Inflation Targeting with Sovereign Default Risk*

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1 Introduction

During the 1980s and 1990s emerging markets experienced recurrent episodes of high inflation and debt crises with high sovereign default premia, and many default events. Since the 2000s, inflation has come down in many of these emerging markets and debt crises have been limited. These developments have occurred as central banks in emerging markets have become more independent and have adopted a monetary policy of setting interest rates to target inflation. In this paper we study the interplay of monetary policy and sovereign default risk and show that inflation target induce not only lower inflation rates but also lower default risk of sovereign debt.

We develop a small open economy dynamic model that combines the workhorse New Keynesian monetary framework of Gali and Monacelli (2005) with the cannonical framework in the sovereign default literature as in Arellano (2008). We use this model to study the interaction between inflation and default risk. These interactions arise through two channels: output and uncovered interest rate parity. First, inflation and default risk are connected because inflation affects output and output affects default risk. When monetary policy leads to volatile and high

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inflation, the induced volatility in output increases default risk. Second, inflation and default risk are connected because both affect the real returns of domestic and foreign debt. Savers have to be indifferent between these two returns. With default risk, the real return on foreign debt is modified because borrowers internalize that the quantity of debt changes the bond price.

The small open economy model we consider consists of households, firms, a monetary authority, and a fiscal authority that borrows internationally. Households value consumption of domestic goods and foreign goods which are imported. They work in firms that produce the domestic output that is consumed by domestic households and exported to the rest of the world.

Final goods firms are competitive and use intermediate goods varieties to produce the domestic output. Intermediate goods firms use labor to produce domestic varieties and face frictions in setting their prices. Firms have to pay an adjustment cost when they change their prices.

The fiscal authority borrows from the rest of the world discount bonds denominated in foreign currency. The fiscal authority is benevolent and uses international borrowing for transfers to households to smooth domestic fluctuations. The fiscal authority, however, lacks commitment in repaying the debt and can default on it. Default risk is reflected in the borrowing rates that the fiscal authority faces. Default induces utility costs which are stochastic shocks and that we interpret as shocks controlling the enforcement of sovereign debt.

The monetary authority uses an nominal interest rate rule in setting monetary policy that depends on inflation relative to its target and a shock. We compare two parametrizations of this interest rate rule applied to the pre and and post inflation target era in emerging markets. The first parameterization has a high inflation target and monetary shocks with large variance. The second parametrization has a low inflation target and monetary shocks with small variance.

We consider the effects of three sources of fluctuations: productivity shocks, monetary shocks, and enforcement shocks. In response to adverse productivity shocks, inflation falls yet default risk rises, leading to a negative comovement between inflation and default risk. An inflation target regime, calls for a stimulative monetary policy in response to the shock because of the resulting low inflation which improves output and alleviates the increase in default risk.

In response to a contractionary monetary policy shock, that increases the nominal interest rate, inflation falls and default risk rises. The increase in default risk, however, is smaller than the increase in nominal interest rates which lead to an immediate appreciation of the exchange rate through the uncovered interest rate parity condition.

Adverse enforcement shocks lead to an increase in default risk and an increase in inflation.

An increase in default risk makes imports more expensive and depreciates the exchange rate. As households substitute away from foreign goods into domestic goods, firms increase their prices. Under inflation targeting, nominal interest rates fall alleviating the increase in default risk.

We also compare our model to the case of Mexico that adopted inflation target in 2001. Prior inflation targeting since 1980 inflation in Mexico was high and on average close to 50% with a standard deviation of close to 50%. During this time, default risk was high. The average spread on Mexican bonds denominated in dollars was close to 400 basis points. Post 2000, inflation in Mexico was on average close to 3% with a volatility of 4% and bond spreads were 70 basis points. We feed into the model two parametrizations of the nominal interest rate rules for the pre and post inflation target periods. We find that consistent with the data our model predicts a reduction in default risk after adopting inflation targeting.

2 Model

We consider a small open economy which is composed by households, final goods firms, intermediate goods firms, a fiscal authority, and a monetary authority. There are three types of goods, imported goods, intermediate goods, and final goods. Final goods is produced from a variety of differentiated intermediate goods. Each variety of intermediate goods is produced with labor. Final goods is demanded by both domestic and foreign agents.

Foreign demand over domestic goods is given by

$$X_t = \left(\frac{P_t}{\varepsilon_t P_t^*} \right)^{-\rho} \xi_t^*$$

where P_t^* and ξ_t^* are the foreign price and aggregate demand, ε_t is the nominal exchange rate, and ρ is the elasticity. Let the real exchange rate e be $e_t = \varepsilon_t P_t^* / P_t$. The foreign demand can be rewritten as

$$X_t = {e_t}^{\rho} \xi_t^*.$$

2.1 Households

Households derive utility from consumption of domestic goods C_t and foreign goods C_t^* and disutility of labor N_t. Their preference is given by

$$E_0 \sum_{t=0}^{\infty} \beta^t u(H(C_t, C_t^*), N_t).$$

where H the aggregate consumption which is a constant elasticity aggregator of domestic and foreign consumption goods.

Taking as given the aggregate prices, the households choose consumption, labor, and domestic bonds B_t^d denominated in the local currency. They receive labor income, dividends D_t, and government transfers T_t. The budget constraint is given by

$$P_t H_t + q_t^d B_{t+1}^d \leq W_t N_t + B_t^d + D_t + T_t.$$

where q_t^d is the nominal discount prices of domestic bonds. We can characterize the representative consumer's problem with the following optimality conditions

$$\frac{u_{N,t}}{u_{H,t}} = -\frac{W_t}{P_t} = -w_t$$

$$\frac{H_{c*,t}}{H_{c,t}} = e_t$$

$$q_t^d = \beta E_t \left[\frac{u_{H,t+1}}{u_{H,t}} \frac{1}{\pi_{t+1}} \right]$$

where inflation rate $\pi_{t+1} = \frac{P_{t+1}}{P_t}$, and e_t is the real exchange rate.

2.2 Final goods producers

Final goods is produced from a variety of differentiated intermediate goods y_{it}, $i \in [0,1]$ under perfect competition,

$$Y_t = \left[\int_0^1 y_t(i)^{\frac{\eta-1}{\eta}} di \right]^{\frac{\eta}{\eta-1}}.$$

where η captures the elasticity of substitution among intermediate goods. Let the price of final goods be P_t^d and intermediate goods price $\{p_t(i)\}$. The profit maximization of problem of the final good producer is

$$\max P_t^d \left[\int_0^1 y_t(i)^{\frac{\eta-1}{\eta}} di \right]^{\frac{\eta}{\eta-1}} - \int_0^1 p_t(i) y_t(i) di.$$

The maximization gives a demand function

$$y_t(i) = \left(\frac{p_t(i)}{P_t^d} \right)^{-\eta} Y_t, \tag{1}$$

$$P_t^d = \left[\int_0^1 p_t(i)^{1-\eta} di \right]^{\frac{1}{1-\eta}}.$$

2.3 Intermediate goods producers

Each differentiated intermediate goods is produced with labor n_{it} with a constant returns to scale production function function and is subject to productivity shocks z_t

$$y_{it} = z_t n_{it} \tag{2}$$

Intermediate goods firms are monopolistically competitive and set the prices for their products taking as given the demand system 1. These firms, however, face price setting frictions in that they have to pay a quadratic adjustment cost when they change their price as in Rotemberg. Taking as the, the wage rate W_t, and the final good price P_t^d, an intermediate firm i chooses labor, and prices to maximize the present discounted value of their profits

$$\max_{\{p_{it}, n_{it},\}} E_0 \sum_t M_{t,0} \left\{ p_{it} y_{it} - (1-\tau) W_t n_{it} - \frac{\varphi}{2} \left(\frac{p_{it}}{p_{it-1}} - 1 \right)^2 P_t^d Y_t \right\}$$

subject to the production function (2) where $M_{t,0}$ is the stochastic discount factor of households denominated in units of domestic goods and τ is the labor subsidy.

Using the households stochastic discount factor and the production function this problem is

$$\max_{\{p_{it}\}} E_0 \sum_t \beta^t \frac{u_H H_{c,t}}{u_c H_{c,0}} \frac{P_0^d}{P_t^d} \left\{ p_{it} y_{it} - \Omega_t y_{it} - \frac{\varphi}{2} \left(\frac{p_{i,t}(j)}{p_{i,t-1}(j)} - 1 \right)^2 P_t Y_t \right\}$$

where $\Omega_t = \frac{(1-\tau)W_t}{z_t}$

$$\max_{\{p_{it}\}} E_0 \sum_t \beta^t \frac{u_H H_{c,t}}{u_c H_{c,0}} \frac{P_0^d}{P_t^d} \left\{ [p_{it} - \Omega_t] y_{it} - \frac{\varphi}{2} \left(\frac{p_{it}}{p_{it-1}} - 1 \right)^2 P_t^d Y_t \right\}$$

Now put in the demand function

$$\max_{\{p_{it}\}} E_0 \sum_t \beta^t \frac{u_H H_{c,t}}{u_c H_{c,0}} \frac{P_0^d}{P_t^d} \left\{ [p_{it} - \Omega_t] \left(\frac{p_{it}}{P_t^d} \right)^{-\eta} Y_t - \frac{\varphi}{2} \left(\frac{p_{it}}{p_{it-1}} - 1 \right)^2 P_t Y_t \right\}$$

The first order condition for each firm after using symmetry across all firms $p_{it} = P_t^d$ results in

$$(1-\tau)]\omega_t = \frac{\eta - 1}{\eta} + \frac{1}{\eta} \varphi \left(\pi_t^d - 1 \right) \pi_t^d - \frac{1}{\eta} E_t \left[\beta \frac{u_H H_{c,t+1}}{u_H H_{c,t}} \frac{Y_{t+1}}{Y_t} \varphi \left(\pi_{t+1}^d - 1 \right) \pi_{t+1}^d \right] \tag{3}$$

where $\omega_t = \Omega_t / P_t^d$. This equation is the classical New Keynesian Philips curve that relates inflation and output.

2.4 Monetary Authority

The monetary authority conducts policy using nominal interest rates rules. Nominal rates r_t^d are set based on the level of inflation relative to the target $\frac{\pi_t}{\bar{\pi}}$, and also respond to a monetary shock m_t

$$r_t^d = R^{1-\rho} \left[\left(\frac{\pi_t}{\bar{\pi}} \right)^{\phi} \right] m_t \tag{4}$$

where m_t is the monetary shock and $R = \bar{\pi} / \beta$.

2.5 Fiscal Authority

The fiscal authority is benevolent and maximizes the utility of households. It borrows from international lenders short-term loans B_{t+1} at price q_t in local currency and transfers to house-

holds the net receipts from its operations. Letting B_t denote the outstanding debt of the government the government budget constraint is

$$T_t + \tau W_t N_t = \varepsilon_t [q_t B_{t+1} - B_t] \tag{5}$$

Every period the government chooses (B_{t+1}) and decides whether to default on its outstanding debt. Default induces a reduction in outstanding debt to R and a utility cost ν_t. During default the government budget constraint is as in (5) but with $B_t = R$, and period utility is reduced by an exogenous shock ν_t, which follows the stochastic process

$$\nu_t = \bar{\nu} + \rho_\nu \nu_{t-1} + \sigma_\nu \epsilon_{\nu,t},$$

with $\epsilon \sim \mathcal{N}(0,1)$.

The ν_t shock generates fluctuations in the value of default for the government. The quantitative literature of sovereign debt emphasizes that random fluctuations in default values are necessary to fit data on government spreads in emerging and advanced economies. In most of the quantitative literature, fluctuations in default values are generated by assuming convexity of the output costs of default. In our model, as in Aguiar et al (2013), such fluctuations are directly induced by ν_t shocks.

The government's objective is to maximize the present discounted value of the utility derived from public goods net of any default costs,

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t (u(H(C_t, C_t^*), N_t) - D_t \nu_t), \tag{6}$$

where $D_t = 1$ when the government defaults and zero otherwise.