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# INFLATION TARGETING IN PRACTICE: KOREAN EXPERIENCE\*

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In this paper we examine how the Bank of Korea has actually been practicing inflation targeting, based on the evolving features of the core institutional framework, such as target index, target level and range, transparency and independence. We also look at the evolution of the policy rate (call rate target) and the attainment of the target range over seven years to shed light on the operational properties of inflation targeting and targeting performance in Korea. In addition, we explore further several key issues that still remain controversial concerning inflation targeting. To this end, we focus on addressing the following questions. a) Is it desirable to lower the current inflation target level further (the medium-term inflation target is set at 3%)? b) Which price index—headline CPI or core (or underlying) CPI—is more appropriate for the Bank of Korea to target? c) How long a target horizon represents a reasonable balance?

JEL classification: E31; E52; E61.

## 1. Introduction

The economic and financial environment in Korea has changed fundamentally across many dimensions over the years since the outbreak of the 1997 financial crisis. There has also been a change in the conduct of monetary policy in the course of this time. The Bank of Korea long operated a monetary policy framework that emphasized the role of monetary aggregates, until officially abandoning monetary targeting and adopting explicit inflation targeting in 1998 following the 1997 financial crisis.<sup>1)</sup> In 1998, the Bank of Korea decided to announce an annual inflation target as its nominal anchor for monetary policy in response to the revision of the Bank of Korea Act that came into effect in April 1998. Since then, the Bank of Korea has put more emphasis on interest rates in its day-to-day implementation of policy under inflation targeting by keeping the policy rate (overnight call rate) close to its target. It is noteworthy that the policy rate was replaced from March 2008 by the Base Rate — the reference interest rate applied in transactions between the Bank and financial institutions such as repurchase agreements (RPs), the Bank's lending and deposit facilities, etc.

The revised provisions of the Bank of Korea Act (last revised in February 2004) set the ground for the Bank of Korea to shift from annual inflation targeting to medium-term inflation targeting on the basis of three-year targets established since 2004. In accordance with this

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1) It now appears that there was insufficient discussion, and a lack of thorough investigation, as to whether the rationale that partially underpinned monetary targeting could be sustained when the Bank of Korea shifted to an inflation targeting regime in 1998 in the wake of the 1997 financial crisis.

revised Act, the Bank of Korea sets up an inflation target in consultation with the government every three years and draws up and announces a plan for the operation of monetary policy incorporating that target. In addition, to ensure the accountability and transparency of the MPC's decisions, the Bank of Korea publishes the minutes of its deliberations, together with the votes of individual members, after a six-week lag and prepares a detailed report on monetary policy for submission to the national assembly twice a year.

The revision of the Act that came into effect in April 1998 also boosted the Bank of Korea's independence as the Minister of Finance and Economics (MOFE) no longer serves as the chairman of the Monetary Policy Committee, which is entrusted with monetary policy decisions. This position is now taken by the Governor of the BOK, although two of the MPC members are appointed by the recommendation of the government. The Bank of Korea was given a greater degree of independence from the government in 2004 after the Deputy Governor became an *ex-officio* member of the Monetary Policy Committee.

It appears that the Bank of Korea has been implementing a flexible inflation target in actual practice, which allows it to focus on other objectives as well as its primary goal of maintaining price stability. Within the constraints imposed by its medium-term inflation target, the Bank of Korea has in practice left itself policy discretion to respond to current output conditions, and other short-run developments. This framework, within which the central bank can exercise what is termed 'constrained discretion,'<sup>2)</sup> is understood as the important advantage that inflation targeting can confer.

The Bank appears to have performed relatively well in terms of achieving its inflation target, except for 2006 when actual core CPI inflation ended up falling well below the lower bound of its target range. While it is now close to ten years since the Bank of Korea adopted inflation targeting, we still need a better understanding or clarification of many controversial issues, such as the optimal target level, the choice of targeted price index, and inflation target horizon and range. Notably, more rigorous analyses that address these issues are essential for enhancing the practical efficiency of the current medium-term inflation targeting regime in Korea.

The goal of this paper is two-fold. First, we briefly examine how the Bank has actually been practicing inflation targeting, based on the evolving features of the core institutional framework, such as target index, target level and range, transparency and independence. We also look at the evolution of the policy rate (call rate target) and the attainment of the target range over seven years to shed light on the operational properties of inflation targeting and targeting performance in Korea. Second, we explore further several key issues that still remain controversial concerning inflation targeting. To this end, we focus on addressing the following questions. a) Is it desirable to lower the current inflation target level further (the medium-term inflation target is set at 3%)? b) Which price index — headline CPI or core (or underlying) CPI — is more appropriate for the Bank of Korea to target? c) How long a target horizon represents a reasonable balance?

This paper is organized as follows. In section 2, we describe the inflation targeting in actual

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2) See Bernanke and Mishkin (1997) and King (1999), among others.

practice in Korea, by examining the evolving features of the core institutional framework, the operational properties of inflation targeting, and targeting performance. In section 3, we explore further several key issues that need to be clarified to enhance the practical efficiency of medium-term inflation targeting in Korea.

## **2. Inflation Targeting In Practice**

### **2.1 Institutional Framework**

#### **2.1.1 Target Index**

In the early stage of inflation targeting in Korea, i.e., during 1998 and 1999, the headline CPI was chosen as a target index, mainly because of its familiarity to the general public. Then a core CPI, which excludes from the CPI items liable to suffer supply shocks, was adopted as the target index in 2000. The core CPI was used as the target index both under the annual targeting regime of 2001 to 2003, when an unofficial medium-term target was also operated, and under the medium-term inflation targeting regime from 2004 to 2006. The items excluded consist of certain non-grain agricultural and petroleum products. A total of 49 items was stripped out from the 516 items comprising the CPI, or 11.7% of the index in terms of weight. When a central bank focuses on a core CPI, it is incumbent on the central bank to explain its choice of target index and help the public understand its relation to headline CPI (Bernanke and Mishkin, 1997). However, a practical problem arising in the use of core CPI as the target index is the possibility of a divergence between the public's perception of the true rate of inflation and the core rate of inflation. People are sensitive to changes in the prices of agricultural and petroleum products that they consume daily. Thus, if they see that the central bank's concern for prices excludes those items, it may impair the public credibility of the central bank's monetary policy.<sup>3)</sup> A second issue has to do with the argument that even though prices of the excluded items fluctuate sharply, they tend to return to their previous level within a relatively short period of time. Under such circumstances, if monetary policy reacts whenever prices change, it will only have a perverse effect. It was against this backdrop that the Bank of Korea has eventually opted for annualized average headline CPI as the index for the current medium-term targeting period of 2007 to 2009.

#### **2.1.2 Target Level and Range**

The inflation target was set at  $9\pm1\%$  for 1998, reflecting the sharp depreciation of the won following the outbreak of the financial and currency crisis, but then set at a substantially lower level of  $3.0\pm1\%$  for 1999 and of  $2.5\pm1\%$  for 2000. Subsequently it was maintained at a midpoint of 3% with a band of plus/minus one percentage points around the annual targeting regime of 2001 to 2003. The inflation target range has been retained at the same midpoint level

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3) In addition, if a narrowly defined index such as core CPI is used as the target index, it is more likely that inflation targeting will meet with distrust if a wide gap opens up between the target index and the necessities that make up the cost-of-living. Another argument against such a narrowly defined index is that it can be a less useful guide to the formation of inflation expectations.

of 3%<sup>4)</sup> within a range of plus/minus 0.5 of a percentage point under the medium-term inflation targeting regime from 2004<sup>5)</sup> to 2009.<sup>6)</sup> Under the medium-term inflation targeting regime, the Bank's performance in attaining the inflation target will be judged on the basis of the three-year annualized average increase in the CPI.<sup>7)</sup>

As Bernanke and Mishkin (1997) point out, setting the inflation target too low is not desirable in that very low inflation can reduce real-wage flexibility due to the downward rigidity of the nominal wages and hence worsen the allocative efficiency of the labor market. Furthermore, too low an inflation target may lead the economy to fall into deflation.

The medium-term inflation targeting as it has been actually practiced on the basis of three-year targets for the two periods since 2004 is designed to secure a firm belief among the markets and the general public in the consistency of the central bank's operation of monetary policy over the medium-term horizon. A less rigorous yardstick is, therefore, needed than the average rate in each year. More importantly, within the constraint imposed by the Bank's medium-term inflation target, the Bank has in practice left itself some scope (policy discretion) to respond to current output and financial market conditions, exchange rates, and other short-run developments. This implies that implementing a medium-term target permits the Bank a transition path by which the temporary inflation induced by important supply shocks, such as oil price shocks, dies out gradually over time. In other words, medium-term inflation targeting is capable of functioning as a looser straitjacket than annual inflation targeting. In addition, it appears that the Bank's choice of a three-year medium-term inflation target is at least partially prompted by the practical consideration of the length of monetary transmission lags, which is around two to three years. It is generally accepted in Korea, and supported by the evidence provided by Hyun E. Kim (2000),<sup>8)</sup> that a lag of 7 to 9 quarters is needed for the effect of the maximum effect of a change in monetary policy to be exercised on the inflation rate.

Fundamentally, in determining the bandwidth of inflation target, practical considerations call for a balanced trade-off between flexibility and credibility: a band that is too wide undermines the credibility of IT, whereas a band that is too narrow (or zero) can prompt an unwarranted need to change monetary policy stance even for a small deviation from the targeted inflation

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- 4) At that time, an appropriate level of trend inflation corresponding to overall economic conditions while underpinning the stable growth of the Korean economy was estimated at around 3%.
  - 5) At the time the medium-term inflation target was introduced, proposals for changing the target index to the rate of increase in the CPI were examined. But with a view to securing policy consistency, the use of core inflation was finally continued: changing the target index might have brought about a perception that the principal elements of monetary policy were liable to frequent change.
  - 6) In practice, in setting the medium-term inflation target at the range of  $3.0 \pm 0.5\%$  for the period 2007 to 2009, the Bank aimed to reflect the appropriate rate of inflation consistent with Korean economic fundamentals and to allow itself flexibility in conducting monetary policy to deal with short-term economic fluctuations.
  - 7) The choice of the three-year target horizon was based on the following practical consideration: if the target horizon were shortened to two years, it could create the impression that the inflation target was being frequently changed. What is more, if in the first of these two years inflation deviated from its target range, its rate would have to be brought down too brutally the following year, putting a heavy burden on policy. On the other hand, if the target horizon were set at four years, it would be generally recognized as long term.
  - 8) He investigates the lag structures in the interest rate channel of monetary transmission in Korea using dynamic simulations to predict the lagged effects of change in the policy rate on real GDP and the inflation rate based on the estimates for the two structural equations used by Rudebusch and Svensson (1998) — the IS curve with the policy rate included and the Phillips curve.

rate. The use of an appropriate target range for inflation gives the central bank additional flexibility by allowing what it consider to be “unavoidable” inflation induced by supply shocks or other short-run developments. A one-percentage point band was, however, fitted around the mid-point of the target range to allow various uncertainties surrounding the economy to be taken into account.

### **2.1.3 Focus on the Policy Rate (Call Rate Target)**

When inflation targeting was first adopted, the target for money supply was established on the basis of M3 following policy consultations with the IMF. There were fears that it would stoke inflation expectations if no target was announced for the growth of the monetary aggregate that had been used as the intermediate target in the pre-crisis period. Accordingly, a monetary policy operating framework similar to the current ‘two-pillar system’ of the ECB was put in place, under which M3 served as the intermediate target in tandem with the declaration of an inflation target. Following the graduation from IMF tutelage (the cessation of policy consultations with the IMF) in September 2000, however, M3 was converted from an intermediate target to a monitoring variable.<sup>9)</sup> This effectively meant the transition from the dual framework of monetary targeting alongside inflation targeting to a pure inflation targeting framework.

From early 1999, the Monetary Policy Committee (MPC) began to focus on the call money rate in referring to the direction of monetary policy decided upon at its policy-setting meeting and announced publicly. The citing of a specific figure as a target commenced from the May 1999 meeting.<sup>10)</sup> Subsequently, the MPC clearly described the scale of the adjustment sought when changing the call rate target, so that the call money rate took its place as the operating target of monetary policy. From 1999 onwards, the MPC decided and announced its call rate target every month. From September 1998, it changed its “direction of monetary and credit policy” to the rationale for the decision and from 1999 it shifted to a monthly framework for the decision concerning the direction of monetary policy and abandoned the setting up of the direction of monetary policy on a quarterly basis.

### **2.1.4 Transparency and Accountability**

#### **(Monthly Announcement of Monetary Policy Direction)**

Every month the direction of monetary policy is announced immediately after the policymaking meeting (deliberations and resolution of the Monetary Policy Committee). The Governor of the Bank of Korea gives a press conference at which he explains at some length the details of the policy decisions taken and the background to them.

#### **(Publication of the MPC Minutes)**

At first the minutes of the discussions at the policy-setting meeting of the Monetary Policy

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9) From 2003 onwards, even the monitoring range for M3 was no longer formally established.

10) Previously, most of the announcements had been vaguely worded, such as “strive for the downward stabilization of interest rates,” but that May, the Monetary Policy Committee stated that “the overnight call rate will be managed stably around its current level (4.75%).”

Committee (MPC) were published in the Monthly Bulletin two months after the meeting was held. From 2005 the length of time before publication was shortened: from the MPC meeting in April, the minutes were put up on the BOK's website six weeks after the date of the policy-setting meeting.

### **(Compilation of Monetary Policy Report)**

When an inflation targeting regime was adopted, monetary policy reports were compiled every year in the form of a single full-length annual report and a summarized semiannual report. Since 2004 the full-length report has been published every six months, prefaced by an executive summary. Included in its contents are whether or not the inflation target has been achieved, details of the actual operation of monetary policy, policy outcomes and future policy directions. The Monetary Policy Report is submitted twice a year to the National Assembly. Initially the economic forecasts were limited to a one-year horizon, but this has been lengthened to a two-year horizon. And the Bank makes clear the extent of ex-ante uncertainties surrounding forecast inflation and output growth by constructing fan charts (probability density functions) for their forecast outcomes up to two years ahead.

### **(Testimony before the National Assembly)**

The Governor of the Bank of Korea appears before the National Assembly to testify on the economic outlook and the future directions of monetary policy.

### **(Speeches, Lectures and Interviews)**

By giving lectures, speeches, interviews and suchlike, the Bank's governor, members of the Monetary Policy Committee and senior executive officers keep the public informed about current monetary policy matters and the future thrust of policy.

## **2.2 Operation of Monetary Policy**

### **2.2.1 Evolution of the Policy Rates**

While taking the achievement of the inflation target as its overriding objective, the Bank of Korea has been implementing a flexible inflation target in actual practice, which allows its attention to other objectives as well in conducting monetary policy, including output, financial markets, and exchange rates. A look at the evolution of the policy rate (call rate target) over the last decade or so helps us to shed light on the operational features of inflation targeting in Korea (see Figure 1).

It appears that the Bank of Korea paid attention to countering financial market instability and upward pressures on prices for 2000. In order to narrow the spread<sup>11)</sup> between short-term and long-term interest rates, which reflected heightened financial market instability, the call

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11) Inflation expectations had become widespread owing to the acceleration of the GDP growth rate and the rise in wages and charges for public services, together with financial market instability associated, for example, with the Daewoo Group restructuring. Consequently despite the stability of short-term interest rates, long term interest rates moved upward (on the basis of monthly average yield on corporate bonds, January 1999, 7.89%; September 1999, 10.41%; January 2000, 10.25%).



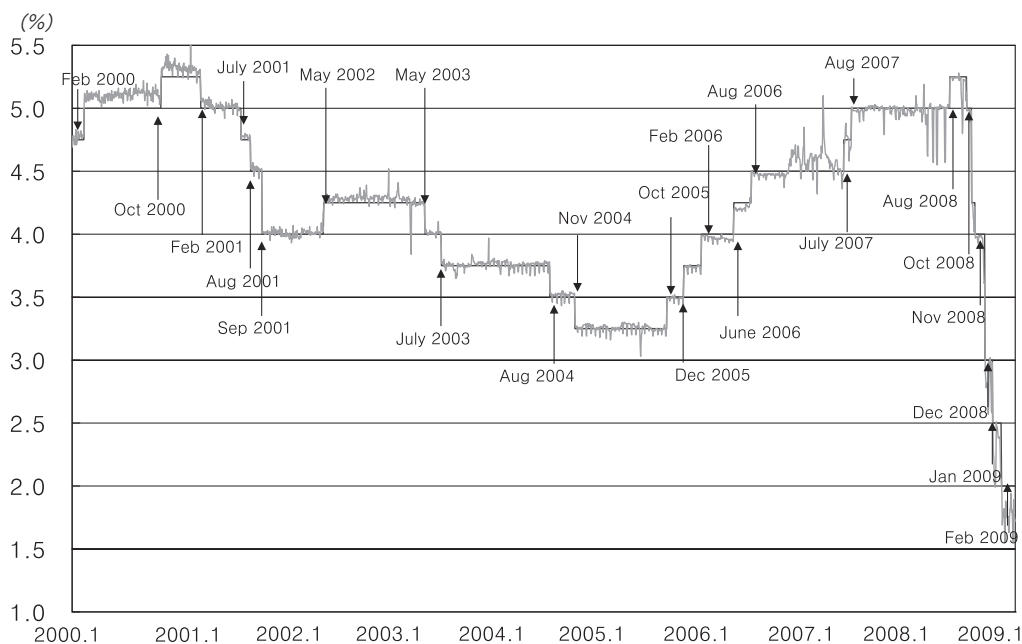


FIGURE 1: Evolution of the Policy Rate

money rate target was raised by a quarter of a percentage point (25bp) in February (4.75% → 5.00%). Following this, a high rate of GDP growth continued, arousing fears of a gradual rise in inflationary pressures. The call money rate target was, therefore, raised by a quarter of a percentage point in October (5.00% → 5.25%).

In 2001, the focus was placed on changes in economic activity and external shocks, so as to secure the stabilization of core inflation. In the early weeks of 2001, the upward trend of prices accelerated, whereas business activity at home and abroad suffered a slowdown. This downturn was further intensified by the events of September 11 in the United States. As a consequence, the policy rate target was lowered in a series of steps (a total of 1.25 percentage points during the year).<sup>12)</sup> In tandem with the slowing of the US economy in the wake of 9/11, central banks around the world expanded liquidity supply and brought down interest rates. Seeing that prices were rising more slowly in the early months of 2002, but that business activity was picking up, the policy rate was raised by a quarter of a percentage point (25bp) (4.00% → 4.25%). Consumer spending nevertheless surged and business activity turned buoyant, boosted by the sharp rise in credit card use and the lowering of interest rates. Inflation, meanwhile, decelerated in response to the stability of the exchange rate and of charges for public services. During 2003 to 2004, business activity experienced a persistent downturn, in line with which the call rate was reduced by 25bp each time in May and July 2003 and in August and November 2004 (4.25% → 4% → 3.75% → 3.50% → 3.25%). In 2005, the long-lasting low-

12) February (Δ25bp): 5.00% → July (Δ25bp): 4.75% → August (Δ25bp): 4.50% → September (Δ50bp): 4.00%.



interest rate policy stance had generated the side-effects of abundant market liquidity while the economic recovery was gradually becoming more evident. Largely to moderate such side-effects, the policy rate was raised by 25bp in October and again in December in 2005 (3.25% → 3.50% → 3.75%); and this was followed up by further 25bp upward adjustments in February and June and August 2006 (3.75% → 4.00% → 4.25% → 4.50%). These decisions to raise the policy rate three times in a row in 2006 appear to reflect the Bank's policy stance of gradually reducing the degree of monetary accommodativeness in keeping with the trend of improvement in the real economy. During the first half of 2007, the Bank kept the call rate target unchanged at 4.5%, in line with its policy stance that the rapid increase in market liquidity would not weaken the foundation for price stability from the medium and long-term perspective. Meanwhile, as the recovery of the real economy became more evident from around the beginning of the latter half of 2007, it was judged that upward price pressures would gradually build up. Accordingly, the Bank adjusted the call rate target upward by 25bp in July and again in August 2007 to 5.0%. The Bank raised the Base Rate<sup>13)</sup> by 25bp from 5.0% to 5.25% in August 2008 to counteract the inflationary pressure driven primarily by the run-up in the international oil price. Meanwhile, to alleviate the liquidity crunch caused by the unprecedented global financial crisis and its deteriorating economic consequences, the Bank continued to cut the Base Rate starting in October 2008 through February 2009, five times in a row, by 325bp to 2.0%.

### 2.2.2 Policy Making Process

Before the MPC decides the level of the overnight call rate target every month, it is crucial for the Bank to clearly understand the potential effects on economic activities and price changes of setting the call rate target for the month ahead. To this end, the Bank of Korea undertakes the following policy-making process. First, the Bank assesses the potential effects of the change in economic conditions during the coming month on inflation, based on the estimators generated mostly using the BOK macro-model. Since it is not wholly confident in these estimators, the Bank also uses a number of indicators compiled by processing statistics to measure their marginal impacts on inflationary pressure. This may be labeled as the "Look-at-Everything approach." Second, suppose forecast inflation is expected to exceed the midpoint of the target range, but at the same time, there is a high likelihood of an economic slowdown or financial market instability. In such a scenario, the Bank will face difficulties in selecting the appropriate policy direction. It then should make some well reasoned judgments to prioritize its multiple objectives. Third, once the Bank has decided to adjust the policy rate target, it needs to determine the scale of the adjustment. The target has so far been adjusted by half a percentage point only on a single occasion, which was once undertaken on September 19, 2001 as an emergency measure deemed advisable and indeed crucial.

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13) The policy rate which the Monetary Policy Committee decides every month was replaced from March 2008 by the Base Rate.

## 2.3 Inflation Targeting Performance

### 2.3.1 Attainment of Inflation Target

Figure 2 depicts trends in the inflation targets and the behavior of the annualized average CPI and core CPI inflations. The CPI inflation registered 7.5% in 1998 and 0.8% in 1999, in both cases below the lower bound of the inflation target range. Core inflation stood at 1.8% (2.3% rise in CPI inflation) in 2000, remaining stable within its target range. It rose to 3.6% (4.1% rise in CPI inflation) in 2001, reflecting the depreciation of the Korean won and increases in public service charges. However, its level was still within its target range for that year. The core CPI inflation was stable at 3% within its target range for the period 2002 – 2003. Under the medium-term inflation targeting regime from 2004 to 2006, the core CPI inflation showed a downward trend from 2.9% (3.0% rise in CPI inflation) in 2004 to 2.3% (2.6% rise in CPI inflation)<sup>14</sup> in 2005 and subsequently to 1.8% (2.1% rise in CPI inflation) in 2006. Thus, most notably in 2006, actual core CPI inflation ended up falling well below the lower bound of its target range, while having dropped slightly below it in 2005. The annualized average increase in the CPI, or headline inflation, which was chosen as the target index for 2007 to 2009, continued to hover around the lower bound of its target range in the first nine months of 2007. Following this, CPI inflation showed a big upward swing from 2.5% (2.3% in core CPI inflation) in 2007 to 4.7% (4.3% in core CPI inflation) in 2008, mainly due to the oil price hike.

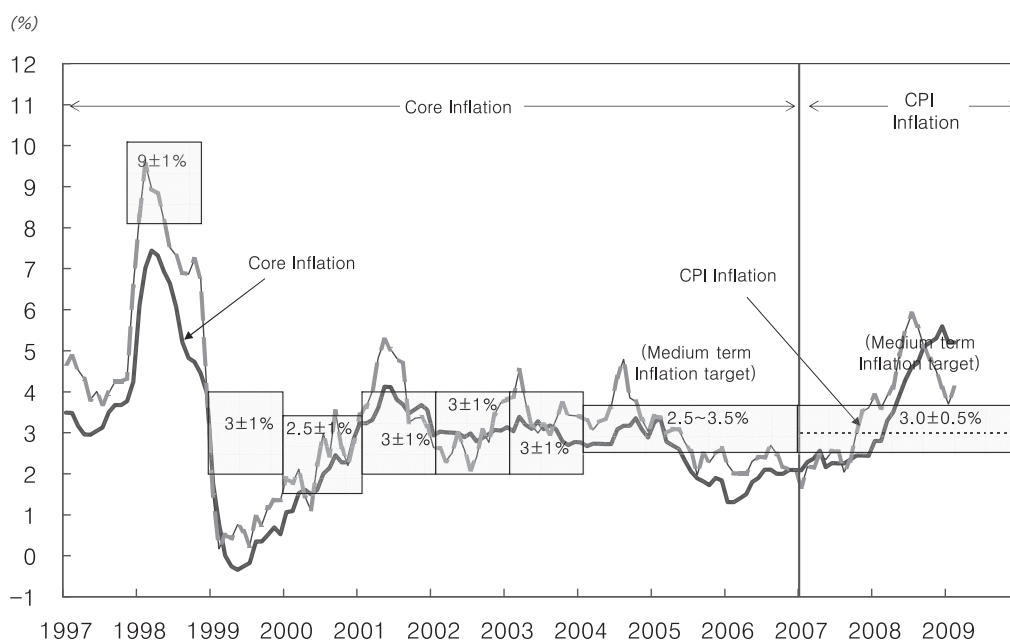


FIGURE 2: Inflation Targets and Actual Inflation Rates

14) During 2003 – 2004, the CPI inflation rate accelerated, under the impact of supply-side factors including the outbreak of the US-led war against Iraq, and a steep rise in agricultural product prices, whereas core inflation remained stable at the midpoint of its target range in view of lackluster domestic demand.

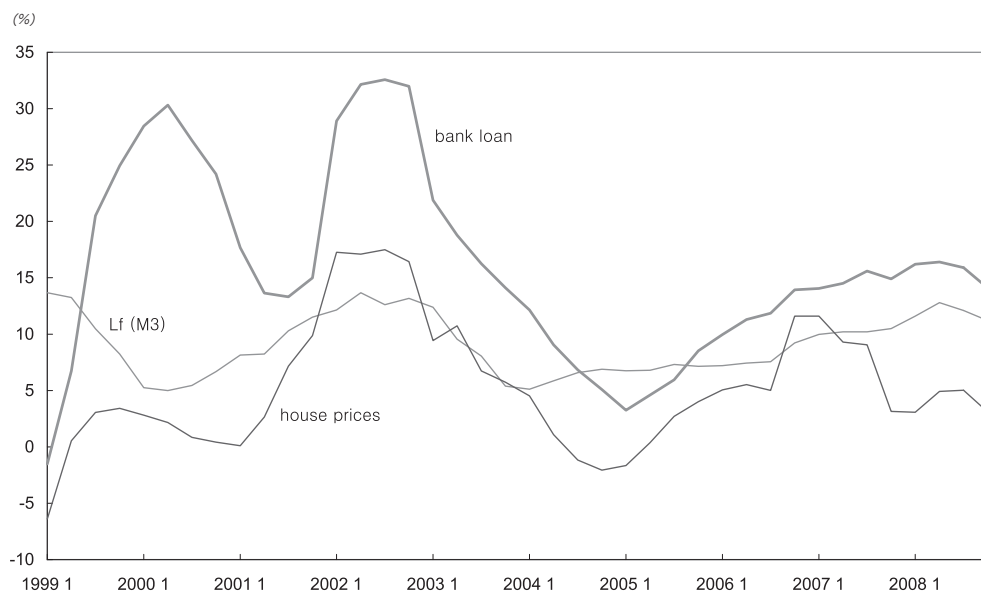


FIGURE 3: House Prices and Bank Loan

### 2.3.2 The Policy Rate and Monetary Aggregate

Traditional money demand theory suggests that money demand may be predicted to decrease when interest rates (i.e., the opportunity cost of holding money) rise and vice versa. Many people still believe that such a negative relationship between the two variables holds even though the money demand function may be unstable. Thus, when the Bank raised the call rate target in a series of five steps of 25bp each time from 3.25% to 4.5% over the period 2005 to 2006, it was expected that the growth rates of monetary aggregates such as M3 or Lf (broad monetary aggregates) would decline. It turned out, in contrast, that their growth rates did not decrease at all and instead kept accelerating during the corresponding period. The Bank perceived this puzzling phenomenon to be closely tied to the recent run-up in house prices in Korea, mostly centering on apartments, as many other countries had been experiencing. In line with this perception, the housing finance loans actually soared for the same period. Figure 3 shows that the growth rates of both house prices and bank loans have tended to move together since around 2002. From this evidence, we can conjecture that the monetary aggregates would show a rapid increase even though the call rate target was adjusted upward by 1.25%p during that period.

It is interesting to note that a recent study by Yoo (2007) confirms this conjecture. According to his empirical results, it emerges that the money demand function over the post-crisis period in Korea actually depended positively on house prices as well as on output, and negatively on the short-term interest rate. More importantly, the upward adjustment of the call rate target by 1.25%p during the period 2005 to 2006 brought about a drop of money demand (monetary aggregate) of about 1%, while at the same time the recent hikes in house prices caused an increase in money demand of about 2% (see Figure 4). Taken together, the results suggest that

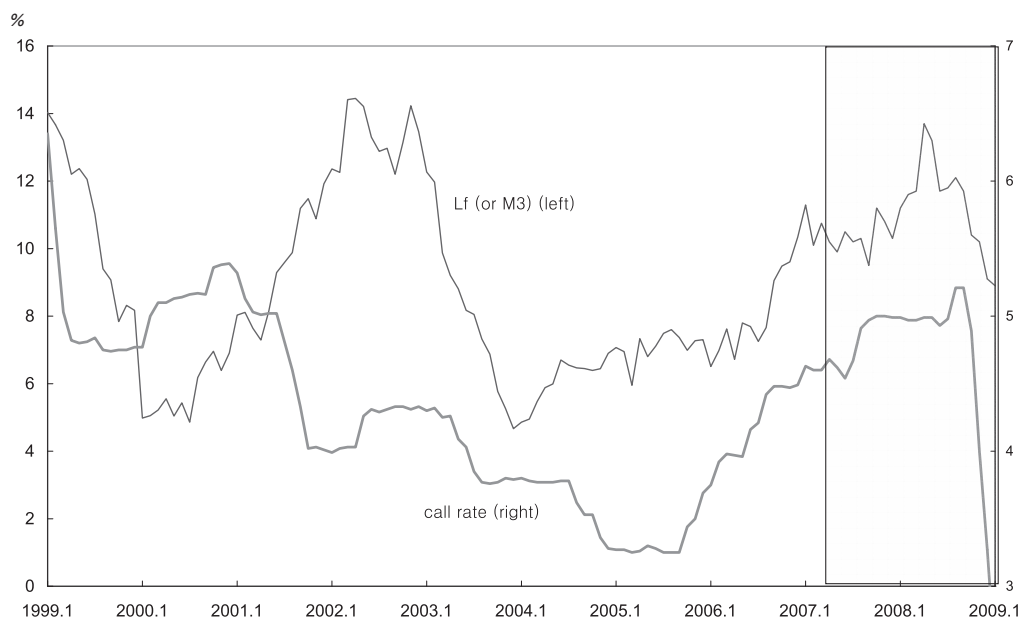


FIGURE 4: Call Rate Target and Monetary Aggregate

the recent run-up in house prices was the main culprit behind the sharp rise in the growth rates of the monetary aggregates by about 1 percentage point even though the call rate target was adjusted upward by as much as 1.25%p over that period.

### 3. Core Issues with Inflation Targeting

We explore further several core issues that need to be considered for enhancing the practical efficiency of the current medium-term inflation targeting regime in Korea. To this end, we focus on addressing the following questions that still remain at issue concerning inflation targeting: first, is it desirable to lower the current inflation target level further (the medium-term inflation target is set at 3%)? ; second, which price index — headline CPI or core (or underlying) CPI — is more appropriate for the Bank of Korea to target? ; third, how long a target horizon represents a reasonable balance? We consider these questions in turn.

#### 3.1 Inflation Target Level

It is generally accepted that an optimal inflation target should be determined at the level where the costs of disinflation (or inflation reduction), as measured by the total output loss, is equal to the long-run benefits associated with a corresponding increase in the level and possibly the trend growth of real output. The balance between the costs and benefits of a new, lower level of inflation is a key consideration for policymakers in deciding on the extent of inflation reduction; if inflation reduction exceeds the benefits, it appears desirable

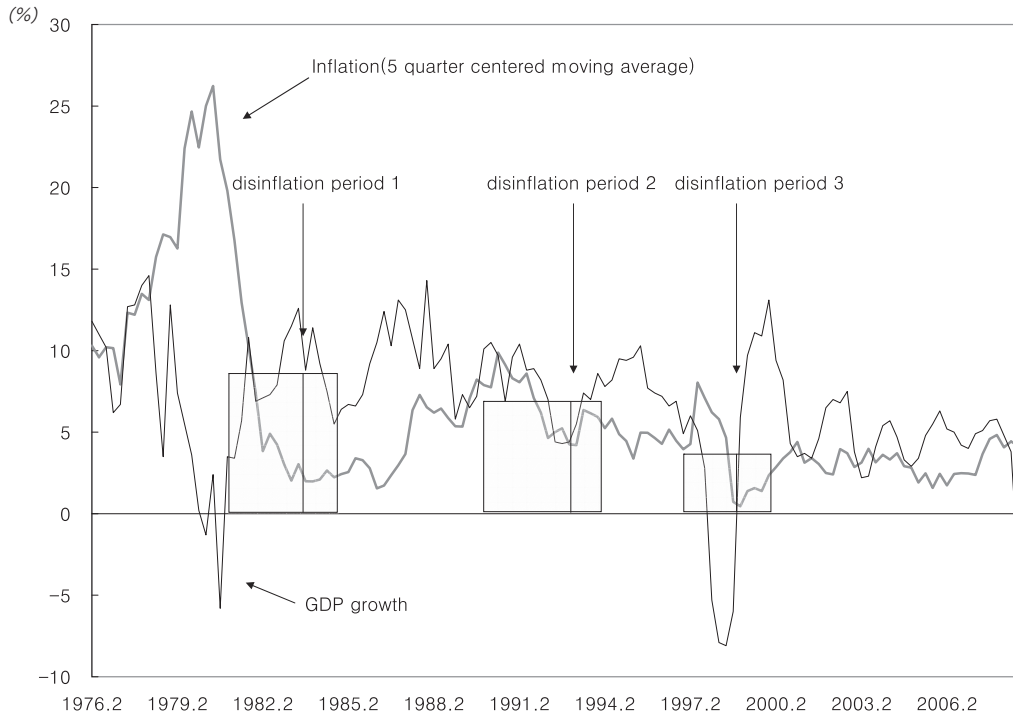


FIGURE 5: Disinflationary Episodes

to engineer an inflation increase, and vice versa. In this respect, a better understanding of the true measurement of the sacrifice ratio, usually referred to as the total output loss arising from a permanent one percentage point reduction in inflation, would provide a useful guide for determining an optimal inflation target level.

While a number of methods for estimating sacrifice ratios have been offered, we focus on estimating the sacrifice ratio using the models examined by Ball (1994) and Cecchetti and Rich (2001), among others. Ball (1994) focuses solely on specific disinflationary episodes — periods when contractionary monetary policy are believed to have caused reductions in both inflation and output. The first step in Ball is to identify the disinflationary episodes in which trend inflation falls substantially. Trend inflation is a smoothed version of actual inflation, defined as a nine-quarter centered moving average of actual inflation: trend inflation in quarter  $t$  is the average of inflation from  $t-4$  through  $t+4$ . A disinflationary episode is defined as any period that starts at an inflation peak and ends at a trough having an annual rate at least two points lower than the peak. A peak is defined as a quarter in which trend inflation is higher than in the previous four quarters and the following four quarters; a trough is a quarter when trend inflation is lower than the four quarters on each side. Ball then develops a simple method for estimating the sacrifice ratio for each disinflationary period: he calculates the ratio of the total output loss to the change in trend inflation. The denominator of the sacrifice ratio is the change in trend inflation over the disinflationary episode — the difference between inflation at the peak and at the trough. The numerator is the sum of the deviations of actual output

TABLE 1: Disinflationary Episodes and Sacrifice Ratios

Episodes	Change in Inflation (A)	Accumulated GDP Gap (B)	Sacrifice Ratio (B/A)
81. 4 – 84. 1	8.3%p	13.7%	1.7
90. 3 – 93. 2	5.7%p	9.9%	1.7
97. 2 – 99. 1	7.6%p	14.1%	1.9
Average	7.2%p	12.6%	1.8

from its trend or natural level over an episode. Ball assumes that output is at its trend level at the inflation peak and again at its trend level four quarters after the inflation hit peak, or four quarters after the trough. The underlying reason behind this assumption is that output tends to return to trend with a lag as the effects of disinflation are persistent. Trend output is illustrated as a log-linear line connecting the two actual output levels. Thus, the numerator of the sacrifice ratio can be measured as the sum of deviations between the fitted trend and log output.

We apply Ball's approach to the Korean case using quarterly data on CPI inflation and real GDP.<sup>15)</sup> Figure 5 presents three disinflationary episodes starting in inflation peaks and ending in troughs: one occurring during the early 1980s and the other two in the 1990s. So as to eliminate the noise, we define trend inflation as a five-quarter centered moving average, which differs from Ball's (1994) nine-quarter centered moving average, reflecting a short duration of the business cycle of the Korean economy. The quarter at time  $t$  is an inflation peak (trough) if trend inflation at time  $t$  is higher (lower) than trend inflation at time  $t-1$  or time  $t+1$ . Following Ball (1994), we determine trend output by connecting output at the inflation peak to output four quarters after the trough. Inflation and output are measured by the change in the consumer price index (CPI) and real gross domestic product (GDP), respectively, over the period 1975:Q1 – 2005:Q4. According to Ball's (1994) estimates using quarterly data, there are sizable differences in the sacrifice ratios across countries, with the highest ratios occurring in Germany (2.9) and the United States (2.4), and the lowest (0.8) in both France and the United Kingdom. Our estimate of the average sacrifice ratio, 1.8, is within the previous range but a little higher than average.

Table 1 reports the sacrifice ratio for each disinflationary episodes identified over the period 1976:Q1 – 2005:Q4. It turns out that trend inflation falls by an average for the three episodes of 7.2 percentage points (annually). The average sacrifice ratio across the three disinflationary episodes is 1.8. Interestingly, the sacrifice ratios for individual episodes are roughly the same order of magnitude.

Next, we generate estimates of the sacrifice ratio using the two-variable structural vector autoregression (SVAR) system considered by Cecchetti (1994) and Cecchetti and Rich (2001). As we have noted, Ball (1994) focuses on the disinflationary episodes in which inflation is reduced and output falls solely due to a policy shift to tight money, while ignoring the cases

15) Following analyses are adopted from Junhan Kim (2006a).

in which inflation increases and output rises as a result of shifts that move toward monetary loosening. Another potential problem with Ball's approach lies in his implicit assumption that aggregate supply shocks are not occurring during the disinflationary episodes. Ball admits that such supply shocks can create measurement errors in his estimates of the impact of monetary policy on output and inflation for these episodes, but does not attempt to identify aggregate demand (or monetary) and aggregate supply shocks. Cecchetti (1994) and Cecchetti and Rich (2001) address these concerns about Ball's methods by creating an estimate of the sacrifice ratio that is based on the structural identification of aggregate demand and aggregate supply shocks using a two-variable structural VAR system. To this end, they focus on obtaining information about the impact of aggregate demand policy on output and inflation from upturns as well as downturns by identifying the aggregate demand and aggregate supply shocks explicitly based on the SVAR approach. The SVAR model with identifying restrictions based on economic theory allows us to interpret one of the two structural innovations as a monetary policy (or aggregate demand) shock, and evaluate monetary policy's impact on output and inflation and thus measure the sacrifice ratio. Following Cecchetti (1994) and Cecchetti and Rich (2001), we consider the following two-variable VAR model:

$$y_t = \sum_{i=1}^n a_{11}^i y_{t-i} + a_{12}^0 \pi_t + \sum_{i=1}^n a_{12}^i \pi_{t-i} + \epsilon_t^y \quad (1)$$

$$\pi_t = a_{21}^0 y_t + \sum_{i=1}^n a_{21}^i y_{t-i} + \sum_{i=1}^n a_{22}^i \pi_{t-i} + \epsilon_t^\pi \quad (2)$$

Where  $y_t$  is the log of output at time  $t$ ,  $\pi_t$  is the inflation rate between time  $t-1$  and  $t$ ,  $\epsilon_t^y$  is an aggregate supply shock at time  $t$ ,  $\epsilon_t^\pi$  is an aggregate demand shock at time  $t$ , and  $\epsilon_t$  is assumed to be i.i.d. and serially uncorrelated with the covariance matrix  $E[\epsilon_t \epsilon_t'] = \Omega$  for all  $t$ . To evaluate the dynamic impact of the structural shocks including a monetary policy shock on output and inflation, we need to invert the VAR representation (equations (1) and (2)) into the unrestricted vector moving average (VMA) representation of (equations (3) and (4)), which provides the impulse response of the output and inflation to structural shocks:

$$y_t = \sum_{i=0}^{\infty} b_{11}^i \epsilon_{t-i}^y + \sum_{i=0}^{\infty} b_{12}^i \epsilon_{t-i}^\pi = B_{11}(L) \epsilon_t^y + B_{12}(L) \epsilon_t^\pi \quad (3)$$

$$\pi_t = \sum_{i=0}^{\infty} b_{21}^i \epsilon_{t-i}^y + \sum_{i=0}^{\infty} b_{22}^i \epsilon_{t-i}^\pi = B_{21}(L) \epsilon_t^y + B_{22}(L) \epsilon_t^\pi \quad (4)$$

Where  $B_{ij}(L)$  is a polynomial in the lag operator  $L$ . Following Blanchard and Quah (1989), we impose the restriction  $B_{12}(1) = 0$ , which implies that aggregate demand shocks ( $\epsilon_t^\pi$ ) have no long-run effect on the level of output ( $y_t$ ). The effect of a monetary policy shock on the



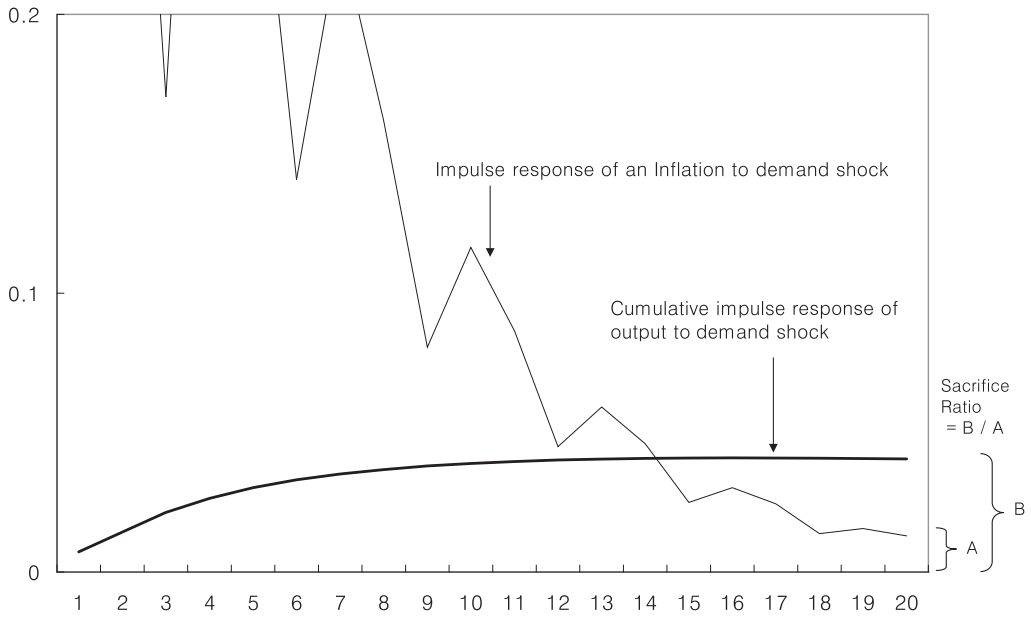


FIGURE 6: Impulse Responses of Output and Inflation

level of inflation, over a horizon  $\tau$  is the sum of the coefficients in  $B_{22}(L)$ , which can be written more specifically as  $\partial\pi_{t+\tau}/\partial\epsilon_t^\pi = b_{22}^i$ . The impact of a monetary policy shock on the level of output, over a horizon  $\tau$ , can be computed from the sum of the coefficients in  $B_{12}(L)$  as  $\partial y_{t+\tau}/\partial\epsilon_t^\pi = \sum_{j=0}^{\tau} (b_{12}^j)$ . The relative impact of monetary policy on output and inflation yields an estimate of the sacrifice ratio ( $S(\tau)$ ), over a horizon  $\tau$  which can be computed as equation (5):

$$S(\tau) = \frac{\sum_{j=0}^{\tau} (\partial y_{t+\tau}/\partial\epsilon_t^\pi)}{(\partial\pi_{t+\tau}/\partial\epsilon_t^\pi)} = \frac{(\sum_{i=0}^{\tau} b_{12}^i)}{b_{22}^i} \quad (5)$$

The numerator of  $S(\tau)$  in equation (5) measures the cumulative output loss through the first  $\tau$  periods, while the denominator implies the magnitude of disinflation through the  $\tau$  periods. Following Cecchetti, we examine the case in which the horizon is relatively short. We truncate the structural VMA representation (equations (3) and (4)) at 20 quarters and set  $\tau$  equal to five years. It appears that five years would be a reasonable characterization of the period after which a monetary policy shock is regarded as having a permanent effect on the level of inflation. Estimating the sacrifice ratio of equation (5) by setting  $\tau$  equal to five years for the period 1980:Q1 – 2005:Q4 yields a sacrifice ratio  $S(\tau)$  of 3.1. Figure 6 illustrates the relationship between the sacrifice ratio and the sum of the structural impulse response functions for output and inflation occurring 20 quarters (five years) after a shift in monetary policy. The numerator of  $S(\tau)$ , which measures the cumulative five-year output loss from a

contractionary monetary policy undertaken at time  $t$ , turns out to be 0.041 (denoted by B in Figure 6), while the denominator, measuring the impact of the contractionary monetary policy on disinflation five years later, is a much smaller 0.013 (denoted by A in Figure 6). Note that there are some differences in magnitude between the responses of inflation and output. A contractionary monetary shock leads to a more rapid decrease in inflation along with a modest and more protracted output decline. Taken together, the estimates presented yield a plausible approximation of the sacrifice ratio for Korea, ranging from 1.8 by Ball's method to 3.1 by Cecchetti's method based on the structural VAR estimates. On balance, the evidence suggests that the Bank of Korea needs to be very cautious in lowering the current inflation target level (the medium-term inflation target is set at 3%), in the sense that inducing disinflation in the present era of low inflation would be more costly. It seems most likely that if an inflation reduction by one percentage point would cause a loss in total output (real GDP) of as much as two to three percent, it would be hard to claim that the benefits from disinflation outweigh its costs.<sup>16)</sup>

### 3.2 The Choice of Target Index (Core vs. Headline CPI Index)

One of key issues that need to be determined to implement inflation targeting involves which price index is more appropriate for the Bank of Korea to target — headline CPI or core (or underlying) CPI inflation. In deciding on the price index, what matters from a practical point of view is whether a monetary authority implementing IT should be held responsible for non-monetary factors such as supply shocks that typically tend to be the most volatile. It has been argued that targeting headline CPI, that is more subject to supply shocks, may not be appropriate. This has led many countries adopting IT monetary regimes to favor targeting a narrower measure of core (or underlying) inflation rather than headline CPI inflation. However, one argument against targeting core CPI is that targeting a narrowly defined index such as core CPI may not provide a useful guide for the formation of inflation expectations. While the decision on which price index to target depends on a balancing of its costs and benefits, empirical analysis will in the end shed light on this issue. To address this issue, we first examine the basic statistics and univariate AR (lag=12) models for headline CPI, core CPI, and the agricultural and petroleum products (APP) price index, which is most subject to supply shocks in headline CPI and excluded from core CPI, as shown in Table 2. All price indices considered here are monthly data covering the period from 1999:1 to 2007:11 and published by the Korea National Statistics Office. Note that the volatility of the APP price index, with a weight of 10.8, as measured by the standard deviation of its annual percentage change, turns out to be much larger than that of headline CPI. It is thus likely that APP price volatility would have a non-negligible impact on headline CPI. However, the persistence of the shocks in core CPI, as measured by the sum of the AR coefficients, is a little bit larger than that of headline

16) It is worth noting that the identifying restrictions of Cecchetti's two-variable SVAR system could generate misleading estimates of the sacrifice ratio arising from the inherent difficulty in identifying separate components of aggregate demand shocks. Thus, it is not wholly implausible for the estimated monetary policy shock (identified as the aggregate demand shock) to also include other shocks to government spending or shifts in consumption, as well as changes in monetary policy (Cecchetti and Rich, 2001).

TABLE 2: AR Models for CPI Inflation

	Headline CPI	Core CPI	Agricultural and Petroleum Products Price Index
Weight in headline index	100	89.2	10.8
Annual percent change Average	2.72	2.36	5.41
Standard Deviation	1.04	0.99	4.13
Correlation with CPI Inflation	1.00	0.88	0.56
AR model (lag=12)			
Adjusted R2	0.82	0.92	0.52
Sum of AR coefficients	0.72	0.83	0.56
Standard error	0.44	0.28	2.85

CPI.

Table 3 presents summary statistics for the time-series data of the all-item CPI (headline CPI) and core CPI indexes over both the pre-crisis period (1990–1998) and the post-crisis period (1999–2006) during which the Bank of Korea conducted monetary policy according to a flexible inflation targeting framework. We measure inflation as the monthly change in the natural log of the price level from 1990:1 through 2006:12. The annualized monthly inflation rates for both measures of CPI averaged 5–6% during the pre-crisis period, but began to slow down in 1999 and halved to less than 3% over the post-crisis period. Furthermore, the variances of both CPI inflations have also been lowered: the standard deviation of the headline CPI inflation rate has declined slightly from 6.4% over the pre-crisis period to 5.4% for the post-crisis one, while that of core CPI inflation has fallen considerably from 4.9% to 2.9% for the same period. Especially, note that the difference in the standard deviations of the headline CPI and core CPI inflation for the post-crisis period (2.5%) is on the order of 1.0%p greater than that between them during the pre-crisis period (1.5%).

Table 4 reports summary statistics for the cross-sectional distribution of the annualized monthly price changes over the pre-crisis and post-crisis periods, using data on 516 components of the all-item CPI and 467 components of the core CPI over the period 1990:1–2006:12. We aim to examine whether summary statistics of the cross-sectional distribution of the annualized monthly price changes conform to the basic statistics of time-series variations of the two CPI inflations in Table 3.

Relative to the pre-crisis period, the mean value of the cross-sectional distribution of the two CPI inflations halves over the post-crisis period—during which the Bank of Korea has been implementing a flexible inflation target. This result is quite in line with the mean pattern of the aforementioned time-series variations of both CPI inflations during the same period. The standard deviation of the cross-sectional distribution of the all-item CPI inflation, unlike that of the time-series data of the all-item CPI, shows a 5%p increase in the post-crisis period

TABLE 3: Summary Statistics of Headline and Core CPI Inflation

	1990–1998	1998–2006	1990–2006 (%)
All Item CPI			
Mean	5.7	2.9	4.4
Standard Deviation	6.4	5.4	6.1
Core CPI			
Mean	5.2	2.5	4.0
Standard Deviation	4.9	2.9	4.3

TABLE 4: Summary Statistics of Price-changes Distribution

	1990–1998	1998–2006	1990–2006
All-Item CPI (A)			
Mean	5.0(5.7)	2.5(2.9)	3.9(4.4)
Standard Deviation	37.2	43.2	40.0
Kurtosis	106.7	96.7	102.3
Skewness	2.4	1.4	1.9
Core CPI			
Mean	4.4(5.2)	2.1(2.5)	3.4(4.0)
Standard Deviation	20.8	19.4	20.2
Kurtosis	81.1	71.2	76.7
Skewness	3.5	2.1	2.9

compared to the pre-crisis one. In addition, the standard deviation of the cross-sectional distribution of core CPI inflation remains almost the same during the two periods, while that of the time series variations of the core CPI inflation falls off significantly. The skewness of the cross-sectional distribution of the two measures becomes lower over the post-crisis period than for the pre-crisis one, implying more likelihood of recent distributions of the two CPI inflations being symmetrical. The kurtosis of the cross-sectional distribution of both measures still remains at a high level during the two periods, while it shows a 10%p decline in the post-crisis period compared to the pre-crisis period. This result suggests that the cross-sectional distribution of the two CPI inflations may be leptokurtic: the distribution has fatter tails than the normal distribution. As mentioned above, evidence from both time-series data and cross-sectional distributions indicates that the mean and variance of the two measures have declined slightly since the adoption of inflation targeting by the Bank of Korea in 1999. However, the finding that the kurtosis not only remains at a high level but that the optimal trim level has also

TABLE 5: Comparison of the Portion of Excluded Components

		(%)
All-Item CPI	APP Price Index	
10	11.5	
20	27.1	
30	41.6	
40	50.7	

risen in the post-crisis period compared to the pre-crisis period appears to be providing similar signals on the potential problem of high-frequency noise in recent distributions of the two measures.

Another interesting exercise is to examine whether APP price inflation is really more liable to suffer supply shocks than the all-item CPI (headline CPI) inflation, by exploring how often APP price components fall in the tails of the all-item CPI inflation distribution. As we have mentioned, one common method for measuring underlying or core components of inflation excludes certain prices such as those of the APP price index from the computation of the index on the assumption that these components represent high-variance noise. For this exercise, we use the cross-sectional distribution of the annualized monthly price changes over the period 1990:1–2006:12, based on 516 components of the all-item CPI and 49 components of the APP price index. The results in Table 5 indicate that there is no big difference in the proportion of excluded components between the all-item CPI inflation and APP price inflation. The components of APP price inflation found in the 10% lower and upper tails (combined) of the distribution of the all-item CPI inflation turn out to be 11.5%, which is very close to the 10% level for all-item CPI inflation. As the cutoff of the distribution gets larger (e.g., 20%, 30%, etc.), the proportion of components excluded from APP price inflation tends to exceed that of the all-item CPI inflation by about 10%p. From this it would appear to be misleading to exclude the APP price index from the computation of the aggregate CPI.

Our next task is to demonstrate the effect of the APP price shock on headline CPI and core CPI at the relevant target horizon, so as to assess whether including the APP price index in the targeted CPI index makes any difference or not. To this end, we use a three-variable VAR model, including both measures of CPI inflation along with the APP price inflation, to estimate the dynamic impulse responses of each measure of CPI inflation to APP inflation shock (see Hoffmaister, 2001). Figure 7 shows that a one standard deviation shock (or a one percentage point shock) to APP price index translates into a larger response in headline CPI inflation than in core CPI, reflecting the higher correlation between headline CPI inflation and APP price inflation. A one percentage point shock to APP price inflation leads to an increase in headline CPI inflation of about 0.4 percentage points in two months after impact and a steady decline thereafter, with mean reversion at around the seventh month. Meanwhile, core CPI inflation shows a very modest response to APP price inflation shock within seven months. This result

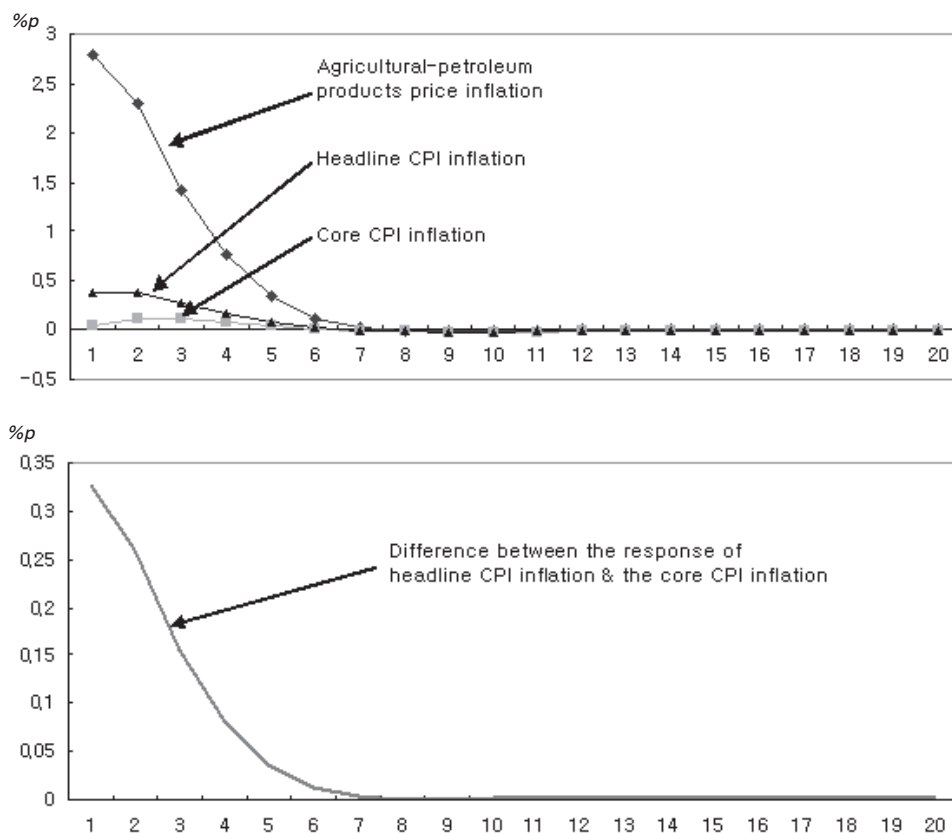


FIGURE 7: Impulse Responses to APP Inflation shock

implies that headline CPI inflation is more vulnerable to supply shocks for a shorter horizon. As the lower panel of Figure 7 reveals, the difference between the response of headline and core CPI inflation following the APP price inflation shock is about 30bp at the first month, and quickly dies out in seven months. What is of particular interest in this experiment is the finding that as long as the inflation target horizon is at least greater than a year it will make no difference whether the BOK targets headline or core CPI.

Statistically, if the population distribution has fat tails, then the mean of a sample distribution with trimmed tails will be a more efficient estimator of the population mean than the mean of the untrimmed distribution. The fat tails of the price change distribution all imply large price movements relative to the average. Thus, excluding fat tails (outlying portions) from the price change distribution of the components of the aggregate CPI would help isolate the price changes of the components expected to persist over medium-term horizons of several years and thereby allow the more precise estimation of the average price change (trend inflation). This statistical argument is a driving force that underpins the use of what is termed the “trimmed

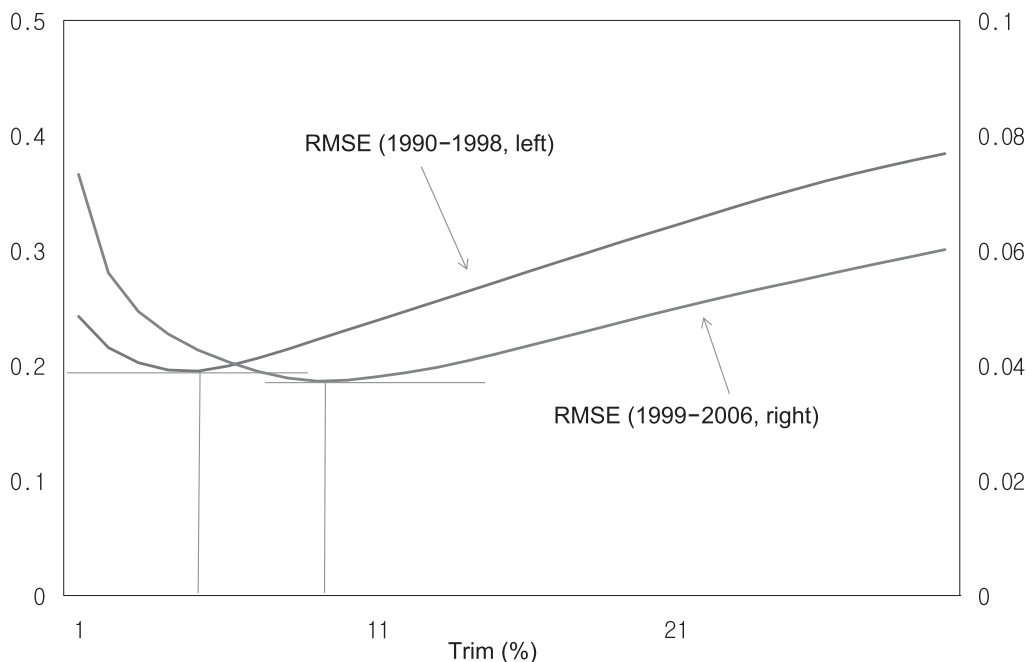


FIGURE 8: RMSE of Trimmed Mean Estimators

mean”<sup>17)</sup> which is a commonly used measure of core inflation.

As a final exercise, we examine whether there is any noteworthy change in the crosssectional distribution of aggregate CPI inflation in the post-crisis period compared to that preceding the crisis, using the estimators of the trimmed mean and optimal trim. Following Bryan and Cecchetti (1994) and Bryan et al. (1997), we first calculate the trimmed means, which are limited-influence estimators that average only the central part of the cross-sectional distribution after truncating the tails.<sup>18)</sup> We then compute an optimal trim that minimizes the averaged deviations (RMSE) of the monthly price change of trimmed components from trend inflation approximated by the twenty-four month centered moving average of the CPI inflation. The

17) This core inflation measure was proposed by Bryan and Cecchetti (1994), and Wiggins (1997). The methodology has been applied to the New Zealand CPI inflation rate by Roger (1997), and to the United Kingdom inflation rate by Hasan and Yates (1999). Clark (2001) also evaluates five core inflation measures including the trimmed mean, by three different criteria: accuracy in tracking trend inflation, predictive content for future inflation, and complexity. He finds that the trimmed mean turns out to perform better in the USA than the core inflation measures considered.

18) The trimmed mean is calculated using the following steps. First, compute the monthly percent change in each component of the CPI and then rank them from the smallest to the largest; second, construct the cumulative sum of the relative importance of weights for each rank ordered price change; third, truncate those ordered price changes for which the cumulative weights are either less than  $x\%$  or greater than  $(100-x)\%$  of the distribution; fourth, for the ordered price change that has a cumulative weight ( $W_i$ ) greater than  $x\%$  or less than  $(100-x)\%$ , reset the corresponding weight as  $(W_i-x)\%$  or as  $(100-2x)\%$ ; and finally, re-weight the truncated ordered price changes and normalize them so that the weights given to the components included add up to 1, which yields a trimmed mean. For more detailed elaboration on the methods of computation, refer to Clark (2001) and Bryan et al. (1997).



trimmed means are calculated using monthly data on 516 components of the aggregate CPI (seasonally adjusted) in the pre-crisis and post-crisis periods. Figure 8 displays the RMSEs of trimmed estimators and an optimal trim for each period. One intriguing result is that the optimal trim that minimizes the RMSEs is found to have risen from 5% in the pre-crisis period to as much as 9% under the inflation targeting regime. This means that an efficient trimmed mean can be obtained over the post-crisis period by trimming 9% from each tail of the distribution, as against a truncation of 5% from each tail for the pre-crisis period. On balance, this evidence suggests that we can obtain an efficient measure of core inflation by discarding a larger portion of the tails in the distribution of individual price changes. While the inflation became more stable under IT regime, this does not necessarily vouchsafe that individual price components contain more accurate information about the trend inflation.

### 3.3 Target Horizon

As Mishkin (2000) argued, the use of too short a horizon can lead to too frequent misses of the inflation target and thus pose a controllability problem, even when monetary policy is being conducted optimally. In addition, too short a horizon can bring about instability in policy instruments, because attempts to achieve the inflation target over the short horizon will induce policy instruments to move around too much. In this respect, a recent study by Junhan Kim (2006b) will help gain insight into the optimal inflation target horizon in Korea.

Kim (2006b) claims that by adding a medium-term constraint requiring averaged inflation over a certain horizon to be on target, to an otherwise standard central bank's optimization problem, the second best result can be attained under discretionary monetary policy. The reason for this outcome is that the constraint works as a committing mechanism for the central bank. This is in line with the literature on 'the conservative central bankers.' A more detailed elaboration on the features of the central bank's optimization problem and a key finding on the optimal horizon would be informative for evaluating the current inflation target horizon in Korea. As shown in equation (6), the central bank is assumed to minimize its loss function, defined as the weighted sum of changes in the inflation gap ( $\pi_t^2$ ) and the output gap ( $y_t^2$ ) from their respective target values,<sup>19)</sup> subject to the constraint of the typical Phillips curve (equation (7)) and the medium-term constraint (equation (8)).

$$\min \quad L^{CB} = (1 - \beta)E_0 \sum_{t=0}^{\infty} \beta^t [\pi_t^2 + \lambda y_t^2], \quad (6)$$

$$\text{s.t.} \quad \pi_t = \beta E_t \pi_{t+1} + \alpha y_t + \epsilon_t, \quad (7)$$

$$E_0 \sum_{h=0}^{H-1} \pi_{t+h} = 0, \quad H \geq 1, \quad (8)$$

$$\text{and} \quad \epsilon_t = \rho \epsilon_{t-1} + u_t. \quad (9)$$

Where  $\epsilon_t$  in equation (9) is the cost-push shock, and is assumed to follow an AR(1) process;  $u_t$  is the mean zero and a constant variance *i.i.d.* process;  $H$  is the horizon over which

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19) Target values are normalized to zero.

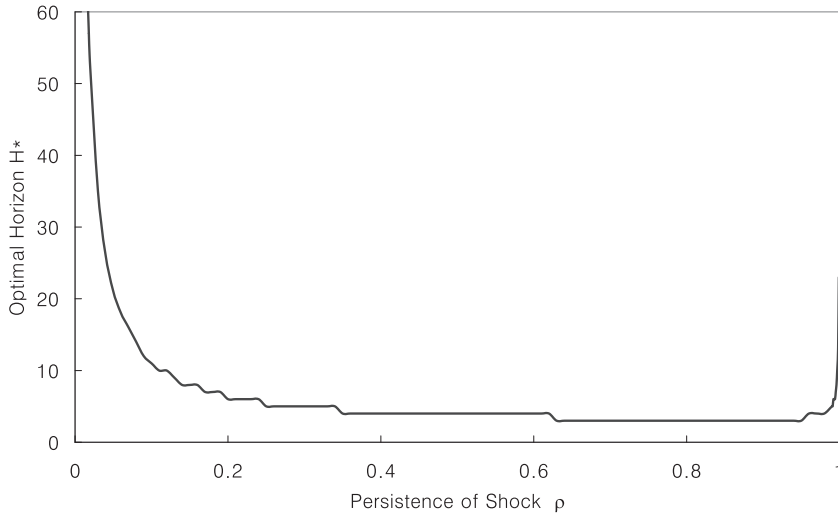


FIGURE 9: Persistence of Cost-push Shocks and Optimal Target Horizon

inflation is averaged. Under the assumption that the central bank cannot commit credibly to its future actions (i.e., monetary policy is inevitably discretionary), deriving optimal solutions for  $\{\pi_t, y_t\}$  and rearranging in terms of  $\pi_t$  yields the following optimal solution for  $\pi_t$ :

$$\pi_t = -\frac{\lambda}{\alpha} \left( y_t - \frac{1}{H} \sum_{h=0}^{H-1} y_{t+h} \right) \quad (10)$$

Equation (10) implies that optimal monetary policy under inflation targeting would be to maintain an inflation rate at time  $t$  that is proportional to the output gap normalized by the averaged future output gaps over a certain horizon  $H$ . As a next step, expressing both  $\pi_t$  and  $y_t$  in terms of  $\epsilon_t$ , substituting  $\pi_t = f(\epsilon_t)$  and  $y_t = f(\epsilon_t)^{20)}$  into the loss function (6) approximated by the sum of  $\text{Var}(\pi_t)$  and  $\text{Var}(y_t)$ , and taking the derivative of the sum of  $\text{Var}(\pi_t)$  and  $\text{Var}(y_t)$  with respect to  $H$  would lead to the following optimal target horizon  $H^*$ .<sup>21)</sup>

$$\frac{1 - \rho^{H^*}}{H^*} = \beta \rho (1 - \rho) \quad (11)$$

20)  $y_t$  and  $\pi_t$  can be denoted as functions of the cost-push shock ( $\epsilon_t$ ) using equations (7), (8), and (9), and expressing  $y_t$  and  $\pi_t$  with respect to  $\epsilon_t$  as follows.

$$y_t = \frac{\frac{\lambda}{\alpha} (1 - \frac{1-\rho^H}{H(1-\rho)})}{\frac{\lambda}{\alpha} (1 - \frac{1-\rho^H}{H(1-\rho)}) (1-\beta\rho) + \alpha} \epsilon_t, \quad \pi_t = \frac{\frac{\lambda}{\alpha} (1 - \frac{1-\rho^H}{H(1-\rho)})}{\frac{\lambda}{\alpha} (1 - \frac{1-\rho^H}{H(1-\rho)}) (1-\beta\rho) + \alpha} \epsilon_t.$$

21) The central bank's loss function, equation (6), can be approximated by  $(1 - \beta) E_0 \sum_{t=0}^{\infty} \beta^t [\pi_t^2 + \lambda y_t^2] \simeq \text{Var}(\pi_t) + \lambda \text{Var}(y_t)$ . Then, substituting  $\pi_t = f(\epsilon_t)$  and  $y_t = f(\epsilon_t)$ , and rearranging with respect to  $\epsilon_t$  yields the following result;

$c^2 (d^2 + \lambda) \text{Var}(\epsilon_t) \pi_t$  where  $c \equiv \frac{1}{d(1-\beta\rho) + \alpha}$ ,  $d \equiv -\frac{\lambda}{\alpha} (1 - \frac{1-\rho^H}{H(1-\rho)})$ . Then taking the derivative of  $\text{Var}(\pi_t) + \lambda \text{Var}(y_t)$  with respect to  $H$  will lead to equation (11).

It is straightforward from equation (11) to find a negative relationship between the optimal target horizon  $H^*$  and the AR(1) coefficient  $\rho$  measuring the persistence of the cost-push shock. As shown in Figure 9, when  $\rho$  is less than 0.1— a very modest persistence, the optimal horizon stays at a high level, suggesting that it may be desirable for the central bank to react modestly to the cost-push shock since there is a strong trade-off between  $\rho$  and the optimal target horizon  $H^*$ . Meanwhile, when  $\rho$  is within the range 0.2 and 0.95, the optimal target horizon does not show much difference. For example, the optimal target horizon  $H^*$  is 6 when  $\rho$  is equal to 0.2, but when  $\rho$  increases within the range of 0.25 to 0.34,  $H^*$  remains the same at 5. Likewise, when  $\rho$  rises within the range of 0.35 to 0.5,  $H^*$  stays the same at 4. While we need to be cautious about pinning down an optimal target horizon from this analysis, it would not be wholly implausible to suggest a period from 4 to 6 quarters as a reasonable optimal target horizon, given the presumption that  $\rho$  could be relatively persistent in a small open economy such as Korea.<sup>22)</sup>

#### 4. Conclusion

In this paper we review Korean experience with inflation targeting and address issues concerning the fine tuning of the inflation targeting framework. Although it has not yet been convincingly demonstrated that the low and stable inflation exhibited in recent years is in fact attributable to the adoption of inflation targeting, the Korean experience suggests that inflation targeting did in fact help. Actual inflation remained within the target range, inflation became less volatile, and the balance between price stability and other goals of monetary policy have been well maintained.

However, the case for its success does not go unchallenged. Price stability does not necessarily imply that measuring inflation becomes easy. In fact it is quite the opposite. Economic and financial environments are constantly changing under stable prices. This sometimes makes it even harder for central bankers to pick up on inflationary pressures in an accurate and timely manner. This is why central bankers focus more on core inflation than headline inflation, but does not necessarily imply that they should target core inflation. Inflation targeting is a monetary policy framework that constrains central bankers so that inflation bias from discretionary policy can be mitigated. It hinges on gaining trust from the public. Although the core inflation index helps us to detect trends in inflation, it poses a challenge to communication with the public. This is also true for the target level and the target horizon. They both work as a commitment mechanism. Selecting too high a target or too long a horizon, ‘optimal’ though they may be for the central bankers or economists, undermines the

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22) Hoffmaister (2001) explored several practical issues, including an optimal target horizon, for consideration in adopting an inflation targeting framework in Korea. Based on simulation exercises using the structural VAR, he argued that a target horizon of 18 months allows a reasonable balance between the volatility of real variables and the prevalence of the supply shocks in inflation outcomes. However, it turns out that horizons exceeding 18 months cause the volatilities of real interest rate and real exchange rate to increase, while shorter horizons are subject to supply shocks.

very foundation for the success of inflation targeting, which is credibility and transparency.

Consequently central bankers must choose the right balance between discretion and commitment. These are the issues addressed in this paper. First, in order to investigate the optimal target level of inflation, sacrifice ratios are calculated. Empirical evidence confirms that disinflation is not without costs, and the costs of lowering inflation seems to exceed the benefits. However, if inflation expectations can be lowered by credible and efficient monetary policy, the cost of disinflation in the future may not be as high as in the past. Second, the price change distribution is investigated for the right target index. We shows that there is little difference between agricultural and petroleum products and other products in terms of how often the price changes fall in the tails of the distribution. This implies that the benefit from the information content in core inflation may not outweigh the opacity of the concept. Last, the theoretical model for the medium-term targeting framework is suggested to shed some light on the issue of the optimal target horizon. While the persistence of price shocks is a crucial element in determining the horizon, the estimate can vary widely among models and estimation methodologies. So further research on the issue is needed.

This paper presents what we can learn from experiences, what constitute the tasks for further improvement, and how they should be tackled. This paper is not, however, intended to be a specific policy recommendation, so the results presented in this paper should be interpreted with caution. There is no doubt that further refinements are necessary both on theoretical and practical grounds.

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