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**“Natural Rate Measures in an  
Estimated DSGE Model of the U.S. Economy”**

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## What the paper does

1. The EDO Model (**E**stimated **D**ynamic **O**ptimization-based)
2. The Estimation
3. The Storytelling

## The EDO Model

Extension of Christiano, Eichenbaum, and Evans (JPE, 2005)

- Sticky Prices (w/ indexation)
- Sticky Wages (w/ indexation)
- investment adjustment costs
- variable capacity utilization

- 2 sector economy
  - sector 1: used for nondurables consumption and residential capital
  - sector 2: used for durables consumption and non-residential capital
  
- Habit Forming Preferences over
  1. non-durable consumption
  2. durable consumption
  3. residential capital
  4. leisure

- Sources of business cycles: 14 shocks
  - 3 markup shocks
  - 2 permanent technology shocks
  - 3 temporary investment specific-shocks
  - 4 preference shocks
  - 1 aggregate demand shock
  - 1 monetary policy shock

Monetary Policy:

$$\hat{R}_t = \phi_r \hat{R}_{t-1} + (1 - \phi_r) \bar{R}_t + \epsilon_t^r$$

$$\bar{R}_t = \phi_1 \hat{\pi}_t^{gdp} + \phi_2 \hat{\pi}_{t-1}^{gdp} + \phi_3 \hat{g}_t^{gdp} + \phi_4 \hat{g}_{t-1}^{gdp}$$

# Estimation

Bayesian methods

- **Eleven Observables, Sample: 1984Q1-2004Q4**
  1. Nominal GDP
  2. Nominal Consumption (non-durables and non-housing services)
  3. Nominal Consumption (durables)
  4. Nominal Investment (residential)
  5. Nominal Investment (business)
  6. GDP inflation
  7. C inflation (non-durables and non-housing services)
  8. C inflation (durables)
  9. Hours
  10. Wage inflation
  11. Federal Funds rate

- Estimate 39 structural parameters
- Back out time series for the 14 innovations (from 11 observables)

Q: Are those time series for the shocks identified?

- Which shocks are important sources of business cycles? Forecasting Error Variance Decomposition at horizon 10 years

	$C^{nd}$	$I^{res}$	$C^d$	$I$	$Y$
Perm Tech Shock $\epsilon^{zk}$	0.35	0.08	0.21	0.01	0.59
Perm Tech Shock $\epsilon^{zm}$	0.17	0.12	0.01	0.02	0.37
Inv. Tech Shock $\epsilon^{a,nr}$	0.34	0.64	0.34	0.92	0.01

- Find that **permanent technology shocks** are the most important sources of business cycles in output
- For the components of aggregate demand the main sources are **efficiency shocks to investment** and **the two permanent technology shocks**

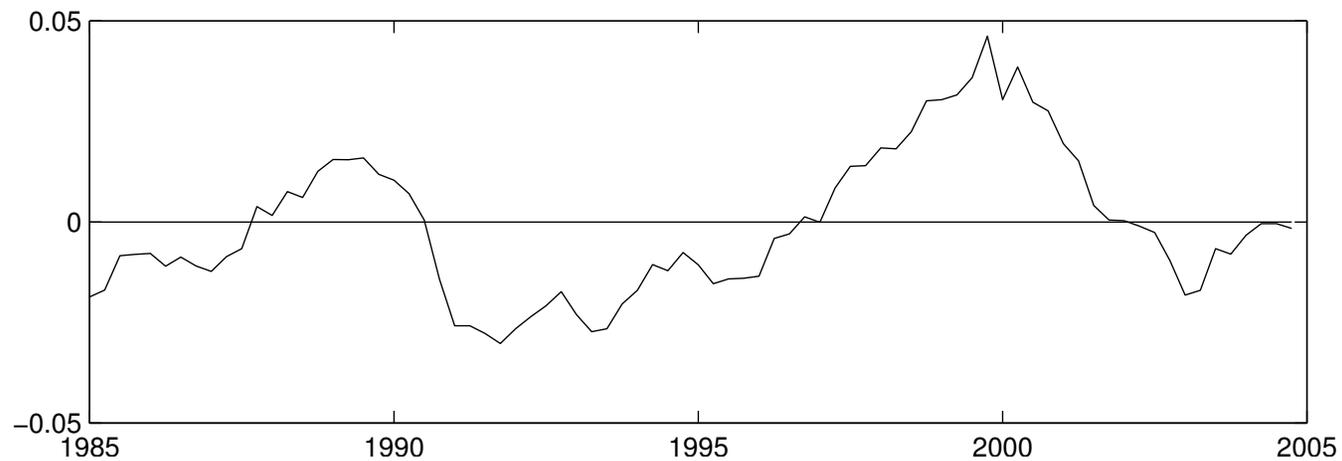
**Q:** Finding robust to including the relative price of business investment?

## **Storytelling in the EDO Model**

- Traditional output gap measures deviations of actual output from trend. Example: Deviations from a linear trend:

NBER peak: 1990Q3 and 2001Q1

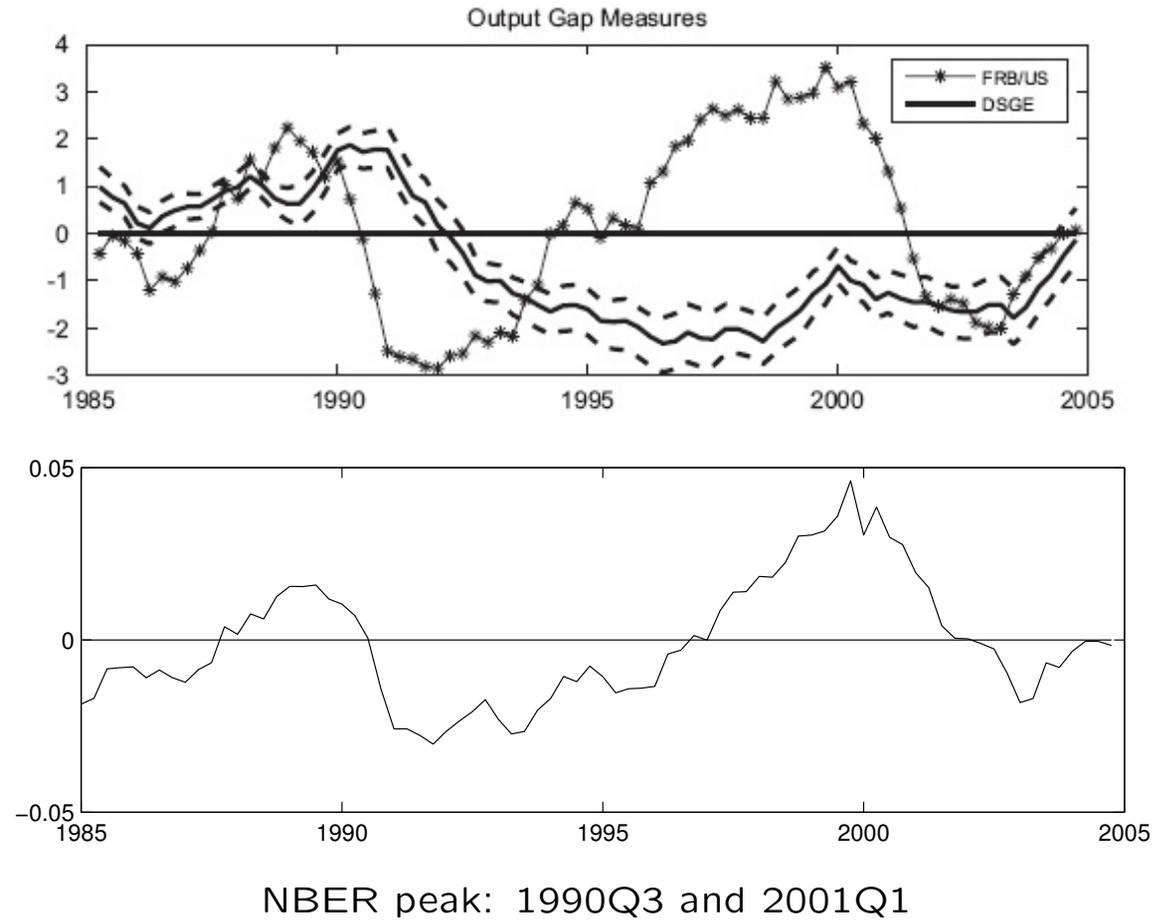
$$\ln Y_t - \alpha - \beta t$$



## Model-Based Output Gap

- Potential output,  $Y_t^n$ : level of output in an economy *without*
  - price stickiness
  - wage stickiness
  - markup shocks
  - monetary policy shocks
- Output gap = actual - potential output

$$Y_t^{gap} = \log Y_t - \log Y_t^n$$



- Traditional output gap measures deviations of actual output from trend.
- Model-based output gap measures are a very different object.
- Q: Why judge a model as compelling if the model-based output gap measure coincides with a traditional output gap measure?

- **Why is this concept of the output gap important?**

In simpler frameworks it has been shown (eg Woodford '03) that

1. inflation dynamics depend on  $Y_t^{gap}$
2. monetary policy should aim to stabilize  $Y_t^{gap}$  in order to maximize welfare
3. optimal interest rate rules should respond to  $Y_t^{gap}$  rather than other output measures

**Is this concept of the output gap also important in the current theoretical framework?**

- Can the authors show that the welfare criterion depends on their definition of the output gap?

- Is the model-based output gap important for optimal policy?
  - In a simple model, Sveen and Weinke (2006) show that an interest rate feedback rule that responds to wage and price inflation is at least as good (from a welfare point of view) as one that responds to inflation and the model-based output gap.
  - In a medium-scale estimated DSGE model, Schmitt-Grohe and Uribe (2007) show that the welfare loss of a rule that responds only to price and wage inflation vis-a-vis the Ramsey optimal policy is **minimal**.

## Suggested Alternative Output Gap Measure

Use the welfare-maximizing (or Ramsey optimal) level of output as potential output