The Performance of Targeting Monetary Policies in a Small Open Economy

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This paper examines the performance of targeting monetary policies in a dynamic optimizing model. Towards this end I develop a small open economy version of the New Keynesian model and calibrate it to the recent Korean data. By modeling the central bank as an optimizing agent with explicit weights on different components of the objective function, I explore the consequences of alternative specifications of the central bank's objectives. Policy simulations include variations on inflation targeting, nominal income growth targeting and exchange rate targeting. Simulation results suggest that inflation targeting is preferable to nominal income growth and exchange rate pegging in smoothing out fluctuations in inflation and the output-gap.

Keywords: Targeting monetary policy, Inflation targeting

JEL Classification: E52, E54

I. Introduction

Inflation targeting has recently been adopted in several developed countries as a framework for monetary policies. A growing number of emerging market economies (EMEs) have been encouraged to adopt inflation targeting as well.[1] Korea is also one of a number of

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EMEs that have adopted inflation targeting. This paper investigates the dynamics of the Korean economy since the implementation of inflation targeting, to access its appropriateness for EMEs. While much of the previous literature has been conducted with closed economy models, increasing interest has been given to small open economies.[2]

In the literature, I find that a broad consensus seems to have formed regarding the superiority of inflation targeting as a monetary framework. Nonetheless, some recent research has questioned the optimality of inflation targeting in all circumstance. Specifically focusing on small open economies, McCallum and Nelson (1999) argued in favor of nominal income growth targeting over inflation targeting. One attractive feature of their macroeconomic model is an emphasis on modeling imports as intermediate goods in production instead of components of consumption:[3] for Korea, consumer goods accounted for only 13% of imports in 2002; capital equipment and intermediate goods comprised the remaining 87%. In section II, I start with the specification of McCallum and Nelson (1999) to develop a micro-founded dynamic stochastic model calibrated to the Korean economy.

However, in contrast with McCallum and Nelson (1999), I model the central bank as a dynamically optimizing agent acting under discretion, rather than imposing an estimated policy rule. The policy rule - a Taylor rule typed one single equation reaction function - is limited in describing the behavior of the central bank. Inflation targeting is a statement about the objectives of the central bank. As such, under the assumption that the central bank is itself a rational, optimizing agent in the model, it is preferable to model the objective function of the central bank and then derive the resulting targeting rule, rather than specifying an exogenous, static policy reaction equation as they did.

I compare different primary objectives of the central bank. Thus, I can investigate its appropriateness of monetary policies by comparing

[1] For the international experience of adopting inflation targeting, refer to Bernanke *et al.* (1999), and Schaechter *et al.* (2000).

[2] For the investigation of inflation targeting in the closed model, see Clarida *et al.* (1999) and Jensen (2002).

[3] Most open economy literature that investigates the monetary policies, for example, Clarida *et al.* (1999), and Gali and Monacelli (2002), treats imported goods as final consumption goods.

the performance under different weights on the central bank's loss function. The performance of the monetary policies is evaluated how well they perform in smoothing out fluctuations in inflation, the output-gap, or other macroeconomic variables. Policy simulations include variations on inflation targeting, nominal income growth targeting and exchange rate targeting. Simulation results suggest that inflation targeting is preferable to nominal income growth and exchange rate pegging in smoothing out fluctuations in inflation and the output-gap.

This paper is organized as follows. In section II, we start with a New Keynesian model developed by McCallum and Nelson (1999).[4] The model presumes that economic agents are solving dynamic optimization problems with rational expectations, as in the Neo -Classical literature. In the model, however, prices are presumed not to adjust freely within each period but instead respond gradually. The specific price adjustment mechanism utilized here is a variant of Fuhrer and Moore (1995). I calibrate the model to Korean quarterly data from 1987.Q2 to 2000.Q4 by specifying the parameter values of the model in section III and simulate it to evaluate targeting policies such as inflation targeting, nominal income growth targeting and exchange rate targeting in section IV. Finally, section V concludes the paper.

II. The Model

The model is a variant of a now standard New Keynesian open-economy model, using McCallum and Nelson (1999)'s formulation. The model is derived from the optimization of infinitely-lived households. The households consume a variety of goods, provide their labor in the factor market, and hold and trade domestic and

[4] For the literature on New Keynesian (or New Neo-Classical Synthesis) stochastic dynamic models, see Goodfriend and King (1997), Lane (2000), and Clarida, Gali, and Gertler (1999). New Keynesian models bring imperfect competition and nominal rigidities into the dynamic stochastic general equilibrium structure. In these models, the price decisions of firms that are optimal given the assumed frictions to price adjustment lead to nontrivial effects of monetary policy on real variables. Monetary policy may thus become a potential stabilization measure, as well as a source of economic fluctuations. Hence for academic researchers New Keynesian stochastic dynamic model provides a good tool to analyze the effect of monetary policy.

foreign bonds. In addition, they serve as a sole provider of differentiated consumption goods, to be sold both domestically and aboard. To this end, they hire labor and import intermediates to produce output.

In particular, imports are treated not as final goods, as is typical in the literature, but instead as raw-material inputs or intermediates. Such a specification captures better the features of data especially to a small open economy, that of Korea. According to the Korean data on imports by use, as of 2002, consumption goods account for 13% of total imports whereas intermediates for 49%, and capital goods for 38%. In addition, this specification theoretically yields a behavior of inflation and exchange rate change, closer to that found in the data.[5]

Contrary to McCallum and Nelson (1999), this paper adopts a price adjustment mechanism from Fuhrer and Moore (1995), rather than Calvo (1982), which is adopted in McCallum and Nelson. As McCallum (1994) has criticized, Calvo's specification of inflation process violates the natural-rate hypothesis. Additionally, as Mankiw (2000) has discussed, far too little inertia in inflation dynamics is implied in the Calvo's specification, of which inflation process has only a forward-looking nature. Instead, in the Fuhrer and Moore's specification inflation process has an additional backward-looking nature. This nature yields inflation inertia since past inflation can not respond to new information about current or future monetary policy. In addition, this paper has different features from McCallum and Nelson (1999) by dropping the assumption of habit formation of consumption.[6]

[5] McCallum and Nelson (2001) investigated whether the behavior of inflation and exchange rate movement was changed under different treatment of imported goods. They compared two models. One is Gali and Monacelli (2002), in which imports enter as final goods. The other is McCallum and Nelson (1999), in which imports enter as raw materials and intermediates. They found that McCallum and Nelson (1999) generated a lower and more delayed correlation between inflation and exchange rate change.

[6] If the feature of habit formation of consumption is incorporated into the model, the variability of inflation and nominal income growth is slightly reduced. But this reduced variability happens only when the central bank does not pay attention to the change of the interest rate. Incorporating the feature of habit formation into the model, thus, does not change the main result of the paper.

In the following, I present a log-linearized version of the model. A detailed specification of the model is described in the appendix. Finished consumption goods are produced by a Cobb-Douglas production function:

$$y_t = (1-\delta)\, a_t + (1-\delta)\, n_t + \delta\, im_t, \tag{1}$$

where y_t represents output, a_t a stochastic technological shock, n_t labor, and im_t imported raw materials and intermediates. A technological shock (a_t) is assumed to follow an AR (1) process. That is, $a_t = \rho_a a_{t-1} + \varepsilon_{a,t}$, and $\varepsilon_{a,t} \sim N(0, \sigma^2_{\varepsilon a})$.

Output is either consumed by domestic households or exported so that aggregate demand equation is described as

$$y_t = \left(1 - \frac{EX}{Y}\right) c_t + \left(\frac{EX}{Y}\right) ex_t, \tag{2}$$

where c_t represents domestic consumption, ex_t represents export, and EX/Y represents the steady-state export-output ratio. Exports depend on the real exchange rate (q_t) and foreign output (y_t^*), the latter of which exogenously follows a stochastic process.

$$ex_t = \eta_q q_t + \eta_{y^*} y_t^*, \tag{3}$$

where the foreign output is assumed to follow an AR (1) process. That is, $y_t^* = \rho_{y^*} y^*_{t-1} + \varepsilon_{y^*,t}$, and $\varepsilon_{y^*,t} \sim N(0, \sigma^2_{\varepsilon y^*})$. The real exchange rate by definition equals the nominal exchange rate less the difference between the domestic and foreign price levels.

$$q_t = s_t + p_t^* - p_t. \tag{4}$$

Consumption is determined by an Euler equation, as a function of nextperiod's expected consumption and the current ex ante real interest rate (times the intertemporal elasticity of substitution), with an exogenously given preference shock (v_t). The preference shock is assumed to follow an AR (1) process. That is, $v_t = \rho_v v_{t-1} + \varepsilon_{v,t}$, and $\varepsilon_{v,t} \sim N(0, \sigma^2_{\varepsilon v})$.

The Fisher equation replaces the real interest rate with the current nominal rate (i_t) and expected inflation ($E_t \pi_{t+1}$), providing a direct channel for monetary policy in the real economy.

$$c_t = E_t c_{t+1} + (1/\sigma) E_t \pi_{t+1} - (1/\sigma) i_t + \upsilon_t, \tag{5}$$

The uncovered interest rate parity condition is assumed to hold with an exogenous risk premium that follows an AR (1) process.

$$i_t = i_t^* + E_t \Delta s_{t+1} + \kappa_t, \tag{6}$$

where i_t^* represents foreign interest rate and κ_t represents a risk premium shock, which is assumed to follow an AR (1) process. That is, $\kappa_t = \rho_\kappa \kappa_{t-1} + \varepsilon_{\kappa,t}$, and $\varepsilon_{\kappa,t} \sim N(0, \sigma^2_{\varepsilon\kappa})$.

In the following, I consider how the price is determined in the model. Following Fuhrer and Moore (1995), I consider a model of overlapping wage contracts. In a two-period contracting world, wages prevailing in the current period becomes the average of the contract wage negotiated in periods $t\,(w_t)$ and $t-1\,(w_{t-1})$. Thus the firm marks up the price as a following manner. In the following, I consider how the price is determined in the model.

$$p_t = \frac{1}{2}(w_t + w_{t-1}). \tag{7}$$

In the two-period contracting specification of Fuhrer and Moore (1995), agents care about relative real wages over the life of the wage contract. Thus, the current wage contract in real terms is an average of the lagged and the expected future wage contracts in real terms, adjusted for excess demand, $y_t - \bar{y}_t$.[7]

$$w_t - p_t = \frac{1}{2}\{(w_{t-1} - p_{t-1}) + E_t(w_{t-1} - p_{t+1})\} + \varphi\{(y_t - \bar{y}_t) + (y_{t-1} - \bar{y}_{t-1})\} \tag{8}$$

Substituting w_t of equation (7) with equation (8), I get an inflation equation such as

$$\pi_t = \frac{1}{2}(\pi_{t-1} + E_t \pi_{t+1}) + \frac{\varphi}{2}\{(y_t - \bar{y}_t) + (y_{t-1} - \bar{y}_{t-1})\} \tag{9}$$

In this model, the central bank also behaves optimally, choosing the values of the instrument - the interest rate to minimize the loss function:

[7] Note that the contracts are still negotiated in nominal terms.

$$L_0 = E_0 \sum_{t=0}^{\infty} \beta^t \{ \omega_\pi \pi_t^2 + \omega_{\Delta x} \Delta x_t^2 + \omega_{\Delta s} \Delta s_t^2 + \omega_{y-\bar{y}} (y-\bar{y})_t^2 + \omega_{\Delta i} \Delta i_t^2 \} \quad (10)$$

The loss function incorporates preferences for targeting inflation, the nominal income growth or the exchange rate. In addition, it incorporates preferences for output stability and smoothing the interest rates. The coefficients, ω_π, $\omega_{\Delta x}$, and $\omega_{\Delta s}$ reflect the central bank's preference for inflation, the nominal income growth, and the exchange rate movement being at target, respectively. The coefficient, $\omega_{y-\bar{y}}$, represents a preference for maintaining output at potential. The coefficient, $\omega_{\Delta i}$, represents a preference for interest rate smoothing. This preference reflects the fact that especially for EMEs, the central bank has a tendency to smooth the interest rate change in order to maintain financial stability. An explicit weight on the nominal interest rate or the exchange rate does not usually follow from the specification of the utility function of the representative agent.[8] However, in the model large swings in interest rates or exchange rates are costless - whereas the recent crises experienced by Korea and several other emerging markets suggest these models may miss the importance of avoiding "sudden stops" and other large (possibility non-linear) disruptions to the business and financial sector.

Despite the formal separation of exchange rate management from the other tools of monetary policy (in Korea as in many other countries), manipulating the exchange rate has important implications for monetary policy. In the model, it is in effect a monetary policy action. Given the expressed importance that the Bank of Korea has given to movements in the value of the Won, I additionally simulate the impact of explicit concern for the variability of the exchange rate in the loss function of the central bank. This approach also is consistent with the concern for currency stability among small open economies documented in the "fear of floating" literature.[9]

In addition, the central bank, especially in the EMEs, has a motive to stabilize changes in interest rates, to avoid the potential costs from financial fragility that may be exacerbated by volatile

[8] In the case of the closed economy model, refer to Woodford (2003) for the derivation of loss function from the utility function.

[9] See Calvo and Reinhart (2002).

interest rates. Also Bharucha and Kent (1998) investigates the Australian monetary policy with loss function of the central bank with explicit weights on the nominal interest rate and the exchange rate.

The model economy consists of the equations mentioned above as well as exogenous shock processes. If I describe the model in a state-space form, it can be written as

$$A_0\begin{bmatrix} z_{1t+1} \\ E_t z_{2t+1} \end{bmatrix} = A_1\begin{bmatrix} z_{1t} \\ z_{2t} \end{bmatrix} + B_1 u_t + \begin{bmatrix} \varepsilon_{t+1} \\ 0_{n_2 \times 1} \end{bmatrix}. \tag{11}$$

where z_{1t} is a vector containing predetermined variables.

$$z_{1t} = [a_t, v_t, \kappa_t, y_t^*, \pi_{t-1}, y_{t-1}, i_{t-1}, \Delta q_{t-1}, q_{t-1}, \Delta s_{t-1}]' \tag{12}$$

z_{2t} is a vector containing forward-looking variables such that

$$z_{2t} = [q_t, c_t, \pi_t]' \tag{13}$$

ε_t, is a vector of shocks which are assumed to follow an AR (1) process.

$$\varepsilon_t = [\varepsilon_{at}, \varepsilon_{vt}, \varepsilon_{\kappa t}, \varepsilon_{y_t^*}, 0,0,0,0,0,0,0,0,0,0]' \tag{14}$$

Pre-multiplying the above equation by A_0^{-1}, I get the following equation.

$$\begin{bmatrix} z_{1t+1} \\ E_t z_{2t+1} \end{bmatrix} = A\begin{bmatrix} z_{1t} \\ z_{2t} \end{bmatrix} + B u_t + \begin{bmatrix} \varepsilon_{t+1} \\ 0 \end{bmatrix}, \tag{15}$$

where note that $A_0^{-1}[\varepsilon_{t+1}\ 0]' = [\varepsilon_{t+1}\ 0]'$ for the model we consider. And the loss function can also be written in the matrix form.

$$L_t = Y_t' K Y_t, \tag{16}$$

where K is a diagonal matrix, with the preference weights on the diagonal. And Y_t is a vector containing policy variables such that

$$Y_t = [\pi_t, \Delta x_t, \Delta s_t, y_t - \bar{y}_t, \Delta i_t]', \tag{17}$$

which is also related with z_{1t}, z_{2t} and u_t in the following manner.

$$Y_t = C_z \begin{bmatrix} z_{1t} \\ z_{2t} \end{bmatrix} + C_u u_t . \qquad (18)$$

And we consider the interest rate as a single instrument variable so that $u_t = i_t$.

I solve the model specified by the above state-space form by applying a method of linear rational expectations model proposed by Söderlind (1999).

III. Calibration

In this section, I calibrate the model economy developed in the previous section, and simulate the model economy. Towards this end, I set values for parameters used in the model economy. Table 1 presents specific values for parameters. Baseline parameter values for the model are chosen based on recent Korean data from 1987.Q2 to 2000.Q4.

In line with the literature, the time discount rate (β) and coefficient of relative risk aversion (σ) are assigned values of 0.99 and 5, respectively. Following Park and Shin (2000), I set the mark-up ratio ($\theta / \theta - 1$) to 11% so that elasticity of demand for consumption varieties (θ) equals 10.09. The elasticity between domestic goods and imported goods in the production function, ρ, is set to 5 so as to produce variability of the model economy comparable with that in the data. The average of the import share of GDP ($Q(IM/Y)$) over this period was equal to 0.20, implying that $\delta = (\theta / \theta - 1) \times Q(IM/Y)$ is 0.222. During the same period, the export -output ratio (EX/Y) was 0.214.

The elasticity of exports to the real exchange rate (η_q) is set to 0.538, following Lee and Kim (1991). They estimated an export equation by regressing export volume on the real exchange rate and control variables. The estimated elasticity does not reflect changes in the price, implying that this is its maximum possible value. I set an elasticity of exports to the foreign income (η_{y^*}) to 1, considering the fact that exports have a sizable effect on the Korean economy. The coefficient of the output-gap in the Phillips curve ($\varphi / 2$) is set to 0.077 as in Nam (2003), which estimated the Phillips curve using Korean data from 1986.Q1 to 2001.Q4.

Following Nam and Pyo (1997), I specify domestic and foreign

TABLE 1
VALUES OF PARAMETERS

Parameter	Description	Value
β	Time discount rate	0.99
σ	Coefficient of relative risk aversion	5
θ	Elasticity of demand for consumption varieties	10.09
ρ	Production elasticity b/w domestic and imported goods	5
$\varphi/2$	Slope of Phillips curve	0.077
$Q(IM/Y)$	Import share of GDP	0.20
EX/Y	Export-output ratio	0.214
η_q	Elasticity of exports to real exchange rate	0.538
η_{y^*}	Elasticity of exports to foreign income	1
ρ_a	AR (1) coefficient of productivity process, a_t	0.89
ρ_v	AR (1) coefficient of preference process, v_t	0.30
ρ_κ	AR (1) coefficient of risk premium process, κ_t	0.50
ρ_{y^*}	AR (1) coefficient of foreign income process, y_t^*	0.81
$\sigma_{\varepsilon a}$	Standard deviation of productivity shock, ε_{at}	0.02
$\sigma_{\varepsilon v}$	Standard deviation of preference shock, ε_{vt}	0.01
$\sigma_{\varepsilon\kappa}$	Standard deviation of risk premium shock, $\varepsilon_{\kappa t}$	0.04
$\sigma_{\varepsilon y^*}$	Standard deviation of foreign income shock, ε_{y^*t}	0.0075

technological shock processes such that AR (1) coefficient of a domestic technological shock (ρ_a) is given as 0.89, and that of a foreign technological shock (ρ_{y^*}) is given as 0.81. And their standard deviations of domestic ($\sigma_{\varepsilon a}$) and foreign technological shocks ($\sigma_{\varepsilon y^*}$) are given as 0.02 and 0.0075, respectively.

The AR (1) coefficient of preference shock process (ρ_v) is set to 0.3 and its standard deviation ($\sigma_{\varepsilon v}$) to 0.01. Those values are close to values reported by MaCallum and Nelson (1998). The AR (1) coefficient of risk premium process (ρ_κ) is set to 0.50 and its standard deviation ($\sigma_{\varepsilon\kappa}$) to 0.04, following MaCallum and Nelson (1999).

To see the properties of the model, I examine impulse response functions of the model economy to exogenous shocks. The model economy is based on the case of inflation targeting, in which $\omega_\pi=1$, $\omega_{\Delta i}=0.1$, and other weights are zero in the loss function of Equation (10). The model economy is hit by four exogenous shocks - shocks to technology ($\varepsilon_{a,t}$), preference ($\varepsilon_{v,t}$), risk premium ($\varepsilon_{\kappa,t}$), and foreign output ($\varepsilon_{y^*,t}$). Figures 1-4 plot impulse response functions. Figure 1 depicts responses to a unit shock to technology. A unit increase in $\bar{y}_t$ leads to an increase in the output, but a slight

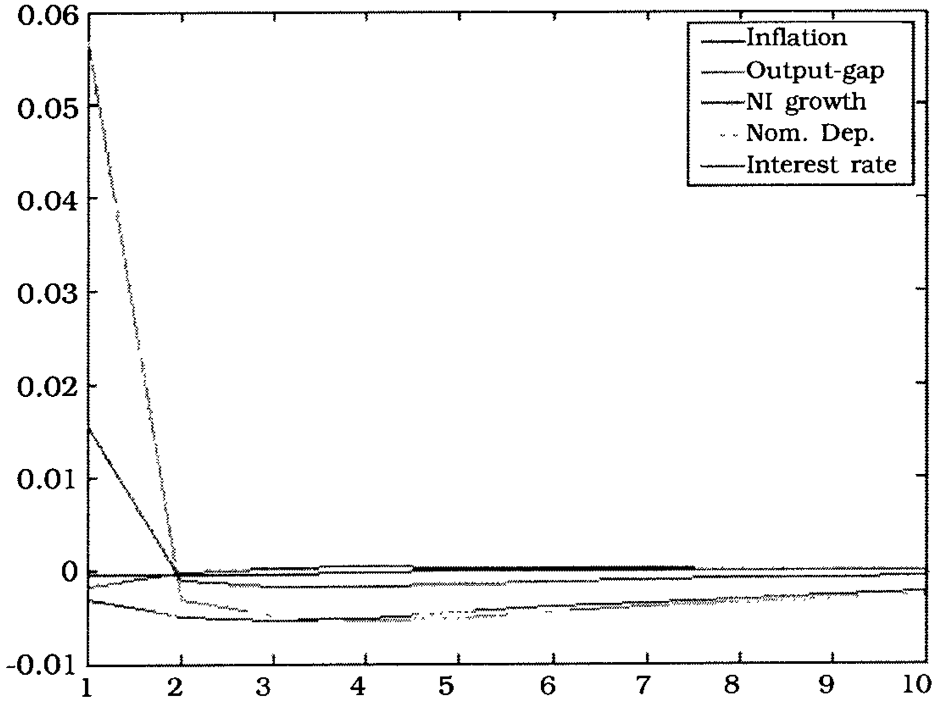

FIGURE 1

IMPULSE RESPONSE TO AN ONE STD OF TECHNOLOGY SHOCK

decrease in the output-gap since the potential output jump more than the output. And nominal income shows a jump temporarily. A favorable supply shock brings the price down. Both fallen output -gap and inflation bring about an decrease in the interest rate. The increase in income involves a jump in import demand that can only be satisfied by an exchange rate depreciation.

In Figure 2, we see that a preference shock leads to an upward jump in output-gap and inflation. This increase in output-gap and inflation brings about an increase in the interest rate and nominal income. The increased demand for domestic output results in an appreciation of the exchange rate. Figure 3 presents impulse responses to a risk premium shock. From Eq. (6), it is clear that an increase in risk premium will bring about a blip in the same direction in the current exchange rate s_t, implying an depreciation. This depreciation helps an expansion of export demand and the output. The interest rate is raised in response to an increase in the output-gap. In the meantime, inflation is little affected by the risk premium shock. Finally, in Figure 4 we see that a foreign income shock leads to an increase in the output and inflation temporarily.

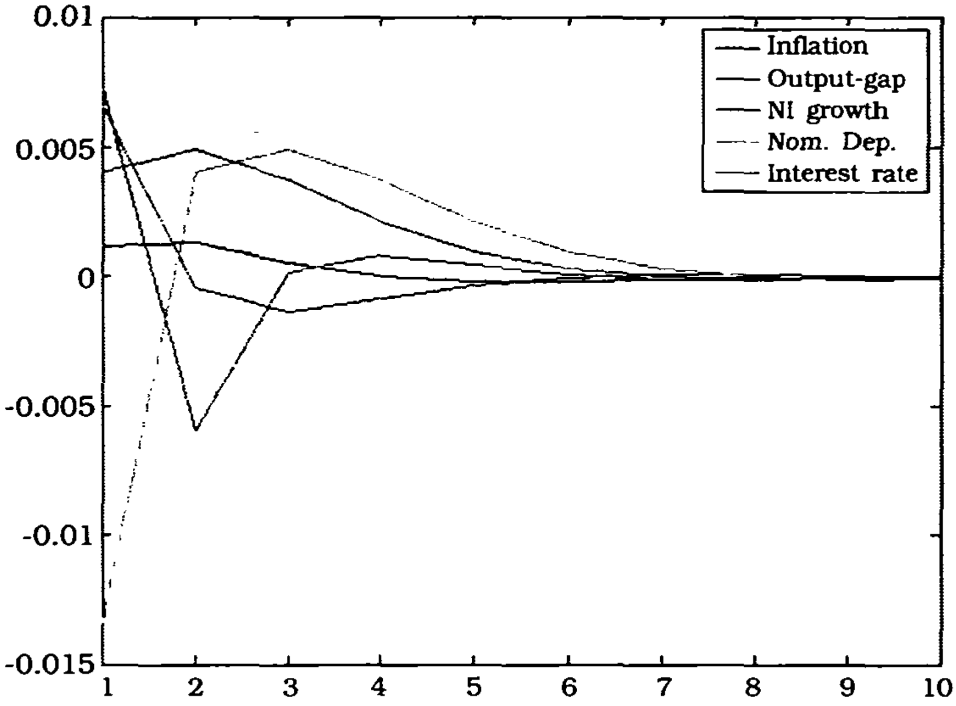

FIGURE 2
IMPULSE RESPONSE TO AN ONE STD OF PREFERENCE SHOCK

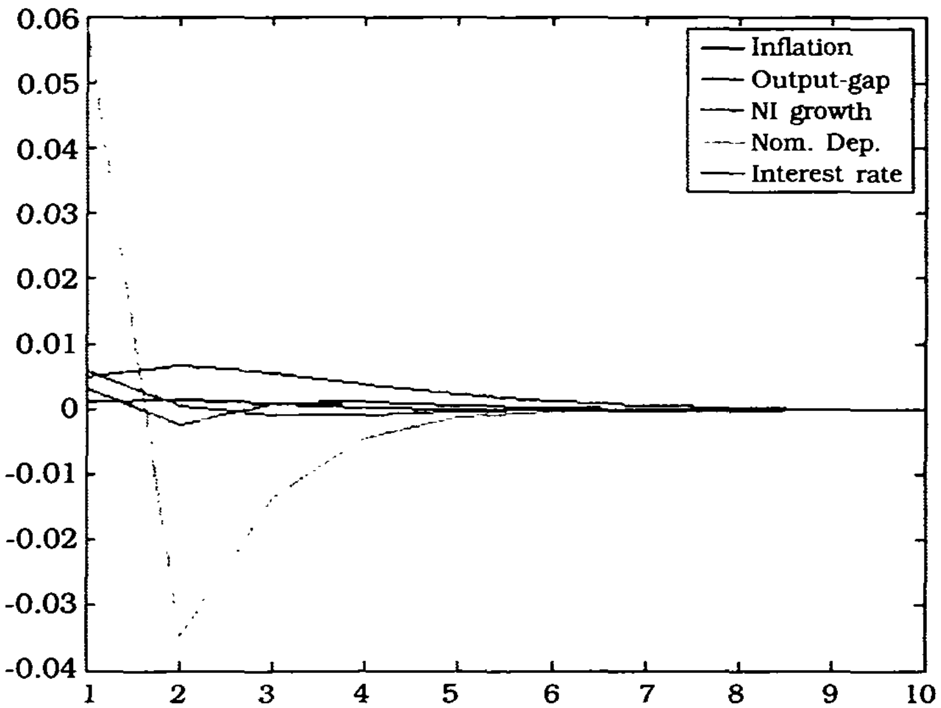

FIGURE 3
IMPULSE RESPONSE TO AN ONE STD OF RISK PREMIUM

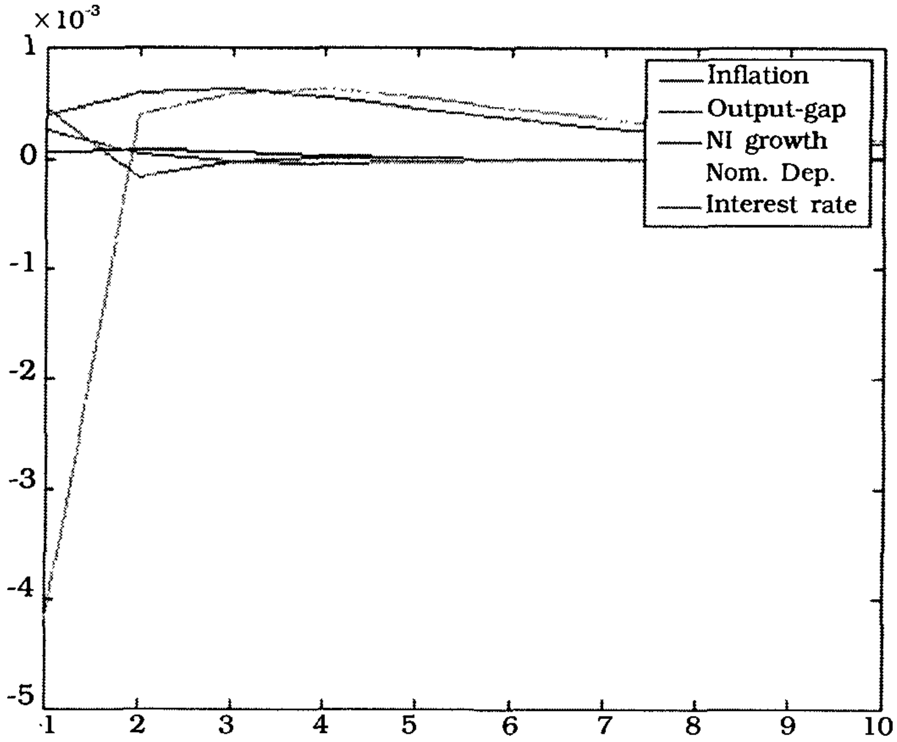

FIGURE 4
IMPULSE RESPONSE TO AN ONE STD OF FOREIGN INCOME

The increase in the output-gap and inflation brings about an increase in the interest rate. And strengthened foreign demand for domestic good leads to an appreciation of the exchange rate.

Impulse responses of the nominal income growth and exchange rate targeting are basically similar to those of inflation targeting, even though the former two targetings have a prolonged shape of responses.

IV. Experiments

In this section, I simulate the model economy to evaluate targeting monetary policies. I consider several targeting policies-inflation, nominal income growth, and exchange rate.[10] In henceforth, I abbreviate Inflation Targeting to IT, Nominal Income Growth

[10] For the detailed derivation of the numerical solution, see Söderlind (1999).

Targeting to NIGT, and Exchange Rate Targeting to ET. I assess how well a targeting policy succeeds in smoothing out fluctuations in inflation, the output-gap, the nominal income growth rate, and variability of exchange rates. The less volatile are those macroeconomic variables, the more successful, I conclude, is a targeting policy. A targeting policy adjusts an interest rate instrument when a targeted variable deviates its targeted path as well as when output deviates the natural rate. Specific policy rules of IT, NIGT and ET are specified by putting weights on components of the central bank's loss function.[11] Under a specific policy rule, the weights of the loss function has the following values.

IT: $\omega_{\pi} = 1$, $\omega_{\Delta x} = 0$, and $\omega_{\Delta s} = 0$.

NIGT: $\omega_{\pi} = 0$, $\omega_{\Delta x} = 1$, and $\omega_{\Delta s} = 0$.

ET: $\omega_{\pi} = 0$, $\omega_{\Delta x} = 0$, and $\omega_{\Delta s} = 1$.

For example, IT puts the weight on its target variable, *i.e.*, inflation (π), but does not put the weight on other variables such as the nominal income growth (Δx) and the exchange rate movement (Δs). On the other hand, NIGT puts the weight only on its target variable, *i.e.* the nominal income growth (Δx), but does not put the weight on inflation (π) and the exchange rate movement (Δs). And ET puts the weight only on its target variable, *i.e.* the exchange rate movement (Δs), but does not put the weight on inflation (π) and the nominal income growth (Δx).

Table 2 through 4 provide the simulation results. Table 2 presents the simulation result of strict targeting, which implies that the central bank is only concerned about its target variable. Thus, the central bank does not pay attention to the output-gap, that is, $\omega_{y-\bar{y}}=0$.

The third through fifth columns of Table 2 present the standard

[11] The term of *X*-Targeting is identified as a regime in which the central bank (i) has deviations of *X* from its desired path as one argument of its loss function, and (ii) behaves optimally in light of its model of the economy. Some literature defines the term in a different way. Gali and Monacelli (2002), for example, identifies *X*-targeting as a regime in which the central bank succeeds in fully stabilizing *X*, and thus *X* is fixed for all the time.

TABLE 2

EXPERIMENT 1 $(\omega_{y-\bar{y}}=0)$

		$\omega_{\pi}=1$	$\omega_{\Delta x}=1$	$\omega_{\Delta s}=1$
	$\sigma(4\times\pi)$	0.0000	5.0897	10.0722
	$\sigma(y-\bar{y})$	0.0000	2.6462	2.8274
$\omega_{\Delta i}=0$	$\sigma(\Delta x)$	1.7786	0.9130	2.7359
	$\sigma(\Delta s)$	8.9765	8.4215	0.0001
	$\sigma(4\times i)$	14.5981	20.8448	18.1464
	$\sigma(4\times\pi)$	1.1141	3.8841	10.0722
	$\sigma(y-\bar{y})$	0.9208	2.0025	2.8274
$\omega_{\Delta i}=0.1$	$\sigma(\Delta x)$	1.9270	0.4818	2.7359
	$\sigma(\Delta s)$	9.2254	7.7342	0.0001
	$\sigma(4\times i)$	6.8280	14.8956	18.1464
	$\sigma(4\times\pi)$	1.8749	2.9138	10.0722
	$\sigma(y-\bar{y})$	1.1821	1.5116	2.8274
$\omega_{\Delta i}=0.5$	$\sigma(\Delta x)$	1.9937	1.2274	2.7359
	$\sigma(\Delta s)$	9.4959	8.2131	0.0001
	$\sigma(4\times i)$	5.8960	7.3348	18.1464
	$\sigma(4\times\pi)$	2.3354	2.9260	10.0722
	$\sigma(y-\bar{y})$	1.3089	1.5090	2.8274
$\omega_{\Delta i}=1$	$\sigma(\Delta x)$	2.0315	1.5456	2.7359
	$\sigma(\Delta s)$	9.6294	8.7471	0.0001
	$\sigma(4\times i)$	5.6084	5.3796	18.1464

deviations of the artificial data under IT, NIGT, and ET, respectively. The variables of which standard deviations are reported in the table are the annualized inflation $(4\times\pi)$, the output-gap $(y-\bar{y})$, the nominal income growth (Δx), the exchange rate movement (Δs), and the annualized interest rate $(4\times i)$. The first column shows which value of the weight $(\omega_{\Delta i})$ is put on the interest rate change in the central bank's loss function. The first panel of the table reports the simulation results of the case of $\omega_{\Delta i}=0$, in which the central bank is concerned about the financial instability induced from the interest rate change. From the first panel I find that for inflation, IT gets the lowest s.d. (0.0000). For the output-gap, IT also gets the lowest s.d. (0.0000). Thus, IT perfectly controls the variability of both inflation and the output-gap so that both of them are on the targeted paths. But, for the nominal income growth rate, NIGT gets the lowest s.d. (0.9130). ET also gets the lowest s.d. (0.0001) for the

TABLE 3

EXPERIMENT 2 ($\omega_{y-\bar{y}}=0.25$)

		$\omega_{\Delta p}=1$	$\omega_{\Delta x}=1$	$\omega_{\Delta s}=1$
	$\sigma(4\times\pi)$	0.0000	2.7610	9.4258
	$\sigma(y-\bar{y})$	0.0000	1.4918	2.7132
$\omega_{\Delta i}=0$	$\sigma(\Delta x)$	1.7786	0.3229	2.6107
	$\sigma(\Delta s)$	8.9765	7.6827	0.2948
	$\sigma(4\times i)$	14.5981	16.4195	18.1568
	$\sigma(4\times\pi)$	0.8721	2.4356	9.4227
	$\sigma(y-\bar{y})$	0.7265	1.2791	2.7113
$\omega_{\Delta i}=0.1$	$\sigma(\Delta x)$	1.8608	0.6825	2.6085
	$\sigma(\Delta s)$	9.0251	7.5893	0.2993
	$\sigma(4\times i)$	7.9965	12.1882	18.1429
	$\sigma(4\times\pi)$	1.6627	2.3208	9.4106
	$\sigma(y-\bar{y})$	1.0575	1.2327	2.7040
$\omega_{\Delta i}=0.5$	$\sigma(\Delta x)$	1.9503	1.3356	2.5999
	$\sigma(\Delta s)$	9.3373	8.2731	0.3219
	$\sigma(4\times i)$	6.4535	7.0691	18.0878
	$\sigma(4\times\pi)$	2.1373	2.5272	9.3960
	$\sigma(y-\bar{y})$	1.2059	1.3248	2.6950
$\omega_{\Delta i}=1$	$\sigma(\Delta x)$	1.9962	1.5841	2.5893
	$\sigma(\Delta s)$	9.4949	8.7382	0.3583
	$\sigma(4\times i)$	6.0244	5.5837	18.0198

nominal exchange rate variability.

The second to the forth panel of the table varies the weight on the interest rate change from 0.1, 0.5 and 1. I find the same results as found in the first panel. For inflation, IT gets the lowest standard deviation. For the output-gap, IT also gets the lowest standard deviation. But, for the nominal income growth rate, NIGT gets the lowest standard deviation. ET also gets the lowest standard deviation for the nominal exchange rate variability.[12]

[12] As found in the last column of Table 2, the variability of all variables does not change for ET. Thus the performance of ET is not associated the attitude of the central bank to the interest rate variability. That is, when the central bank does not need to care about the output-gap, the performance of ET does not change whether or not it cares about the stability of the interest rate. This is a very interesting fact, which implies that financial market of the interest and the exchange rate is strongly

TABLE 4
EXPERIMENT 3 ($\omega_{y-\bar{y}}$=0.5)

		ω_{π} = 1	$\omega_{\Delta x}$ = 1	$\omega_{\Delta s}$ = 1
	$\sigma(4\times\pi)$	0.0003	2.0068	8.8638
	$\sigma(y-\bar{y})$	0.0001	1.1000	2.6114
$\omega_{\Delta i}$ = 0	$\sigma(\Delta x)$	1.7787	0.6549	2.5044
	$\sigma(\Delta s)$	8.9766	7.7492	0.5605
	$\sigma(4\times i)$	14.5977	15.5998	18.1698
	$\sigma(4\times\pi)$	0.7342	1.8627	8.8576
	$\sigma(y-\bar{y})$	0.6143	0.9819	2.6077
$\omega_{\Delta i}$ = 0.1	$\sigma(\Delta x)$	1.8297	0.9184	2.5001
	$\sigma(\Delta s)$	8.9400	7.7251	0.5695
	$\sigma(4\times i)$	8.8075	11.6328	18.1414
	$\sigma(4\times\pi)$	1.5120	1.9998	8.8338
	$\sigma(y-\bar{y})$	0.9684	1.0751	2.5932
$\omega_{\Delta i}$ = 0.5	$\sigma(\Delta x)$	1.9215	1.4042	2.4836
	$\sigma(\Delta s)$	9.2342	8.3271	0.6138
	$\sigma(4\times i)$	6.9067	7.2761	18.0290
	$\sigma(4\times\pi)$	1.9877	2.2749	8.8052
	$\sigma(y-\bar{y})$	1.1276	1.2036	2.5756
$\omega_{\Delta i}$ = 1	$\sigma(\Delta x)$	1.9706	1.6109	2.4635
	$\sigma(\Delta s)$	9.3983	8.7354	0.6838
	$\sigma(4\times i)$	6.3743	5.9262	17.8918

Tables 3, 4 and 5 present the simulation result of flexible targeting. Under flexible targeting regime, the central bank is concerned about its target variable as well as the output-gap. Table 3 represents the simulation results of the flexible targeting regime with the weight on the output-gap equal to 0.25, *i.e.*, $\omega_{y-\bar{y}}=0.25$. Table 4 represents the simulation results of the flexible targeting regime with the weight on the output-gap equal to 0.5, *i.e.*, $\omega_{y-\bar{y}}=0.5$. And Table 5 represents the case of the weight on the output-gap equal to 1, *i.e.*, $\omega_{y-\bar{y}}=1$. From Tables 3 through 5, I find the same results as found in Table 2. That is, IT is superior in smoothing out fluctuations in inflation and the output-gap. In the meantime, NIGT is superior in lowering the variability of the nominal income growth. And ET yields a more stable movement in

integrated as found in the uncovered interest rate parity.

TABLE 5

EXPERIMENT 4 ($\omega_{y,\ y}=1$)

		$\omega_{\Delta p}=1$	$\omega_{\Delta x}=1$	$\omega_{\Delta s}=1$
$\omega_{\Delta i}=0$	$\sigma(4\times\pi)$	0.0001	1.3836	7.9354
	$\sigma(y-\bar{y})$	0.0000	0.7530	2.4370
	$\sigma(\Delta x)$	1.7787	0.9888	2.3348
	$\sigma(\Delta s)$	8.9766	7.9616	1.0217
	$\sigma(4\times i)$	14.5980	15.0047	18.1893
$\omega_{\Delta i}=0.1$	$\sigma(4\times\pi)$	0.5739	1.3556	7.9239
	$\sigma(y-\bar{y})$	0.4821	0.7069	2.4300
	$\sigma(\Delta x)$	1.8005	1.1566	2.3269
	$\sigma(\Delta s)$	8.8721	7.9547	1.0394
	$\sigma(4\times i)$	9.8672	11.5369	18.1309
$\omega_{\Delta i}=0.5$	$\sigma(4\times\pi)$	1.3066	1.6400	7.8805
	$\sigma(y-\bar{y})$	0.8448	0.8922	2.4027
	$\sigma(\Delta x)$	1.8842	1.4837	2.2968
	$\sigma(\Delta s)$	9.1065	8.4023	1.1233
	$\sigma(4\times i)$	7.6246	7.8270	17.9040
$\omega_{\Delta i}=1$	$\sigma(4\times\pi)$	1.7712	1.9615	7.8337
	$\sigma(y-\bar{y})$	1.0132	1.0479	2.3715
	$\sigma(\Delta x)$	1.9346	1.6426	2.2625
	$\sigma(\Delta s)$	9.2662	8.7300	1.2483
	$\sigma(4\times i)$	6.9407	6.5716	17.6341

the nominal exchange rate than IT and NIGT.

Thus I can summarize the simulation results found from tables 2 through 5 as follows. A targeting policy performs well in smoothing out fluctuations of its own target. That is, IT produces a more stable inflation, NIGT produces a more stable nominal income growth, and ET produces a more stable movement of the nominal exchange rate.

In addition, IT has an advantage in lowering the variability of the output-gap against NIGT and ET. Regardless of the weight on the output-gap in the loss function - that is, strict targeting or flexible targeting - this facts are found.

Therefore, if we evaluate a targeting policy by looking at how inflation and the output-gap are stabilized, IT seems to be the best performer.

V. Conclusion

This paper investigates the appropriateness of targeting monetary polices in a small open economy, that of Korea. To this end, I develop a dynamic optimizing model developed by McCallum and Nelson (1999). However, in contrast with McCallum and Nelson (1999), I model the central bank as a dynamically optimizing agent acting under discretion, rather than imposing an estimated policy rule.

I compare different primary objectives of the central bank, which are represented on the weight in the loss function. I investigate its appropriateness of monetary policies by comparing the performance under different weights on the central bank's loss function. The performance of the monetary policies is evaluated on how well they perform in smoothing out fluctuations in inflation, the output-gap, or other macroeconomic variables. Policy simulations include variations on inflation targeting, nominal income growth targeting and exchange rate targeting.

In order to calibrate the model economy, I take some parameter values from the literature on the Korean economy, and from the Korean data from 1987.Q2 to 2000.Q4. From the simulation results, I find that a targeting policy performs well in smoothing out fluctuations of its own target. That is, IT produces a more stable inflation, NIGT produces a more stable nominal income growth, and ET produces a more stable movement of the nominal exchange rate. In addition, IT has an advantage in lowering the variability of the output-gap against NIGT and ET. Regardless of the weight on the output-gap - that is, strict targeting or flexible targeting - these facts are found. Therefore, simulation results suggest that inflation targeting is preferable to nominal income growth and exchange rate pegging in smoothing out fluctuations in inflation and the output-gap.

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Appendix: The Model in detail

In this section, I develop a model economy to be used in the simulations. Following McCallum and Nelson (1999), I assume a small open economy in which economic agents decide production and consumption over their infinite life horizon. Contrary to McCallum and Nelson, I simplify the utility function by dropping the assumption of habit formation of consumption. Especially, I adopt a price adjustment mechanism from Fuhrer and Moore (1995), rather than Calvo (1982), which is adopted in McCallum and Nelson.

In the model economy there exist a continuum of households of measure 1, and they consume a variety of goods, provide labor in the factor market, and hold and trade bonds. In addition, they are only a provider of differentiated consumption goods that are consumed both domestically and abroad. A typical household maximizes discounted sum of streams of present and future consumption, $E_0 \sum_{t=0}^{\infty} \beta^t U(C_t)$, where consumption, C_t, as shown below, is a composite consumption of differentiated good produced domestically:
$C_t = [\int_0^{\infty} C_t(j)^{(\theta-1)/\theta} dj]^{\theta/(\theta-1)}$.

Domestic residents do not import foreign goods for the purpose of consumption. All imported goods are to be used for intermediates in the production process. This assumption is compatible with the fact that most of imported goods are used for materials or intermediates rather than used for final goods in Korea.

When consumption is given as a sort of Dixit-Stiglitz, the price index comparable with composite consumption has the following form: $P_t^A = [\int_0^{\infty} P_t(j)^{1-\theta} dj]^{1/(1-\theta)}$.

A household also holds bonds - both domestic currency denominated one (B_t) and foreign currency denominated one (B_t^*). Domestic and foreign currency denominated bonds pay the real interests, r_t and r_t^* respectively in maturity. Foreign currency denominated bond pays risk premium, κ_t as well.

In addition, a household, as a producer of a differentiated consumption good, hires labor (N_t) and pays wage (W_t) for using labor. The household produces a good using a technology given as $Y_t = f(A_t, N_t, IM_t)$. A_t represents a technology shock, and IM_t represents intermediates utilized in the production of final goods.

On the other hand, the household sells a differentiated final good at the price, P_t, and at that price it produces the good as much as consumers demand. The demand for the good consists of two parts. One part is from the domestic (D_t), and the other is from the foreign (EX_t). Also the household provides labor in the domestic labor market. A resource constraint which the household faces is shown below.

$$\begin{aligned} &P_t(D_t + EX_t) + W_t N_t^S + P_t^A B_t(1+r_t) + P_t^A Q_t B_t^*(1+r_t^*)(1+\kappa_t) \\ &= P_t^A C_t + W_t N_t + P_t^A Q_t IM_t + P_t^A B_{t+1} + P_t^A Q_t B_{t+1}^*, \end{aligned} \tag{A1}$$

where Q_t represents real exchange rate. Putting λ_t as the Lagrange multiplier to the resource constraint divided by the aggregate price (P_t^A)[13], ξ_t as the Lagrange multiplier to the production function, the F.O.C.s for C_t, B_{t+1}, B_{t+1}^*, N_t, and IM_t becomes, respectively.

$$U_1(C_t) = \lambda_t. \tag{A2}$$

$$\lambda_t = \beta E_t \lambda_{t+1}(1+r_t). \tag{A3}$$

$$Q_t \lambda_t = \beta E_t Q_{t+1} \lambda_{t+1}(1+r_t^*)(1+\kappa_t). \tag{A4}$$

$$W_t/P_t = (\xi_t/\lambda_t) f_2(A_t, N_t, IM_t). \tag{A5}$$

$$Q_t = (\xi_t/\lambda_t) f_3(A_t, N_t, IM_t). \tag{A6}$$

The transversality conditions for asset stock of the household as well as the optimization conditions also should be satisfied.

$$\lim_{t \to \infty} \beta^t \lambda_t B_{t+1} = 0. \tag{A7}$$

$$\lim_{t \to \infty} \beta^t \lambda_t Q_t B_{t+1}^* = 0. \tag{A8}$$

The nominal bond denominated by domestic currency is associated in the following manner with the real bond denominated by domestic currency.

[13] The supersript A denotes the aggregate variable to distinguish it from the individual variable.

$$(1+i_t) = E_t(P^A_{t+1}/P^A_t)(1+r_t), \tag{A9}$$

where i_t is the nominal interest which is redeemed to the nominal bond denominated by domestic currency. I specify a spontaneous utility function in the following form: $U(C_t)=e^{\omega_t}C_t^{1-\sigma}/(1-\sigma)$, where ω_t is a preference shock, that is, a sort of demand shock. From Equation (A2), (A3), and (A9), I get a relationship between consumption, inflation, and the nominal interest rate.

$$c_t = E_t c_{t+1} + (1/\sigma)E_t\pi_{t+1} - (1/\sigma)i_t + \upsilon_t, \tag{A10}$$

where $c_t = \log C_t$, and $\upsilon_t = -(1/\sigma)(E_t\omega_{t+1} - \omega_t)$ is assumed to follow an AR (1) process.

$$\upsilon_t = \rho_\upsilon \upsilon_{t-1} + \varepsilon_{\upsilon,t}, \qquad \varepsilon_{\upsilon,t} \sim N(0, \sigma^2_{\varepsilon\upsilon}). \tag{A11}$$

From Equation (A3), (A4), and (A9), I get the uncovered interest parity.

$$i_t = i_t^* + E_t\Delta s_{t+1} + \kappa_t, \tag{A12}$$

where $s_t = \log S_t$, and S_t is the nominal exchange rate and defined as $S_t = Q_t P_t^A/P_t^*$. κ_t is a risk premium shock, and is assumed to follow an AR (1) process.

$$\kappa_t = \rho_\kappa \kappa_{t-1} + \varepsilon_{\kappa,t}, \qquad \varepsilon_{\kappa,t} \sim N(0, \sigma^2_{\varepsilon\kappa}). \tag{A13}$$

Now let us look at the production activity of a household. The household is a producer of a differentiated good. It has monopolistic power over its product so that it sets the price on it. At the price it sets, it decides the amount of production corresponding to demand. And I assume the domestic and foreign demand function have a form of Dixit-Stiglitz.

$$D_t = (P_t/P_t^A)^{-\theta} D_t^A. \tag{A14}$$

$$EX_t = (P_t/P_t^A)^{-\theta} EX_t^A, \tag{A15}$$

where $\theta > 1$, and D_t^A and EX_t^A are an aggregate of D_t and EX_t, respectively. Taking a log on the two equations above, I get the following equations.

$$d_t = -\theta(p_t - p_t^A) + d_t^A. \tag{A16}$$

$$ex_t = -\theta(p_t - p_t^A) + ex_t^A. \tag{A17}$$

The following equation shows how demand for a differentiated good consists of domestic demand and foreign demand.

$$y_t = (1 - \frac{EX}{Y})d_t + (\frac{EX}{Y})\, ex_t, \tag{A18}$$

where $y_t = \log Y_t$, $d_t = \log D_t$, and $ex_t = \log EX_t$. EX/Y is the steadystate ratio of exports to output. Foreign demand for the domestic good is assumed to have the following function.

$$EX_t = Q_t^{\eta_q}\, Y_t^{*\eta_{y^*}}. \tag{A19}$$

Taking a log on the above equation gives

$$ex_t = \eta_q q_t + \eta_{y^*} y_t^*, \tag{A20}$$

where η_q represents the elasticity of exports to the real exchange rate, and η_{y^*} represents the elasticity of exports to the foreign income.

And I consider the foreign nominal interest rate (i_t^*) and the foreign income (y_t^*) taken as given exogenously. The foreign income is assumed to follow an AR (1) process.

$$y_t^* = \rho_{y^*} y_{t-1}^* + \varepsilon_{y^*,t}, \quad \varepsilon_{y^*,t} \sim N(0, \sigma_{\varepsilon y^*}^2). \tag{A21}$$

Now let us consider how y_t is determined when is p_t is set. First, look at how p_t is set. From Equation (A16), (A17), and (A18), I get

$$y_t - y_t^A = -\theta(p_t - p_t^A). \tag{A22}$$

And the following equation holds as well.

$$y_t - \bar{y}_t^A = -\theta(p_t - \bar{p}_t^A), \tag{A23}$$

where $\overline{p}_t^A$ is the price level corresponding to the potential income level, $\overline{y}_t^A$.

The price mechanism follows Fuhrer and Moore (1995), where wage negotiations are conducted in terms of the wage relative to an average of real contract wages in effect over the life of a contract. In a consequence inflation process has a characteristic of inertia, and the current inflation has the following form.

$$\pi_t = \frac{1}{2}(\pi_{t-1} + E_t\pi_{t+1}) + \frac{\varphi}{2}\{(y_t - \overline{y}_t) + (y_{t-1} - \overline{y}_{t-1})\}. \qquad \text{(A24)}$$

That is, inflation (π_t) depends on both realized inflation of the previous period and expected inflation of the next period.

Now let us look at how the potential output is determined when the price is flexible. The production is assumed to have the following form.

$$Y_t = [\alpha(A_t N_t)^{-\rho} + (1-\alpha)IM_t^{-\rho}]^{-1/\rho}. \qquad \text{(A25)}$$

Taking a log of the above equation, I get

$$y_t = (1-\delta)a_t + (1-\delta)n_t + \delta im_t, \qquad \text{(A26)}$$

where $\delta = (1-\alpha)(IM/Y)^{-\rho}$. A technological shock (a_t) is assumed to follow an AR (1) process.

$$a_t = \rho_a a_{t-1} + \varepsilon_{a,t}, \qquad \varepsilon_{a,t} \sim N(0, \sigma_{\varepsilon a}^2). \qquad \text{(A27)}$$

When the price is flexible, output reaches to the potential level $(Y_t = \overline{Y}_t)$, equation (A26) becomes

$$\overline{y}_t = (1-\delta)a_t + \delta\overline{im}_t. \qquad \text{(A28)}$$

If the equilibrium is symmetric, that is, $\overline{Y}_t = \overline{Y}_t^A$.

Taking a log on equation (A6) gives the following equation

$$q_t = \log(\xi_t / \lambda_t) - (1+\rho)(im_t - y_t). \qquad \text{(A29)}$$

When the price is flexible, the mark-up rate is constant so that the following equation holds

$$\overline{im}_t = \bar{y}_t - \frac{1}{1+\rho} q_t . \tag{A30}$$

Substituting equation (A28) for the above equation, I get the equation for the potential output.

$$\bar{y}_t = a_t - \frac{1}{1+\rho} \frac{\delta}{1-\delta} q_t . \tag{A31}$$

References

Bharucha, N., and Kent, C. Inflation Targeting in a Small Open Economy. Research Discussion Paper, No. 9807, Reserve Bank of Australia, 1998.

Bernanke, B. S., Laubach, T., Mishkin, F. S., and Posen, A. S. *Inflation Targeting: Lessons from the International Experience.* Princeton, New Jersey: Princeton University Press, 1999.

Calvo, G. On the Microfoundations of Staggered Nominal Contracts: A First Approximation. Mimeograph, Columbia University, 1982.

Calvo, G., and Reinhart, C. M. "Fear of Floating." *Quarterly Journal of Economics* 117 (No. 2 2002): 379-408.

Clarida, Richard, Gali, Jordi, and Gertler, Mark. "The Science of Monetary Policy: A New Keynesian Perspective." *Journal of Economic Literature* 37 (No. 4 1999): 1161-707.

Fuhrer, J. C., and Moore, G. "Inflation Persistence." *Quarterly Journal of Economics* 110 (No. 1 1995): 127-60.

Gali, Jordi, and Monacelli, Tommaso. Optimal Monetary Policy and Exchange Rate Volatility in a Small Open Economy. NBER Working Paper, No. 8905, 2002.

Goodfriend, M., and King, R. G. "The New Neoclassical Synthesis and the Role of Monetary Policy." in B. S. Bernanke, and J. J. Rotemberg (eds.), *NBER Macroeconomics Annual.* Cambridge MA: MIT Press, pp. 231-83, 1997.

Jensen, Henrik. "Targeting Nominal Income Growth or Inflation." *American Economic Review* 92 (No. 4 2002): 928-56.

Lane, Philip R. The New Open Economy Macroeconomics: A Survey. CEPR working paper, 2000.

Lee, Hwan-Ho, and Kim, Kyu-Han. "Estimation of the Export and Import Function in Korea: Focused on the Effects of Leads and Lags in Exchange Rate Movements." *Financial Economic Research* 24 (1991).

Mankiw, N. Gregory. The Inexorable and Mysterious Tradeoff between Inflation and Unemployment. NBER Working Paper, No. 7884, 2000.

McCallum, Bennettt T. "A Semi-Classical Model of Price Level Adjustment." *Carnegie-Rochester Conference Series on Public Policy* 41 (1994): 251-84.

McCallum, Bennett T., and Nelson, Edward. Performance of Operational Policy Rules in an Estimated Semi-Classical Structural Model. NBER Working Paper, No. 6599, 1998.

__________. "Nominal Income Targeting in an Open-Economy Optimizing Model." *Journal of Monetary Economics* 43 (No. 3 1999): 553-78.

__________. Monetary Policy for an Open Economy: An Alternative Framework with Optimizing Agents and Sticky Prices. NBER Working Paper, No. 8175, 2001.

Nam, Kwanghee. "Non-Tradeable Sector and Inflation Targeting." *Economic Papers* 6 (No. 1 2003): 1-23, Bank of Korea.

Nam, Kwanghee, and Pyo, Hak K. "Comparison of Business Cycles among Korea, U.S. and Japan." *Journal of Korean Economic Analysis* 3 (No. 1 1997): 1-24 (in Korean).

Park, Hyung-Soo, and Shin, Kwan-Ho. "Optimal Monetary Policy Rule for the Korean Economy." *Quarterly Economic Analysis* 6 (No. 2 2000), Bank of Korea (in Korean).

Ryan, C., and Thompson, C. Inflation Targeting and Exchange Rate Fluctuations in Australia. Research Discussion Paper, No. 2000-06, Reserve Bank of Australia, 2000.

Schaechter, Andrea, Stone, Mark R., and Zelmer, Mark. Adopting Inflation Targeting: Practical Issues for Emerging Market Countries. Occassional Paper, No. 202, International Monetary Fund, 2000.

Söderlind, Paul. "Solution and Estimation of RE Macromodels with Optimal Policy." *European Economic Review* 43 (Nos. 4-6 1999): 813-23.

Svensson, Lars E. O. "Inflation Targeting as a Monetary Policy Rule." *Journal of Monetary Economics* 43 (No. 3 1999): 607-54.

Woodford, Michael. *Interest and Prices: Foundations of a Theory of Monetary Policy*. Princeton, New Jersey: Princeton University Press, 2003.