

# EC 831: Empirical Methods in Macroeconomics

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**Shocks and Government Beliefs: The Rise and Fall of  
American Inflation**

Central bank does not know the true structure of the economy.

SWZ attribute the rise and fall of inflation to an intricate interaction between

- the central bank's beliefs and
- economic shocks

Central banks' model of the Phillips curve deviates in two ways from the true data generating model

- ① they omit the public's rational expectation of inflation from its Phillips curve
- ② they think the regression coefficients in its Phillips curve are changing over time

# The Model

Lucas natural-rate version of Phillips curve

- Systematic monetary policy is neutral

$$u_t - u^{**} = \theta_0(\pi_t - E_{t-1}\pi_t) + \theta_1(\pi_{t-1} - E_{t-2}\pi_{t-1}) + \tau_1(u_{t-1} - u^{**}) + \sigma_1 w_{1,t} \quad (1)$$

True Inflation process

$$\pi_t = x_{t-1} + \sigma_2 w_{2,t} \quad (2)$$

- $u_t$  : Unemployment rate
- $\pi_t$  : Inflation
- $u^{**}$  : Natural rate of unemployment
- $x_t$  : Part of inflation controlled by the "government"
- $w_{1,t}$  and  $w_{2,t}$  are i.i.d. uncorrelated std.normal shocks

- "reverse engineer a set of government beliefs that can explain the low-frequency swings in U.S. data "
- "while insisting that the true DGM have the strong policy irrelevance of the Lucas supply function"

# Central Bank problem

Minimize the loss function

$$\min_{\{x_{t-1}\}_{t=0}^{\infty}} \widehat{E} \sum_{j=0}^{\infty} \delta^j ([\pi_{t+j} - \pi^*]^2 + \lambda[u_{t+j} - u^*]^2) \quad (3)$$

$$\text{s.t. } u_{t+j} = \widehat{\alpha}'_{t+j|t+j-1} \Phi_{t+j} + \sigma w_{t+j} \quad (4)$$

which is the central banks' perceived model of the economy

- $\Phi_t$  : lags of inflation and unemployment
- True DGP is (1) but central bank uses (4) in policy making
- $\widehat{\alpha}_{t|t-1}$  is the central bank's best guess about true structural parameters
- $x_{t-1} = h(\widehat{\alpha}_{t|t-1})' \Phi_t$ : where  $h(\cdot)$  is the "best response"

# Central Bank Beliefs

$$u_t = \alpha_t' \Phi_t + \sigma w_t$$

$$\alpha_t = \alpha_{t-1} + \Lambda_t$$

Central bank believes the economy drifts over time.

- Perceived drift governed by  $\Lambda_t \sim N(0, V)$

$$\hat{\alpha}_{t|t-1} \equiv E(\alpha_t | I_{t-1})$$

$$I_t \equiv \{u_1, \pi_1, \dots, u_t, \pi_t\}$$

$$\text{Let } P_{t|t-1} \equiv \text{Var}(\alpha_t | I_{t-1})$$

# Updating Central Bank Beliefs

Given  $\alpha_{1|0}$  and  $P_{1|0}$  use the Kalman Filter

$$\hat{\alpha}_{t+1|t} = \hat{\alpha}_{t|t-1} + \frac{P_{t|t-1}\Phi_t(u_t - \Phi_t'\hat{\alpha}_{t|t-1})}{\sigma^2 + \Phi_t'P_{t|t-1}\Phi_t}$$

$$P_{t+1|t} = P_{t|t-1} - \frac{P_{t|t-1}\Phi_t\Phi_t'P_{t|t-1}}{\sigma^2 + \Phi_t'P_{t|t-1}\Phi_t} + V$$

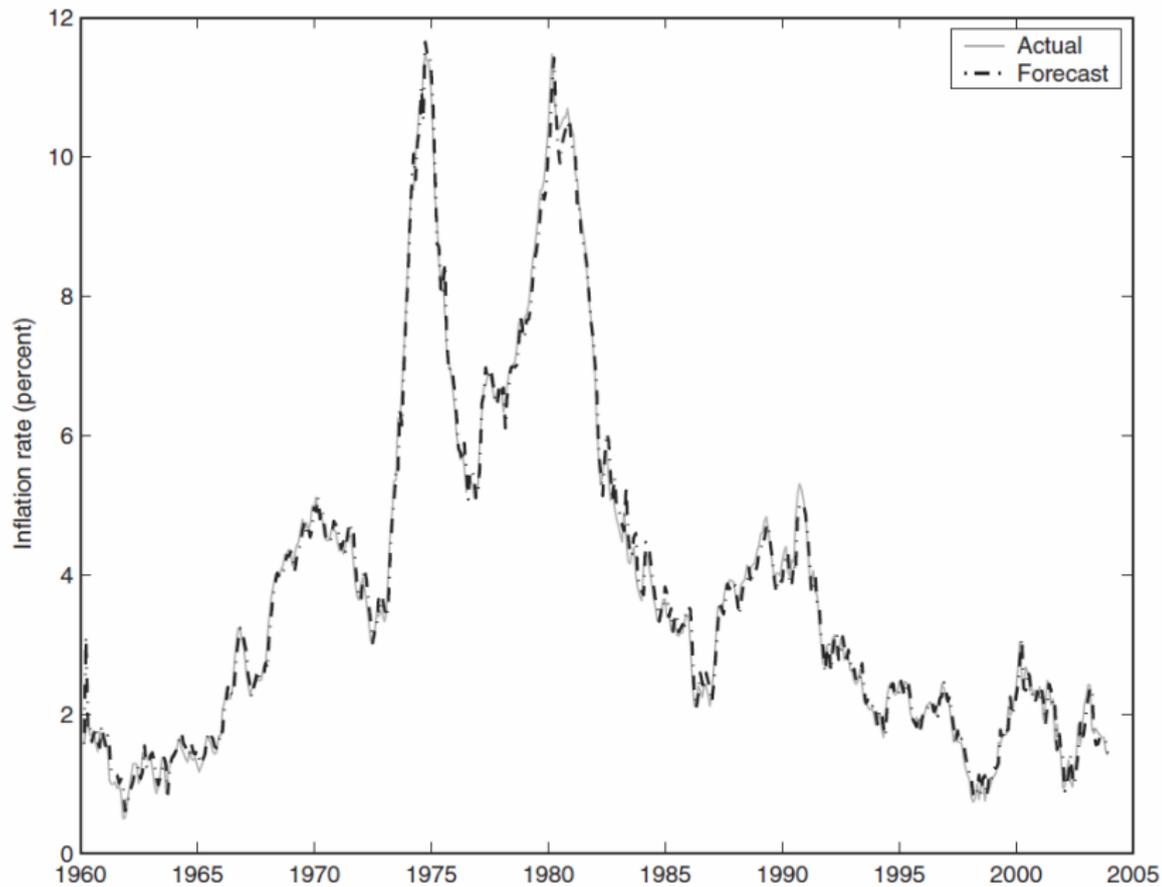
## Fixed parameters

- $\delta, \lambda, \pi^*, u^*$  and  $\hat{\alpha}_{1|0}$

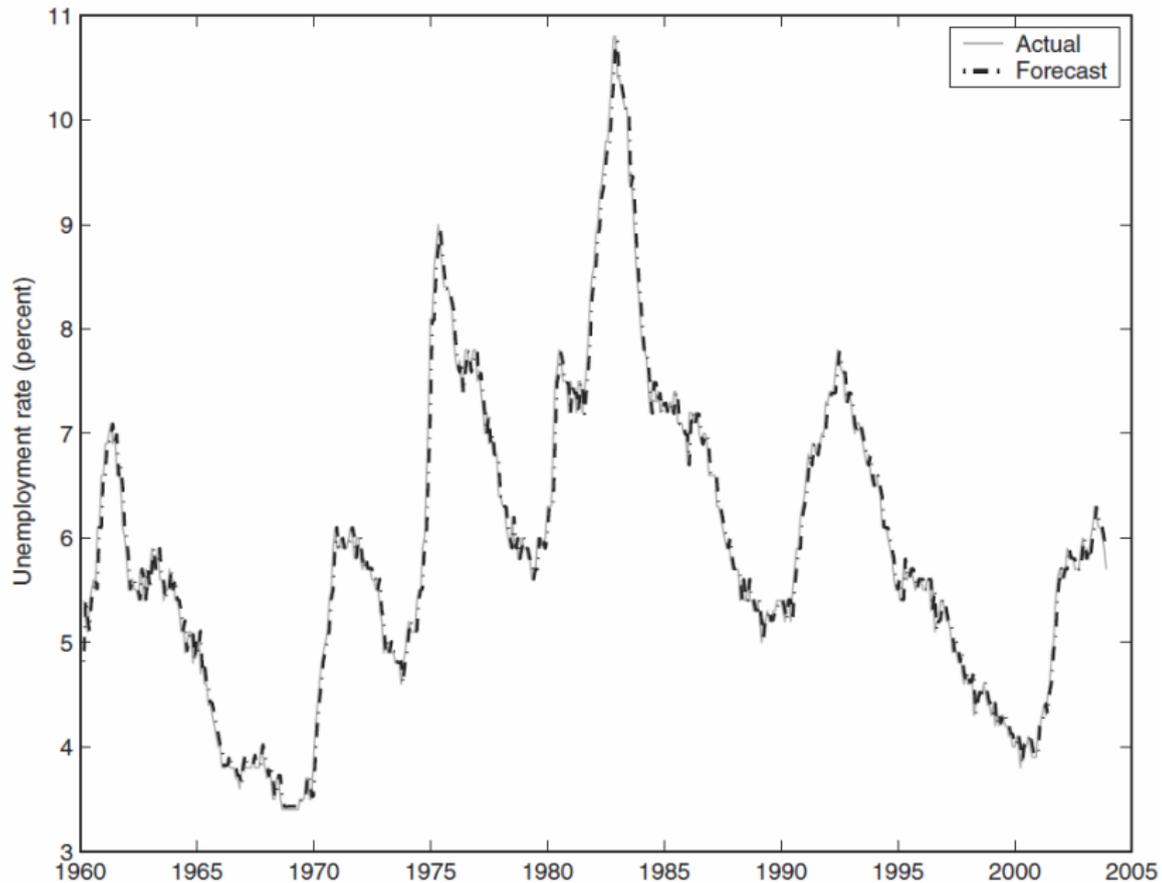
Estimated Parameters:  $\phi = \{v^*, \theta_0, \theta_1, \tau_1, \zeta_1, \zeta_2, C_p, C_v\}$

- $v^* = u^{**}(1 - \tau_1)$
- $V = C'_V C_V$
- $P_{1|0} = C'_P C_P$
- $\zeta_1 = 1/\sigma_1^2$
- $\zeta_2 = 1/\sigma_2^2$
- $\theta_0, \theta_1$  and  $\tau_1$  are parameters of the supply curve

# Inflation



# Unemployment



Consider the simplified version of the model:

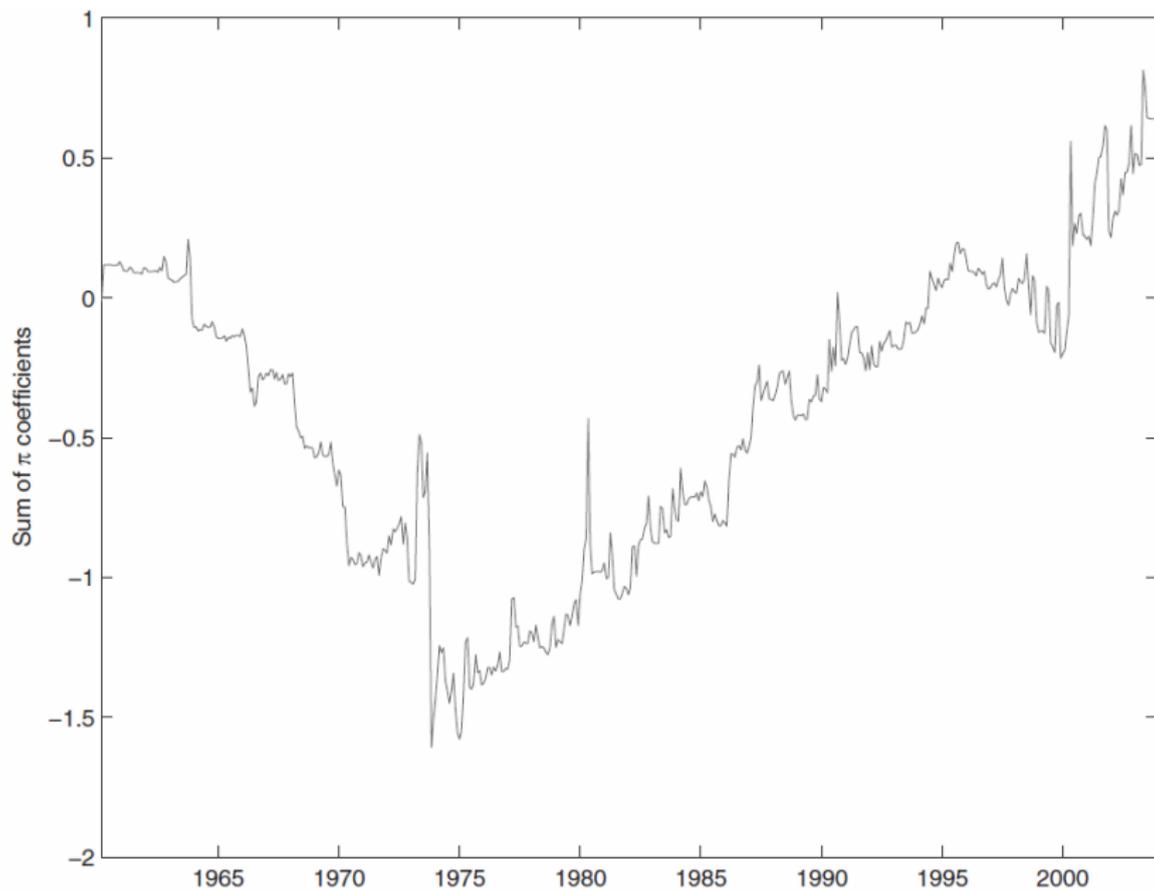
$$u_t - u^{**} = \theta_0(\pi_t - E_{t-1}\pi_t) + \sigma_1 w_{1,t}$$

SWZ estimate of  $\theta_0$  : (-ve) and close to zero.

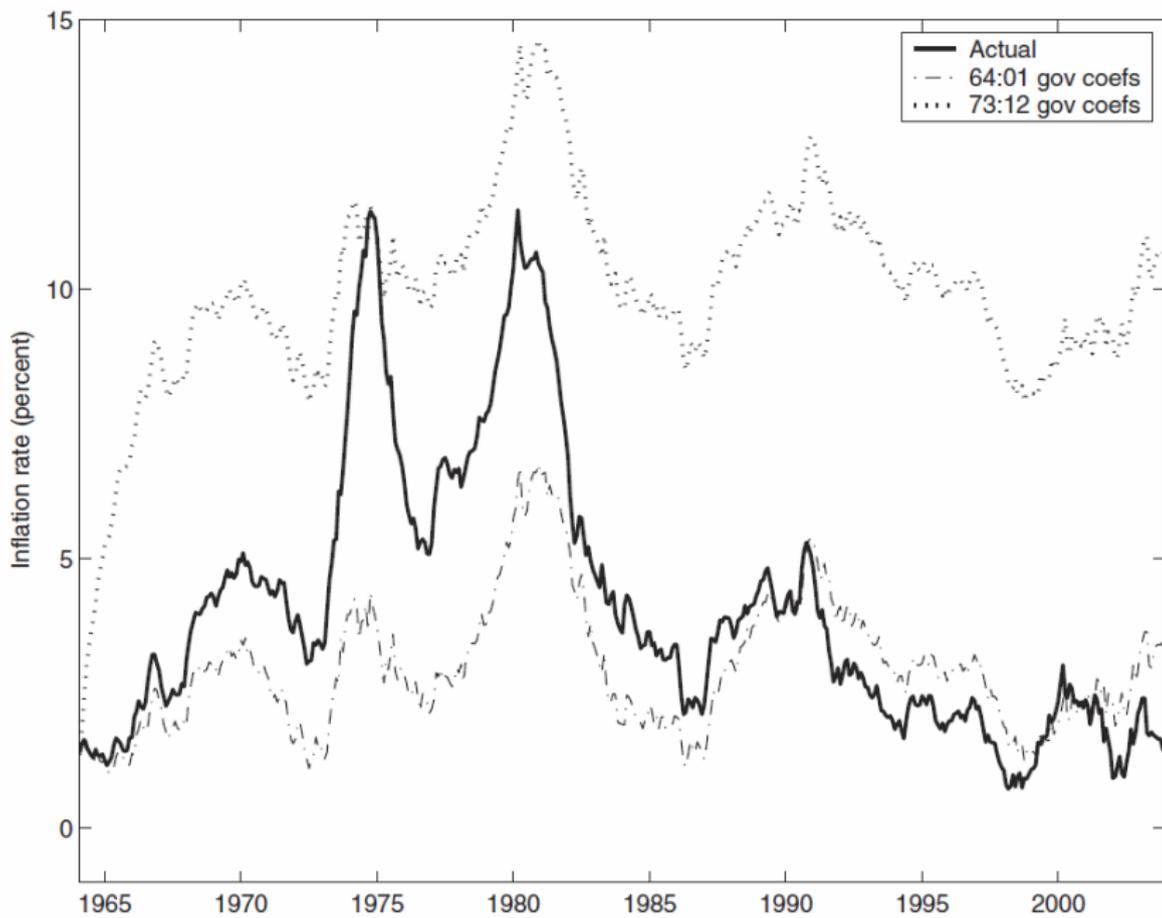
- Not much harm (in terms of unemployment) of lowering inflation

But central bank's estimate of  $\theta_0$  can change over time

# Evolution of Beliefs



# Belief Counterfactuals



# Belief Counterfactuals

