Lectures in Monetary Economics
Lecture 4

Properties of optimal policy

Harris Dellas

Department of Economics
University of Bern

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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 :

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
- Nominal price rigidity. It has two implications
  1. Deviation of mark up from frictionless -constant- level
  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/markup).

$$\widehat{y}_t^N = E_t \widehat{y}_{t+1}^N - \frac{1}{\gamma}(\widehat{R}_t - E_t \pi_{t+1} - \widehat{r}_t^{NS}) \tag{2}$$

$$\pi_t = \beta E_t \pi_{t+1} + \kappa \widehat{y}_t^N \tag{3}$$

$\widehat{r}_t^{NS} = log r_t^N - log \beta$ where r_t^N is the natural rate of the real interest rate. It satisfies

$$(Y_t^N)^{-\gamma} = \beta E_t r_t^N (Y_{t+1}^N)^{-\gamma}$$

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)

A. Perfect price stabilization

Demonstration

When the households are on their labor supply and face no rationing in consumption their Marginal Rate of Substitution between consumption and leisure equals the real wage

$$\frac{\nu h^{\sigma}}{C_t^{-\gamma}} \equiv \boxed{MRS_t} = W_t/P_t \tag{4}$$

Under *flexible* prices and imperfect competition the optimal price (same for all firms) is a *fixed* markup over nominal marginal cost

$$P_t = \Lambda NMC_t = \frac{\Lambda W_t}{MPN_t} \Rightarrow\Rightarrow \frac{W_t}{P_t} = \frac{MPN_t}{\Lambda} < MPN_t \tag{5}$$

MPN_t is the marginal product of labor and MNC_t is the nominal marginal cost. The firms produce too little.

To make the flexible price equilibrium efficient ($MRS_t = W_t/P_t = MPN_t$) the government can subsidize the cost of employment, so that the true nominal marginal cost is $(1-\tau) * MNC_t$. Using this in equation 5 we have that if $(1-\tau)\Lambda = 1$ then the monopolistic distortion is eliminated, $MRS_t = MPN_t$. Consequently, if monetary policy could produce a markup in the economy that was the same for all firms and equal to Λ the fixed price economy could be replicate the flexible price economy and be efficient too.

How can this markup stabilization be achieved?

By making the general price level constant. 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.
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 :

$$\Omega = -0.5E_t \sum_{\tau=0}^{\infty} \beta^{\tau} \left(\frac{\theta}{\Upsilon} \pi_{t+\tau}^2 + (\gamma + \sigma)(\widehat{y}_{t+\tau}^N)^2 \right) = - 0.5E_t \sum_{\tau=0}^{\infty} \beta^{\tau} \left(\pi_{t+\tau}^2 + F(\widehat{y}_{t+\tau}^N)^2 \right) \quad (6)$$

$F = \kappa/\theta$. 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: Price stability 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).
- The real interest rate shadows the natural interest rate rate (equation 2).

If there is some price dispersion when the policy is implemented (Yun, 2005) then there is a transition period with non-zero inflation. In the long run -asymptotically- price stability emerges as the optimal policy.

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

Interest rate targeting

Targeting the natural rate of interest

$$R_t = r_t^N \tag{7}$$

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

$$\begin{bmatrix} \widehat{y}_{t+1}^N \\ \pi_{t+1} \end{bmatrix} = A \begin{bmatrix} \widehat{y}_t^N \\ \pi_t \end{bmatrix}, A = \begin{bmatrix} 1 & 1/\gamma \\ 0 & \beta \end{bmatrix}^{-1} \begin{bmatrix} 1 & 0 \\ -\kappa & 1 \end{bmatrix} \tag{8}$$

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

$$logR_t = logr_t^N + k_\pi \pi_t + k_y \widehat{y}_t^N \tag{9}$$

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

$$\kappa(k_\pi - 1) + (1 - \beta)k_y > 0 \tag{10}$$

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!

A forward looking rule

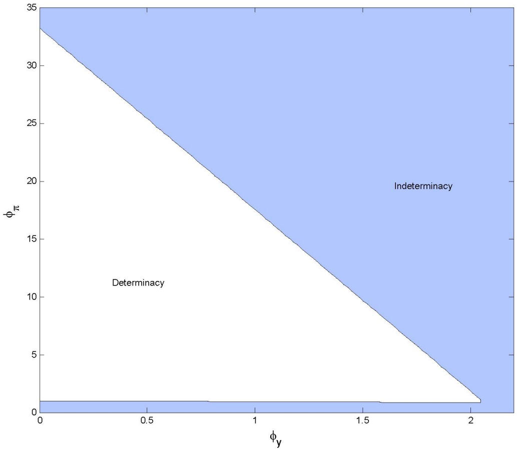
(Loose) Intuition: An increase in the nominal interest rate that exceeds the rate of inflation increases real interest rates, discouraging current aggregate demand, leading to a reduction in the interest rate

$$logR_t = logr_t^N + k_\pi E_t\pi_{t+1} + E_t k_y \widehat{y}_{t+1}^N \qquad (11)$$

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

Figure 4.2



Rules that do not require information on unobservables

The previous rules require too much information on the part of the monetary authorities, namely, knowledge of the natural rate of interest (or the natural rate of output).

We will return to this issue when discussing the debates on the great inflation of the 70s.

We now consider procedures that impose lower informational demands.

A standard Taylor rule

$$logR_t = r + k_\pi \pi_t + k_y \widehat{y}_t^S \tag{12}$$

with $r = -log\beta$.
Re-write it in terms of the welfare relevant output gap $\widehat{y}_t^N$

$$logR_t = r + k_\pi \pi_t + k_y \widehat{y}_t^N + k_y \widehat{y}_t^{SN} \tag{13}$$

and use $\widehat{R_t} = logR_t - r$ in the IS equation.
Note that the last term in equation (13) 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.

A forward looking Taylor rule

$$logR_t = r + k_\pi E_t \pi_{t+1} + k_y E_t \widehat{y}^S_{t+1} \qquad (14)$$

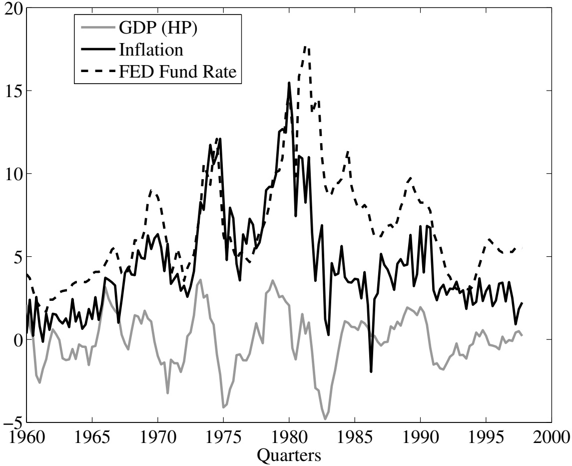
TASK:

Suppose that the technology shock follows the process

$$logA_t = (1-\rho) log\overline{A} + \rho logA_{t-1} + e_t$$

Evaluate the welfare performance of the policy rules given by equations 13 and 14 under alternative assumptions about the values of the reaction coefficients. What are your main conclusions. How well and under what conditions can it approximate well the optimal policy discussed earlier? (For the other parameters use a standard parametrization).

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 3).

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)		

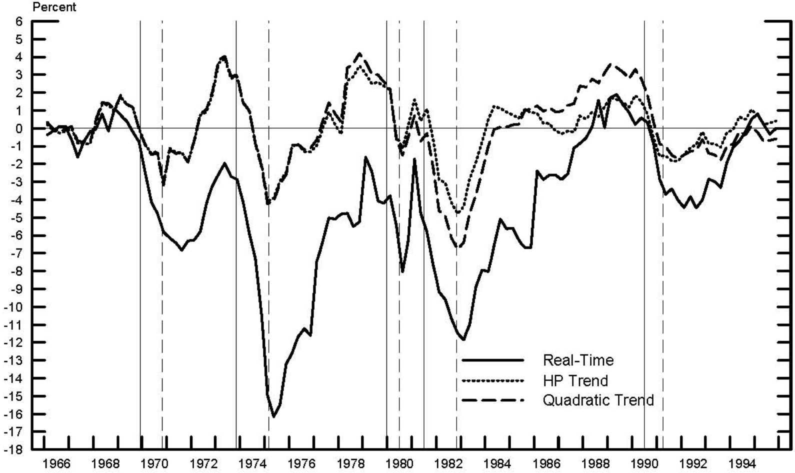
Notes: The table presents NLLS estimates of:

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

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.

Collard and Dellas 2008: Extend L-S to allow for imperfect info and learning regarding potential output.

$$\widehat{y}_t = E_t\widehat{y}_{t+1} - \tau(\widehat{R}_t - E_t\widehat{\pi}_{t+1}) + \widehat{g}_t \tag{15}$$

$$\widehat{\pi}_t = \beta E_t\widehat{\pi}_{t+1} + \kappa(\widehat{y}_t - \widehat{z}_t) \tag{16}$$

$$\widehat{R}_t = \rho_R\widehat{R}_{t-1} + (1-\rho_R)(\psi_\pi\widehat{\pi}_t + \psi_y\widehat{y}_t) + \varepsilon_t^R \tag{17}$$

where $\widehat{y}_t$, $\widehat{\pi}_t$ and $\widehat{R}_t$ denote output, inflation and the nominal interest rate, all measured as percentage deviations from the steady state.

$$\widehat{z}_t = \rho_z\widehat{z}_{t-1} + \varepsilon_t^z, \tag{18}$$

$$\widehat{g}_t = \rho_g\widehat{g}_{t-1} + \varepsilon_t^g \tag{19}$$

Main finding: The case for indeterminacy in the pre–Volcker period remains overwhelming when the alternative is the standard NK version without output gap mis-perceptions. But it does not dominate as conclusively the specification with *incomplete* information and determinacy.
In particular, comparing the marginal log–data densities: Calculate the posterior probability of indeterminacy against determinacy.

- Determinacy model with perfect information to that with indeterminacy: the probability is 0.999 in favor of indeterminacy.
- Indeterminacy against imperfect information case: The probability in favor of indeterminacy is 0.83.

Table: Probabilities

Models	Probability
Determinacy, Perfect Info. vs Indeterminacy	0.0005
Determinacy Perfect Info. vs Determinacy Imperfect Info	0.0028
Determinacy Imperfect Info. vs Indeterminacy	0.1711

This result indicates that one cannot confidently rule out the possibility that imperfect information about the true state of the economy may have contributed significantly to the great inflation of the 1970s.