Optimal Monetary Policy

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Outline

(Some parts build on Adolfson-Laséen-Lindé-Svensson 08a,b)
(Sole responsibility...)

- What is optimal monetary policy (in theory and in practice)?
- Alternatives to optimal monetary policy?
- The loss function: Welfare or mandate?
- Interest-rate smoothing
- Resource utilization, potential output
- Commitment (in a timeless perspective)
- Conclusions, summary

What is optimal monetary policy (in theory)?

- Best way to achieve CB's monetary-policy mandate
- Flexible inflation targeting: Set instrument rate so as to stabilize both inflation around inflation target and the real economy (resource utilization, output gap)
- Loss function (quadratic)

$$\mathrm{E}_t \sum_{\tau=0}^{\infty} \delta^{\tau} L_{t+\tau}$$

$$L_t = (\pi_t - \pi^*)^2 + \lambda (y_t - \bar{y}_t)^2$$

- Model (linear)

$$\begin{bmatrix} X_{t+1} \\ Hx_{t+1|t} \end{bmatrix} = A \begin{bmatrix} X_t \\ x_t \end{bmatrix} + Bi_t + \begin{bmatrix} C \\ 0 \end{bmatrix} \varepsilon_{t+1}$$

X_t predetermined variables in quarter t, x_t forward-looking variables, i_t instrument rate, ε_{t+1} i.i.d. shocks

What is optimal monetary policy (in theory)?

- Target variables

$$Y_t = \begin{bmatrix} \pi_t - \pi^* \\ y_t - \bar{y}_t \end{bmatrix}$$

$$Y_t = D \begin{bmatrix} X_t \\ x_t \\ i_t \end{bmatrix},$$

- Loss function

$$L_t = Y_t' \Lambda Y_t$$

Λ positive semidefinite matrix of weights

$$\Lambda = \begin{bmatrix} 1 & 0 \\ 0 & \lambda \end{bmatrix}$$

What is optimal monetary policy (in theory)?

- Minimize intertemporal loss function subject to model, under commitment in a timeless perspective
- Optimal policy, policy function, explicit instrument rule

$$i_t = F_i \begin{bmatrix} X_t \\ \Xi_{t-1} \end{bmatrix}$$

Ξ_{t-1} vector of Lagrange multipliers of model equations for forward-looking variables, from optimization in previous period

$$\Xi_t = M_{\Xi X} X_t + M_{\Xi \Xi} \Xi_{t-1}$$

What is optimal monetary policy (in theory)?

- Solution, optimal equilibrium

$$\begin{bmatrix} x_t \\ i_t \end{bmatrix} = \begin{bmatrix} F_x \\ F_i \end{bmatrix} \begin{bmatrix} X_t \\ \Xi_{t-1} \end{bmatrix}$$

$$Y_t = \bar{D} \begin{bmatrix} X_t \\ \Xi_{t-1} \end{bmatrix}$$

$$\begin{bmatrix} X_{t+1} \\ \Xi_t \end{bmatrix} = M \begin{bmatrix} X_t \\ \Xi_{t-1} \end{bmatrix} + \begin{bmatrix} C \\ 0 \end{bmatrix} \varepsilon_{t+1}$$

What is optimal monetary policy (in theory)?

- In theory: Solve for optimal policy function once and for all, then set instrument rate according to

$$i_t = \begin{bmatrix} F_x \\ F_i \end{bmatrix} \begin{bmatrix} X_t \\ \Xi_{t-1} \end{bmatrix}$$

$$\Xi_t = M_{\Xi X} X_t + M_{\Xi\Xi} \Xi_{t-1}$$

- Not so in practice

What is optimal monetary policy (in practice)?

- Forecast targeting (mean forecast, approximate certainty equivalence)
- Choose instrument rate path so that the forecast of inflation and resource utilization “looks good”
- “Looks good”: Inflation goes to target and resource utilization (output gap) goes to normal (zero) at an appropriate pace
- Choose instrument-rate path (forecast) so as to minimize intertemporal loss function of forecast of inflation and resource utilization

What is optimal monetary policy (in practice)?

- Projections (conditional mean forecasts)
  $z_{t+\tau,t}$ projection in period t of realization of variable $z_{t+\tau}$ in period $t+\tau$
  $z^t \equiv \{z_{t+\tau,t}\}_{\tau=0}^{t} \equiv \{z_{t,t}, z_{t+1,t}, ...\}$ projection path in period t of variable z_t
- Projection model (projection in period t for horizon $\tau \geq 0$, $\varepsilon_{t+\tau,t} = 0$)

$$\begin{bmatrix} X_{t+\tau+1,t} \\ Hx_{t+\tau+1,t} \end{bmatrix} = A \begin{bmatrix} X_{t+\tau,t} \\ x_{t+\tau,t} \end{bmatrix} + Bi_{t+\tau,t}$$

$$Y_{t+\tau,t} = D \begin{bmatrix} X_{t+\tau,t} \\ x_{t+\tau,t} \\ i_{t+\tau,t} \end{bmatrix}$$

What is optimal monetary policy (in practice)?

- Set of feasible projections $\mathcal{T}(X_{t|t}) \equiv$ set of projections (i^t, Y^t, X^t, x^t) that satisfy the projection model for given $X_{t,t} = X_{t|t}$ (estimated state of the economy)
- Loss function over projections (with “commitment term”, Svensson-Woodford 05)

$$L(Y^t, x_{t,t} - x_{t,t-1}, \Xi_{t-1,t-1}) \equiv$$

$$\sum_{\tau=0}^{\infty} \delta^{\tau} Y'_{t+\tau,t} \Lambda Y_{t+\tau,t} + \frac{1}{\delta} \Xi'_{t-1,t-1}(x_{t,t} - x_{t,t-1})$$

- Optimal policy projection (OPP) $(\hat{\imath}^t, \hat{Y}^t)$ minimizes $L(Y^t, x_{t,t} - x_{t,t-1}, \Xi_{t-1,t-1})$ subject to $(i^t, Y^t, x_{t,t}) \in \mathcal{T}(X_{t|t})$
- Linear set of feasible projections, convex loss function, OPP unique

What is optimal monetary policy (in practice)?

- OPP will satisfy ($\Xi_{t-1,t} = \Xi_{t-1,t-1}$)

$$\begin{bmatrix} \hat{x}_{t+\tau,t} \\ \hat{\imath}_{t+\tau,t} \end{bmatrix} = \begin{bmatrix} F_x \\ F_i \end{bmatrix} \begin{bmatrix} X_{t+\tau,t} \\ \Xi_{t+\tau-1,t} \end{bmatrix}$$

$$Y_{t+\tau,t} = \bar{D} \begin{bmatrix} X_{t+\tau,t} \\ \Xi_{t+\tau-1}, t \end{bmatrix}$$

$$\begin{bmatrix} X_{t+\tau+1,t} \\ \Xi_{t+\tau,t} \end{bmatrix} = M \begin{bmatrix} X_{t+\tau,t} \\ \Xi_{t+\tau-1,t} \end{bmatrix}$$

- $\hat{\imath}^t$ and $\hat{\imath}_t$ depend on $X_{t|t}$ (state of the economy) and $\Xi_{t-1,t-1}$ (commitment)

What is optimal monetary policy (in practice)?

- Policy decision $(\hat{\imath}^t, \hat{Y}^t)$: Implementation?
- $\Xi_{t,t}$ is determined
- Announce $\hat{\imath}^t$ and $\hat{Y}^t$ (possibly more), set $i_t = \hat{\imath}_{t,t}$
- Private sector-expectations $\mathrm{E}_t^p x_{t+1}$ are formed
- x_t, Y_t are determined in period t
- In period $t+1$, ε_{t+1} is realized and X_{t+1} is determined
- New policy decision in period $t+1$ given $X_{t+1|t+1}$, $\Xi_{t,t}$.

What is optimal monetary policy (in practice)?

- Determinacy?
- May require out-of-equilibrium commitment (explicit or implicit). Deviate from $\hat{\imath}_{t,t}$ if economy deviates from optimal projection (Taylor principle, Svensson-Woodford 05)

$$i_t = \hat{\imath}_{t,t} + \varphi(\pi_t - \hat{\pi}_t)$$

$$i_t = \hat{\imath}_{t,t} + \varphi[\pi_t - \pi^* + \frac{\lambda}{\kappa}(y_t - \bar{y}_t) - (y_{t-1} - \bar{y}_{t-1})]$$

What is optimal monetary policy (in practice)?

- Judgment?
- Add judgment z^t (add factors, Svensson 05, Svensson-Tetlow 05): $\mathcal{T}(X_{t|t}, z^t)$

$$z^{t+1} = A_z z^t + \eta^{t+1}$$

- $\hat{\imath}^t$ and $\hat{\imath}_t$ depend on $X_{t|t}$, z^t (everything relevant) and $\Xi_{t-1,t}$

What is optimal monetary policy (in practice)?

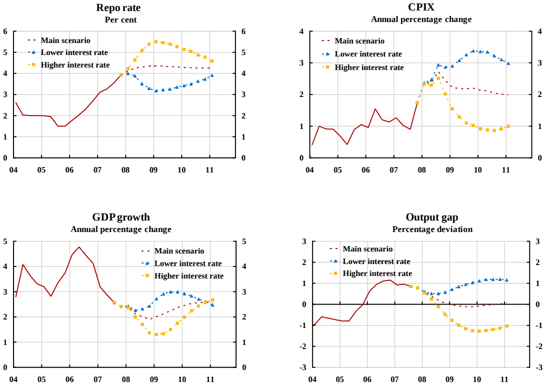
- Note:

  Object of choice is i^t, instrument rate path, not policy function F_i:

  Choose i^t so as to minimize $L(Y^t, x_{t,t} - x_{t,t-1}, \Xi_{t-1,t-1})$ subject to $(i^t, Y^t, x_{t,t}) \in \mathcal{T}(X_{t|t})$

What is optimal monetary policy (in practice)?

- Riksbank, February 2008: Subset of $\mathcal{T}(X_{t|t})$, feasible projections (X^t, x^t, i^t, Y^t)



- Riksbank chose Main Scenario

Alternatives to optimal monetary policy?

- Add hoc policy
- With or without explicit instrument-rate path?
- Projections assuming historical policy function
  - Why follow historical policy (new board members)
  - Bad response for some shocks (ALLS)
- Simple instrument rule (Taylor-type rules, cross-checking only)
- No CB follows simple instrument rule
- All central banks use more information than the arguments of a simple instrument rule
- Revealed preference: CB deviates from simple instrument rules in order to do better policy

Why optimal monetary policy?

- Forecast targeting (Svensson 05, Woodford 07) better policy, and arguably better prescription: All info that affects the forecast of the target variables affects the instrument-rate path and current instrument-rate setting; all info that has no impact on forecast has no impact on instrument rate path and current setting
- More explicit optimal policy: Try to make explicit and more systematic what is already going on implicitly

The loss function: Welfare or mandate?

- Welfare-based loss function
  - Quadratic approximation of utility of representative agent
  - Very model-dependent; not robust
  - Very complex; all distortions show up
  - Difficult to verify
  - Bad history
- Simple loss function
  - Interpretation of mandate (price stability, medium-term inflation target, avoid (unnecessary) real-economy fluctuations)
  - Flexible inflation targeting: Stabilize inflation around inflation target and real economy (resource utilization, output gap)
  - Standard quadratic

Loss function: Parameters?

- Parameters?
  - Estimate: $\lambda_y = 1.1$, $\lambda_{\Delta i} = 0.37$
  - Vote
  - Revealed-preference experiments
- If not agreement on parameters
  - Generate alternative feasible policy projections by OPPs for different loss function parameters
  - Efficient alternative feasible policy projections to choose between

The loss function: Interest-rate smoothing?

- Interest-rate smoothing: $\lambda_{\Delta i}(i_t - i_{t-1})^2$?
  - Empirical, but difficult to rationalize
  - Not disturb markets
  - Result of uncertainty, learning, estimation of current state of economy, Kalman filtering implies serial correlation
  - Commitment, history dependence
  - Less so recently: Fed, Riksbank, Bank of England
  - Instrument-rate path adjustment, not just current instrument rate

Resource utilization, output gap, potential output

- Stability of real economy (resource utilization)
- Measures of resource utilization (gaps: output, employment, unemployment)
- Output gap between output and potential output: Potential output?
- (Stochastic) trend, unconditional flexprice, conditional flexprice, constrained efficient, efficient minus constant
- Capital and other state variables

Commitment in a timeless perspective

- Commitment term in loss function (Svensson-Woodford 05, Marcet-Marimon 98): $\frac{1}{\delta}\Xi'_{t-1}(x_t - x_{t|t-1})$
  - Cost of deviating from previous expectations
  - Requires whole vector of Lagrange multipliers and forward-looking variables (23 in Ramses)

Commitment: Calculating initial Ξ_{t-1}

Adolfson-Laséen-Lindé-Svensson 08a

1. Assume past policy optimal: Equation for Ξ_{t-1}

$$\Xi_{t-1} = M_{\Xi X} X_{t-1} + M_{\Xi\Xi} \Xi_{t-2} = \sum_{\tau=0}^{\infty} (M_{\Xi\Xi})^{\tau} M_{\Xi X} X_{t-1-\tau}$$

2. Assume past policy systematic: Combine first-order conditions for shadow prices ξ_t and Ξ_t and estimated instrument rule with model equation, solve for Ξ_{t-1}

$$\bar{A}' \begin{bmatrix} \xi_{t+1|t} \\ \Xi_t \end{bmatrix} = \frac{1}{\delta} \bar{H}' \begin{bmatrix} \xi_t \\ \Xi_{t-1} \end{bmatrix} + \bar{W} \begin{bmatrix} X_t \\ x_t \\ i_t \end{bmatrix}$$

$$i_t = f_{iX} X_t + f_{ix} x_t$$

Conclusions, summary

- Do optimal monetary policy more explicitly
- Optimize over feasible set of projections rather than choosing policy function
- Loss function: Interpretation of CB mandate rather than welfare
- Loss function: Parameters
- Feasible in medium-sized DSGE models (Adolfson-Laséen-Lindé-Svensson 08a)
- Better than alternatives
- More work on measures of resource utilization, potential output
- Less interest-rate smoothing?
- Commitment in a timeless perspective feasible