

Inflation Targeting

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1. Introduction: Inflation targeting

- 1 An announced numerical inflation target
- 2 Forecast targeting, flexible inflation targeting: Choose policy rate path so forecast of inflation and real economy “looks good” (stabilizes inflation around target and resource utilization around normal)
- 3 A high degree of transparency and accountability

2. History and macroeconomic effects

- Starts 1990 in NZ, now about 25 countries
- Effects on inflation, inflation expectations, and output
- Success: Flexible and resilient monetary-policy regime

3. Theory

- Central role of projections
- Policy choice: Choice of interest-rate path, not policy function, in feasible set of projections
- Targeting rules
- Implementation of policy and equilibrium determination
- Uncertainty: State of the economy, the transmission mechanism
- Judgment

Outline

4. Practice

- Publishing a policy-rate path
- Case studies: The Riksbank and Norges Bank
- Preconditions for emerging-market economics

5. Future

- Price-level targeting
- Financial stability and asset prices [To be written?]
- Additional issues?

6. Conclusions

[To be written.]

2. History and macroeconomic effects

- Starts 1990 in New Zealand
- Now about 10 advanced and 15 emerging-market and developing countries

2. History: Approximate adoption dates

Country	Date	Country	Date
New Zealand	1990 q1	Korea	2001 m1
Canada	1991 m2	Mexico	2001 m1
United Kingdom	1992 m10	Iceland	2001 m3
Sweden	1993 m1	Norway	2001 m3
Finland	1993 m2	Hungary	2001 m6
Australia	1993 m4	Peru	2002 m1
Spain	1995 m1	Philippines	2002 m1
Israel	1997 m6	Guatemala	2005 m1
Czech Republic	1997 m12	Slovakia	2005 m1
Poland	1998 m10	Indonesia	2005 m7
Brazil	1999 m6	Romania	2005 m8
Chile	1999 m9	Turkey	2006 m1
Colombia	1999 m9	Serbia	2006 m9
South Africa	2000 m2	Ghana	2007 m5
Thailand	2000 m5		

2. History and macroeconomic effects

- Effects on inflation, inflation expectations, and output for advanced and emerging-market countries
- Success: Flexible and resilient monetary-policy regime

3. Theory

Linear quadratic model (approximation around stochastic steady state)

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

X_t predetermined, x_t forward-looking variables, i_t (policy) instruments
 Y_t target variables, typically $Y_t \equiv (\pi_t - \pi^*, y_t - \bar{y}_t, \dots)'$

$$Y_t = D \begin{bmatrix} X_t \\ x_t \\ i_t \end{bmatrix} \equiv [D_X \ D_x \ D_i] \begin{bmatrix} X_t \\ x_t \\ i_t \end{bmatrix} \quad (2)$$

Intertemporal loss function

$$E_t \sum_{\tau=0}^{\infty} \delta^\tau L_{t+\tau} \quad (0 < \delta < 1) \quad (3)$$

Period loss

$$L_t \equiv Y_t' \Lambda Y_t \quad (4)$$

Λ weight matrix, typically $\Lambda \equiv \text{Diag}(1, \lambda, \dots)$

3. Theory

Optimization under commitment in a timeless perspective, solution;

$$\begin{bmatrix} x_t \\ i_t \end{bmatrix} = F \begin{bmatrix} X_t \\ \Xi_{t-1} \end{bmatrix} \equiv \begin{bmatrix} F_x \\ F_i \end{bmatrix} \begin{bmatrix} X_t \\ \Xi_{t-1} \end{bmatrix} \quad (5)$$

$$\begin{bmatrix} X_{t+1} \\ \Xi_t \end{bmatrix} = M \begin{bmatrix} X_t \\ \Xi_{t-1} \end{bmatrix} + \begin{bmatrix} C \\ 0 \end{bmatrix} \varepsilon_{t+1} \quad (6)$$

$$Y_t = D \begin{bmatrix} I & 0 \\ F \end{bmatrix} \begin{bmatrix} X_t \\ \Xi_{t-1} \end{bmatrix} \equiv \tilde{D} \begin{bmatrix} X_t \\ \Xi_{t-1} \end{bmatrix} \quad (7)$$

Ξ_t Lagrange multipliers for lower block of (1)

Optimal instrument rule,

$$i_t = F_i \begin{bmatrix} X_t \\ \Xi_{t-1} \end{bmatrix} \quad (8)$$

Certainty equivalence:

Matrices F and M depend on A, B, H, D, Λ , and δ , but not on C

3. Theory

Standard theory of (optimal) monetary policy:

- Central bank commits to some (optimal) policy function F_i
- Private sector combines policy function with model, solves for rational-expectations equilibrium

Not in practice:

- IT central bank announces current policy rate, indicates or announces path of future policy rate, publishes forecast of inflation and the real economy
- Private sector responds to this information, and the actual equilibrium results
- Forecasts and projections of the policy rate, inflation, and the real economy take center stage.

How to model and understand?

3.2 Projection model; feasible set of projections

- $u^t \equiv \{u_{t+\tau,t}\}_{\tau=0}^{\infty}$ *projection* (conditional mean forecast) in period t
- *Projection model* for the projections (X^t, x^t, i^t, Y^t) in period t
($\varepsilon_{t+\tau,t} = 0$ for $\tau \geq 1$)

$$\begin{bmatrix} X_{t+\tau+1,t} \\ Hx_{t+\tau+1,t} \end{bmatrix} = A \begin{bmatrix} X_{t+\tau,t} \\ x_{t+\tau,t} \end{bmatrix} + Bi_{t+\tau,t} \quad (9)$$

$$Y_{t+\tau,t} = D \begin{bmatrix} X_{t+\tau,t} \\ x_{t+\tau,t} \\ i_{t+\tau,t} \end{bmatrix} \quad (10)$$

$$X_{t,t} = X_{t|t} \quad (11)$$

$X_{t|t}$ estimate of predetermined variables in period t (allows for imperfectly observed state of the economy)

- $\mathcal{T}(X_{t|t})$ *feasible set of projections* for given $X_{t|t}$, the set of projections (X^t, x^t, i^t, Y^t) that satisfy (9)-(11)

3.3 Optimal policy choice

- Policy problem in t : Determine optimal projection $(\hat{X}^t, \hat{x}^t, \hat{i}^t, \hat{Y}^t)$ that minimizes intertemporal forecast loss function,

$$\mathcal{L}(Y^t) = \sum_{\tau=0}^{\infty} \delta^{\tau} L_{t+\tau,t} \quad (0 < \delta \leq 1), \quad (12)$$

subject to $(X^t, x^t, i^t, Y^t) \in \mathcal{T}(X_{t|t})$

Period forecast loss

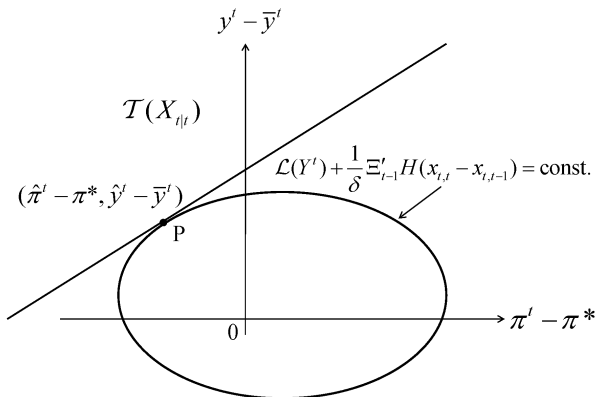
$$L_{t+\tau,t} = Y_{t+\tau,t}' \Lambda Y_{t+\tau,t} \quad (13)$$

- Optimization under commitment in timeless perspective, modified loss function (Svensson-Woodford 05)

$$\min \left\{ \mathcal{L}(Y^t) + \frac{1}{\delta} \Xi'_{t-1} H(x_{t,t} - x_{t,t-1}) \right\} \text{ s.t. } (X^t, x^t, i^t, Y^t) \in \mathcal{T}(X_{t|t}) \quad (14)$$

3.4 Illustration of optimal policy choice

$$Y^t = (\pi^t - \pi^*, y^t - \bar{y}^t)' = (\{\pi_{t+\tau,t} - \pi^*\}_{\tau=0}^{\infty}, \{y_{t+\tau,t} - \bar{y}_{t+\tau,t}\}_{\tau=0}^{\infty})'$$



3.6 Alternative implementation of timeless perspective

- Alternative implementation of timeless perspective (Giannoni-Woodford 02, Svensson-Woodford 05): Restriction instead of modified loss function

$$x_{t,t} = F_x \begin{bmatrix} X_{t|t} \\ \Xi_{t-1} \end{bmatrix} \quad (15)$$

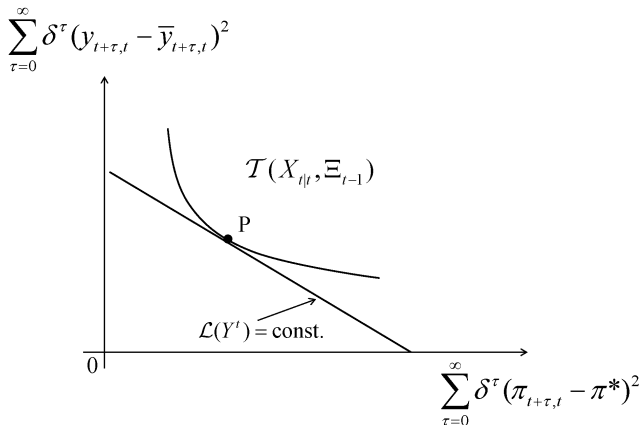
$\mathcal{T}(X_{t|t}, \Xi_{t-1})$, the *restricted feasible set of projections*, the subset of the feasible set of projections $\mathcal{T}(X_{t|t})$ that satisfy (15) for given $X_{t|t}$ and Ξ_{t-1}

- Optimal policy projection is also the solution to the problem

$$\min \mathcal{L}(Y^t) \text{ subject to } (X^t, x^t, i^t, Y^t) \in \mathcal{T}(X_{t|t}, \Xi_{t-1}) \quad (16)$$

3.6 Illustration with forecast Taylor curve

$$\mathcal{L}(Y^t) = \sum_{\tau=0}^{\infty} \delta^\tau (\pi_{t+\tau,t} - \pi^*)^2 + \lambda \sum_{\tau=0}^{\infty} \delta^\tau (y_{t+\tau,t} - \bar{y}_{t+\tau,t})^2 \quad (17)$$



3.7 Targeting rules

- General targeting rule (Giannoni-Woodford 09, Svensson 99)

$$\sum_{s=-a}^b g_s Y_{t+s+\tau,t} = 0 \quad (\tau \geq 0)$$

- Simplest New Keynesian model (Svensson-Woodford 05)

$$\pi_{t+\tau,t} - \pi^* + \frac{\lambda}{\kappa} [(y_{t+\tau,t} - \bar{y}_{t+\tau,t}) - (y_{t+\tau-1,t} - \bar{y}_{t+\tau-1,t})] = 0$$

- Simple and practical way to characterize optimal policy in small models
- Complex in larger models
- Arguably, for practical policy, policymakers need to look at graphs only

3.8 Implementation and equilibrium determination

- Implicit out-of-equilibrium commitment (Svensson-Woodford 05), for instance,

$$i_t = \hat{i}_{t,t} + \varphi(\pi_t - \pi_{t,t})$$

Svensson-Woodford 05: $\varphi > 1$ (Taylor Principle) ensures determinacy

- Private-sector expectations influenced (determined) by central-bank forecast

3.9 Uncertainty

- Uncertainty about the state of the economy (Svensson-Woodford 03)
- Uncertainty about the model/transmission mechanism (Onatski-Williams 03, Svensson-Williams 07)

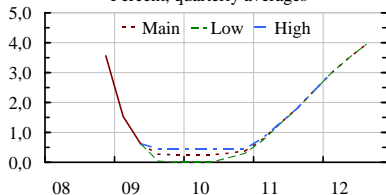
3.10 Judgment

- Time-varying add factors/deviations
(Reifschneider-Stockton-Wilcox 97, Svensson 05,
Svensson-Tetlow 05)

4.2 Practice: The Riksbank

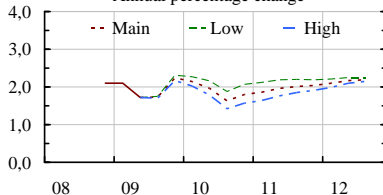
Policy options, July 2009

a. Alternative repo-rate paths
Percent, quarterly averages

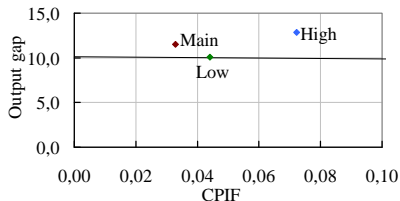


b. CPIIF

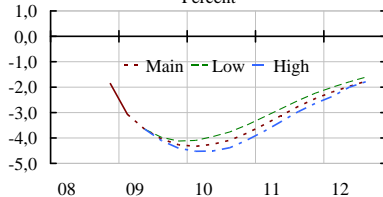
Annual percentage change



c. Variability tradeoffs



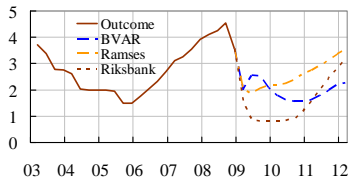
d. Output gap
Percent



4.2 Practice: The Riksbank

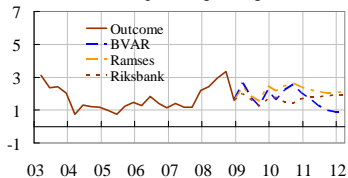
The application of judgment, February 2009

a. Repo rate
Percent

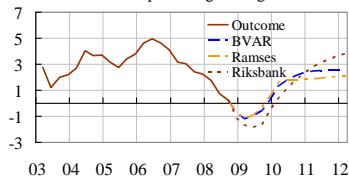


b. CPIF

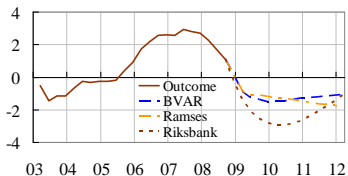
Annual percentage change



c. GDP growth
Annual percentage change



d. Output gap
Percent



5. Future

- The end of history of monetary policy?
[To be written?]
- Welfare optimization?
[To be written?]
- Price-level targeting
- Inflation targeting and financial stability: Lessons from the financial crisis (Bean 09, Kohn 08, Svensson 09)
[To be written?]