Potential and natural output

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March 22, 2010

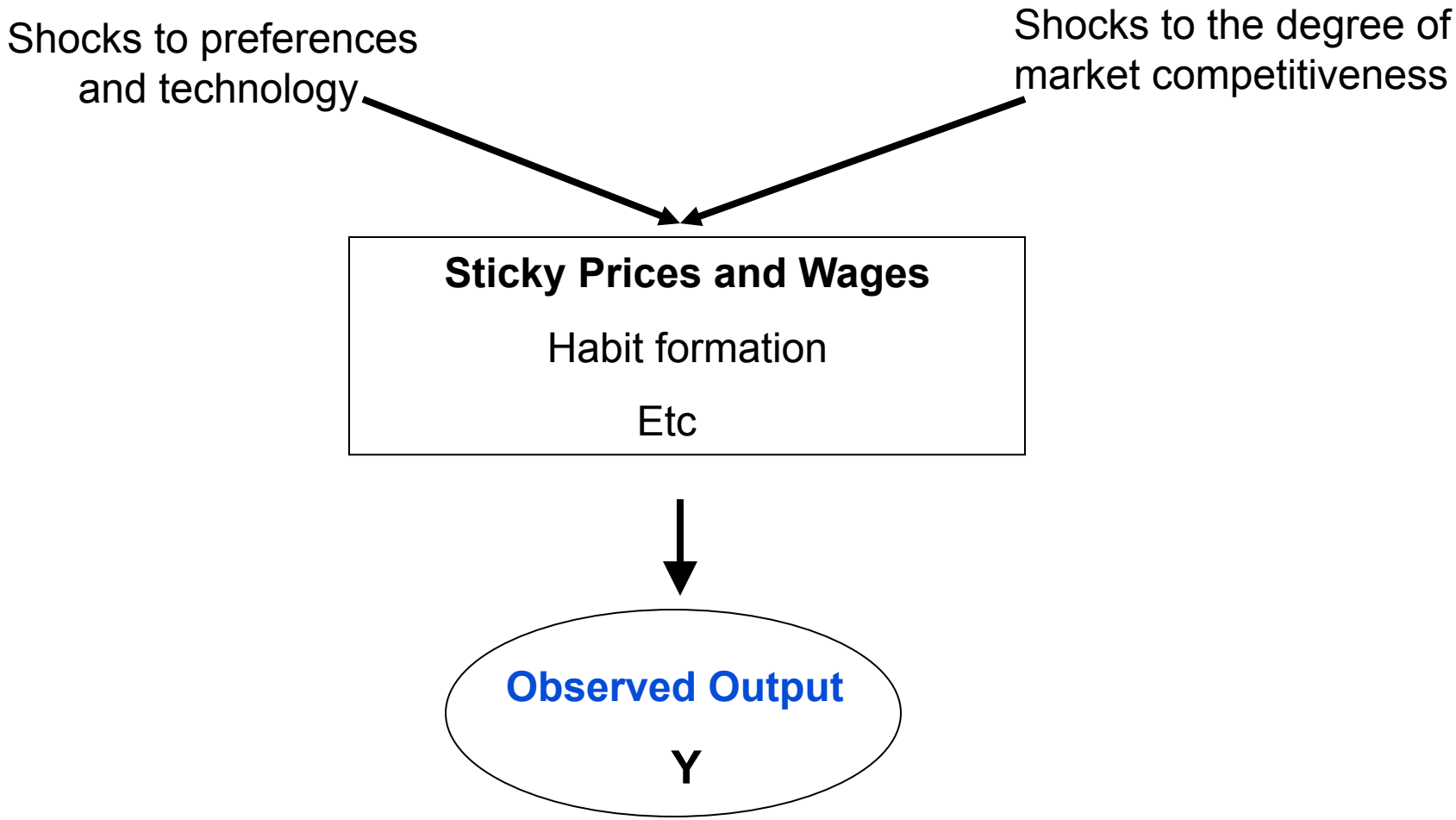
Definitions

- Efficient output
  - Level of output that would prevail under perfect competition
- Potential output
  - Level of output that would prevail under imperfect competition, but flexible prices and wages and constant markups
- Natural output
  - Level of output that would prevail under imperfect competition, but flexible prices and wages

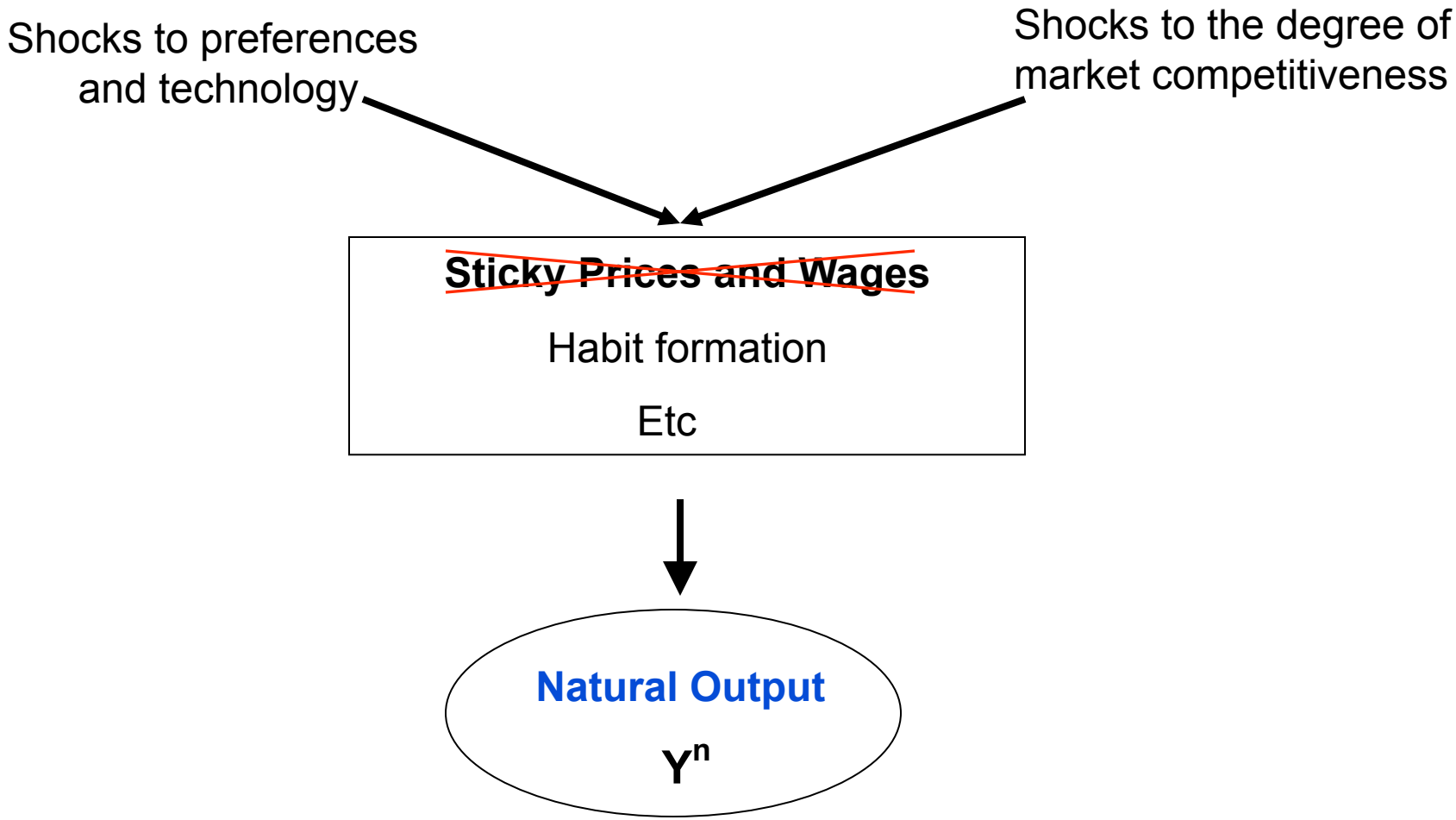
Why estimate natural output?

- Actual output - natural output
  - Importance of nominal rigidities
- Potential output - natural output
  - Exogenous markup variation in prices and wages
  - Monetary policy inflation-output trade-off
- If markup shocks are interpreted as tech. or preference
  - Natural = potential

Model economy

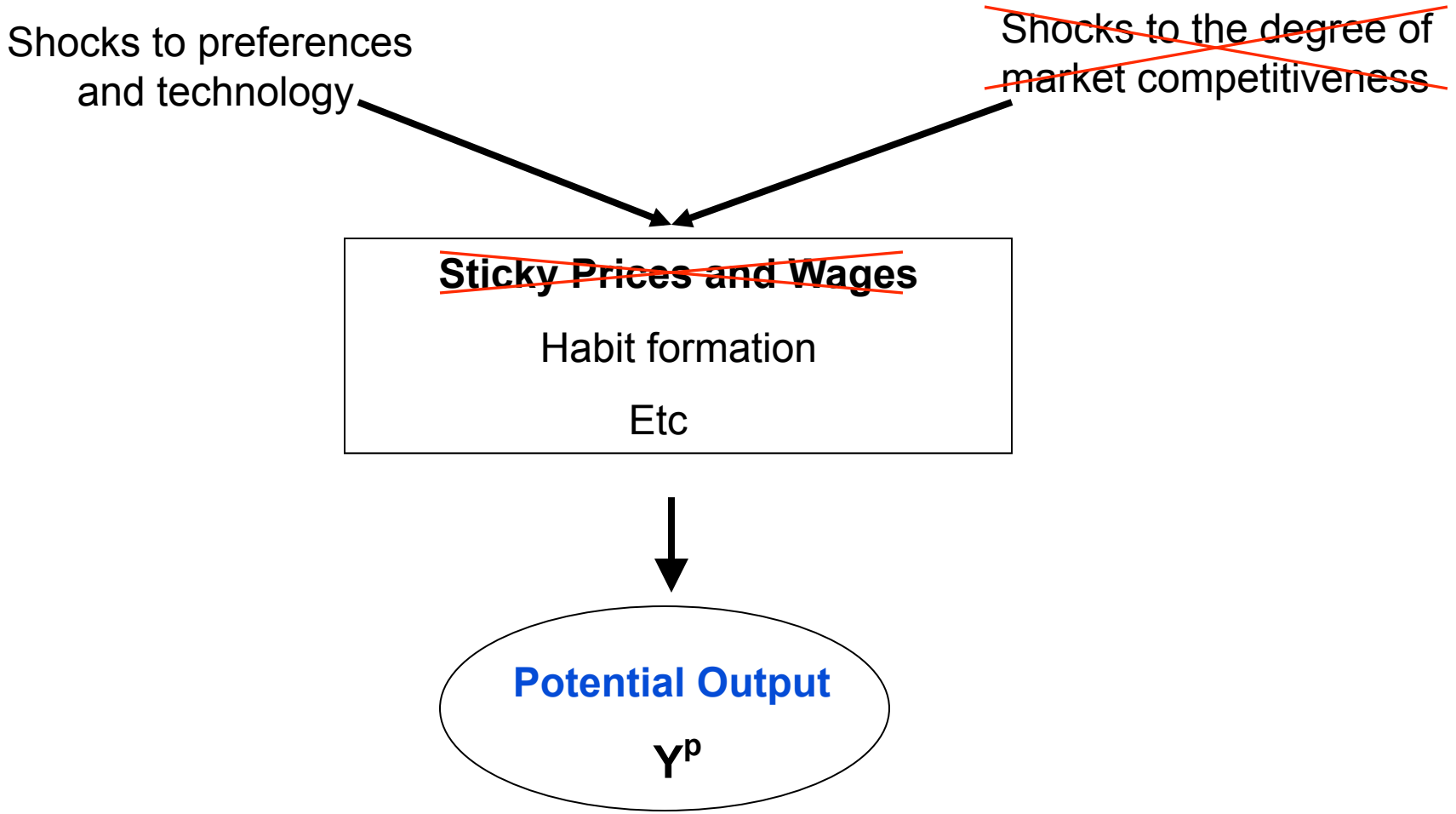


Model economy under flex prices/wages



Natural = level of output that would be observed under imperfectly competitive markets and flexible prices and wages

Model economy under flex prices/wages and no markup shocks



Potential = level of output that would be observed under imperfect competition, but flexible prices and wages and constant markups

Preview of the results

- Potential output is smooth
  - More modest business cycles had markets been competitive
  - Large portion of fluctuations are inefficient
  - Gap resembles “standard” measures of BC
- Natural output is implausibly volatile
  - Casts doubts on structural interpretation of innovations in price and wage Phillips curves

Outline

- Model
- Estimates of *potential* output
  - What is the share of inefficient fluctuations?
- A brief comparison to the literature
- Estimates of *natural* output
- Alternative interpretation of markup shocks

The model

- NK model with exogenous capital accumulation

- 5 blocks:
  - Intermediate firms
  - Final-good producers
  - Households
  - Employment agencies
  - Policy makers

The model

- Production technology of final-good producers

$$Y_t = \left[\int_0^1 Y_t(i)^{\frac{1}{1+\lambda_{p,t}}} di \right]^{1+\lambda_{p,t}}$$

The model

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price markup shock

The model

- Production technology of intermediate-goods producers

$$Y_t(i) = A_t L_t(i)^{\alpha}$$

  - Monopolistically competitive markets
  - Optimizing firms set prices by maximizing PDV of profits
  - Calvo type stickiness: a fraction ξ_p of firms cannot re-optimize
    - index prices to ss and past inflation

The model

- Households maximization problem

$$E_0 \sum_{t=0}^{\infty} \beta^t \, b_t \left[\log \left(C_t - h C_{t-1} \right) - \varphi \, \frac{L_t^{1+\nu}}{1+\nu} \right]$$

subject to

$$P_t C_t + T_t + B_t \leq R_{t-1} B_{t-1} + Q_t(i) + \Pi_t + W_t(i) L_t(i)$$

  - Monopolistically competitive suppliers of specialized labor
  - Calvo-type stickiness: a fraction ξ_w of HH cannot re-optimize
    - index wages to ss and past inflation-productivity

The model

- Employment agencies aggregate differentiated labor into homogeneous labor

$$L_t = \left[\int_0^1 L_t(i)^{\frac{1}{1+\lambda_{w,t}}} di \right]^{1+\lambda_{w,t}}$$

wage markup shock

The model

- Monetary policy sets the short-term nominal interest rate following a Taylor-type rule

$$\frac{R_t}{R} = \left(\frac{R_{t-1}}{R}\right)^{\rho_R} \left[\left(\frac{\bar{\pi}_{t-3,t}}{\pi_t^*}\right)^{\phi_\pi} \left(\frac{Y_t / Y_{t-4}}{e^{\gamma}}\right)^{\phi_y} \right]^{1-\rho_R} \varepsilon_{R,t}$$

Exogenous disturbances

- Tastes & technology
  - Productivity → growth rate is AR(1)
  - Inter-temporal preference shock → AR(1)
- Shocks to markets competitiveness
  - Mark-up shock in wages → *i.i.d.*
  - Mark-up shock in prices → *i.i.d.*
- Monetary policy
  - MP shocks → *i.i.d.*
  - Inflation target shock → persistent AR(1)

Data

- Observable variables
  1. GDP
  2. Hours
  3. Wages
  4. Inflation
  5. Federal funds rate

- Quarterly data from 1954:III to 2006:II

Data

- Observable variables
  1. GDP
  2. Hours ➔ Total hours / population 22-64 age (Francis-Ramey)
  3. Wages ➔ Compensation of employees (NIPA) / total hours
  4. Inflation
  5. Federal funds rate

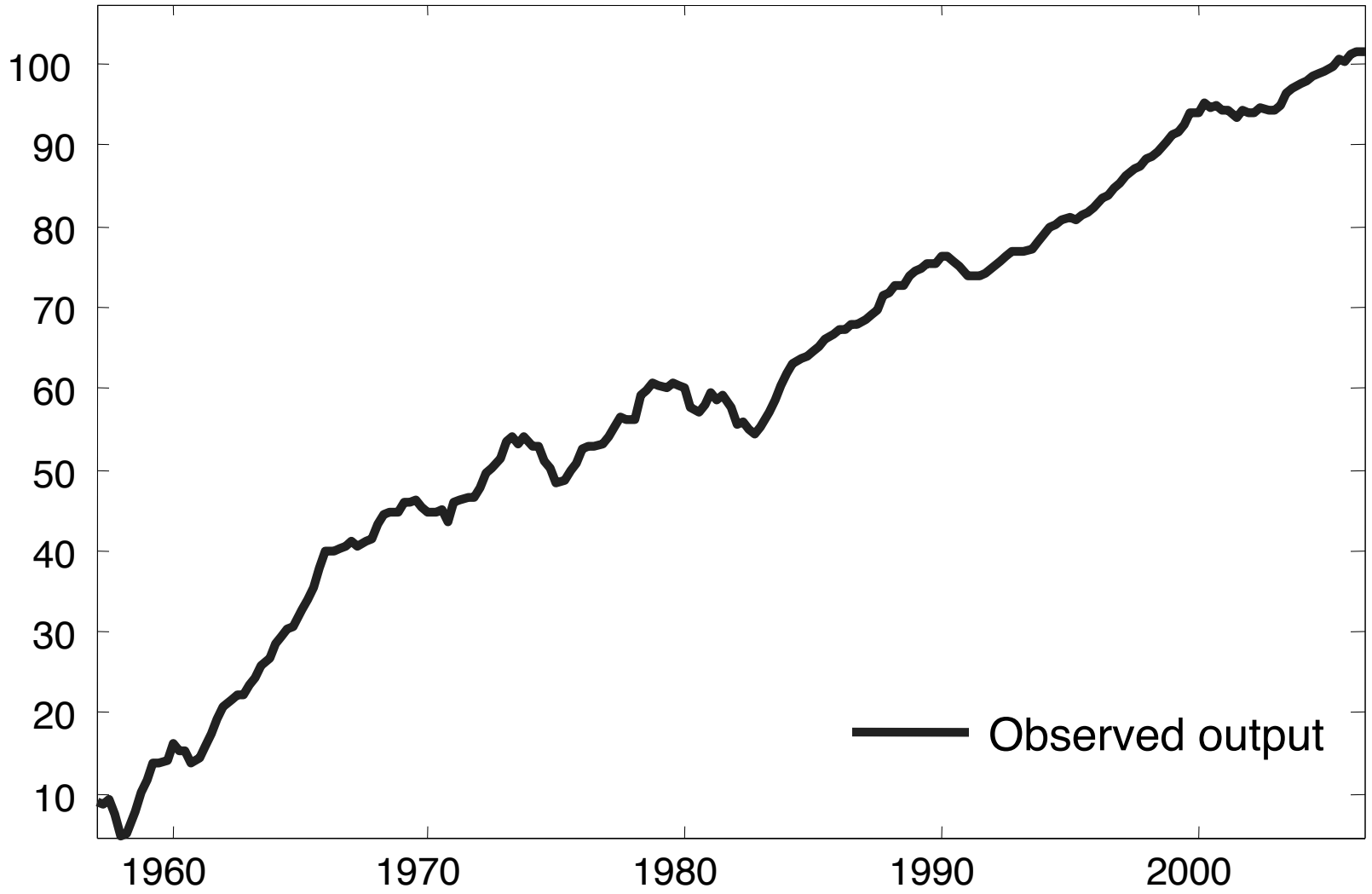
- Quarterly data from 1954:III to 2006:II

Why this model

Relative to simplest NK framework

- Additional frictions
  - Habits and indexation
- Sticky wages
  - Output gap ≠ real marginal cost
- Wages and hours observable
  - Labor share is observable (as in Sbordone, Gali & Gertler)
  - Productivity is observable ➔ make contact with RBC

Output


100
90
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60
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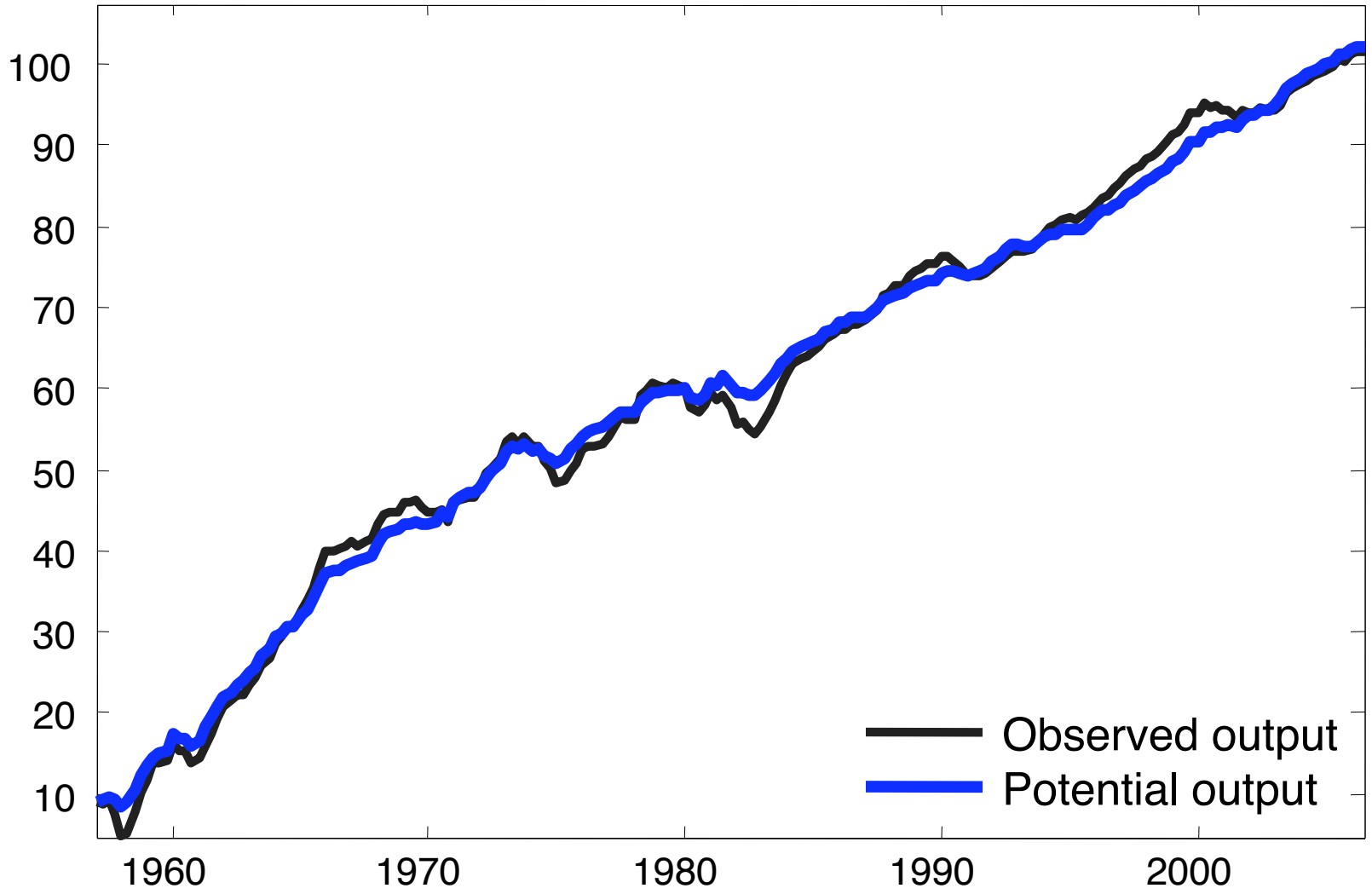
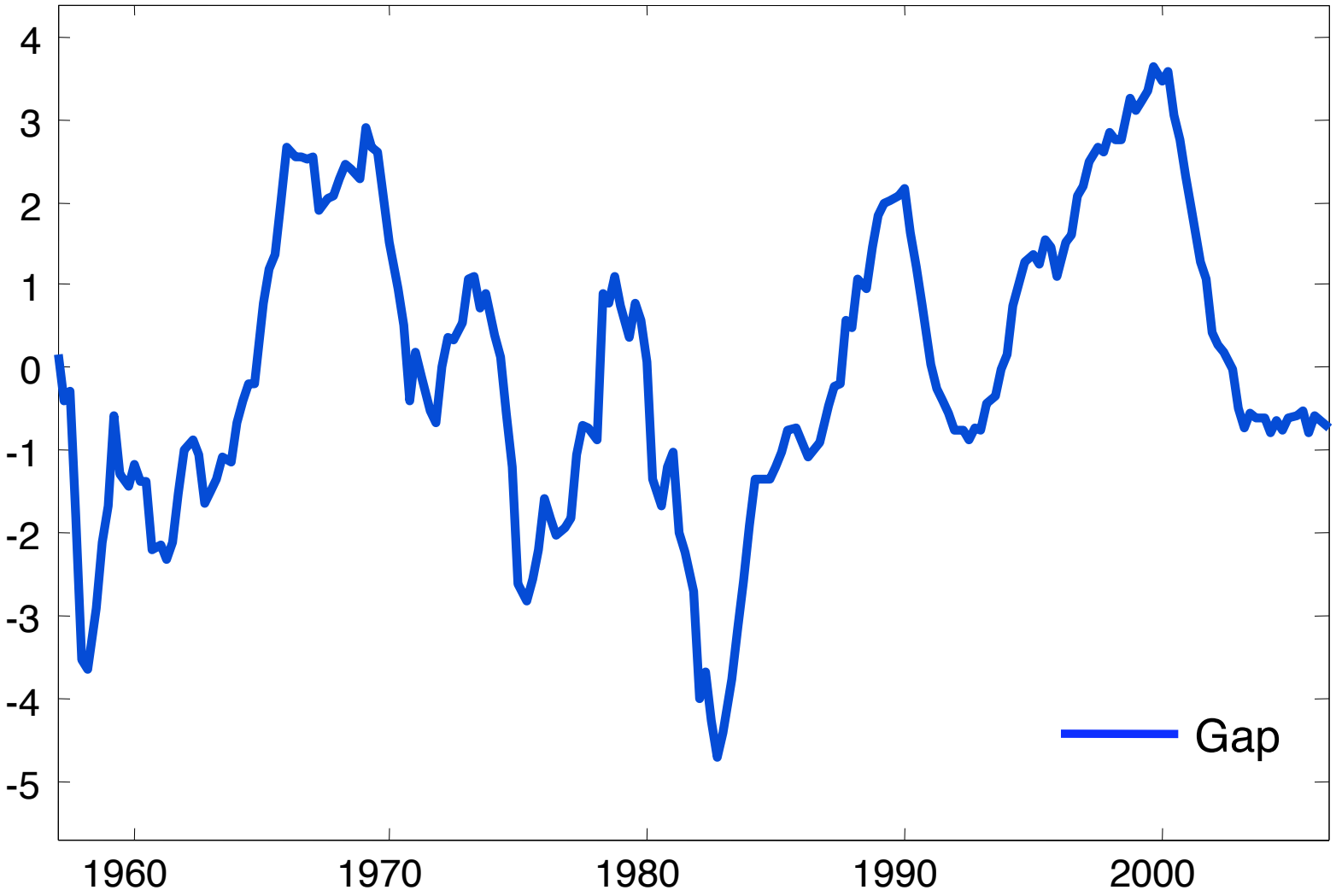
10
1960
1970
1980
1990
2000
Observed output

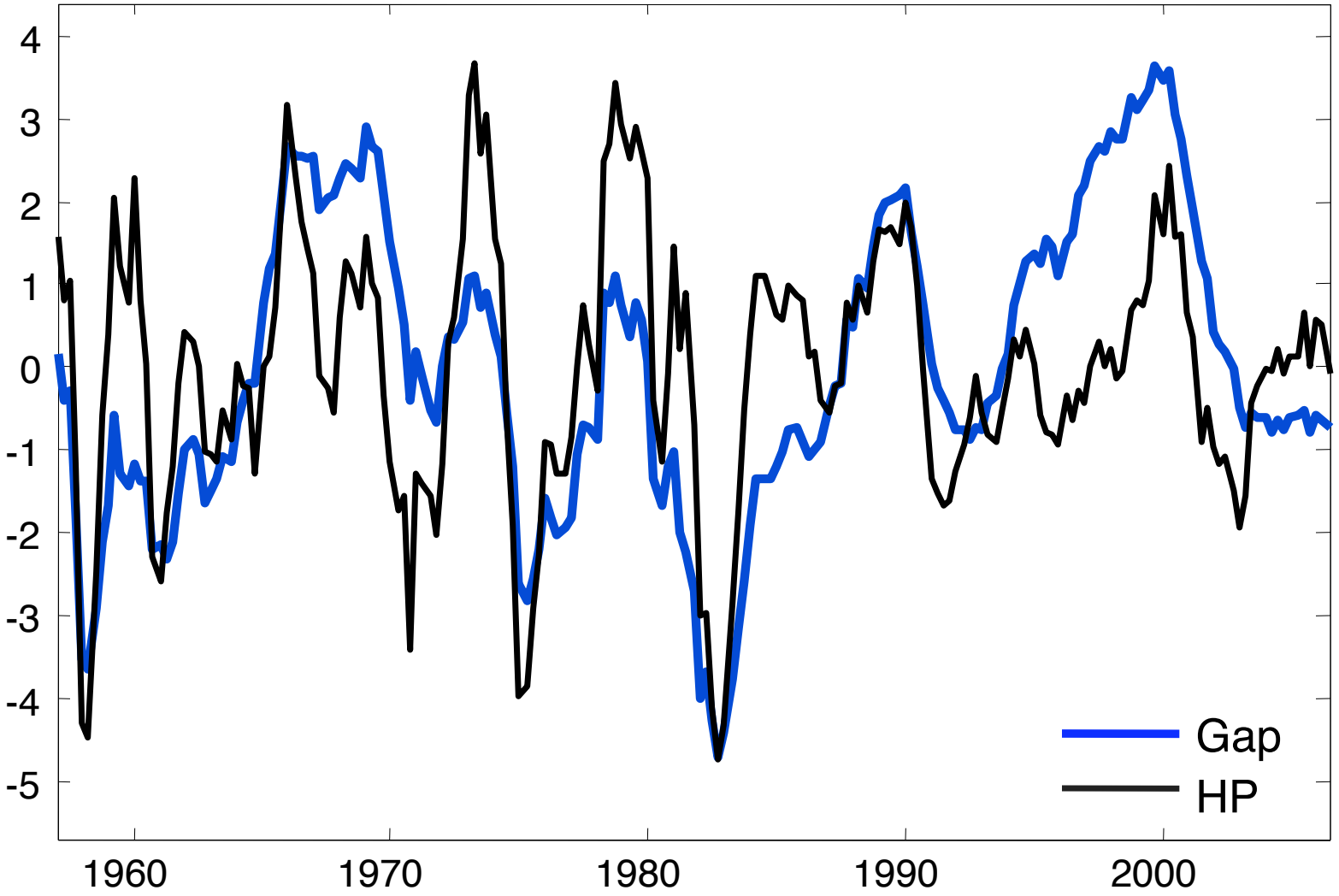
Potential Output



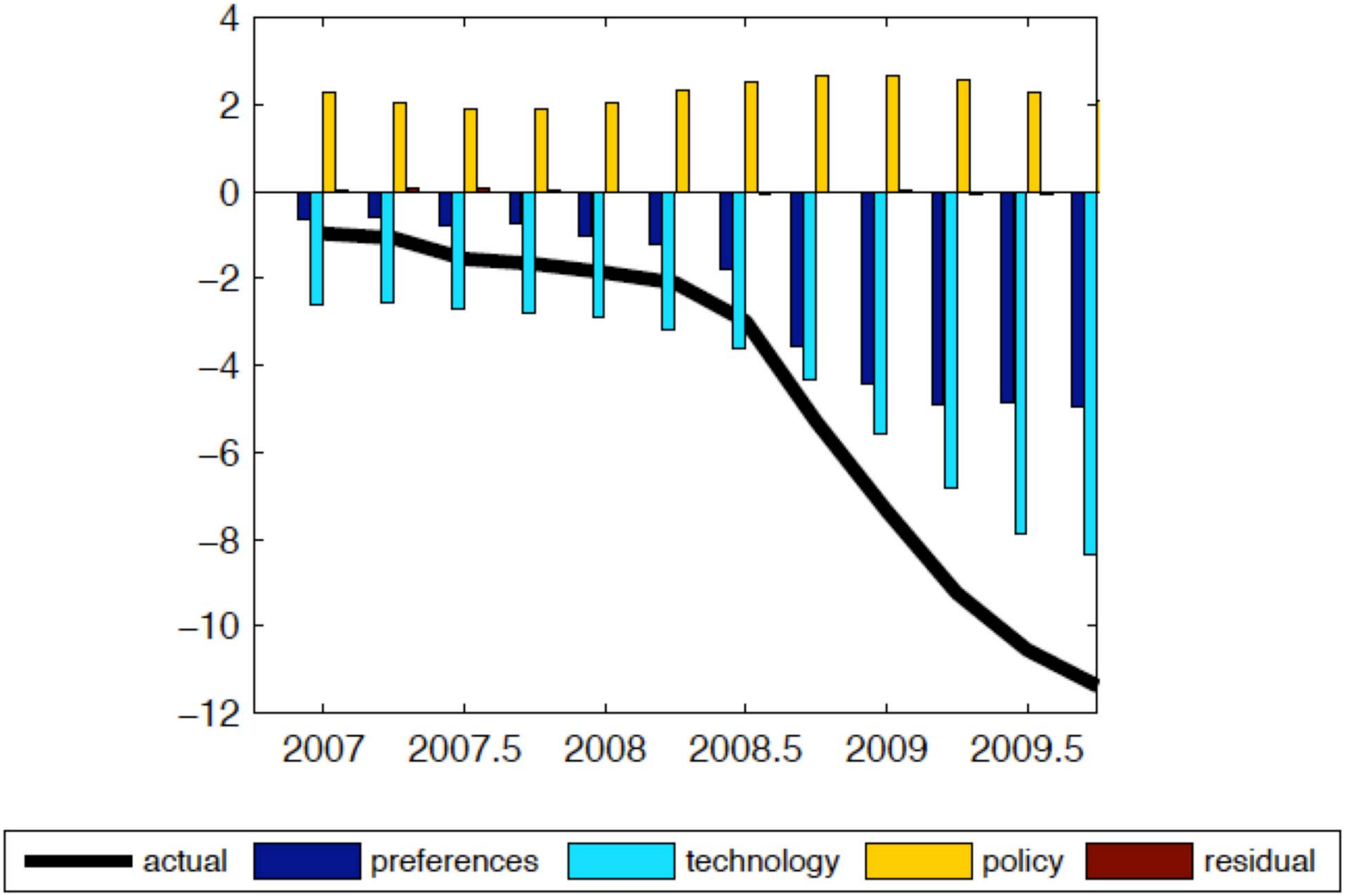
Output Gap and Business Cycles



Output Gap and Business Cycles



Most recent estimates of the output gap



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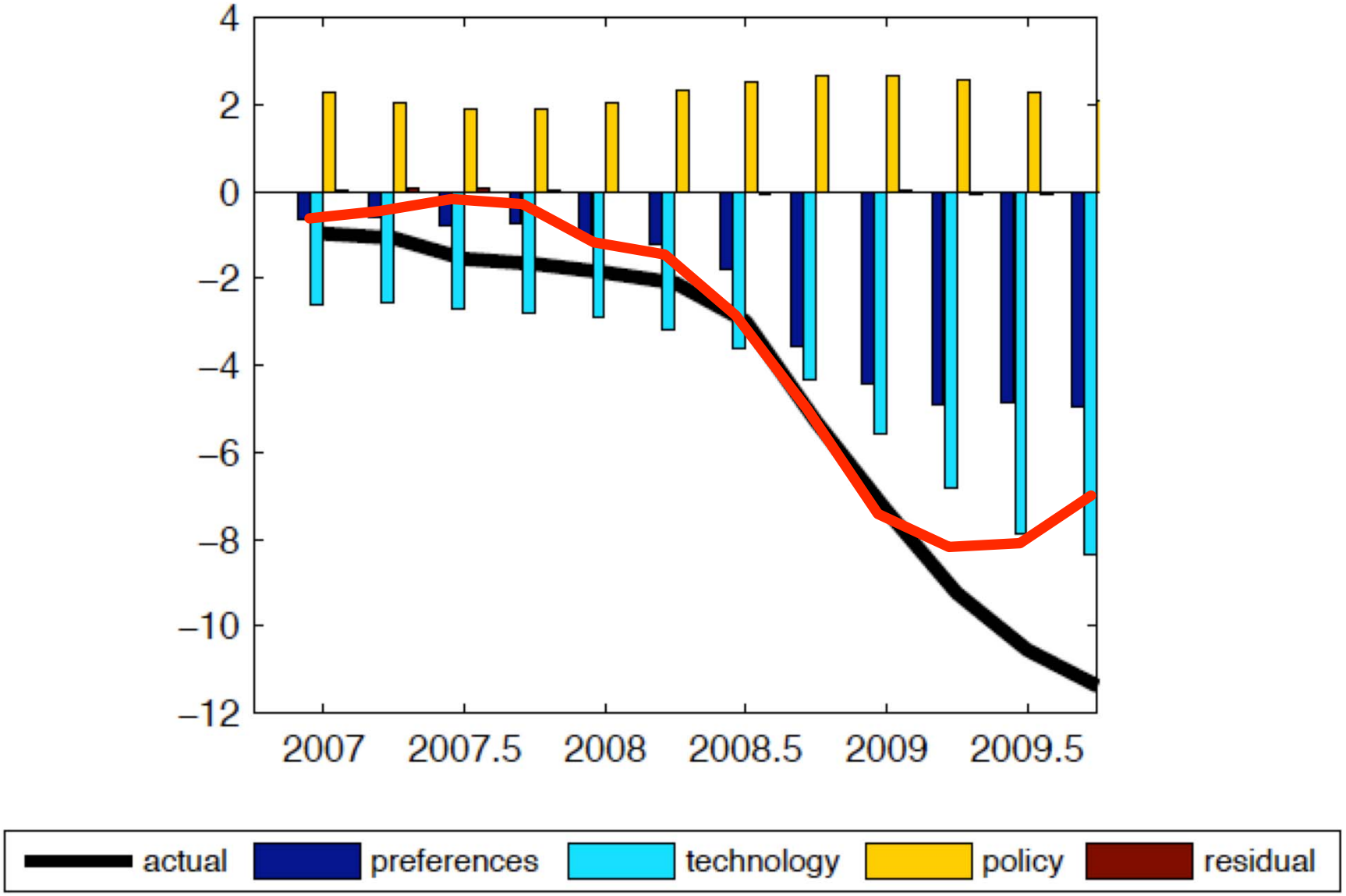
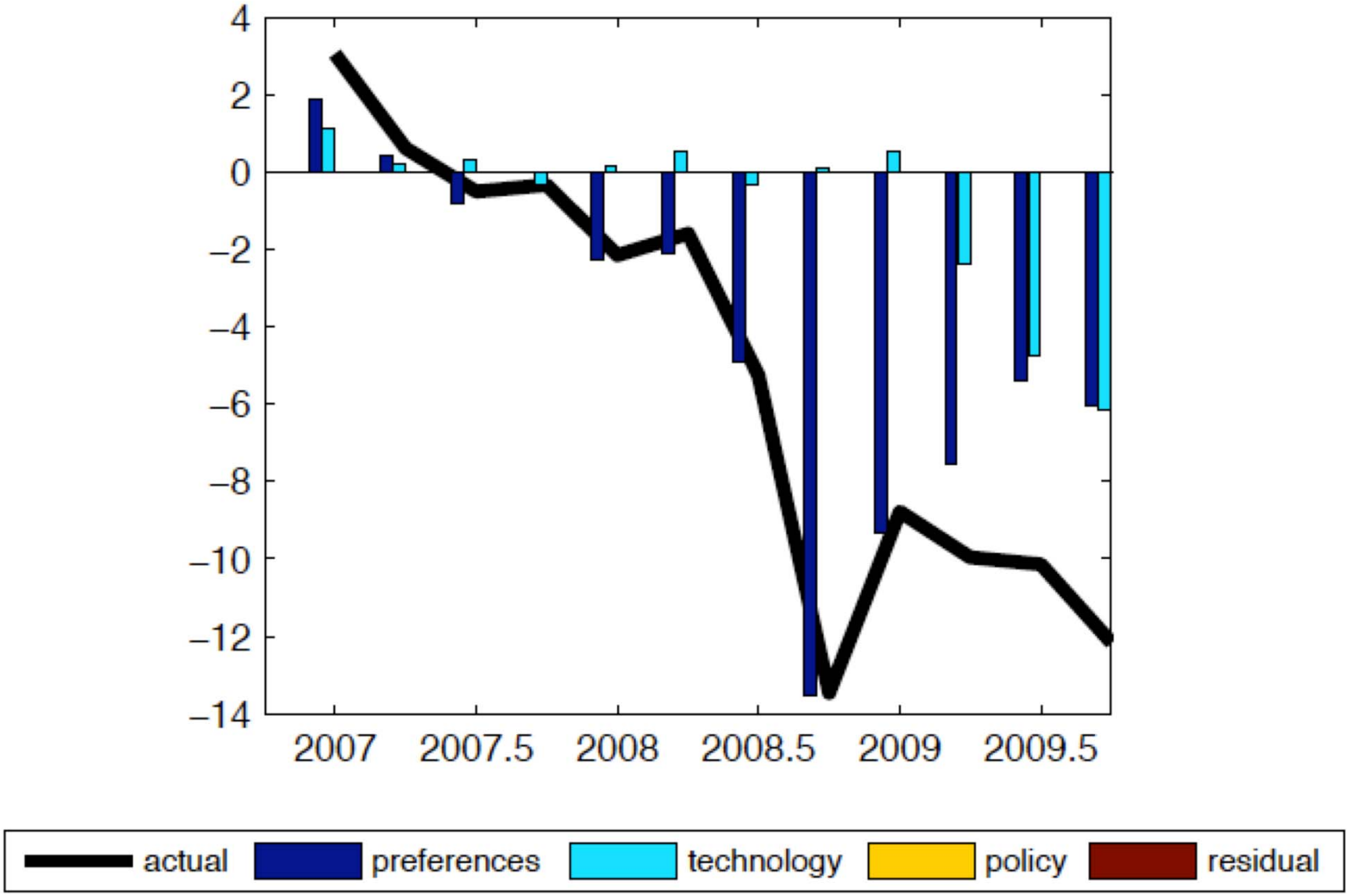
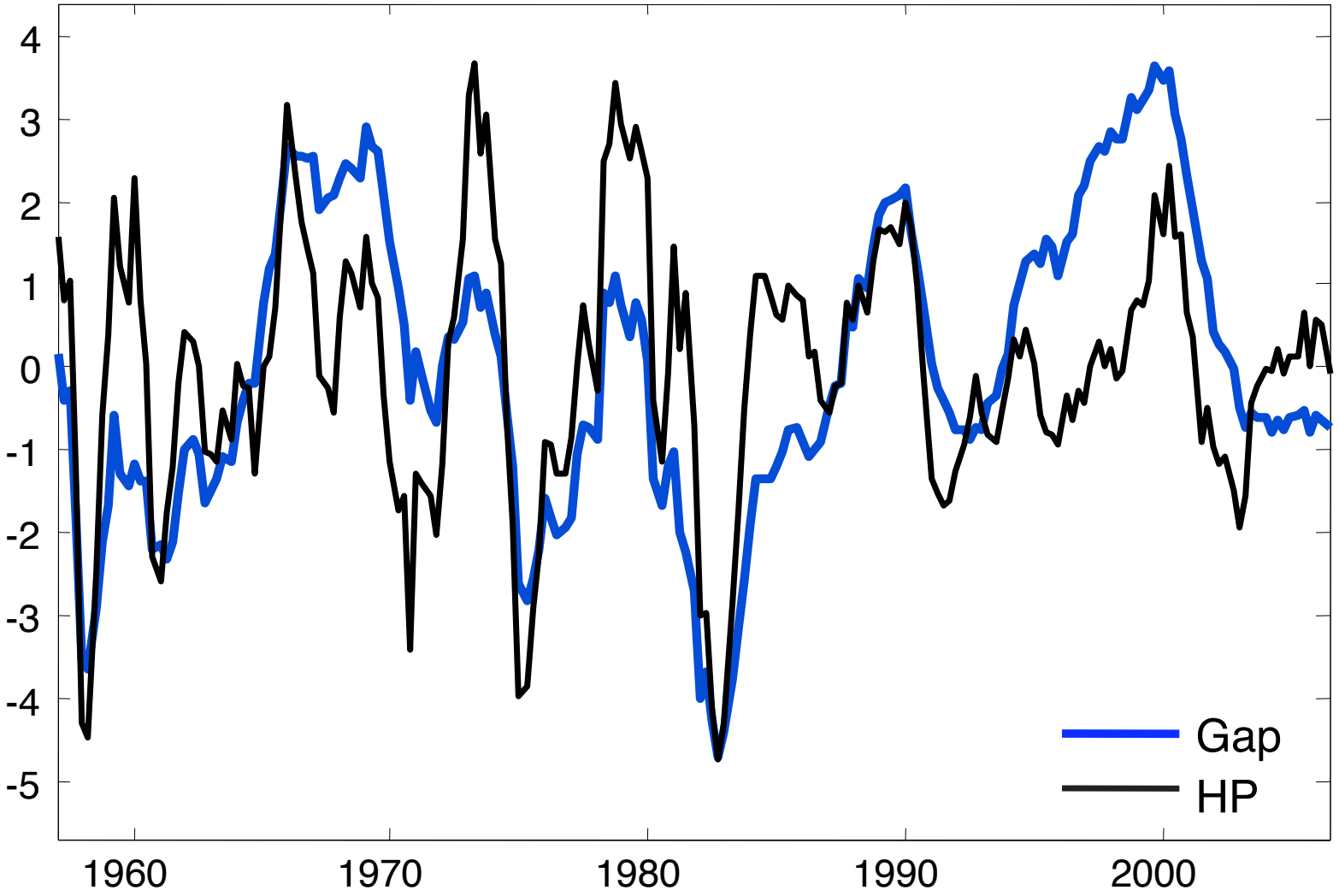


Most recent estimates of the Equilibrium RIR



Output Gap and Business Cycles



How inefficient are BC fluctuations?

- A useful decomposition

$$\underbrace{y_t - y_t^{hp}}_{\text{BC}} =$$

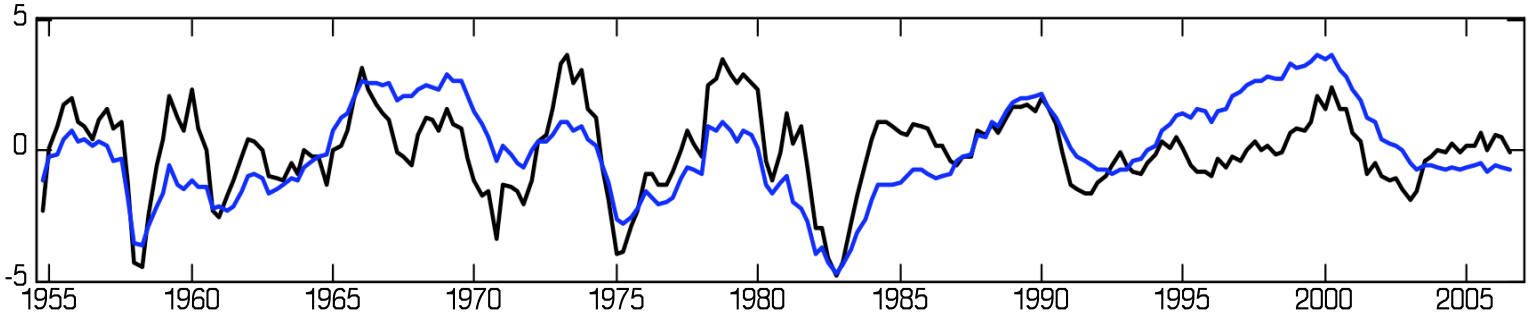
How inefficient are BC fluctuations?

- A useful decomposition

$$\underbrace{y_t - y_t^{hp}}_{\text{BC}} = \underbrace{y_t - y_t^{*}}_{\text{output gap}} + \underbrace{y_t^{*} - y_t^{*hp}}_{\text{“BC for potential”}} + \underbrace{y_t^{*hp} - y_t^{hp}}_{\Delta \text{ in HP trends}}$$

How inefficient are BC fluctuations?

gap



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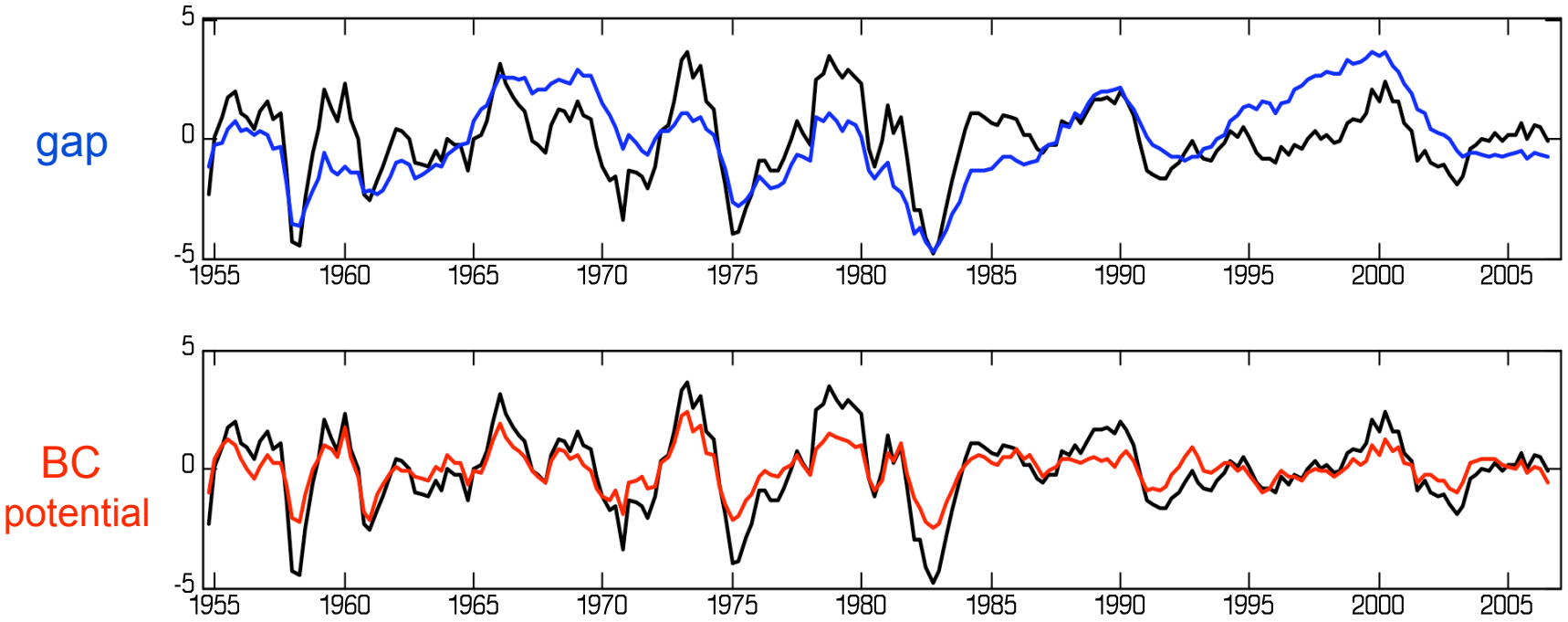

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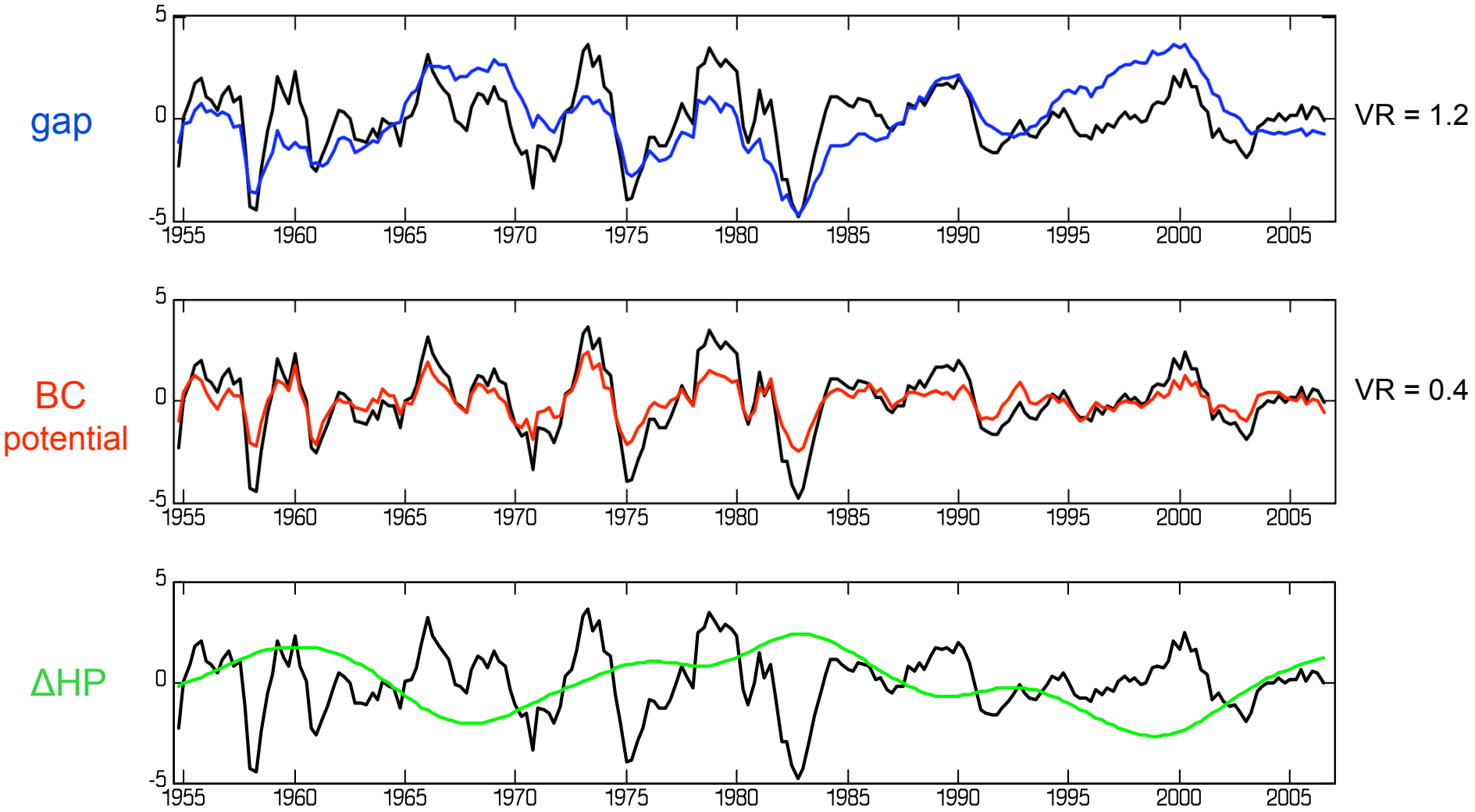


Potential output and business cycles

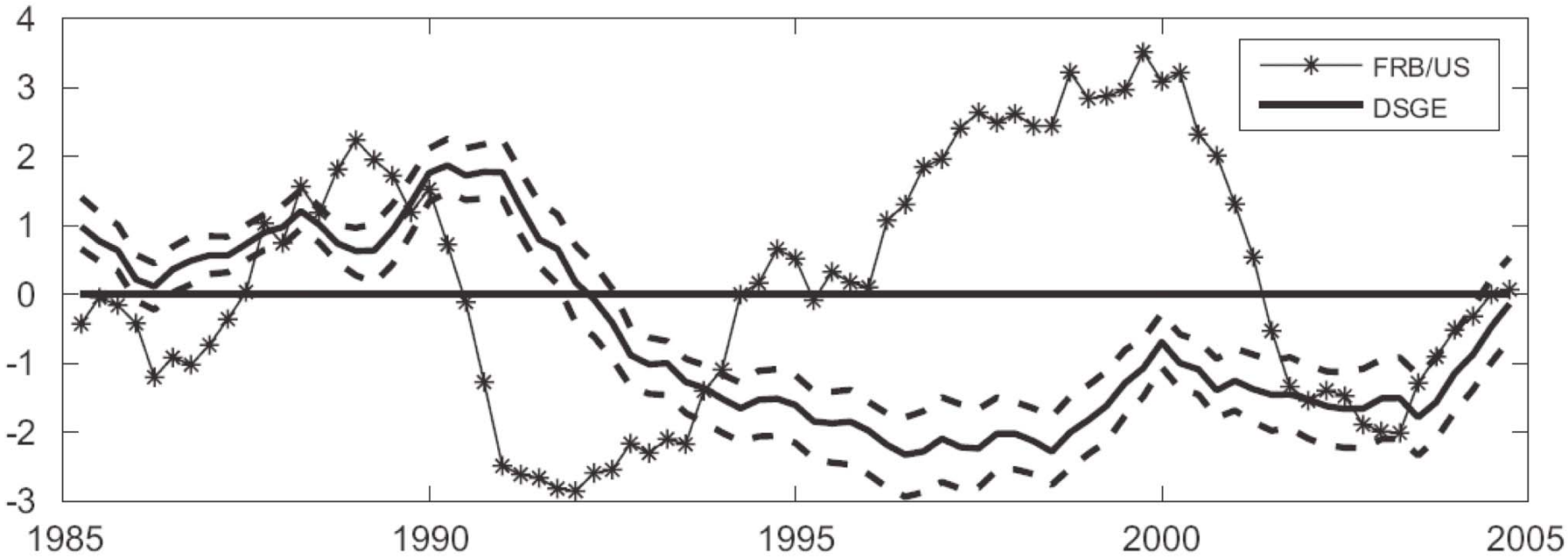
- DSGE-gap resembles “standard” measures of BC

- This result is not typical in the literature

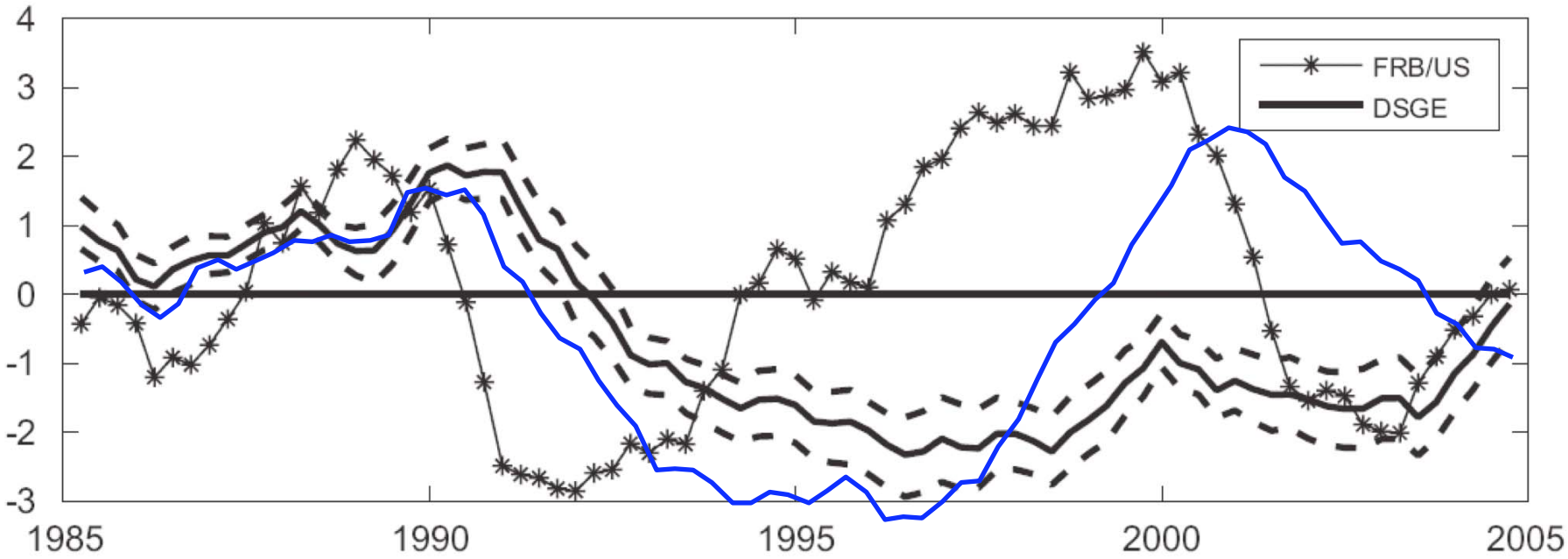
“Going after” (a subset of) the literature

- Output gap estimates differ from standard measures
  - Edge, Kiley and Laforte (2008)
  - Levin, Onatski, Williams and Williams (2005)
  - Andrés, López-Salido and Nelson (2005)

Edge, Kiley and Laforte (2008)

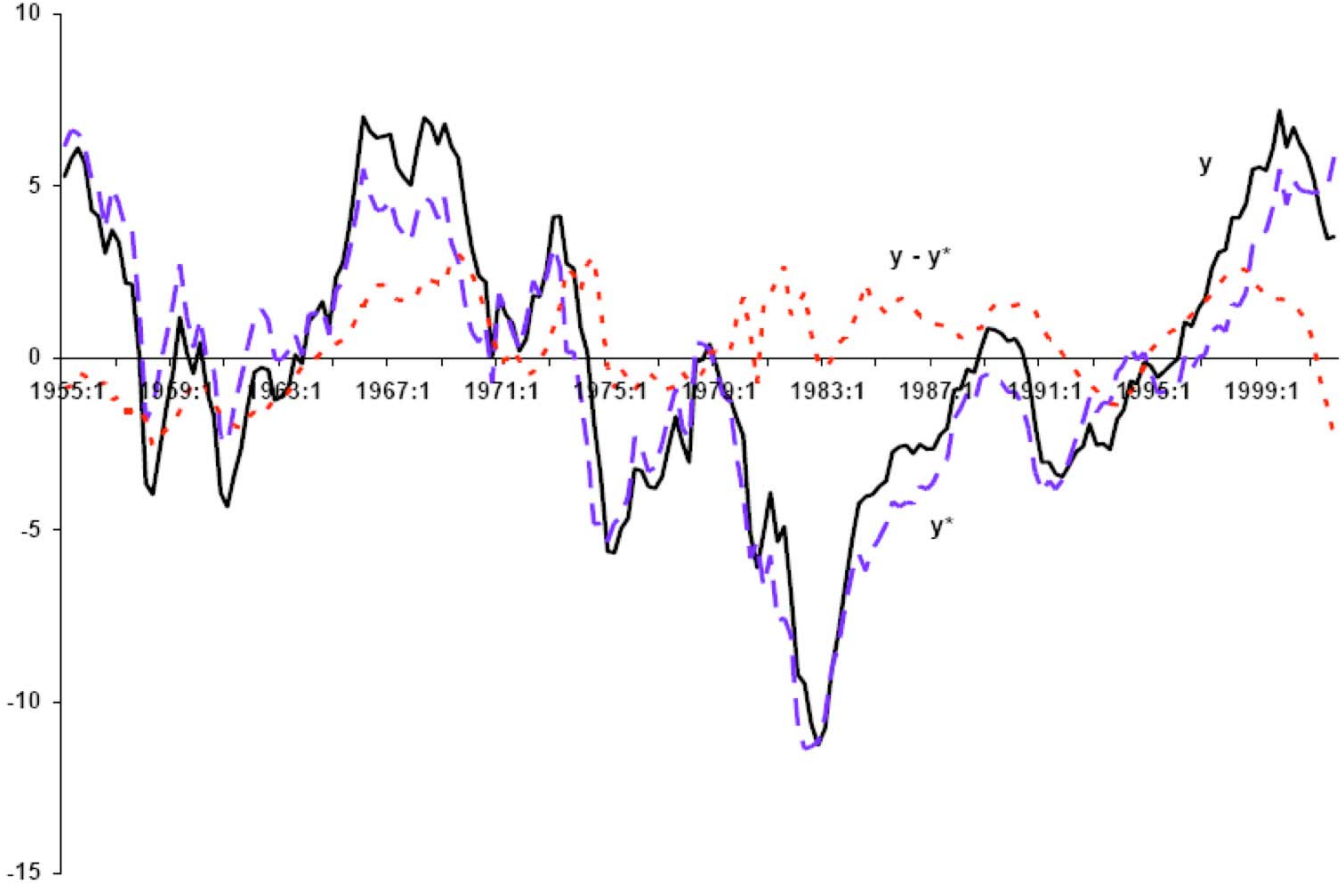


Edge, Kiley and Laforte (2008)



"Our" gap without π^*

LOWW (2005)


10
5
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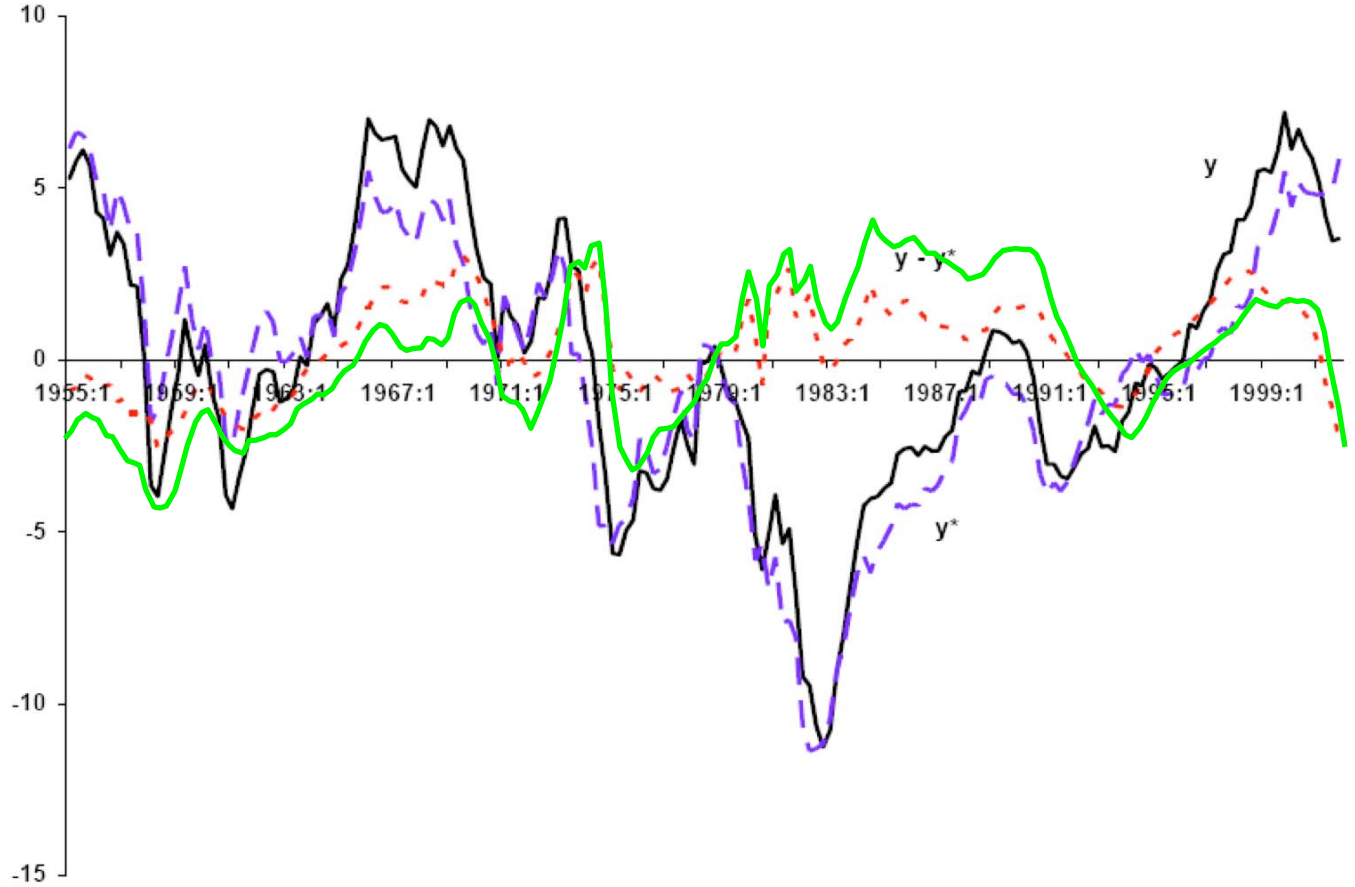
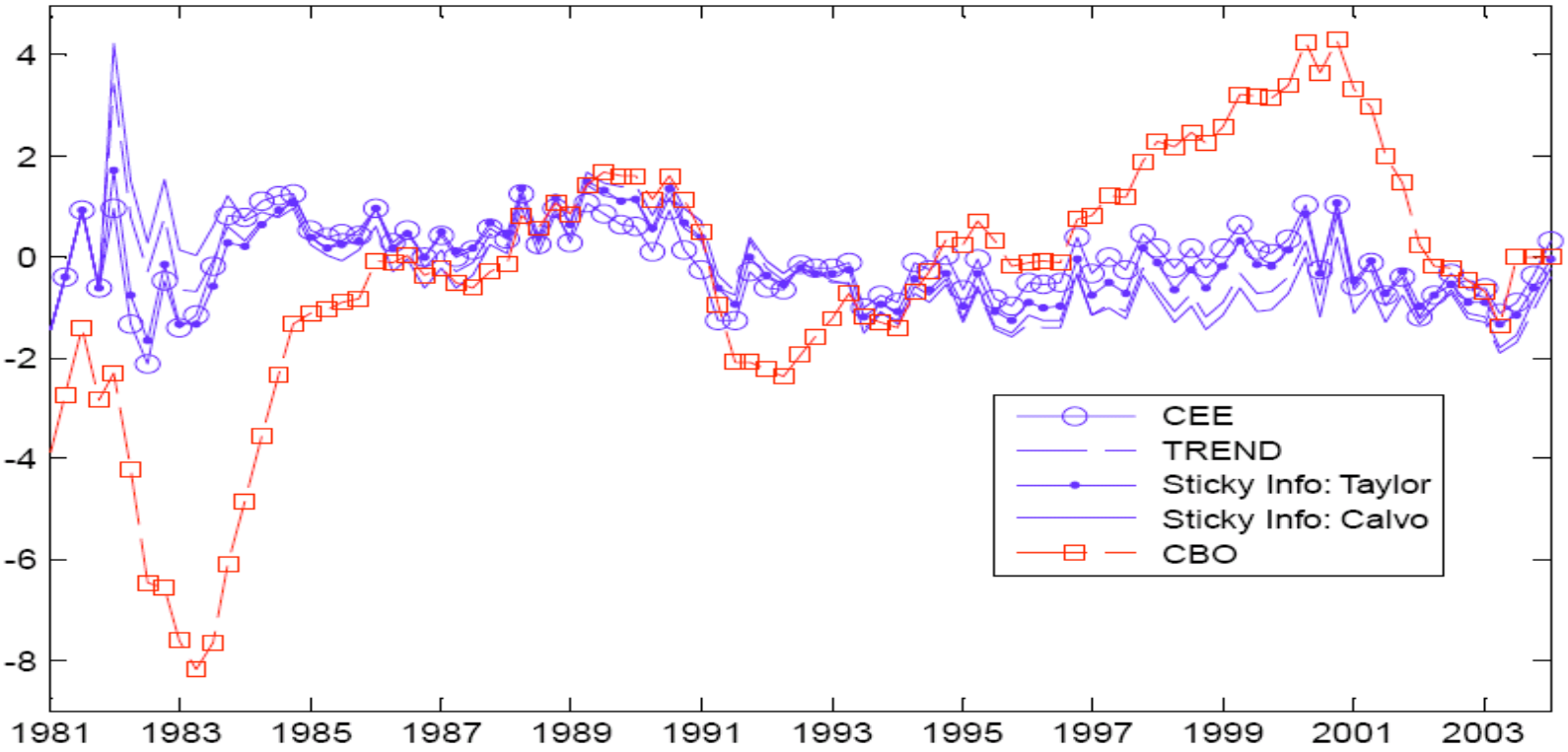
-10
-15
1955:1
1959:1
1963:1
1967:1
1971:1
1975:1
1979:1
1983:1
1987:1
1991:1
1995:1
1999:1
y
y - y*
y*

LOWW (2005)



"Our" gap with LOWW dataset and policy rule

Andrés, López-Salido and Nelson (2005)



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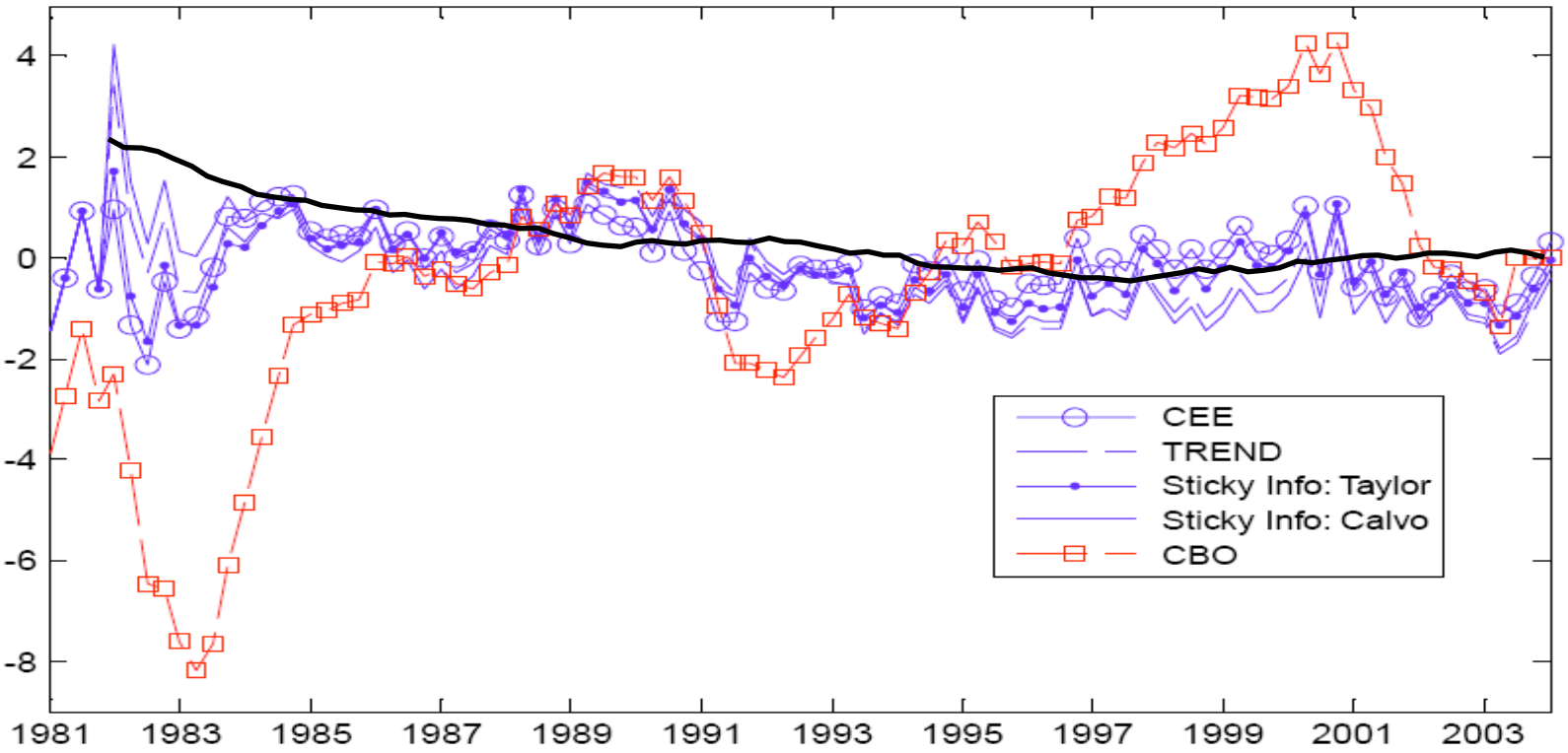


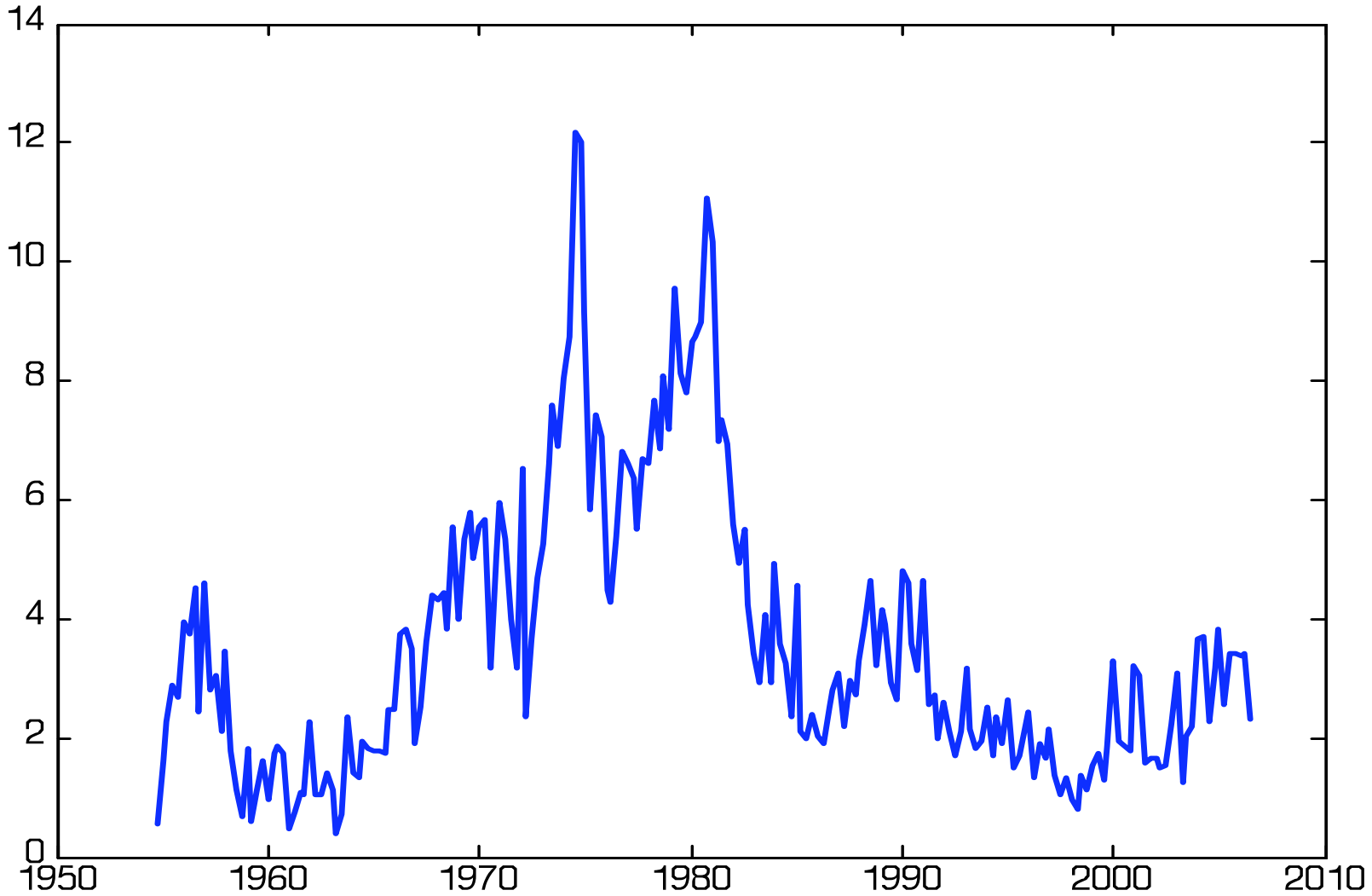
—— "Our" gap without *markup shocks*

Importance of shocks to Phillips curve

- Simplest Phillips curve

$$\pi_t = \beta \; E_t \pi_{t+1} + \kappa \; g_t + \lambda_{p,t}$$

US inflation (GDP deflator)



Importance of shocks to Phillips curve

- Simplest Phillips curve

$$\pi_t = \beta \; E_t \pi_{t+1} + \kappa \; g_t + \lambda_{p,t}$$

- If no shocks to Phillips curve
  - Gap forced to explain high frequency variation in inflation
  - Need low price stickiness
  - Potential output ≈ actual output

Why the mix of shocks matters

- Gap resembles economic slack if choose shocks to appropriately account for low & high frequency fluctuations in data

Shock	Purpose
Labor supply	Hours, low frequency
Inflation Target	Inflation, low frequency
Price markup	Inflation, high frequency
Wage markup	Wages, high frequency

- **Rationale**: 1) model fits better 2) proxies for features outside model's scope, i.e. reduced form shocks

"Going after" (a subset of) the literature

- Output gap estimates differ from standard measures
  - Edge, Kiley and Laforte (2008)
  - Levin, Onatski, Williams and Williams (2005)
  - Andrés, López-Salido and Nelson (2005)
- One exception: Sala, Soderstrom and Trigari (2008)

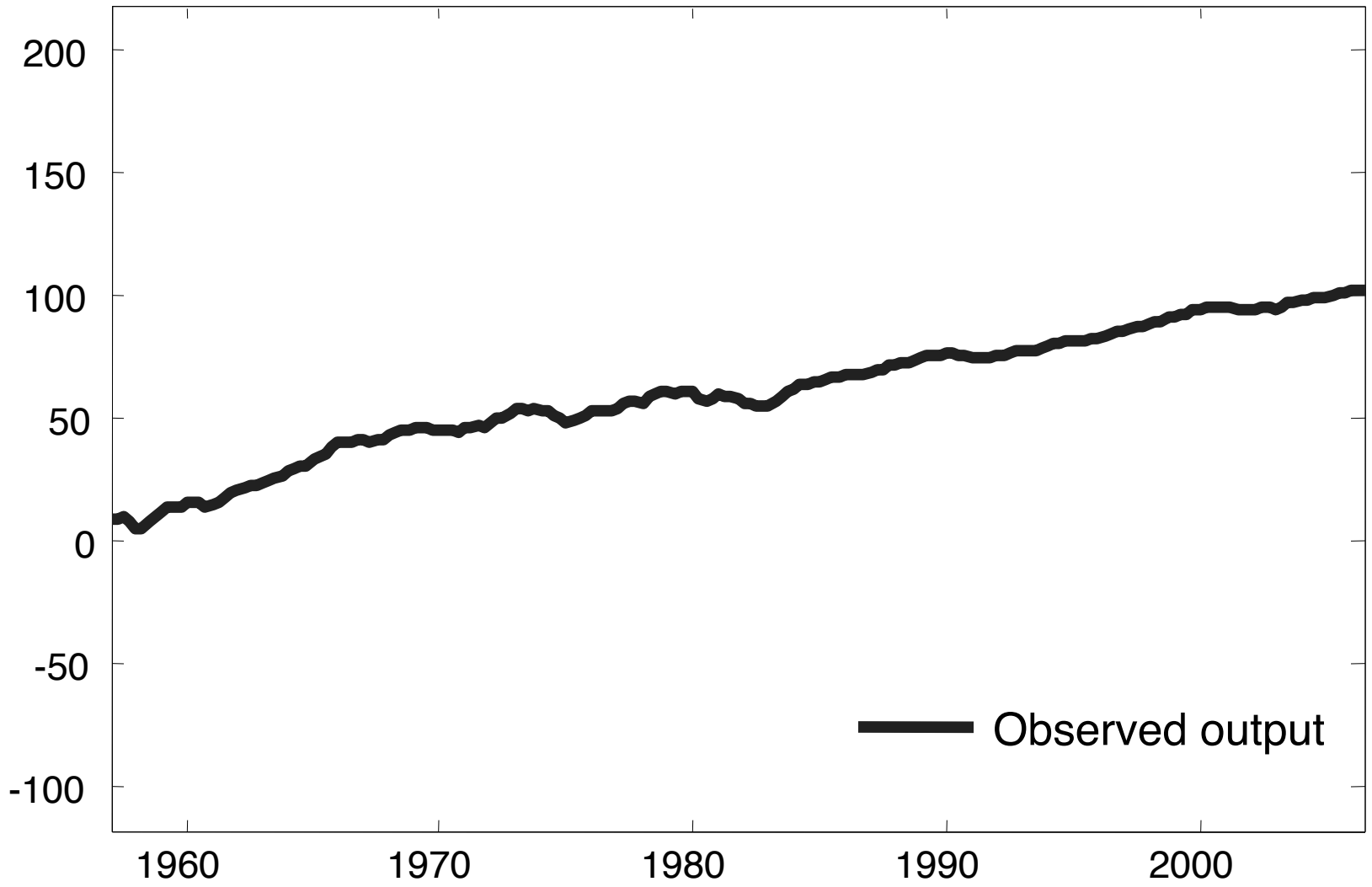
Potential output and business cycles

- DSGE-gap resembles “standard” measures of BC
- This result is not typical in the literature
- One important ingredient:
  - Shocks to Phillips curve

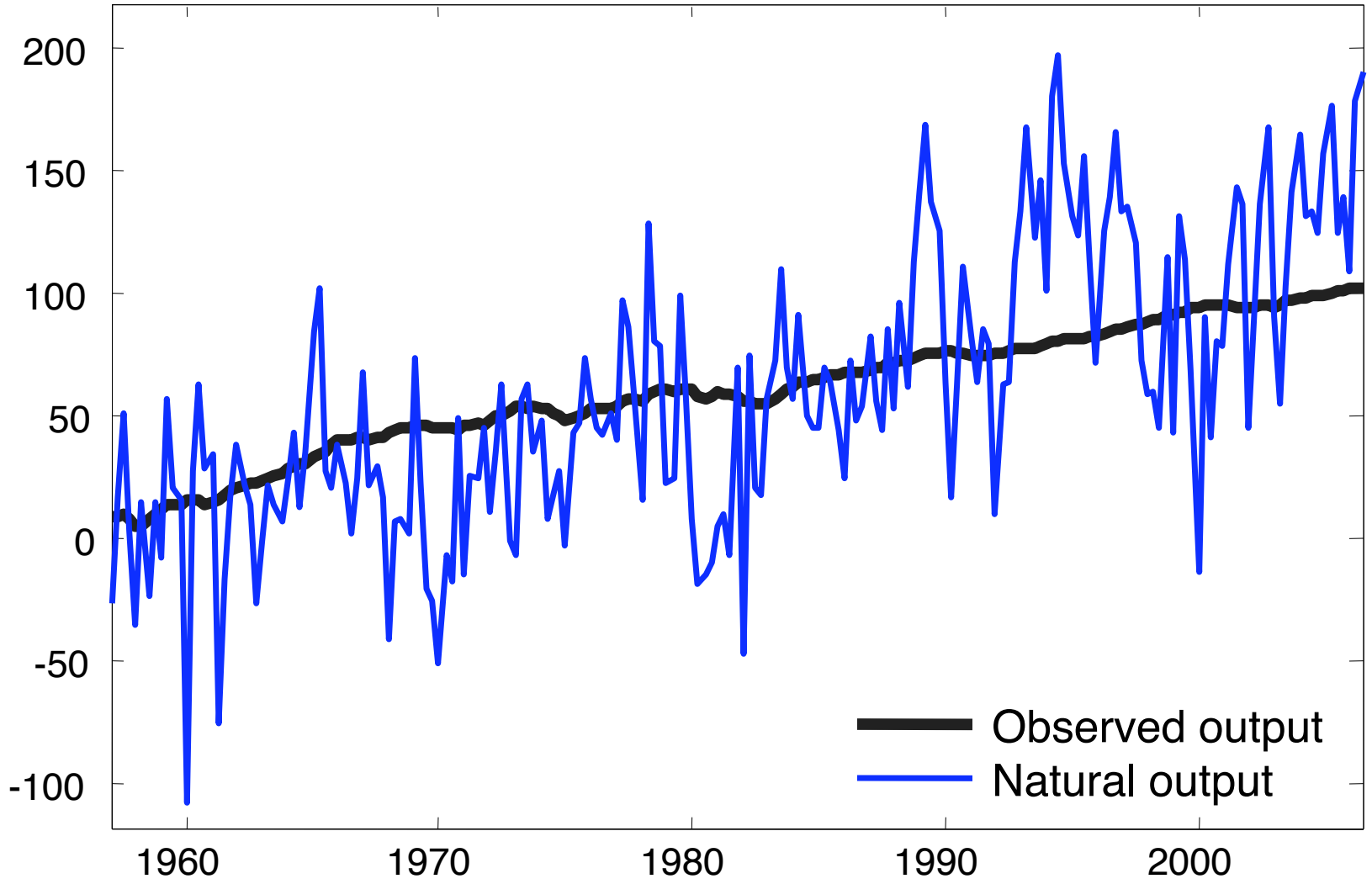
Outline

- Model
- Estimates of *potential* output
- A brief comparison to the literature
- Estimates of *natural* output
- Alternative interpretation of markup shocks

Output


200
150
100
50
0
-50
-100
1960
1970
1980
1990
2000
Observed output

Natural Output



Why is natural output so volatile?

- Wage markup shocks are implausibly volatile
  - Imply variation of desired markups between -/+ 400%

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  - Imply variation of desired markups between -/+ 400%

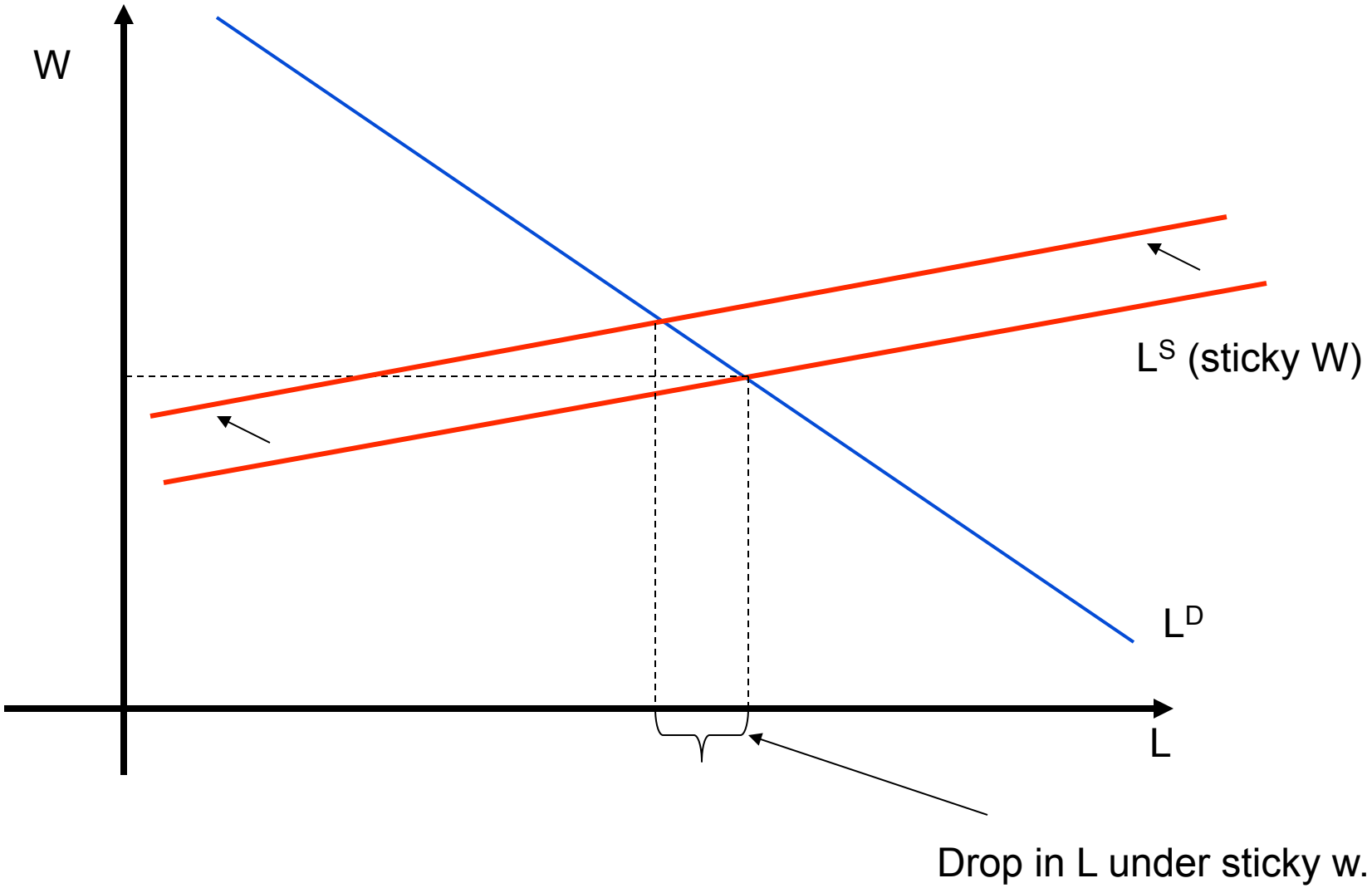
$$w_t = \gamma_1 w_{t-1} + \gamma_2 E_t w_{t+1} + \kappa \ \mu_t^w + \kappa \ \lambda_{w,t}$$

Std ≈ 30 basis points

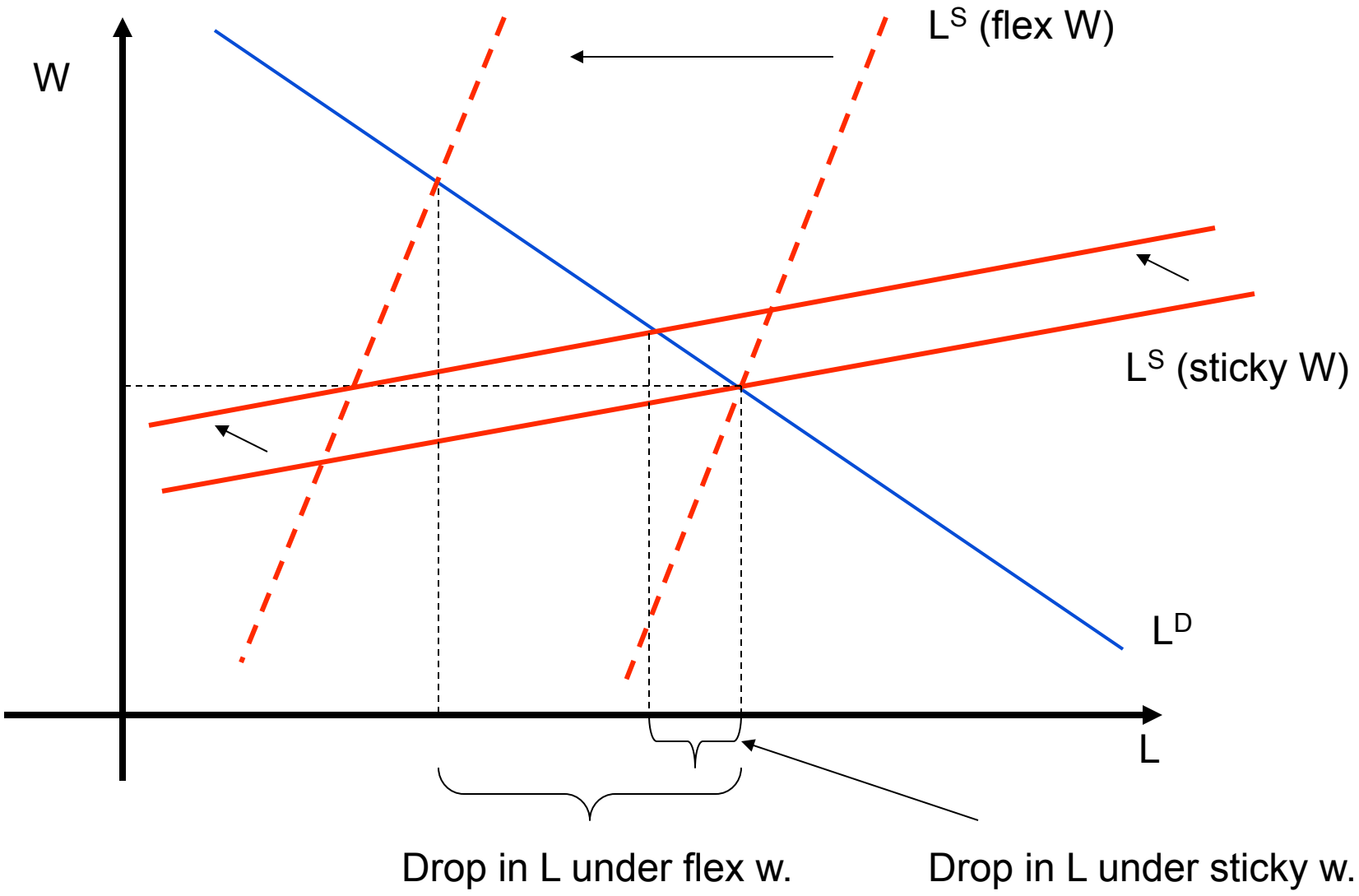
Why is natural output so volatile?

- Wage markup shocks are implausibly volatile
  - Imply variation of desired markups between -/+ 400%
  - Why “not a problem” under sticky wages?

The effect of wage markup shocks



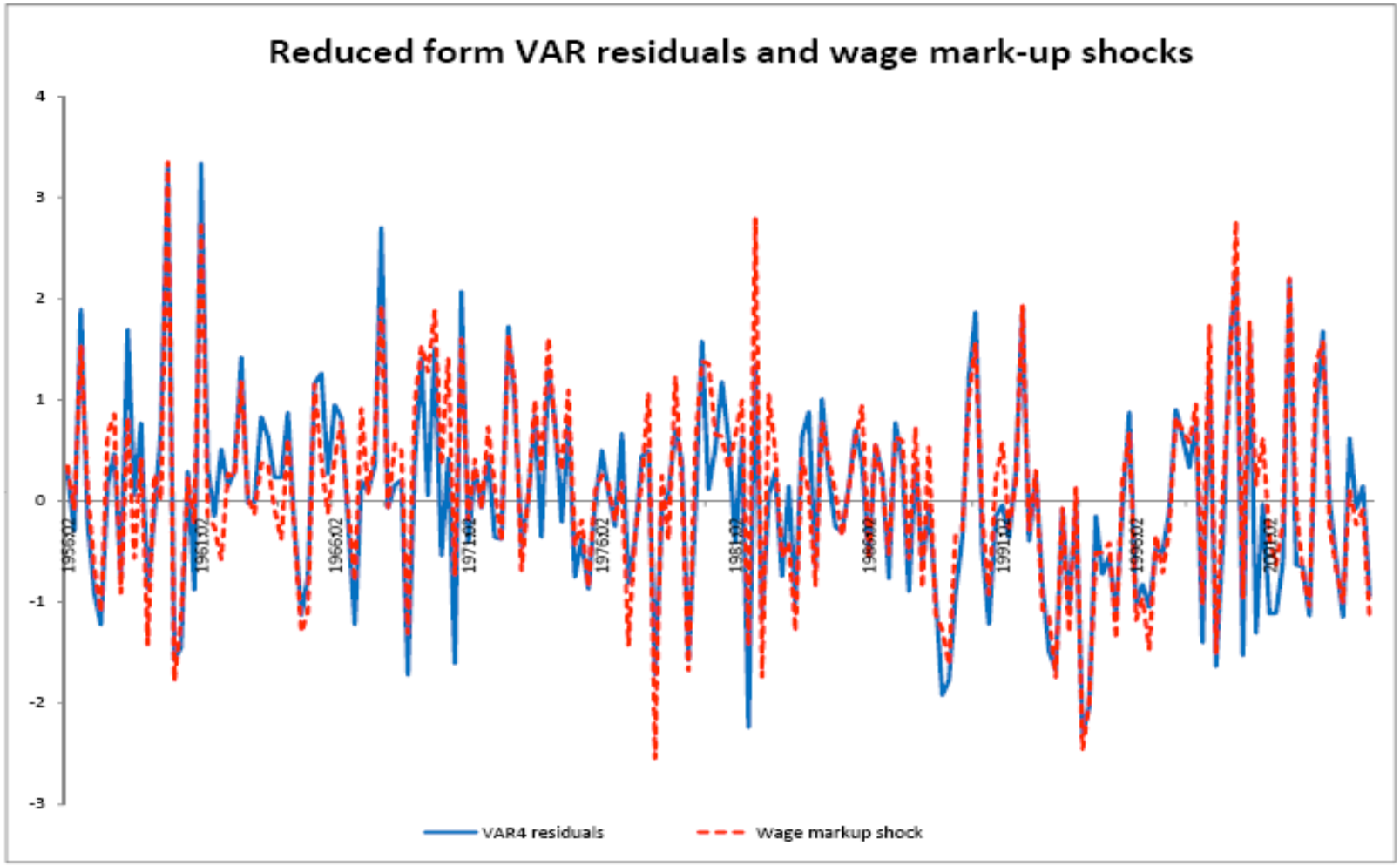
The effect of wage markup shocks



Wage markup shocks

- Are these shocks plausible?
  - Model misspecification?
  - Coincide with reduced form residuals from VAR(4)

Wage markup shocks



Wage markup shocks

- Are these shocks plausible?
  - Model misspecification?
  - Coincide with reduced form residuals from VAR(4)
- Variance decomposition at BC frequencies
  - Explain negligible share of variance in all series but wages
    - 2% output, 5% hours

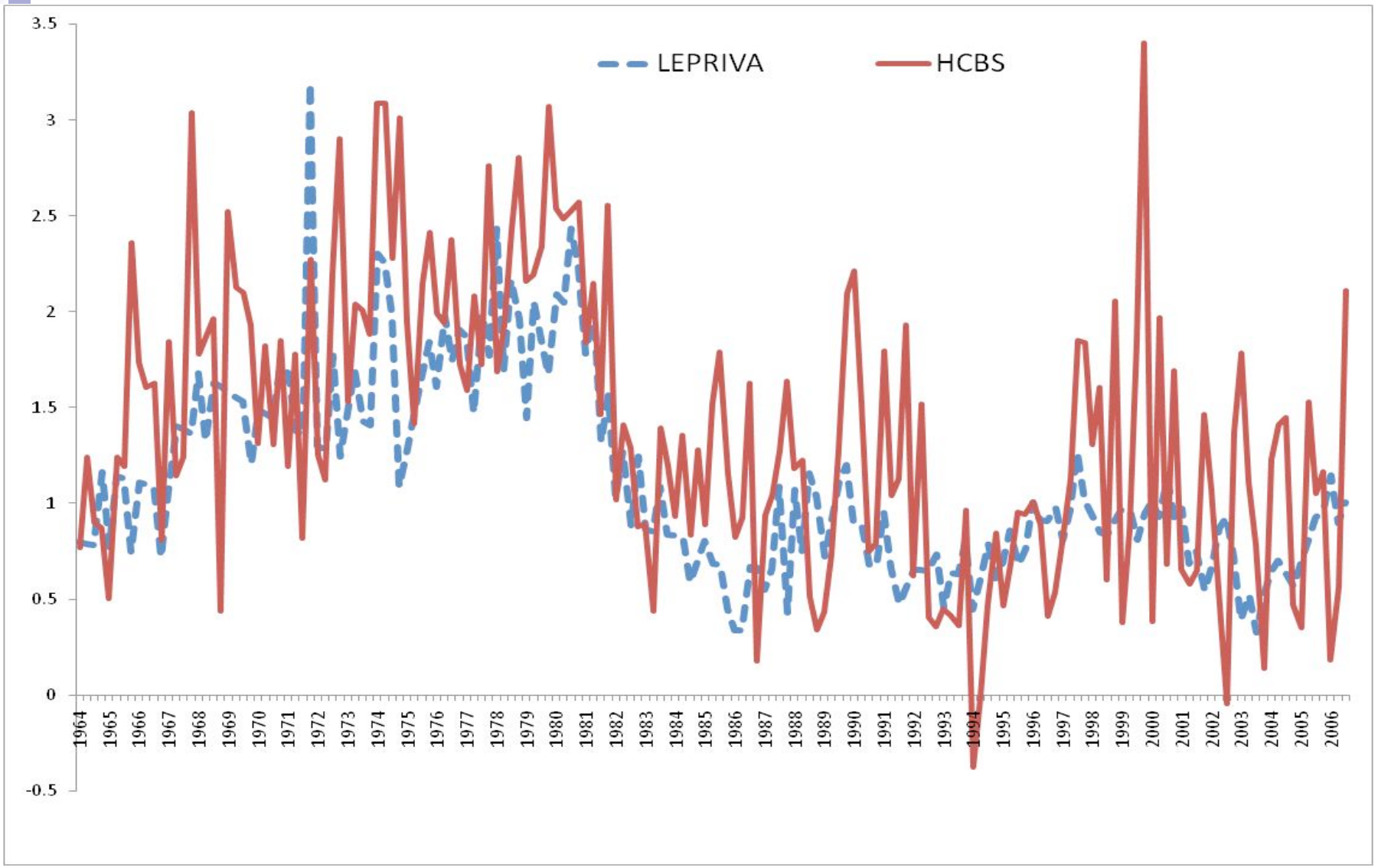
Outline

- Model
- Estimates of *potential* output
- A brief comparison to the literature
- Estimates of *natural* output
- Alternative interpretation of markup shocks

Alternative interpretation of markup shocks

- Noise
  - sampling error
  - idiosyncratic shocks across multiple wage (price) series
    - Very different high frequency behavior
    - Abraham et al. (1999), Bosworth and Perry (1994)
    - Boivin and Giannoni (2006 and 2009)

Alternative wage series



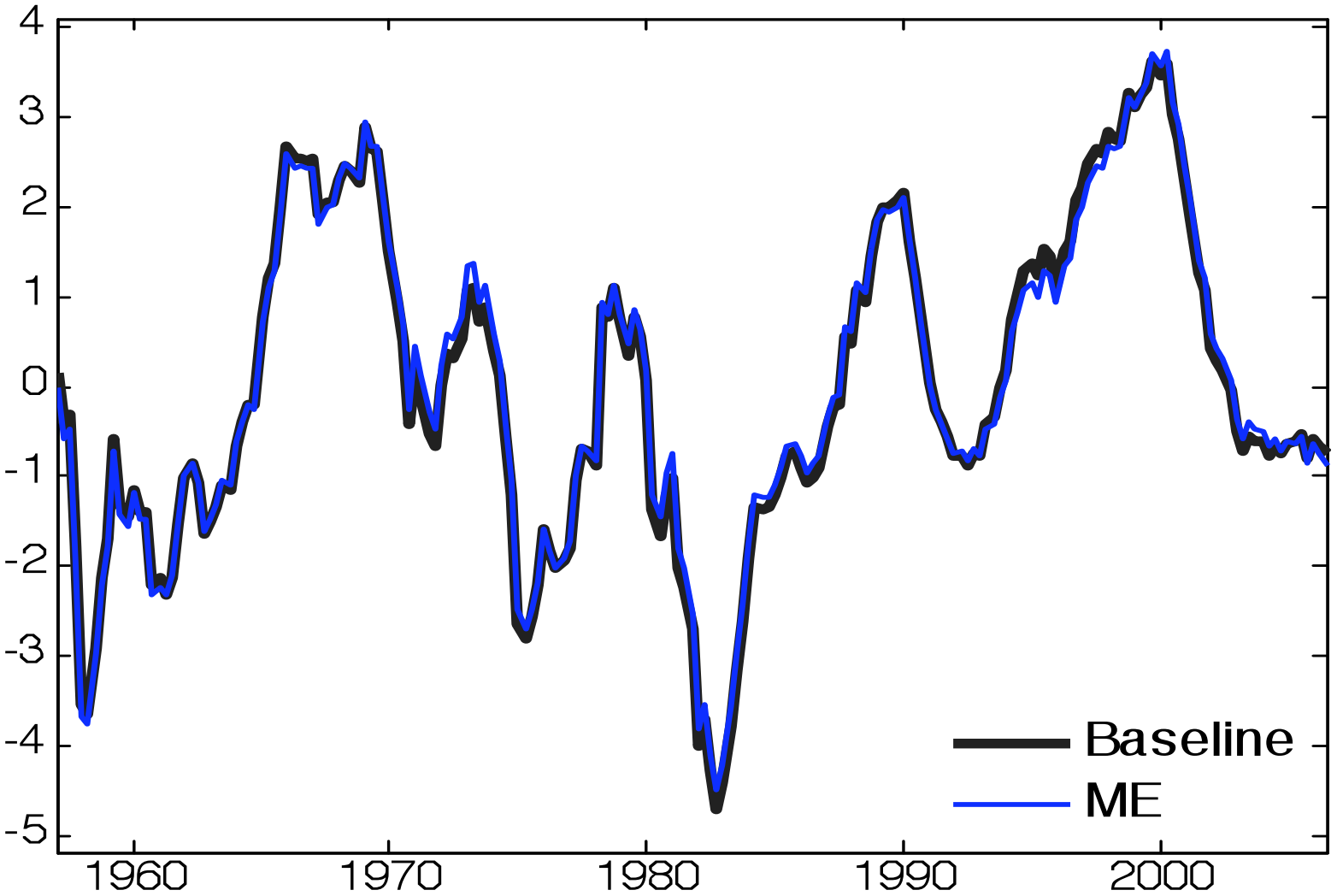
Alternative wage series

- Growth rate of nominal wages
- LEPRIVA
  - hourly compensation of non-supervisory and production workers (Establishment Survey)
- HCBS
  - hourly compensation in the business sector
  - includes dividend payments and other stuff that has little to do with wages

Alternative interpretation of markup shocks

- Noise
- Model with measurement errors fits data as well

Output Gaps



Alternative interpretation of markup shocks

- Noise
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- Natural $\propto$ potential output
  - More plausible implications for flex prices and wages economy

Alternative interpretation of markup shocks

- Noise
- Model with measurement errors fits data as well
- Natural $\propto$ potential output
  - More plausible implications for flex prices and wages economy
- Caveat: all ME, extreme assumption

Robustness

- MLE

Robustness

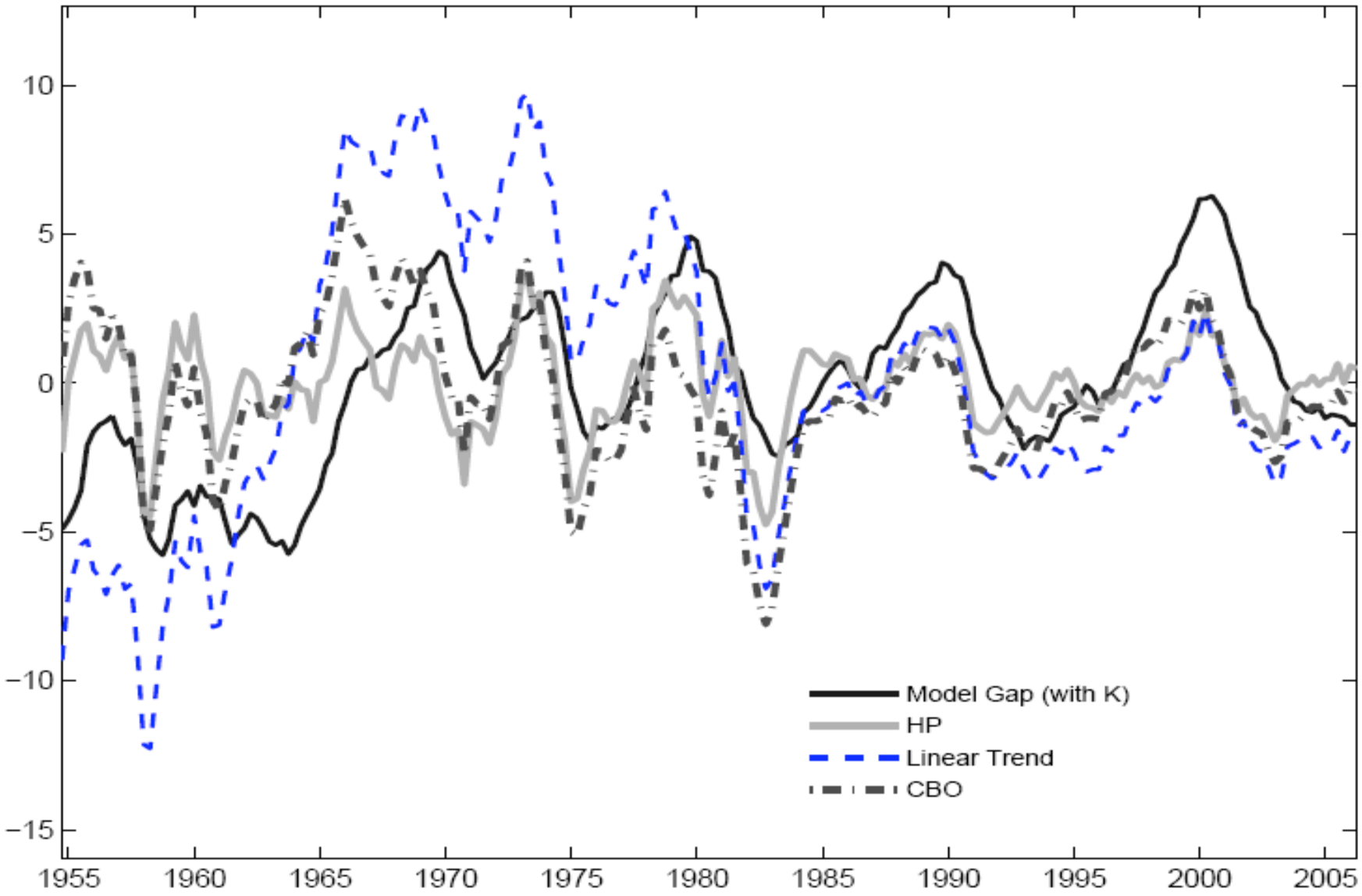
- MLE

- Labor supply shocks (persistent)
  - Gap even closer to HP, CBO

Robustness

- MLE
- Labor supply shocks (persistent)
  - Gap even closer to HP, CBO
- Larger model with endogenous capital accumulation and additional propagation mechanisms
  - CEE (2005), Smets and Wouters (2007)

Gap in Model with Capital



Conclusions

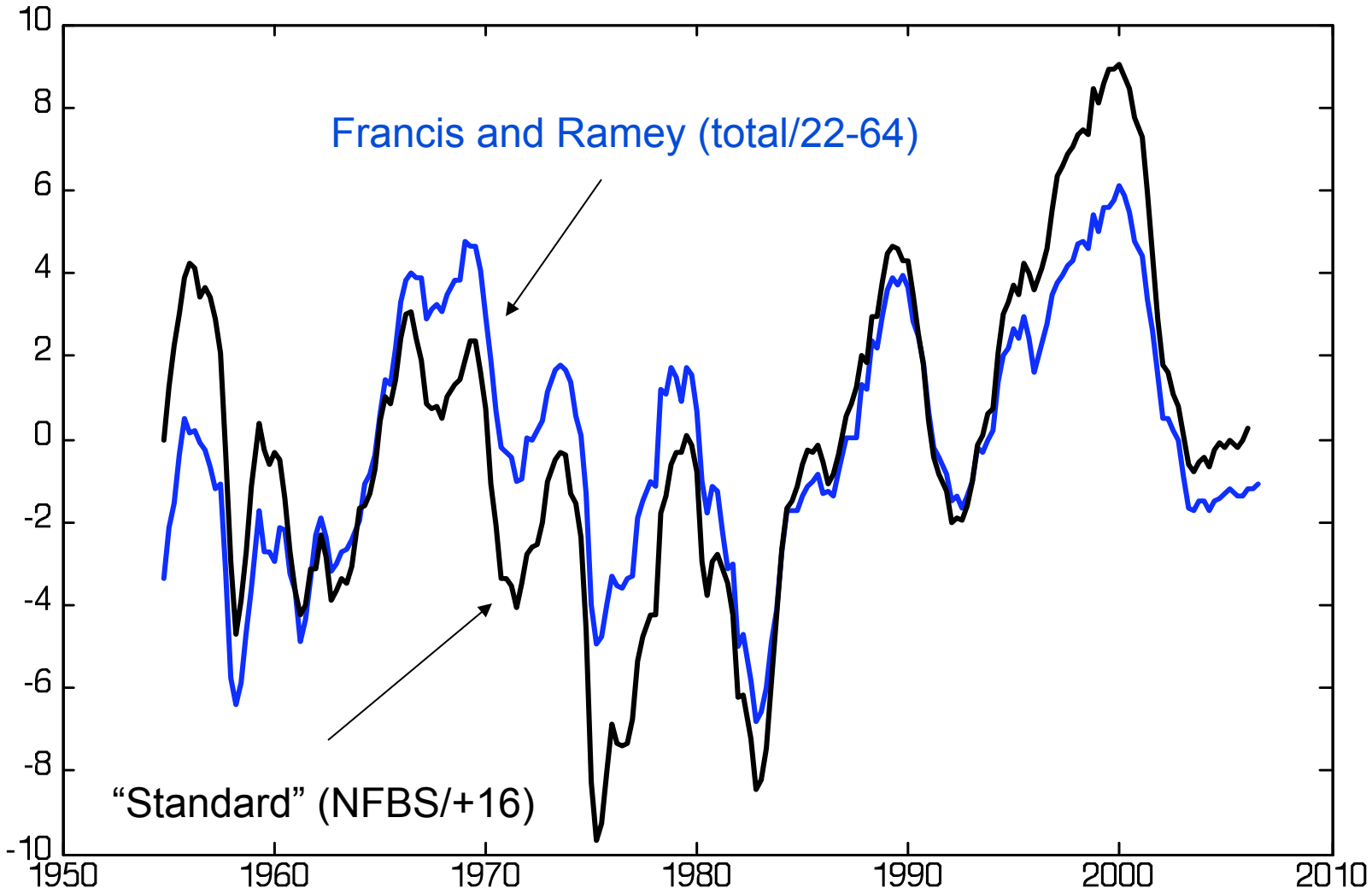
- Potential output is smooth
  - Inefficient business cycles
- Natural output is implausibly volatile
  - Casts doubts on structural interpretation of innovations in price and wage Phillips curves
- Alternative interpretation that fits data as well
  - Shocks to Phillips curves are not structural
  - ➔ No distinction between natural and potential output

Additional material

1. Hours measures

2. How inefficient are business cycles in a model with K?

1. Hours


10
8
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-2
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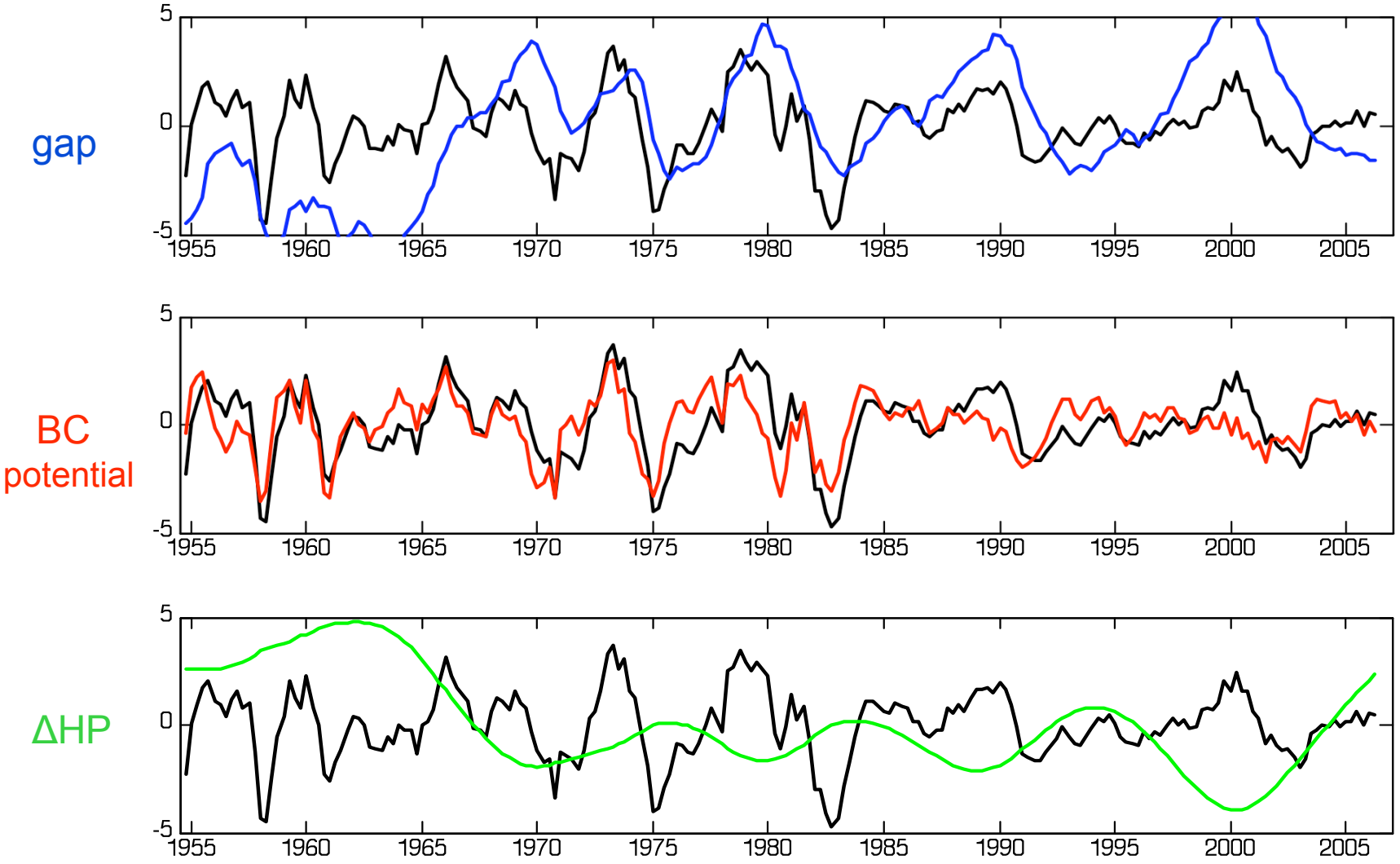
-8
-10
1950
1960
1970
1980
1990
2000
2010
Francis and Ramey (total/22-64)
“Standard” (NFBS/+16)

2. BC decomposition in a model with K



2. BC decomposition in a model with K (hours)