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Inflation Targeting in Korea: A Model of Success?

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I. Introduction

Korea has managed inflation targeting as a framework for monetary policy since 1998. In this policy setting, core inflation is the target and the call money market rate, which the Bank of Korea (BOK) can control, is the operational target of monetary policy. Prior to the adoption of the call market rate and inflation targeting, the BOK had exploited a variety of monetary aggregates ranging from the reserve base to M3 as an intermediate target.

After a few years of inflation averaging more than five percent per year, the rate of change of the CPI decelerated sharply to a little over one percent in 1999 - the first year of inflation targeting. Since then, the annual rates of inflation in terms of the CPI and core CPI have remained around 3-4 percent mostly within the target ranges. On the surface, this record suggests that inflation targeting has been effective in sustaining price stability in Korea. However, delving deep into the operations of monetary policy, such an evaluation calls for qualifications. Since the 1997-98 financial crisis, inflation has not been the main concern, but economic downturn has. In addition, there has been a sharp appreciation of the won-dollar exchange rate, which has helped keep prices of imported goods low, and eventually the price level. In such an environment with low inflationary pressure, the new framework has not been subject to a real test of controlling inflation.

The BOK had lowered the call money market rate continuously from five percent (February 2000) to 3.25 percent (November 2004). It had remained unchanged until October 2005 when it was raised by 0.25 percentage points. Understandably, monetary policy has been expansionary since 2000. However, the expansionary monetary policy has not been effective in bringing about economic recovery. The loose monetary policy appears to have done little in the way of stimulating domestic demand, specifically the investment demand. Although the real interest rate has fallen and the availability of credit has increased, business firms have shown little signs of taking advantage of the low cost of financing to increase their capital investment.

The purpose of this paper is to analyze the extent to which inflation targeting has contributed to stabilizing prices in Korea since 1999 when the targeting was instituted. For this purpose, this paper examines the mode of operation, channels, and effects on macroeconomic variables of monetary policy. Before discussing these issues, this paper summarizes the history of monetary policy in section II.

Section III is devoted to an empirical examination of the extent to which inflation targeting has contributed to sustaining price stability. To this end, raw data on the rates

of inflation measured by the CPI and core CPI during the periods of and before inflation targeting are presented for a visual inspection. Then, following Levin, Natalucci, and Piger (2004) time series models are estimated to gauge the relative role of the size of inflation shocks and the propagation of inflation shocks in explaining the volatility of inflation. This examination will help us determine whether the decrease in inflation volatility during the periods of inflation targeting is due to the fall in the size of inflation shocks or inflation targeting itself. Finally, sensitivity of changes in inflation expectation to changes in actual inflation is estimated in terms of the method suggested by Levin, Natalucci, and Piger (2004) in order to analyze whether the formation of inflation expectations has changed after the introduction of inflation targeting.

In Section IV, a monetary reaction function is estimated to infer the way in which monetary policy was conducted during the period of inflation targeting. In order to account for the forward-looking nature of monetary policy, which appears to be characteristic of monetary policy of the BOK, a modified version of the methodology suggested by Clarida, Gali, and Gertler (1998, 2000) is used. This estimation will help us understand better the importance of changes in inflationary pressure and the output gap in policy responses of the BOK.

In Section V, the transmission mechanism of monetary policy is investigated in term of structural VAR models developed by Christiano, Eichenbaum, and Evans (1999). Concluding remarks are in section VI.

II. History of Monetary Policy in Korea

Before the currency crisis in 1997, the intermediate target of monetary policy of the Bank of Korea was a monetary aggregate such as M1or M2. This aggregate was then adjusted to achieve its policy objectives. After the 1997-98 financial crisis, the Bank of Korea adopted inflation targeting and began using the interest rate as the operational target. After some years of the two-pillar system in which a monetary aggregate also served as an operational target, pure inflation targeting was established in 2004. This section briefly summarizes the history of monetary policy in Korea.[1]

II.1. Monetary Targeting

Monetary policy in Korea has been conducted in various systematic frameworks since 1957, when the “Fiscal Financial Stabilization Plan” was first

[1] Most part of this section follows the descriptions in Bank of Korea (2002a, 2002b).

introduced as an overall framework of macroeconomic policy in order to curve high rates of inflation resulted from the large fiscal deficit the government ran during the Korean War and the post-war reconstruction period that followed. Under the plan, the limit for the rate of growth of M1 was pre-announced quarterly or yearly. After running current account deficits for a number of years, Korea had to accept a stand-by credit agreement with the IMF (March 1965). This agreement required Korea to set up a concrete value of monetary target in consultation with the IMF, which marked an important change in monetary policy operations in Korea.

In 1976, the Bank of Korea began setting its own M1 growth rate target as the current account started to improve. Three years later the Bank changed the monetary target to a M2 growth rate since the demand for M1 became much less stable than before. In setting the target value of money supply the BOK used the EU method of the quantity equation of money.

The Bank of Korea maintained monetary targeting until the mid-1990s. Largely because of stability of the M2 demand, the Bank was able to keep the M2 growth rate closer to the target value. However, changes in the trust account system in 1996 had made the M2 demand unstable. As a result, from 1997 the Bank of Korea used two monetary aggregates M2 and MCT, which is a broader measure of money that includes CD and trust cash fund. However, the usefulness of MCT as a monetary target declined with a change in the required reserve system.[2]

After the 1997-98 crisis that forced Korea to accept an IMF rescue financing with policy conditionality, the Bank of Korea adopted a broad measure of money, M3 as a reference value together with a corresponding supply limit of monetary base. At the same time, the Bank revised the Bank of Korea law in late 1997 to adopt inflation targeting and to explicitly announce the target rate of inflation. The Bank introduced a system of monetary policy operations in which a target of inflation was made public and the growth rate of M3 was the operational target similar to the two-pillar system of the European Central Bank.

Although the Bank of Korea did not need to consult the IMF in deciding the target rate of growth of M3 from 1999, the Bank kept the two pillar system setting the target rate of growth of M3, because it was concerned about possible confusion in financial markets a sudden dropping of M3 cold cause. For the two years beginning in 2001, a target M3 growth rate was not set, but only monitored. Since 2003, the monitoring of M3 growth was brought to an end. This change has completed the transition from the two-pillar to a pure inflation targeting system.

[2] Required reserves were imposed on CD.

II.2. Interest Rate as an Operational Target

There had been a debate on whether the interest rate could be a more reliable operational target than a monetary aggregate since mid 1990s. However, it was only after the 1997-98 financial crisis that the interest rate was accepted as an operational target. The BOK used the interest rate as an explicit operational target on September 30, 1998, when it lowered the call money market interest rate from 8.1% to 7%. Since 1999, the BOK's Monetary Policy Committee (MPC) has indicated the general direction of monetary policy by announcing the target call rate.

II. 3. Inflation Targeting

During the early years of inflation targeting (1998-1999), the CPI inflation rate was adopted as the benchmark indicator because it was familiar to the Korean Public and the IMF policy conditionality required such an adoption. From 2000, the underlying or core CPI inflation rate has been chosen as the benchmark inflation indicator, which leaves out the prices of petroleum and agricultural products except cereals. One of the major reasons for excluding these prices is that it is difficult to control them by an aggregate demand policy such as monetary policy and these prices are greatly affected by exogenous factors including the international price of oil and the weather.

The target inflation rate has been determined annually in consideration of expected changes in domestic and international economic as well as financial market conditions. The target range of ±1% is allowed to take into account various economic uncertainties. In 1998, the initial year of inflation targeting, the target had been set at 9±1%, but lowered to 3±1% in 1999 and again to 2.5±1% in 2000 before being raised to 3±1% in 2001. Since 2000, the Bank of Korea has announced a medium-run inflation target to account for the lag in monetary policy. The medium-run target was 2.5% and 2.5-3.5% for 2002 and 2003 respectively. For the 2004-2006 period, the medium-run inflation target was set at 2.5-3.5%.

In setting the call rate target every month, the Monetary Policy Committee follows the look-at-everything approach that monitors movements of many variables such as production, demand, prices, real estate prices, the GDP gap, NAIRU, and the P* ratio.[3] In addition to price stabilization, economic growth, balance of payments, and financial market stability are also important objectives of monetary policy. In this sense

[3] P* ratio is the ratio of the long-run equilibrium price level to the current price level.

"flexible" inflation targeting rather than strict inflation targeting and an eclectic approach characterize Korea's monetary policy. Like Greenspan's baby steps, the target call rate is adjusted gradually (0.25-0.5%) and when set, open market operations are carried out to keep the rate closer to the target.

In the past, much of the monetary policy process was kept in secret, but since the introduction of inflation targeting monetary policy operations have become much more transparent than before. The Monetary Policy Committee announces the direction of monetary policy as soon as a decision is reached. The chairman publicly explains the content and background of the decision in detail. The monetary policy report is submitted to Congress every year. In addition, the chairman, monetary policy committee members, and other relevant officials try to inform the public on pending monetary policy issues and future policy directions through various means such as public addresses, interviews, and conferences.

III. How Successful has Inflation Targeting been?

III.1. Basic Statistics

One of the easiest ways to evaluate inflation targeting is to examine whether the actual inflation rate has remained closer to or within the range of the target. Figure 1 shows the rates of CPI and core inflation rates as well as the ranges of the target since 1997. The vertical line indicates the starting date of inflation targeting (the second quarter of 1998). The inflation rates shown in Figure 1 are annualized quarterly rates. During the initial years of inflation targeting (1998-1999) when the CPI was used as the benchmark index, actual inflation rates were higher than the target rates. Beginning in 2000 when the core CPI inflation rate was chosen as the benchmark, actual inflation rates have been closer to the target ranges, but in a quite a few instances they moved out of the ranges.

Based on this record, inflation targeting does not appear to have been much successful. However, under inflation targeting, the central bank does not have to keep a short-term inflation rate such as a quarterly inflation rate within the range. Rather, the central bank tries to keep inflation within the target range over a longer horizon. Therefore, to provide a better picture of how successful inflation targeting has been, it is more instructive to observe changes in the annual inflation rate on a monthly basis as shown in Figure 2. The vertical line indicates the starting month of inflation targeting (April 1998). During the initial period of inflation targeting when CPI inflation was

used as the benchmark (1998-1999), actual CPI inflation rates were often outside of the target ranges. However, since 2000 when core CPI inflation was used as the benchmark, the actual core CPI inflation rate has been mostly within the range of the target. That is, in about two years after the adoption of inflation targeting, the Bank of Korea was able to keep inflation within the range.

In Figures 1 and 2, it is seen that the average rates of inflation have come down since the introduction of inflation targeting. In addition, the volatility of inflation has decreased. To examine further these developments, the sample means and standard deviations of inflation before and after inflation targeting are estimated. The two different periods before inflation targeting are the 10-year period from 1987 to 1996 and the seven- year period from 1990 to 1996. In both cases, 1997 and 1998 are excluded from the samples to eliminate the bias caused the financial crisis and the announcement on inflation targeting. For inflation targeting, the two periods that are considered are one from April 1998 to August 2005 and the other from January 1999 to August 2005. Again 1998 is excluded in the latter period to avoid the after effects of the financial crisis and to account for the fact that prices increases in 1997 (when inflation targeting was neither announced nor adopted) are counted in measuring the annual inflation rates in 1998 when monthly data are used.

Table 2 confirms that the inflation rate has been lower and less volatile during the periods of than prior to inflation targeting. Note that the reduction in the sample mean and volatility of inflation tends to be larger for the core than the CPI inflation rate, which is related to the fact that the Bank of Korea targeted the core CPI inflation rate during the periods of inflation targeting. From these simple plots and data, the BOK was able to bring down and keep inflation within the target range after a few years of learning.

However, the lower mean and volatility of inflation may not necessarily have been the consequences of successful inflation targeting. Weaker and less frequent shocks that change the rate of inflation may have been responsible for its lower volatility while slow growth may have been responsible for its lower rate. In order to shed light on causes of the lower and less volatile inflation rate during the periods of inflation targeting, first time series models of inflation are estimated to examine the relative role of the size and propagation of inflationary shocks in explaining the volatility of inflation. If the size of the shocks was smaller during rather than prior to the periods of inflation targeting, it is difficult to conclude that the reduction in the volatility of inflation is a result of inflation targeting. Second, data on inflation expectation are used to investigate how the private sector adjusts its expectations on inflation under

inflation targeting.

III.2. Inflation Persistence and Inflation Shocks

. To the extent that policy operations of the monetary authority to achieve the target inflation are perceived to be credible, economic agents may respond less sensitively to inflation shocks as they are less likely to change their expectation on inflation rates. This section first examines the persistence of inflation. Then, simple time series models are estimated to examine the relative role of shocks to inflation and propagation of these shocks in generating inflation volatility. This examination may explain the relative role of monetary policy and the size of inflation shocks in reducing inflation volatility during the periods of inflation targeting. For example, if the decrease in the inflation volatility is mostly due to the decrease in the size of the inflation shocks, then one cannot conclude that inflation targeting has been effective.[4]

Table 2 reports auto-correlation of the two inflation rates. For the quarterly inflation data, the fourth quarter auto-correlations are lower during the periods of inflation targeting in the case of CPI inflation than those during the periods before inflation targeting, although they are similar in the case of core CPI inflation. For the annual inflation rates on a monthly basis, the auto-correlations at most horizons are lower during the periods of than prior to inflation targeting. The reduction in the auto-correlation tends to be larger for longer horizons. Overall, the persistence of inflation is lower during the periods of inflation targeting.

As for the relative role of shocks to inflation and their propagation, an univariate AR process for inflation of the following form is estimated:

$$(1) \qquad \pi_t = \mu + \sum_{j=1}^{K} \alpha_j \pi_{t-j} + \varepsilon_t$$

where π_t is inflation rate at time t, μ and α_j are constants, and ε_t is a serially uncorrelated error term, which is interpreted as shocks to inflation. The order (K) of the AR process is determined by the Akaike criterion. The total variance of inflation can be decomposed into the part due to inflation shocks ε_t and another part due to the propagation of inflation shocks.

Table 3 reports the standard deviations of inflation shocks (under “Shocks”), the

[4] Levin, Natalucci, and Piger (2004) used similar methods.

standard deviations of inflation due to the propagation of inflation shocks (under "Propag"), and the ratio of the variance of inflation shocks to the variance of inflation (under "Ratio"). Both the size of inflation shocks and the standard deviation of inflation due to propagation of inflation shocks decrease during the periods of inflation targeting, but the decrease in the size of the standard deviation of inflation due to the propagation of inflation shocks is larger than that of inflation shocks itself. This finding suggests that the reduction in inflation volatility is not mainly due to the decrease in shocks to inflation. This finding may be taken as evidence that inflation targeting has contributed to reducing the volatility of inflation. However, it should be noted that the time series model does not show why and through what process inflation targeting has been effective in reducing the volatility of inflation. All can be said is that the public had confidence in the ability and determination of the monetary authority in stabilizing prices. But this conclusion begs the question as to why the public came to trust the words of the monetary authority so much after the introduction of inflation targeting

III.3. Inflation Expectation

Under inflation targeting, it is important that the monetary authority maintain transparency of the conduct of its monetary policy. As summarized in Section II, the BOK has tried to improve its transparency by communicating with the private sector. If firms and households believe that the monetary authority will be able to sustain price stability, their expectations on inflation may become less sensitive to changes in actual inflation. For example, in response to inflationary shocks, the private sector would not change its inflation expectations it would under different circumstances, if inflation targeting convinced the private sector that inflationary shocks would be countered and hence lead to a weaker inflationary outcome.

To examine this possibility, the following equation is estimated:

$$(4) \qquad \Delta\pi^{e}_{t,t+q} = \lambda + \beta\Delta\pi_{t-k,t} + \varepsilon_t$$

where $\pi_{t-k,t}$ is the inflation rate(CPI) from time t-k to t, $\pi^{e}_{t,t+4}$ is an expectation of inflation from time t to t+4 formed at time t. Coefficient β shows the sensitivity of changes in inflation expectations to changes in inflation. The data on inflation expectations are obtained from the quarterly KDI economic outlook. The estimation

takes 1, 2, 3, and 4 for the expectation horizon q and 4 and 8 for the actual inflation horizon k. The two estimation periods are chosen: 1999-2005:2 (2000-2005:2 for k=8) for the period of inflation targeting and 1987-1996 for the period before. CPI inflation is chosen as the dependent variable because of the lack of expectation data on core inflation.

Table 4 (1) reports estimated values of β. '*' and '**' show that the estimates are significant at 10% and 5% levels, respectively. It can be seen that the estimated β is smaller for the period of inflation targeting than for the period before. The estimates are often not statistically significant, but there are more cases where they are significantly different from zero at the 10% level during the period before than after inflation targeting. This finding suggests that inflation expectations were more sensitive to changes in actual inflation in the period before than after inflation targeting.

To examine the robustness of the results, changes in the output growth rate is included as an additional regressor to control the effect of changes in the real sector of the economy on inflation expectations... For this purpose the following equation is estimated:

(5) $$\Delta\pi^{e}_{t,t+q} = \lambda + \beta\Delta\pi_{t-k,t} + \gamma\Delta yg_{t-k,t}\varepsilon_t$$

where $yg_{t-k,t}$ is the growth rate of real GDP from t-k to t.

Table 4 (2) reports estimates of β. The main conclusion does not change. Changes in inflation expectations respond less to changes in actual inflation during the periods of than before inflation targeting. The sample mean and volatility of inflation dropped during the period of inflation targeting. A decrease in the size of inflation shocks explains a small part of the drop in inflation volatility. The persistence of inflation also fell, and the drop in inflation volatility is mostly due to the changes in the propagation of inflation shocks. The sensitivity of changes in inflation expectations to changes in actual inflation rates is lower during the periods of inflation targeting.

However, these pieces of evidence do not necessarily prove that inflation targeting has been successful, unless one can show the process through which inflation targeting has been effective. It is possible that the introduction of inflation targeting has contributed to lowering inflationary expectations by publicly setting the target range of inflation. This argument might hold, if the public understood the mechanism of inflation targeting and believed in the resolve of the central bank to sustain price stability. For a long time before 1999, the public had paid little attention to the policy announcements

and had had little confidence in the ability of the monetary authorities in controlling inflation. It will be therefore difficult to argue that the mere introduction of the new system was able to convince the public that the monetary authorities would be able to meet the target rate of inflation from the first year of inflation targeting. At the same time, since 2001 the monetary authority has placed more emphasis on reviving domestic demand and thus has maintained an expansionary stance of monetary policy, which may not have anchored inflation expectation as firmly as our results suggest.

IV. Monetary Reaction Function

This section analyzes the relative importance the monetary authority has attached to controlling inflation and to stabilizing output during the period of inflation targeting in their conduct of monetary policy. First, raw data and facts are examined and then a formal analysis of estimating the monetary reaction function of the BOK follows.

IV.1. Facts and Data

Figure 3 shows the call money rate and annualized inflation rates (using monthly data). As discussed earlier, the rates of inflation measured by the CPI and core CPI were relatively stable during the periods of inflation targeting, but the call money rate was even more stable. But this simple graphical representation may not provide a clear picture of the BOK's policy reactions since the target range of inflation has changed over time and so has the target rate of inflation (from the CPI inflation rate to the core CPI inflation rate). To adjust for these changes, deviations of the actual from the target rates of inflation are calculated.

Figure 4 shows the call money rate and deviation of inflation from the target for the period of 1999-2005. The left scale is for inflation while the right scale is for the call money rate. Changes in these two variables in Figure 4 raise some questions as to whether monetary policy has been conducted in a manner consistent with actual and expected movements in the price and other macroeconomic variables. There was weakening of inflation pressure in 1999, but the monetary authority allowed a sharp rise in the interest rate. During the period of the IT bubble in 2000, the BOK appeared to have overacted by letting the interest rate to rise above 6 percent, which was too high. Since 2001, there has been a clear declining trend in the deviation of inflation from the target. The Korean economy has also suffered from a lack of domestic demand that has

resulted in slow growth of output. Yet until the early months of 2000, the interest rate remained at a high level on average, fluctuating between 5 and 5.5 percent. In retrospect one might argue that the monetary authority should have been more aggressive in reviving the economy than controlling inflation

IV.2. Estimating Monetary Reaction Function

In order to examine further the conduct of monetary policy in response to changes in inflationary pressure output gap, this section estimates a monetary reaction function of the BOK based on the monetary policy rule of Clarida, Gali, and Gertler (1998 and 2000). This reaction function allows for interest rate smoothing or gradual changes in the interest rate, which is an important feature of the monetary policy in Korea.

The following form of the monetary policy rule is estimated.

$$(2) \qquad r_t = (1-\rho)\alpha + (1-\rho)\beta\left(E\left[\pi_{t+n} - \pi_t^* \mid \Omega_t\right]\right) + (1-\rho)\gamma\left(E\left[y_t - y_t^* \mid \Omega_t\right]\right) + \rho r_{t-1} + \varepsilon_t$$

where r_t is the nominal interest rate, π_{t+n} is the rate of inflation between periods t and t+n, y_t is real output, π_t^* is the target rate of inflation, y_t^* is the potential output, E is the expectation operator, Ω_t is information available to the central bank at the time it sets the interest rate, ρ captures the degree of interest rate smoothing, β and γ measures the strength of the response of the central bank to any deviation from the target inflation rate and change in the output gap.

As discussed in Clarida, Gali, and Gertler (1998, 2000), equation (2) implies the following set of orthogonality conditions that can be exploited for estimation:

$$(3) \qquad E\left[r_t - (1-\rho)\alpha - (1-\rho)\beta\left(\pi_{t+n} - \pi_t^*\right) + (1-\rho)\gamma\left(y_t - y_t^*\right) + \rho r_{t-1} \mid u_t\right] = 0$$

where u_t include any lagged variables that help forecast inflation and output, as well as any contemporaneous variables that are uncorrelated with shocks to the interest rate smoothing equation.[5]

[5] Refer to Clarida, Gali, and Gertler (1998, 2000)

Equation (2) is estimated by Generalized Methods of Moments, following Clarida, Gali, and Gertler (1998, 2000) for the period of 1999-2005:8.[6] Monthly data is used since the estimation period is relatively short. Industrial production represents output, and the output gap is obtained by applying the HP filter. In this estimation, the actual rate of inflation is used as a proxy for the target. The inflation rate for 1999 is the rate of change of the CPI and thereafter core CPI inflation.

The results are reported in Table 4. The estimated value of β is 1.58, which is positive and significantly different from zero. This result suggests that the BOK adjusts interest rates in response to changes in inflationary pressure. The estimated value of β, which is greater than one, also implies that the BOK is prepared to make larger changes in the interest rate to bring about equally large changes in the real interest rate that may be necessary to stabilize prices. The estimate of γ is 0.32, which is statistically significant, implies that the policy objectives of the BOK also include stabilizing the output gap.

V. Channels and Effects of Monetary Policy

V.1. Policy Developments

Changes in the call money rate that the BOK controls send signals to financial markets as to the direction of monetary policy. The changes in the call money rate are then expected to change the behavior of financial institutions in their lending and firms and households in their spending. As discussed in Section III.3, the BOK pursues not only the price stability, but also output stability. Since the late 2000, the monetary authorities have been sending a clear signal to the market that they are prepared to pursue an expansionary monetary policy to the extent that such a policy does not endanger price stability. Although the BOK has tried to stabilize the output gap by adjusting its operational instrument, the call money rate, it is not clear whether the BOK's monetary operations have exerted significant effects on aggregate demand and if that have through what channels of monetary policy. In this section, we discuss whether the monetary policy actions of the BOK have an influence on the real economy effectively and how the monetary policy affects the real economy.

The channels of monetary policy in the setting of inflation targeting are rather straightforward. A cut in the call money rate would under normal circumstances lead to

[6] For instruments, a constant, 1, 2, 3, 4, 5, 6, 9, 12 lags of the interest rate, CPI inflation rate, core CPI inflation rate, and IP are used.

lower rates of interest in financial markets, which would in turn stimulate investment and consumption. Figure 7 shows call money rate, the yield on a 3-month corporate bond, 3-year corporate bonds with an AA- rating, 1-year treasury bonds, 3-year treasury bonds, and 5-year treasury bonds from 1999. Over the long run, these interest rates move together with the call money rate. Correlations of the yield on the 3-month corporate bond, 3-year corporate bonds with an AA- rating, 1-year treasury bonds, 3-year treasury bonds, and 5-year treasury bonds with the call money rate are 0.95, 0.88, 0.88, 0.83, and 0.81, respectively. As the call money rate decreased from the late 2000, so did other interest rates.. For example, the yield on 3-year corporate bonds with an AA- rating decrease fell off from about 8% to below 5% in recent periods. It is also clear that the real interest rate declined during this period since the inflation rate was relatively stable.

On the other hand, movements of these interest rates digress substantially from those of the call money rate in the short-run as shown in the Figure 6. Correlations of the differences between the yields on 3-month corporate bond, 3-year corporate bonds with an AA- rating, 1-year treasury bonds, 3-year treasury bonds, and 5-year treasury bonds on the one hand and the call money rate on the other are 0.45, 0.05, 0.26, 0.12, and -0.01 in the short run respectively

After a sharp rise in 2001 and 2002, however, the rate of growth of M3, a measure of liquidity of the economy, has also slowed down since 2003, and so have the rates of growth of M1 and M2 (Figure 8). By looking at changes in the interest rates and monetary aggregates, the monetary authority might have not been aggressive enough in stimulating domestic demand. It is possible that the contraction of domestic demand caused by non-monetary factors has been so strong that it has offset the monetary expansion to reduce the aggregate demand for credit by firms and households to result in a decrease in the interest rate and lowering the rates of change of monetary aggregates.

This possibility is somehow backed up by the saving and investment behavior of firms. In recent years, the flow of funds estimated by the BOK shows that the business sector has been a net savor of the economy. When they are sitting on huge amounts of retained earnings, it is not surprising that a small change in the call rate will have no effect on their investments. Although the available evidence is sketchy, it appears that business firms have invested their savings in stocks and real estate on a large scale, thereby becoming a major source of asset speculation and inflation. Should the BOK have lowered the call rate further until they observed a pick up in the economy? In this regard, the Japanese experience with monetary policy that has lowered

the interest rate to zero is instructive. It indicates the possibility that any further monetary expansion may push the economy into a liquidity trap even in Korea.

For large firms, in particular those belonging to Korea's industrial groups, have developed access to international financial markets; a marginal increase in the call money rate is not likely to affect their investment behavior to the extent that they can raise funds on international financial markets at a lower rate.

It is also unclear as to whether the lower interest rate that has prevailed has exerted expansionary effects on capital investment. Figure 9 shows the growth rates of real fixed investments, real private consumption, and real GDP. The growth rate of real fixed investment picked up for two years from 2001, but it was still low, and investment has overall remained stagnant since the 1997-98 crisis.

In many economies, in particular advanced ones, monetary policy mostly works through the markets for housing, commercial buildings, other real estate, and financial assets. The lower interest rates have fueled speculation in markets for real estate and equities, thereby accelerating asset inflation. The housing prices have risen on average about 30% since 2001. However, a series of measures including imposition of heavy taxes and administrative control on trading and holding real estate have squelched a further boom in the real estate markets.

Figure 10 reports the log of housing prices multiplied by 100 that depicts the booming housing market. Stock prices jumped up by about 70% from 2001 shown in Figure 11 in term of the log of stock prices multiplied by 100. Although the stock market and housing boom could have produced a significant wealth effect to induce consumption spending, banks and other non-bank financial institutions have been reluctant to extend loans to households in the aftermath of the credit card crisis in 2001 and 2002, which may have contributed to a very low level of consumption growth in 2003 and 2004 (Figure 9).

It is often pointed out that monetary expansion, among other factors, has created a bubble in the real estate market. When asset market speculation accelerates, the expansionary effects of monetary policy are likely to be visible. The bubble will in turn help increase capital investment and consumption spending, but it will eventually burst, inflicting a serious damage on the economy. Policy authorities may then need to step in to curb the speculation, thereby reducing the effects of expansionary policy, which the Korean policy makers did by imposing heavy taxes and administrative control on trading and holding real estate. In some respect, the Korean policymakers have been contradictory in managing macroeconomic policies. While pursuing expansionary monetary policy, they have also blocked off one main channel of

monetary policy, the housing market channel.

V. 2. VAR Analysis

This section examines the effects and the transmission channels of monetary policy in term of the VAR methodology.[7] The structure of the VAR model under consideration is similar to the one developed by Christiano, Eichenbaum, and Evans (1999), which has been one of the most widely used methods of identifying monetary policy shocks.[8] As the basic model, a four- variable recursive VAR system is constructed. The data vector is {IP, CPIC, CR, MB}, where IP is the log of industrial production, CPIC is the core Consumer Price Index, CR is the call money rate, and MB is the monetary base.

The core CPI, instead of the CPI, is used since the BOK targeted the core CPI for most of the sample period. The call money rate is the operational instrument of monetary policy during the sample period. Following Christiano, Eichenbaum, and Evans (1999), a measure of a monetary aggregate is also included. The ordering is {IP, CPIC, CR, MB} where contemporaneously exogenous variables are ordered first, and monetary policy shocks are identified as shocks to the operational instrument, the call money rate. The sample period is from 1999 to 2005:8. A constant term is included in the model. Two lags are chosen based on Akaike criterion.[9] Figure 12 shows the impulse responses to monetary policy shocks with a 68% error band in the basic model over a 24-month horizon. On the top of each graph, the names of the responding variables are denoted.

In response to typical shocks to monetary policy, the call money rate moves up by about 0.7% first and then rises again by about 0.9% in the next month. Then, the rate decreases over time and is back at the initial level in about 9 months. The monetary base decreases on impact by about 0.45%, and then falls further by 0.65% in about 3-5 months. Thereafter it continues to fall for the next two years or so.

Industrial production falls off to a maximum of about 0.33% in about six months, and then returns to the initial level in about 15 months or so. The core CPI gradually decreases over time until it turns up about three years later. In general, these responses are not inconsistent with the textbook effects of monetary policy actions,

[7] Leeper, Sims, and Zha (1996) and Christiano, Eichenbaum, and Evans (1999) provide a good summary of the literature.
[8] For example, Christiano, Eichenbaum, and Evans (1996,2004) and Kim (2001) used similar identification methods.
[9] For the effects of monetary policy shocks during the period before inflation targeting, refer to Kim (1999) that used a structural VAR model.

except that the effects of monetary policy on the real variables disappear soon after the policy change.

In order to examine the channels of transmission of monetary policy shocks, the basic model is extended to construct a five-variable model. The data vector is {IP, CPIC, CR, MB, X}, where X is an additional variable to infer the transmission mechanism. The model is then estimated to examine: the responses of various interest rates including longer-term interest rates to the changes in the call money rate; the responses of various monetary aggregates such as M1, M2, and M3 to examine the extent to which changes in monetary policy affect credit conditions of the economy; changes in asset prices such as housing and stock prices; and finally the responses of business fixed investment and retail sales.

Figure 13 shows the impulse responses of various interest rates such as the yield on a 3-month corporate bond, 3-month CD, 3-year corporate bonds with an AA-rating and 5-year treasury bonds from 1999. On impact, short-term interest rates such as the yields on a 3-month corporate bond and 3-month CD rise in the short-run. In about three months, the yields on a 3-month corporate bond and 3-month CD increase by 0.075 and 0.06 % respectively. On the other hand, the responses of the long-term rates are not significantly different from zero. The call money rate shocks do not last very long. This may explain why the long-term rates do not respond and why the real effects of monetary policy peter out in a short period of time.

Figure 14 shows the responses of monetary aggregates to a change in the call money rate. M1 declines by about 0.6 % in five months, but the responses of M2 and M3 move very little, if any. Figure 15 depicts the responses of business-fixed investments, retail sales, housing prices, and stock prices. Business-fixed investments decrease sharply in the short run. The maximum effects of 1% drop are observed in about four months. Retail sales also decrease sharply in the short run. The maximum effect of about 1.8% drop is found in about five months. The housing prices do not change but the stock price declines significantly. Probably due to various regulations and control on the housing market, housing prices do not change much.

The results of the VAR analyses are inconclusive and should be taken with some caution as to both the channels and effects of monetary policy changes because some results do not seem consistent with conventional effects of monetary policy. For example, the sharp short-run response of business investment to the monetary shock, although the long-term interest rates do not move, which is not easy to be explained by the standard theory on the effects of monetary policy.

VI. Concluding Remarks

The pieces of empirical evidence presented in this paper lead to the conclusion that inflation targeting in Korea has been effective in sustaining price stability. However, this conclusion requires qualifications. Although the empirical evidence tends to support that the size of inflation shocks has not been the main cause of the reduction in inflation volatility and that inflation expectations have become less sensitive to inflation shocks, the empirical examination does not prove that the targeting has been responsible for these developments. This is because one cannot ignore other developments that they may have weakened inflationary pressure more than the targeting itself.

First, as noted earlier, the economic environment of Korea has been favorable for stable inflation. During the most part of inflation targeting, the Korean economy has suffered from a lack of domestic demand, which has in turn suppressed inflationary pressure. In addition, the appreciation and stability of the Korean Won against the US dollar has also clearly stabilized import prices, and in turn, helped to keep the inflation rate low. At the same time, wage increases have been modest, and international prices of imported goods have in fact declined. In the future when the Korean economy starts to recover and faces stronger inflationary pressure, the new monetary policy framework in Korea will go through the real test.

Second, although we did not discuss international or open economy perspectives in this paper, Korea is considered a small open economy where the exchange rate policy constitutes an important part of monetary policy in Korea. Recent changes in international economic linkages of the Korean economy may put the inflation targeting to a real test for its effectiveness.

Among other developments trade liberalization has limited the scope for controlling core inflation in Korea. Prices of tradables, which account for substantial part of the index measuring core inflation, are mostly exogenous to an open economy like Korea's and changes in the prices of non-tradables are likely to be dictated by changes in nominal wages. Korea has developed an open trade regime in which imports of a large number of goods and services whose prices constitute the core CPI index are subject to low rates of tariffs and other non-tariff barriers. As a result, an expansion of domestic demand for tradables that is not met by domestic suppliers is easily satisfied by their imports; there is little room for domestic prices of tradables to deviate from their international levels especially when the nominal exchange rate is stable.

In this case, monetary policy works through the non-tradable sector of the

economy in influencing core inflation. Prices of tradables in China and Japan, the two major sources of Korea's imports, have moved little if not declined in recent years. Nominal wages of regular employees in manufacturing have been rising at an annual rate of almost ten percent since 2001. Assuming wage increases in the non-tradable sector keep pace with those of the tradable sector, it might be reasonable to argue that most of the increase in core inflation has come from the wage increases. In the future when there is more inflationary pressure originating in the non- tradable sector, it may be far more challenging for the BOK to keep the inflation target.

It is also widely known that the monetary authorities of Korea have intervened in the foreign exchange market and controlled capital movements to stabilize the nominal exchange rate. This policy of maintaining the exchange rate in effective term stable has generated and necessitated sterilization of trade surpluses. This has meant that the monetary authority has operated its monetary policy in a framework of two nominal anchors.

Since 2001 when the IT bubble burst, there has been contraction of domestic demand. In the absence of any inflationary pressure, Korea's policy makers have found room for undertaking expansionary monetary and fiscal policy to revive the weakening economy. Therefore the monetary authority has been able to accommodate an exchange rate policy that has been geared to stabilizing a nominal exchange rate in effective term that has in turn necessitated the sterilization of surpluses on both the current and financial accounts. The surplus has not been fully mopped up and the instrument of sterilization has been monetary stabilization bonds, many of which have had maturity less than three months and hence are good substitutes for M3. Stabilization of the exchange rate has therefore been supportive of the expansionary stance of monetary policy.

However, when the economy is overheated and tightening of monetary policy is called for, the two-anchor system may break up. The tighter monetary policy may induce capital inflows and may not deteriorate the current account much if it reduces import demand and policy authorities try to prevent the exchange rate from appreciation. An exchange rate policy that attempts to stabilize the nominal effective exchange rate will necessitate the sterilization of capital inflows, which will frustrate the efforts of the monetary authorities in managing a tighter monetary policy.

To the extent that the monetary authorities operate an intermediate exchange rate regime, they cannot fully liberalize the capital account unless they are prepared to give up monetary policy. The interest rates in Korea have not deviated by any substantial degree from those prevailing in financial markets of its major trading partners. While

restricting the range of movement of the nominal exchange rate, the monetary authorities could push down the market interest rates probably because capital account transactions can be controlled. However, given many legal and illegal routes through which capital moves in and out of the country, there is likely to be a limit to which any difference in the interest rates in domestic and international capital markets can be maintained.

Does the preceding argument mean that Korea should adopt a standard model of inflation targeting with free floating and capital account liberalization or its variant for a framework of monetary policy? If Korea continues with an intermediate regime, not free floating, it will have to retain capital controls. Even then the open trade regime will reduce the scope of monetary policy. Sooner or later the public may realize the limit of the ability of the monetary authorities in controlling inflation. The announcement of the target range of core inflation has then the danger of falling on deaf ears, thereby making inoperative the expectation channel.

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Table 1. Sample Mean and Standard Deviation of the Inflation Rate

(1) Mean

	Quarterly Rate (Quarterly)		Annual Rate (Monthly)	
	CPI	Core CPI	CPI	Core CPI
1987-1996	6.0	5.6	5.9	6.2
1990-1996	6.1	5.8	5.6	5.9
1998:4-2005:8	2.7	2.4	3.2	2.7
1999-2005:8	2.9	2.6	2.8	2.4

(2) Standard Deviation

	Quarterly Rate (Quarterly)		Annual Rate (Monthly)	
	CPI	Core CPI	CPI	Core CPI
1987-1996	3.2	3.0	1.9	1.6
1990-1996	3.6	3.2	1.8	1.5
1998:4-2005:8	2.3	1.8	1.7	1.1
1999-2005:8	2.3	1.6	1.4	1.1

Table 2. Autocorrelation

(1) Quarterly Inflation Rate (Quarterly Data)

	CPI				Core CPI			
Quarter	1	2	3	4	1	2	3	4
1987-1996	0.07	-0.23	0.12	0.51	0.14	-0.28	0.06	0.51
1990-1996	0.13	-0.16	0.10	0.61	0.23	-0.28	0.02	0.65
1998:2-2005:2	-0.02	-0.06	0.05	0.28	0.25	-0.09	0.13	0.46
1999-2005:2	-0.11	-0.16	-0.10	0.20	0.23	-0.20	-0.04	0.50

(2) Annual Inflation Rate (Monthly Data)

	CPI				Core CPI			
Month	1	3	6	12	1	3	6	12
1987-1996	0.95	0.84	0.67	0.15	0.96	0.85	0.70	0.38
1990-1996	0.96	0.87	0.78	0.43	0.97	0.89	0.81	0.60
1998:4-2005:8	0.93	0.70	0.35	-0.40	0.97	0.80	0.44	-0.39
1999-2005:8	0.91	0.75	0.53	0.09	0.97	0.87	0.65	0.14

Table 3. Inflation Volatility due to Inflation Shocks

(1) Quarterly Inflation Rate (Quarterly Data)

	CPI Inflation Rate			Core CPI Inflation Rate		
	Shocks	Propag	Ratio	Shocks	Propag	Ratio
1987-1996	3.0	1.2	0.86	2.6	1.5	0.75
1990-1996	2.9	2.1	0.66	2.2	2.4	0.45
1998:4-2005:8	2.4	0.0	1.00	1.6	0.9	0.74
1999-2005:8	2.3	0.0	1.00	1.6	0.3	0.97

(2) Annual Inflation Rate (Monthly Data)

	CPI Inflation Rate			Core CPI Inflation Rate		
	Shocks	Propag	Ratio	Shocks	Propag	Ratio
1987-1996	0.6	1.8	0.09	0.4	1.5	0.07
1990-1996	0.5	1.7	0.07	0.3	1.4	0.05
1998:4-2005:8	0.5	1.6	0.11	0.3	1.4	0.06
1999-2005:8	0.4	1.0	0.15	0.3	1.1	0.06

Table 4. Sensitivity of Changes in Inflation Expectation to Changes in Inflation Rate

(1)

	1987-1996		1999-2005	
	k=4	k=8	k=4	k=8
q=1	0.48* (0.27)	0.77 (0.55)	0.05 (0.13)	0.42 (0.25)
q=2	0.34 (0.23)	0.91* (0.50)	-0.03 (0.10)	0.29 (0.17)
q=3	0.28 (0.24)	1.02* (0.51)	0.02 (0.88)	0.32* (0.15)
q=4	0.28 (0.28)	1.10* (0.59)	0.04 (0.10)	0.32* (0.15)

(2)

	1987-1996		1999-2005	
	k=4	k=8	k=4	K=8
q=1	0.43* (0.24)	0.81 (0.53)	-0.03 (0.19)	0.48 (0.16)
q=2	0.35 (0.24)	0.93* (0.51)	0.01 (0.15)	0.43* (0.21)
q=3	0.31 (0.25)	1.05* (0.52)	0.08 (0.14)	0.46** (0.19)
q=4	0.36 (0.29)	1.12* (0.61)	0.12 (0.14)	0.46** (0.19)

Table 5. Estimated Monetary Reaction Function

	ρ	α	β	γ
Point Estimate	0.915	4.24	1.58	0.32
Standard Error	0.007	0.06	0.29	0.04

Figure 1. Inflation Rates (Quarterly Inflation Rate using Quarterly Data)

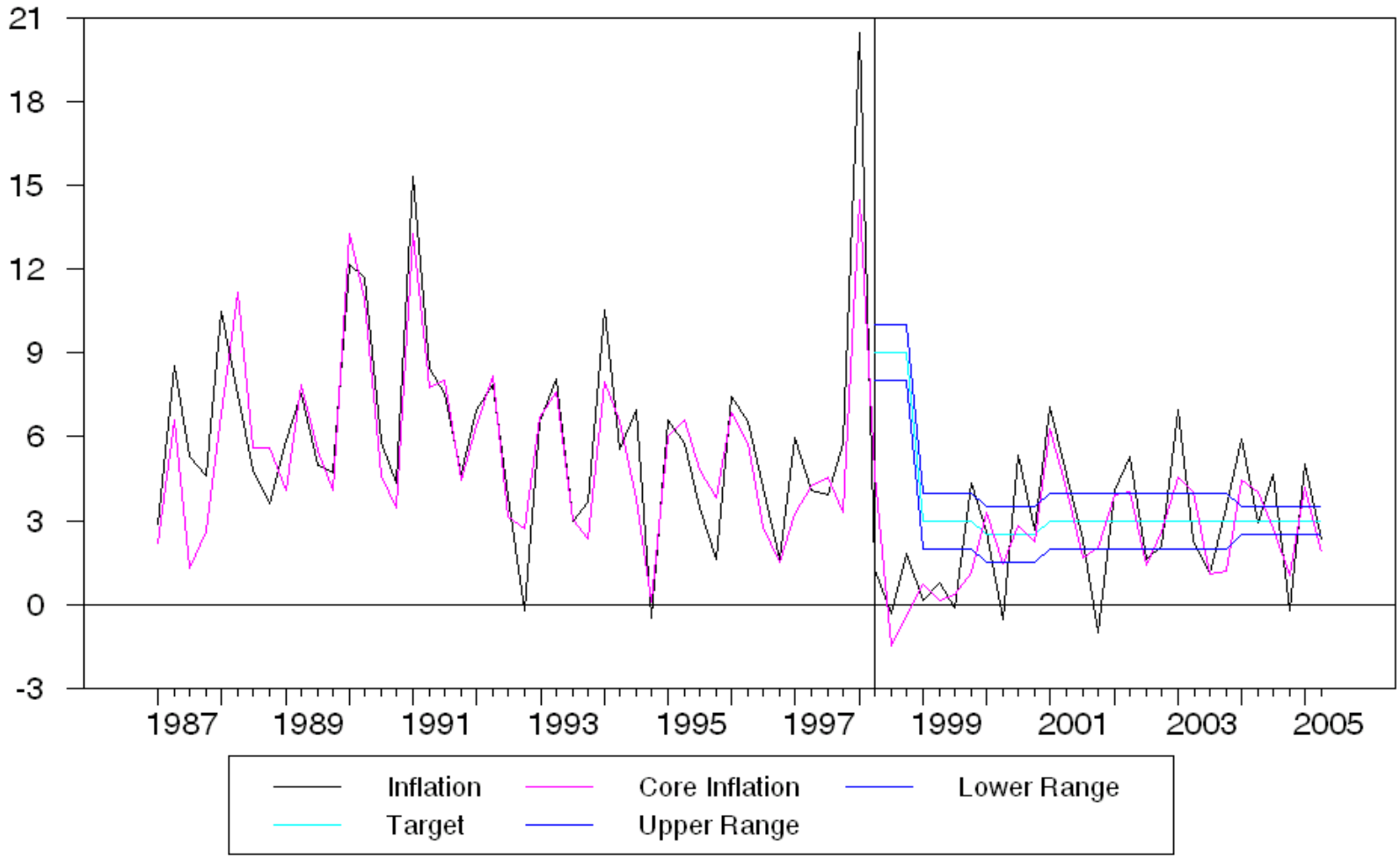

Figure 2. Inflation Rate (Annual Inflation Rate using Monthly Data)

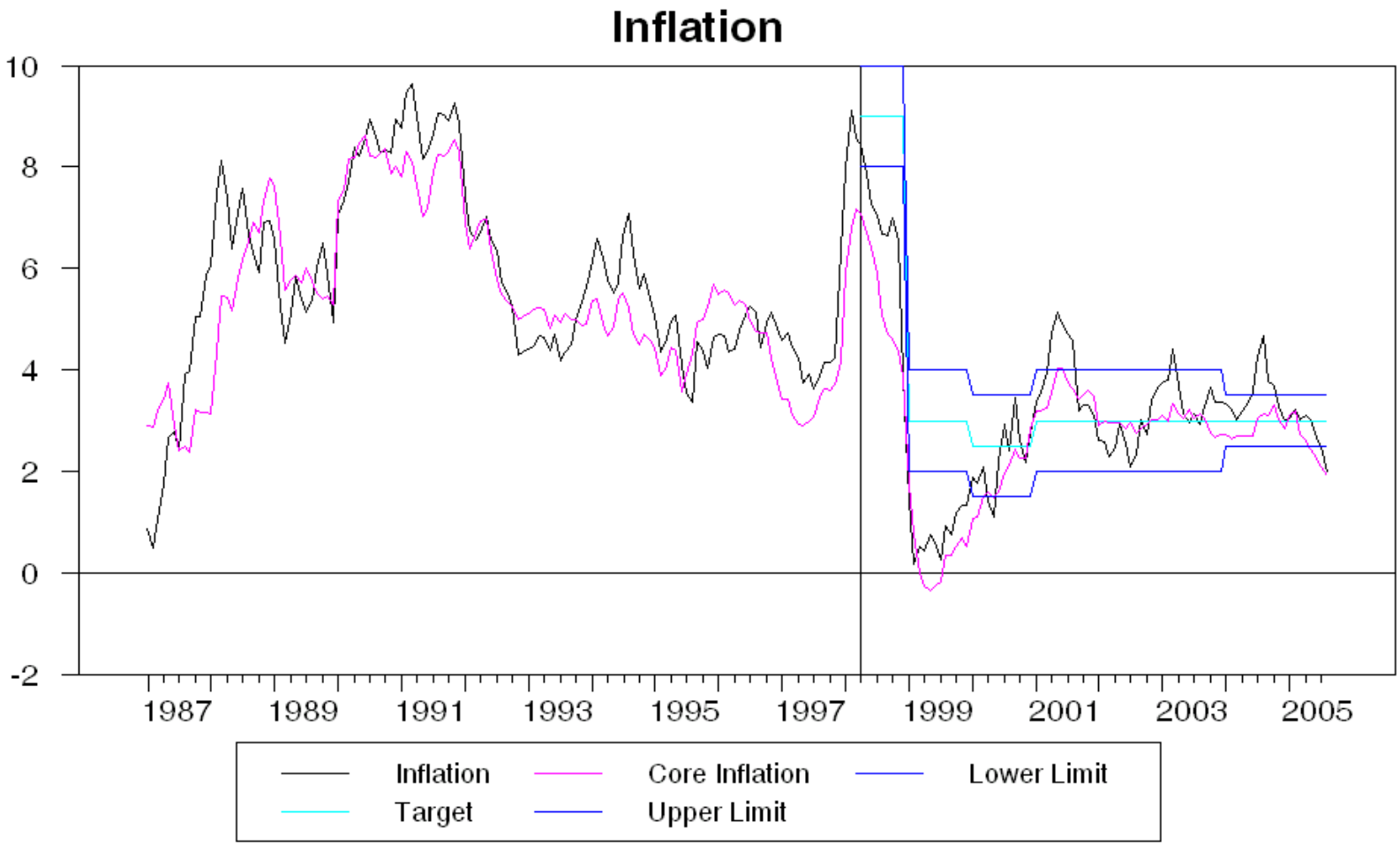

Figure 3. Call Money Rate and Inflation Rates

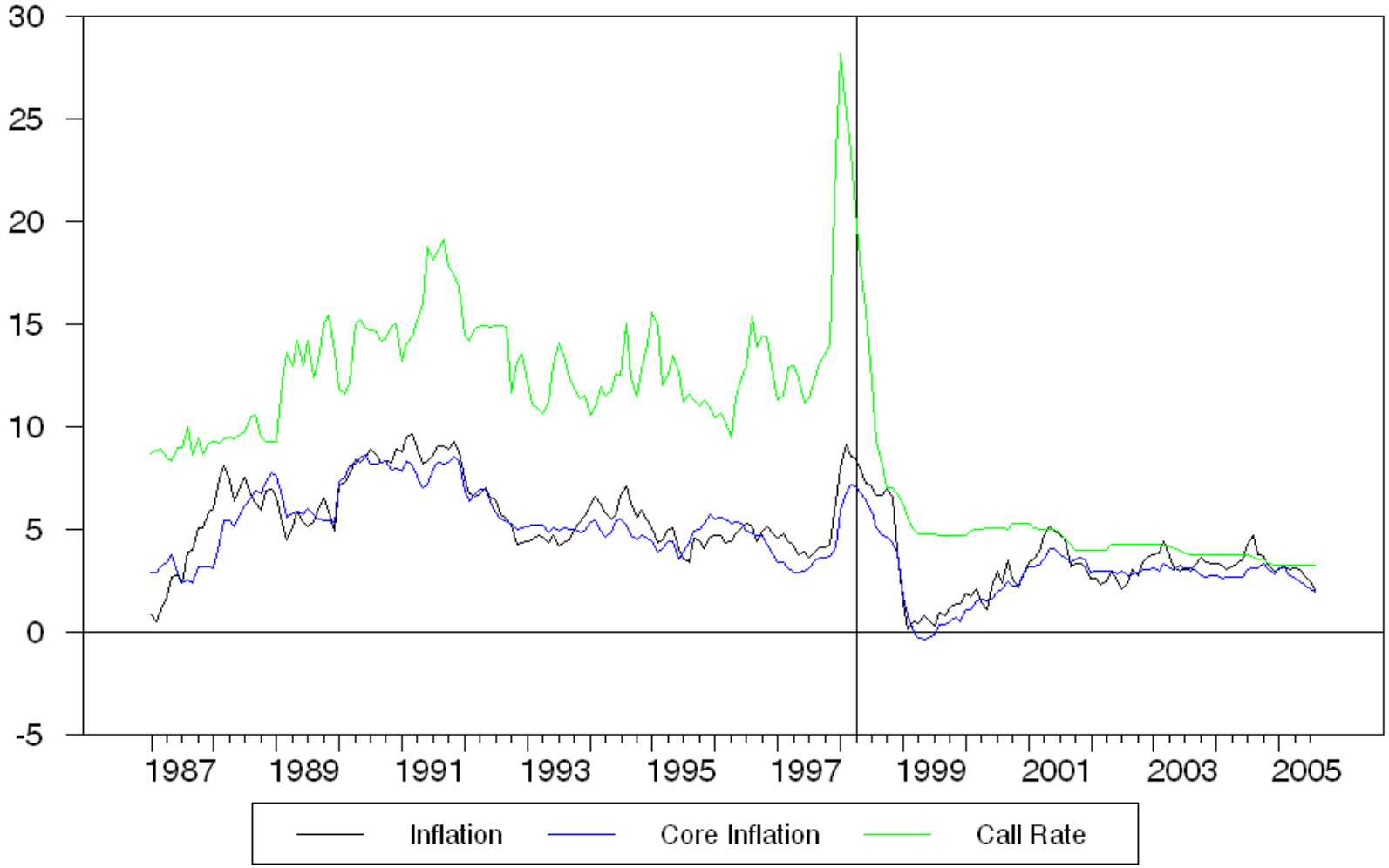

Figure 4. Inflation Rate (Deviation From Target) and Call Money Rate

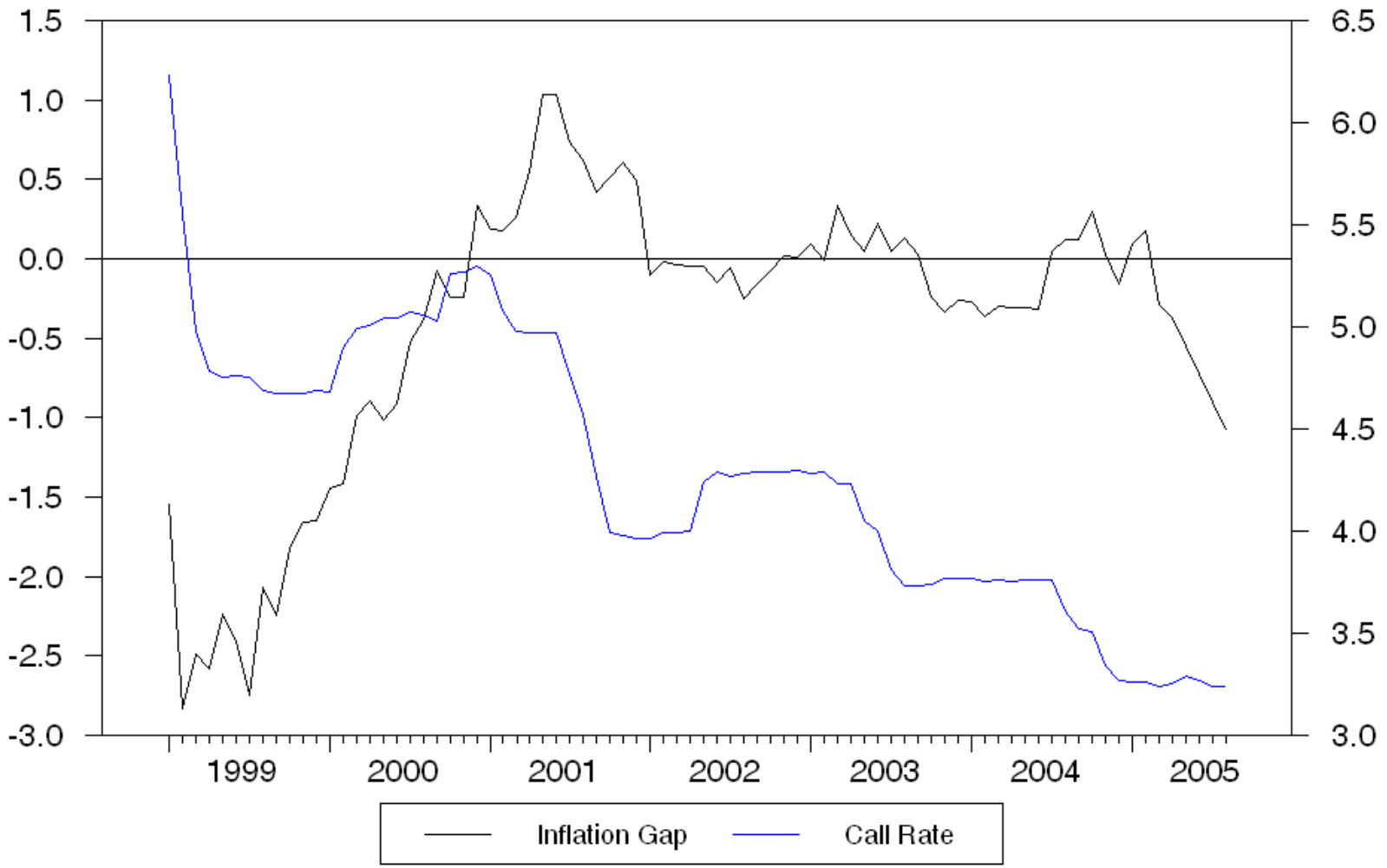

Figure 5. Inflation Rate (Moving Average) and Call Money Rate

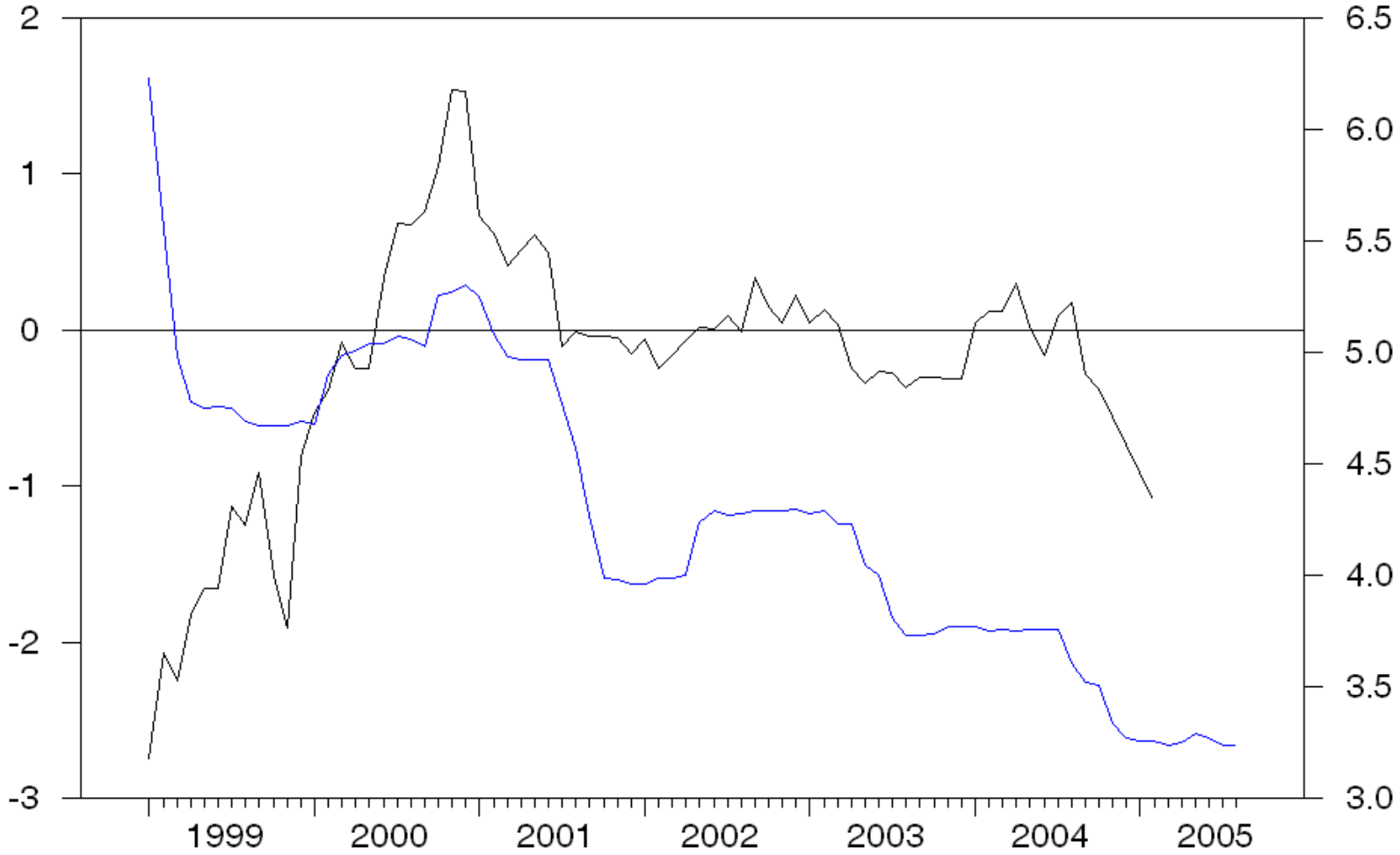

Figure 6. Output Gap and Call Money Rate

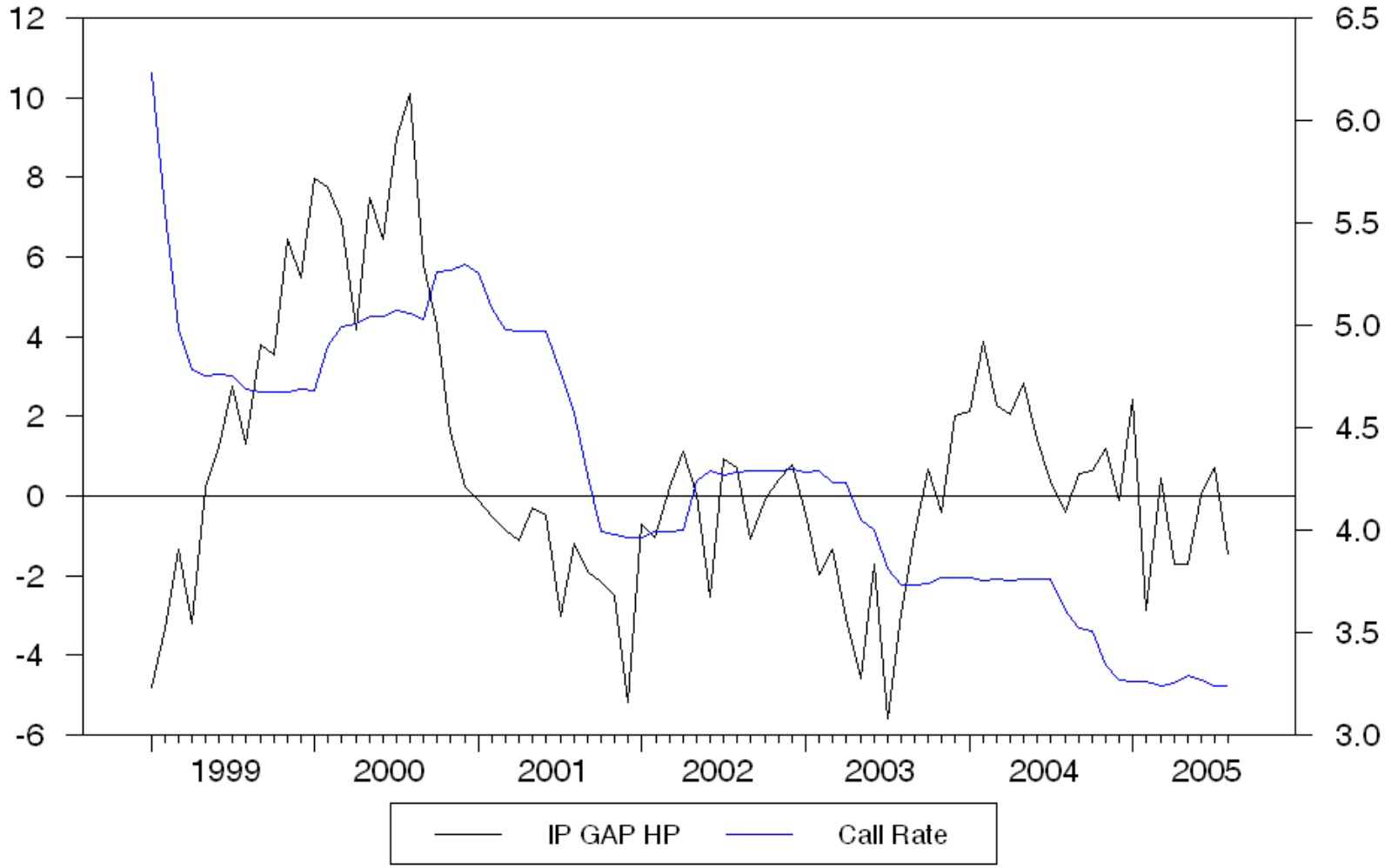

Figure 7. Nominal Interest Rates

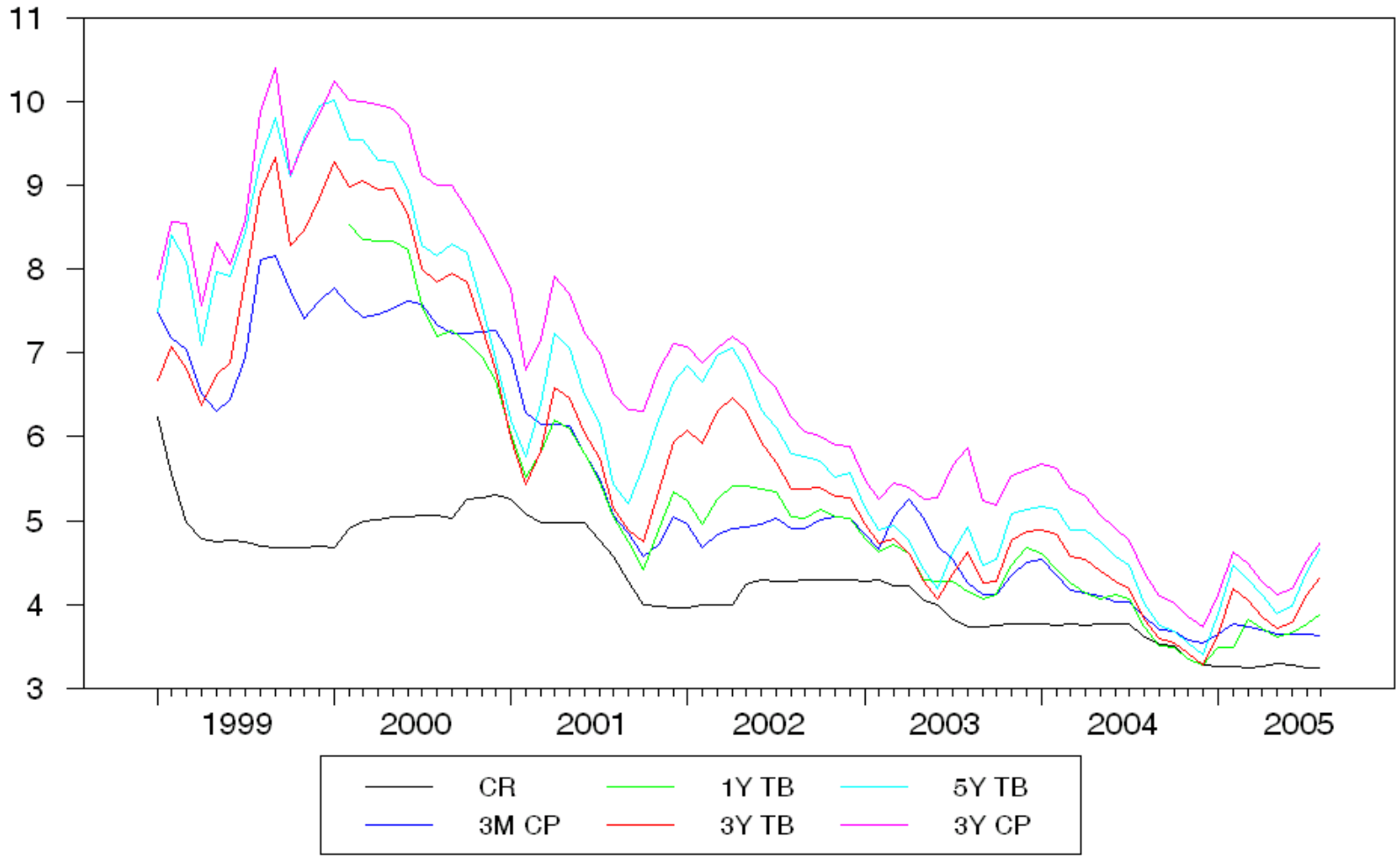

Figure 8. Growth Rates of Monetary Aggregates

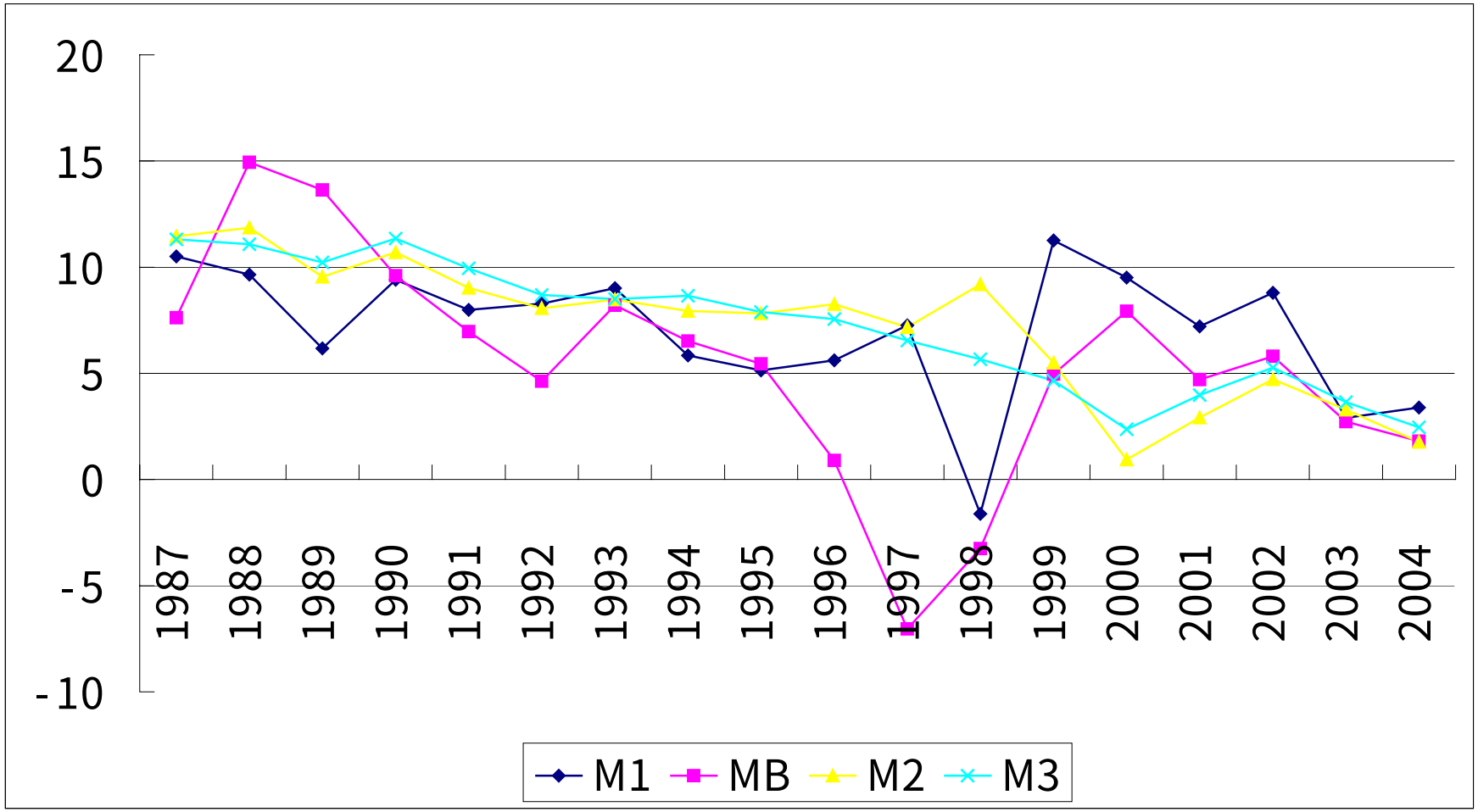

Figure 9. Growth Rates of Real GDP, Real Fixed Investments, and Real Consumption

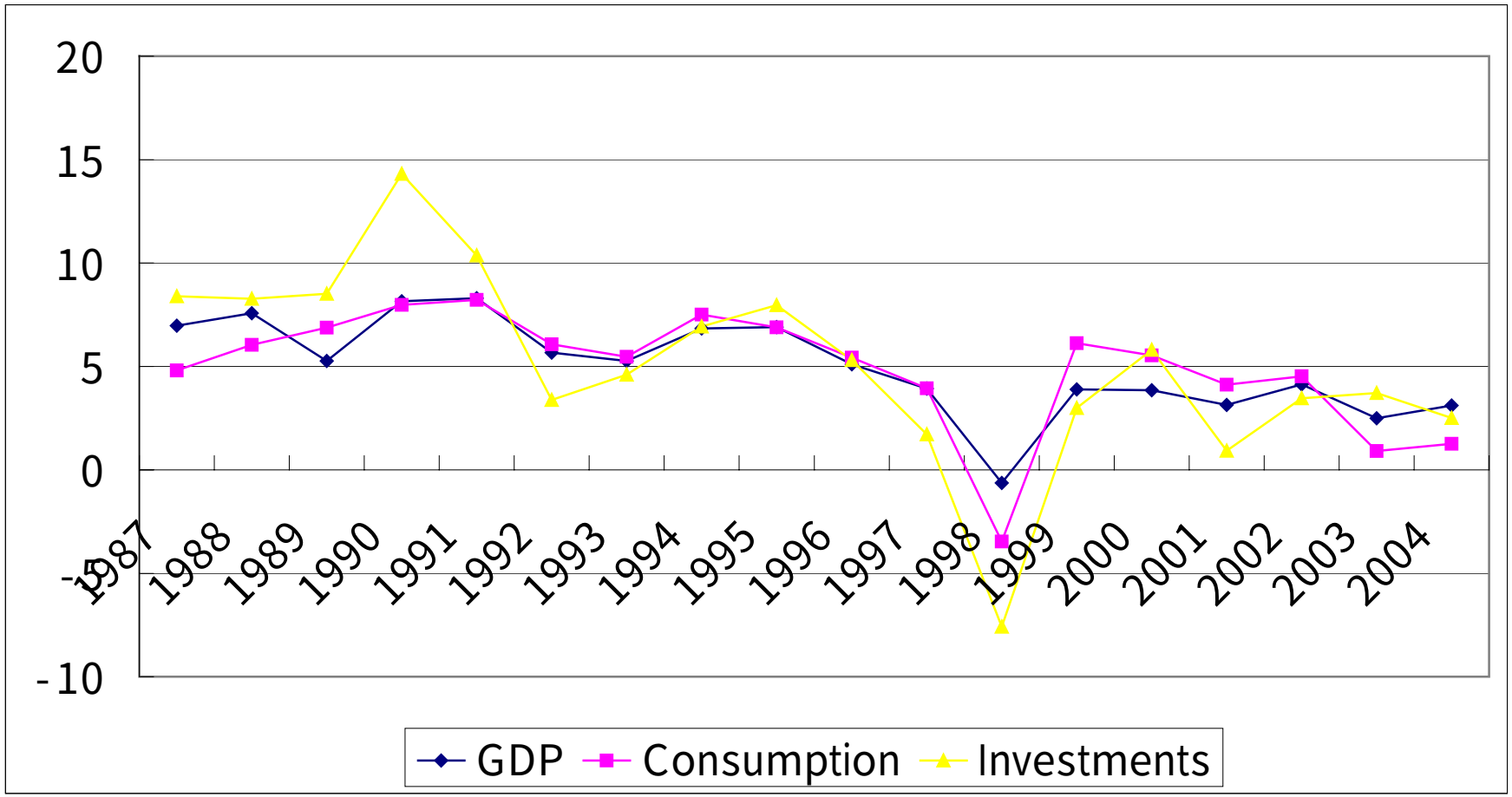

Figure 10. Housing Price and Call Money Rate

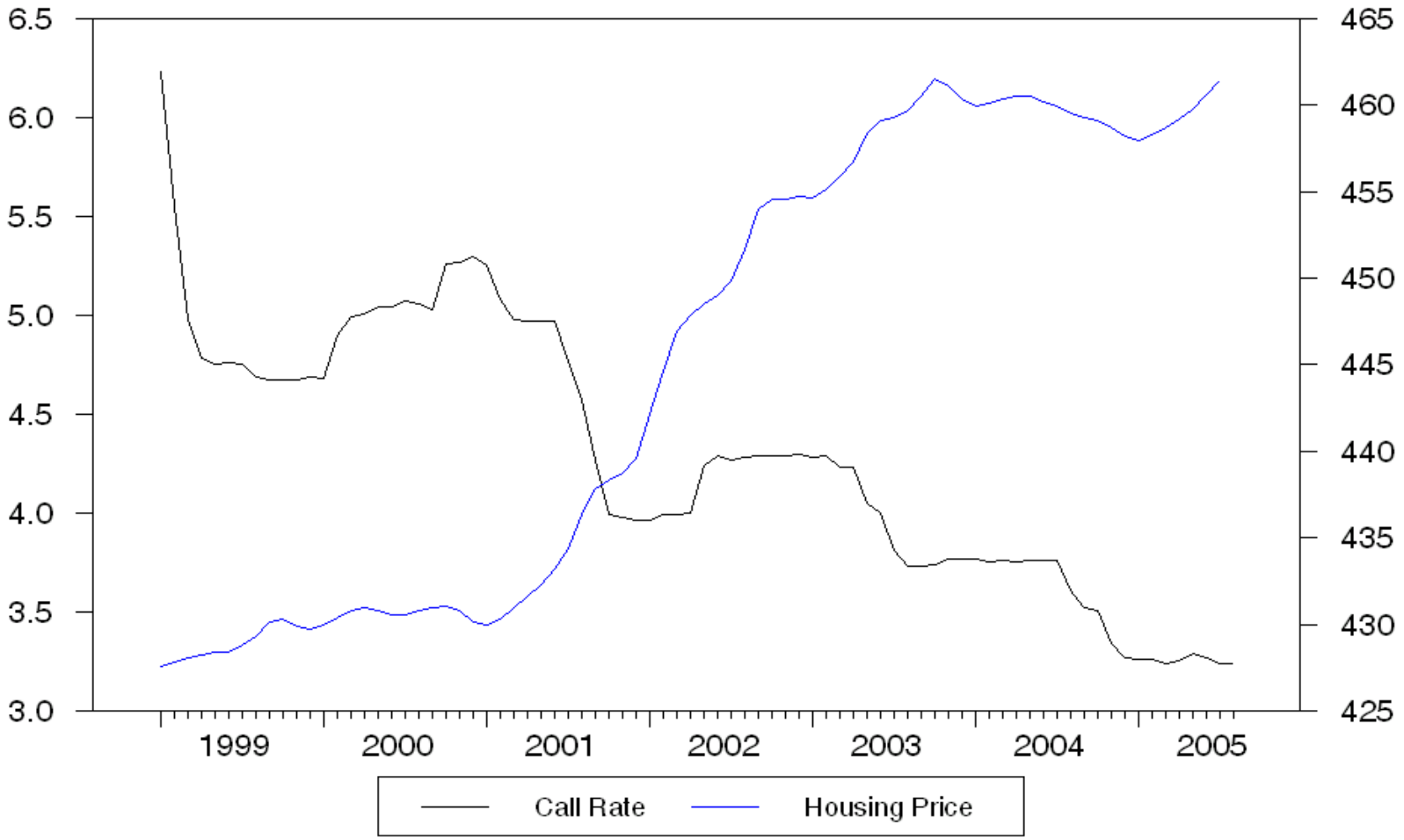

Figure 11. Stock Price and Call Money Rate

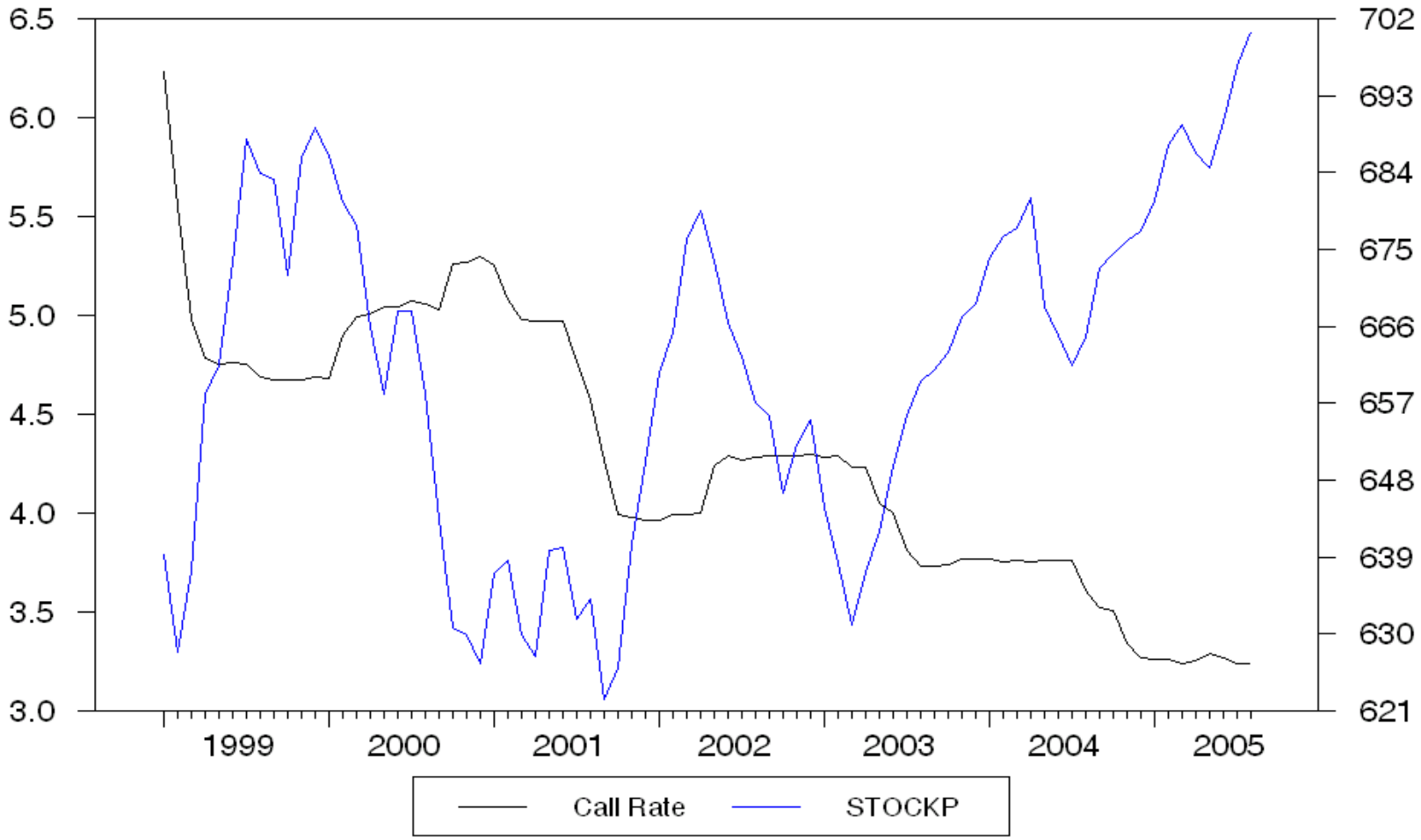

Figure 12. Impulse Responses to Monetary PolicyShocks: Basic Model

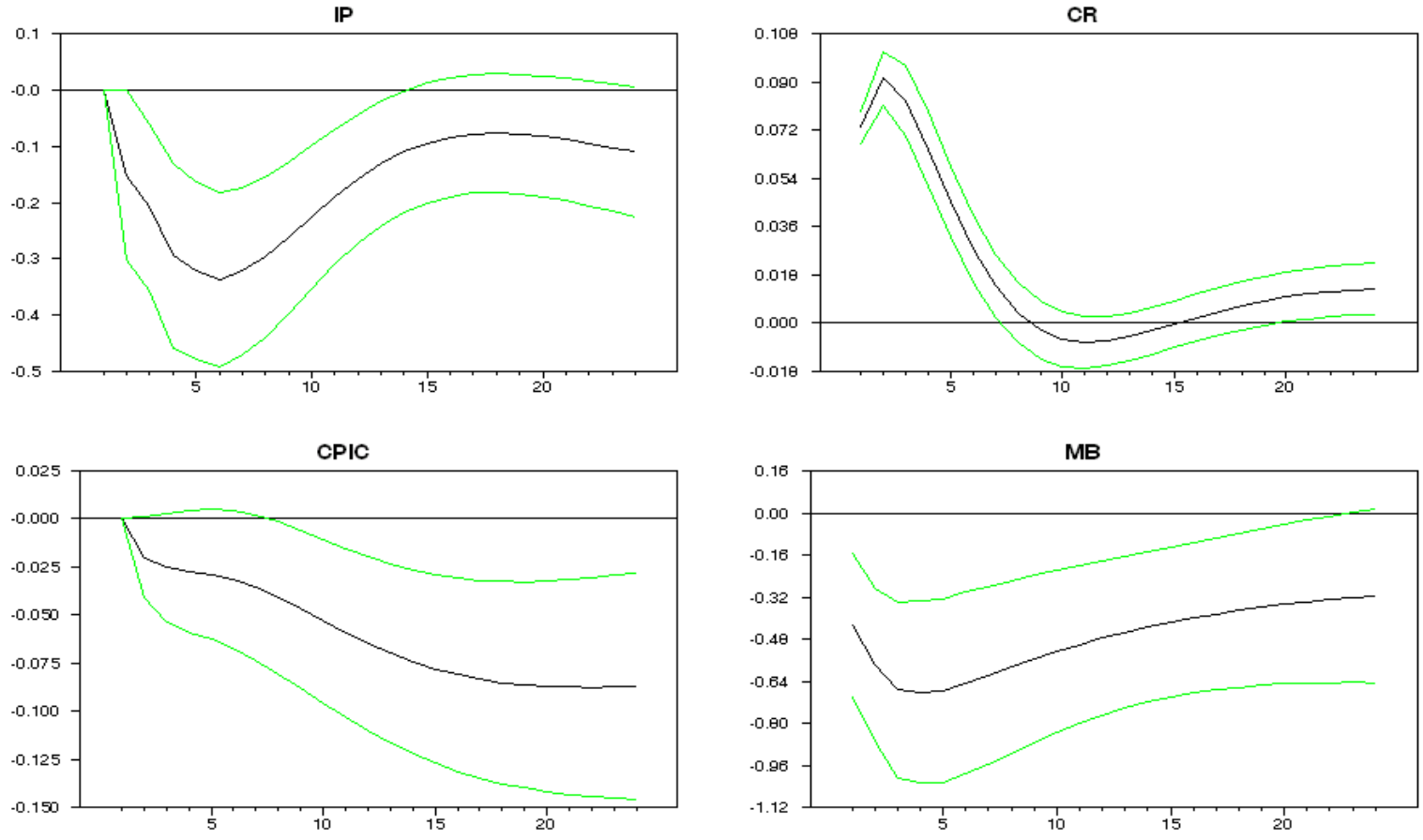

Figure 13. Impulse Responses to Monetary Policy Shocks: Interest Rates

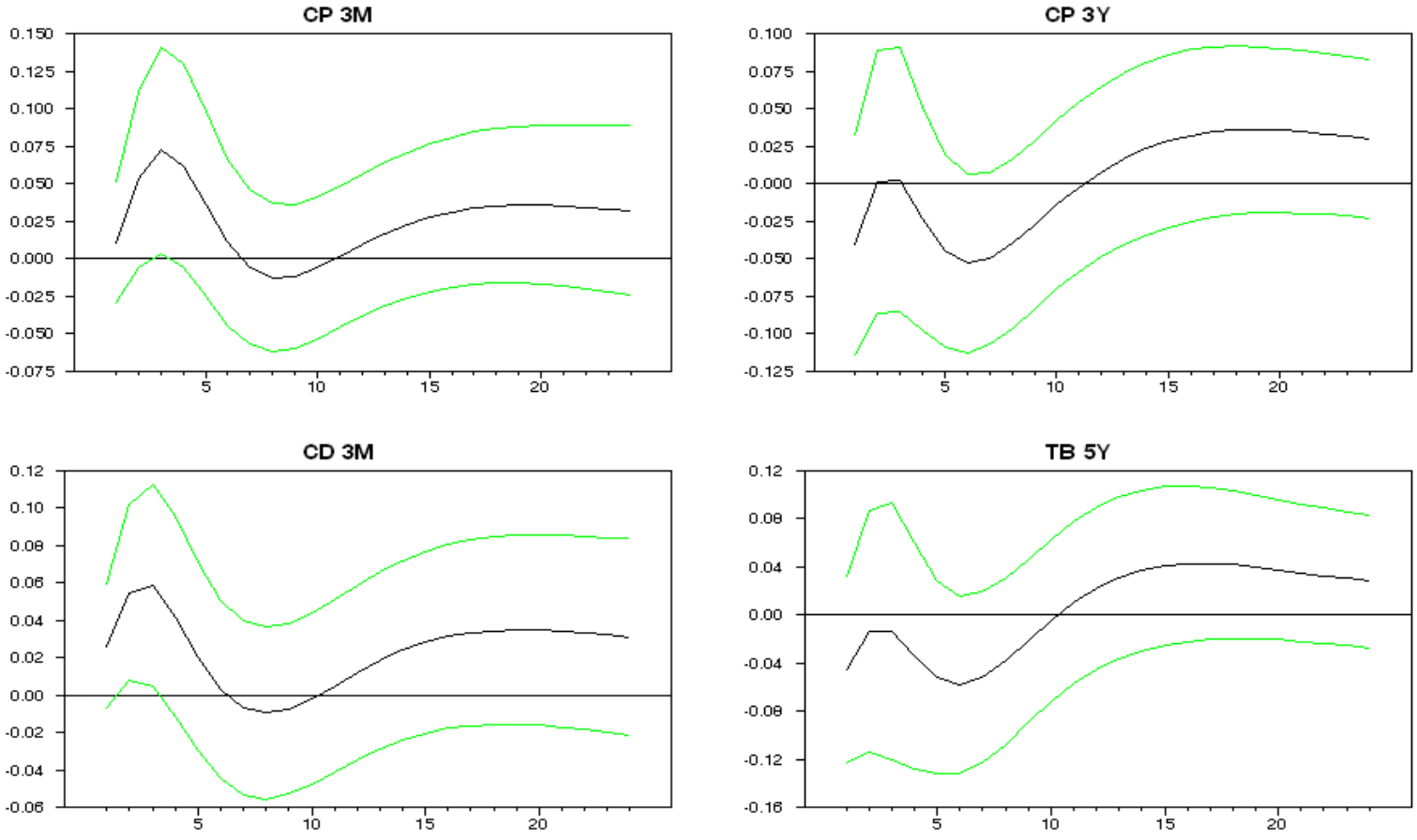

Figure 14. Impulse Responses to Monetary Policy Shocks: Monetary Aggregates

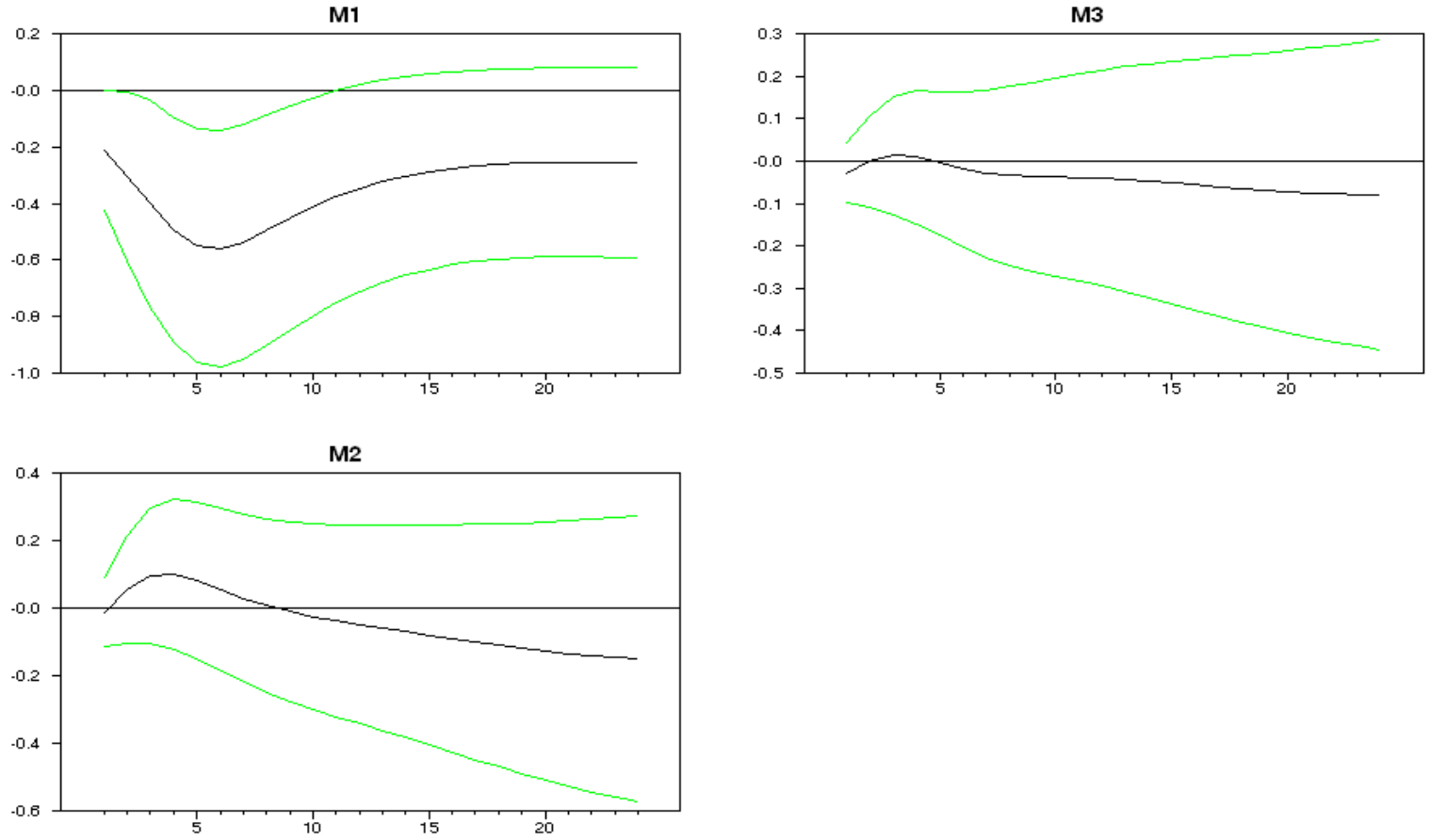

Figure 15. Impulse Responses to Monetary Policy Shocks: Business Fixed Investments, Stock Price, Housing Price