examines the determinants of the relative housing prices --- sales and *chonsei* prices --- and shows that the relative housing prices depend on the ratio of nominal to real interest rate. It is probably easy to expect that the discrepancy between the two housing prices is widened as the (expected) inflation rate increases. At the same time, however, the discrepancy can also be widened when the real interest rate declines, even though the monetary authority sincerely sticks to a pre-announced inflation target. In fact, this argument applies not only to the housing prices, but also to the prices of general nominal assets that are not hedged against inflation.

If the monetary authority has concerns over the potential wealth transfers due to the fluctuations of real interest rates, it could, at least in theory, maintain the relative housing prices (or relative prices of real to nominal assets) by proportionately adjusting the (expected) inflation rate. Translated into a business cycle horizon, this could mean that it would be desirable to take a less active interest

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[2] According to the *1997 National Wealth Survey*, the total value of household housing (excluding land) is 485 trillion won, which is approximately 50% of the total building value of all sectors. Applying this ratio of 50% to the total land value estimate, 1,548 trillion won, yields 1,259 (=774+485) trillion won as the total value of housing (including land). Using 28% as the ratio of *chonsei* dwellings and 60% as the ratio of *chonsei* to sales prices, one can obtain 212 trillion won in 1997, which is estimated to inflate to 284 trillion won as of the end of 2003, applying the *chonsei* price index. This amount is almost 40 percent of GDP (721 trillion won) or 80 percent of total equity value (355 trillion won) in 2003.

rate policy than the one otherwise prescribed by a standard Taylor rule.[3] Interpreted in the longer-run horizon that is more directly related to the paper's model, this result implies that, if a country's real interest rates are permanently lowered, the monetary authority can lower the inflation target to preserve the value of nominal assets.

This paper is organized as follows. Section 2 contains a theoretical model that explains the determination of housing prices. The first part of this section discusses the arbitrage condition between the sales and *chonsei* prices, and the second part presents a simple general-equilibrium growth model that includes housing sector. Section 3 presents the results of a crude empirical analysis on the ratio of sales to *chonsei* prices in Korea, and Section 4 discusses its possible implications on monetary policy. Section 5 concludes with brief remarks.

2. Theoretical Discussion

2.1. Interest Rate, Inflation Rate, and Real Estate Prices: A Partial Equilibrium Approach

Chonsei vs. Purchasing a House

It has long been recognized that the existence of inflation raises the value of real assets relative to financial assets that are not hedged against inflation risks. In Korea, the discrepancy between the sales and *chonsei* prices for the same housing can be referred to as a typical example for this.

[3] The recent volatility in asset prices under the stable and low inflation environment has triggered a challenge on the standard inflation targeting framework. While a majority of economists (e.g. Bernanke and Gertler(2001), and Gilchrist and Leahy(2002)) still support the standard monetary policy framework represented by Taylor rules, a group of economists (e.g. Cecchetti et. al.(2000), Borio and Lowe(2002), and Hahm and Hong (2003)) argue that the monetary authority needs to react to asset price bubbles in order to stabilize the economy. See Bean(2003) for this debate. Although from a quite different perspective, this paper's result could be interpreted to provide a rationale for the monetary policy that considers asset price fluctuations.

A household in Korea has two choices when it comes to housing: either purchase or *chonsei* a house. In general, however, the purchasing price is much higher than the *chonsei* price for the basically same housing services. There may be many potential explanations from various perspectives, but the primary reason for the huge discrepancy between the two prices seems to lie in the expectation on capital gain.[4] That is, the *chonsei* renters will recoup only the deposit in monetary unit upon maturity, but the owners will be able to enjoy capital gains if the house prices are rising.

Of course, as far as house prices are subject to fluctuations, the purchase of houses increases risks, hence discounting the sales prices. If, however, there exists an underlying factor that persistently increases house prices, then the sales price should rise to reflect the expected capital gain. And the general price inflation is the most compelling example of the underlying factor that persistently increases house prices.

<u>*An Arbitrage Condition*</u>

The arbitrage condition between the sales and *chonsei* prices shows such a relationship:

$$(1) \qquad P_t^H = \left\{ \, i_t P_t^C + E_t(P_{t+1}^H) \, \right\} / \; (1+i_t) \quad ,$$

where P_t^H is sales price at time t, P_t^C is *chonsei* price, i_t is nominal interest rate, $E_t(P_{t+1}^H)$ is the sales price at time t+1 expected at time t. That is, the sales price at

[4] There are inherent differences between homeowners and *chonsei* renters. For example, the homeowners are free to move whenever they want, while the *chonsei* renters do not enjoy such a freedom. In contrast, however, the homeowners should bear the cost to maintain the quality of houses that *chonsei* renters do not have to care about. *A priori*, therefore, it is not clear whether the sales price should be higher than the *chonsei* price. In addition, the homeowners also have to pay taxes on houses, which would rather lower the house sales price relative to *chonsei* price.

time t is the discounted sum of the return for housing services (or the opportunity cost of dwelling in the house rather than leasing the house on a *chonsei* contract), $i_t P_t^C$, and the expected sales price at time t+1, $E_t(P_{t+1}^H)$.

This arbitrage condition can be recursively solved forward, and the solution will be a complicated function of the expectations about future *chonsei* prices and interest rates. Assuming a steady state with no speculative bubbles (in which the interest rate is fixed at i and the *chonsei* price increases at a constant rate of π), however, Equation (1) produces a simple and intuitive result:

$$(2) \qquad \frac{P_t^H}{P_t^C} = \frac{i}{i-\pi} \quad .$$

That is, the ratio of the sales to *chonsei* price is equal to the ratio of nominal to real interest rate. Of course, this result is based on many restrictive assumptions. Nevertheless, if the sustained real interest rate is around 4 percent and *chonsei* price inflation rate is around 3 percent (a medium-term target inflation rate of the monetary authority in Korea), this ratio becomes 1.75, which is similar to the ratio of sales to *chonsei* price at the end of 2003.[5]

Financial vs. Real Asset Prices

As a matter of fact, this result can be applied to rather general asset prices. In a steady state economy where the nominal interest rate is fixed at i, the price of a financial asset that yields a constant return R in monetary unit at every point in time is determined by $\int_0^\infty e^{-is} R ds = R/i$, while the price of a real asset that provides service flow whose price increases at a constant inflation rate π can be expressed as $\int_0^\infty e^{-is} \mathrm{Re}^{\pi s} ds = R/(i-\pi)$. Therefore, the existence of inflation pushes up the

[5] The ratio of sales to *chonsei* prices of apartments at the end of 2003 was 1.7 for the nation and

price of a real asset relative to that of financial asset providing the same service, and their ratio becomes the same as the sales to *chonsei* prices, $\frac{P_t^H}{P_t^C} = \frac{i}{i-\pi}$.[6]

From this result, it is easily confirmed that a rise in the inflation rate would raise the price of real asset relative to that of financial asset. What has not been much discussed in the literature, however, is that the same effect can be generated by the decline of real interest rate. Defining the real interest rate as $r \equiv i - \pi$, Equation (2) can be re-expressed as $\frac{P_t^H}{P_t^C} = 1 + \frac{\pi}{r}$, implying that the relative price is determined by the ratio of inflation rate to real interest rate, rather than by the inflation rate alone. Therefore, even when the monetary authority sincerely maintains a pre-announced target level of inflation rate, the ratio of sales to *chonsei* price rises if the real interest rate is lowered.

In order to relate this discussion to monetary policy, however, it seems necessary to explicitly understand the general price level. In other words, the meaning of "real estate price" or "*chonsei* price" rather than the relative price of those two needs to be clarified in the context of general price inflation. At the same time, if the discussion is extended from the housing market to the macro-economy, the real interest rate and rent need to be taken as endogenous variables. In this sense, this subsection's discussion is viewed as a partial equilibrium approach in which inflation rate, real interest rate, and rent are exogenously determined. In order to sense a general equilibrium flavor, the next subsection will examine a very simple growth model.

2.0 for Seoul. (Kookmin Bank(2004))

[6] The sales to *chonsei* price ratio can also be considered in this context. The prices of *chonsei* and sales are $P_0^C = \int_0^t e^{-is} R_s ds + P_0^C e^{-it}$ and $P_0^H = \int_0^t e^{-is} R_s ds + P_t^H e^{-it}$, respectively. The main difference between the two prices is that, at time t, *chonsei* renters are left with the *chonsei* deposit at time 0, while the owners are left with the house price at time t ($P_t^H = P_0^H e^{\pi t}$). Comparing the two prices, one can derive $P_0^H / P_0^C = (1 - e^{-it}) / (1 - e^{-(i-\pi)t}) \approx i / (i - \pi)$.

2.2 A Simple Growth Model: A General Equilibrium Approach

A Growth Model

Consider a representative household who earns (nominal) income $i_t A_t$ from asset A_t and spends $P_t C_t$ and $R_t H_t$ for consumption C_t and housing service H_t, respectively. If the instantaneous utility function is given by $\ln(C_t^{\alpha} H_t^{1-\alpha})$ and the time discount rate is ρ, then the household solves the following optimization problem:

(3) $$Max. \int_0^{\infty} \ln(C_t^{\alpha} H_t^{1-\alpha}) \ e^{-pt} d_t \ , \ s.t. \ \dot{A}_t = i_t A_t - P_t C_t - R_t H_t \ ,$$

where $\dot{A}_t$ denotes the increase in the asset level. If the (nominal) value of the asset is the sum of (nominal) values of capital and houses,

(4) $$A_t \equiv P_t^K K_t \ + P_t^H H_t ,$$

it is easy to show that the growth rate of consumption as well as capital becomes proportional to the real interest rate, or $i_t - \dot{P}_t^K / P_t^K$:

(5) $$\frac{\dot{C}_t}{C_t} = \frac{\dot{H}_t}{H_t} = i_t - \frac{\dot{P}_t^K}{P_t^K} - \rho \ .$$

Production and Capital Market Efficiencies

In this economy with no frictions where real and nominal variables can be completely separated, the relative prices of real assets to consumption goods are entirely determined by the supply side, or the technology that stipulates how many units of real assets are accumulated at the expense of one unit sacrifice of consumption. In order to make this point clear, assume the following technology:

(6) $$\dot{K}_t + \dot{H}_t = D(BK_t - C_t) .$$

For simplicity, this equation takes a linear production function BK_t and treats capital and house as perfect substitutes at the supply side. A peculiar feature in this equation is the coefficient $0 < D \leq 1$ that measures the units of increase in future capital when present consumption is reduced by one unit. While $D = 1$ is the standard case in growth models, the case of $D < 1$ can be interpreted in line with a *Tobin's q* model in the sense that $D < 1$ implies a real adjustment cost in investment.[7] Another, perhaps more pertinent, interpretation of D may be the degree of capital market efficiency. In other words, if the capital market efficiency is low, or $D < 1$, then the capital accumulation process is marred although the production efficiency B is maintained.

Once the model is set up as above, it is easy to derive the equilibrium relative prices by equating the resource constraint (Equation (6)) and the budget constraint (Equations (3) and (4)). That is, using Equations (3) and (4),

(7) $$\dot{P}_t^K K_t + P_t^K \dot{K}_t + \dot{P}_t^H H_t + P_t^H \dot{H}_t = i_t (P_t^K K_t + P_t^H H_t) - P_t C_t - R_t H_t$$

is derived, and by equating this equation to equation (6), one can obtain the following four equilibrium conditions:

[7] Of course, while the adjustment cost vanishes when the economy approaches a steady state in *Tobin's q* models, Equation (6) assumes that the cost exists permanently for simplicity. See Abel and Blanchard(1983) and Lim and Weil(2003) for growth models that explicitly incorporate formal

(8-1) $P_t / P_t^K = D \;\Rightarrow\; P_t^K = P_t / D$

(8-2) $P_t^H / P_t^K = 1 \;\Rightarrow\; P_t^H = P_t^K$

(8-3) $i_t - \dot{P}_t^K / \dot{P}_t^K = DB$;

(8-4) $(i_t P_t^H - R_t - \dot{P}_t^H) / P_r^K = 0 \;\Rightarrow\; i_t - \dot{P}_t^H / P_t^H = R_t / P_t^H \;\Rightarrow\; R_t = BP_t$.

These results are easily predictable from the assumptions. That is, Results (8-1) and (8-2) state that the relative price of capital (or house) to consumption good is determined by D, while Result (8-3) indicates that the real interest rate is determined by B multiplied by D, or the efficiency of the capital transformation process from present to the future. Result (8-4) is an arbitrage condition that the benefit from the purchase of house, the sum of rent R_t and capital gain $\dot{P}_t^H$, should be equal to the opportunity cost, $i_t P_t^H$.

<u>*Inflation and Chonsei Price*</u>

The introduction of money in this model economy does not affect any relative prices, hence any resource allocation processes. Therefore, if the monetary authority inflates a certain target price, say, consumption price P_t, at a rate of π, the asset prices will increase at the same rate. In contrast, however, the rate of inflation can affect the relative price of *chonsei*. As far as an arbitrage condition holds between the *chonsei* and rent markets, the opportunity cost of *chonsei*, $i_t P_t^C$, should be equal to the rent:

Tobin's q specifications..

(9) $P_t^C = R_t / i_t = BP_t /(DB + \pi)$.

Price Responses to a Decline in Real Interest Rate

What would happen to this economy if the real interest rate permanently declines? First, the growth rate is unambiguously lowered (Equation (5)). The relative prices of assets to consumption goods, however, depend on the sources of the decline in interest rate. If the real interest rate is lowered due to the decline in B, then the relative price of house (or capital) does not change (Equation (8-1)), and only the relative price of *chonsei* declines (Equation (9)). If, in contrast, the real interest rate is lowered due to the decline in D, then both the house (or capital) and *chonsei* prices rise, but the price of house rises more than that of *chonsei*. [Figure 2] describes this situation.

The intuition that the decline in B does not change the relative price of house can be explained as follows. The price of house is ultimately determined by $P^H = \int_0^\infty e^{-(i-\pi)s} R ds = \dfrac{R}{i-\pi}$, and thus the fall in the real interest rate itself is a factor to raise the house price by lowering the discount rate for the future (or the return rate of alternative investment). In a general equilibrium set-up, however, the rent R is also lowered by the decline in B because consumption goods supplied by the same amount of capital are decreased while the supply of houses remains at the same level. In the particular model of this subsection, the instantaneous fall in R exactly cancels off the effect from the decline in the real interest rate, leaving the house price unchanged.[8] In contrast, if the real interest rate is lowered due to the decline in D, the supply of consumption goods and R do not change, raising the house price.

[8] In this case, the relative price of capital to consumption good does not change, but the shadow price of capital (as well as consumption good) jumps up. That is, an unanticipated adverse shock to productivity decreases the level of consumption, and the *ex post* marginal utility of consumption good is higher than the marginal utility that was expected before the shock was realized.

Price Index and the Target Rate of Inflation

In the above, it was shown that the house price does not change if the real interest rate declines due to a fall in B. Yet it is worthwhile to note that the house price here was the relative price of house to consumption goods. In other words, this "price" becomes the price in monetary unit, only when the monetary authority uses the price of consumption goods as a target. In practice, however, it seems common to include rent as an important component of the target CPI.[9] If, for example, the monetary authority gradually increases the price index,

$$(10) \qquad q_t \equiv P_t^{\alpha} R_t^{1-\alpha}$$

(instead of P_t), then the price of housing (as well as P_t) in monetary unit will rise even when a fall in B lowers the real interest rate (see [Figure 2] for the time paths of the housing prices in this case).

Although the *chonsei* price in monetary unit is also affected by the choice of target price as well as the source of the decline in real interest rate, the ratio of sales to *chonsei* prices depends only on the inflation rate as confirmed in the previous subsection. Therefore, if the monetary authority lowers the target inflation rate proportionately in response to the decline in the real interest rate, the discrepancy of the *chonsei* price from the sales price would not be expanded. [Figure 2] also shows the time paths of housing prices when the monetary authority follows such a rule.

Quantity Responses to a Decline in Real Interest Rate

Though not a central issue in this paper, the responses of the quantity

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[9] In Korea, the weight of rent is approximately 15% in the headline CPI that does not include owner's equivalent rent (www.nso.go.kr). If the owner's equivalent rent were included in the CPI, the weight of rent would be increased to approximately 31%, which is similar to that in the U.S. at

variables with respect to a decline in the real interest rate can also be traced (see Appendix for algebra). One of the results worth noting is that a fall in the real interest rate lowers the ratio of consumption to housing at the steady state, but raises the ratio of consumption to capital.

It is natural to decrease the steady state level of capital to housing ratio as the real interest rate (or the marginal rate of return for capital) declines due to a fall in B, because the shock that lowers the marginal rate of return for capital does not directly lowers the marginal utility from the housing service.[10] Therefore, the household reduces the saving for capital accumulation (hence income), but not the saving for housing. This optimization behavior leads to a decrease in the steady state level of consumption, but not as much as the decrease in the steady state level of capital. Recalling that the measured income is a linear function of capital, this implies that the steady state saving rate in the aggregate falls when the real interest rate declines. At the same time, however, the saving rate for housing investment rises with a fall in the real interest rate or growth rate, which seems to be consistent with the recent experiences of the global economy as mentioned in the Introduction.

<u>*Remarks*</u>

In order to learn intuitions in a straightforward way, this subsection introduced a very simple growth model in which all of the prices are instantaneously adjusted from one steady state to another. This model may be extended in various dimensions to generate rich dynamics of asset prices. For example, a Cobb-Douglas production function can be used instead of the linear production function of this subsection (results are available upon request). In this case, a fall in the efficiency growth rate gradually lowers the real interest rate, and thus the discrepancy between the sales and *chonsei* prices is also widened at a gradual pace. Another variant would be to explicitly introduce the *Tobin's q* model, which would produce short-run fluctuations of asset prices. Perhaps the most interesting

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31.5% (www.bls.gov).

[10] When the real interest rate declines due to a fall in D, the results become complicated. See the Appendix.

variation of the model, however, might be the one in which housing rents adjust to fluctuations of interest rates in a gradual manner (probably due to a slow adjustment of housing market relative to consumption goods market). This feature that relaxes the tight link between the housing and other markets would be able to generate short-run deviations of rents from interest rates, hence the fluctuations of house prices.

3. A Brief Look at the Data

Based on the theoretical discussion of the previous section, this section takes a brief look at the actual data of the sales and *chonsei* prices of apartments from Korea.[11] While it would also be of great interest to examine the house prices in relation to general prices and macroeconomic fluctuations, the model's predictions regarding these issues are not sufficiently clear. At the same time, it is very likely that various shocks have generated uneven effects across the housing market and other markets in actual data. This section, therefore, limits the scope of analysis to the relative housing prices that are presumably immune to the noises generated by housing market specific shocks. In addition, considering that most theoretical discussion was based on steady state analyses, the empirical examination is also focused on the relationships of long-run trends across variables.

[Figure 3] shows the trends of relevant variables since 1986, the first year of the available data, along with their HP filtered trends. First, the ratio of sales to *chonsei* prices ([Figure 3A]) had declined from almost 3 in the late 1980s to around 1.5 in 2000, and bounded back toward 2 since then. Second, apart from the exceptional hike during the currency crisis period in 1998, the nominal interest rate ([Figure 3B]) had also declined from over 15% in the early 1990s to around 6% in 2003.[12] Third, however, the expected inflation rate ([Figure 3C]) had also been

[11] Data were collected from the *Monthly House Prices* published by Kookmin Bank. Since the ratio of the sales to *chonsei* prices is not available prior to December 1998, this variable was extended backward using their inflation rates of the sales and *chonsei* prices.
[12] Yield rate on 3-year corporate bond (*Monthly Bulletin*, Bank of Korea) was used for the nominal interest rate.

lowered from over 5% in the late 1980s to below 3% in 1998 and 1999, operating as a factor to lower the ratio of sales to *chonsei* prices.[13] Fourth, in contrast, the portion of expected inflation in the nominal interest ([Figure 3D]) has been rising from below 20% in 1998 and 1999 to over 40% in 2003, mainly due to the decline in the real interest rate in spite of stable inflation expectations, which seems to operate as an important factor for the rebound of the housing price ratio.

Although the inflation and interest rates seem to be capable of explaining the *direction* of the long-term trend of the housing price ratio, they are not sufficient to explain the ratio's *magnitude*, particularly the ratio around 3 in the late 1980s and early 1990s. During this period, the portion of the expected inflation rate in the nominal interest rate was nearly 50%, implying that the inflation and interest rates cannot generate the housing price ratio over 2. This observation invites discussions on other factors (such as bubbles and taxes) that can potentially explain the house price hikes in the late 1980s. In contrast, both the direction and magnitude of the housing price ratio since 1999 appear to fluctuate within the range that can be "explained" by the fluctuation of inflation and interest rates.

4. Discussion on Monetary Policy

No direct implications on monetary policy can be drawn from the growth model presented in this paper: there exists neither short-run fluctuation nor social cost from inflation. Therefore, any meaningful discussion on monetary policy, if any, should be based on a separate presumption that the society wishes to minimize the fluctuation of the relative prices between sales and *chonsei* --- more generally, the relative values between real and financial assets. A rationale for this presumption may be found from the argument that the increased uncertainty about the relative asset prices is likely to shrink financial transactions and economic activity. A more direct, though less founded, argument is that the wealth redistribution between real asset holders and financial asset holders itself incurs a

[13] The expected inflation rate was obtained by annualizing forecast values for the next three years of inflation at every quarter using the structural vector auto-regression estimation composed of two variables, GDP and core inflation. See Cho(2003) and Kim(1996) for details.

cost to the society.

Taylor Rule for Short-run Stabilization

Once the presumption that the fluctuation of relative asset prices is costly is accepted, its implication on short-run monetary policy can be conjectured. Suppose a standard Taylor rule is written as:

(11) $i_t = i_t^* + \lambda_y (y_t - y_t^*) + (\lambda_\pi - 1)(\pi_t - \pi_t^*)$ or $r_t = r_t^* + \lambda_y (y_t - y_t^*) + \lambda_\pi (\pi_t - \pi_t^*)$,

where y_t is output, λ_y and λ_π are the coefficients "optimally" chosen by the monetary authority, and asterisk denotes target levels.[14] Recalling that the fluctuation of the relative asset prices depend on π_t and r_t symmetrically with opposite signs (Equation (2)), the monetary authority concerning the relative asset prices would add a third term in the Taylor rule with a new coefficient λ_P, the simplest form of which could be:[15]

(12) $r_t = r_t^* + \lambda_y (y_t - y_t^*) + \lambda_\pi (\pi - \pi_t^*) + \lambda_P [(\pi_t - r_t) - (\pi_t^* - r_t^*)]$, $\lambda_P > 0$,

or $r_t = r_t^* + \dfrac{\lambda_y}{1+\lambda_P}(y_t - y_t^*) + \dfrac{\lambda_\pi + \lambda_P}{1+\lambda_P}(\pi - \pi_t^*)$.

This result implies that the monetary authority concerned on the relative asset prices should react to output fluctuations (and to inflation fluctuation, too, if $\lambda_\pi < 1$) less actively than it otherwise would. Conversely speaking, the optimal monetary

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[14] King(1999) takes 0.5 for both λ_y and λ_π as typical estimates.

[15] Equation (2) holds only on the steady state, but it is conjectured that the relative asset prices are positively related, though not proportional, to the ratio of nominal to real interest rate in a rather complex way off the steady state.

policy rule ignoring relative asset prices is likely to generate “excessive volatility” of the relative asset prices, if assessed by a central banker who believes the fluctuation of asset prices is not desirable.

Target Inflation Rate when the Long-run Growth Rate Declines

If the decline in real interest rate and/or growth rate is secular rather than cyclical, the appropriate response of the monetary authority concerning the relative asset price stabilization is obvious: lower the target rate in proportion to the decline in real interest rate, since otherwise the real asset prices would permanently rise relative to financial asset prices.[16]

The secular decline in capital productivity and real interest rates may not be common in developed economies, but it is a likely scenario in developing economies like Korea. In fact, the convergence theory based on either the Neoclassical growth model (Barro(1991), Mankiw, Romer and Weil(1992)) or technology diffusion (Lucas(2000), Parente and Prescott(1994)) predicts a secular decline of (capital) productivity growth rate and real interest rate. [Figure 4], copied from Cho and Koh(1999), shows the long-term trends of capital productivity and real interest rates in Korea for the past 30 years, which seems to be consistent with such predictions.

It may also be possible to seek the relevancy of this paper’s discussion to Japan, whose growth rate dropped from around 3.5% in the 1980s to around 0.5% in the 1990s. As argued by Hayashi and Prescott(2002), suppose that this decline in the growth rate was due to a slow-down in TFP growth (B in the context of this paper’s model, or possibly D in the sense that capital market inefficiency can lower the real interest rate) rather than aggregate demand. Also suppose that the monetary authority followed a Taylor Rule with the target inflation rate around 2.5% under the assumption that the potential growth rate be 3.5% in the late 1980s,

[16] A similar discussion can be found in Friedman(1969) where he argues that the optimal rate of inflation is minus real interest rate.

although it had already dropped, say, far below 3%.[17] This Taylor rule then would be likely to recommend lowering the interest rate to stabilize output (under the misguided target), which could raise the real asset prices relative to financial asset prices. If the monetary authority, having realized that the potential growth rate had declined, began to adjust the target inflation rate to a lower level (say, 1%) afterwards, it became likely that the real asset prices fell. In other words, unless the slow-down in growth is clearly attributable to short-term demand shocks, it could be dangerous to conduct an aggressive interest rate policy.

5. Concluding Remarks

This paper discusses the relationship between interest rates and inflation rates on one part and the house prices (typical real asset prices) relative to *chonsei* prices (typical nominal asset prices) on the other. The key point of the paper is that the relative price of sales to *chonsei* depends on the ratio of inflation to real interest rates, and thus even when the monetary authority maintains a pre-announced target level of inflation rate, the relative price of sales to *chonsei* rises if the real interest rate declines. Recognizing this relationship, it is argued that there might be a rationale for a less aggressive interest rate policy than would be recommended by a standard Taylor rule, if the society wishes to minimize the fluctuation of the relative housing prices (or the relative values between real and financial assets). Over the longer-term, it would make sense to lower the target inflation rate in an economy where the efficiency growth and real interest rate secularly decline.

In economies with very low interest rates, however, it is naturally asked how much to lower the target inflation rate. Given the widespread apprehension about the zero (nominal) interest rate bound, in particular, this question becomes challenging. That is, as the real interest rate declines toward zero, the monetary authority may have to accept either a higher discrepancy between real and financial

[17] Clarida, Gali and Gertler(1997) found that 6 major advanced economies including Japan appeared to have pursued an implicit form of inflation targeting. More specifically, Leigh(2003) found that the interest rate policy of the Bank of Japan appeared to fit a conventional forward-looking Taylor rule with the target inflation rate around 2.5% in the 1980s but around 1% in the 1990s.

asset values or a higher risk of hitting the zero interest rate bound. Regarding many issues, including this thought-provoking one, the paper does not provide rigorous discussions yet, and many arguments remain at conjecture levels. No doubt that far more research is needed before drawing conclusions in this area.

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Appendix: Dynamics of the Model in the Text

The dynamics of the model in the text can be traced by solving the following three equations for C_t, H_t and K_t:

$$(5)\qquad \frac{\dot{C}_t}{C_t} = \frac{\dot{H}_t}{H_t} = i_t - \frac{\dot{P}_t^K}{P_t^K} - \rho = r_t - \rho = DB - \rho \quad ;$$

$$(6)\qquad \dot{K}_t + \dot{H}_t = D(BK_t - C_t) \quad ;$$

$$C_t = \frac{\alpha}{1-\alpha}\frac{R_t}{P_t}H_t = \frac{\alpha}{1-\alpha}r_t H_t = \frac{\alpha}{1-\alpha}DBH_t \quad .$$

from the optimization of instantaneous allocation between consumption and housing expenditure. While C_t and H_t always move along the steady state paths (although the steady state level of C_t can jump at the moment when a shock arrives), K_t has a transitional dynamics governed by:

$$\frac{\dot{K}_t}{K_t} = DB - \left[(DB-\rho) + \frac{\alpha}{1-\alpha}D^2B\right]\frac{H_t}{K_t} \quad .$$

In a steady state, therefore, these three equations yield:

$$\frac{C}{H} = \frac{\alpha}{1-\alpha}DB \quad ;$$

$$\frac{K}{H} = \frac{1}{\rho}\left[(DB-\rho) + \frac{\alpha}{1-\alpha}D^2B\right] \quad \text{; hence}$$

$$\frac{K}{C} = \frac{1-\alpha}{\alpha}\frac{1}{\rho DB}\left[(DB-\rho) + \frac{\alpha}{1-\alpha}D^2B\right] \quad .$$

Using these results, it can be shown that a fall in either B or D decreases the steady state values of C/H, K/H, and K/C. Finally, the aggregate saving rate at the steady state,

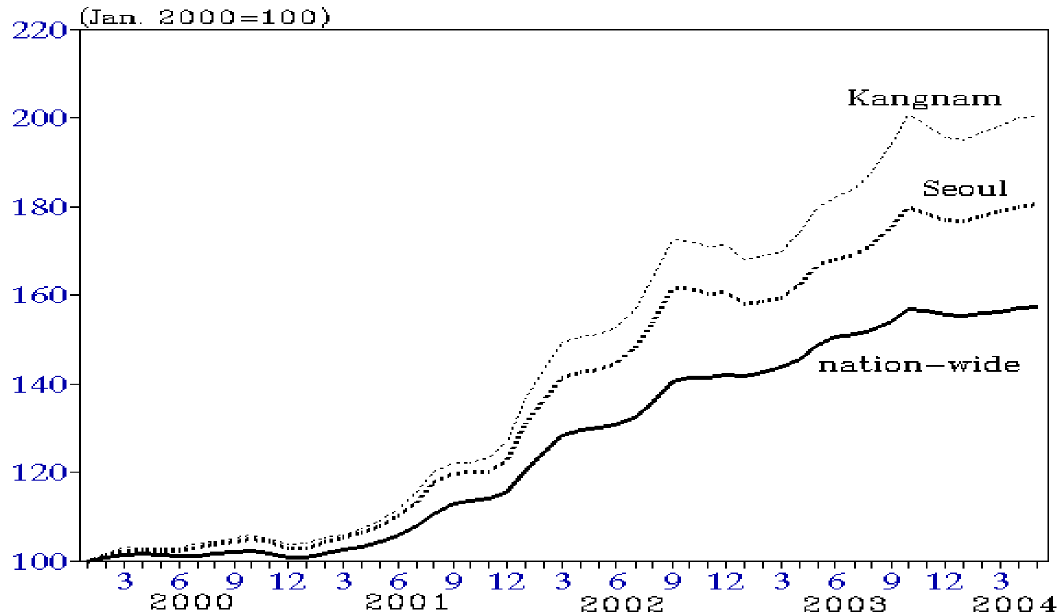
$$1-\frac{C}{BK} \quad = \quad 1-\frac{\alpha}{1-\alpha}\frac{\rho D}{[(DB-\rho)+\{\alpha/(1-\alpha)\}D^2 B]} \quad ,$$

declines with a fall in B and increases with a fall in D, but the housing investment ratio to output,

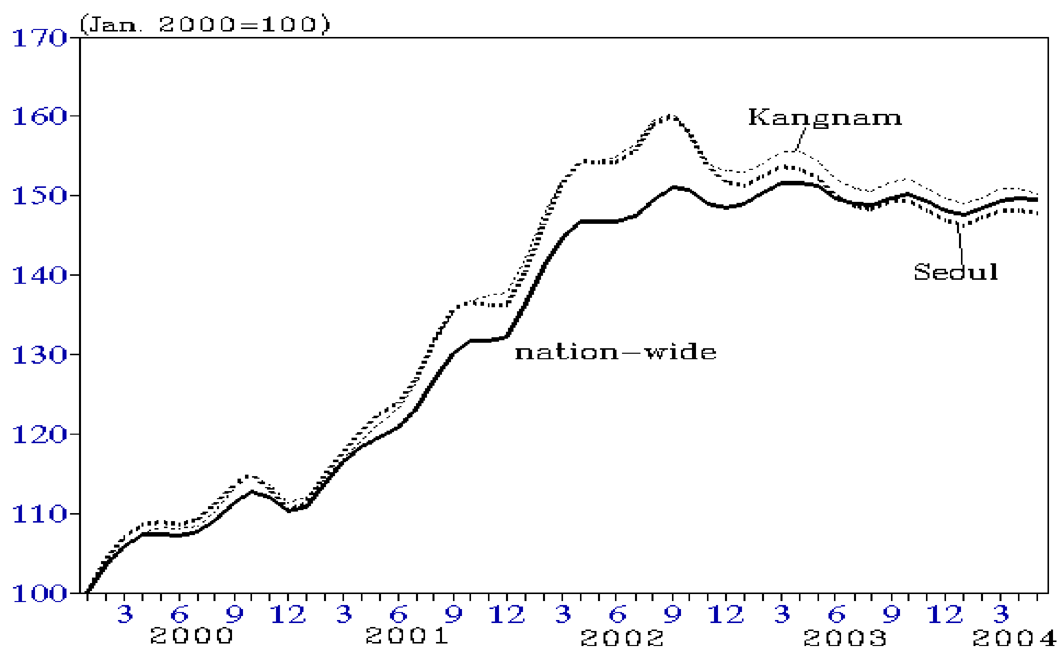
$$\frac{\dot{H}/D}{BK} \quad = \quad \frac{\rho}{DB}\frac{1}{[1-\{\alpha/(1-\alpha)\}D/\{1-\rho/DB\}]} \quad ,$$

increases with a fall in B (its direction with a fall in D becomes ambiguous).

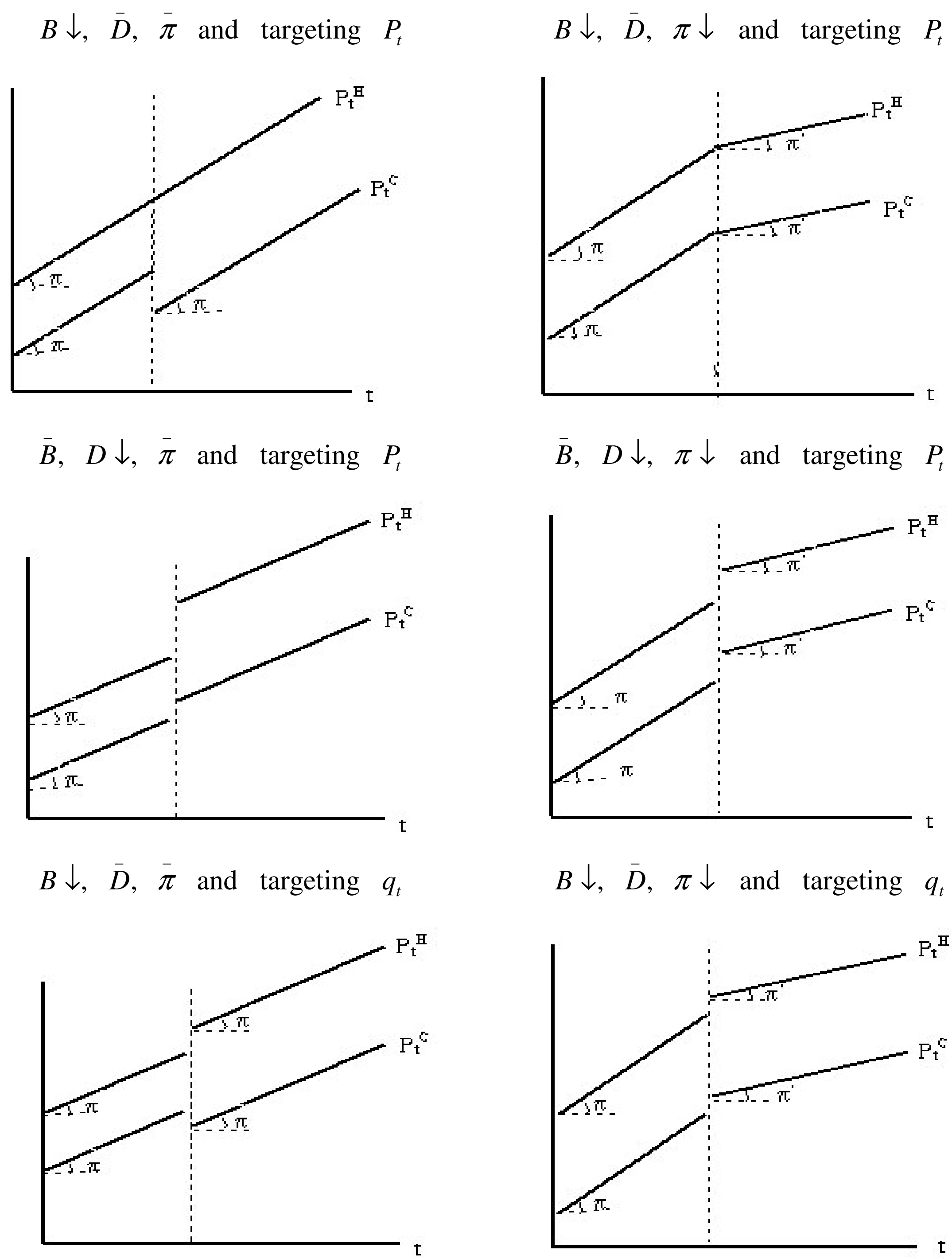
[Figure 1A] Trends of House Prices



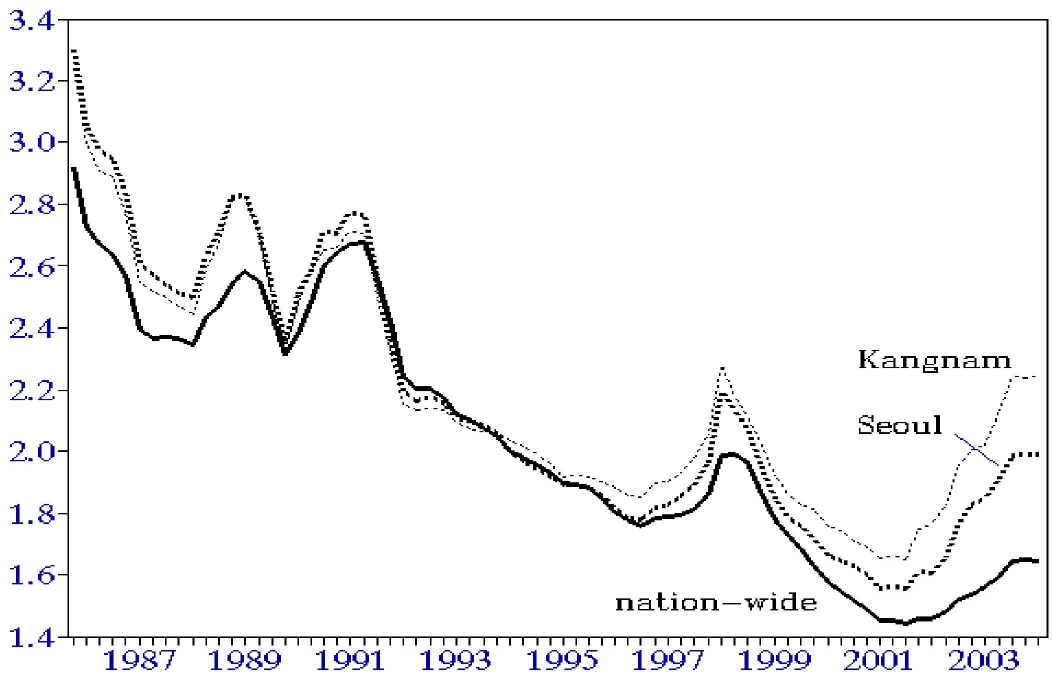
[Figure 1B] Trends of *Chonsei* Prices



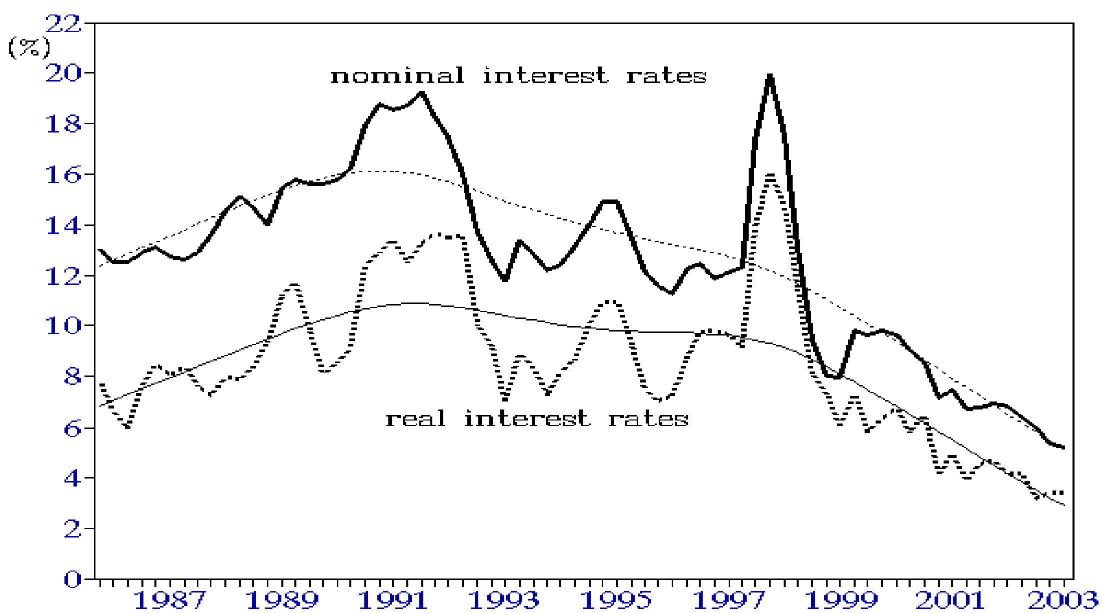
[Figure 2] Time Paths of House Price (P_t^H) and *Chonsei* Price (P_t^C)



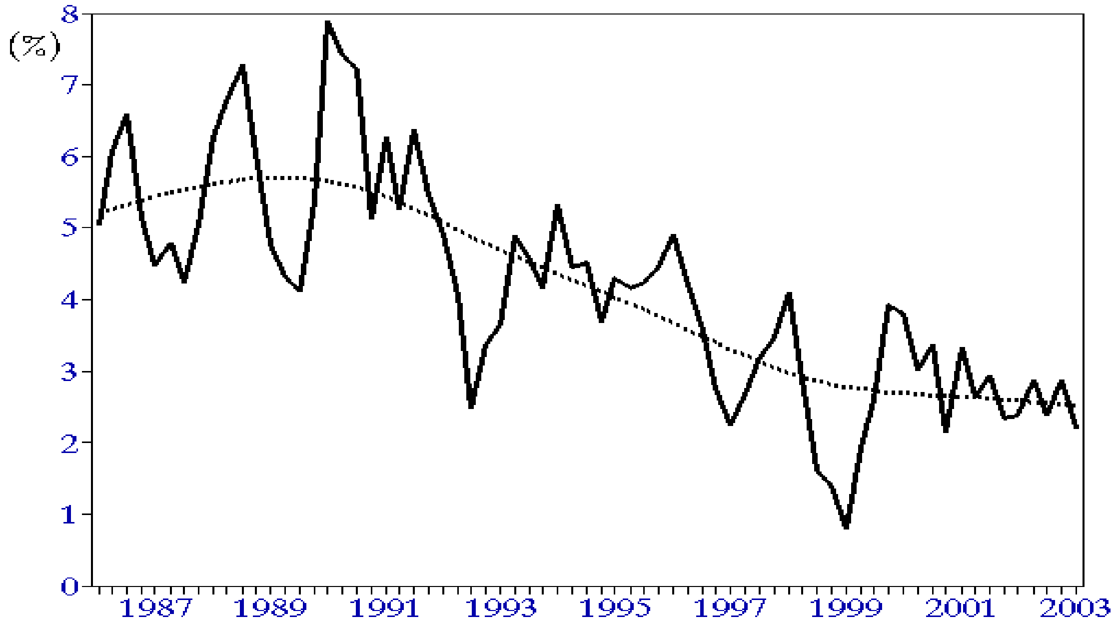
[Figure 3A] Ratio of Sales to *Chonsei* Prices



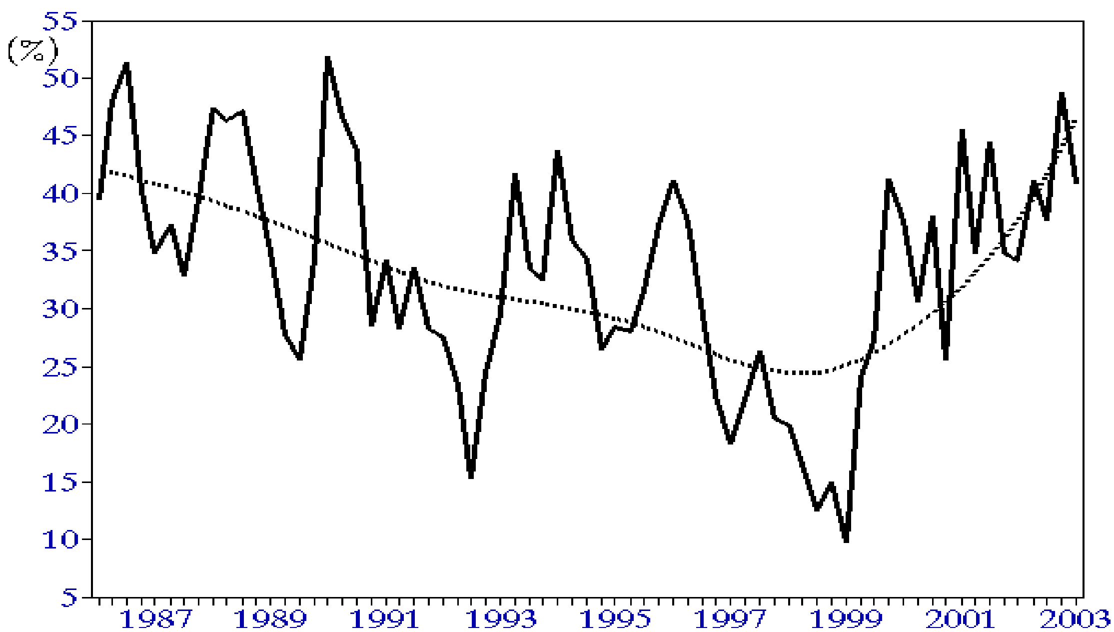
[Figure 3B] Nominal vs. Real Interest Rates



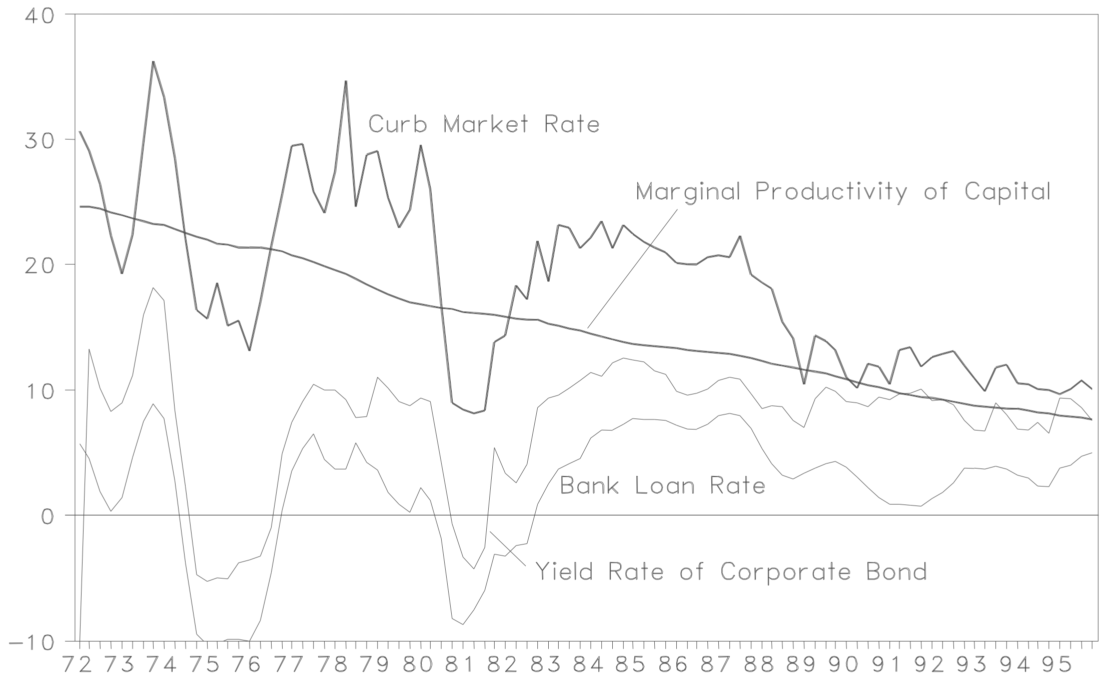
[Figure 3C] Expected Inflation Rate



[Figure 3D] Expected Inflation Rate as a Portion of Nominal Interest Rate



[Figure 4] Trends of Real Interest Rates of Korea



Source: Cho and Koh(1999).