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MONETARY POLICY, REAL EXCHANGE RATE, AND THE CURRENT ACCOUNT IN A SMALL OPEN ECONOMY

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Resumen
Utilizando un modelo con precios rígidos para una economía abierta y pequeña este artículo compara las consecuencias de dos regímenes monetarios alternativos sobre un conjunto de variables. El régimen base consiste en una regla donde el Banco Central ajusta su tasa de interés en respuesta a desviaciones de la inflación proyectada o del producto con respecto a sus valores objetivo. El régimen de política alternativo considera, además, cambios en la tasa de interés en respuesta a fluctuaciones en el tipo de cambio real. Esta inclusión de un objetivo para el tipo de cambio real en la regla de política puede ser importante si el Banco Central se preocupa, además de la inflación, de fluctuaciones en la cuenta corriente del país. Los resultados muestran que la regla alternativa puede ayudar a reducir la volatilidad de las cuentas externas y, en algunos casos, también puede ayudar a reducir la volatilidad de la brecha-producto. Sin embargo, esta regla induce una mayor volatilidad en la inflación y hace que esta variable converja a su estado estacionario de manera más lenta.

Abstract
Using a sticky price model for small open economy this paper compares the consequences of two alternative monetary policies over a set of variables. The baseline case assumes a policy rule for the Central Bank that has inflation forecast and output as a target. The alternative policy is a rule that also includes a target for the real exchange rate. The inclusion of a target for the real exchange rate in the policy reaction function of the Central Bank could be important if the monetary authority is concerned about fluctuations in the current account. The results show that the alternative policy can help to reduce the volatility of the external accounts and in some case it can also help to reduce the volatility of the output gap. However, this policy introduces more volatility in inflation and it also makes the convergence of this variable to its steady state level slower.

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1 Introduction

Recent papers on optimal monetary policy in open economies have emphasized the role of the exchange rate in the transmission mechanism of the monetary policy (Ball, 1998; Svensson, 1998). In an open economy the monetary policy has a direct impact on aggregate demand as well as on the exchange rate. Movements in the exchange rate, in turn, reinforce the effects of monetary innovations on the aggregate demand through its impact on intermediate input demand. At the same time, the exchange rate has a direct impact on the price of traded goods and on inflation. As a result, the monetary policy is more efficient in controlling inflation in an open economy context. If the primary objective of the monetary policy is to control inflation, as is the increasing consensus during the last two decades (King, 1999), then an optimal monetary policy would imply a vigorous use of the exchange rate channel to stabilize inflation. This, however, implies the acceptance of a higher variability in output and the real exchange rate (Cipriani, 1999; Svensson, 1998).

This is not a trivial issue if the Central Bank (CB) has other secondary objectives besides controlling inflation. The Central Bank of Chile, for example, has a formal objective with regard to the stability and well functioning of the external payment system. This objective has been interpreted as maintaining a sustainable current account deficit. Specifically, there is a operational objective of keeping this deficit between 4% and 5% of the GDP (Medina and Valdés, 1999).

Motivated by the Chilean experience it would be interesting to ask how much volatility in other variables, different from inflation, would imply a strict inflation targeting policy like the one proposed by Svensson (1998)? Or, how would be the path of inflation and how much volatility in this variable would follow from a shock under a policy that also targets other variables, in particular the real exchange rate?

The objective of this paper is to compare the consequences of alternative monetary policy rules on the volatility of a set of variables for the case of a small open economy. In particular I analyze the consequences of two alternative monetary rules: a modified Taylor rule that includes an inflation-forecast and the output gap as an intermediate targets and a rule that combines the previous one with a target for the real exchange rate (RER). The analysis is made by simulating the responses of a set of variables to different shocks under this two policy regimes and by calculating the implied standard devi-

ations. The results show that the inclusion of a target for the RER reduces the volatility of the external accounts and, in some case, it also reduces the volatility of the output gap. On the other hand, this policy introduces more volatility in inflation and also makes the convergence of this variable to its steady state level last longer.

The model used to do the simulations is based on the two sector model for a small open economy by Obstfeld and Rogoff (1995). Households are infinitely-lived and they consume a bundle of traded and non traded goods. The nontraded sector is characterized by firms producing in a monopolistically competitive environment and sticky prices *a la* Calvo (1983). The tradable sector is competitive and produces a single homogenous commodity that can be exported or consumed domestically. Households can borrow in the world capital market to finance their excess of demand for traded goods. However, the international capital market is not perfect and domestic households have to pay a risk premium over the world interest rate. I assume that this premium is a function of the stock of debt held by domestic agents. The larger is the stock of debt the larger is the default risk. A larger default risk, in turn, implies a larger interest rate the domestic agents must pay.

A typical problem in modeling fluctuations in the current account when the economy is small and consumers are infinitely-lived is the non-stationarity of the stock of foreign assets. In this case, individuals can permanently borrow at an exogenous world interest rate and the stock of net foreign assets will never converge. This implies that the steady-state of the economy is not stationary. Previous works on optimal monetary policy for the case of small open economies avoid this problem by assuming that the interest rate is equal to the inverse of the discount factor in the Euler equation. In this case, however, consumption of tradable goods and the current account are constant over time, and there is no change in the asset position in response to any shock.[1]

In this model the imperfection in the capital market allows to endogeneize the effective interest rate faced by domestic households and this in turn pins down a stationary steady state for the stock of foreign liabilities.

The paper is organized as follows: the second section presents the model and characterizes the shocks that affect this economy. In the third section I

[1]Two other approaches have been used to deal with this problem. The first is to consider an overlapping generations model, where a stationary equilibrium exists because people face a positive probability of dying. The second approach is to define a utility function with an endogenous rate of time preference (Mendoza, 1991).

discuss the two alternative policy rules. The fourth section presents the simulations of the model. The parametrization is made taking in consideration some standard parameters in the RBC literature as well as some parameters consistent with the Chilean experience. The fifth section concludes.

2 The Model

2.1 The Economy

Consider a small open economy with traded and nontraded consumption goods. The economy is inhabited by a continuum of consumers-producers households with mass 1. Households are indexed by $j\epsilon[0,1]$ and they maximize the following utility function:

$$U_t^j = \sum_{i=0}^{\infty} \beta^i \left\{ \frac{\sigma}{1-\sigma}(C_{t+i}^j)^{\frac{\sigma-1}{\sigma}} + \frac{a}{1-\alpha}\left(\frac{M_{t+i}^j}{P_{t+i}}\right)^{1-\alpha} - \frac{\kappa}{2}\left(y_{N,t+i}(j)\right)^2 \right\} \quad (1)$$

where $C_{t+i}^j = \left[\gamma^{\frac{1}{\theta}}(C_{T,t+i}^j)^{\frac{\theta-1}{\theta}} + (1-\gamma)^{\frac{1}{\theta}}(C_{N,t+i}^j)^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}}$ represents a basket of goods composed by a nontraded composite good, C_N, and a internationally traded good, C_T. The parameter σ measures the intertemporal elasticity of substitution and the parameter θ is the intratemporal elasticity of substitution. The general specification for the preferences over consumption in (1) allows to generate different kind of current account responses to monetary shocks. I will return to this point later.

The nontraded composite good is a CES aggregator of a continuum of differentiated nontraded goods:

$$C_{N,t}^j = \left[\int_0^1 C_{N,t}^j(z)^{\frac{\varepsilon-1}{\varepsilon}} dz\right]^{\frac{\varepsilon}{\varepsilon-1}} \quad (2)$$

Households optimize the composition of their bundle of nontraded goods by maximizing (2) subject to the constraint $P_{N,t}C_{N,t} = \int_0^1 p_t(z)C_{N,t}^j(z)dz$ where $P_{N,t}$ is the price index of the composite nontraded good and $p_t(z)$ is the price of nontraded good z. As a result of this maximization we obtain the household's j demand for good z :

$$C_{N,t}^j(z) = \left(\frac{p_t(z)}{P_{N,t}}\right)^{-\varepsilon} C_{N,t}^j \quad (3)$$

This demand is a function of the relative price of good z with respect to the price index of nontraded goods, and the total consumption of nontraded goods of household j. Parameter ε is the constant price-elasticity of demand for good z.

Domestic agents hold two types of assets: money balances (M) and an internationally traded bond (B). They produce a single nontraded good $y_{N,t}(j)$ in a monopolistically competitive way and they receive a constant endowment of y_T^j units of the traded good. Using the traded goods as a *numeraire* the budget constraint faced by household j is given by:

$$\begin{aligned} & C_{T,t}^j + \frac{P_{N,t}C_{N,t}^j}{P_{T,t}} + \frac{M_{t+1}^j - M_t^j}{P_{T,t}} + B_{t+1}^j - (1+r_t)B_t^j \\ = \;& y_T^j + \frac{p_t(j)y_{N,t}(j)}{P_{T,t}} + \tau_t^j \end{aligned} \tag{4}$$

where r_t is the return of the international bond in terms of tradable goods, and $P_{T,t}$ is the price of the traded good expressed in units of domestic currency.

From FOCs of the maximization problem (1) of household j and aggregating over the continuum of household we obtain the following expressions for consumption of nontraded and traded goods:

$$C_{T,t} = \beta^{-\sigma} E_t \left\{ (1+r_{t+1})^{-\sigma} \left(\frac{q_{t+1}}{q_t} \right)^{\theta-\sigma} C_{T,t+1} \right\} \tag{5}$$

$$\frac{C_{T,t}}{C_{N,t}} = \frac{\gamma}{\gamma - 1} \left(\frac{P_{N,t}}{P_{T,t}} \right)^{\theta} \tag{6}$$

where q_t is the RER defined as $q_t = \frac{P_t^T}{P_t}$, and P_t is a consumption-based price index (the CPI):

$$P_t = \left[\gamma P_{N,t}^{1-\theta} + (1-\gamma) P_{T,t}^{1-\theta} \right]^{\frac{1}{1-\theta}} \tag{7}$$

Equation (5) is the Euler equation for consumption of the traded good. This expression emphasizes the role of the consumption-based interest rate in determining the evolution of consumption of the traded good (Dornbush, 1983). The consumption- based interest rate corresponds to the interest rate on the international bonds adjusted by the evolution of the RER. If the RER is rising future consumption becomes cheaper and there is an intertemporal

substitution of present consumption for future consumption. This effect operates with elasticity σ. However, an increase in the RER also implies that future consumption of the traded good is more expensive. This encourages substitution from nontraded to traded goods in the present. This effect operates with elasticity θ. If the former effect dominates ($\sigma > \theta$) then a depreciation of the RER will rise today's consumption of traded goods.

The production sector is characterized by households that act as a monopoly in the production of a single nontraded good. Each household maximizes profits by choosing the price of the good j it produces subject to the demand for this good. However, as in Calvo (1983) only a fraction ϕ of the producers can reset their prices each period. If that is the case they choose $p_t^*(j)$ to maximize,

$$\sum_{i=0}^{\infty} \phi^i E_t \left\{ \Lambda_{t,t+i} \frac{p_t^*(j) - MC_t}{P_{N,t+i}} y_{N,t+i}(j) \right\} \tag{8}$$

s.t.

$$y_{N,t}(j) = \left(\frac{p_t(j)}{P_{N,t}} \right)^{-\varepsilon} C_{N,t} \tag{9}$$

where $\Lambda_{t,t+i}$ is the relevant discount factor and MC_t is the nominal marginal cost . The RHS of equation (8) is the aggregate demand for good j and $C_{N,t} = \int_0^1 C_{N,t}^j dj$ represents the aggregate demand for nontraded goods.

The solution of this problem defines the reset price j in period t:

$$p_t^*(j) = \frac{\varepsilon}{\varepsilon - 1} \frac{\sum_{i=0}^{\infty} (\phi\beta)^i E_t \left\{ \Lambda_{t,t+i} MC_t \frac{y_{N,t+i}}{(P_{N,t+i})^{\varepsilon}} \right\}}{\sum_{i=0}^{\infty} (\phi\beta)^i E_t \left\{ \Lambda_{t,t+i} \frac{y_{N,t+i}}{(P_{N,t+i})^{1-\varepsilon}} \right\}} \tag{10}$$

Assuming there is no public spending the government budget constraint is given by:

$$\frac{M_{t+1} - M_t}{P_{T,t}} - \tau_t = 0 \tag{11}$$

With this equation and the equilibrium in the nontraded sector we obtain an expression for the aggregate accumulation of international bonds, which corresponds to the current account:

$$B_{t+1} = (1 + r_t) B_t + y_T - C_{T,t} \tag{12}$$

2.2 International Capital Market

Standard models for small open economies assume that the international capital market is competitive and domestic agents can borrow or lend as much as they want at the given interest rate. This assumption makes it problematic to define a steady state equilibrium in models with infinitely lived individuals: domestic agents can lend (borrow) without any bound and without any endogenous mechanism that warrants an equilibrium with a constant stock of foreign claims.[2]

Typically this problem has been solved by assuming that the intertemporal discount factor satisfies $\beta = (1 + r)^{-1}$, where r corresponds to the (exogenous) interest rate charged in the international market (Obstfeld and Rogoff, 1995 (appendix)). Under this condition, consumption of the traded good is constant over time and the current account is always zero (provided that the endowment of the traded good in the economy is constant).

In this model I relax the assumption of perfect international capital markets. I assume that the interest rate the domestic agent takes as a given depends on the stock of net foreign debt of the economy. In particular the interest rate is given by [3]:

$$(1 + r_t) = (1 + r_t^*) \left(\frac{B_t}{\tilde{B}} \right)^{\psi}$$

where $(1 + r_t^*)$ is the risk-free international interest rate and $\psi \geq 0$ is a parameter that measures the premium the domestic economy must pay. Basically this expression captures the fact that countries with a high stock of debt must pay a premium over the interest rate that prevails in the international capital market. In this particular case there is a stock of debt minimum $\tilde{B}$ above which the country start paying the premium. For levels below this threshold the country receive a discount.

As we will see below, this friction in the international capital market allow to edogenize the interest rate that determines the accumulation process. In turn, this makes it possible to pin down a stationary steady state level for the international bonds held by domestic households.

[2] In a closed economy the real interest rate depends on the capital stock which evolve over time ensuring a steady state equilibrium.

[3] Organes (1998) uses a similar approach in a paper on capital inflows and optimal taxation.

2.3 Steady State

The steady state of the model is characterized as follows. The real exchange rate is constant in the steady state and so is the consumption of traded goods. Then, from the Euler equation (5) we can define the steady state value for the real interest rate faced by domestic residents:

$$r = \beta^{-1} - 1 \tag{13}$$

Given $\tilde{B}$, we can pin down the steady state level of net foreign assets:[4]

$$B = \left(\frac{1+r}{1+r^*}\right)^{\frac{1}{\psi}} \tilde{B} \tag{14}$$

If we assume that $r = r^*$ (i.e. the discount factor of domestic residents is the same as in the rest of the world) then $B = \tilde{B}$. From equation (12) and given the stock on net foreign assets the consumption of traded goods in steady state must satisfy:

$$C_T = rB + y_T \tag{15}$$

where Y^T is the endowment of traded goods. Steady state output in the nontraded sector is given by:

$$y_N = C_N = \left(\frac{\varepsilon - 1}{\varepsilon}\frac{1}{\kappa}\right)^{\frac{\sigma}{\sigma+1}} (1-\gamma)^{\frac{1}{\sigma+1}} \tag{16}$$

The term $\frac{\varepsilon-1}{\varepsilon}$ is the inverse of the markup for the fully flexible prices case. The larger is the elasticity of demand for nontraded goods (ε) the smaller is the markup in steady state and the larger is output of nontraded goods. The parameter κ corresponds to the marginal disutility of work. The smaller is this parameter the larger is output. For convenience I normalize the relative price index of nontraded goods with respect to the price of the traded good in the steady state to unity, $\frac{P_N}{P_T} = 1$. This normalization defines a certain value for the endowment of traded goods in the domestic economy as we will see below. With this normalization we also have that the RER in steady state is unity and $C_N = \frac{(1-\gamma)}{\gamma} C_T$.

In order to fully define the steady state notice that the stock of foreign liabilities is a constant fraction of total output: $B = \varpi(y_N + y_T)$. Using

[4] In this model $\tilde{B}$ is exogenously determined.

equation (12) and the relation between C_N and C_T we obtain the following expressions for B and y_T:

$$B = \frac{\varpi \frac{1}{1-\gamma} y_N}{(1 - \varpi r)} \tag{17}$$

$$y_T = \frac{\gamma}{1-\gamma} y_N - rB \tag{18}$$

2.4 Log-linearized model

The model is log-linearized using Taylor expansions around the steady state. Let a variable in lowercase with a hat represent the log deviation with respect to the steady state. Then, the model can be described by the following system of linear equations:

2.4.1 Aggregate Supply and Inflation

Let $\hat{x}_{N,t}$ be the output gap in the nontraded sector measured as the difference between the stochastic components of current output and the potential output.[5] Then, from the resetting price equation (9) we can define the following expression for the inflation of nontraded goods:

$$\hat{\pi}_{N,t} = \lambda \hat{x}_{N,t} + E_t \hat{\pi}_{N,t+1} + u_t \tag{19}$$

where $\lambda = \frac{(1-\phi)(1-\beta\phi)}{\phi}$. This equation is a version of the Phillips curve that relates inflation positively to the output gap. The term u_t captures a cost push factor that may affect the inflation rate.

2.4.2 Aggregate Demand

From the FOCs for the consumption of traded goods we obtain the following equation:

$$\hat{c}_{Tt} = -\sigma \hat{r}_t + (\theta - \sigma)\left(E_t \hat{q}_{t+1} - \hat{q}_t\right) + E_t \hat{c}_{Tt+1} \tag{20}$$

Equation (18) is an Euler equation for traded goods that adjusts the interest rate by the evolution of the RER.

[5] Notice that output in the traded sector is always at its steady-state level.

From the FOCs we also obtain an expression that relates the output gap in the nontraded sector with the RER and the consumption of traded goods:

$$\hat{x}_{N,t} = -\frac{\theta}{1-\gamma}\hat{q}_t + c_{Tt} - z_t \tag{21}$$

where we use the fact that the log deviation of consumption of nontraded goods from steady state is equivalent to deviation in output in this sector. The term z_t in this equation is the potential output, which I assume follows a stationary stochastic process.

Finally, the uncovered interest rate parity defines a linear expression for the real exchange rate:

$$\hat{q}_t = E_t(\hat{\pi}_{t+1}) - \hat{\imath}_t + \hat{r}_t + E_t(\hat{q}_{t+1}) \tag{22}$$

2.4.3 Real Interest Rate and Current Account

The log-deviation of the real interest rate faced by domestic agents corresponds to:

$$\hat{r}_t = \hat{r}_t^* + \psi\hat{b}_t \tag{23}$$

Using equation (12) and the steady state relation for consumption of traded goods we derive a linear expression for the stock of foreign assets:

$$\hat{b}_{t+1} = (1+r)(\hat{r}_t + \hat{b}_t) + \left(\frac{Y^T}{B}\right)\hat{y}_t^T - \left(\frac{Y^T}{B}r\right)\hat{c}_t^T$$

Finally, the relation of CPI inflation, nontraded inflation (i.e. inflation of nontraded goods) and the RER can be expressed as:

$$\hat{\pi}_t = \hat{\pi}_{N,t} + \frac{(1-\gamma)}{\gamma}(\hat{q}_t - \hat{q}_{t-1}) \tag{24}$$

2.4.4 Policy Rule

The instrument the Central Bank uses to conduct monetary policy is the short-term nominal interest rate. Following Parrado, the rule that defines the target for the interest rate is given by:

$$\bar{\imath}_t = \omega_\pi E_t\hat{\pi}_{t+k} + \omega_x\hat{x}_{N,t} + \omega_q\hat{q}_t \tag{25}$$

where $\hat{\pi}_{t+k} = \pi_{t+k} - \bar{\pi}$ is the deviation of the CPI inflation with respect to its target, $\bar{\pi}$. Equation (23) is a modified Taylor rule that replaces current inflation by a forecast of the deviation of inflation from a determined target. It also includes a target for the RER if the parameter ω_q is different form zero. This rule is consistent with a reaction function for the interest rate obtained from an inflation-targeting optimal monetary policy as in Svensson (1998).

I assume the CB does not adjust the monetary policy instantaneously in response to a shock. In other words, the nominal interest rate follows a partial adjustment process:

$$i_t = \rho \bar{i}_t + (1-\rho) i_{t-1} + \nu_t \tag{26}$$

The term ν_t represents a monetary shock that captures deliberate decisions of the authority to deviate from the rule,or mistakes in the conduction of the monetary policy.

2.4.5 Exogenous process

Equations (27), (28), (29), (30) describe the evolution of the exogenous shocks to the system. I assume that the three shocks follow an autorregresive process:

$$\begin{aligned} u_t &= \rho_u u_{t-1} + \varepsilon_t^u && (27) \\ r_t^* &= \rho_r r_{t-1}^* + \varepsilon_t^r && (28) \\ \nu_t &= \rho_\nu \nu_{t-1} + \varepsilon_t^\nu && (29) \\ z_t &= \rho_z z_{t-1} + \varepsilon_t^z && (30) \end{aligned}$$

where ε_t^u, ε_t^r, ε_t^ν and ε_t^z are i.i.d. innovations distributed with zero mean and variance $\sigma_u^2 = \sigma_z^2 = 1$ and $\sigma_r^2 = \sigma_\nu^2 = 0.5$.

3 Monetary Policy Regimes

As it was said in the introduction, in the context of an open economy the exchange rate has important consequences in the discussion of optimal monetary policy.

The nominal exchange rate provides an extra channel for transmission of monetary policy directly through its impact on the prices of traded goods

and indirectly through its effect on aggregate demand when price are sticky (i.e. when movement in the nominal exchange rate affects the RER). It can also provide a nominal anchor to guide expectations about future inflation. Since inflation is a forward looking variable in the model, driving expectations improves the trade-off faced by the CB in implementing the monetary policy. The exchange rate can also be important if the monetary authority has as a secondary objective a certain target for output or the current account. In the Chilean case, for example, the CB explicitly define among its objectives the stabilization of the external payments. This has been interpreted as a target for the current account deficit of 4% to 5% of the GDP. Behind this objective for the current account there is the idea that an excessive deficit in this variable can jeopardize the normal functioning of the external payment system (Medina and Valdés, 1999). If the economy has sticky prices, fluctuations in the nominal exchange rate will affect the RER and as long as these fluctuations affect the current account, an objective for the current account may also imply an objective for the RER.

Welfare considerations about a target for the current account are dubious. In the perspective of the intertemporal approach, the current account acts has a buffer against different shocks. Limiting its fluctuations would also reduce its capacity in absorbing shocks. In any case, this discussion is far beyond from the objective of this paper.

It is well known that in the context of an open economy the CB faces a trade-off between controlling the interest rate and the exchange rate. Therefore, if the monetary authority decides to influence the RER it will lose some independence in managing the monetary policy. To analyze how this trade-off affects the performance of the monetary policy I define two types of policy rules. The base line policy is a modified Taylor Rule where the CB follows a forecast-inflation target together with a target for the (nontraded) output gap. The alternative policy is a rule that includes a forecast-inflation target, an output gap target and also includes a target for the RER. This rule can be justified in the spite of the previous discussion about the objectives of the CB. The idea is that by affecting the trajectory of the RER the authority can also stabilize the current account.[6].

I assume the auterregresive coefficient that defines the degree of persis-

[6]In fact, the exchange rate policy followed by the Chilean CB until september of 1999 defined a target zone for the nominal exchange rate with intervention of the monetary authority in this zone to eliminate excessive fluctuations in the RER.

tency of the monetary policy is the same under both regimes, and equal to 0.7. This is consistent with the estimates in Parrado (1999) for the Chilean case. Table 1 summarizes the coefficients of the reaction functions implied by the two policy rules:

Table 1
Reaction Function Coefficients

Base line Policy		Managed Policy	
ρ	0.7	ρ	0.7
ω_π	1.5	ω_π	1.5
ω_x	0.5	ω_x	0.5
ω_q	0	ω_q	2.5

4 Simulations

This section presents the set of simulations for this economy. The goal is to analyze the impact of exogenous shocks under the two policy rules defined above and to compare the implied volatility over the variables of the model. The exogenous shocks considered are (1) a cost push shock that impacts the inflation of nontraded goods directly, (2) an external shock that increases the international interest rate, (3) a monetary shock that increases domestic nominal interest rate, and (4) a technology shock that increases potential output in the nontraded sector.

4.1 Parametrization

The model is parameterized using some standard parameters in the RBC literature and some figures consistent with the features of the Chilean economy for quarterly data. In particular, it is assumed that the proportion of traded goods in the consumption bundle in the steady state is 0.5 as in Parrado (1999). The ratio between stock of net foreign asset and output is taken to be -2.66. This value corresponds to the case where the country is net debtor in the steady state and it is equivalent to a debt/GDP ratio of 66% for annual data on GDP.[7] The probability that firms change prices is $\phi =$

[7]If growth is positive in the long run then a constant debt/GDP ratio implies a current account deficit in the steady state. In the Chilean case, potential output growth rate

0.75 which implies that firms reset prices every four periods in average. I take the parameter ψ to be equal to 0.015. This corresponds to a premium of 0.6% for a debt/GDP ration of 100% and 1.7% for a debt/GDP ratio of 200%.

Finally two key parameters are the elasticities of intertemporal substitution and intratemporal substitution. The response of the current account to fluctuations in the RER, and therefore to the monetary policy, will depend on which of them is larger. I assume that the intertemporal effect dominates, i.e. a monetary contraction leads to a temporary reduction in consumption of traded goods. This in turns implies a temporary positive balance in both, the trade balance and the current account. The value for the parameters are $\theta = 1/6$ and $\sigma = 1/4$. These values are not based on any estimation and are somehow arbitrary. However, my goal is to compare two alternative policies and not to address quantitative results about the response of the trade balance or the current account. Therefore, this arbitrariness is not so important. Table 2 summarizes the value of the parameters of the model:

Table 2
Parametrization of the model

Parameter	Value	Parameter	Value
β	0.99	ψ	0.015
θ	1/6	κ	2
σ	1/4	ρ_u	0.9
γ	0.50	ρ_r	0.7
ϕ	0.75	ρ_v	0.3
ϖ	-2.66	ρ_z	0.9

4.2 Results

Figures 1 to 4 present the impulse-response function under these two policy rules for the four shocks. The solid line corresponds to the base line case and the dotted line to the rule that includes a target for the RER.

In the case of the cost push shock the monetary reaction seems to be more aggressive when the CB includes the RER in the policy rule (figure 1). In this case, the nominal interest rate rises about 70 basis points. In the base line case the nominal interest rate only increases 40 basis points. However,

is around 6% acording to some estimations (Massad, 1998). With an objective for the current account of 4% deficit, the implied ratio debt/GDP corresponds to 0.66.

if we consider the ex-post real interest rate in terms of the consumption bundle, we see that the reaction of the CB is more aggressive in the base line case (the initial fall in this variable is due to smooth reaction of the nominal interest rate in response to the shock). As a consequence, the contraction in the output gap is larger in this case and both nontraded inflation and CPI inflation are lower as compared with the alternative policy. Not surprising, the RER is less volatile under the RER-targeting regime. Table 3 presents the standard deviations generated by the different shocks under the assumed parametrization of the model. As we can see, the RER is three times more volatile in the base line case. The base line policy also increases volatility of both the trade balance and the current account. The standard deviation of these two variables in the base line case is three times larger than under the RER-targeting policy. On the other hand, both nontraded inflation and CPI inflation are less volatile in the base line case. Under this policy regime CPI inflation is 50% less volatile and nontraded inflation is 30% less volatile as compared with the alternative policy.

In both regimes, consumption of traded goods falls in response to the monetary contraction. This is reflected in the positive response of the trade balance, which in this case is just the opposite of consumption of traded goods, and the positive reaction of the current account. It is important to note that this result depend critically on the values of both the intertemporal elasticity of substitution and the intratemporal elasticity of substitution. In the base line case the response of both variables to the shock is larger as compared with the alternative policy. Notice that the stock of net foreign liabilities remains below its initial level more than 50 periods after the shock. This implies that the speed of convergence to the steady state is relatively low in this model.

It is worthwhile to notice that output is almost 3 times more volatile under the base line case as compared with the RER-target policy rule. This seems to contradict the traditional wisdom that output volatility is lower under flexible exchange rate, as Parrado finds. However, a RER-targeting policy does not imply a tight nominal exchange rate. On the contrary, when price adjustment is slow and the CB targets the RER, movements in the monetary policy accelerate the adjustment in the nominal exchange rate reducing volatility of consumption of nontraded goods and output.

The results are consistent with the analytical results of Cipriani (1999). Cipriani shows that in the case of a small open economy the optimal monetary policy, given the loss function he assumes, implies a higher output volatility

together with less variance in the inflation rate. The optimal monetary policy in his case also implies a larger volatility in the exchange rate. My results shows that if the CB has a main objective to reduce inflation it will react more aggressively against cost push shocks. The consequences will be a lower inflation level and volatility at the cost of higher volatility in the output gap and the RER, and more instability in the current account.

Table 3
Standard Deviations

	CP Shock		Ext. Shock		Monet. Shock		Tech. Shock	
	BL	RER	BL	RER	BL	RER	BL	RER
CPI Inflat.	15.23	23.04	21.58	13.96	15.39	3.99	15.29	15.29
NT Inflat.	18.35	23.67	2.81	9.29	2.21	0.34	1.10	14.57
Output Gap	11.87	3.31	12.86	3.14	15.71	3.57	2.98	20.85
Nom. Int.	13.58	20.19	0.94	6.06	10.38	3.31	5.65	15.00
Real Int.	2.03	1.25	2.73	7.95	6.26	1.83	2.34	0.82
TB	1.07	0.30	5.96	7.32	1.52	0.35	2.10	0.46
Debt Stock	1.15	0.31	22.32	21.85	0.48	0.10	1.92	0.44
CA	0.16	0.05	8.34	8.21	0.26	0.06	0.33	0.07
RER	14.41	4.01	24.45	5.59	18.92	4.30	28.21	6.20

BL: base line policy; RER: RER-targeting policy

Figure 2 presents the effects of the external shock. Under both policy regime the CB accommodates the external shock by increasing the real interest rate. This result is consistent with the optimal monetary policy in Gali and Monacelli (1999). In their model they show that the optimal monetary policy implies a positive correlation between the domestic and world interest rates, even in absence of coordination among CBs. Here, the reaction of the monetary authority is less strong in the base line case as compared with the alternative policy. As a consequence the output gap rises in the base line case while it falls under RER-targeting. In both cases CPI inflation falls after an initial positive response to the shock. However, under the alternative policy rule it falls below its steady state level and it remains there for many periods. Nontraded inflation also falls under this policy rule and converges to its steady state level at a very slow speed.

The reaction of the RER to the external shock is positive under the two policies but its volatility is lower under the RER-targeting policy. This is

explained by the fact that under this policy the CB rises real interest rate almost one to one with the increment in the external interest rate.

The contraction in the monetary policy improves the trade balance in both cases. However, given the assumption that the country is a net debtor in the steady state the rise in the external interest rate produces a deficit in the current account. It is important to note that in this case the RER-targeting policy does not reduce substantially the volatility of this variable and it implies a higher volatility in the trade balance and the output gap.

Figure 3 shows the reactions to a monetary shock. The nominal interest rate rises as a response to the shock but the increment is smaller than the size of the shock. This is due to the reaction of the authority that immediately reduces the interest rate. Under RER-targeting the CB is more active in cutting down the nominal rate. As a consequence, the increment in the real interest rate and the fall in output are larger under the base line policy. For all the variables of the model, the volatility is smaller in the case of the RER-target policy. This not surprising since the reaction of the CB in this case is a fast restoration of the interest that would have prevailed before the shock.

Finally figure 4 presents the responses to the technological shock in the nontraded sector. In this case the monetary authority accommodates the shock by reducing the nominal interest rate. In the base line case the resulting contraction in the real is interest rate is much stronger than in the RER-targeting regime. In consequence, consumption and output of nontraded goods accommodate faster to their new steady state level and the fall in the output gap is lower under the former policy as compared with the later one. From table 3 we can see that the implied standard deviation of the output gap is ten times larger in the case of the RER-targeting than in the base line case.

The RER reacts positively to the shock under both policy rules but in the base line case the initial depreciation is larger than under the alternative policy. This is reflected in the volatility of this variables which is four times larger in the base line case as compared with the RER-targeting policy. The trade balance and the current account, in turn, falls in response to the reduction in the real interest rate and the depreciation of the RER. Therefore, one of the consequences of technological improvement in the nontraded sector is an -transitory- accumulation of foreign liabilities.[8] The volatility of both the

[8] The assumption that the steady state level of the stock of foreign liabilities is stationary ensures that all the effects on this variable are transitory.

trade balance and the current account are also four times larger under the base line regime as compared with the alternative policy.

Nontraded inflation falls after the shock and CPI inflation reacts positively to the shock but then it falls. For both, the adjustment to their steady state level is faster under the base line policy regime. In the case of CPI inflation its volatility is almost the same in both regimes but nontraded inflation is more than ten times more volatile under the alternative policy regime.

5 Summary and Conclusions

Using a sticky price model for a small open economy this paper analyzes the consequences of two alternative monetary policy rules. The base line rule is a modified Taylor rule that includes forecast inflation targeting together with a target for the output gap. The alternative rule includes an additional target for the RER. The model assumes an imperfection in the international capital market that allows to pin down a stationary level for the stock of net foreign liabilities and analyze the effect of different shocks on the current account.

The simulations of the model show that in the base line case the central bank reacts more aggressive in response to cost push shocks. As a consequence inflation is less volatile than under the alternative rule. The cost of this policy is a larger variance in output, RER and current account. When the economy is affected by external shock the monetary authority accommodates the shock by adjusting the real interest rate in the same direction as the movement in the international rate. Under the RER-targeting policy the increment in the real interest rate is almost one to one with the shock which implies a lower volatility in the RER, CPI inflation and the output gap. However this policy increases notably the volatility of nontraded inflation and does not reduce the volatility of the current account. When shocks come from the own monetary authority, the RER-targeting rule dominates the base line policy in terms of the volatility of the variables of the model. Finally, the RER-targeting policy reduces the volatility of the RER and the current account when the economy is hit by a technologic shock but introduces more volatility in the inflation of nontraded goods and in the output gap. In this case, CPI inflation over react under the alternative policy and it converges slower to its steady state level.

The inclusion of a target for the RER in the policy reaction function of

the central bank could be important if the monetary authority is concerned about different objectives other than controlling inflation, in particular about large fluctuations in the current account. In general, this policy can help to reduce the volatility of the external accounts and in some case can also help to reduce the volatility of the output gap. However, having a target for the RER introduces more volatility in the inflation and also makes the convergence of this variable to its steady state level last long.

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Figure 1: Impulse-response function. Cost Push Shock

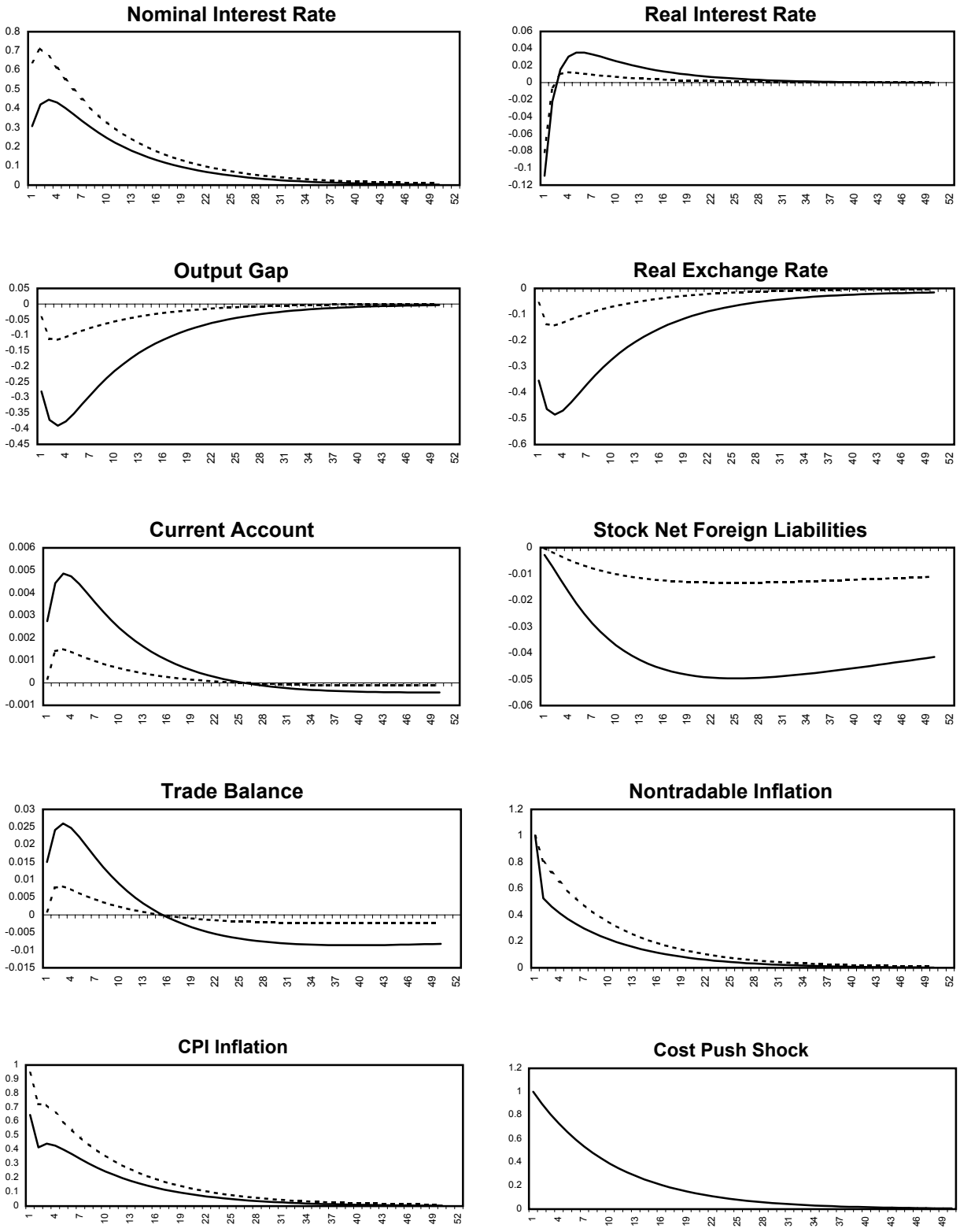


Figure 2: Impulse-response function. External Shock

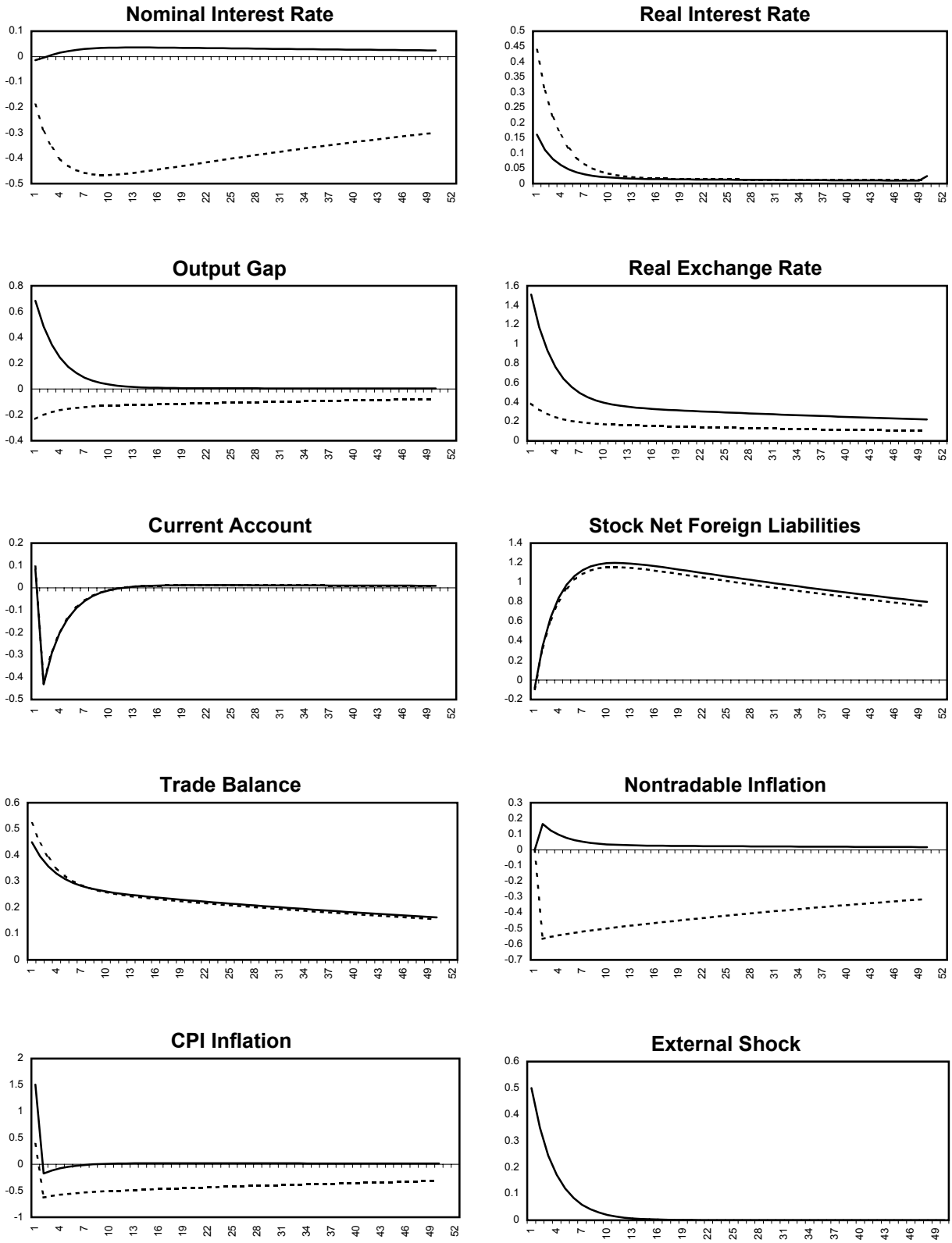


Figure 3: Impulse-response function. Monetary Shock

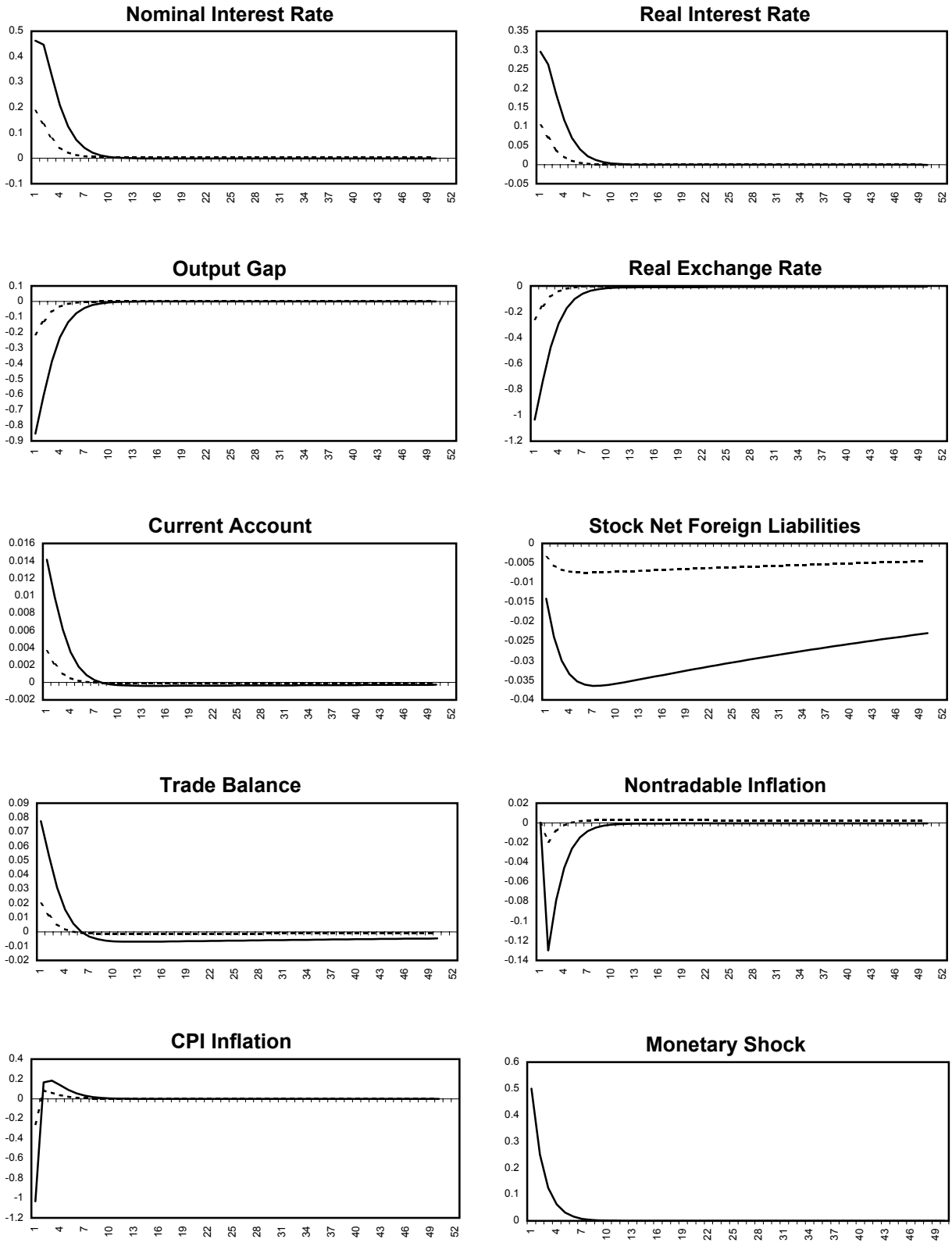
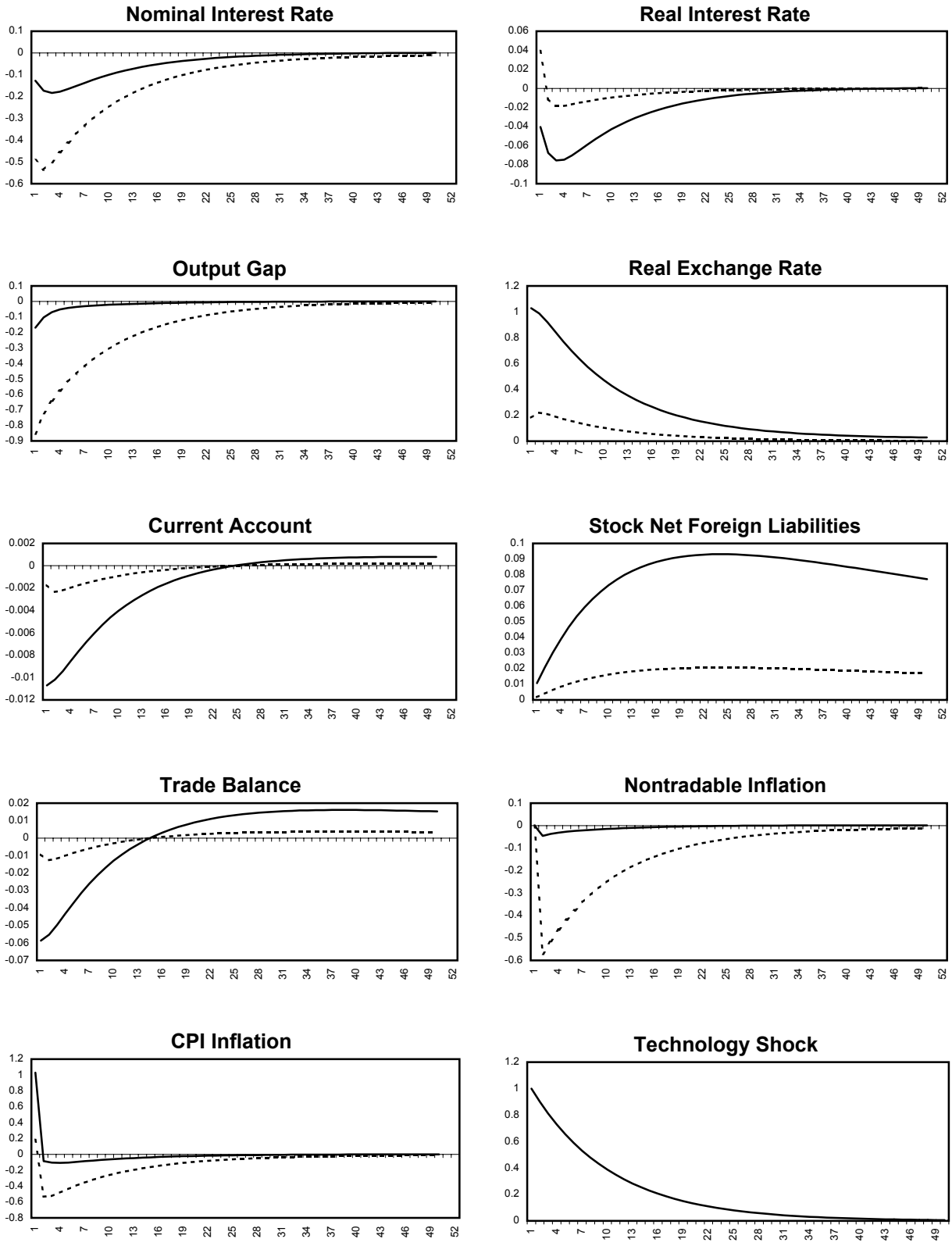


Figure 4: Impulse-response function. Technology Shock



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