Monetary Policy Regimes and Economic Performance: The Historical Record, 1979-2008

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Today's talk:

Issue: ***'Are SVAR-based policy counterfactuals reliable?'***

➔ Based on DSGE models, we explore to which extent SVAR-based counterfactuals can reliably capture the impact of changes in the Taylor rule on the properties of the economy

Motivation:

SVAR-based policy counterfactuals are widely used:

➔ Primiceri (*ReStat*, 2005), Sims and Zha (*AER*, 2006), Gambetti, Pappa, Canova (*JMCB*, 2006) etc. etc.

However:

- **reliability has never been systematically checked conditional on a set of DGPs**
- **only piece of evidence—Benati and Surico (*AER*, 2009)—is negative …**

Motivation (continued):

➔ Benati and Surico provide a single example based on estimated DSGE models in which SVARs fail to uncover the truth about the DGP …

In particular, SVAR-based counterfactual dramatically fails to capture the impact of changes in the Taylor rule …

So, how serious is the problem?

Do Benati and Surico's results crucially depend on their specific DGP, or do they point towards a general problem?

Let's start by considering the key conceptual issue involved …

The problem in a nutshell

- Take a New Keynesian model
- Consider two sets of parameters for the Taylor rule:

$$\text{Taylor}^1 \Rightarrow [\rho^1, \psi_\pi^1, \psi_y^1]$$
$$\text{Taylor}^2 \Rightarrow [\rho^2, \psi_\pi^2, \psi_y^2]$$

Together with other parameters, you have:

$$\text{Taylor}^1 \Rightarrow \text{DSGE}^1 \Rightarrow \text{SVAR}^1 \Rightarrow \text{MonetaryRule}^1$$
$$\text{Taylor}^2 \Rightarrow \text{DSGE}^2 \Rightarrow \text{SVAR}^2 \Rightarrow \text{MonetaryRule}^2$$

where MonetaryRule^i, $i = 1, 2$ is interest rate equation of the structural VAR representation of the DSGE model

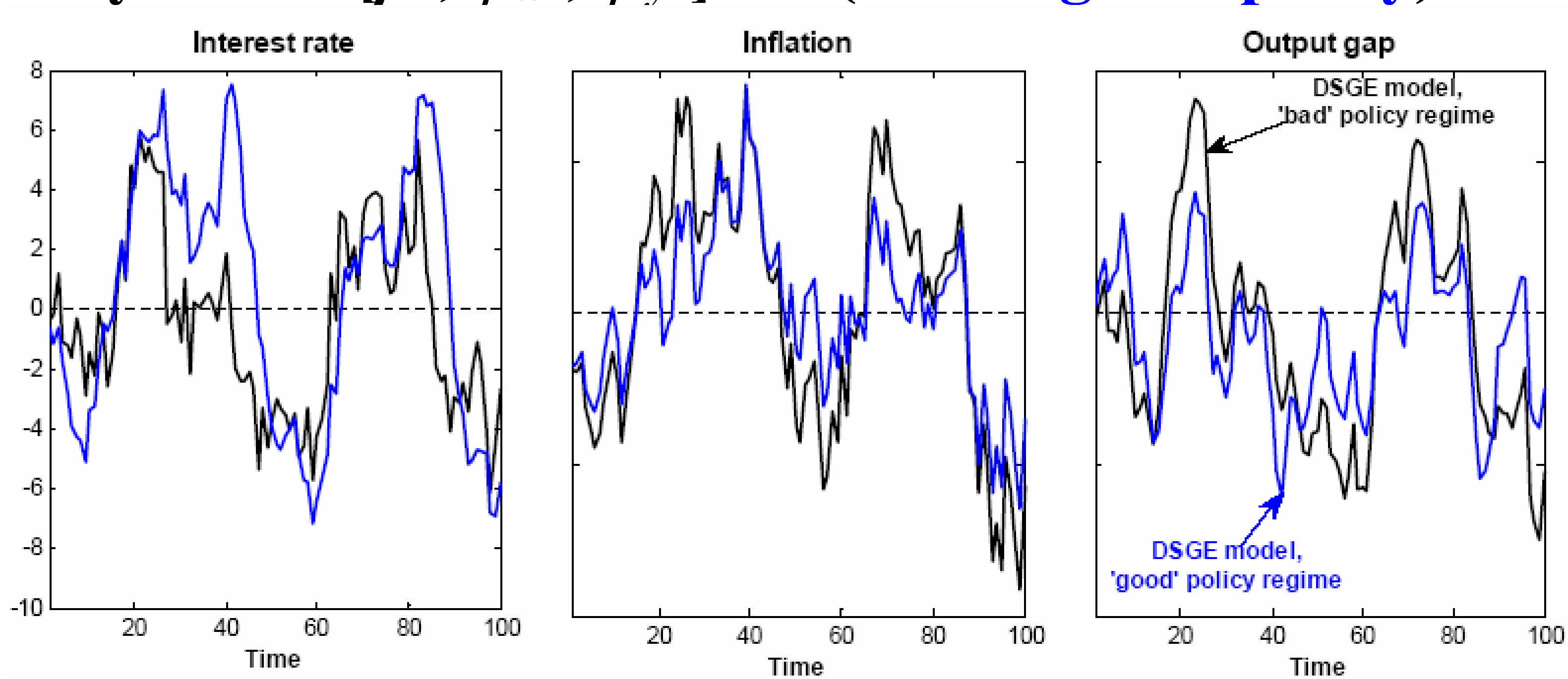
Key issue is: 'Switching MonetaryRule^1 and MonetaryRule^2 is not the same as switching Taylor^1 and Taylor^2'

➔ difference is sometimes large …

A simple illustration:

Feed same set of shocks to New Keynesian 3-equation 'toy' model conditional on two alternative Taylor rules:

- **Taylor[1] ➔ $[\rho^1, \psi_\pi^1, \psi_y^1]$ (call it 'bad' policy)**
- **Taylor[2] ➔ $[\rho^2, \psi_\pi^2, \psi_y^2]$ (call it 'good' policy)**



Switching Taylor[1] and Taylor[2] within the DSGE model causes black lines to become blue, and viceversa …

Two alternative notions of policy counterfactual:

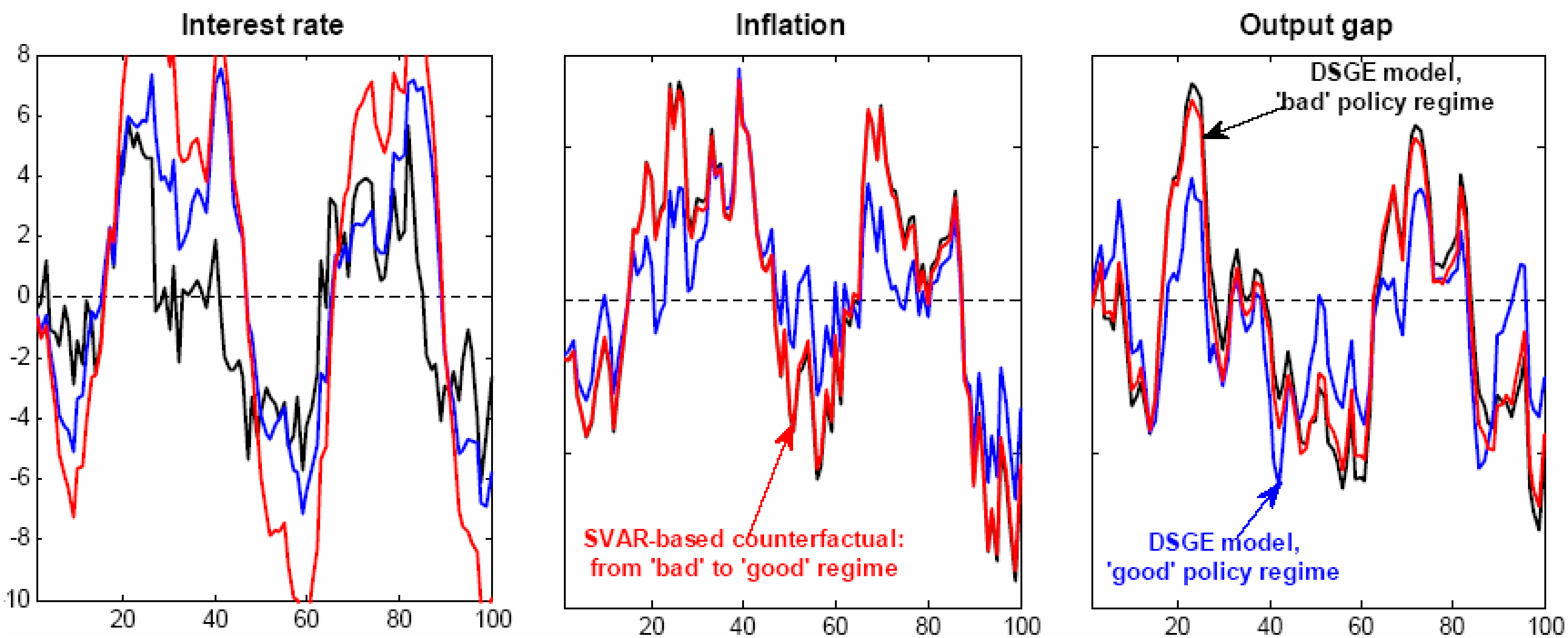
- **Switching Taylor^1 and Taylor^2 within the DSGE model is the authentic policy counterfactual**
- **switching MonetaryRule^1 and MonetaryRule^2 within the SVAR model is the SVAR-based policy counterfactual**

Question: ***'Can I replicate the authentic policy counterfactual by switching the monetary rules of the structural VAR representations of the DSGE models?'***

The answer is NO, and the difference between the outcome of the authentic policy counterfactual and the outcome of the SVAR-based counterfactual is sometimes large …

Let's see in this case how large the error is in going from 'bad' to 'good' ➔ imposing MonetaryRule^2 in SVAR^1

If SVAR-based counterfactual worked, red lines would be identical to the blue lines …but this is clearly not the case …



- **On the contrary, for inflation and output gap you hardly move from the 'bad' regime (➔ red almost identical to black)**
- **SVAR-based counterfactual fails to capture truth**

➔ Let's see results based on numerical methods …

Theoretical properties of SVAR-based policy counterfactuals

- **Model: standard New Keynesian model with backward and forward-looking components**

$$y_t = \gamma y_{t+1|t} + (1-\gamma) y_{t-1} - \sigma^{-1}(R_t - \pi_{t+1|t}) + \epsilon_{y,t}$$

$$\pi_t = \frac{\beta}{1+\alpha\beta}\pi_{t+1|t} + \frac{\alpha}{1+\alpha\beta}\pi_{t-1} + \kappa y_t + \epsilon_{\pi,t}$$

$$R_t = \rho R_{t-1} + (1-\rho)[\phi_\pi \pi_t + \phi_y y_t] + \epsilon_{R,t}$$

- **Country: United States**
- **Sample period: post-1960 period**
- **Bayesian estimates from Benati's (*QJE*, 2008)**

These 'benchmark' estimates imply certain theoretical properties for the economy
➔ trivially recovered from VAR implied by DSGE model …

I will show results from the following exercise:

- **Let Taylor^B ≡ [ρ^B, $\psi_\pi{}^B$, $\psi_y{}^B$] be the estimated benchmark Taylor rule**
- **Let Taylor^A ≡ [ρ^A, $\psi_\pi{}^A$, $\psi_y{}^A$] be an alternative Taylor rule, with different values of the key coefficients**

We have

Taylor^B → DSGE^B → SVAR^B → MonetaryRule^B
Taylor^A → DSGE^A → SVAR^A → MonetaryRule^A

which implies two sets of theoretical standard deviations for the series

SVAR^B → STDs^B
SVAR^A → STDs^A

By definition, Substituting Taylor^{A} with Taylor^{B} implies that STDs^{A} becomes STDs^{B}

Question: *'What if I try to do that via the SVARs, by imposing MonetaryRule^{B} into SVAR^{A}?'*

Let STDs^{C} (C for counterfactual) be the theoretical standard deviations of the series produced by such SVAR-based policy counterfactual

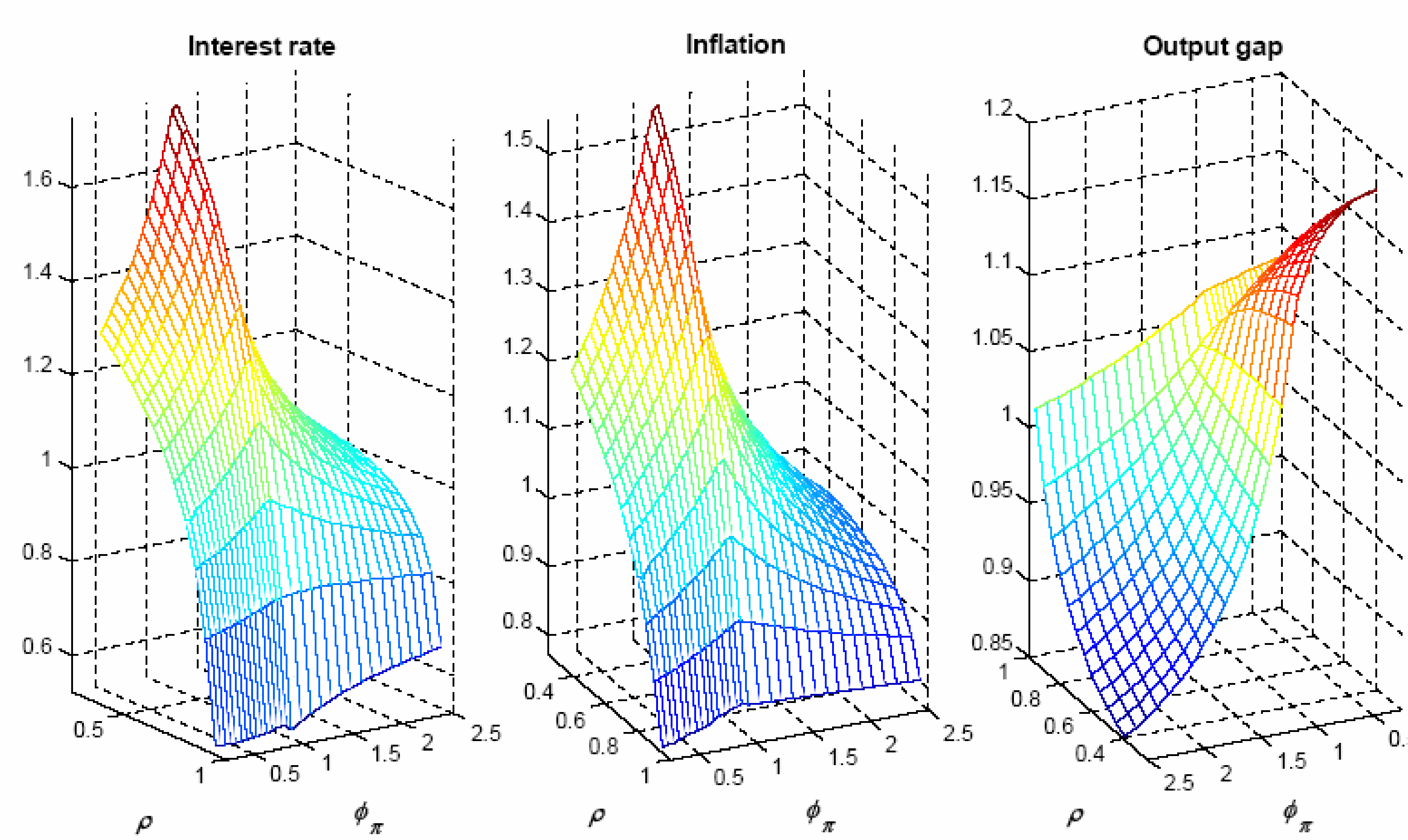
If it worked fine, we would have, for each variable

$$\text{STDs}^{C} = \text{STDs}^{B}$$

So that for each possible alternative Taylor rule (Taylor^{A}), their ratio would be uniformly one …

➔ but that's not the case

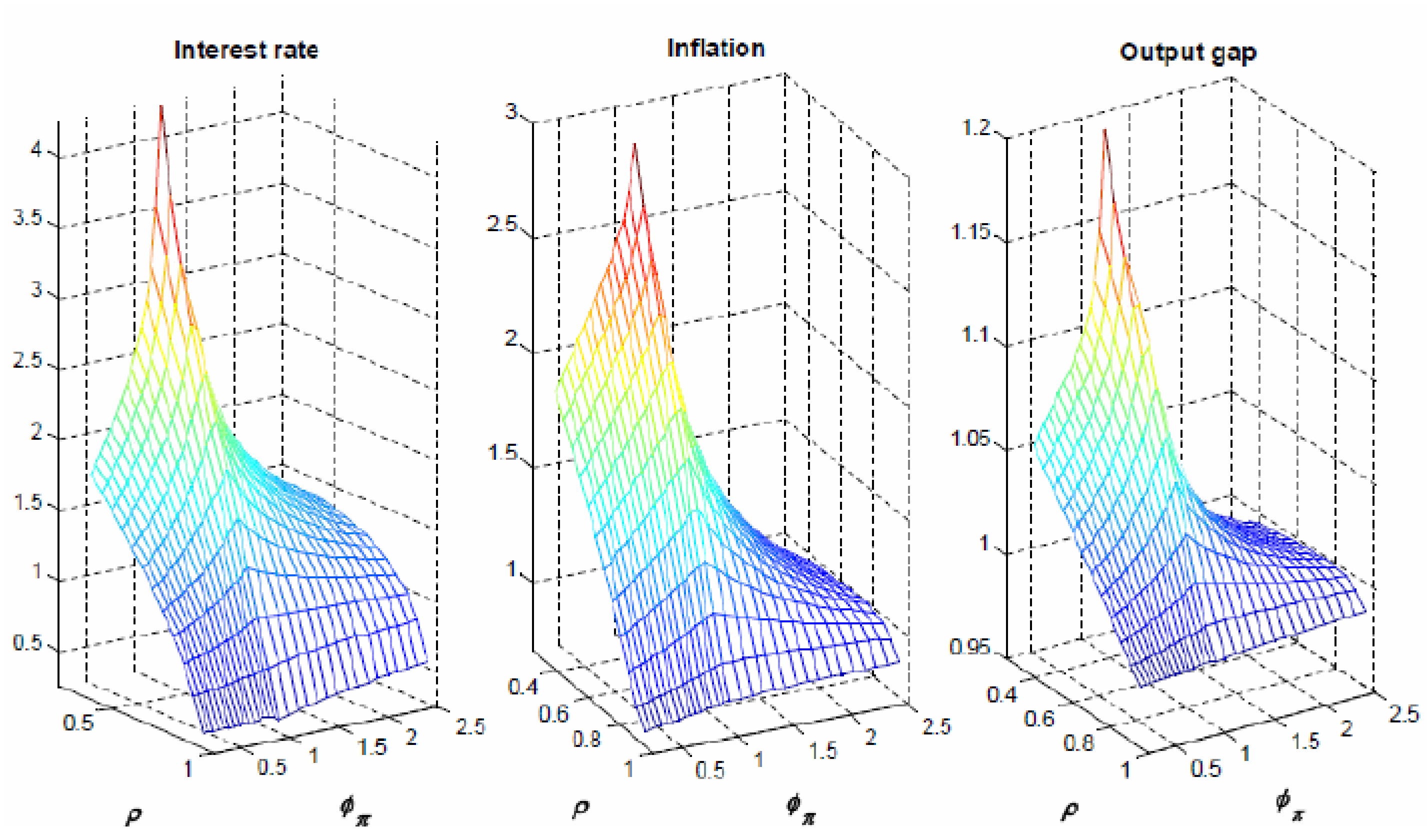
The ratio STDs^{C}/STDs^{B} for grids of values for ρ^{A} and ψ_{π}^{A}:



Only close to 1 if Taylor^{A} is close to Taylor^{B} …

➔ In general, SVAR-based counterfactual fails …

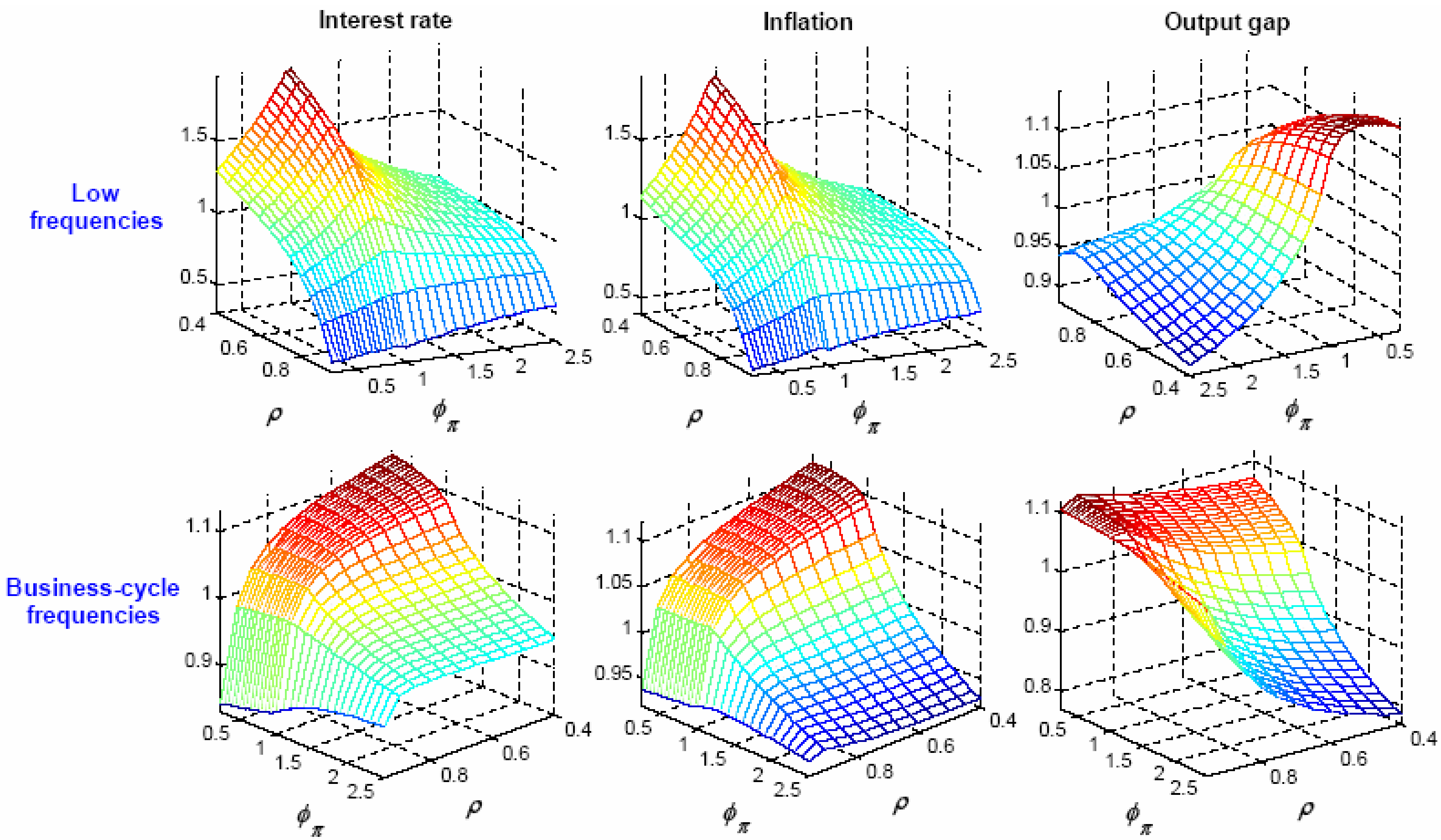
Same results based on two alternative DSGE models:
(*i*) Lubik and Schorfheide (*AER*, 2004)
(*ii*) Andres, Lopes-Salido, and Nelson (*JEDC*, 2009),
which I estimate for post-WWII United States



Results based on Lubik and Schorfheide (*AER*, 2004)

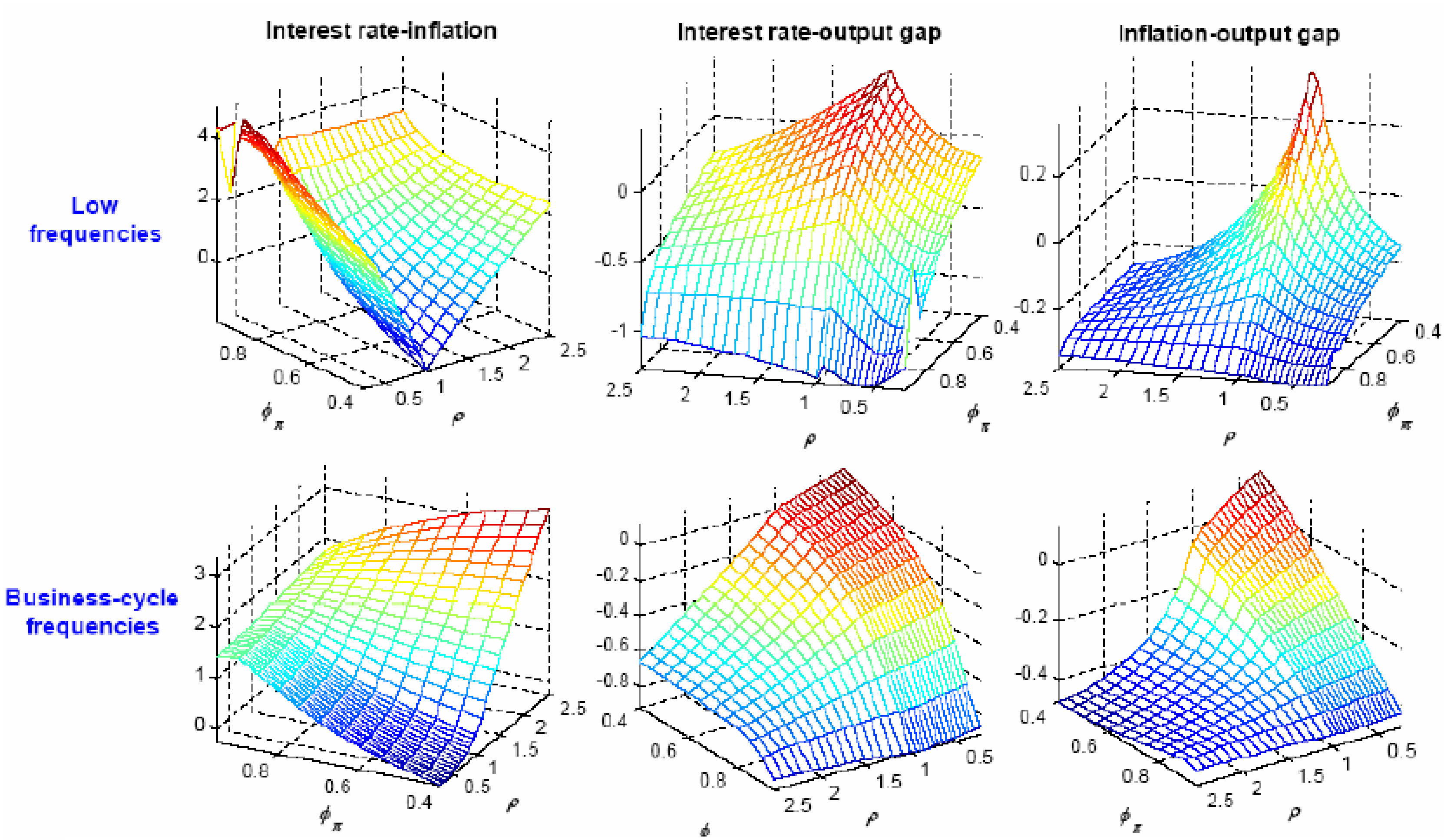
More evidence on this based on theoretical cross-spectral statistics between benchmark and counterfactual VARs

If counterfactual worked well, for each series cross-spectral gain between benchmark and counterfactual would be one



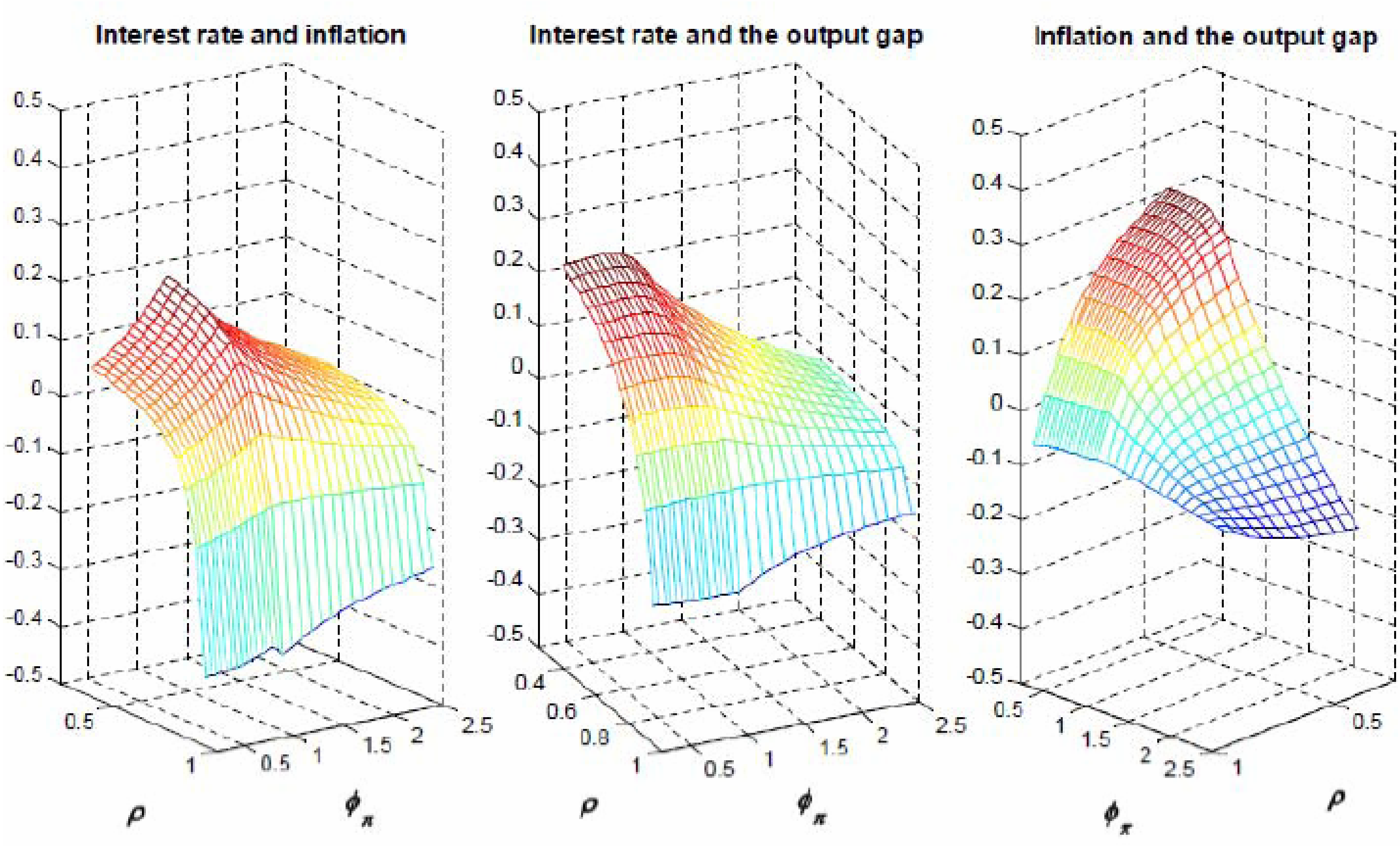
It clearly is not …

SVAR-based counterfactual also distorts macro relationships:



I: Difference between counterfactual and benchmark cross-spectral gains is sometimes large …

II: Difference between counterfactual and benchmark unconditional correlations:



‘Where does the problem originate from?’

I show it is due to the cross-equations restrictions imposed by rational expectations on the solution of macroeconomic models with forward-looking components …

Formally, let the SVAR representations of the DSGE model conditional on 2 alternative values of the policy parameters, θ_1 and θ_2, be:

$$\tilde{B}_0(\theta_1)Y_t = \tilde{B}_1(\theta_1)Y_{t-1} + ... + \tilde{B}_p(\theta_1)Y_{t-p} + \epsilon_t$$

$$\tilde{B}_0(\theta_2)Y_t = \tilde{B}_1(\theta_2)Y_{t-1} + ... + \tilde{B}_p(\theta_2)Y_{t-p} + \epsilon_t$$

The SVAR-based counterfactual associated with imposing the SVAR’s structural monetary rule for regime 2 onto the SVAR for regime 1 produces the following structure:

$$\left[\begin{array}{c} \tilde{B}_0^R(\theta_2) \\ \tilde{B}_0^{\sim R}(\theta_1) \end{array}\right] Y_t = \left[\begin{array}{c} \tilde{B}_1^R(\theta_2) \\ \tilde{B}_1^{\sim R}(\theta_1) \end{array}\right] Y_{t-1} + \ldots + \left[\begin{array}{c} \tilde{B}_p^R(\theta_2) \\ \tilde{B}_p^{\sim R}(\theta_1) \end{array}\right] Y_{t-p} + \epsilon_t$$

The problem is clear:

- **SVAR-based counterfactual only changes θ in the interest rate equation**
- **it leaves θ unchanged in the other equations**

Therefore, in general, results from SVAR-based counterfactual are different from results of DSGE-based counterfactual …

Now let’s see an extreme example in which the model solution is vector white noise: I show this is only case in which SVAR-based counterfactual works …

Analytical example:

An extreme example: consider a purely forward-looking New Keynesian model:

$$R_t = \rho R_{t-1} + (1-\rho)[\phi_\pi \pi_t + \phi_y y_t] + \epsilon_{R,t}$$

$$\pi_t = \beta \pi_{t+1|t} + \kappa y_t + z_t$$

$$y_t = y_{t+1|t} - \tau(R_t - \pi_{t+1|t}) + g_t$$

Setting $\phi_y=\rho=\rho_z=\rho_g=0$, under determinacy model has following 'VAR representation' *sui generis*:

$$\underbrace{\begin{bmatrix} R_t \\ \pi_t \\ y_t \end{bmatrix}}_{Y_t} = \underbrace{\frac{1}{1+\kappa\tau\phi_\pi}\begin{bmatrix} 1 & \kappa\phi_\pi & \phi_\pi \\ -\kappa\tau & \kappa & 1 \\ -\tau & 1 & -\tau\phi_\pi \end{bmatrix}}_{A_0} \underbrace{\begin{bmatrix} \epsilon_{R,t} \\ z_t \\ g_t \end{bmatrix}}_{\epsilon_t}$$

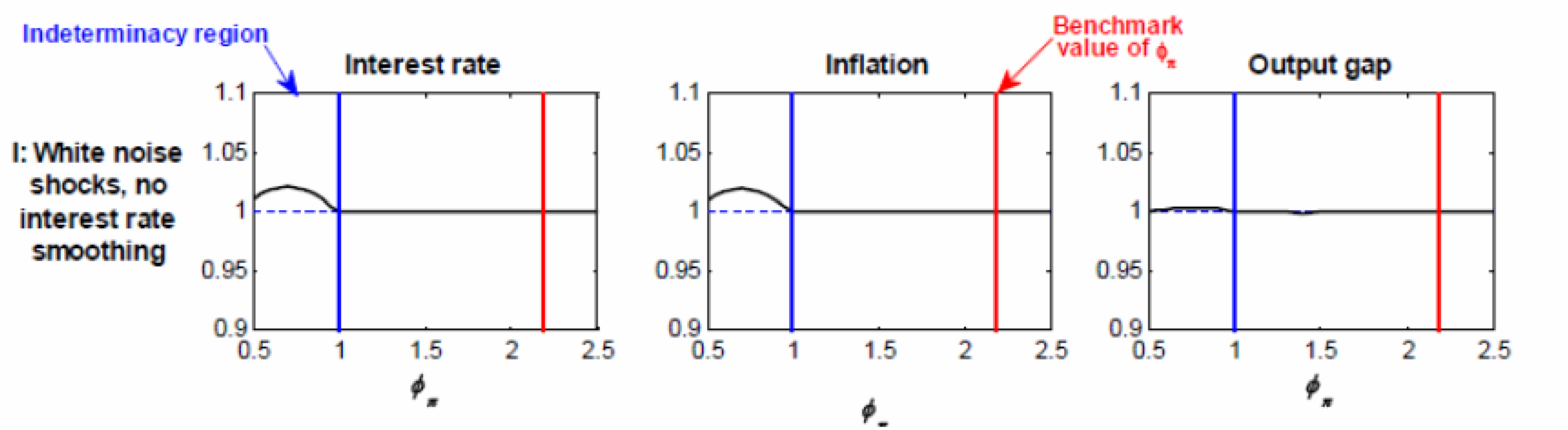
No dynamics because (*i*) model is purely forward-looking; (*ii*) shocks are white noise; (*iii*) solution under determinacy

SVAR representation is:

$$\underbrace{\begin{bmatrix} 1 & -\phi_\pi & 0 \\ \tau & 0 & 1 \\ 0 & 1 & -\kappa \end{bmatrix}}_{A_0^{-1}} \underbrace{\begin{bmatrix} R_t \\ \pi_t \\ y_t \end{bmatrix}}_{Y_t} = \underbrace{\begin{bmatrix} \epsilon_{R,t} \\ z_t \\ g_t \end{bmatrix}}_{\epsilon_t}$$

Policy parameter only appears in the interest rate equation, but not in the other equations …

➔ this suggests SVAR-based counterfactuals should work fine



Indeed, it does …

In the figure in previous page notice that SVAR-based counterfactual still fails under indeterminacy …

Lubik and Schorfheide (*JEDC* 2003, *AER* 2004):

- **under indeterminacy, solution depends on additional latent AR(1) process**
  ➔ expectations of inflation and output gap—which depend on policy parameter—do not drop out of IS and Phillips curves
  ➔ policy parameter enters the SVAR equations for inflation and output gap

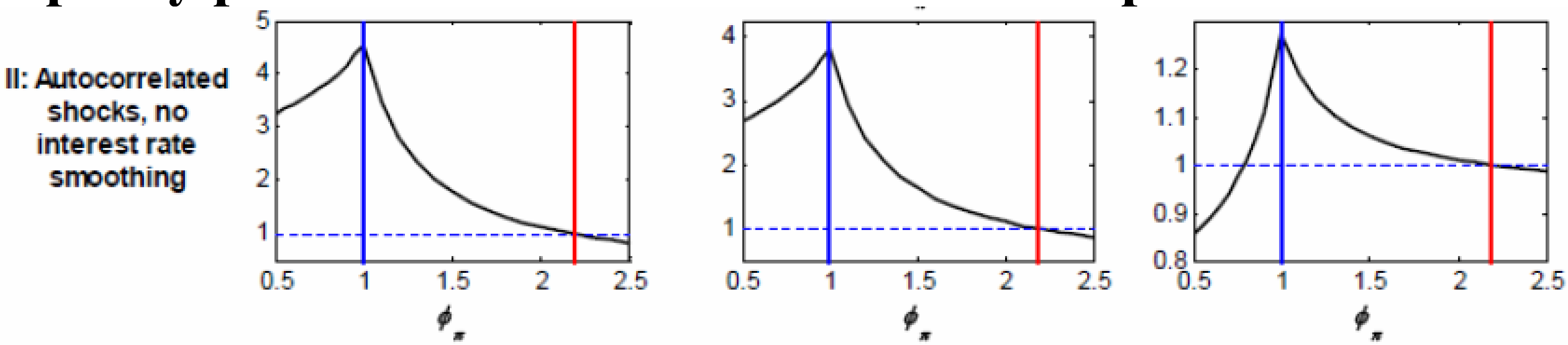
However, even under determinacy, as soon as you relax these extreme assumptions, the counterfactual fails …

Let's relax the assumption of white noise shocks …

Assume shocks to IS and Phillips curves are AR(1) processes.

I show analytically—see equation (17)—that now inflation, output, contain AR(1) component, so that

- **their expectations are not zero**
- **such non-zero expectations cause complex convolutions of policy parameter to enter the IS and Phillips curves …**



SVAR-based counterfactual fails even under determinacy,

➔ Analogous results for models with partly backward-looking components in the IS and Phillips curves …

'How relevant is the problem in practice?'

Only way to answer would be to know the true data generation process …

In what follows I will provide tentative evidence on likely practical relevance of the problem, based on estimated DSGE models for Great Inflation and most recent period

- **Countries: United States, United Kingdom**
- **Models: (*i*) standard New Keynesian backward- and forward-looking, and (*ii*) Andres, Lopes-Salido, and Nelson (*JEDC*, 2009)**
- **Estimation: Bayesian ➔ Random-Walk Metropolis**
- **I allow for one-dimensional indeterminacy, but no sunspot shocks**

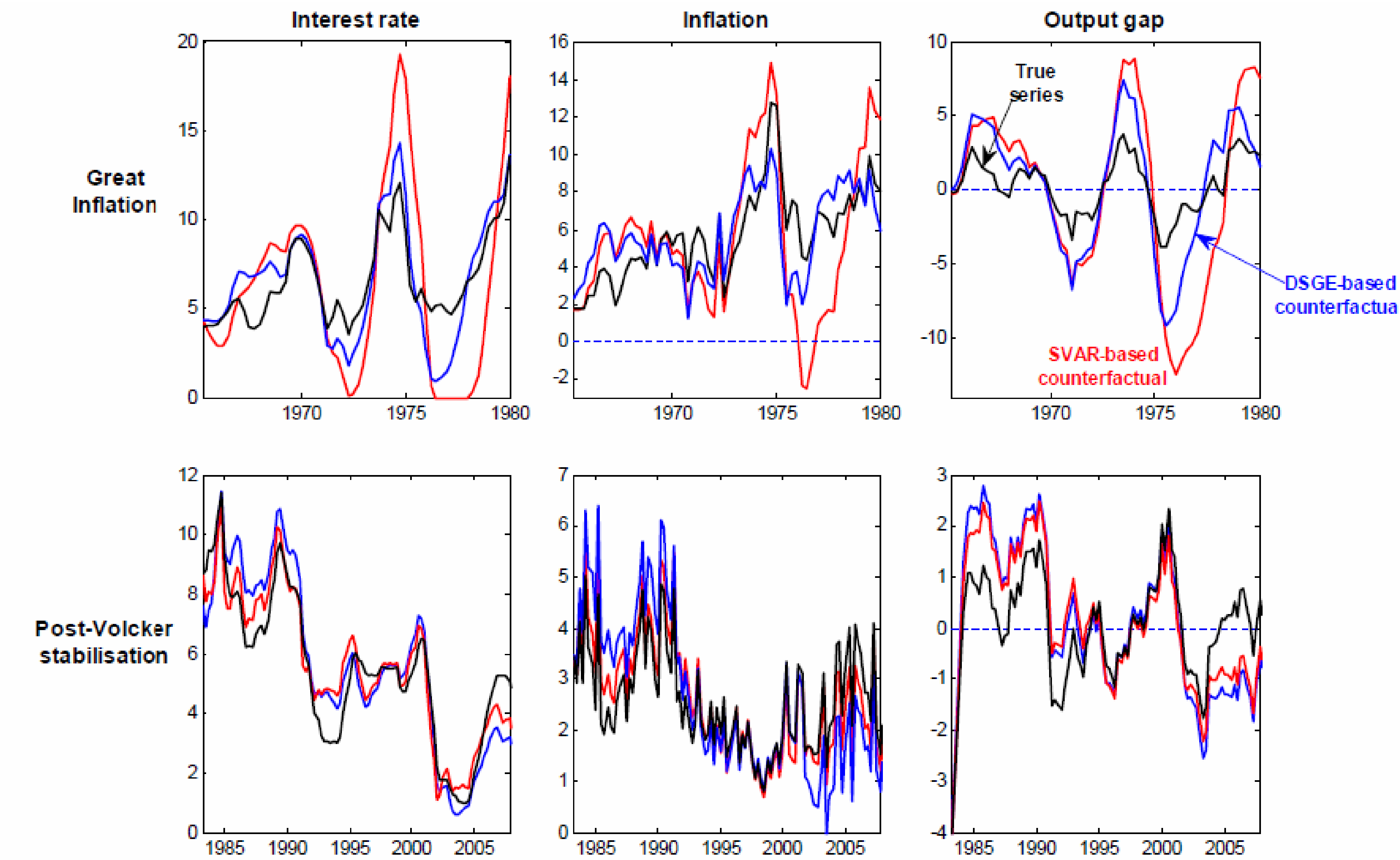
  ➔ with sunspot shocks, identification problem under indeterminacy …

Then, based on estimated models for two periods, I perform policy counterfactuals

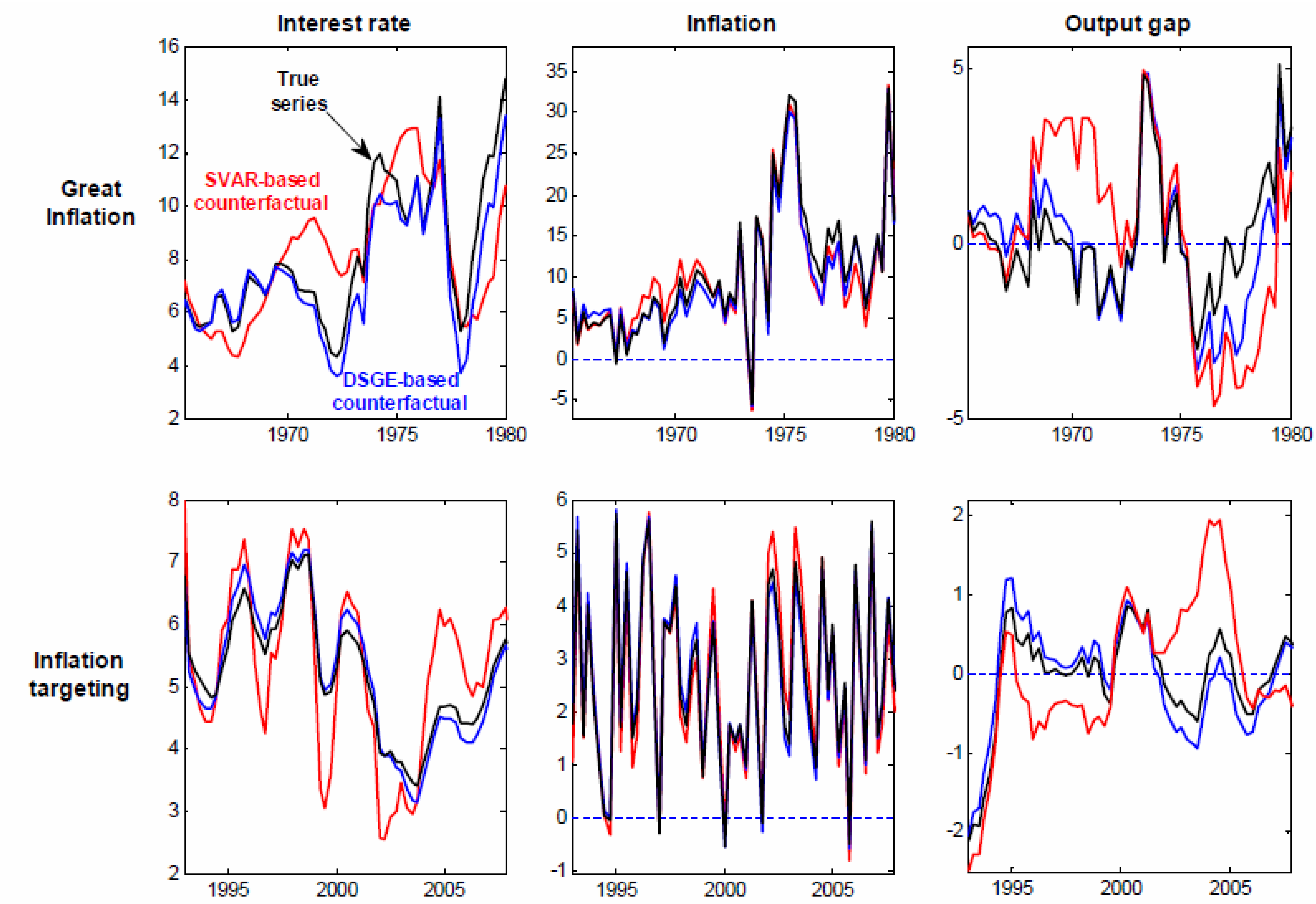
- **both DSGE-based and SVAR-based**
- **for both periods**

Let's see the results …

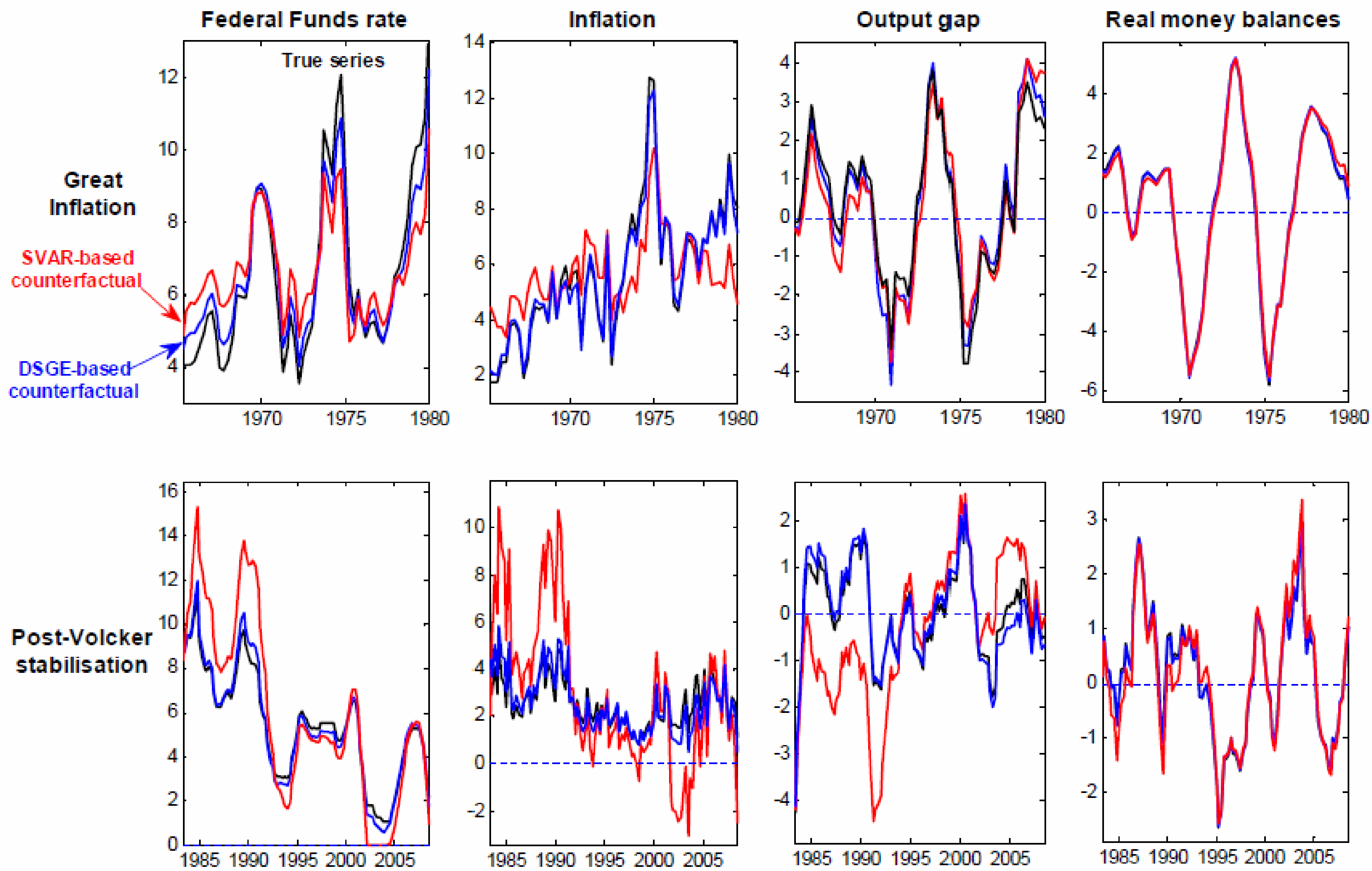
I: U.S., New Keynesian backward- and forward-looking model



II: U.K., New Keynesian backward- and forward-looking model



IIi: U.S., Andres *et al.* (JEDC, 2009) model



Key points to stress: I

Results are already sufficiently bad without sunspots …

If I allow for sunspots, everything becomes worse, because

- **there's an identification problem under indeterminacy (*N* VAR residuals, *N*+1 shocks)**
  ➔ 'identified' shocks under indeterminacy are not true structural shocks
- **the DSGE-based counterfactual 'kills off' the sunspots, the SVAR-based one cannot …**
  ➔ results are necessarily distorted

Key points to stress: II

SVAR-based counterfactuals suffer from key logical problem

- **reliability crucially depends on unknown structural characteristics of data generation process**
  ➔ extent of forward- as opposed to backward-looking behaviour, etc.

- **you can't just assume it**

- **only way to check for reliability within specific context is to estimate a (DSGE) structural model …**

- **but that's exactly what the SVAR methodology wanted to avoid in the first place!!**

Summing up

SVAR-based counterfactuals perform well only conditional on extreme model features → model solution is vector white noise

Under normal circumstances SVAR-based counterfactuals always suffer from an approximation error which can be quite substantial …

Results from SVAR-based counterfactuals should be taken with caution, precisely because they may suffer from a substantial imprecision …

SVAR-based counterfactuals suffer from crucial logical problem: only way to check for reliability within specific context is to estimate structural model …