Economics Letters 147 (2016) 112–115

Contents lists available at ScienceDirect

Economics Letters

journal homepage: www.elsevier.com/locate/ecolet

Inflation level and inflation volatility: A seigniorage argument

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HIGHLIGHTS

- We explain the positive relationship between inflation level and inflation volatility.
- The main argument follows the Laffer curve logic applied to seigniorage.
- The result is robust to multiple and unique equilibria.
- The result holds locally and globally.

ARTICLE INFO

Article history:
Received 10 June 2016
Received in revised form
18 August 2016
Accepted 25 August 2016
Available online 30 August 2016

JEL classification:
E31
E41
E52
E62

Keywords:
Inflation
Inflation uncertainty
Seigniorage

ABSTRACT

We use a standard dynamic general equilibrium model with flexible prices, money in the utility function, exogenous fiscal policy and accommodating monetary policy to analytically demonstrate the positive relationship between the steady state level of inflation and business cycle inflation volatility. This result holds in the presence of unique as well as multiple equilibria.

1. Introduction

Empirically there is a consensus that the rate of inflation is positively correlated with inflation volatility (Grier and Perry, 1998; Daal et al., 2005; Fountas and Karanasos, 2007).

To our knowledge, the only explanation of this phenomenon has been offered by Ball (1992). In his model monetary policy dominates fiscal policy, and higher inflation creates uncertainty about the optimal time to disinflate, which drives up inflation volatility.

Our paper generates the result without modeling an explicit effort to disinflate by the central bank. Instead, the positive correlation between inflation level and volatility arises due to two assumptions: First, the central bank is not completely independent and seigniorage revenue from printing money is used to balance the government budget. Second, the government deficit is stochastic.

The mechanism is as follows: seigniorage is approximately equal to the product of inflation and real money balances. Real money balances decrease with higher inflation. Therefore, when inflation is high and the fiscal shock dictates that seigniorage needs to generate an additional one percent of GDP in revenues, inflation has to increase by more, since real money balances (the tax base) are small.

Consider the Laffer curve for seigniorage and inflation displayed in Fig. 1: Gross inflation is displayed on the horizontal axis and seigniorage revenue is depicted on the vertical axis. The Laffer curve flattens out with higher levels of gross inflation. As a direct result, obtaining one additional percent of GDP in seigniorage revenue requires a larger increase in inflation when the latter is already high.

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http://dx.doi.org/10.1016/j.econlet.2016.08.034
0165-1765/

Empirically, episodes of high inflation are more likely to occur in developing countries (Fischer et al., 2002), which tend to have de-facto less independent central banks (Cukierman et al., 1992; Dincer and Eichengreen, 2014), stronger links between deficits and seigniorage wheninflation is high (Fischer et al., 2002) and a positive correlation between deficits and inflation (Catão and Terrones, 2005; Lin and Chu, 2013). Finally, a substantial empirical literature demonstrates the negative correlation between central bank independence and inflation level (for a survey see Cukierman, 2008). This evidence supports the relevance of our model for high inflation episodes.

We use a standard dynamic general equilibrium model with flexible prices, money in the utility function, exogenous fiscal policy and accommodating monetary policy. Our assumptions allow us to analytically describe the model solution in the case of unique as well as multiple equilibria. For all cases we demonstrate the positive relationship between the steady state level of inflation and business cycle inflation volatility.

2. The model

The model consists of households that have an endowment of consumption goods and hold money and bonds. They receive transfers from the government that are financed exclusively by seigniorage.

Households maximize their discounted utility with respect to consumption C_t, money M_t and private bonds B_t.

$$\mathbb{E}_t \sum_{i=0}^{\infty} \beta^i \left[\frac{C_{t+i}^{1-\sigma}}{1-\sigma} + \frac{\gamma}{1-b} \left(\frac{M_{t+i}}{P_{t+i}} \right)^{1-b} \right]. \tag{1}$$

The intertemporal rate of substitution is governed by $\sigma > 0$, and $b > 0$ represents the inverse of the interest rate elasticity of money demand. The budget constraint of the household in real terms is

$$C_t + \frac{M_t}{P_t} + \frac{B_t}{P_t} = Y_t + \frac{M_{t-1}}{P_t} + \frac{i_{t-1}B_{t-1}}{P_t} + x_t. \tag{2}$$

Bonds pay gross interest i_t, Y_t is the household's endowment of the consumption good and x_t is the real value of government transfer.

The first order conditions with respect to bonds and money yield:

$$C_t^{-\sigma} = \beta i_t \mathbb{E}_t \left(\frac{P_t}{P_{t+1}} C_{t+1}^{-\sigma} \right) \tag{3}$$

$$\frac{\gamma \left(\frac{M_t}{P_t} \right)^{-b}}{C_t^{-\sigma}} = \frac{i_t - 1}{i_t}. \tag{4}$$

In an endowment economy we assume $C_t = Y_t = 1$, and in equilibrium $B_t = 0$ for the representative household. The government distributes transfers x_t financed entirely by seigniorage revenues, implying:

$$\frac{M_t - M_{t-1}}{P_t} = x_t. \tag{5}$$

The transfers follow the stochastic process

$$x_t = x + \epsilon_t, \quad \epsilon_t \sim N(0, \sigma^2). \tag{6}$$

The innovation ϵ_t is i.i.d. Notice that the stochastic process x_t is defined for the level of transfers because we want to fix the volatility of fiscal shocks in terms of percentage points of GDP. If the process x_t was postulated in logarithmic terms,[1] the results of the paper will only get stronger due to the positive link between steady state inflation, the steady state level of transfers and the volatility of fiscal shocks (measured in percentage points of GDP).

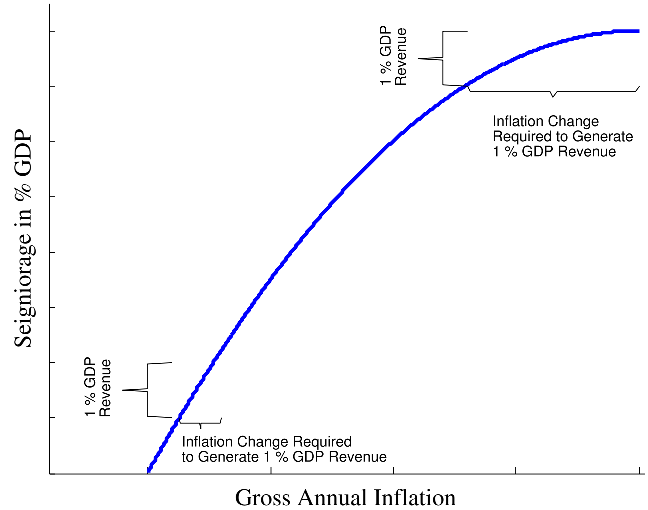

Fig. 1. Laffer curve for seigniorage and inflation.

We introduce inflation $\pi_t = \frac{P_t}{P_{t-1}}$ and real money balances $m_t = \frac{M_t}{P_t}$ to simplify the system (3)–(5) and obtain:

$$\gamma m_t^{-b} = 1 - \beta \mathbb{E}_t \left(\frac{1}{\pi_{t+1}} \right) \tag{7}$$

$$m_t - \frac{m_{t-1}}{\pi_t} = x_t. \tag{8}$$

Since consumption equals 1, the transversality condition is given by

$$\lim_{t \to \infty} \beta^t m_t = 0. \tag{9}$$

Eqs. (6)–(9) characterize the equilibrium.

3. Steady state

The steady state solution is given by

$$x = \left(\frac{\pi \gamma}{\pi - \beta} \right)^{\frac{1}{b}} \frac{\pi - 1}{\pi} \tag{10}$$

$$m = \left(\frac{\pi \gamma}{\pi - \beta} \right)^{\frac{1}{b}}. \tag{11}$$

4. Linearization

Let us introduce $\hat{x}_t = x_t - x$, $\hat{m}_t = \log(m_t/m)$, $\hat{\pi}_t = \log(\pi_t/\pi)$ and linearize (7) and (8) around the steady state to obtain:

$$-b\hat{m}_t = \mathbb{E}_t \hat{\pi}_{t+1} \frac{1}{\frac{\pi}{\beta} - 1} \tag{12}$$

$$\hat{x}_t = m\hat{m}_t - \frac{m}{\pi}(\hat{m}_{t-1} - \hat{\pi}_t) \tag{13}$$

$$\hat{x}_t = \epsilon_t. \tag{14}$$

We solve this system consisting of (12)–(14) by iterating Eq. (13) one period forward, taking its expectation in period t, and simplifying it using (12) and (14):

$$\mathbb{E}_t \hat{m}_{t+1} = ((1-b)/\pi + b/\beta)\hat{m}_t. \tag{15}$$

The solution to (15) is characterized in the following lemma.

[1] For example $\log(x_t) = \log(x) + \epsilon_t$.