Inflation Targeting and Exchange Rate Management in Korea

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This paper investigates the experience of inflation targeting in Korea with emphasis on the exchange rate management. Korean call rate responds to not only expected inflation but also output gap and changes in real effective exchange rate of the Korean won, when we estimate call rate reaction function over the period of 1999-2007. It was found that the call rate responded to changes in real effective exchange rate more than it did to expected inflation. We also examined whether Korean inflation targeting was actually centered on the exchange rate by estimating the Singaporean style of exchange rate reaction function. It was found that the monetary policy in Korea was not as much exchange-rate-centered as in Singapore, since the nominal effective exchange rate of the Korean won responded modestly to inflation and output gap, far less than that of the Singaporean dollar responded to them.

Keywords: Inflation targeting, Exchange Rate Centered Monetary Policy, Call Rate Reaction Function, BBC, Real Effective Exchange Rate

I. Introduction

As Korea encountered financial crisis in December 1997, she switched from market average exchange rate system to free floating exchange rate system with the full-fledged opening of the capital market. She also switched from the monetary targeting to the inflation targeting system by enforcing the new Bank of Korea Act in April 1998. She became one of many emerging market economies that officially adopted inflation targeting with floating exchange rate system.

Until the mid-1990s, many emerging market economies tried to fix exchange rate through the currency board system, the common currency, and the dollarization. But since the late 1990s when the Asian financial crisis occurred, a growing number of countries have implemented inflation targeting with floating exchange rate system. For instance, the adoption of inflation targeting in Korea in January 1998 was followed by that in Mexico in January 1999 and in Brazil in June 1999.

The exchange rate should be determined purely in the market without government intervention under floating regime, but many countries make efforts to prevent exchange rate form changing rapidly for ‘fear of floating’. The authorities endeavor to stabilize exchange rate with sterilized invention in the foreign exchange market and/or controls on foreign capital movements, when exchange rate fluctuates widely. Korea is not an exception. She adopted the free floating system, but intervened in the market more frequently than not.

The increasing trend of interregional trade and financial integration also threatened floating regime. Many economists who emphasize the monetary and exchange rate cooperation in the East Asian argue for the exchange rate targeting instead of inflation targeting (Williamson, 2001). As China adopted the flexible basket peg in July 2005, Ito (2005) suggested the flexible basket peg system in the East Asia to achieve regional economic integration,

However, there have been many objections to such exchange rate-centered policy as the East Asian basket currency peg. Eichengreen (2007) argued that the European style of exchange rate cooperation cannot succeed in the East Asia, because exchange rate would fluctuate greatly with the active capital flows in the region that is not integrated politically. Therefore, he recommends inflation targeting policies with floating regime instead of exchange rate-centered policies for regional exchange rate cooperation. He thinks that regional stability can be attained with economic stability in each country while exchange rates are floating under high degree of capital mobility in the region.

Regarding the exchange rate management under the inflation targeting, three views can be listed (Ho and McCauley, 2003). First, the interest rate should indirectly respond to the exchange rate, as far as the exchange rate affects the current and future rate of inflation. Under inflation targeting with floating of exchange rate, interest rate will react to inflation and thereby indirectly to exchange rate movements. Secondly, the interest rate should respond to the exchange rate in addition to the inflation and output gap. According to Ball (1999) and Svensson (2000), the optimal monetary policy in the open economy is that interest rate responds to the exchange rate as well as inflation and output gap. Thirdly, exchange rate itself should be the target to stabilize inflation and output. The Singapore as a small open economy implemented the Taylor monetary rule in which the nominal effective exchange rate of the Singaporean dollar rather than the interest rate served as the instrument for the monetary policy (Ee et al, 2004). Chile and Israel also have set an exchange rate target in the process of achieving price stability (Amato and Gerlach, 2002). The recent supporters of the East Asian basket peg such as Williamson (2001), Park and Yang (2006), Moon and Rhee (2007) belong to this group.

This paper investigates the role of exchange rate in the implementation of inflation targeting in Korea. Studies on the inflation targeting in Korea such as Song (1999), Park and Shin (2000), Jun (2006), Kim and Park (2006) had not considered the role of exchange rate, probably because the faithful implementation of free floating exchange rate system should have excluded the exchange rate variable in the monetary reaction function. Eichengreen (2004) was the front runner to have explicitly studied the role of exchange rate in the monetary policy in Korea. He showed that the interest rate responded directly to the exchange rate movements in Korea. The recent studies on the Korean monetary reaction function have included exchange rate variable in addition to inflation and output gap (Shin, 2007; Cho et al, 2008; Enders et al, 2008).

This paper is organized as follows. Section Ⅱ describes features of Korean data and Korean experience of intervention in the foreign exchange market. Section Ⅲ introduces the monetary rule in the open economy and estimates the rule. Section Ⅳ discusses whether the Korean monetary rule was exchange rate-centered. Section Ⅴ concludes the paper.

II. Data and Intervention Experience

This section looks into the trend of key variables in the monetary rule and their correlations. The actual operation of floating exchange rate system is also reviewed with respect to the intervention in the foreign exchange market.

1. Variables in the Monetary Reaction Function

Figure 1 shows the movements of call rates, CPI inflation and won/dollar exchange rate since 1998 when the inflation targeting was introduced. After having peaked to 26% per annum in January 1998, call rate declined rapidly below 10% per annum in August 1998 and even below 5% per annum in March 1999. It was maintained below 5% per annum, but it bottomed out at 3.25% per annum in 2005. Consumer price inflation rose to 8.7% per annum in February 1998 and then fell to less than 1% in 1999, compared to the same of the previous year. It rose again, but maintained below 4% on average. The exchange rate of the Korean won vis-à-vis the dollar peaked to 1,701 in January 1998 and then fell to 1,100 in 2000. It rose to 1,300 in 2001 and fell steadily afterwards.

Figure 1. Trends of Call Rates, Inflation and Exchange Rate

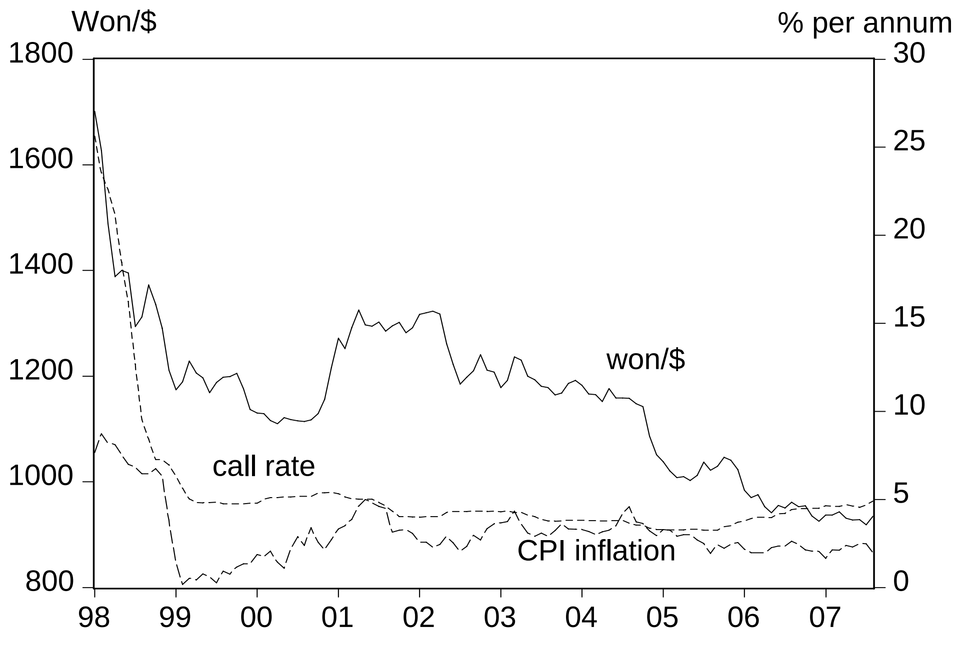


Figure 1 is notable in the following aspects. First, exchange rates, interest rates, and inflation skyrocketed immediately after the financial crisis and then stabilized next year. Secondly, interest rates rose amid a fall in inflation and exchange rate after 2005. It happened although inflation rate had been below the lower bound of inflation target of 3 ± 0.5% since July 2005. Therefore, rising interest rates after 2005 seems to imply that the monetary authorities were concerned about rising housing prices.

Figure 2. Inflation and Output Gap

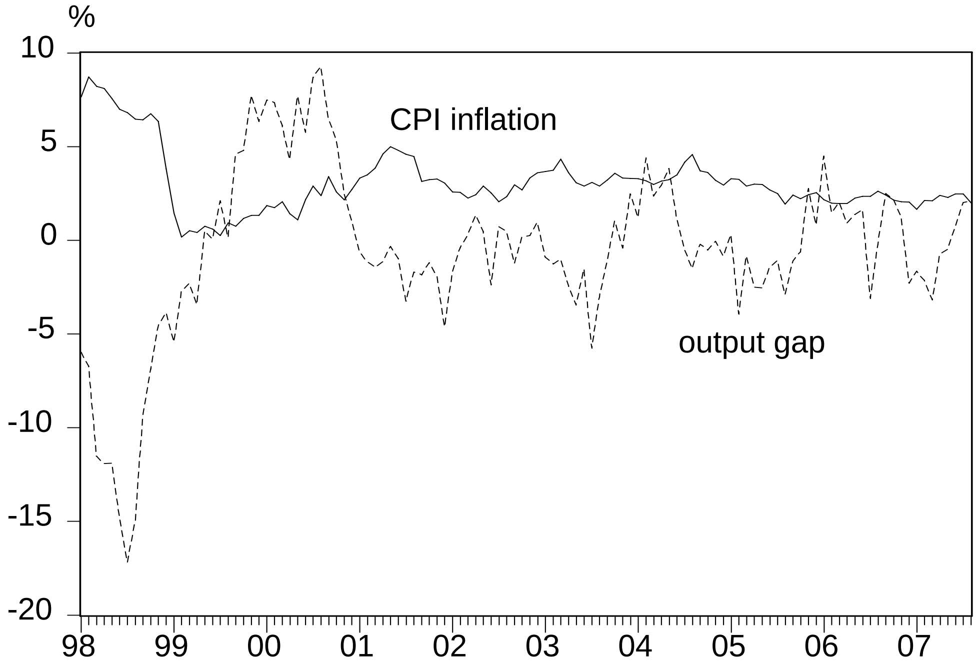


Figure 2 shows the trends of inflation and output gap. The output gap is measured as the difference between the log value of the actual industrial production index and its trend log value obtained by applying Hodrick-Prescott filter over Jan. 1990 – Sep. 2007. The negative relationship between inflation and output gap notably implies that the Korean economy has faced the supply shock rather than demand shock since the financial crisis. Upon the supply shock, it will be really difficult for the monetary authorities to stabilize both inflation and output with the adjustment of interest rates.

Since the relationships among variables change by periods, three periods of 1998.1-2007.8, 1999.1-2007.8, and 2005.1-2007.8 are chosen. The second period just excludes the unstable year of 1998 after the crisis. The last period is the period when call rate began to rise from the bottom of 3.25% per annum.

Table 1. Correlation Coefficient among determinants of call rate

	Inflation	Output Gap	Exchange Rate
Inflation	1.0	-0.66	0.62
Output Gap	-0.25 (-0.25)	1.0	0.43
Exchange Rate	0.28 (0.50)	-0.10 (-0.16)	1.0

Note 1) Upper right:1998.1-2007.8 Lower left:1991.1-2007.8

In parentheses: 2005.1-2007.8.

Table 1 shows the correlation coefficient among inflation, output gap, and exchange rate that are considered to determine call rates under inflation targeting. The correlations change little, if the year of 1998 is excluded. Inflation and exchange rate have the positive correlation, and inflation and output gap have the negative correlation. The output gap and exchange rate show the negative correlation, if the year of 1998 is excluded.

Table 2. Correlation Coefficient between Call Rates and its Determinants

	Inflation	Inflation 12 months later[1)]	Output Gap	Exchange Rate(\/$)	Changes in Exchange Rate[2)]
98.1 - 07.8	0.72	-0.54	-0.11	0.62	-0.07
99.1 - 07.8	-0.30	0.18	0.26	0.21	0.20
99.1- 04.12	-0.39	-0.07	0.25	0.02	0.24
05.1 - 07.8	-0.54	0.06	0.22	-0.92	0.09

Notes: 1) excludes the last 12 months due to 12-month horizon.

2) Changes from the previous month.

On the other hand, the correlations between call rate and each variable in Table 1 change much by periods. It is generally expected that the monetary authority increases call rate when inflation rate goes up, output gap widens or domestic currency depreciates. Table 2 shows whether these relationships hold actually. If observations during 1998 are excluded from the sample, the correlation coefficients between call rate and such variables as inflation, output gap, and exchange rate have the expected sign with some reservations.

Most countries that have implemented inflation targeting responded strongly to inflation according to Clarida et al (1998). Contrastingly, inflation-targeting Korea did not respond strongly to inflation. The correlation between call rate and inflation has been weak. Call rates are more correlated with changes in exchange rate, as shown in Table 2. It is notable that call rates are more correlated with future inflation than present inflation, when the observations in 1998 are excluded,,

2. Experiences of Floating Regime under Inflation Targeting

Korea switched to free floating exchange rate system right after the 1997 financial crisis from the market average exchange rate system- a sort of managed floating. Reinhart and Rogoff (2004) show that Korea has put in place *de facto* free floating since July 1998. IMF also classifies the Korean exchange rate system as free floating. However, many people claim that Korea still operates managed floating. Willet (2004) points out that study of Reinhart and Rogoff (2004) focuses on exchange rate fluctuations, but neglects the accumulation of foreign reserves as in Korea. Park, Chung, and Wang (2001) argue that Korea intervened in the foreign exchange market for 'fear of floating' and show that there has been no significant change in exchange rate volatilities since the financial crisis.

We should not depend too much on exchange rate volatility to distinguish free floating from managed floating. When the inflation targeting is introduced at the same time with free floating, the impacts of inflation targeting on exchange rate should be investigated (Edwards, 2006). If exchange rate was stabilized with the implementation of inflation targeting, little changes in exchange rate volatility cannot be the evidence of foreign exchange market intervention and managed floating.

Therefore, we seek to find evidences for exchange market invention in the operation of floating exchange rate system. Table 3 shows the issues of Foreign Exchange Market Stabilization Bonds and the accumulated losses of the Fund. They increased rapidly with the appreciation of the won since 2002. The losses of the Fund accumulated to 25 trillion won in 2006.

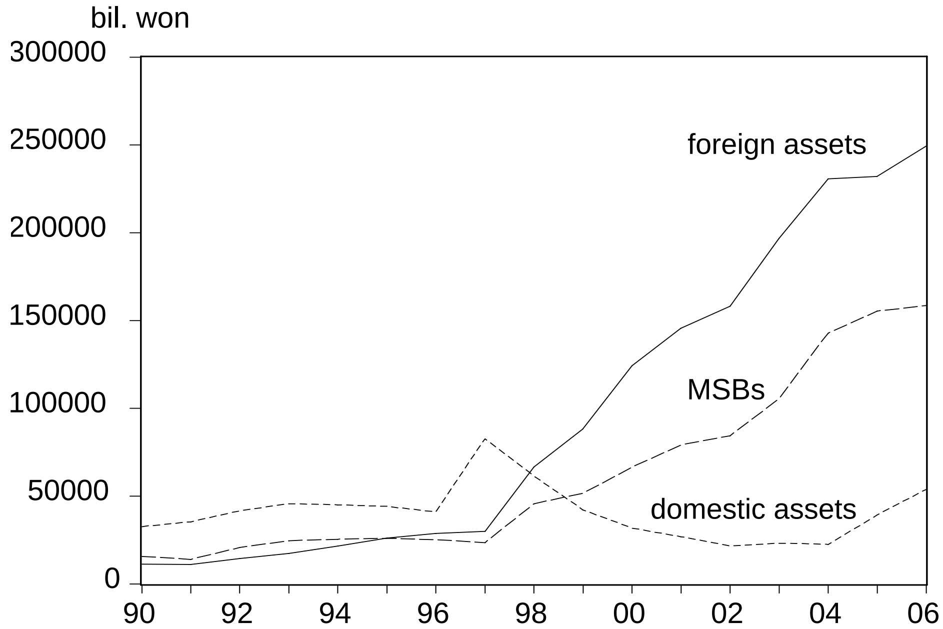
Table 3. Foreign Exchange Market Stabilization Fund

(trillion won)

	Bonds issued	Outstanding	Losses accumulated
2000	31.2	14.7	0.5
2001	34.8	13.8	0.6
2002	42.6	18.1	2.4
2003	51.6	30.4	2.9
2004	52.8	37.9	13.2
2005	77.6	49.0	17.8

Sources: Ministry of Planning and Budget, Moon and Rhee(2007).

Figure 3. Accounts of the Bank of Koea



The Bank of Korea did not allow the monetary expansion accompanying the accumulation of foreign assets. Figure 3 shows that the outstanding amount of the Monetary Stabilization Bonds increased rapidly during 1999-2004 when the issues of Foreign Exchange Market Stabilization Bonds also increased. Table 4 shows that the

Bank of Korea also accumulated losses due both to the interest on the Monetary Stabilization Bonds and evaluation losses accrued from the appreciation of the won.

Table 4. Accounts of the Bank of Korea

(trillion won)

	Total Assets	Total Liabilities	Undivided earned surplus	Reserves
1998	127.8	122.4	3.3	2.0
2002	179.5	171.1	2.9	5.4
2003	219.7	211.7	2.1	5.7
2004	253.0	247.2	-0.1	5.9
2005	271.2	267.4	-1.8	5.7
2006	303.0	300.9	-1.7	3.7

Ⅲ. Monetary Reaction Function

In this section, we investigate Korean experiences of inflation targeting in the past decade by constructing the conventional interest rate reaction function in the open economy and estimating it using the Korean data. We pay attention to the impacts of exchange rate on the monetary policy. As long as exchange rate affects inflation and output gap, it has to influence the monetary policy. The issue here is how much exchange rates are important to the monetary authority.

1. Interest Rate Reaction Function

The monetary rule in the inflation-targeting open economy can be formulated as follows, if wages and prices are rigid in short term and 'flexible inflation targeting' that minimizes the variance of both inflation and output gap is adopted (Clarida et al, 1998; Ball, 1999; Svensson, 2000).

$$i_t^* = i' + \beta(E[\pi_{t+n} | \Omega_t] - \pi^*) + \gamma(E[y_t | \Omega_t] - y^*) + \xi E[z_t | \Omega_t]. \qquad (1)$$

where i_t^* is target of call rate, i' is the long-run equilibrium call rate, π_{t+n} is inflation between t and t+n, y_t is output, π^* is inflation target, z_t is other variables including exchange rate, and Ω_t is information at time t.

In equation (1) it is assumed that the monetary authority determines the target level of short-term nominal interest rates in consideration of a number of variables including the difference between expected inflation and inflation target, output gap, and exchange rate. The authority actively increases the interest rate target to control inflation, if $\beta > 1$. It accommodates inflation by passively increasing the interest rate target, if $\beta < 1$.

The interest rate can be adjusted gradually from the previous level to the target level, as in equation (2). This is evidenced by Figure 1 and Figure 2 in which interest rate changes slowly, compared to inflation and output gap.

$$i_t = (1 - \rho)\, i_t^* + \rho\, i_{t-1} + v_t. \qquad (2)$$

where ρ is the smoothing coefficient ($0<\rho<1$) and v_t is the interest rate shock.

We obtain the following interest rate reaction function by combining equation (1) and (2).

$$i_t = (1-\rho)\ \alpha + (1-\rho)\ \beta\ E[\pi_{t+n} | \Omega_t] + (1-\rho)\ \gamma\ E[x_t | \Omega_t] + (1-\rho)\ \xi\ E[z_t | \Omega_t] + \rho\ i_{t-1} + v_t. \quad (3)$$

where $\alpha \equiv i' - \beta\ \pi^*$, and $x_t \equiv y_t - y^*$.

Finally, replacing expected inflation with actual inflation produces equation (4).

$$i_t = (1-\rho)\alpha + (1-\rho)\ \beta\ \pi_{t+n} + (1-\rho)\ \gamma\ x_t + (1-\rho)\ \xi\ z_t + \rho i_{t-1} + \varepsilon_t. \quad (4)$$

where ε_t is the sum of exogenous shock v_t and linear combinations of the forecast errors of inflation, output, exchange rate and etc.

The disturbance ε_t in equation (4) should be orthogonal to the information Ω_t.

$$E[\ \varepsilon_t\ |\ \Omega_t\ ] = 0. \quad (5)$$

Several variables could be included in z_t. Clarida et al (1998) include real exchange rate, foreign interest rate, and money, whereas Ball (1999) includes just real exchange rate. Svensson (2000) includes foreign interest rates, foreign output, and risk premium on foreign exchange. Kim and Oh (2005) consider exchange rate and money for the case of Korea.

Since this paper aims to study the role of exchange rate in the operation of inflation targeting in Korea, it focuses on the exchange rate. Ball (1999) and Svensson (2000) suggest the following type of the Taylor rule in the open economy (Taylor, 2001).[1]

$$i_t = \delta_0 + \delta_1\ \pi_{t+n} + \delta_2\ x_t + \delta_3\ e_t + \delta_4\ e_{t-1} + \rho i_{t-1} + \varepsilon'_t. \quad (6)$$

where e_t is the real exchange rate.

The nominal interest rate responds to the real exchange rate in the current and previous period in equation (6). The theory expects that δ_1, $\delta_2 > 0$, $\delta_3 < 0$, and δ_4 is indeterminate, when higher e_t means real appreciation. The authority responds differently to the current and previous real exchange rate, as the real appreciation in the previous period generally leads to the real depreciation in the current period. This implies that $\delta_4 > 0$ and that the authority tends to respond to changes in the real exchange rate.

[1] δ_0 in equation (6) cannot be constant, if long-run interest rate and inflation target change. But this problem is neglected.

Ball (1999) finds that the monetary policy is generally optimal when $\delta_3 + \delta_4 < 0$. Meanwhile, Svensson (2000) finds that it is optimal when $\delta_3 + \delta_4 = 0$, but the variance of inflation declines at the cost of increased variance of output.[2]

When the interest rate responds to changes in the real exchange rate, equation (6) is transformed into equation (7).

$$i_t = \delta'_0 + \delta'_1 \pi_{t+n} + \delta'_2 x_t + \delta'_3 e_t + \delta'_4 e_{t-1} + \rho' i_{t-1} + \varepsilon''_t. \quad (7)$$

In fact the real exchange rate has unit root in most countries, so that equation (7) can deal with the unit root in real exchange rate. Mohanty and Klau (2004) apply equation (6) and (7) to study the monetary rule in the inflation-targeting emerging market economies.

2. Estimation

The monthly data of uncollateralized call rate, industrial production index, CPI inflation over the same month the previous year, and real effective exchange rate of the Korean won compiled by the JP Morgan (higher values mean real appreciation) are used over the sample period of Jan. 1991 – August 2007. The output gap was calculated by subtracting from the logged value of seasonalized industrial production index its trend value that was obtained by applying Hodrick-Prescott filtering over March 1990 – August 2008.

The equations were estimated applying General Method of Moment technique in consideration of the orthogonality condition in equation (5). All explanatory variables and their lagged values were chosen as instrument variables.[3]

The Dickey-Fuller and Phillips-Perron unit root test over the period of January 1998 – August 2007 turned out that call rate and output gap did not have unit root, but inflation and real effective exchange rate had one unit root. It is very unique that inflation has the unit root in Korea, since it has no unit root in many other countries. Although inflation variable cannot be used considering the nonstatinarity problem, this problem is often neglected in the estimation using Korean data, especially when theory requires inflation variable.

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[2] Ball (1999) finds that the monetary policy is optimal when $\delta_3 = -0.37$, $\delta_4 = 0.17$. They turn out $\delta_3 = -0.45$, $\delta_4 = 0.45$ in Svensson (2000).

[3] The Bartlett Kernal and Newey-West fixed bandwidth method was applied to get HAC. 1, 6, 9, and 12-month lagged values are chosen in the instruments.

Table 5. Estimation of Call Rate Interaction Function (GMM)

	Const.	π_t	π_{t+12}	x_t	i_{t-1}	e_t	e_{t-1}	Δe_t	Δe_{t-1}	Adj. R^2	Over-ID P value
(A)	0.30 (16.87)	0.034 (3.48)		0.048 (10.14)	0.91 (274.7)					0.97	0.96
(B)	0.27 (0.37)		0.018 (1.49)	0.025 (15.60)	0.87 (124.1)	-0.033 (-6.49)	0.034 (7.21)			0.97	0.94
(C)	0.30 (15.74)	0.019 (2.14)		0.021 (8.71)	0.91 (232.8)			-0.033 (-5.00)	0.006 (1.40)	0.97	0.93
(D)	0.33 (9.3)		0.027 (2.36	0.019 (5.91	0.89 (200.4			-0.052 (-8.11	-0.002 (-0.51	0.96	0.97

Notes: 1) t-values are in parenthesis

2) The estimation period of equation (A) and (C) is Jan. 1998-Aug.2007 and that of (B) and (D) is Jan.1999-Aug.2007.

Table 5 shows the estimation results of the various forms of call rate interaction function over the different period. The adjusted R^2 is very high in all equations. The P value of the overidentification $\chi 2$ statistic is also very high so that the overidentification restrictions are appropriate. The notable thing is that the estimation is sensitive to the period, which was anticipated to a certain degree by the correlation analysis in Table 2.

When the estimation starts from January 1998, call rate responds to the current inflation instead of the expected inflation that is measured by the inflation 12 months ahead. The estimation that excludes the variable of real effective exchange rate or includes the variable of changes in real effective exchange rate is significant. When the estimation starts from January 1999, however, call rate responds to the expected inflation rather than current inflation. The estimation that excludes the variable of real effective exchange rate is not significant, but the estimation that includes the variable of changes in real effective exchange rate is significant.

These results were noticed by the correlation analysis in Table 2. Estimation results were better when the estimation started from 1999, because the Bank of Korea announced the target of call rate as policy instrument starting from May 1999.

Korea has opted for 'flexible inflation targeting' in which call rate reacts to the output gap and exchange rate depreciation as well as inflation. As seen in equation (D) in Table 5, the reaction of call rate to exchange rate appreciation is larger than the reaction of call rate to inflation and output gap. Meanwhile, the long-run response of call rate to (future) inflation has been estimated to be only 0.25 in equation (D) in Table 5, as the Bank of Korea has accommodated inflation. This is contrasted with experiences of several advanced countries that have actively raised interest rates to control inflation (Clarida et al, 1998).

Studies on the call rate reaction function in Korea that consider explicitly the exchange rate in the right hand side include Mohanty and Klau (2004), Eichengreen (2004), Kim and Oh (2005), and Cho et al (2008). All except for Kim and Oh (2005) consider the reaction of call rate to changes in exchange rate or both the current and lagged exchange rate and found the significant reaction of call rate to exchange rate. However, Kim and Oh (2005) consider the reaction of call rate to lagged (real) exchange rate and find it insignificant.[4]

3. Structural Stability

Structural stability of the reaction function can be tested by changing estimation period and adding new variable to the instrumental variables. The call rate began to rise since November 2004 and the sterilized intervention in the foreign exchange market became difficult since 2005 due to the accumulated losses in Foreign Exchange Stabilization Fund. Thus one can check structural stability by dividing the estimation period into pre-2005 and post-2005 period. But we compare the estimation results in the whole period and pre-2005 period, because the number of observations in post-2005 period is smaller than the number of instrumental variables.

The correlation analysis in Table 2 shows that the correlation of call rate and future inflation changes to a large extent according to the sampling period. For instance, in equation (D) in Table 5 the coefficient of the 12-month-ahead inflation is estimated to be significantly positive during Jan. 1999-Aug. 2007. But that is estimated to be insignificantly negative during the pre-2005 period. Therefore, the call rate reaction function in Korea is structurally unstable, particularly regarding the reaction of call rate to future inflation.

Equation (6) or (7) is the reduced form so that it could be sensitive to the structure of the model. To test this kind of structural instability, we check how much the

[4] If equation (6) is estimated omitting the current real exchange rate variable, the lagged real exchange rate turns out to be insignificant even in our study.

estimated coefficients change when such variables as US federal fund rates and M2 growth in Korea are added to the instrumental variables.

Table 6. Changes in Reaction Coefficients: Instrument Added (GMM estimation)

	Const.	π_{t+12}	x_t	i_{t-1}	Δe_t	Δe_{t-1}	Adj. R^2
(D) in Table 5	0.33 (9.35)	0.027 (2.36)	0.019 (5.92)	0.89 (200.4)	-0.052 (-8.11)	-0.002 (-0.51)	0.96
Federal fund rate	0.48 (17.65)	-0.006 (-1.27)	0.020 (12.09)	0.89 (189.35	-0.054 (-12.51)	-0.011 (-5.62)	0.96
M2 growth	0.49 (17.40)	0.008 (1.36)	0.023 (20.32)	0.87 (214.16)	-0.023 (-7.04)	-0.009 (-4.02)	0.97

Notes: t value in parentheses. Estimation during Jan.1999-Aug.2007.

It was found in Table 6 that the coefficients of output gap, lagged call rate, and real appreciation whose t-values were high did not change much, but the relatively less significant coefficient of future inflation did change much with the addition of such an instrument as federal fund rate and M2 growth.

Ⅳ. Was Korea's Monetary Policy Exchange Rate-Centered?

It was shown in the previous section that the reaction of call rate to real appreciation or depreciation is relatively large, compared to expected inflation, under the inflation targeting system in Korea. In other words, exchange rate played the important role in Korea's monetary policy. Then can we say that Korea has implemented the exchange rate-centered monetary policy to achieve inflation target in which the exchange rate instead of the interest rate is the policy instrument? This section intends to answer this question by examining whether Korea has implemented the Singaporean style of exchange rate-centered monetary policy.

1. Exchange Rate-Centered Monetary Policy

If the exchange rate-centered monetary policy was pushed strongly to make exchange rate the policy instrument of the central bank, exchange rate would replace call rate in the monetary reaction function of equation (4). As the country becomes open to foreign trade and foreign capital movement, more attention will be paid to the monetary transmission channel through exchange rate. Thus the exchange rate targeting such as the flexible basket peg or BBC(basket, band, crawl) system becomes the monetary rule. In fact, the monetary authority in highly opened Singapore formulates its monetary reaction function as follows (Parrodo, 2004; Ee et al., 2004).

$$\Delta e_t = (1-\rho)\alpha + (1-\rho)\beta\pi_{t+n} + (1-\rho)\gamma x_t + \rho\Delta e_{t-1} + \varepsilon_{t.} \qquad (8)$$

The Monetary Authority of Singapore manipulates changes in nominal effective exchange rate as the policy instrument in order to stabilize domestic inflation and output. Ee et al (2004) estimated equation (8) using the Singaporean monthly data during 1991-2002 and found that $\beta = 1.891$, $\gamma = 0.423$, $\rho = 0.847$, when $n = 9$. When (future) inflation and output gap rise by 1% point respectively, the nominal effective exchange rate of the Singaporean dollar appreciates 1.9% and 0.4% in the long run to stabilize inflation and output respectively. Since the smoothing coefficient ρ is near one, however, the Singaporean dollar appreciates or depreciates very slowly.

Many economists who emphasize the concept of the fundamental equilibrium exchange rate and monetary and exchange rate cooperation in the East Asian region argue that Korea's monetary policy should be exchange rate-centered rather than interest rate-centered as nowadays. They even suggest that Korea should follow the

BBC system of Singapore (Williamson, 2001; Ito, 2005; Moon and Rhee, 2007). We provide the estimation results in the following to show that Korea's monetary policy was not exchange rate-centered, although it reacted to changes in exchange rate to some extent.

2. Estimation

Table 7 shows the estimation results of the reaction function of the nominal effective exchange rate during the period of inflation targeting in Korea. All coefficients are significant in Korea, when equation (8) is estimated during Jan.99-Aug.07. When inflation and output gap rise by 1% point respectively, the nominal effective exchange rate of the Korean won appreciates 0.32% and 0.09% in the long run to stabilize inflation and output respectively. However, the smoothing coefficient ρ is small (ρ = 0.2) in Korea.

Table 7. Estimation of the Reaction Function of the Nominal Effective Exchange Rate (GMM)

Period	Constant	π_t	x_t	Δe_{t-1}
98.1-07.8	-0.95 (-5.40)	0.389 (6.49)	0.025 (0.92)	0.36 (20.53)
99.1-07.8	-0.67 (-3.42)	0.26 (3.82)	0.069 (2.26)	0.20 (3.39)

Note: t-values in parenthses.

Then can we say that the monetary policy in Korea is exchange rate-centered as in Singapore since all coefficients are significant in Table 7? The short-run response of nominal effective exchange rate to inflation and output gap is almost the same in magnitude in both countries. However, the long-run response is much larger in Singapore, as the smoothing coefficient in Singapore is more than 4 times that in Korea. We can say that Korea adjusted nominal effective exchange rate to attain the stability in inflation and output gap during the inflation targeting period of Jan.99-Aug.07, but that the monetary policy in Korea was not as much exchange rate-centered as in Singapore. The nominal effective exchange rate in Korea fluctuated more than in Singapore.

One can raise the question that Korea's monetary policy during the years of inflation targeting in which call rate responded more to real appreciation (or depreciation) than to inflation was optimal? Answering this question is beyond the scope of this paper. This paper has been confined to the estimation of the reduced form reaction function of such policy instruments of call rate or nominal effective exchange rate. However, the recent study of McCallum (2006) on the optimality of the Singaporean exchange rate-centered monetary regime may provide some answers to the question. McCallum (2006) suggests that whether the monetary regime should be interest rate-centered or exchange rate-centered depends crucially on the export/output ratio. As the export/output ratio increases, the exchange rate-centered monetary regime may have more relevance.

The export/output ratio of around 30% in Korea is certainly above the average of other countries, but only the half of that in Singapore. Therefore, the current practice of inflation targeting in Korea in which exchange rate directly affects the policy instrument of call rate seems to be appropriate, considering its high export/output ratio.

Ⅴ. Concluding Remarks

Korea adopted inflation targeting in 1998. She also switched to floating exchange rate system from the market average exchange rate system in the same year. This paper has paid attention to the reaction of call rate to not only inflation but also output gap and exchange rate under the inflation targeting and floating regime.

We obtained the estimation results that call rate reacted more to real appreciation (or depreciation) than to (future) inflation and output gap in Korea. In particular, Korea has accommodated inflation since the coefficient of inflation in the call rate reaction function was far less than 1 and even unstable structurally. Korea seems to have been passive to inflation under inflation targeting, because economic situations were so favorable to inflation that inflation often fell below the lower bound of inflation target during the past decade.

We also examined whether Korea’s monetary policy can be characterized as exchange rate-centered monetary policy like the Singaporean monetary policy. We found that the monetary policy in Korea was not as much exchange rate-centered as in Singapore, because Korea was not as much open as Singapore. Korea might prefer exchange rate targeting or the BBC rule of the Singaporean style to inflation targeting when Korea becomes more open to foreign trade and foreign capital movements.

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