

Cho, Dongchul

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Monetary Policy During and After the Crisis in Korea

Dongchul Cho

Korea Development Institute

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Foreword

It is common that interest rate policy draws a great deal of attention. However, there has been few cases that triggered such an intense debate as did the high interest rate policy carried out by the IMF and the Korean government right after the outbreak of currency crisis in 1997. This policy invited a tremendous degree of controversy among ordinary people as well as economists, both domestically and internationally. The IMF argued that the high interest rate policy was inevitable in order to stabilize perilous currency market, while others argued that this policy only raised the bankruptcy risks of highly leveraged Korean firms and destabilized the currency market. Since then, the interest rate has been lowered to a historic level, opening up the “super low interest rate era.” Just as there was hot debate about whether the interest rate was too high right after the currency crisis, there is now debate on whether the current interest rate is too low.

Motivated by these debates, Dr. Dongchul Cho attempts to assess the post-crisis interest rate policy. More specifically, he raises two questions: (i) whether the high interest rate policy right after the outbreak of crisis was effective on exchange rate stabilization and (ii) whether the post-crisis interest rate policy can be justified in light of the optimal monetary policy rule framework. In order to answer the first question, he presents a theoretical framework that explains how a temporarily high interest rate policy can stabilize the depreciating exchange rate through either signaling effect or unanticipated monetary shock. As for empirical evidence, he summarizes the existing literature showing that the results are still inconclusive. In order to answer the second question, he calibrates an optimal monetary policy model. Using the result of this experiment, he argues that the high interest rate policy appears hard to be justified from the second quarter of 1998. He also argues that the low interest rate policy since 1999 can be justified only when GDP deflator as opposed to Core CPI was used, while leaving the question unanswered whether GDP deflator is a better measure of inflation than Core CPI.

I hope this work by Dr. Cho can help scholars and policymakers to better understand the post-crisis interest rate policy, from which future monetary policymaking will eventually benefit. Finally, Dr. Cho and I share the appreciation toward the Research Center for International Finance(RCIF) for their full support on this research.

Choong Soo Kim
President
Korea Development Institute

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Summary

This paper discusses Korea's post-crisis monetary policy, focusing on two questions: (i) whether the high interest rate policy right after the outbreak of crisis was effective on exchange rate stabilization and (ii) whether the post-crisis interest rate policy can be justified in light of the optimal monetary policy rule framework. In the first part, this paper presents a theoretical framework that explains how a temporarily high interest rate policy can stabilize the depreciating exchange rate through either signaling effect or unanticipated monetary shock. As for empirical evidence, the paper summarizes the existing literature showing that the results are still inconclusive, but if there is any country in Asia where the policy was effective, it is likely to be Korea. Then the paper discusses conjectures that can explain this result for Korea. In the second part, this paper discusses monetary policy objectives and implied interest rate policy rules, and how to understand the post-crisis interest rate policy of Korea by comparing calibration results of such policy rules with the actual interest rate policy. The high interest rate policy in 1998 can be justified only when the actual (year-on-year) inflation rates as opposed to expected inflation rates were used. In contrast, the low interest rate policy since 1999 can be justified only when GDP deflator as opposed to Core CPI was used. Then the paper criticizes the actual year-on-year inflation rate as an inflation index for the monetary policy, and argues that the high interest rate policy appears hard to be justified from the second quarter of 1998.

CHAPTER 1

Introduction

Korean history will probably record the last three years of the 20th century as a period of dramatic economic policy experiments. Reforms affected virtually the entire economy, from financial and labor markets to the corporate and government sectors.

Macroeconomic policy was no exception. Immediately following the outbreak of the crisis, the fiscal authority decided to mobilize funds totaling more than 12 percent of GDP for purposes of financial sector restructuring. But this was nothing compared to the revolution in monetary policy. Before the crisis, the fluctuation of the currency was limited to a narrow range, and a variety of restrictions were maintained on capital inflows and outflows. The crisis led to a complete change of face: the exchange rate was allowed to float freely, and the capital account was liberalized. Inflation targeting was introduced as a legal mandate, and the intermediate target of monetary policy was shifted from the monetary aggregates such as M2 to short-term interest rates.¹

Perhaps the most dramatic and controversial aspect was interest rate policy. In November and December 1997, when the currency crisis was triggered, stabilization of the exchange rate had been the foremost policy objective. Overnight inter-bank call rates were raised to more than 30 percent from the previous level of 12 to 13 percent in order to attract capital inflows and limit outflows. Partly in response, the GDP growth rate plunged to -8 percent (year-on-year) in the second quarter of 1998, and the unemployment rate skyrocketed to over 8 percent, from less than 3 percent before the crisis. A large number of firms, unable to bear the now higher costs of servicing their debts, were plunged into bankruptcy, and the volume of non-performing loans in the financial sector rose explosively.

Eventually, the foreign exchange market stabilized, and the call rate was lowered to 8 percent by the end of September 1998. On September 30 the Bank of Korea lowered the call rate target by 100 basis points, signaling that the goal of monetary policy had shifted from stabilizing the currency's value to boosting the economy. The call rate continued to be lowered until it hit historically low levels of 4 to 5 percent, inaugurating the era of "super-low interest rates." The path of interest rates is shown in Figure 1,

1. Detailed explanations about the evolution of monetary policy scheme in Korea after the crisis can be found in Cho (2002).

together with the won/dollar exchange rate, and along with the corresponding variables in Thailand and the Philippines.

There has been no shortage of arguments criticizing and defending the interest rate policies adopted in response to the crisis. The relevant literature is already very large. Rather than surveying this terrain again, in this paper I focus on two issues that require further clarification and that would benefit from additional research. These issues are whether the high interest rate policy was effective in stabilizing the exchange rate and whether post-crisis interest rate policy was too tight or too loose when judged from the vantage point of the literature on optimal interest rate rules. If the high interest rate policy was ineffective or, rather, contributed to further depreciation of the exchange rate after the crisis, it was then a mistake. But even if the policy helped to stabilize the exchange rate, it still does not sufficiently justify the high interest rate policy in terms of whether it was an efficient means of achieving the ultimate goal of monetary policy -- stabilization of inflation and output.

CHAPTER 2

The High Interest Rate Policy

Interest rate policy was at the center of the crisis program designed by the International Monetary Fund and implemented by the Korean government. The country's agreement with the Fund essentially declared that the immediate goal was to stabilize the exchange rate (not inflation or the level of output) and that the interest rate would be raised substantially to achieve this end.²

2.1 Theoretical Underpinnings

Along with questions about whether this focus on stabilizing the exchange rate was justified as a way of restoring confidence in financial markets and stability to the Korean economy, given that the country had already taken some steps toward making its exchange rate more flexible in the years leading up to the crisis, the presumption that interest rate hikes were the appropriate device for achieving that goal was also challenged in the literature on the Asian crisis countries (see e.g., Furman and Stiglitz 1998). The conceptual framework laid out by Cho and West (2001) is helpful for addressing this question. That framework starts with the uncovered interest parity condition, which can be written as:

$$(1) \quad i_t = E_t s_{t+1} - s_t + d_t.$$

where i_t is (net) domestic interest rates; s_t is the log of the spot exchange rate

2. The Letter of Intent stated that "[m]oney market rates will be allowed to rise sufficiently and will be maintained at that level or higher as needed to stabilize the market"(1997.12.3); "Raise call rates to 30%, or above if needed, to stabilize the exchange rate" (1997.12.24); "Call rates have been at around 30% since Dec. 26 and will be kept high until the foreign exchange situation improves" (1998.1); "With the mitigation of the immediate foreign exchange crisis, call rates will be cautiously allowed to ease, in line with continued exchange rate stabilization" (1998.2); "Interest rate policy will continue to be conducted in a flexible and symmetric manner. Subject to the objective of maintaining stability in the foreign exchange market, call interest rates will continue to be lowered, in line with market conditions" (1998.5); "Interest rate policy will continue to be conducted in a flexible manner with upward and downward adjustments as necessary." (1998.7); "Easy monetary stance will be maintained" (1998.11).

(with higher values indicating depreciation); E_t denotes expectations; and d_t is a risk premium that incorporates the fluctuation of foreign interest rates. The orthodox relationship follows directly: if i_t is increased, but $E_t s_{t+1}$ and d_t are unchanged, then s_t must fall (the exchange rate must appreciate).

This channel may be offset, however, insofar as increases in the interest rate are associated with increases in the risk premium. That is, the effect of i_t on s_t depends on the indirect but endogenous movement of d_t , which may be represented by:

$$(2) \quad d_t = \lambda i_t + \mathbf{u}_{dt},$$

where λ is a parameter and \mathbf{u}_{dt} is a disturbance term. The conventional view would be $\lambda < 0$ or $\lambda = 0$. In an alternative view, such as that of Furman and Stiglitz (1998), $\lambda > 0$ (or substantially greater than zero), higher interest rates are associated with higher risk.

It is important to note that while the monetary authority sent consistent signals that the high interest rate policy was temporary, it also indicated that the timing of its abandonment would depend on the movement of the exchange rate. Since investors in the currency market were forward looking, they presumably incorporated this information into their expectations. This idea can be captured by modeling i_t as endogenously determined through the policy reaction function:

$$(3) \quad i_t = a E_{t-1} s_t + u_{mt}$$

where a is a parameter and u_{mt} is a disturbance term. The IMF's preferences can be modeled by assuming $a > 0$; in other words, the monetary authority leans against expected exchange rate depreciation.

Equations (1)-(3) can be used to derive solutions for the three endogenous variables, i_t , s_t , and d_t , under the stability assumption $0 < b \equiv [1 + a(1 - \lambda)]^{-1} < 1$. In order to make the implications more transparent, assume that both \mathbf{u}_{dt} and \mathbf{u}_{mt} follow AR(1) processes with the AR coefficients $0 < \phi_d < 1$ and $0 < \phi_m < 1$, respectively: $\mathbf{u}_{dt} = \phi_d \mathbf{u}_{dt-1} + \varepsilon_{dt}$ and $\mathbf{u}_{mt} = \phi_m \mathbf{u}_{mt-1} + \varepsilon_{mt}$, where ε_{dt} and ε_{mt} are innovations. The Appendix uses these assumptions to derive explicit solutions for the effects of exogenous variables. Figure 2 summarizes those solutions intuitively.

Suppose that there was a shock to the risk premium term, ε_{dt} , at time 0. (This can be thought of as capturing the impact of the crisis elsewhere in Asia on Korea.) This unanticipated increase in risk causes the exchange rate to depreciate and the interest rate to rise (i.e., both i_t and s_t rise). In Figure 2, this is represented by an upward shift of the interest rate-exchange rate frontier which connects the equilibrium values of s_t and i_t (where the

parameter a is still to be determined).³ If it is assumed that the risk premium is persistent (that is, that $\phi_d > 0$) and that the system is stable ($0 < b \equiv [1 + a(1 - \lambda)]^{-1} < 1$), then the frontier gradually shifts back to the origin following the shock. One may justify this persistence by the fact that the restoration of market confidence or foreign reserves takes time.

Given this frontier, a monetary authority for which the level of the exchange rate appears in the objective function can resort to two tools. First, it can operate on investors' expectations by announcing a monetary policy rule. This can be captured by assuming an increase in the parameter a , and by the upward rotation of the diagonal line in Figure 2. By announcing their policy rule, the monetary authority chooses a value of a , which pins down the economy's position (in other words, it pins down a particular equilibrium pair of s_t and i_t along the interest rate-exchange rate frontier). In the extreme case where a approaches infinity, we have the case of a currency board system as in Hong Kong. At the other extreme, as a approaches zero, only s_t adjusts, while i_t is fixed. By raising a , the case in question, the monetary authority declares that interest rate policy will henceforth more closely target fluctuations in the exchange rate. If credible, this policy announcement can feed into the investors' expectations about the future path of the interest rates, which will be stabilizing immediately. This is the "signaling effect."

The monetary authority's second tool is to adopt a policy stance that is even more contractionary than anticipated by the market. This is represented by a positive value for ε_{mt} and by movement in Figure 2 along the interest rate-exchange rate frontier in a northeast direction. As shown in the Appendix, a contractionary monetary shock (under the assumption of stability) causes the interest rate to rise and the exchange rate to appreciate; again, this is the orthodox effect. By this interpretation, the collapse of Korea's exchange rate was caused by an increase in the perceived level of risk, and the exchange rate would have collapsed still more dramatically than was actually the case had the monetary authority not pursued a policy even more contractionary than anticipated by the market.

One important point to note from this discussion is that the goal of the high interest rate policy taken to stabilize the exchange rate was not just to surprise the market with an unusually tight monetary policy, but also to impress upon investors the intentions of the monetary authorities. That is, the authorities sought to stabilize the exchange rate by exploiting what is referred to above as the signaling effect. The repeated announcements of the Korean government and the IMF regarding the stance of monetary policy suggest that the policymakers were attempting to utilize this signaling channel.

3. This frontier, $(1 - \lambda) i_t + (1 - \phi_d) s_t = \phi_d^t \varepsilon_{d0}$, is derived by eliminating a from the solutions for i_t and s_t , for $\varepsilon_{mt} = 0$ for all t . I call this line the interest rate - exchange rate frontier in the sense that the monetary authority cannot alter it.

Unfortunately, this analysis suggesting that high interest rate policy was indeed effective in stabilizing the exchange rate is contingent on the validity of the stability assumption – in other words, that $0 < b \equiv [1 + a(1 - \lambda)]^{-1} < 1$. If the risk premium is sufficiently responsive to the interest rate ($\lambda > 1$), then the model becomes unstable and the preceding logic breaks down. In this case, the appropriate policy for stabilizing the exchange rate is to reduce interest rates ($a < 0$). This may be the case that Furman and Stiglitz (1998) had in mind – that higher interest rates so increased the cost of servicing the heavy debt loans of Korean banks and firms that investors began worrying about the possible bankruptcy of Korean enterprise, leading them to demand a higher risk premium for holding Korean assets. This, then, is the heterodox result. While the preceding model helps by identifying the issues and assumptions on which the controversy turns, that controversy can be resolved only by examining the data.

2.2 Empirical Findings

Table 1 summarizes empirical research on the impact of interest rates on the exchange rate in the context of the Asian crisis. General conclusions are evidently difficult to draw. Indeed, there may be good reasons why empirical work in this area is inconclusive. First, the high interest rate policy was maintained for only a limited time, six months to a year depending on the country concerned. Even if weekly data are available, this still provides only 25 to 50 observations and few degrees of freedom for empirical work. Daily data provide more degrees of freedom but contain substantial amounts of noise.

Second, there is the problem of identification (whether we observing the impact of monetary policy on the variable or variables of interest – the exchange rate, for example – or the effect of those other variables on monetary policy). Although identification problems are pervasive in empirical macroeconomics, identification is likely to be particularly difficult in currency crisis periods, which feature large disturbances and structural shifts.

Nevertheless, there is some evidence of the orthodox effect of high interest rates in Korea. Park and Choi (1999), Dekle, Hsiao and Wang (1999), Tanner (1999), Barsurto and Ghosh (2000), and Cho and West (2000, 2001) all find evidence for the orthodox effect in the Korean data, although their findings for other Asian countries is more mixed. As an experiment, Figure 3 shows the impulse responses estimated from bivariate vector autoregressions (VARs) for the exchange rate and the interest rate, country by country.⁴ Bearing in mind all the reservations why VARs like these

4. Sample periods for the VARs were one year after the outbreak of the crises: 12/1/1997-11/30/1998 for Korea and 7/1/1997-6/30/1998 for Thailand and the Philippines. 10 lagged

should be regarded cautiously, the left-hand figure for each country can be interpreted as showing the effect of an increase in the interest rate on the exchange rate. These results suggest that Korea was the only country where interest rate hikes led to appreciation of the exchange rate.

Why then was the result different in Korea? There are several potential explanations. The first of these is destructive: it is the possibility of misidentification. Specifically, there is the danger of misattributing to monetary policy the effects of two important country-specific events that may have significantly affected the investors' expectations in the currency market and thereby the exchange rate. The first such event was the announcement by the U.S. government on 24 December 1997 that a second line of emergency loans from G-7 countries would be made available. The second was the successful completion of the negotiation in February 1998 between the Korean government and foreign creditors for converting more than \$20 billion in short-term debt into long-term debt. These two events occurred soon after the interest rate was raised, complicating efforts to isolate the effect of the high interest rate policy.

A second possible explanation for the contrast with other countries is that the high interest rate policy was more credible in Korea. In comparison with Thailand and the Philippines, the interest rate in Korea moved far more closely with the exchange rate (Figure 1). The simple correlation between the two variables is 0.300 for Korea but only 0.064 for Thailand and -0.135 for the Philippines. The impulse responses estimated in Figure 3 show that the interest rate rose (or, more precisely, was raised by the monetary authority) in response to the increase in the shock to the risk premium only in Korea. The variance decompositions in Figure 4 also suggest that the interest rate was largely determined by the exchange rate shock in Korea, while it was determined independently in the other countries. That is, the announcement by the government and the IMF that interest rates would be raised and kept at higher levels for as long as needed to stabilize the exchange rate appears to have been more credible in Korea, at least *ex post*. Investors may have come to believe that the Korean monetary authority was very serious about achieving its goal of exchange rate stabilization while continuing to regard skeptically the policy announcements of other countries.⁵

Although this evidence is less than definitive, it is also true that many arguments critical of the high interest rate policy are equally or perhaps

variables, or approximately 2 weeks, were included in the VAR, and the exchange rate was put first in the Cholesky decomposition. Differenced data were used in estimation, but the impulse responses were calculated for the levels. Dotted lines indicate 95% confidence bands in each graph.

5. The legal introduction of inflation targeting in 1998 might have served to raise Korea's monetary policy credibility, but this does not seem to be the major factor behind the success in exchange rate stabilization. Inflation targeting had not yet become standard practice in 1998, and many international investors were worried about the possibility of deflation rather than inflation.

even more questionable. For example, there is criticism that high interest rates actually aggravated the problem of capital outflows in December 1997, but this criticism overlooks the fact that an even larger capital outflow (reflecting the actions of domestic as well as foreign investors) might have resulted had interest rates not been raised. In this regard, it may be noteworthy that, while foreign banks drastically reduced their exposures to Korea in December 1997, a substantial amount of foreign currency flowed into Korea seeking high interest rates. For example, net private transfers, which had been slightly negative until October 1997, increased sharply to approximately 2 percent of monthly GDP in December 1997, and then gradually declined to zero as the call rate was lowered.

CHAPTER 3

Monetary Policy and Standard Policy Objectives

If the high interest rate policy was ineffective or, rather, contributed to further depreciation of the exchange rate after the crisis, it was then a mistake. But even if the policy helped to stabilize the exchange rate, as suggested by the preceding evidence, it still does not follow that the policy was optimal. In other words, the question is whether stabilization of the exchange rate should have been the intermediate target of policy – that is, whether it was an efficient means of achieving the ultimate goals of concern to the authorities.

3.1 Policy Objectives and the Optimal Policy Rule

The standard way of modeling optimal policy is to assume that the monetary authority minimizes a loss function of the form:

$$(4) \quad \text{Min. } (1-\alpha)(\pi-\pi^*)^2 + \alpha(y-y^*)^2,$$

where π and y are the inflation rate and the level of output, respectively, $*$ denotes the target levels of these variables, and α is a parameter that reflects the preferences of the authorities (the relative weights they attach to these targets). The standard assumption, then, is that stable output and low inflation are the ultimate goals of policy. Strictly speaking, a central bank with a legal mandate to target inflation, like the Bank of Korea after the crisis, should set $\alpha=0$.⁶ In practice, however, most countries expect the monetary authority to be concerned with the stabilization of business cycles within an “acceptable” range of inflation; that is, the monetary authority is expected to set α such that $0 < \alpha < 1$, since economic activity would experience severe fluctuations otherwise. Thus, while the Bank of Korea announced a medium-term inflation target of 2.5 percent in 1999, annual inflation

6. The new Bank of Korea Act (passed by the National Assembly in December 1997 and that took effect on April 1, 1998) declares that the primary goal of monetary policy is price stability instead of multiple, obscure objectives such as the soundness of the banking system and economic growth. Since 1999, the Bank of Korea has announced the next year's inflation target at the end of every year, and the Board of Governors convenes every month to set up the policy directions (mostly the level of call rate as the operating target) in accordance with the announced inflation target.

was allowed to deviate from that target by ± 1 percent.

One implication of this formulation is that exchange rate stabilization, in and of itself, is not the ultimate goal of economic policy. For a small, open economy like Korea, Ball (1999) shows that the optimal monetary policy rule relates a linear combination of the interest rate and exchange rate (what is referred to in the literature as the Monetary Conditions Index, or MCI) to the two gaps in the preceding objective function:⁷

$$(5) \quad MCI \equiv w(r-r^*) - (1-w)(e-e^*) = \beta'(\pi-\pi^*) + \gamma'(y-y^*),$$

where r and e are the real interest rate and log of the real exchange rate, respectively, and w , β' and γ' are the parameters that depend on the underlying economic structures and the policymaker's preferences.⁸ Ignoring the distinction between control and state variables and the distinction between expected and actual inflation, rearranging this equation yields an expression for the nominal interest rate, $i \equiv r + \pi$:

$$(6) \quad i = (\pi + r^*) + \beta(\pi - \pi^*) + \gamma(y - y^*) + \delta(e - e^*),$$

where the parameters β , γ , and δ are appropriately transformed from equation (5).⁹

According to Equation (6), the interest rate should be raised, even if there has been no change in current levels of inflation and output, in response to depreciation of the currency. Currency depreciation boosts aggregate demand, which implies both faster inflation and higher levels of output in the future. Optimal policy today will respond to this information about economic conditions tomorrow – information conveyed by the exchange rate – even though the level of the exchange rate itself is not a policy objective. Ignoring the distinction between nominal and real variables, which is sensible for the very short-term, Equation (3) in the previous chapter can be interpreted as a special case of Equation (6), where $a = \delta$ and u_{mt} comprise the remaining inflation and output gap terms. Intuitively, the interest rate policy in response to the crisis had to be tied to the fluctuation of the exchange rate fluctuation because the latter was the dominating factor

7. See Ball (1999) for details. Basically, he sets up a simple macroeconomic model that is composed of an open economy IS curve, an open economy Phillips curve, and interest parity condition. Under this set-up of the model economy, one can show that the optimal policy rule can be stated as a linear combination of the two state variables, π and y .

8. In fact, Ball (1999) proposes a policy rule that considers the short-term effect of the lagged exchange rate, but I did not include this effect for two reasons. First, this rule appears to be sensitive to an ad hoc specification about economic structures. Second, I applied this part in the calibration exercises, but the results did not change much.

9. Strictly speaking, Equation (6) is not a formula describing the optimal interest rate rule in the sense that the right hand side includes an endogenous variable, e : when i changes, e changes too.

determining macroeconomic fluctuations.

3.2 Calibration

Even if there is some theoretical justification for using high interest rates to defend the exchange rate following the shock of the crisis, there remains the question of whether the authorities' response was too much or too little. Were the interest rate responses optimal, in other words? Or were there alternative interest rate paths that would have resulted in a lower social loss, as measured by equation 4?

One way of addressing this question is by calibrating the optimal interest rate rule of equation 6. Doing so is useful not just for assessing the high interest rate policy adopted in response to the crisis but also for analyzing the "super-low" interest rate environment established once confidence had been restored. (Compared with pre-crisis levels of around 12 percent, call rates were reduced to approximately four percent, depths that had not been experienced in Korea since the 1960s.)

I imposed a value of five percent for r^* , reflecting the commonly cited potential growth rate of Korea after the crisis, and 2.5 percent for π^* , the medium-term target declared by the Bank of Korea in 1999. As for π , there are important issues. The first issue is which inflation indicator should be used. An obvious candidate is Core CPI, the official inflation target variable used by the Bank of Korea since 1999, which excludes irregular elements such as the prices of agricultural products and petroleum. However, a GDP deflator that covers a wider range of prices than the CPI or Core CPI better represents aggregate economic conditions. After the crisis, in particular, there were significant discrepancies between the Core CPI and GDP deflator due to the deterioration of the terms of trade (as shown in Figures 5A and Figure 5B). In 1999, for example, the Core CPI inflation rate was more than two percent, while the GDP Deflator inflation rate was negative. Therefore, I used both indexes in the following calibration.

A second issue is whether to use data on ex ante expected inflation or ex post actual inflation. Expected inflation is conceptually preferable (particularly when calibrating the real interest rate), but it must be estimated. And, in practice results are likely to differ substantially depending upon the techniques used in estimation. I therefore used the ex post (year-on-year) inflation rate in the benchmark case and an estimate of expected inflation for comparison.

For the Core CPI and GDP deflator, respectively, Figures 4A and 4B compare the actual with expected inflation rates.¹⁰ According to Figure 5A, expectations of inflation (in terms of the Core CPI) had turned negative by

10. Since the data frequency is quarterly, the expected annual inflation rate needs forecast values of up to four quarters ahead.

the end of 1998, before gradually returning to 2 to 4 percent rates of expected inflation thereafter. Another feature of this figure is that expected inflation leads actual inflation, especially in the post-crisis period.

An even more dramatic contrast between the actual and expected inflation rates is in Figure 5B. While the actual inflation rate (in terms of the GDP deflator) exceeded 10 percent in the first quarter of 1998, expected inflation remained at zero, according to these estimates. Expected inflation is far smoother than the actual inflation and remains continually below the target level of 2.5 percent.

It is common in the literature to calibrate $y-y^*$ as the deviation of actual output from the hypothetical level that would have obtained in the absence of demand-side shocks. In order to obtain this output gap, I applied the structural vector autoregression (SVAR) methodology of Blanchard and Quah (1989), using seasonally adjusted real GDP and price index (Core CPI or GDP deflator) data from 1980:I to 2002:I, and eight lags of the respective variables.¹¹ Figure 5C shows the estimated output gap series, the GDP component that is driven by the demand shock alone, along with the peaks and troughs officially defined by the Statistics Bureau of Korea. According to these estimates, the output gap plunged to historically unprecedented depths in 1998, but recovered to approximately zero by 2000. After the crisis, the output gap estimated using the GDP deflator appears to be lower than that estimated using Core CPI, reflecting differences in the behavior of the two price indexes.

For $e-e^*$, I constructed a simple real effective exchange rate (or REER) index based on two currencies, the U.S. dollar and the Japanese yen, with equal weights of 0.5.¹² Figure 5D plots this REER series in percent changes from the base year of 2001. According to this series, the exchange rate in the first quarter of 1998 was approximately 30 percent undervalued.

With these variables in hand, the parameters β , γ and δ still need to be calibrated. Although this calibration should in principle be based on estimates of the relevant parameters derived from the Korean data, this paper simply borrows values from Ball (1999). For both β and γ , Ball assumes a range from 0.5 to 2.0. (The value of β becomes smaller as the weight on the inflation fluctuation in the loss function becomes smaller.) For δ , Ball, Freedman (1994) and Gerlach and Smets (2000) all recommend a value of 0.3, although estimation results in Cho (2002) suggest that a value of 0.1 is more plausible in the Korean case.

11. As for the application of the Blanchard and Quah (1989) methodology to the Korean data, Kim (1996) already reported detailed estimation results. The most critical identification assumption of this technique is that the demand shock does not change the output level in the long-run, while the supply shock does. The only deviation of this paper's estimation from Kim (1996) is that I used the core CPI instead of the GDP deflator.

12. Cho (2002) shows that this simple index is similar to a far more complex index based on 16 trading partners' currencies using the relative portions of trading volumes as the respective currencies' weights.

3.3 Results and Discussion

Figure 6A shows calibration results using actual inflation rates and $\beta=\gamma=\delta=0$, along with the actual call rate (measured as a quarterly average). When the Core CPI is used to measure inflation outcomes, actual interest rates appear to have been too high in the first two quarters of 1998 but too low in 2000 and 2001. When the GDP deflator is used, in contrast, call rates appear to be too high throughout all four quarters of 1998, before falling to roughly appropriate levels in 2000 and 2001. That is, the “super-low interest rates” since 1999 do not appear to be too low if the GDP deflator accurately captures inflationary conditions.

However, call rates immediately following the outbreak of the crisis are too high no matter which price index is used. This finding is placed in relief in Figure 6B, where expected inflation (estimated from a VAR) is used in place of actual inflation. Here optimal interest rates do not exceed ten percent even in 1998, which contrasts with the 30 per cent rates actually observed.

In contrast, Figures 6C, 6E, and 6F show that the high interest rate policy in the first half of 1998 may have been justified, had the authority actively tried to stabilize the inflation or exchange rates and judge the inflation conditions by the actual GDP deflator. In these cases, however, the optimal interest rate falls below zero in the first quarter of 1999, which raises doubts about this policy response.

In short, the key assumption on which assessments of post-crisis interest rate policy appears to turn to which index of inflation is the appropriate guide to policy outcomes, rather than the particular parameter values that are assigned. The question, in other words, is whether Korean policy makers should care about core CPI inflation or the GDP deflator and whether they can formulate reliable estimates of expected inflation. Using expected inflation rates, no reasonable combination of parameter values can justify an interest rate as high as 15 percent in the first half of 1998. The crucial issue when judging the low interest rate policy put in place in 1999 is whether the Core CPI or GDP deflator should be used. Using Core CPI, it is again the case that no combination of reasonable parameter values can justify the authorities’ decision to cut interest rates to less than five percent after 2000.

The question of which index of inflation is more relevant and reliable is not easily answered. However, the actual year-on-year inflation rate used in calibration has a clear shortcoming, despite the fact that the year-on-year changes are commonly used in Korea to calculate baseline inflation rates. For example, while the level of the GDP deflator rose substantially in the first quarter of 1998, it then declined significantly in the second quarter. These wide fluctuations quarter to quarter will not be picked up by the year-on-year inflation rate. Although the volatility of annualized quarter-to-quarter inflation rates (actual, not expected) obtained using the calibrated

model raise questions of reliability, taken at face value, they can justify the high level of interest rates actually observed only in the first quarter of 1998, not thereafter (and recall that interest rates were maintained at high through 1998-Q2 and only gradually reduced in the second half of the calendar year).

Of course, data on current macroeconomic conditions becomes available only with a lag, and monetary policy must be formulated on the basis of uncertain forecasts. In practice, however, it is hard to invoke uncertainty as a justification for the maintenance of high interest rates beyond the first quarter of 1998. Few if any macroeconomic indicators signaled the danger of accelerating future inflation after March; if anything, most variables pointed to the danger of deflation. The exchange rate, which was the leading indicator of short-term price movements during the crisis, began stabilizing in February 1998. Nominal wages, which may be a more informative guide of medium-term inflationary pressures, actually fell in 1998 relative to the preceding calendar year. In short, it is hard to justify the maintenance of the high interest rate policy after the first quarter of 1998, unless one sticks to a possibly deficient indicator like the year-on-year inflation rate.

It is always very difficult to determine an appropriate monetary policy, not just *ex ante* but also *ex post*. But, in the Korean case, evidence suggests that had the authorities begun lowering interest rates earlier, they would not have been forced to shift monetary policy so dramatically in October 1998. Had they starting reducing interest rates earlier and more gradually, they might have helped to avoid a deflationary recession in 1998 and a bubble-like recovery in 1999. They would have avoided what turned out to be the largest biggest business cycle fluctuation experienced in Korea in nearly four decades.

CHAPTER 4

Summary and Conclusions

This paper has discussed Korea's post-crisis monetary policy, focusing on whether the high interest rate policy adopted immediately after the outbreak of the crisis was effective in stabilizing the exchange rate and whether post-crisis interest rate policy can be justified in light of the literature on optimal monetary policy. While it is impossible to determine conclusively whether tight money was effective in stabilizing the exchange rate, if there is any country in Asia for which the policy worked, that country was Korea. As for whether post-crisis monetary policy was too tight, too loose, or just about right, the answer hinges on which index of inflation is appropriate for such calculations. The high interest rate policy maintained in the first quarter of 1998 can be justified if the actual (year-on-year) inflation rate as opposed to the expected inflation rate (estimated from vector autoregressions) is used. The low interest rate policy in place since 1999 can be justified if the GDP deflator rather than the Core CPI is used. But whatever uncertainty remains about the advisability of raising interest rates to observed heights in the first quarter of 1998, analysis suggests that the authorities should have started moving in this direction at an earlier date. In fact, there appears to be latitude for interest rate reductions starting in the second quarter of 1998.

This paper has also revealed that many important issues related to the conduct of monetary policy in Korea remain unresolved. This paper will have succeeded even if it only provokes more active discussion of them.

Appendix: Solutions of the Model in Section 2

The reduced-form solutions to the system in the text are:

$$\begin{aligned} E_{t-1} s_t &= b \sum_j \{ b^j E_{t-1} [u_{dt+j} - (1-d)u_{mt+j}] \}, \\ i_t &= a E_{t-1} s_t + u_{mt}, \\ s_t &= [-(1-d) i_t + E_t s_{t+1} + u_{dt}]. \end{aligned}$$

An unanticipated risk shock: With respect to a unit shock to ε_{dt} at time 0, both the interest rate and the exchange rate both jump initially (s_0 and i_1), but both variables decline smoothly thereafter.

$$\begin{aligned} i_0 &= 0, \\ s_0 &= 1/(1-b\phi_d) > 0, \\ d_0 &= 1 > 0, \\ i_t &= a s_t > 0, & \text{for } t > 0, \\ s_t &= \phi_d^t b/(1-b\phi_d) > 0, & \text{for } t > 0, \\ d_t &= \phi_m^t adb/\{(1-b\phi_d)+1\} > 0, & \text{for } t > 0. \end{aligned}$$

An unanticipated monetary shock: With respect to a unit shock to ε_{mt} at time 0, the interest rate rises and the exchange rate appreciates initially, after which both gradually approach zero over time.

$$\begin{aligned} i_0 &= 1 > 0, \\ s_0 &= -\{(1-d)/(1-b\phi_m)\} < 0, \\ d_0 &= d > 0, \\ i_t &= \phi_m^t b (1-\phi_m)/(1-b\phi_m) > 0, & \text{for } t > 0, \\ s_t &= -\phi_m^t b (1-d)/(1-b\phi_m) < 0, & \text{for } t > 0, \\ d_t &= \phi_m^t b d(1-\phi_m)/(1-b\phi_m) > 0, & \text{for } t > 0. \end{aligned}$$

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<Table 1> Summary of Previous Empirical Research

Authors	Data	Methodology	Conclusion
Goldfajn and Baig (1998)	Various data including daily time-series data Five Asian crisis countries (1997-1998): Indonesia, Korea, Malaysia, Philippines, Thailand Five other crisis countries: Mexico (1982), Chile (1982), Sweden (1992), UK (1992), Mexico (1994)	Estimation of real exchange rates, real interest rates, and the real interest parity relation	The evidence is mixed, but on balance favors the view that the higher interest rates were associated with appreciations in crisis-hit Asian countries.
Park and Choi (1999)	Daily time-series data Korea (97/4/1-98/10/30) Indonesia (97/1/3-98/7/24) Malaysia (97/1/3-98/7/24) Thailand(97/1/20-98/7/24)	Single equation regression using forward exchange rates as control variables	High interest rates appear to cause exchange rate appreciation except for Malaysia.
Dekle, Hsiao and Wang (1999)	Weekly Time-series data (1997-1998) Korea, Malaysia, Thailand	VAR	Interest rate hikes led to exchange rate appreciation, though with long and variable lags.
Goldfajn and Gupta (1999)	Cross-country data for the countries that have undergone currency crises during the period of 1980-1998.	Panel data regressions with various descriptive measures	Dramatic increases in interest rates have been associated with currency appreciation. But there was no clear association for a subsample of countries that have undergone a banking crisis along with a currency crisis.

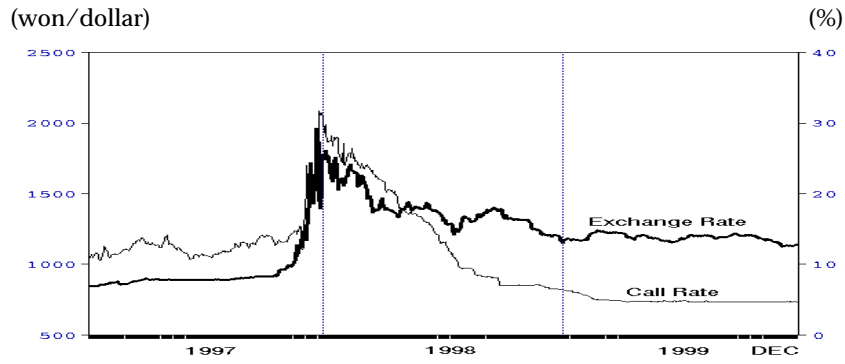
<Table 1> continue

Authors	Data	Methodology	Conclusion
Tanner (1999)	Monthly time-series data (1990:1-1998:12) Indonesia, Korea, Thailand, Brazil, Chile, Mexico	VAR, whose variables include exchange market pressures (the sum of exchange rate depreciation and reserve outflows), monetary policy stance, and the differential between domestic and foreign interest rates.	Contractionary monetary policy helps reduce exchange market pressures.
Gould and Kamin (2000)	Weekly time-series data Five crisis-hit Asian countries(1997-1998): Indonesia, Korea, Malaysia, Philippines, Thailand	Use measures of international credit spreads and of domestic stock prices as proxies for investor concerns about creditworthiness and country risk.	Unable to find a reliable relationship between interest rates and exchange rates.
Cho and West (2000)	Daily time-series data Korea (97/12/17-99/6/30)	Single equation regressions and Vector Error Correction Model	Although the major driving force of the exchange rate stabilization seems to be the recovery of the foreign currency liquidity position, the high interest rate appears to have contributed to the stabilization of the exchange rate.

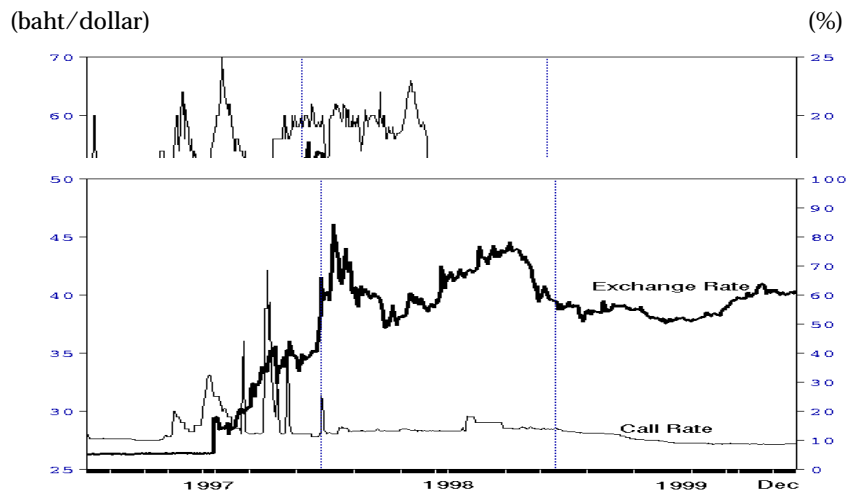
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Authors	Data	Methodology	Conclusion
Barsurto and Ghosh (2000)	Monthly time-series data (1990:1-1998:12) Indonesia, Korea, Thailand	Identify the risk premium by the difference between the actual exchange rate and the (pure monetary model based) theoretical exchange rate, and relate thus defined risk premium with the interest rate policy.	Tighter monetary policy was associated with an appreciation of the exchange rate, and there is little evidence of higher interest rates contributing to a widening of the risk premium.
Aart Kraay (2000)	Data for speculative attack periods in a sample of 75 developed and developing countries over the period 1960-1997.	Examine the behavior of interest rates around successful and failed speculative attacks.	There is no systematic association between interest rates and the outcome of speculative attacks.
Cho and West (2001)	Weekly time-series data Korea(97/12/17-98/12/16) Philippines(97/7/23-98/7/22) Thailand(97/7/23-98/7/22)	Estimate structural parameters of the model composed of two equations, a monetary policy reaction function, and an interest parity relationship.	Point estimates indicate that exogenous increases in interest rates led to exchange rate appreciation in Korea and the Philippines, depreciation in Thailand, but the confidence intervals are huge.

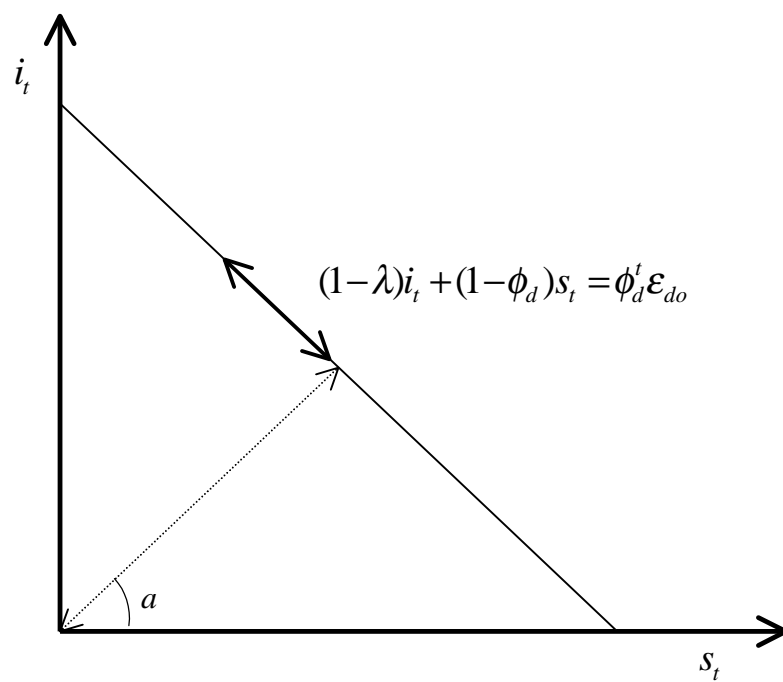
<Figure 1> Exchange Rate and Call Rate Korea



Thailand

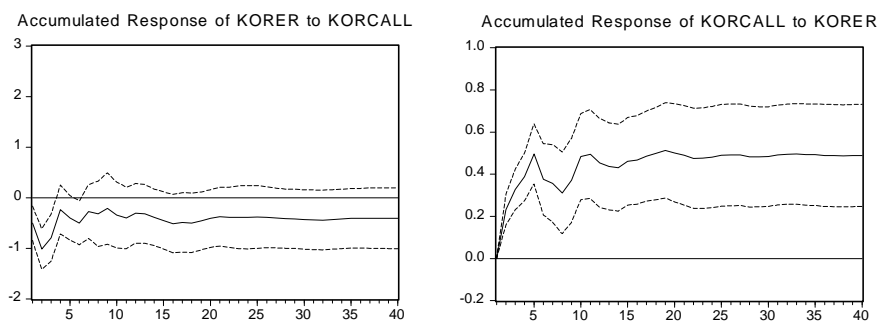


<Figure 2> Determination of the Exchange Rate and the Interest Rate

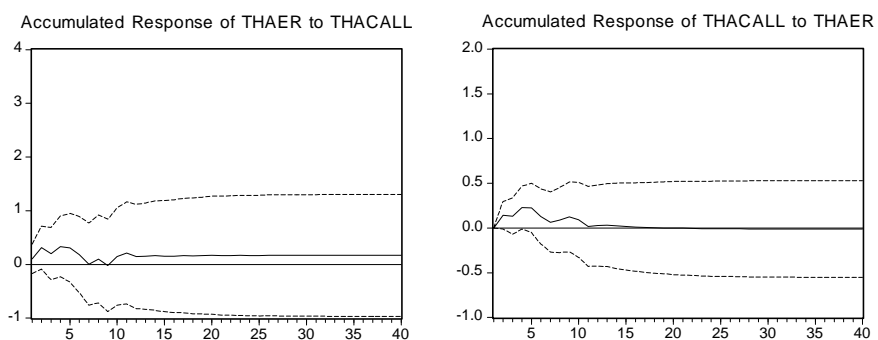


<Figure 3> Impulse Responses from VARs Using Daily Data

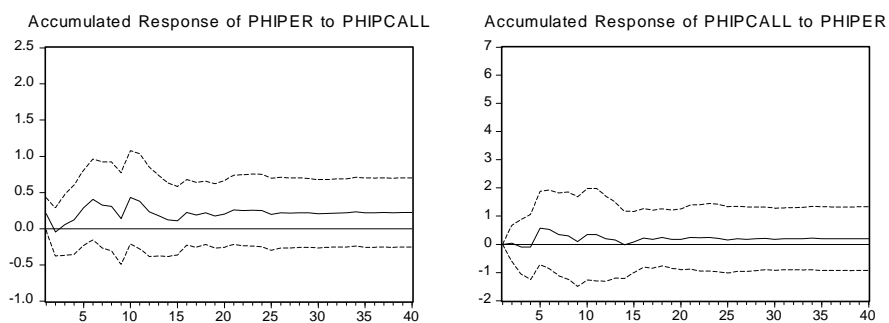
1. Korea



2. Thailand

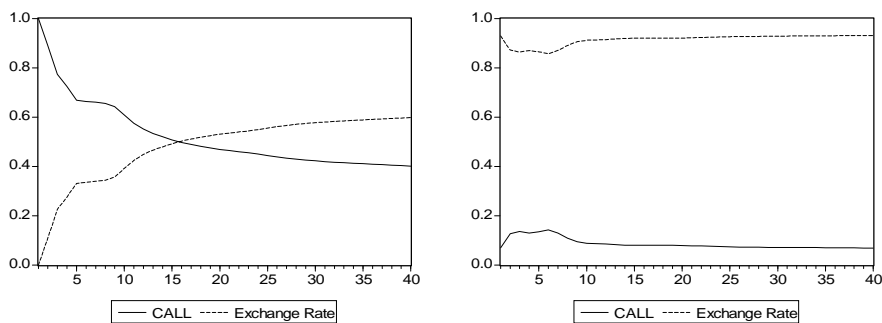


3. Phillipines

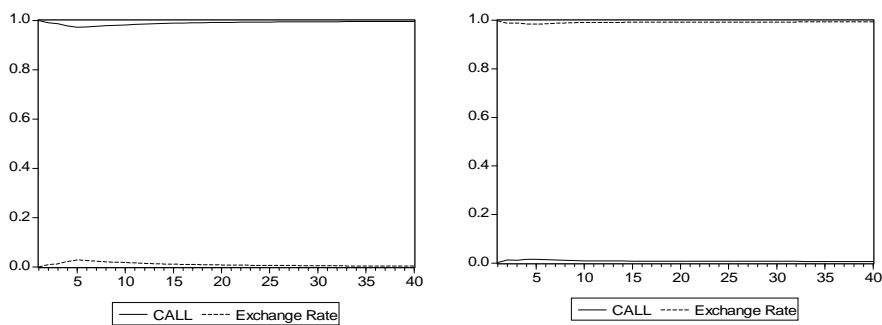


<Figure 4> Variance Decomposition of the Interest Rate and the Exchange Rate

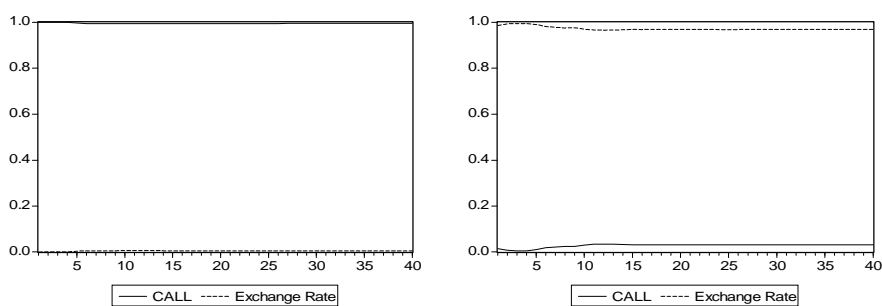
1. Korea



2. Thailand

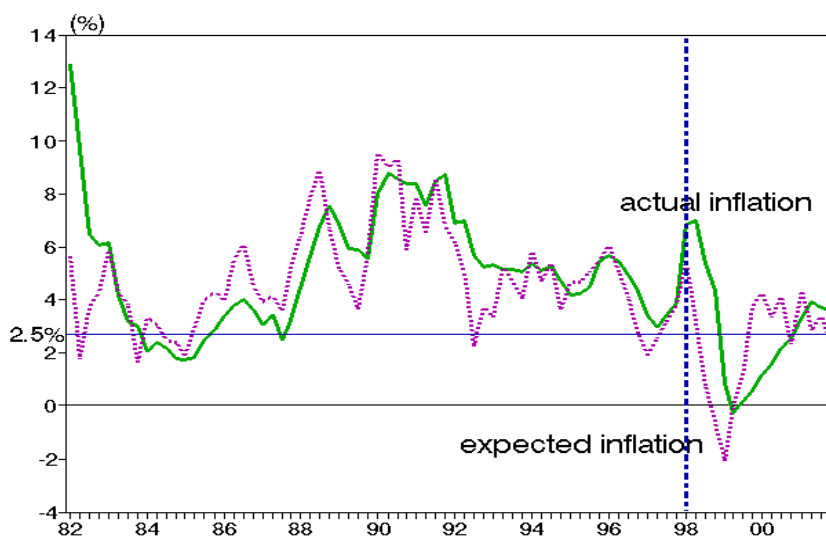


3. Philippines

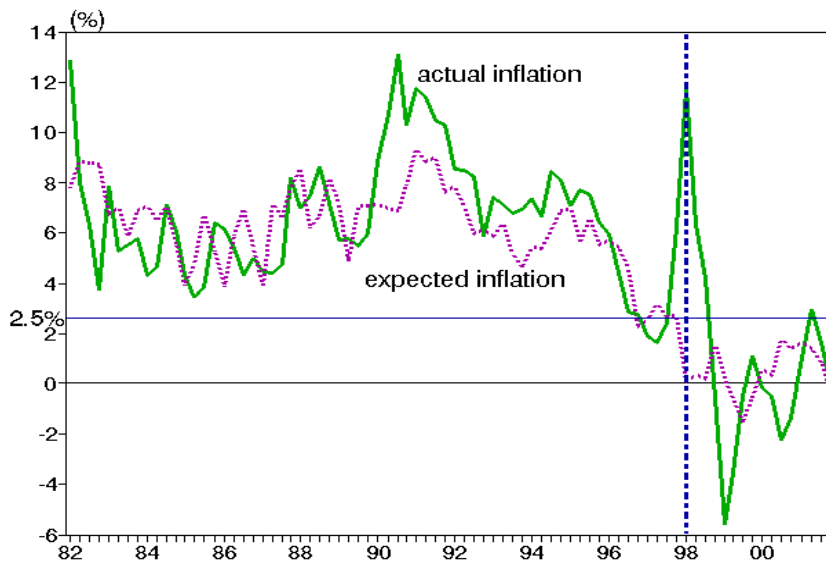


<Figure 5> Variables for Calibration

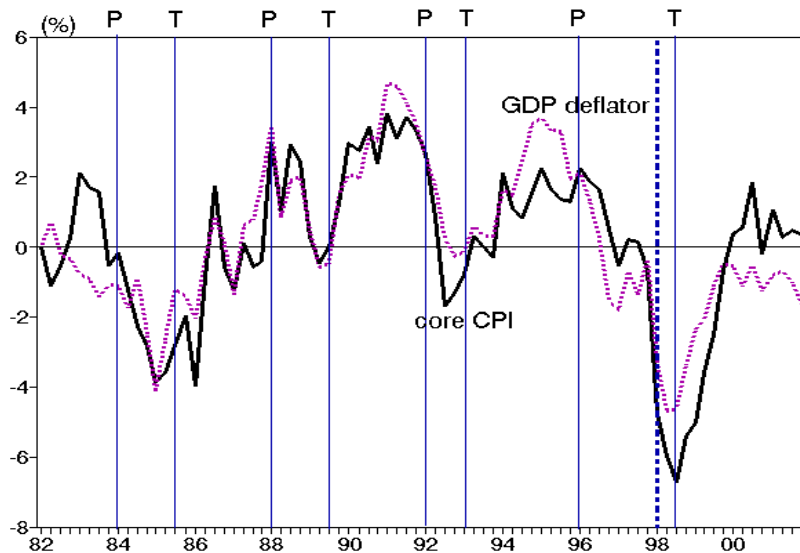
A. Actual vs. Expected Inflation (Core CPI)



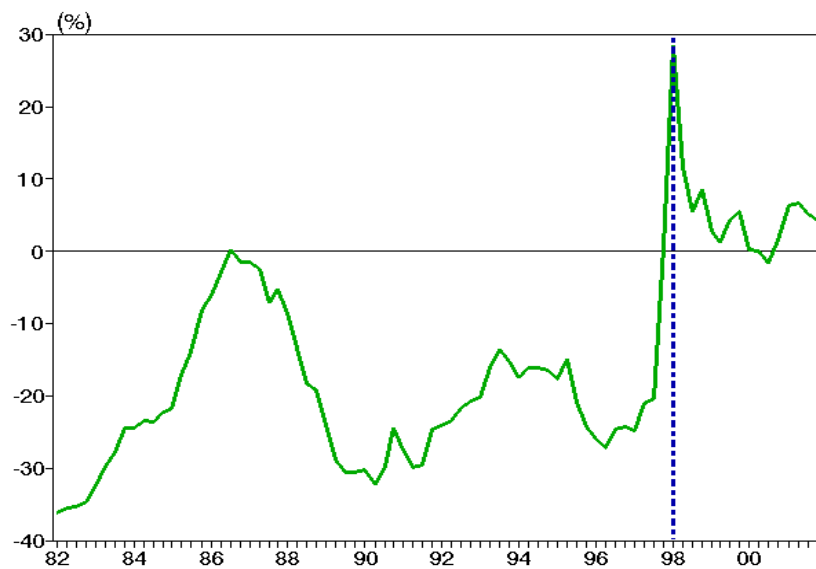
B. Actual vs. Expected Inflation (GDP deflator)



C. Output Gap (Core CPI and GDP deflator)

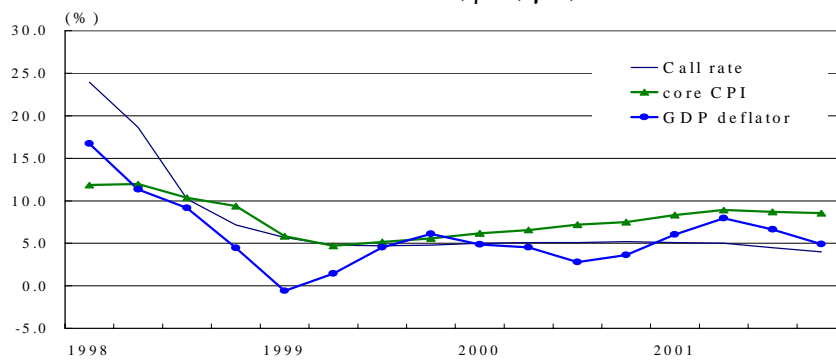


D. Real Effective Exchange Rate (Won vs. Dollar and Yen)

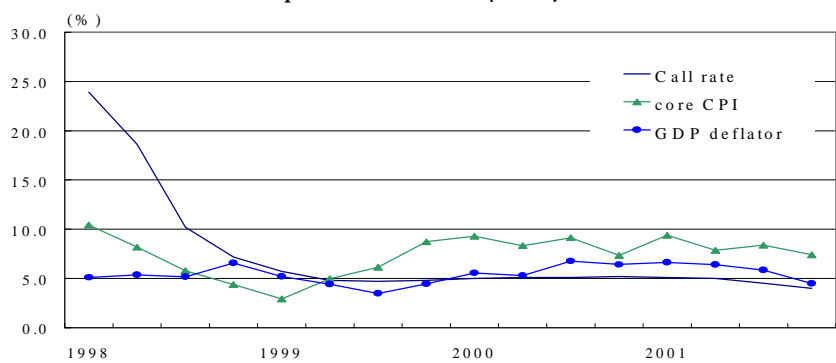


<Figure 6> Calibration Results

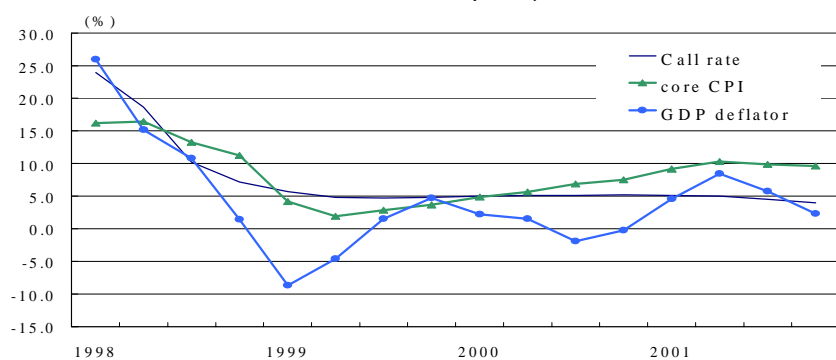
A. Actual Inflation, $\beta=0, \gamma=0, \delta=0$



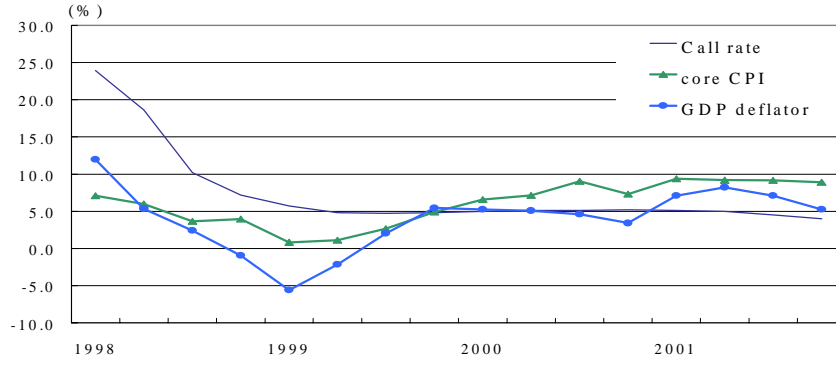
B. Expected Inflation, $\beta=0, \gamma=0, \delta=0$



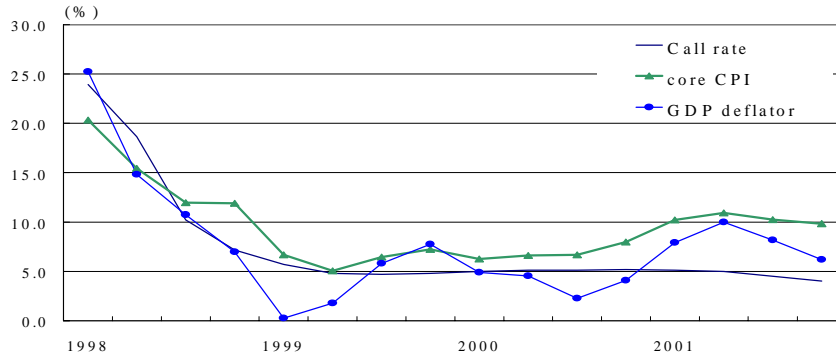
C. Actual Inflation, $\beta=1, \gamma=0, \delta=0$



D. Actual Inflation, $\beta=0, \gamma=1, \delta=0$



E. Actual Inflation, $\beta=0, \gamma=0, \delta=1$



F. Actual Inflation, $\beta=1, \gamma=1, \delta=0.3$

