The Great Inflation and the Greenbook

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- Most evidence to date has been based on reading of narrative record, e.g. Meltzer (2005) vs. Romer (2005)
- Very few attempts to empirically test alternative explanations using dynamics of macroeconomy during Great Inflation

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- We ask whether SWZ are also able to explain **why** the Federal Reserve acted as it did. We use forecast data from the Greenbooks to implicitly identify the rationale behind policy
- "Irrational Expectations Econometrics", Ireland (2003). Learning implies cross-equation restrictions between the 'what' and 'why' of Federal Reserve policy

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- If consistency with Greenbook forecasts is imposed then the learning hypothesis struggles to explain the dynamics of the Great Inflation
- The deterioration in fit is robust to popular alternative specifications of the objectives of Federal Reserve policy.

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- Federal Reserve assumed to have an approximating model of unemployment-inflation dynamics

$$u_t = \alpha_t' \Phi_t + \sigma_w w_t \quad \Phi_t = (\pi_t \ \pi_{t-1} \ u_{t-1} \ \pi_{t-2} \ u_{t-2} \ 1)$$

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- π_t is the policy instrument
- u_t is the outcome of policy

Federal Reserve learning

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- Federal Reserve believes that α_t follows a drifting coefficients model

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\begin{aligned}
u_t &= \alpha_t' \Phi_t + \sigma_w \underbrace{w_t}_{N(0,1)} \\
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- Coefficients can be estimated by recursive application of Kalman filter

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\hat{\alpha}_{t+1|t} &= \hat{\alpha}_{t|t-1} + \frac{P_{t|t-1}\Phi_t \left(u_t - \Phi_t' \hat{\alpha}_{t|t-1} \right)}{\sigma_w^2 + \Phi_t' P_{t|t-1} \Phi_t} \\
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Definition of optimal policy

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- Policy problem of Federal Reserve

$$\min_{\{\pi_t\}_{t=0}^{\infty}} \hat{E} \sum_{j=0}^{\infty} \delta^j \left\{ \left(\pi_{t+j} - \pi^*\right)^2 + \lambda \left(u_{t+j} - u^*\right)^2 \right\}$$

$$s.t.$$

$$u_{t+j} = \alpha'_{t+j} \Phi_{t+j} + \sigma_w w_{t+j}$$

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- Assume Federal Reserve uses 'anticipated utility' (Kreps (1998)) as decision criterion. Federal Reserve then projects forward using current parameter estimates and approximating model

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- Solution is a best-response policy function

$$\pi_t = h(\hat{\alpha}_{t|t-1})'\phi_t \quad \phi_t = (\pi_{t-1} \; u_{t-1} \; \pi_{t-2} \; u_{t-2} \; 1)$$

Estimation without Greenbook data

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- Best-response policy function is an approximation of Federal Reserve behaviour

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- This model can be estimated from data on inflation and unemployment
- Free parameters $\left(\sigma_2 \;\delta\; \lambda\; u^* \;\pi^* \;\sigma_w \;V \;\; \hat{\alpha}'_{1|0} \;\; P_{1|0}\right)$

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- σ_w not identified so normalised
- $\Xi = \begin{pmatrix} \sigma_2 & P_{1|0} & V \end{pmatrix}$ parameters left to estimate

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- Data 1960:1 - 2003:12 annual PCE inflation and civilian unemployment rate

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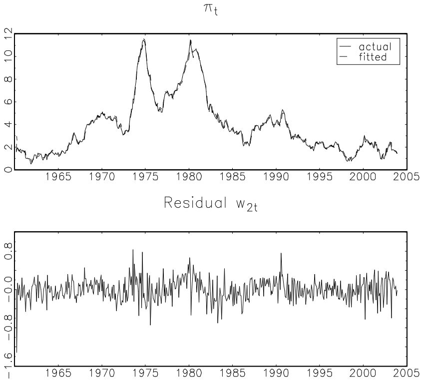

$$\sigma_2 = 0.23$$

- This fit is the source of SWZ claim that the learning hypothesis can explain the Great Inflation

The Philllips curve without Greenbook data

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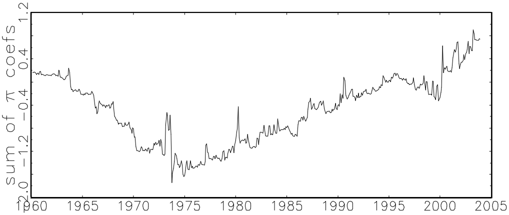
- Evolution of perceived Phillips curve trade-off, as measured by sum of coefficients on inflation in Federal Reserve's approximating model of unemployment-inflation dynamics



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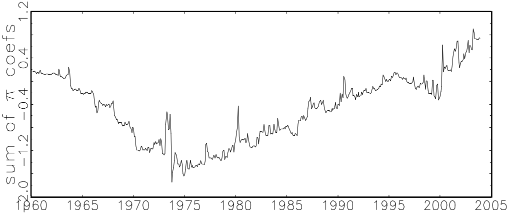

- Clear evidence of discovery and abandonment of Phillips curve

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- These can be compared to unemployment forecasts published in the Greenbooks

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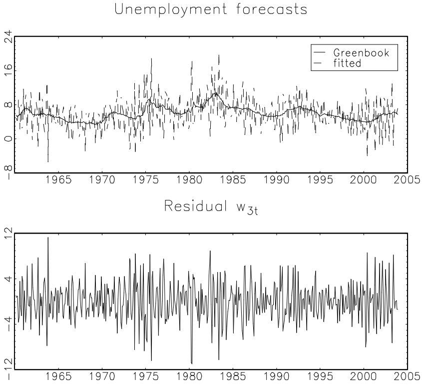

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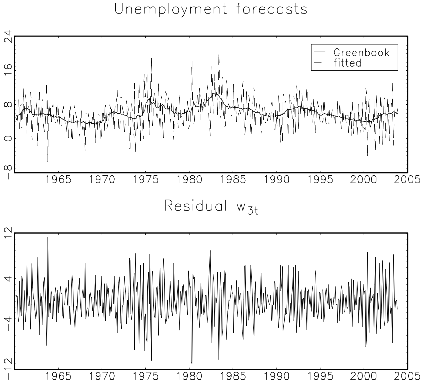

- Unemployment forecasts are much too volatile in the estimated model
- Change forecasts $\hat{E}(u_t - u_{t-1})$ are completely uncorrelated with Greenbook forecasts. Actual and fitted forecasts are not consistent

Estimation with Greenbook data

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- Inconsistence suggests model should be estimated using both aggregate data and Greenbook forecasts

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- 'Irrational Expectations Econometrics' because we estimate according to a cross-equation restriction
- Extra parameter σ_3 implies minor changes to estimation algorithm

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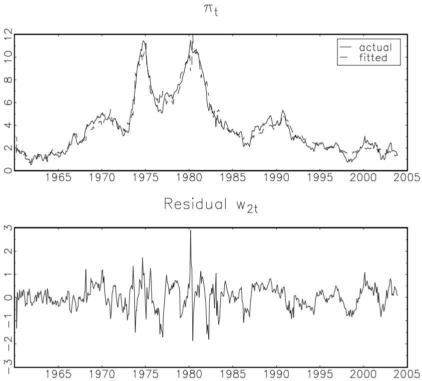

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- Fit to inflation now worse than before (when $\sigma_2 = 0.23$)

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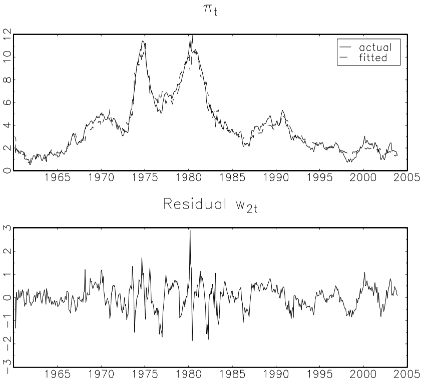

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- Consistency $\Rightarrow$ learning hypothesis has trouble explaining the Great Inflation

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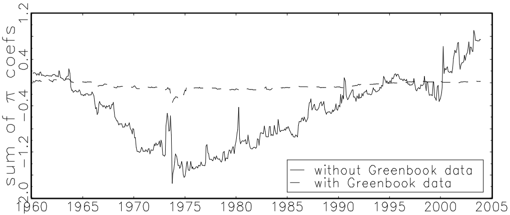

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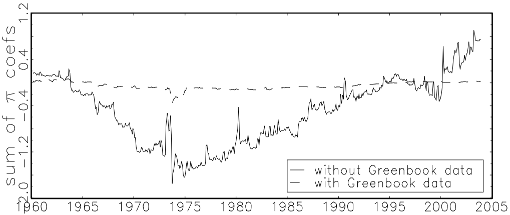

- Discovery and abandonment of Phillips curve less dramatic than before

Unemployment forecasts with Greenbook data

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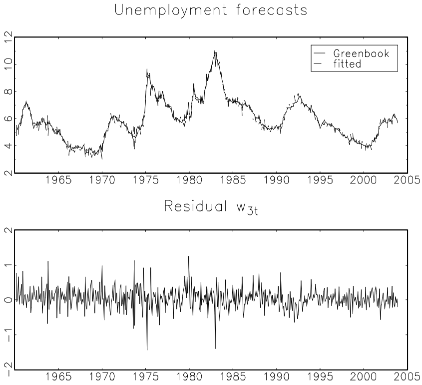

- As expected, fit to Greenbook forecasts has improved. Change forecasts $\hat{E}(u_t - u_{t-1})$ are now significantly correlated

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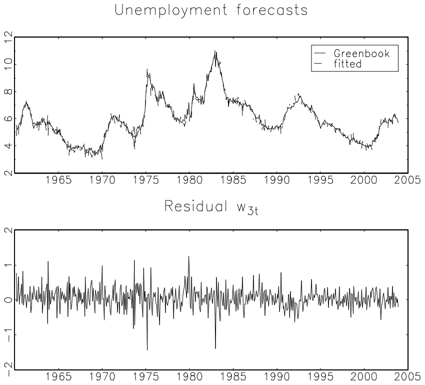

- As expected, fit to Greenbook forecasts has improved. Change forecasts $\hat{E}(u_t - u_{t-1})$ are now significantly correlated
- But this is only at cost of worse fit to dynamics of Great Inflation

Two robustness exercises

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1. Parameter uncertainty

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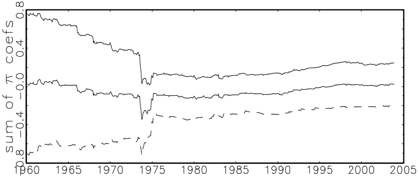

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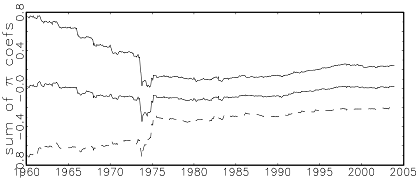

2. Policy smoothing

Two robustness exercises

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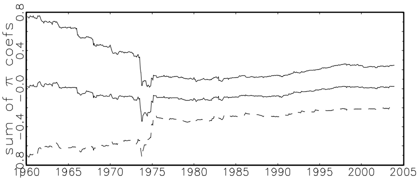

2. Policy smoothing
   - Introduce additional motivation to smooth policy, e.g. to reduce risk of financial instability

Parameter uncertainty

Parameter uncertainty

- Generalised objective for policy

$$\min_{\{\pi_t\}_{t=0}^{\infty}} \hat{E} \sum_{j=0}^{\infty} \delta^j \left\{ (\pi_{t+j} - \pi^*)^2 + \lambda((\tilde{u}_{t+j} - u^*)^2 + var(u_{t+j})) \right\}$$

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- Best-response policy function

$$\pi_t = h(\hat{\alpha}_{t|t-1}; P_{t|t-1})' \phi_t$$

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$$\pi_t = h(\hat{\alpha}_{t|t-1}; P_{t|t-1})' \phi_t$$

- Policy now depends on current parameter estimates $\hat{\alpha}_{t|t-1}$ and *precision with which they are estimated* $P_{t|t-1}$.

Results with parameter uncertainty

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- Significant improvement in statistical fit of model

Parameter	*Baseline model*	*Parameter uncertainty*
σ_2	0.52	0.57
σ_3	0.31	0.26
log-likelihood	−258.1	−208.3

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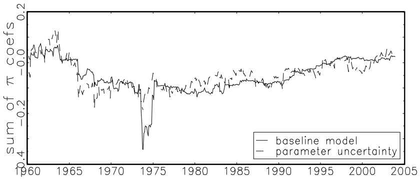
- No change in economic fit of model



Policy smoothing

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- Policy objective under smoothing

$$\min_{\{\pi_t\}_{t=0}^{\infty}} \hat{E} \sum_{j=0}^{\infty} \delta^j \left\{ (\pi_{t+j} - \pi^*)^2 + \lambda \left(\tilde{u}_{t+j} - u^* \right)^2 + 0.5 (\Delta \pi_{t+j})^2 \right\}$$

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- Results

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Policy smoothing

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- Results

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σ_2	0.52	0.49
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log-likelihood	-258.1	-152.2

- Smoothing does improve fit of the model in a statistical sense, but not in an economic sense

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2. SWZ explain **what** the Federal Reserve did, but their explanation for **why** the Federal Reserve acted in this way is inconsistent with forecasts published in the Greenbooks
3. Requiring model forecasts to be consistent with Greenbooks makes the learning hypothesis struggle to explain the dynamics of the Great Inflation. The deterioration is robust to other popular objectives for Federal Reserve policy
4. The door is open to alternative explanations of the Great Inflation