Choice of Monetary Policy Instrument under Targeting Regimes in a Simple Stochastic Macro Model

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Organization

- Introduction & Review of Literature
- Theoretical Model and Results
- Calibration Results for Pakistan
- Conclusion

Introduction

- An Optimal Monetary Policy
- Rule versus Discretion Debate [Kydland and Prescott (1977), Barro and Gordon (1983), Taylor (1993)]
- Instrument Rules and Targeting Rules
  - Instrument Rules: state-contingent reaction functions that link policy tools to performance indicators of the economy, e.g., McCallum Rule (1988), Taylor Rule (1993), etc.
  - Targeting Rules: due largely to Svensson (1997, 1999, 2003), the policy makers choose an appropriate variable to target, e.g., inflation rate, price level, nominal income growth rate.

Price level and Inflation Rate as Targeting Variable

- The Conventional Wisdom (Lebow et al. 1992; Fischer 1994; Haldane and Salmon 1995)
  - price-level targeting leads to a lower long-run variance of the price level but at the cost of increased short-run variability in both inflation rate and output level

  → Inflation Targeting Preferable to Price-Level Targeting

- The 'Free Lunch' (Svensson 1999)
  - the same output variance under both targeting regimes and lower variability of inflation rate under price-level targeting than under inflation targeting

  → Price-Level Targeting Preferable to Inflation Targeting

Deriving Optimal Monetary Policy Rules

- Designing optimal rules often leads to complex rules that cannot be implemented easily (Taylor 1999)
- Models deriving optimal monetary rules in the forward-looking models, e.g., Vestin (2001), Bean (2004) etc., gave results that are not robust and are inconclusive

- ❖ On the other hand, the simple macroeconomic models like the AS-IS-LM seem to be applicable to most of the central banking policies (Adema and Sterken 2005).
- ❖ The analytical solutions of these simple models have meaningful economic explanations, e.g., Poole analysis (1970).
- ❖ Use of IS-LM framework could be made consistent with micro foundation [McCallum and Nelson (1999a)] .

Svensson's (1999) 'Free-Lunch' Model

- Svensson (1999) used dynamic optimization problem to analyze targeting rules where the central implication of the model is subject to a complex existence condition.

- Howitt (2000) and Mishkin (2000) pointed out that the specific assumptions necessary for holding of results in Svensson's model are hard to hold in practice.

- Besides, the result of the model holds only in case when central bank acts under discretion.

Objectives of the Study

- Illustration of Svensson (1999) Model in the AS-IS-LM Framework
- Deriving theoretical results under the assumption that interest rate is set exogenously as a policy instrument by central bank to check sensitivity of Svensson's (1999) result with respect to money versus interest rate pegging regimes.
- The theoretical results of the AS-IS-LM models would then be calibrated for Pakistan.

Analytical Framework

- The basic AS-IS-LM model consists of the following equations.

$$y_t = a - \alpha[i_t - (p^e_{t+1} - p_t)] + \varepsilon_t \; ; \qquad \alpha > 0,$$

$$m_t - p_t = ky_t - \varphi i_t + \eta_t \qquad ; \qquad k > 0, \;\; \varphi > o,$$

$$y_t = \rho y_{t-1} + \gamma(p_t - p^e_t) + v_t \; ; \qquad 0 \leq \rho < 1 \, , \qquad \gamma > 0$$

- The Period Loss Function following Svensson (1999) is given as:

$$L_t = 0.5[(\pi_t - \pi^*_t)^2 + \lambda(y_t - y^*_t)^2] \; ; \;\; \lambda > 0 \, ,$$

$$y^*_t = \rho y_{t-1} + v_t$$

- Under inflation targeting

$$\pi_{t+1} = \pi^*$$

$$y_t = a - \alpha(i_t - \pi^*) + \varepsilon_t$$

- Under Price-level targeting:

$$p_t^* = p_{t-1}^* + \pi^*,$$

$$y_t = a - \alpha[i_t - \pi^* - (p_t^* - p_t)] + \varepsilon_t$$

- In price-level targeting, *overshoots or undershoots of the target are not treated as bygones and be made up* (Svensson 1999)

Inflation Targeting

Solving LM equation (2) for nominal interest rate, i_t, yields the following equation.

$$i_t = \frac{1}{\varphi}[ky_t - (m_t - p_t) + \eta_t]$$

Putting this expression into IS equation (8) and solving for output level would result in

$$y_t = \frac{\varphi(a+\varepsilon_t)+\alpha[(m_t-p_t)-\eta_t+\varphi\pi^*]}{\varphi+k\alpha}.$$

To find the price level at this optimal policy function, we use aggregate demand equation (13) and aggregate supply equation (3) to solve for price-level as a function of optimal real money supply. This results in the following equation.

$$p_t = \frac{\gamma(\varphi+k\alpha)p_t^e+\varphi(a+\varepsilon_t)+\alpha(m_t-\eta_t+\varphi\pi^*)-(\varphi+k\alpha)(\rho y_{t-1}+v_t)}{\gamma(\varphi+k\alpha)+\alpha}.$$

$$E_{t-1}L_t = \left\{\frac{0.5(1+\lambda\gamma^2)}{\gamma^2}\right\} E_{t-1}\left[\frac{\varphi(a+\varepsilon_t)+\alpha[(m_t-p_t)-\eta_t+\varphi\pi^*]-(\varphi+k\alpha)(\rho y_{t-1}+v_t)}{\varphi+k\alpha}\right]^2$$

$$(m_t - p_t) = \frac{(\varphi+k\alpha)\rho y_{t-1}-\varphi(a+\alpha\pi^*)}{\alpha}.$$

Inserting this optimum value into aggregate output equation (13) and simplifying yields the optimal rule for output level.

$$y_t = \rho y_{t-1} + \frac{\varphi\varepsilon_t - \alpha\eta_t}{\varphi+k\alpha}.$$

$$\pi_t = \pi^* + \frac{1}{\gamma}\left(\frac{\varphi\varepsilon_t - \alpha\eta_t}{\varphi+k\alpha} - v_t\right).$$

Price-Level Targeting

$$(m_t - p_t) = \frac{(\varphi + k\alpha)\rho y_{t-1} - \varphi(a + \alpha\pi^*)}{\alpha}$$

$$p_t = p_t^* + \frac{\varphi\varepsilon_t - \alpha\eta_t - (\varphi + k\alpha)v_t}{\varphi(\alpha + \gamma) + \gamma k\alpha};$$

$$y_t = \rho y_{t-1} + \frac{\gamma(\varphi\varepsilon_t - \alpha\eta_t) + \alpha\varphi v_t}{\varphi(\alpha + \gamma) + \gamma k\alpha}.$$

$$\pi_t = \pi_t^* + \frac{\varphi(\varepsilon_t - \varepsilon_{t-1}) - \alpha(\eta_t - \eta_{t-1}) - (\varphi + k\alpha)(v_t - v_{t-1})}{\varphi(\alpha + \gamma) + \gamma k\alpha}.$$

Comparison of Inflation and Price-Level Targeting

- Given the above results, it is now possible to make a comparison between the two targeting regimes under alternative assumptions with regard to monetary policy instruments. The three cases considered are:

➢ General AS-IS-LM framework with negative interest elasticity and positive income elasticity of money demand.

$(\varphi > 0, k > 0)$

→Liquidity Preference Framework

➢ Svensson's (1999) case of money supply being used as a policy instrument where LM Schedule is vertical

→ Quantity Theory of Money $(\varphi \to 0, k \to 1)$

➢ Cover and Pecorino's (2005) case of interest rate being used as a policy instrument, where LM schedule is horizontal

$\varphi \to \infty, k < \infty$

→ Endogenous Money Hypothesis

		Money-Supply Control as Policy Instrument		Interest-Rate Control as Policy Instrument
		Liquidity Preference Framework $(\varphi > 0, k > 0)$	Quantity Theory of Money† $(\varphi \to 0, k \to 1)$	Endogenous Money Hypothesis†† $(\varphi \to \infty, k < \infty)$
Inflation Targeting	$Var(y_t)$	$\frac{\varphi^2\sigma_\varepsilon^2 + \alpha^2\sigma_\eta^2}{(\varphi + k\alpha)^2} + \sigma_\upsilon^2$	$\sigma_\eta^2 + \sigma_\upsilon^2$	$\sigma_\varepsilon^2 + \sigma_\upsilon^2$
	$Var(\pi_t)$	$\frac{1}{\gamma^2}\left(\frac{\varphi^2\sigma_\varepsilon^2 + \alpha^2\sigma_\eta^2}{(\varphi + k\alpha)^2} + \sigma_\upsilon^2\right)$	$\frac{\sigma_\eta^2 + \sigma_\upsilon^2}{\gamma^2}$	$\frac{\sigma_\varepsilon^2 + \sigma_\upsilon^2}{\gamma^2}$
	$Var(p_t)$	$\frac{1}{\gamma^2}\left(\frac{\varphi^2\sigma_\varepsilon^2 + \alpha^2\sigma_\eta^2}{(\varphi + k\alpha)^2} + \sigma_\upsilon^2\right)$	$\frac{\sigma_\eta^2 + \sigma_\upsilon^2}{\gamma^2}$	$\frac{\sigma_\varepsilon^2 + \sigma_\upsilon^2}{\gamma^2}$
Price-Level Targeting	$Var(y_t)$	$\frac{\gamma^2(\varphi^2\sigma_\varepsilon^2 + \alpha^2\sigma_\eta^2) + \alpha^2\varphi^2\sigma_\upsilon^2}{[\varphi(\alpha+\gamma) + \gamma k\alpha]^2}$	$\sigma_\eta^2 + \sigma_\upsilon^2$	$\frac{\gamma^2(\sigma_\varepsilon^2 + \sigma_\upsilon^2)}{(\alpha+\gamma)^2}$
	$Var(\pi_t)$	$\frac{2[\varphi^2\sigma_\varepsilon^2 + \alpha^2\sigma_\eta^2 + (\varphi + k\alpha)^2\sigma_\upsilon^2]}{[\varphi(\alpha+\gamma) + \gamma k\alpha]^2}$	$\frac{2(\sigma_\eta^2 + \sigma_\upsilon^2)}{\gamma^2}$	$\frac{2(\sigma_\varepsilon^2 + \sigma_\upsilon^2)}{(\alpha+\gamma)^2}$
	$Var(p_t)$	$\frac{\varphi^2\sigma_\varepsilon^2 + \alpha^2\sigma_\eta^2 + (\varphi + k\alpha)^2\sigma_\upsilon^2}{[\varphi(\alpha+\gamma) + \gamma k\alpha]^2}$	$\frac{\sigma_\eta^2 + \sigma_\upsilon^2}{\gamma^2}$	$\frac{\sigma_\varepsilon^2 + \sigma_\upsilon^2}{(\alpha+\gamma)^2}$

Model's Results

- Inflation Targeting excludes any concern with output stabilization in face of supply-side shocks
- Contrary to Svensson's results, this model shows that variances of output and price level are not all the same under the two targeting regimes and variance of inflation rate is twice the variance of price level under price-level targeting.
- Under the assumption of Quantity Theory of Money, our results partially support Svensson's results as output variance remains the same under the two targeting regimes but inflation variance is not lower (rather higher) under price-level targeting than under inflation targeting.
- On the contrary, our results imply a 'free lunch' in inflation targeting in the sense that variance of output and price level remains same with lower inflation variability under inflation targeting.
- This result is further supplemented by the observation that inflation targeting has the advantage of being easily understood by public and the resulting transparency increases the probability of promoting low inflation expectations

Calibrating the Models' Results

- Calibration is taking parameters that have been estimated for a similar model into one's own model, and solving one's own model numerically [Kydland and Prescott (1982)].
- we take parameter estimates from the most recent available study, i.e., Khan and Muslehuddin (2011)

Parameters	Short Run	Long-Run
α	0.09	0.007
φ	0.01	0.02
k	0.8	1.27
γ	0.18	0.53
σ_{ε}	0.06	0.09
σ_{η}	0.04	0.07
σ_{v}	0.02	0.03

Source: Khan and Muslehuddin (2011)

Policy Instrument:		Money-Supply				Interest-Rate	
		Liquidity Preference Framework		Quantity Theory of Money		Endogenous Money Hypothesis	
		Short Run	Long run	Short Run	Long run	Short Run	Long run
Inflation Targeting	$Var(y_t)$	0.0024	0.0051	0.002	0.0058	0.004	0.009
	$Var(\pi_t)$	0.0735	0.0181	0.0617	0.0206	0.1235	0.0320
	$Var(p_t)$	0.0735	0.0181	0.0617	0.0206	0.1235	0.0320
Price-Level Targeting	$Var(y_t)$	0.0018	0.0041	0.002	0.0058	0.0790	0.0320
	$Var(\pi_t)$	0.1306	0.0354	0.1234	0.0413	4.8773	0.2280
	$Var(p_t)$	0.0653	0.0178	0.0617	0.0206	2.4386	0.1140

Important Results

- Under Price-level Targeting, the variance of inflation rate is high both in short run and long run ; hence, monetary authority in Pakistan cannot enjoy ‘free lunch’ by targeting price level

- Higher variance of price level under price-level targeting than under inflation targeting when central bank uses interest rate as a policy instrument indicates the problem of price-level indeterminacy in case of Pakistan

- The results clearly indicate that in case of controlling interest rate as a policy instrument, the central bank of Pakistan should not target price level as it would lead to higher instability of both inflation rate and output level.

Conclusions

- Inflation Targeting and Price-level Targeting are compared in particular by using AS-IS-LM framework under alternative monetary policy tools set by central bank.

- Under Inflation Targeting, output variance is vulnerable to any supply side shock and these shocks have one-to-one effect whether central bank uses money or interest rate as a policy instrument.

- When central bank pegs money supply as a policy instrument, variances of output, price level and inflation rate become independent of goods market demand shock under zero interest-elasticity of money demand.

- On the contrary, it is the money market shock that has no impact on variances of the said variables when central bank pegs interest rate as a policy instrument.

Conclusions

- Our results, contrary to Svensson, show that Inflation Targeting results in lower variability of inflation rate with the same output and price level variances.

- The results of calibration for Pakistan show that price-level targeting relative to inflation targeting results in more variation in output level and inflation rate thus No Free Lunch for monetary authorities in Pakistan.

Thank you for your patience!