"From Many Series, One Cycle: Improved Estimates of the Business Cycle from a Multivariate Unobserved Components Model"

by C. Fleischman and J. Roberts

Discussion by Carlos Carvalho
PUC-Rio

Structural and Cyclical Elements in Macroeconomics, FRBSF

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Summary

- Carefully specified state-space model of the joint dynamics of a few output and labor-market series, and an inflation measure
- A few "cointegrating relationships", coupled with a "common-cycle restriction"
- Incorporation of knowledge about methodology for data construction
- Estimate of the "common cycle" component, and of policy-relevant trends

A little detail

- $X_{it} = \lambda_i(L)cyc_t + X^*_{it} + \left(\mathbf{B_i Z_t + A_i\,(L)\,X_{it-1}}\right) + u_{it}$

- $cyc_t = \rho_1 cyc_{t-1} + \rho_2 cyc_{t-2} + \eta_t$: common cycle

- X^*_{it}: stochastic trends (some of them common to pairs of series)

- u_{it}: idiosyncratic residuals; some cross-correlation, but $u_{it} \perp \eta_t$

- Z_t: regressors

A little more detail

- X_{it}:
  - GDP,GDI (per capita)
  - NFBP,NFBI (per capita)
  - NFB sector employment (per capita)
  - NFB sector workweek; labor-force participation rate; employment rate
  - Core CPI inflation
- Sample: 1963:Q2 to 2011:Q1
- Maximum likelihood estimation

Economics, ...

- Economics

$$
\begin{aligned}
ER_t &= \lambda_{40} cyc_t + \lambda_{41} cyc_{t-1} + \lambda_{42} cyc_{t-2} + ER_t^* + \boldsymbol{\alpha} \mathbf{EEB_t} + u_{7t} \\
LP_t &= \lambda_{50} cyc_t + \lambda_{51} cyc_{t-1} + \lambda_{52} cyc_{t-2} + LP_t^* - \boldsymbol{\alpha} \mathbf{EEB_t} + u_{8t}
\end{aligned}
$$

Account for influence of federal and state emergency and extended benefits (EEB) programs on the unemployment rate and labor force participation. Hypothesize that EEB programs may have a first-order effect on the latter, but not on employment (EEB programs typically are available only during periods of unusual weakness in labor demand). Impose the restriction that EEB programs enter ER and LP equations with coefficients that are equal but of opposite sign.

Data knowledge, ...

- Data knowledge

$$
\begin{aligned}
u_{1t} &= \sigma u_{3t} + \boldsymbol{\xi_{1t}} \\
u_{2t} &= \sigma u_{4t} + \boldsymbol{\xi_{1t}}
\end{aligned}
$$

Only one idiosyncratic error for both GDP and GDI (ξ_1) because in the national accounts data, the discrepancy between nonfarm business output and overall output is measured only on the income side.

And "tricks"

- "Tricks"

$$DCPIX_t = A(L)DCPIX_{t-1} + \beta_{11}(L)drpe_{t-1} + \beta_{12}(L) * d85_t * drpe_{t-1} + \beta_2(L)\,drpi_t + \ldots$$

Ten lags of core inflation

$A(1) = 1$ (first coefficient freely estimated; remaining coefficients constrained to be the same)

Relative price of energy enters with a six-quarter moving average

Handle changing effects of energy and import prices by weighting them by their nominal expenditure shares

Results

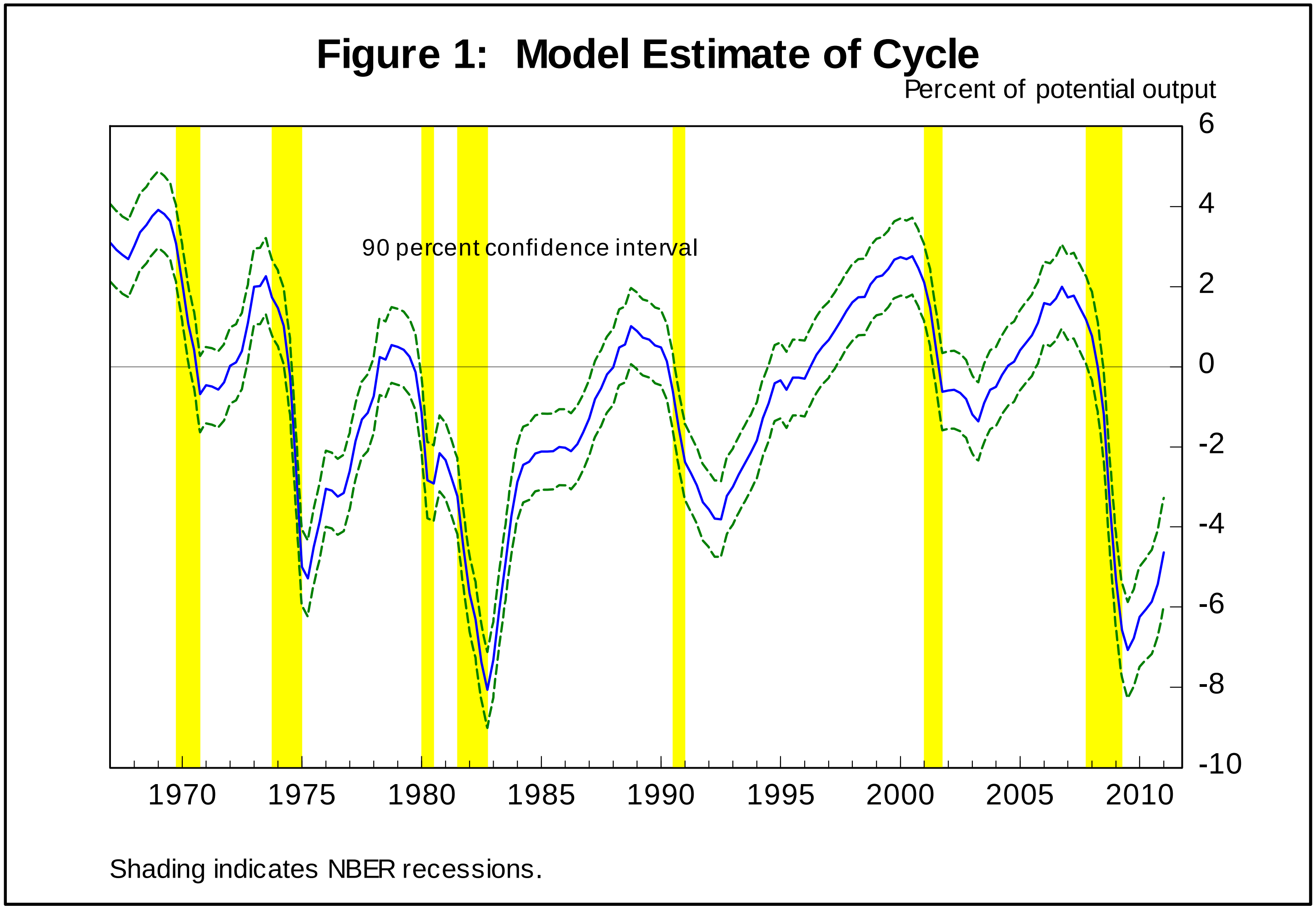


Figure 1: Model Estimate of Cycle
Percent of potential output
90 percent confidence interval
6
4
2
0
-2
-4
-6
-8
-10
1970
1975
1980
1985
1990
1995
2000
2005
2010
Shading indicates NBER recessions.

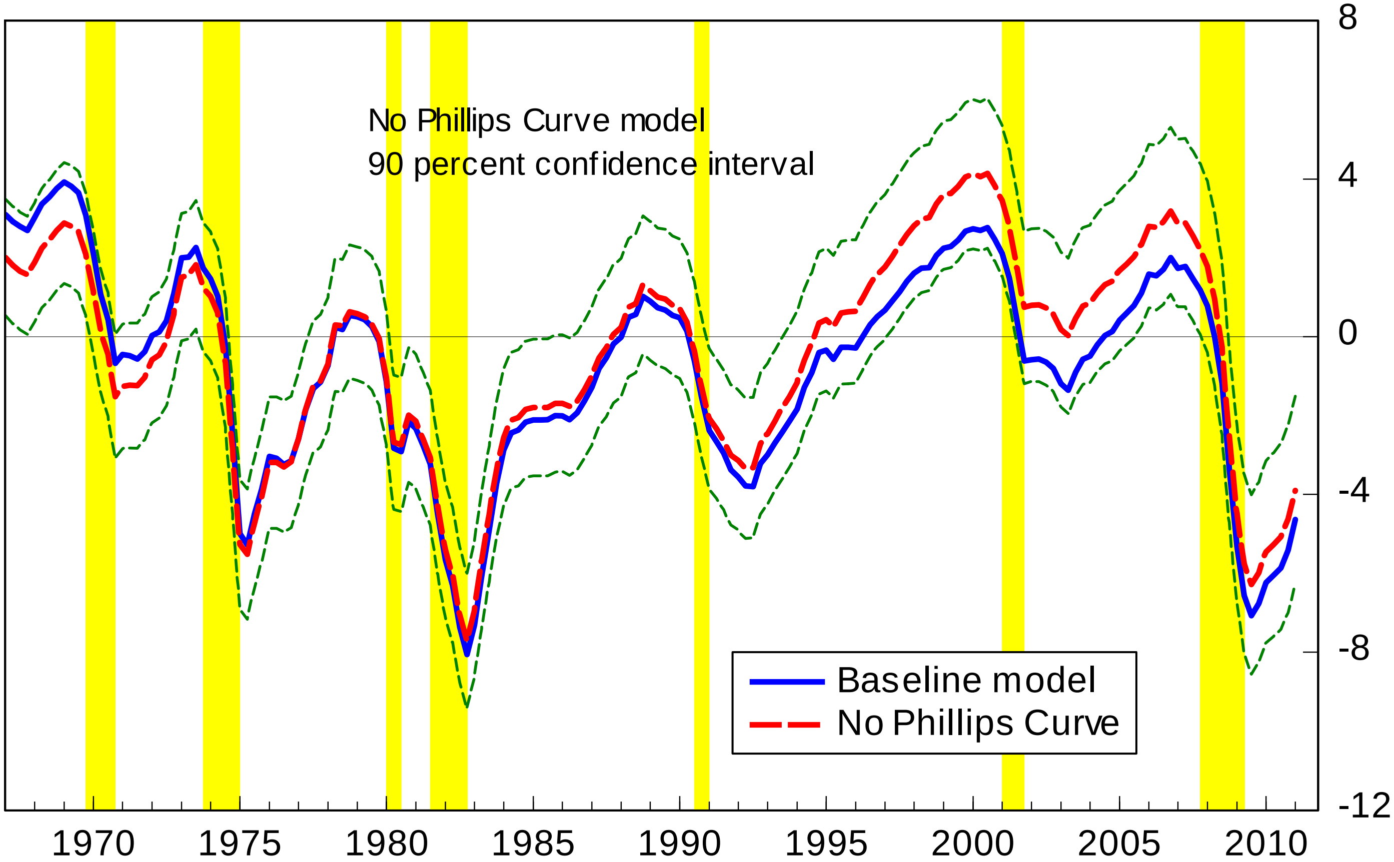
Results

- Focus on Phillips curve

- Challenge: given "PC" view of inflation dynamics, reconcile estimates of very negative output gaps with the fact that inflation hasn't fallen by much

- Backward-looking Phillips curve

Figure 7: Cycle Estimate from No-Phillips Curve Model



Shading indicates NBER recessions.

Alternative PC

- Estimate of the output gap based on PC model in which long-term expectations matter (Carvalho, Eusepi, Moench 2011, wip)

- "NKPC" with arbitrary expectations, as in Preston (2005):

$$\pi_t = \mathbb{E}_t \sum_{T=t}^{\infty} (\alpha\beta)^{T-t} \left[\kappa \left(y_T - y_T^n\right) + \beta(1-\alpha)\pi_{T+1}\right],$$

rewrite as

$$\begin{aligned}\pi_t &= \kappa\frac{1}{1-\alpha\beta}\left(y_t - y_t^n\right) + \frac{\alpha\beta}{1-\alpha\beta}\kappa\mathbb{E}_t \sum_{T=t}^{\infty} (\alpha\beta)^{T-t} \left(\Delta y_{T+1} - \Delta y_{T+1}^n\right) + \\ &\quad \mathbb{E}_t \sum_{T=t}^{\infty} (\alpha\beta)^{T-t} \beta(1-\alpha)\pi_{T+1},\end{aligned}$$

Alternative PC - 2

- Specify empirical (shifting endpoints) model for expectation formation, as in Kozicki and Tinsley (2006)

- Estimate with term structure of survey forecasts of inflation and output growth

- Use it to construct measures of

$$\mathbb{E}_t \sum_{T=t}^{\infty} (\alpha\beta)^{T-t} \Delta y_{T+1} \quad \text{and} \quad \mathbb{E}_t \sum_{T=t}^{\infty} (\alpha\beta)^{T-t} \beta(1-\alpha)\pi_{T+1}$$

- Assume univariate process for y_t^n

- Backout estimate of $y_t - y_t^n$

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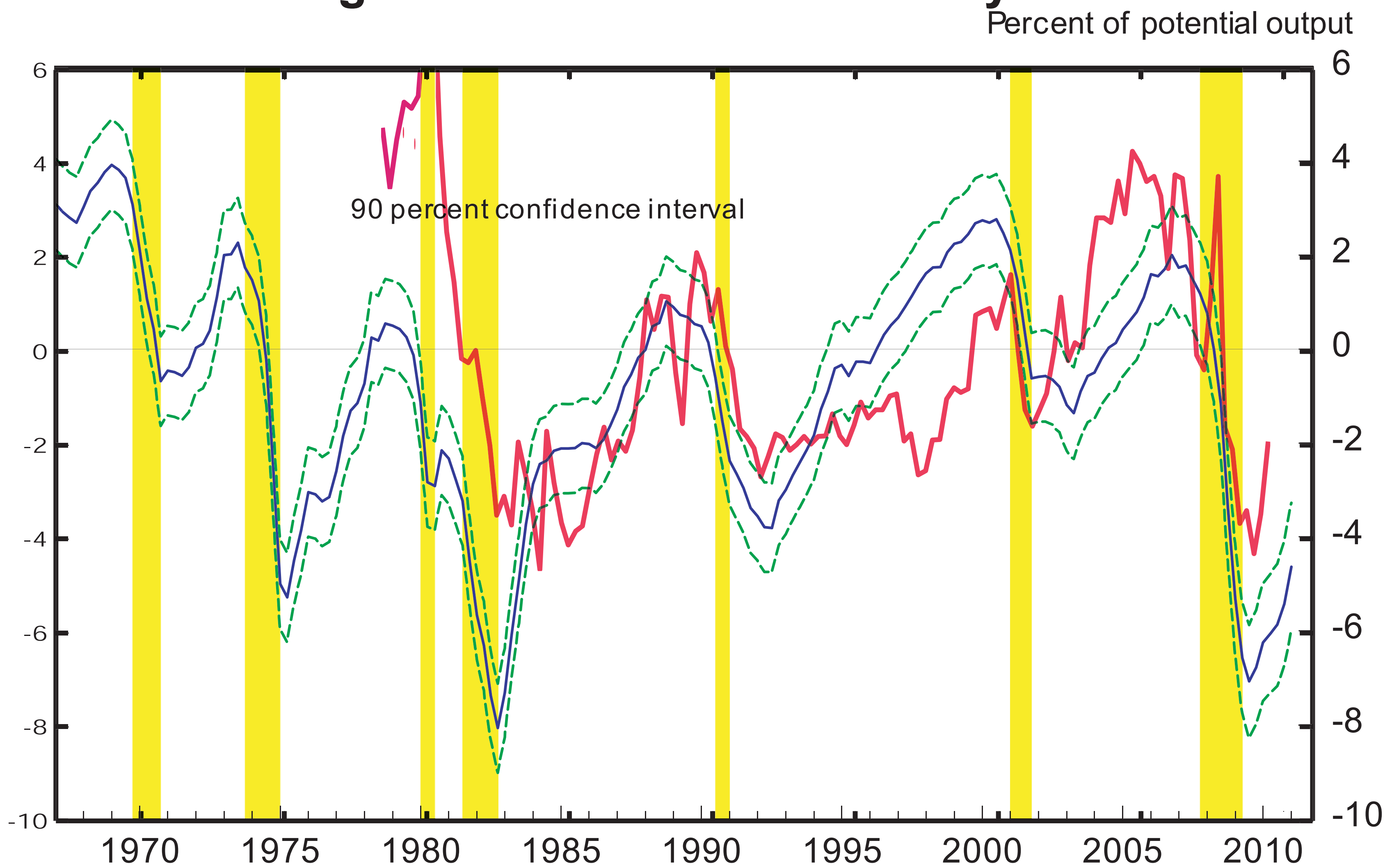

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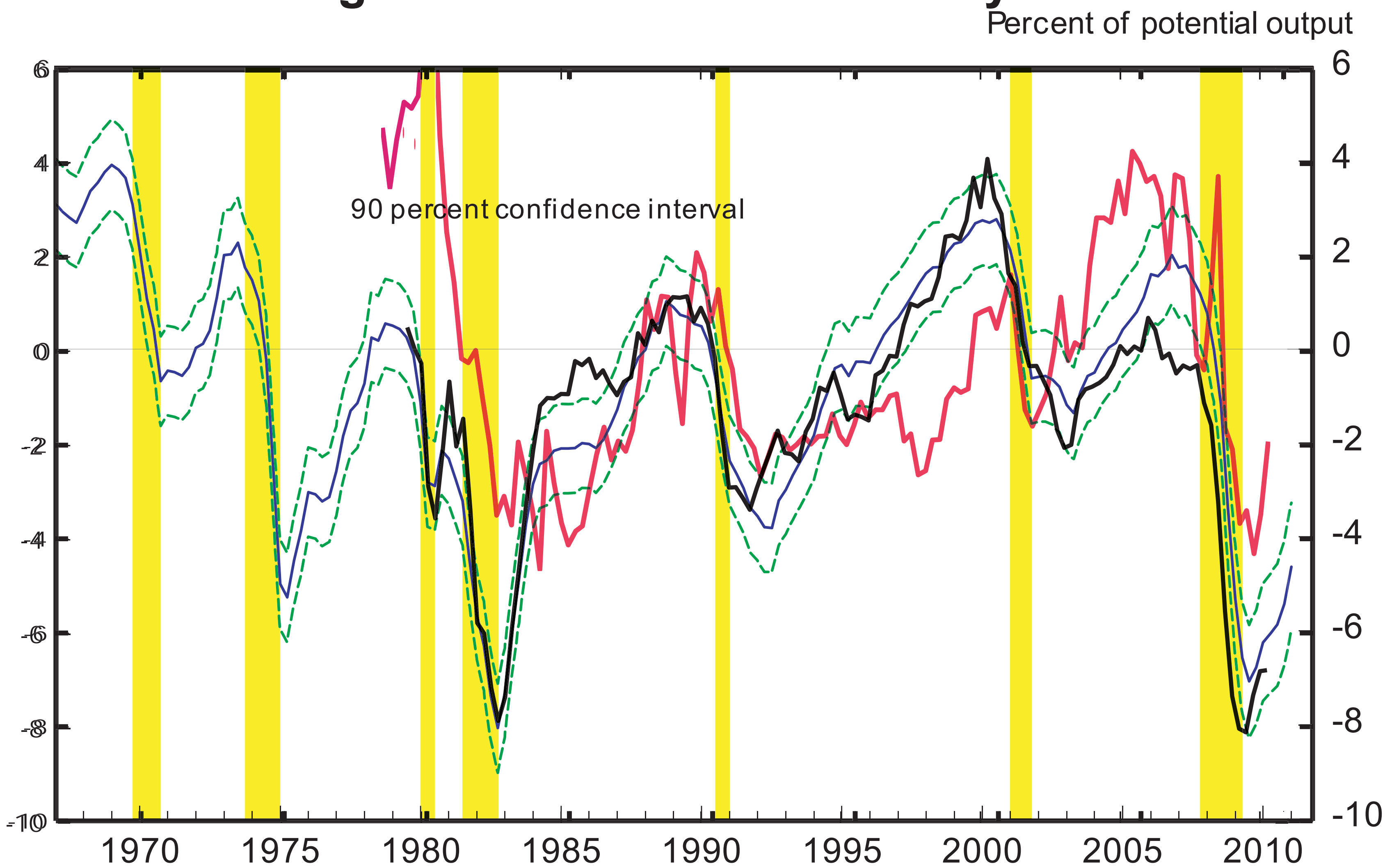

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