E C O N O M I C S   B U L L E T I N

The central bank cost constraint and output−inflation variability: a note on Cecchetti and Ehrmann 2000

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Abstract

The goal of this paper is to extend the model of Cecchetti and Ehrmann 2000 to study the case of developing countries that have a constraint in conducting their monetary policies. Contrary to Cecchetti and Ehrmann 2000 model, our model shows that the existence of such a constraint i.e. cost restriction allows the aggregate demand shock to affect the output−inflation variability. Our model also shows that adding a monetary policy cost restriction to the central bank loss function leads to either a steeper or flatter efficient frontier. This implies that the effect of monetary policy to offset aggregate demand and supply shocks is reduced.

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1. Introduction

Central bank policymakers in any country in the world, developed and developing alike, seek the same goals; namely to stabilize output and price about some path that is expected to be optimal. Developed countries do not have technical constraints in applying monetary policy i.e. open market operation. However, developing countries have. This technical difference is due to the fact that developed countries have well-developed and sophisticated financial markets compared to developing countries.

One of the major and crucial issues in recent times is that central banks in developing countries, engaged in conducting monetary policy by using indirect control, find that they should intervene and create their own instrument to conduct open market operations[1] because their financial markets are underdeveloped. This entails a high cost in the form of negative profits[2]. This issue raises the question about the validity and continuity of such policies in these countries.

Literature shows a lack of academic studies in this area of research. We believe this lack of interest stems from the fact that economists are more interested in describing the behavior of monetary policy in developed countries i.e. the U.S and EMU. Hence, the goal of this paper is to focus on the effect of such constraint on the output-inflation variability.

2. Policy Formulation

Recent research in monetary economics focuses on finding the optimal monetary policy, i.e. the level of the interest rate, that minimize a quadratic loss function (see, for example, Taylor (1979), Cecchetti (1998), Cecchetti and Ehrmann (2000)). The contribution of this paper is to expand the quadratic loss function by adding a third preference, consistent with a real case, to minimize the fluctuation of central bank cost. The policy target is to minimize "(1)" subject to "(2)", "(3)" and "(4)" below:

$$L=E[\alpha(\pi-\pi^*)^2+\eta(y-y^*)^2+(1-\alpha-\eta)(c-c^*)^2] \quad (1)$$

$$y_t=\gamma m^s{}_t+\gamma d_t+s_t \quad (2)$$

$$\pi=m^s{}_t+d_t-\omega s_t \quad (3)$$

$$c_t=-\psi m^s{}_t \quad (4)$$

Equation "(1)" is a general form of a quadratic loss function for one period[3]. E denotes the mathematical expectation. π^*, y^* and c^* are the desired level of inflation, output and central bank cost of conducting monetary policy, respectively. The parameters α, η and (1-α-η) are the weights of interest. Equation "(4)" shows that cost has a negative relation with the money supply (m^s) because issuing more securities i.e. certificate of deposits (contractionay monetary policy) means higher value of interest payments on those securities. Equations "(2)" and "(3)" describe the dynamic structure of the economy (output and inflation). d_t and s_t are aggregate demand and supply shocks, respectively. The source of Equations "(1)" to "(3)" is Cecchetti and Ehrmann (2000), but adjusted with equation "(4)" to meet the goal of this paper. We replaced interest rate by money supply because we target the former by the latter.

3. Central Bank Losses and Monetary Policy

Central bank losses can arise in one of two ways: first, operating losses which occur when operating costs exceed operating income. Operating cost includes mainly the interest rate paid on all accounts and instruments. On the other hand, operating income encompasses income

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[1] For more details about the countries that have used central bank securities and the countries that have switched to central bank securities see Quintyn (1994).

[2] Data from the central bank of Jordan provide evidence, for more details see Sweidan and Maghyereh (2005).

[3] For more details about multiperiod function see Dittmar, Gavin and Kydland (1999).

from local and foreign investments. Second, valuation losses which mean losses arising from the revaluation of assets and liabilities. For the purpose of the current paper, we believe that monetary policy will be ineffective when a central bank operates with such significant operating losses. However, losses arising from revaluation do not have the same effect as operating losses.

Real world evidence which comes from two neighboring countries, Jordan and Israel may clarify this point further. The data in Table (I), below, from both countries over the period (1996-1999) shows that the Central Bank of Jordan (CBJ) and the Bank of Israel (BOI) suffered net losses. But, the main difference between the two countries is that the losses in Jordan are related to the monetary policy itself. During the period (1996-1999) the CBJ intervened aggressively in the market by creating certificates of deposit to absorb the excess liquidity. Certificates of deposit are non-income earning instruments used in the conduct of open market operation. This move was taken at a time when interest rates were high, averaging 8%. This constituted a high cost to the CBJ. For this reason, the CBJ suffered significant losses during the period under study. We are therefore, led to believe that these losses may push the monetary authority in Jordan to ease its monetary policy.

Table (I)
The CBJ and the BIO Net Losses over the Period (1996-1999)

Year	Losses/Profits in the CBJ Million JD	Losses/Profits in the BIO Million NIS	Losses/Profits in the CBJ Million $	Losses/Profits in the BIO Million $
1996	-18.9	-456	-26.6	-140.3
1997	-12.4	-1,095	-17.5	-309.3
1998	-10.0	10,943	-14.1	2,630.5
S 1999	-30.7	-8,731	-43.3	-2,103.9

Source: annual reports of the CBJ and the BOI, different issues.

In the case of the BOI, the balance sheet shows that foreign exchange reserves constitute the main assets of the BOI, amounting to almost 87% of total assets. Consequently, the exchange rate regime allows the rate to move within a wide band. The wide exchange rate fluctuations led the BOI to suffer losses over the period (1996-1999). This suggests that the losses in the BOI are related to exchange rate differentials (revaluation). Moreover, the data from the BOI shows that the main monetary instruments in Israel are: monetary loans; deposits auctions and treasury bills. Some of these instruments are income-earning assets which guarantee some revenues to the BOI.

Evidence from the consolidated balance sheet of the Federal Reserve System, shows that the U.S. government securities are the largest category of its assets, it is approximately 90.0%. This implies that these securities are income-earning assets. Furthermore, in a recent study, Dalton and Dziobek (2005) illustrate that central banks of several developing countries such as Brazil and Chile suffered losses because of the interest differential between the cost of domestic liabilities and returns on their assets. Overall, there is no doubt that conducting a monetary policy in any country has some cost. Nevertheless, the evidence shows that adopting a monetary policy that goes much beyond conventional central banking functions causes losses to the central bank. If this is the case, one may question the effectiveness of an independent monetary policy when financial markets are not yet fully developed. Therefore, we believe these central banks should re-evaluate and minimize the cost of their monetary policy.

4. Results

Appendix A demonstrates the results of the optimization problem stated above. We compare the result of this optimization problem (including monetary policy constraint) with the results of Cecchetti and Ehrmann (2000) (without constraint). It is clear that the original model by Cecchetti and Ehrmann (2000), equation "(A5)", shows that the monetary policy offsets aggregate demand shocks, one-for-one relationship (a_0=1). However, the existence of a constraint in applying monetary policy i.e. cost constraint makes monetary policy unable to offset completely an aggregate demand shock, equation "(A10)", (a_1<1). Furthermore, the results illustrate that the value of b_1, equation "(A11)", is less than b_0, equation "(A6)". This means that the response of monetary policy to supply shock can be described as limited or conservative. These two outcomes lead to the conclusion that a restricted monetary policy leads to more fluctuation in the economy. And that it is unable to push the economy back to the equilibrium. Moreover, this result is also confirmed by calculating the variability of output (σ^2_y) and inflation (σ^2_π). The original model, Cecchetti and Ehrmann (2000) in equations ("(A7)" and "(A8)"), concludes that the variability of both output and inflation depends only on the variance of the aggregate supply shock (σ^2_s), and not on the variance of the aggregate demand shock (σ^2_d). However, with a conservative monetary policy the result will be changed. It is clear from Appendix A, equations ("(A12)" and "(A13)"), that output and inflation variability are affected by both the aggregate demand and supply shocks (σ^2_d, σ^2_s).

Given the values of γ, ω and ψ, the additional preference (cost constraint) in central bank loss function implies that the policymakers have preference dispersion. This analysis assumes that the policymakers focus more on the cost of monetary policy as a priority. As a result, they have two scenarios: either to give attention to the cost of monetary policy and output variability; or to the cost of monetary policy and inflation variability. If the central bank places a fixed weight on targeting inflation, output oscillates. However, if the central bank places a fixed weight on the output then inflation rate fluctuates. This analysis postulates that the existence of the cost constraint in the loss function forces the central bank to concentrate on one of two targets either output or inflation. From a technical point of view, the efficient frontier[4] could be either steep or flat, equation "(A15)", which depends on the preferences of the central bank. In sum, the existence of cost constraint in performing monetary policy, limits the ability of monetary policy to affect aggregate demand. In addition, adopting a tight monetary policy is costly.

5. Conclusion

This paper shows that the existence of constraints in conducting monetary policy, i.e. high monetary policy cost, leads to either a steeper or a flatter efficient frontier. This means inefficient monetary policy; its effect to offset aggregate demand and supply shocks is small. This theoretical analysis sheds light on the fact that developing countries which adopt an economic adjustment program with a constrained (non-well developed) monetary policy, are unable to control output and inflation variability efficiently. Moreover, combating inflation under such circumstances is extremely expensive.

[4] This frontier shows the trade-off between output and inflation variability, for more details see Cecchetti, Flores-Lagunes and Krause (2004).

Appendix A

<u>Cecchetti and Ehrmann 2000 model</u>

$$L = E\left[\alpha(\pi-\pi^*)^2+(1-\alpha)(y-y^*)^2\right] \quad \text{(A1)}$$

$$y_t = -\gamma(r_t - d_t) + s_t \quad \text{(A2)}$$

$$\pi = -(r_t - d_t) - \omega s_t \quad \text{(A3)}$$

Optimization results'

$$r_t = a_0 d_t + b_0 s_t \quad \text{(A4)}$$

$$a_0 = \frac{\alpha+(1-\alpha)\gamma^2}{\alpha+(1-\alpha)\gamma^2} = 1 \quad \text{(A5)}$$

$$b_0 = \frac{-\alpha\omega+(1-\alpha)\gamma}{\alpha+(1-\alpha)\gamma^2} \quad \text{(A6)}$$

$$\sigma^2{}_y = (1-\gamma b_0)^2\sigma^2{}_s \quad \text{(A7)}$$

$$\sigma^2{}_\pi = (\omega+b_0)^2\sigma^2{}_s \quad \text{(A8)}$$

<u>The optimization results' of the model in this paper</u>

$$m^s = -a_1 d_t - b_1 s_t \quad \text{(A9)}$$

$$a_1 = \frac{\alpha+\eta\gamma^2}{\alpha+\eta\gamma^2+(1-\alpha-\eta)\psi^2} \quad \text{(A10)}$$

$$b_1 = \frac{\eta\gamma-\alpha\omega}{\alpha+\eta\gamma^2+(1-\alpha-\eta)\psi^2} \quad \text{(A11)}$$

$$\sigma^2{}_y = (\gamma-a_1\gamma)^2\sigma^2{}_d + (1-\gamma b_1)^2\sigma^2{}_s \quad \text{(A12)}$$

$$\sigma^2{}_\pi = (1-a_1)^2\sigma^2{}_d + (\omega+b_1)^2\sigma^2{}_s \quad \text{(A13)}$$

The slope of the output-inflation variability trade-off

$$\frac{\sigma^2{}_y}{\sigma^2{}_\pi} = \left[\frac{\alpha(1+\omega\gamma)}{\gamma(1-\alpha)(1+\omega\gamma)}\right]^2 \quad \text{without constraint} \quad \text{(A14)}$$

$$\frac{\sigma^2{}_y}{\sigma^2{}_\pi} = \left[\frac{\alpha(1+\omega\gamma)+(\gamma+1)(1-\alpha-\eta)\psi^2}{\eta\gamma(1+\omega\gamma)+(\omega+1)(1-\alpha-\eta)\psi^2}\right]^2 \quad \text{with constraint} \quad \text{(A15)}$$

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