Lecture 3 in Monetary Economics

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Properties of optimal policy

What should the goals of monetary policy be?

A common answer: evaluate policies according to a loss function of the form

$$\Omega = E_t \sum_{\tau=0}^{\infty} \beta^{\tau} L_{t+\tau}, L_t = (\pi_t - \pi_t^{\star})^2 + F(y_t - y_t^{\star})^2 \qquad (1)$$

- What is the right form of such a criterion?
- What are the appropriate target values $\pi_t^{\star}$ and $y_t^{\star}$?
- What is the appropriate relative weight, F?
- Which inflation measure: inflation or price level?
- Which output measure: output relative to trend, or to time-varying potential?
- Stabilize inflation over what horizon?
- Are expected and unexpected variations equally costly?

General principle of optimal policy :

$\boxed{\text{To achieve efficiency in the allocation of resources}}$.

Distortions get in the way of efficiency.

What kind of distortions are present in the NK model?

What kind of tools are available to the monetary authorities for dealing with these distortions?

- Monopolistic distortion. Too little output.
- Nominal price rigidity. It has two implications
  1. Variable mark up (while constant under flexible prices)
  2. Relative price distortion (symmetric preferences, same MRT, yet relative prices differ because of a-synchronized price setting)
- Nominal frictions (such as the constraint that transactions require the use of money)
- Other distortions (such as taxes, minimum wages, private information, etc.)

The nature of optimal monetary policy depends on which of these distortions are present and whether any of these distortions can be –indirectly– countered by monetary policy.

Case 1. The flexible price –natural rate– equilibrium is efficient

The imperfect competition distortion (too little output) is offset by a constant employment subsidy ($= 1/\text{markup}$).

Because the flexible price equilibrium is efficient, optimal policy would like to replicate it by delivering the natural rate of output.

How can this be achieved?

By perfectly stabilizing the price level (zero inflation)

If $P_{it} = P_{jt} = P_t = P$. Because W_t is also the same for all firms, their output is the same, and so is their nominal marginal cost and thus markup independent of whether they have the opportunity to reset price optimally in the current period or not.
Hence the mark up is constant.
There is no price dispersion (and hence, a relative price distortion).

The appropriate choice of the constant subsidy can then deliver a real marginal cost equal to unity, which is the level obtained under flexible prices and perfect competition.

Woodford (2003) shows that a monetary authority that aims at maximizing welfare can achieve this by minimizing the following welfare loss function :

$$\Omega = -0.5E_t \sum_{\tau=0}^{\infty} \beta^{\tau} \left(\frac{\theta}{\Upsilon} \pi_{t+\tau}^2 + (\gamma + \sigma)(\widehat{y}_{t+\tau}^N)^2 \right) =$$

$$-0.5E_t \sum_{\tau=0}^{\infty} \beta^{\tau} \left(\pi_{t+\tau}^2 + F(\widehat{y}_{t+\tau}^N)^2 \right) \tag{2}$$

$F = \kappa/\theta$. The welfare loss is minimized by setting $\pi_t = 0 \, \forall \, t$. With this choice of inflation, the Phillips curve implies that the output gap is also zero.

Important points:

- Price stability is an implication of the pursuit of efficiency, not an ad hoc objective.
  Intuition: It stabilizes the markup and eliminates the relative price dispersion distortion ($p_i/p_j = 1$).
- A side effect of the zero inflation policy is the elimination of the output gap (see the PC).

Deviations from perfect price stabilization: Caveats

- The existence of nominal frictions (money is "essential")
- The zero nominal interest rate lower bound
- Asymmetries across sectors
- Wage and price rigidities

When money is essential: The Friedman rule often describes optimal monetary policy:
Set $R = 0 \rightarrow \pi < 0$

But setting $\pi < 0$ thus leads to price dispersion which is inefficient. Allowing R_t to differ from zero and vary is distortionary too. Need to trade one distortion against the other. Woodford, 2003, shows that in this case, the welfare maximizing objective of the central bank takes the form

$$\Omega_t = \pi_t^2 + F_y(\widehat{y}_t^e)^2 + F_i\widehat{R}_t \tag{3}$$

Optimal policy also involves some interest rate smoothing!

General properties of policy:

- A small deviation from zero inflation (small deflation)
- Also some variability in inflation
- The targeted interest rate is below the one which would be consistent with zero inflation

The targeted interest rate is above the one which would be consistent with zero inflation

Practical relevance of the zero bound.

The case of Japan. Was the zero bound operational? Eggertson-Woodford: Construct a simple model that suggests that the zero bound constraint could have mattered a lot. They suggests a solution to the problem: *Price level targeting*.

Does the lower bound still matter in models that incorporate investment and an open economy? (Christiano, 2005). Not really.

What does the lower bound imply for the effectiveness of fiscal shocks? Very large government spending multiplier.

Monetary union

Basic principles in the conduct of policy:

- We want the relative price (the real exchange rate) to mimic that under flexible prices.
- We also want price stability-elimination of the output gap in each country (in order to take care of within country relative price distortion and the variable markup).

1. If prices are equally sticky and the economies are symmetric then optimal monetary policy entails stabilizing the aggregate inflation rate. The relative price is independent of monetary policy
2. In general, a policy that targets aggregate inflation at the level (Benigno, 2003)

$$\pi_t^{TAR} = m\pi_{1t} + (1-m)\pi_{2t} \tag{4}$$

   is a good approximation to the optimal policy.
3. Larger countries and countries with more sticky prices receive a larger weight.

Because food, energy and asset prices are quite flexible:

- Justification for core inflation targeting (Aoki, 2001).
- Justification for not including asset price inflation in the inflation target.

Wage rigidities

Erceg, Henderson and Levin, 2000

Target wage rather than price inflation.

B. Policy Implementation. What kind of rule can implement optimal monetary policy?

Interest rate targeting

Targeting the natural rate of interest

$$R_t = r_t^N \tag{5}$$

Combining the Phillips and IS curve with the interest rate rule gives

$$\begin{bmatrix} \widehat{y}_{t+1}^N \\ \pi_{t+1} \end{bmatrix} = A \begin{bmatrix} \widehat{y}_t^N \\ \pi_t \end{bmatrix}, \ A = \begin{bmatrix} 1 & 1/\gamma \\ 0 & \beta \end{bmatrix}^{-1} \begin{bmatrix} 1 & 0 \\ -\kappa & 1 \end{bmatrix} \tag{6}$$

The matrix A has one eigenvalue inside and one outside the unit circle. The system has two forward looking variables, $\widehat{y}_t$ and π_t. The Blanchard-Khan criterion indicates the existence of multiple solutions. There is nothing to guarantee that the "good" equilibrium, $\widehat{y}_t = 0$ and $\pi_t = 0$ will obtain.

Partial interest rate targeting- partial response to economic activity

$$logR_t = logr_t^N + k_\pi \pi_t + k_y \widehat{y}_t^N \quad (7)$$

For a unique solution (both eigenvalues must lie outside the unit circle)

$$\kappa(k_\pi - 1) + (1 - \beta)k_y > 0 \quad (8)$$

A sufficient condition is $k_\pi > 1$, that is, a sufficiently strong policy response to inflation. This has been termed the Taylor principle. Note that the unique equilibrium involves $\widehat{y}_t = 0$, $\pi_t = 0$ and $R_t = r_t^N$. The existence of a –credible– policy threat to react to inflation-output gap developments is sufficient to prevent any movements in these variables!

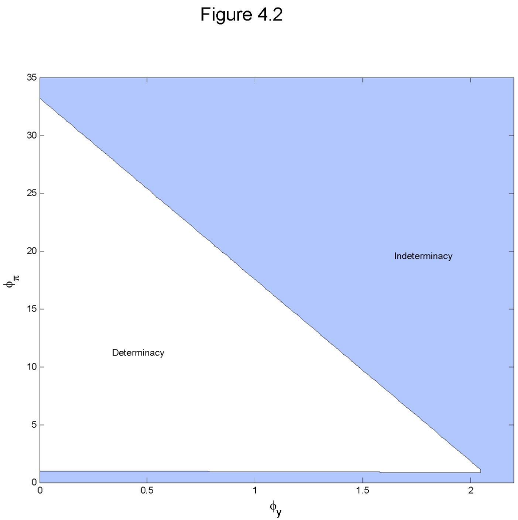
(Loose) Intuition: An increase in the nominal interest rate that exceeds the rate of inflation increases real interest rates, discouraging current aggregate demand, leading to a reduction in the interest rate

A forward looking rule

$$logR_t = logr_t^N + k_\pi E_t \pi_{t+1} + E_t k_y \widehat{y}_{t+1}^N \tag{9}$$

The conditions for a unique equilibrium are now more stringent. The unique equilibrium involves $\widehat{y}_t = 0$, $\pi_t = 0$ and $R_t = r_t^N$. The most noteworthy feature is that the central bank should react neither too weakly nor too strongly to expected inflation and the output gap in order to prevent undesirable, self-fulfilling equilibria from materializing.

Figure: Interest rate rules and determinacy



The previous rules require information on un-observables (natural level of output). The following rule only involves actual and –observable– trend output.

A standard Taylor rule

$$logR_t = r + k_\pi \pi_t + k_y \widehat{y}_t^S \tag{10}$$

with $r = -log\beta$.

Re-write it in terms of the welfare relevant output gap $\widehat{y}_t^N$

$$logR_t = r + k_\pi \pi_t + k_y \widehat{y}_t^N + k_y \widehat{y}_t^{SN} \tag{11}$$

and use $\widehat{R_t} = logR_t - r$ in the IS equation.

Note that the last term in equation (11) involves the (difference between the) natural level and the steady state level of output. Neither is affected by monetary policy, so this term acts as an exogenous shock as far as monetary policy is concerned.

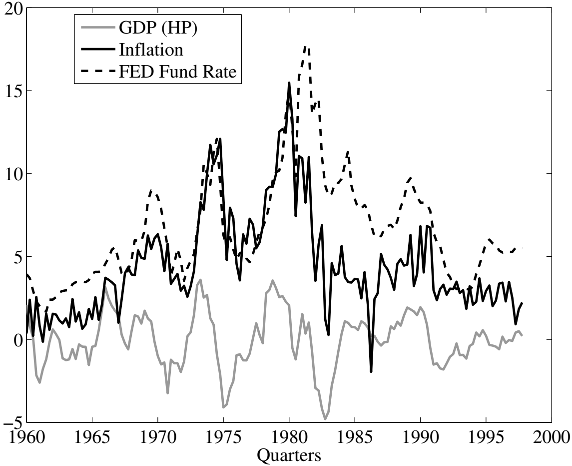
Figure: The properties of the Taylor rule

Table 4.1: Evaluation of Simple Monetary Policy Rules

	Taylor Rule				*Constant Money Growth*	
ϕ_π	1.5	1.5	5	1.5	-	-
ϕ_y	0.125	0	0	1	-	-
$(\sigma_\zeta, \rho_\zeta)$	-	-	-	-	$(0, 0)$	$(0.0063, 0.6)$
$\sigma(\widetilde{y})$	0.55	0.28	0.04	1.40	1.02	1.62
$\sigma(\pi)$	2.60	1.33	0.21	6.55	1.25	2.77
$welfare\ loss$	0.30	0.08	0.002	1.92	0.08	0.38

A simple Taylor-type rule that responds aggressively to movements in inflation can approximate arbitrarily well the optimal policy

Figure: The great inflation



C. Implementation of optimal policy in real time

The great inflation of the 70s

Many theories: The best known is the Barro-Gordon theory that relies on the lack of commitment.

We will focus on those involving a well–meaning, *non–opportunistic* central bank which made honest mistakes.

Clarida et al., 2000: The mistake was a technical one. The great inflation was caused by the violation of the Taylor principle in the conduct of US monetary policy. That is, the CB reaction to -expected- inflation was very weak, leading to indeterminacy ($\beta < 1$ in Figure 4).

TABLE II
BASELINE ESTIMATES

	π^*	β	γ	ρ	p
Pre-Volcker	4.24	0.83	0.27	0.68	0.834
	(1.09)	(0.07)	(0.08)	(0.05)	
Volcker-Greenspan	3.58	2.15	0.93	0.79	0.316
	(0.50)	(0.40)	(0.42)	(0.04)	

Standard errors are reported in parentheses. The set of instruments includes four lags of inflation: output gap, the federal funds rate, the short-long spread, and commodity price inflation.

TABLE IV
ALTERNATIVE HORIZONS

	π^*	β	γ	ρ	p
$k = 4, q = 1$					
Pre-Volcker	3.58	0.86	0.34	0.73	0.835
	(1.42)	(0.05)	(0.08)	(0.04)	
Volcker-Greenspan	3.25	2.62	0.83	0.78	0.876
	(0.23)	(0.31)	(0.28)	(0.03)	
$k = 4, q = 2$					
Pre-Volcker	3.32	0.88	0.34	0.73	0.833
	(1.80)	(0.06)	(0.09)	(0.04)	
Volcker-Greenspan	3.21	2.73	0.92	0.78	0.886
	(0.21)	(0.34)	(0.31)	(0.03)	

Standard errors are reported in parentheses. The set of instruments includes four lags of inflation, output gap, the federal funds rate, the short-long spread, and commodity price inflation.

Orphanides, 2004: The mistake arose from a significant, systematic misperception of potential output. The FED's estimate of potential output failed to capture the well documented productivity slowdown that started some time around 1970. Consequently, its estimate of expected, equilibrium inflation remained too low relative to the actual one. The end of the great inflation came about after the FED had learned about the shift in potential output, rather than from a switch to a more aggressive monetary policy rule (as CGG have argued).

Table 1

Estimated Policy Rules

	α	β	γ	ρ	SEE	$\bar{R}^2$
$i = 1$						
1966:1–1979:2	1.53	1.64	0.57	0.70	0.81	0.86
	(1.31)	(0.38)	(0.12)	(0.07)		
1979:3–1995:4	1.31	1.80	0.27	0.79	1.19	0.90
	(1.84)	(0.48)	(0.30)	(0.11)		
$i = 2$						
1966:1–1979:2	2.12	1.61	0.60	0.67	0.80	0.87
	(1.39)	(0.36)	(0.13)	(0.08)		
1979:3–1995:4	1.07	1.85	0.24	0.78	1.18	0.90
	(1.83)	(0.50)	(0.23)	(0.09)		
$i = 3$						
1966:1–1979:2	2.13	1.65	0.62	0.69	0.88	0.85
	(1.80)	(0.42)	(0.15)	(0.08)		
1979:3–1995:4	0.80	1.89	0.19	0.76	1.17	0.90
	(1.56)	(0.43)	(0.19)	(0.07)		
$i = 4$						
1966:1–1979:2	3.53	1.44	0.61	0.72	0.95	0.84
	(1.85)	(0.41)	(0.21)	(0.10)		
1979:3–1995:4	0.54	1.95	0.17	0.74	1.14	0.90
	(1.41)	(0.38)	(0.15)	(0.05)		

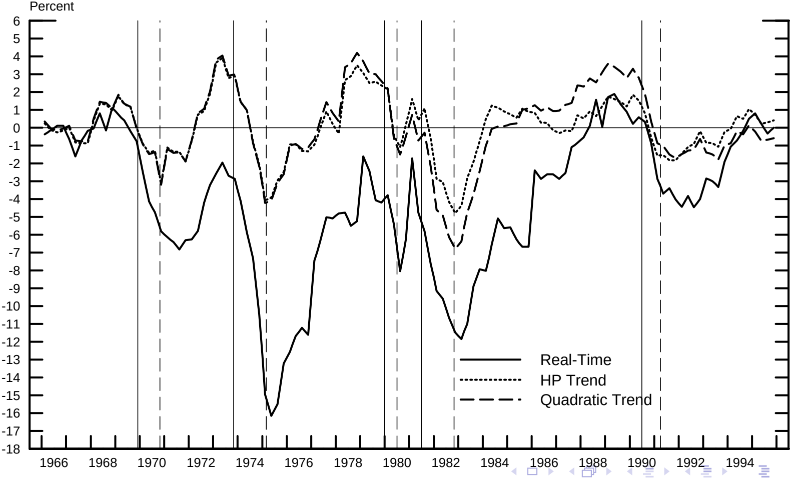
Notes: The table presents NLLS estimates of:

$$f_t = \rho f_{t-1} + (1-\rho)(\alpha + \beta \pi_{t,i|t} + \gamma y_{t|t}) + \eta_t$$

for $i \in \{1, 2, 3, 4\}$. Robust standard errors in parentheses. f_t is the federal funds rate (in percent per year), $y_{t|t}$ the output gap estimate for quarter t (in percent), and $\pi_{t,i|t}$ the forecast of inflation from quarter t to quarter $t+i$ (in percent per year). All regressions for

Figure 5

Real-Time Perceptions and Ex Post Concepts of the Output Gap



Univariate (single equation estimation of the policy rule) vs multivariate (a full macroeconomic model) approach.
Lubik and Schorfheide, 2004: Estimate a small scale, new Keynesian, dynamic, general equilibrium model. They allow for indeterminacies and sunspots. Their work represents the first theoretically and empirically consistent attempt to estimate a DSGE model without restricting the parameters to the determinacy region, a significant methodological innovation.

L-S's main result confirms CGG: In the post 1982 U.S. monetary policy is consistent with determinacy, whereas the pre–Volcker policy is not.