Rethinking Monetary Policy Rules

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Rethinking Monetary Policy Rules: Outline

- The Taylor rule: positive and normative aspects
- Pitfalls in the use of a Taylor rule for monetary policy assessment
- The case for *long term real interest rate rules*

Sources:
- Keynes Lecture at U. of Cambridge
- Jackson Hole discussion of Nakamura, Riblier and Steinsson's "Beyond the Taylor Rule"

The Taylor Rule

- The original Taylor rule (Taylor (1993)):

$$i_t = 4 + 1.5(\pi_t - 2) + 0.5\widehat{y}_t$$

The Original Taylor Rule

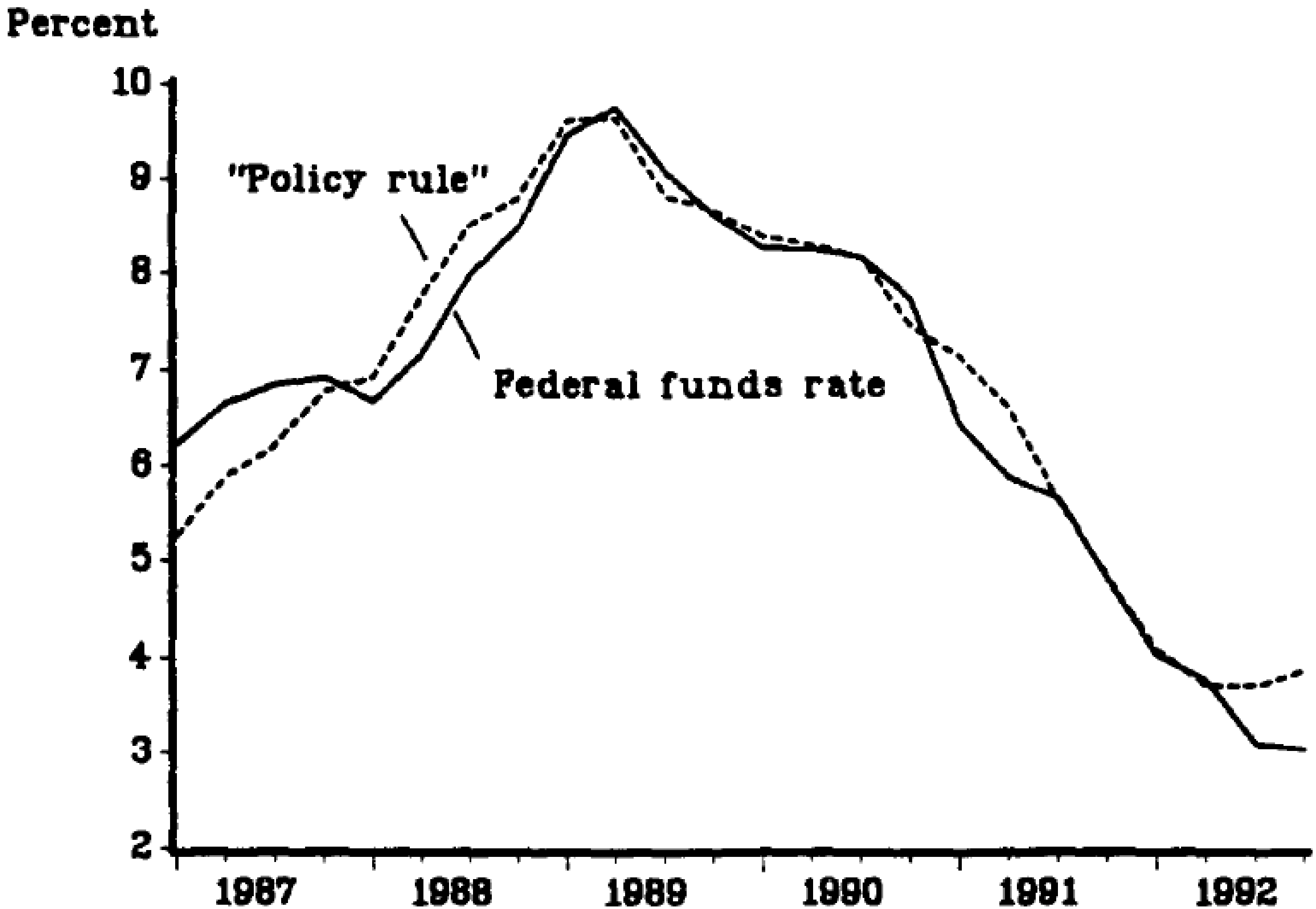


Figure 1. Federal funds rate and example policy rule.

Source: Taylor (1993)

The Taylor Rule

- The original Taylor rule (Taylor (1993)):

$$i_t = 4 + 1.5(\pi_t - 2) + 0.5\widehat{y}_t$$

- Baseline interest rate rule in NK models:

$$i_t = \phi_0 + \phi_\pi \pi_t + \phi_y \widehat{y}_t + v_t$$

- Positive vs normative dimensions of the Taylor rule
- Illustration: U.S. Monetary Policy vs Taylor Rule (Nakamura et al. (2025))

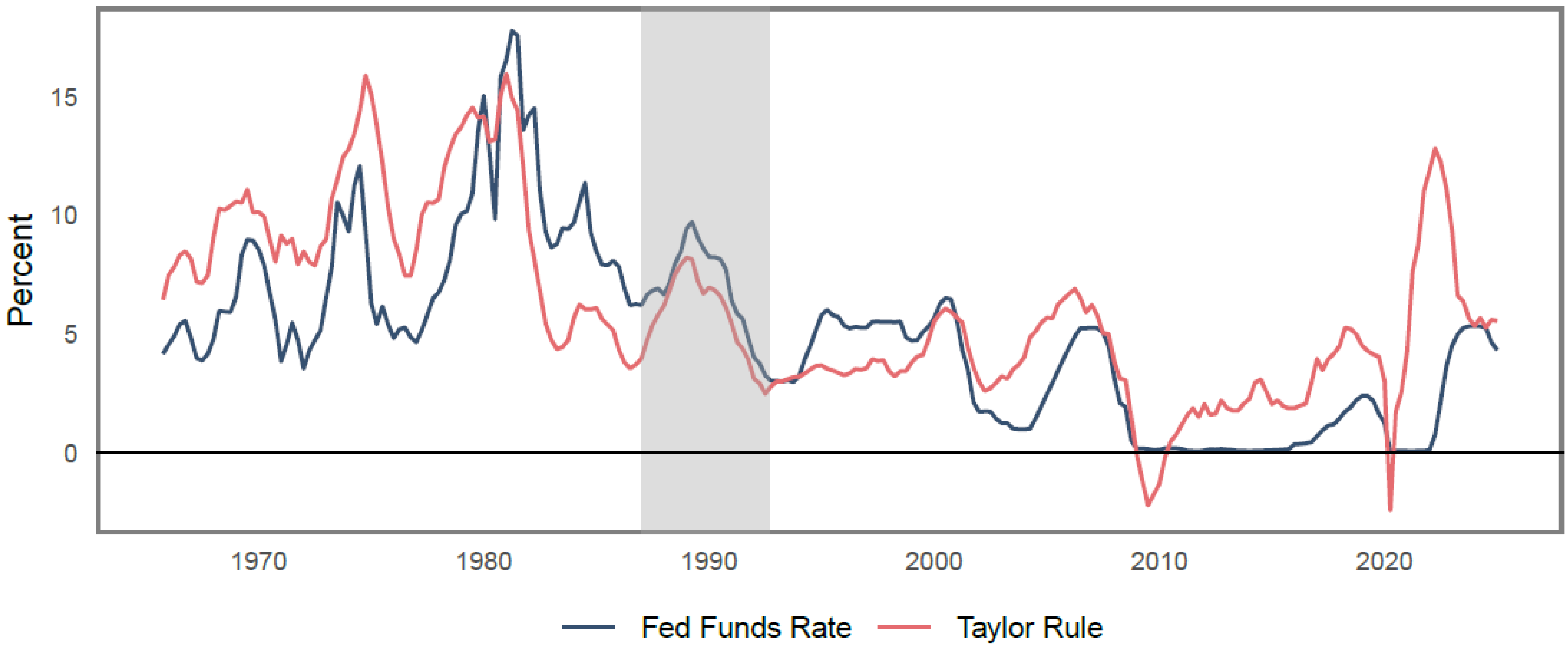


Figure 4: Original Taylor Rule with Retrospective Data

Note: The (light) red line shows the policy rate implied by the original Taylor rule—equation (1). We use retrospective data (i.e., the current data vintage) for the GDP deflator and the Greenbook's measure of the output gap (CBO output gap for last few years). The sample period is 1965Q4-2025Q1. The shaded area shows the sample period considered in Taylor (1993).

Source: Nakamura, Riblier and Steinsson (2025)

The Taylor Rule

- The original Taylor rule (Taylor (1993)):

$$i_t = 4 + 1.5(\pi_t - 2) + 0.5\widehat{y}_t$$

- Baseline interest rate rule in NK models:

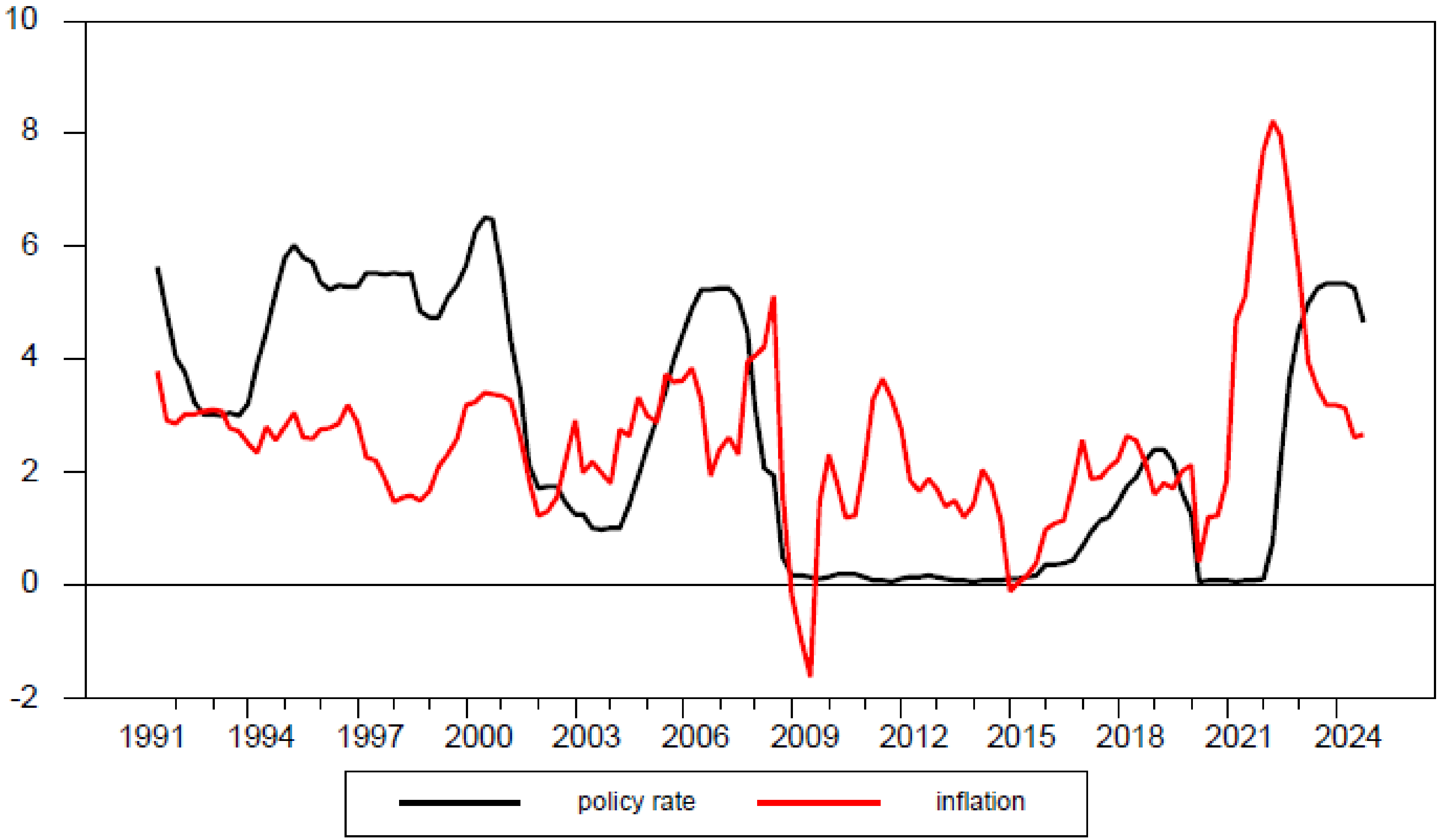
$$i_t = \phi_0 + \phi_\pi \pi_t + \phi_y \widehat{y}_t + v_t$$

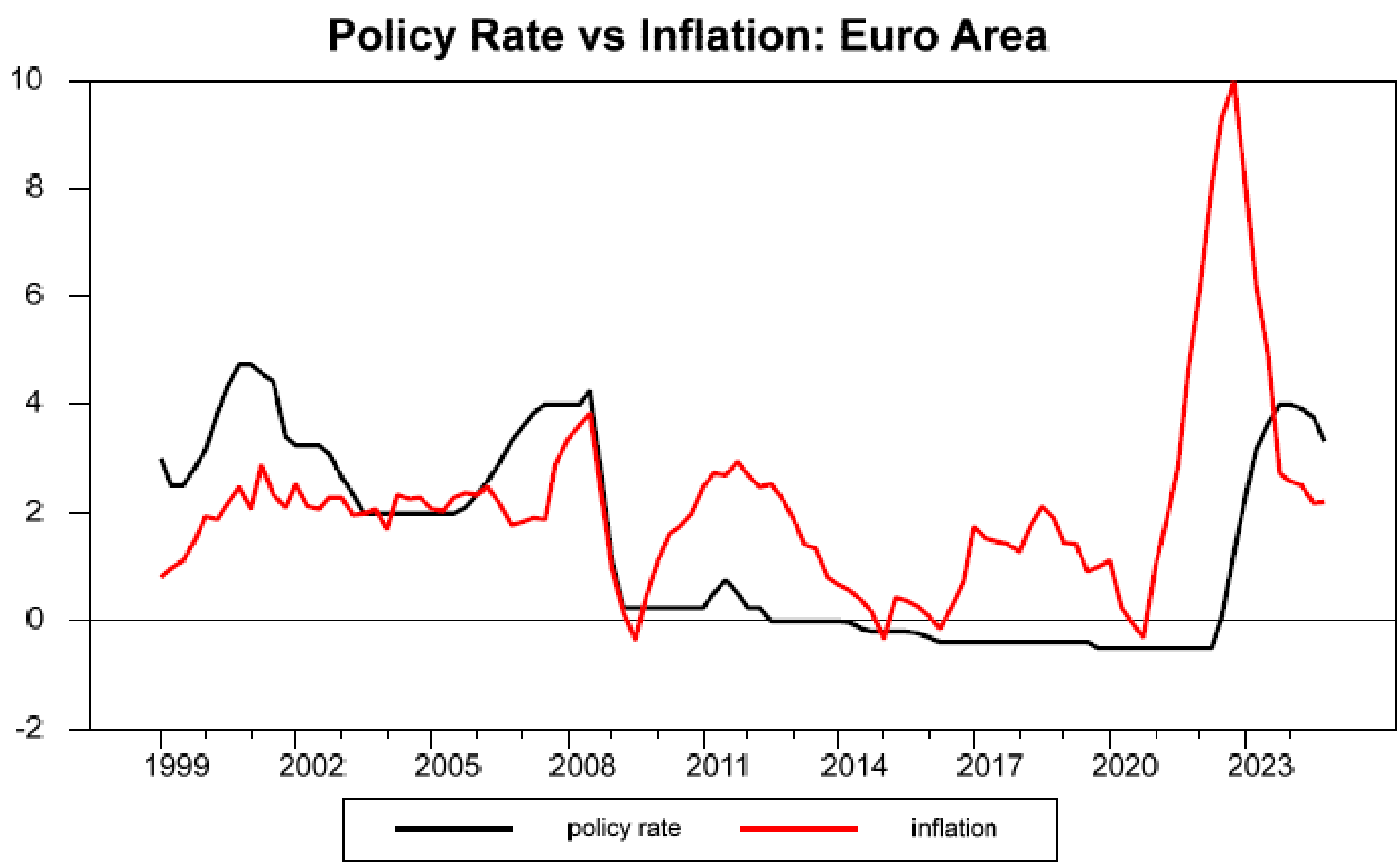
- Positive vs normative dimensions of the Taylor rule
- *Evidence*: U.S. Monetary Policy vs Taylor Rule (Nakamura et al. (2025))
- The Taylor principle

$$\phi_\pi + \frac{1-\beta}{\kappa}\phi_y > 1$$

- *Evidence*: Recent U.S. and euro area developments

Policy Rate vs Inflation: U.S.




Policy Rate vs Inflation: Euro Area
10
8
6
4
2
0
-2
1999
2002
2005
2008
2011
2014
2017
2020
2023
policy rate
inflation

Pitfalls in the Use of Taylor Rules for Policy Assessment

Two Observations

1. Optimal monetary policy is not generally implementable by means of a simple Taylor rule. $\Rightarrow$ Estimated Taylor rules may be misleading
2. Optimal monetary policy's *observable outcomes* do not always satisfy the Taylor principle. $\Rightarrow$ Deviations from the Taylor principle should not be interpreted as *prima facie* evidence of "bad monetary policy"

Illustration: Taylor rule-based assessment of monetary policy when the central bank follows an optimal policy (discretion and commitment):

$$\min \ \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left(\pi_t^2 + \vartheta \widehat{y}_t^2 \right)$$

subject to:

$$\pi_t = \beta \mathbb{E}_t\{\pi_{t+1}\} + \kappa \widehat{y}_t + u_t \tag{1}$$

$$\widehat{y}_t = \mathbb{E}_t\{\widehat{y}_{t+1}\} - \frac{1}{\sigma}(\widehat{i}_t - \mathbb{E}_t\{\pi_{t+1}\} - z_t) \tag{2}$$

where $u_t = \rho_u u_{t-1} + \varepsilon_t$

Pitfalls in the Use of Taylor Rules for Policy Assessment

Optimal Monetary Policy: The Case of Discretion

- Equilibrium under the optimal policy:

$$\pi_t^* = \frac{\vartheta}{\kappa^2 + \vartheta(1-\beta\rho_u)} \; u_t$$

$$\begin{aligned} i_t^* &= \rho + \frac{\vartheta\rho_u + \sigma\kappa(1-\rho_u)}{\kappa^2 + \vartheta(1-\beta\rho_u)} u_t + z_t \\ &= \rho + \left[\rho_u + \frac{\sigma\kappa}{\vartheta}(1-\rho_u)\right] \pi_t^* + z_t \end{aligned}$$

- Implementation if $\frac{\sigma\kappa}{\vartheta} < 1$

$$i_t = \rho + \left[\rho_u + \frac{\sigma\kappa}{\vartheta}(1-\rho_u)\right] \pi_t + z_t + \varphi_\pi(\pi_t - \pi_t^*)$$

with $\varphi_\pi > \left(1 - \frac{\sigma\kappa}{\vartheta}\right)(1-\rho_u)$

Pitfalls in the Use of Taylor Rules for Policy Assessment

- Observed relation

$$i_t = \rho + \left[\rho_u + \frac{\sigma\kappa}{\vartheta}(1-\rho_u)\right]\pi_t + z_t$$

- Estimated rule $i_t = \alpha + \phi_\pi \pi_t + v_t$

Four remarks

1. If $\frac{\sigma\kappa}{\vartheta} < 1$ an estimated Taylor rule will (misleadingly) suggest violation of the Taylor principle
2. The residual from the estimated rule should not be interpreted as an exogenous monetary policy shock
3. Risk of no credibility since $\varphi_\pi(\pi_t - \pi_t^*)$ is never observed
4. Implementation through forward-looking rule (CGG 1999):

$$i_t = \rho + \left[1 + \frac{\sigma\kappa}{\vartheta\rho_u}(1-\rho_u)\right]\mathbb{E}_t\{\pi_{t+1}\} + z_t$$

$\Rightarrow$ no misled assessment if $i_t = \alpha + \phi_\pi \mathbb{E}_t\{\pi_{t+1}\} + v_t$ is estimated.

Pitfalls in the Use of Taylor Rules for Policy Assessment

Optimal Monetary Policy: The Case of Commitment

- Equilibrium under the optimal policy

$$\widehat{p}_t^* = \delta \widehat{p}_{t-1}^* + \psi u_t$$

where $\widehat{p}_t \equiv p_t - p_{-1}$ and with $\delta \in (0,1)$ and ψ a function of underlying parameters. Assuming $\rho_u = 0$:

$$i_t^* = \rho + \left(\frac{\sigma\kappa}{\vartheta} - 1\right)(1-\delta)\widehat{p}_t^* + z_t$$

- Implementation if $\frac{\sigma\kappa}{\vartheta} < 1$:

$$i_t = \rho + \left(\frac{\sigma\kappa}{\vartheta} - 1\right)(1-\delta)\widehat{p}_t + z_t + \varphi_p(p_t - p_t^*)$$

with $\varphi_p > (1 - \frac{\sigma\kappa}{\vartheta})(1-\delta)$

Pitfalls in the Use of Taylor Rules for Policy Assessment

- Observed relation

$$i_t = \rho + \left(\frac{\sigma\kappa}{\vartheta} - 1\right)(1-\delta)\widehat{p}_t + z_t$$

- Estimated rule: $i_t = \alpha + \phi_\pi \pi_t + v_t$

$$\widehat{\phi}_\pi \Rightarrow \frac{1}{2}\left(\frac{\sigma\kappa}{\vartheta} - 1\right)(1-\delta)$$

$\Rightarrow$ misled assessment if $\frac{1}{2}\left(\frac{\sigma\kappa}{\vartheta} - 1\right)(1-\delta) < 1$.

- Relation with Nakamura, Riblier and Steinsson (2025)

A Simple Interest Rate Rule: U.S. Evidence

$$i_t = \alpha + \phi_\pi \pi_t + v_t$$

Empirical Interest Rate Rules: U.S. Evidence
1991Q3-2024Q4

	CPI		Core PCE	
π_t	0.15^{***} (0.05)	0.33^{***} (0.09)	0.43^{***} (0.15)	0.68^{***} (0.17)
$\pi_t * ZLB_t$		-0.57^{***} (0.10)		-1.03^{***} (0.14)
R^2	0.28	0.41	0.29	0.49

The Case for Long Term Real Interest Rate Rules

Monetary Policy Transmission and the Long Real Rate

- Consumption

$$\widehat{c}_t = (1-\beta)\left(\sum_{k=0}^{\infty}\beta^k \mathbb{E}_t\{\widehat{y}_{t+k}\}\right) - \frac{\beta}{\sigma}\sum_{k=0}^{\infty}\beta^k \mathbb{E}_t\{\widehat{r}_{t+k}\} + \frac{\beta}{\sigma(1-\beta\rho_z)} z_t$$

where $r_t \equiv i_t - \mathbb{E}_t\{\pi_{t+1}\}$.

- Real yield on a consol paying a constant real coupon:

$$\widehat{r}^L_t \equiv (1-\beta)\sum_{k=0}^{\infty}\beta^k \mathbb{E}_t\{\widehat{r}_{t+k}\}$$

- Accordingly,

$$\widehat{c}_t = (1-\beta)\left(\sum_{k=0}^{\infty}\beta^k \mathbb{E}_t\{\widehat{y}_{t+k}\}\right) - \frac{\beta}{\sigma(1-\beta)}\widehat{r}^L_t + \frac{\beta}{\sigma(1-\beta\rho_z)} z_t$$

The Case for Long Term Real Interest Rate Rules

Monetary Policy Transmission and the Long Real Rate (cont)

- Investment under convex adjustment costs

$$\widehat{i}_t - \widehat{k}_t = \eta \widehat{q}_t$$

where

$$\widehat{q}_t = [1 - \beta(1-\delta)] \sum_{k=0}^{\infty} \beta^k \mathbb{E}_t\{\widehat{r}^K_{t+1+k}\} - \frac{1}{1-\beta}\widehat{r}^L_t$$

The Case for Long Term Real Interest Rate Rules

Monetary Policy Transmission and the Long Real Rate (cont)

- Investment under convex adjustment costs

$$\widehat{i}_t - \widehat{k}_t = \eta \widehat{q}_t$$

where

$$\widehat{q}_t = [1 - \beta(1 - \delta)] \sum_{k=0}^{\infty} \beta^k \mathbb{E}_t \{\widehat{r}^K_{t+1+k}\} - \frac{1}{1 - \beta} \widehat{r}^L_t$$

Some Observations

- The long term real rate r^L_t is a *sufficient statistic* for the impact of monetary policy on aggregate demand.
- It is natural to think of policy in terms of its impact on the long real rate, even to specify policy in terms of a rule for the long real rate.
- A long rate rule does *not* enlarge the set of feasible outcomes (McGough et al., Woodford)
- But empirical long rate rules allow for a better assessment of the adequacy of monetary policy. Illustrated next by assuming optimal policy, evaluated by means of an estimated simple rule.

The Case for Long Term Real Interest Rate Rules

Equilibrium under a Long Real Rate Rule: An Example

- A simple long real rate rule

$$\widehat{r}_t^L = \phi_\pi \pi_t + \phi_y \widehat{y}_t$$

where $\phi_\pi \geq 0$ and $\phi_y \geq 0$. Combined with

$$\widehat{r}_t^L = \beta \mathbb{E}_t\{\widehat{r}_{t+1}^L\} + (1-\beta)\widehat{r}_t$$

$$\widehat{y}_t = \mathbb{E}_t\{\widehat{y}_{t+1}\} - \frac{1}{\sigma}(\widehat{r}_t - z_t)$$

$$\pi_t = \beta \mathbb{E}_t\{\pi_{t+1}\} + \kappa \widehat{y}_t + u_t$$

yields the difference equation for equilibrium output:

$$\widehat{y}_t = \frac{\sigma(1-\beta) + \beta\phi_y}{\sigma(1-\beta) + \phi_y + \kappa\phi_\pi} \mathbb{E}_t\{\widehat{y}_{t+1}\} + \Psi_z z_t + \Psi_u u_t$$

- Necessary and sufficient condition for local uniqueness:

$$\phi_\pi + \frac{1-\beta}{\kappa}\phi_y > 0$$

- Interpretation through the lens of the Taylor Principle

The Case for Long Term Real Interest Rate Rules

Long Rate Rules for Monetary Policy Assessment

- *Optimal policy with discretion* can be implemented with the rule

$$\widehat{r}_t^L = \frac{\sigma\kappa(1-\beta)(1-\rho_u)}{\vartheta(1-\beta\rho_u)}\pi_t + \frac{1-\beta}{1-\beta\rho_z}z_t$$

- The inflation coefficient under the optimal policy is always positive and can be estimated consistently with OLS

$\Rightarrow$ No misled inference on the adequacy of monetary policy
$\Rightarrow$ No unobserved off-equilibrium response required
$\Rightarrow$ The long real rate captures the impact of forward guidance and QE

The Case for Long Term Real Interest Rate Rules

Long Rate Rules for Monetary Policy Assessment

- *Optimal policy with commitment* can be implemented with the rule

$$r_t^L = \rho + \frac{\sigma\kappa}{\vartheta}\Omega[1-(\delta+\rho_u)+\beta\delta\rho_u]\,\widehat{p}_t + \frac{\sigma\kappa}{\vartheta}\Omega(1-\beta)\delta\rho_u\,\widehat{p}_{t-1} + \frac{1-\beta}{1-\beta\rho_z}z_t$$

  where $\Omega \equiv \frac{1-\beta}{(1-\beta\rho_u)(1-\beta\rho_z)} > 0$

- Estimated simple rule: $r_t^L = \alpha + \phi_\pi \pi_t + v_t$
- But OLS estimates of ϕ_π converge to:

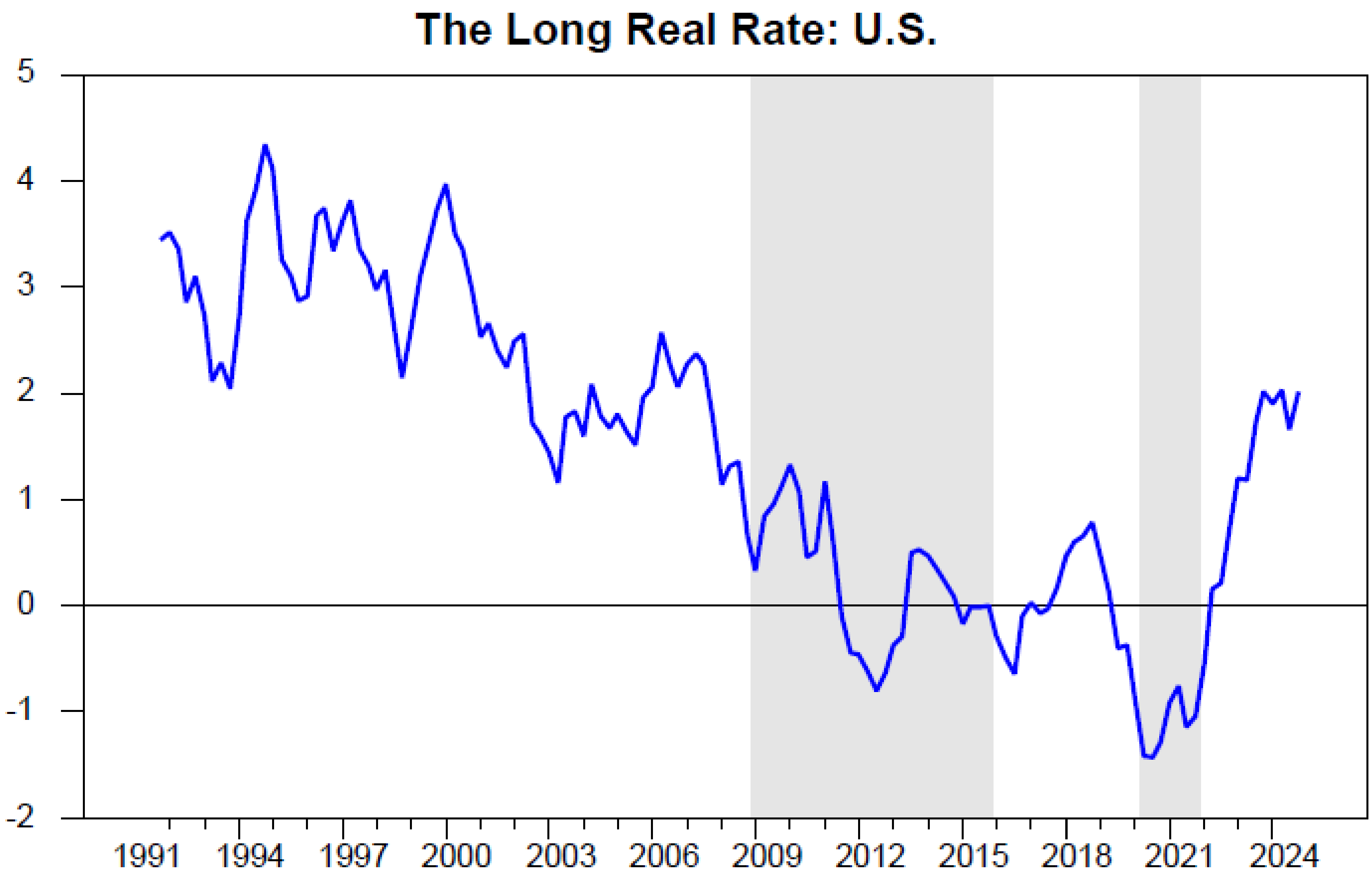
$$\widehat{\phi}_\pi \rightarrow \frac{\sigma\kappa}{2\vartheta}\Omega[1-(\delta+\rho_u)+\delta\rho_u(2\beta-1)]$$

  which will be positive given $\beta \lesssim 1$ since $1-(\delta+\rho_u)+\delta\rho_u > 0$

A Simple Long Rate Rule: U.S. Evidence

$$r_t^L = \alpha + \phi_\pi \pi_t + v_t$$

r_t^L = 10 year Treasury Yield - 10 year SPF inflation forecast


The Long Real Rate: U.S.
5
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A Simple Long Rate Rule: U.S. Evidence

$$r_t^L = \alpha + \phi_\pi \pi_t + v_t$$

r_t^L = 10 year Treasury Yield - 10 year SPF inflation forecast

Empirical Long Real Rate Rules: U.S. Evidence

1991Q3-2024Q4

	CPI		Core PCE	
π_t	0.07^{***} (0.02)	0.14^{***} (0.04)	0.19^{**} (0.07)	0.30^{***} (0.17)
$\pi_t * ZLB_t$		-0.25^{***} (0.10)		-0.46^{***} (0.06)
R^2	0.65	0.04	0.66	0.75

Why Not Long-Term Nominal Rate Rules?

- Nominal yield of a consol with constant nominal coupon:

$$\widehat{i}_t^L = (1-\beta) \sum_{k=0}^{\infty} \beta^k \mathbb{E}_t\{\widehat{i}_{t+k}\}$$

- A simple long-term nominal rate rule

$$\widehat{i}_t^L = \phi_\pi \pi_t + \phi_y \widehat{y}_t$$

where $\phi_\pi \geq 0$ and $\phi_y \geq 0$. Combined with

$$\widehat{i}_t^L = \beta \mathbb{E}_t\{\widehat{i}_{t+1}^L\} + (1-\beta)\widehat{i}_t$$

$$\widehat{y}_t = \mathbb{E}_t\{\widehat{y}_{t+1}\} - \frac{1}{\sigma}\left(\widehat{i}_t - \mathbb{E}_t\{\pi_{t+1}\} - z_t\right)$$

$$\pi_t = \beta \mathbb{E}_t\{\pi_{t+1}\} + \kappa \widehat{y}_t + u_t$$

$\Rightarrow$ uniqueness condition:

$$\phi_\pi + \frac{1-\beta}{\kappa}\phi_y > 1$$

Why Not Long-Term Nominal Rate Rules?

Optimal Policy with Discretion

- Implementation:

$$i_t^L = \rho + \left[\rho_u + \frac{\sigma\kappa}{\vartheta}(1-\rho_u)\right]\frac{1-\beta}{1-\beta\rho_u}\pi_t + \frac{1-\beta}{1-\beta\rho_z}z_t + \varphi_\pi(\pi_t - \pi_t^*)$$

with $\varphi_\pi > 1 - \left[\rho_u + \frac{\sigma\kappa}{\vartheta}(1-\rho_u)\right]\frac{1-\beta}{1-\beta\rho_u}$

- Observed relation:

$$i_t^L = \rho + \left[\rho_u + \frac{\sigma\kappa}{\vartheta}(1-\rho_u)\right]\frac{1-\beta}{1-\beta\rho_u}\pi_t + \frac{1-\beta}{1-\beta\rho_z}z_t$$

- Estimated rule: $i_t^L = \alpha + \phi_\pi \pi_t + v_t$

$\Rightarrow$ estimated inflation coefficient less than one if $\left[\rho_u + \frac{\sigma\kappa}{\vartheta}(1-\rho_u)\right]\frac{1-\beta}{1-\beta\rho_u} < 1$
$\Rightarrow$ misled conclusion regarding indeterminacy
$\Rightarrow$ risk of no credibility since $\varphi_\pi(\pi_t - \pi_t^*)$ is never observed

Why Not Long-Term Nominal Rate Rules?

Optimal Policy with Commitment

- Implementation of *optimal policy with commitment* (assuming $\rho_u = 0$)

$$i_t^L = \rho + \left(\frac{\sigma\kappa}{\vartheta} - 1\right)(1-\delta)\widehat{p}_t + \frac{1-\beta}{1-\beta\rho_z} z_t + \varphi_p (p_t - p_t^*)$$

with $\varphi_p > \left(1 - \frac{\sigma\kappa}{\vartheta}\right)(1-\delta)$

- Observed relation:

$$i_t^L = \rho + \left(\frac{\sigma\kappa}{\vartheta} - 1\right)(1-\delta)\widehat{p}_t + \frac{1-\beta}{1-\beta\rho_z} z_t$$

- Estimated rule: $i_t^L = \alpha + \phi_\pi \pi_t + v_t$

$$\widehat{\phi}_\pi \Rightarrow \frac{1}{2}\left(\frac{\sigma\kappa}{\vartheta} - 1\right)(1-\delta) \lesseqgtr 1$$

$\Rightarrow$ risk of misled inference regarding indeterminacy
$\Rightarrow$ risk of no credibiity if $\frac{\sigma\kappa}{\vartheta} < 1$ since $\varphi_p (p_t - p_t^*)$ unobserved.

Why Not Short-Term Real Rate Rules?

- A simple short-term real rate rule

$$\widehat{r}_t = \phi_\pi \pi_t + \phi_y \widehat{y}_t$$

where $\phi_\pi \geq 0$ and $\phi_y \geq 0$. Combined with

$$\widehat{y}_t = \mathbb{E}_t\{\widehat{y}_{t+1}\} - \frac{1}{\sigma}(\widehat{r}_t - \mathbb{E}_t\{\pi_{t+1}\} - z_t)$$

$$\pi_t = \beta \mathbb{E}_t\{\pi_{t+1}\} + \kappa \widehat{y}_t + u_t$$

$\Rightarrow$ uniqueness condition:

$$\phi_\pi + \frac{1-\beta}{\kappa}\phi_y > 0$$

Why Not Short-Term Real Rate Rules?

- Optimal policy with discretion can be implemented by the rule

$$r_t = \rho + \frac{\sigma\kappa}{\vartheta}(1-\rho_u)\pi_t + z_t$$

with positive estimated inflation coefficient $\Rightarrow$ no misled assessment

- Optimal policy with commitment can be implemented by the rule

$$r_t = \rho + \frac{\sigma\kappa}{\vartheta}(1-\delta-\rho_u)\ \widehat{p}_t + \frac{\sigma\kappa}{\vartheta}\delta\rho_u\ \widehat{p}_{t-1} + z_t$$

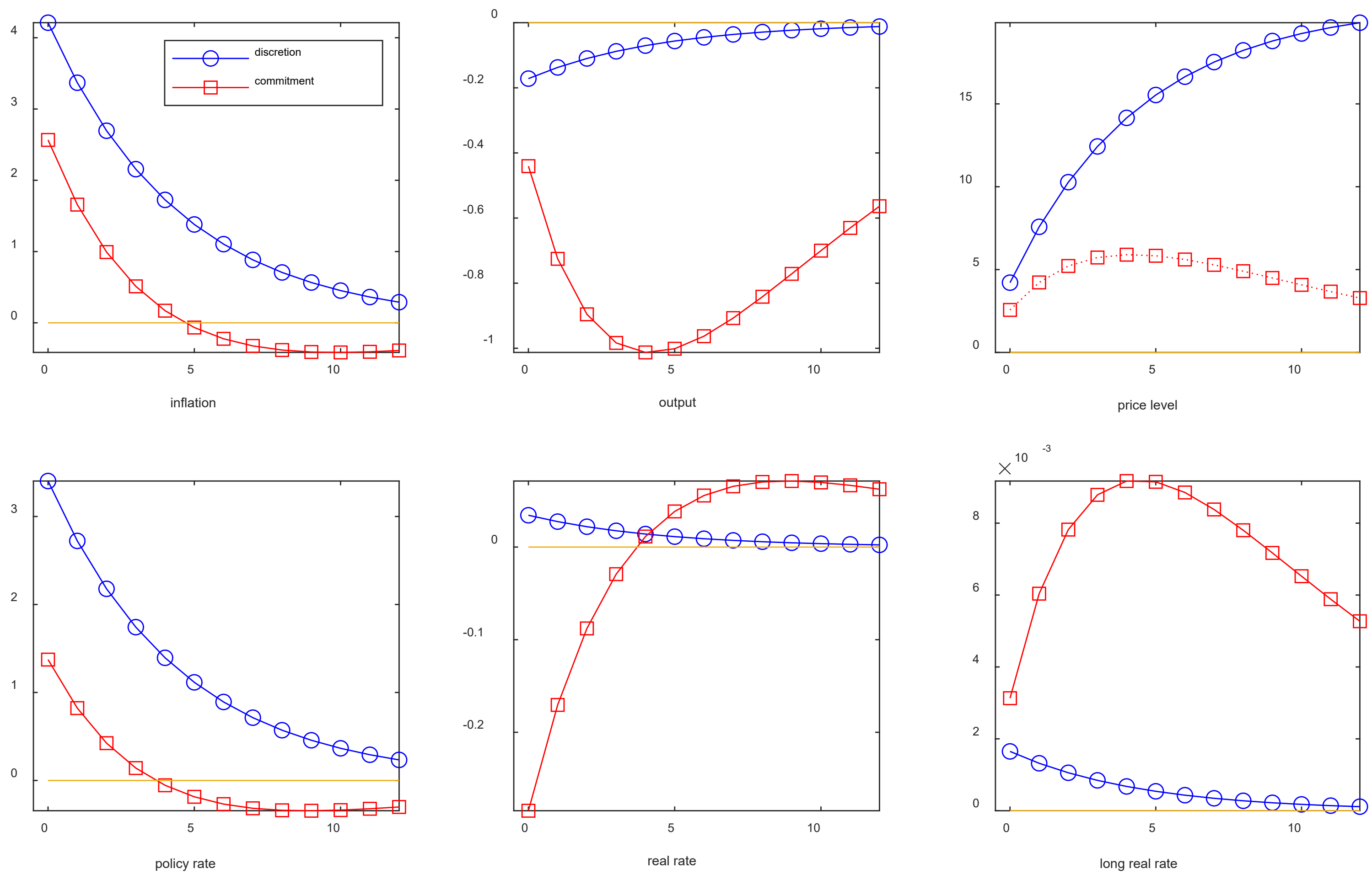
An estimated (mis-specified) rule $r_t = \alpha + \phi_\pi \pi_t + v_t$ implying

$$\widehat{\phi}_\pi \rightarrow \frac{\sigma\kappa}{2\vartheta}(1-\delta-\rho_u-\delta\rho_u)$$

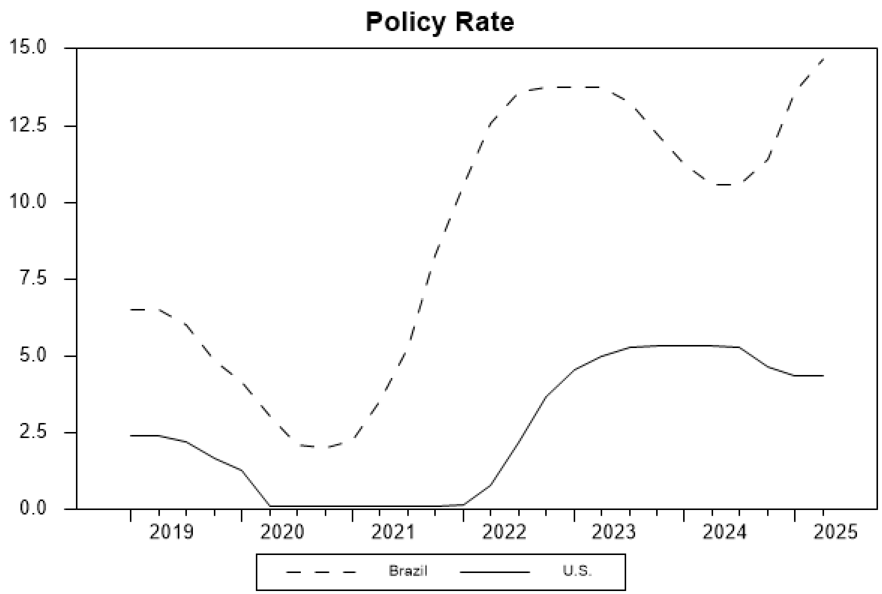
which is negative for $\rho_u > \frac{1-\delta}{1+\delta} \Rightarrow$ risk of misled assessment.

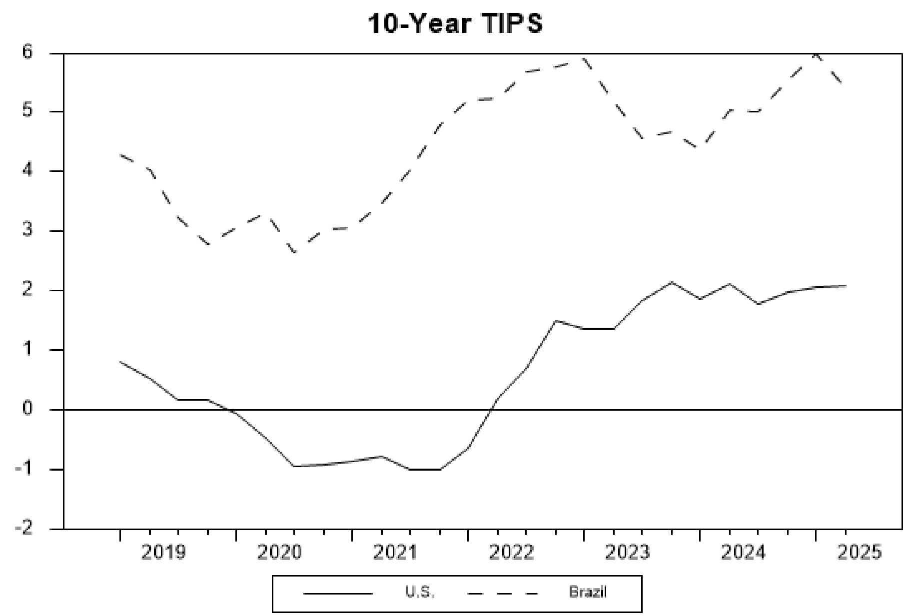
Intuition for negative comovement: See simulations.

Optimal Monetary Policy: Discretion vs Commitment



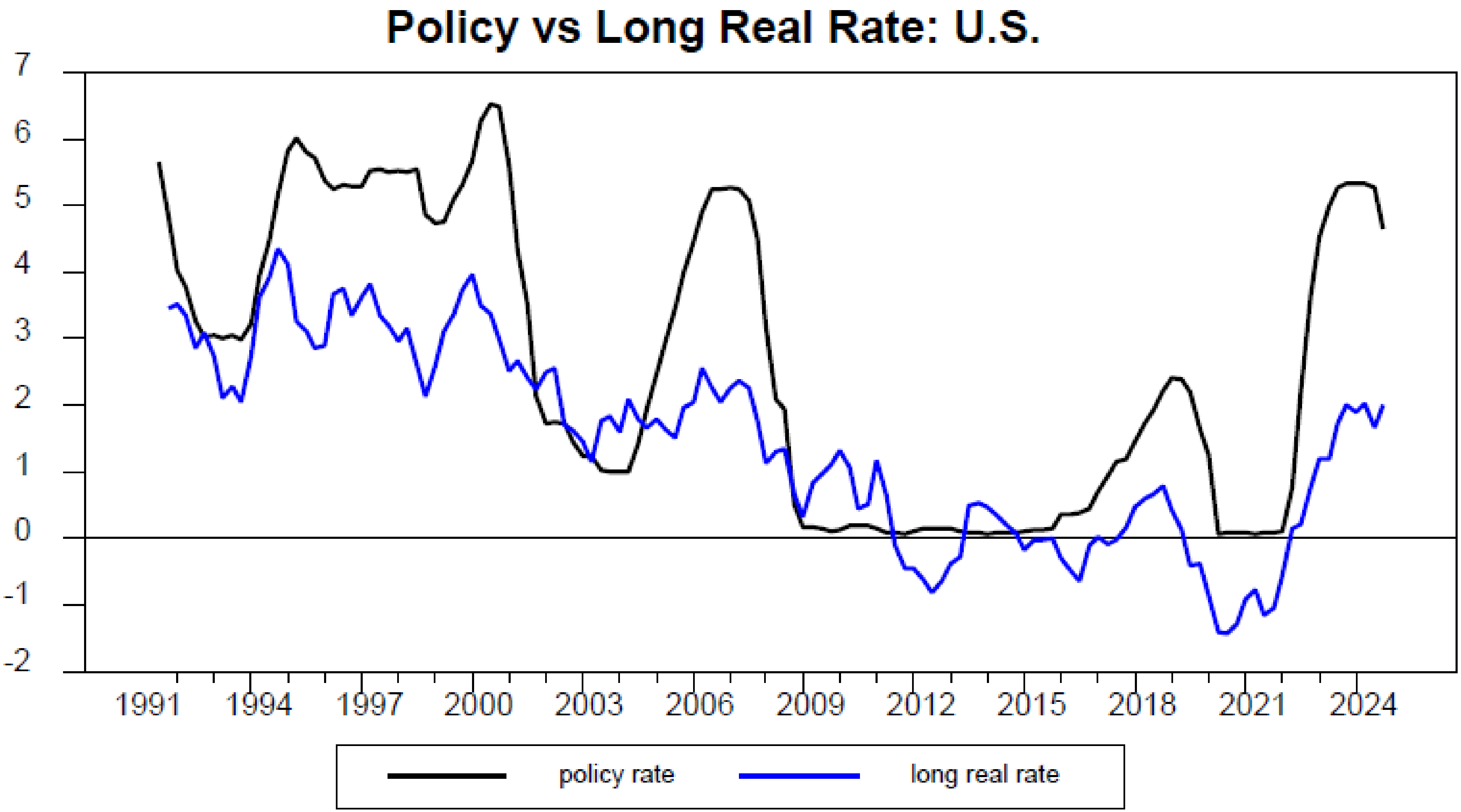
Monetary Policy Responses to the Inflation Surge: U.S. vs Brazil





Main Takeaways

- Fitted Taylor-type rules may be misleading, unless the central bank literally follows a Taylor rule.
- Through the lens of the NK model, the long real rate is the best indicator of the monetary policy stance at any point in time.
- Simple long real rate rules may be embedded easily in a standard NK model
- Empirical long real rate rules may provide a better assessment of the adequacy of monetary policy.



Policy vs Long Real Rate: U.S.
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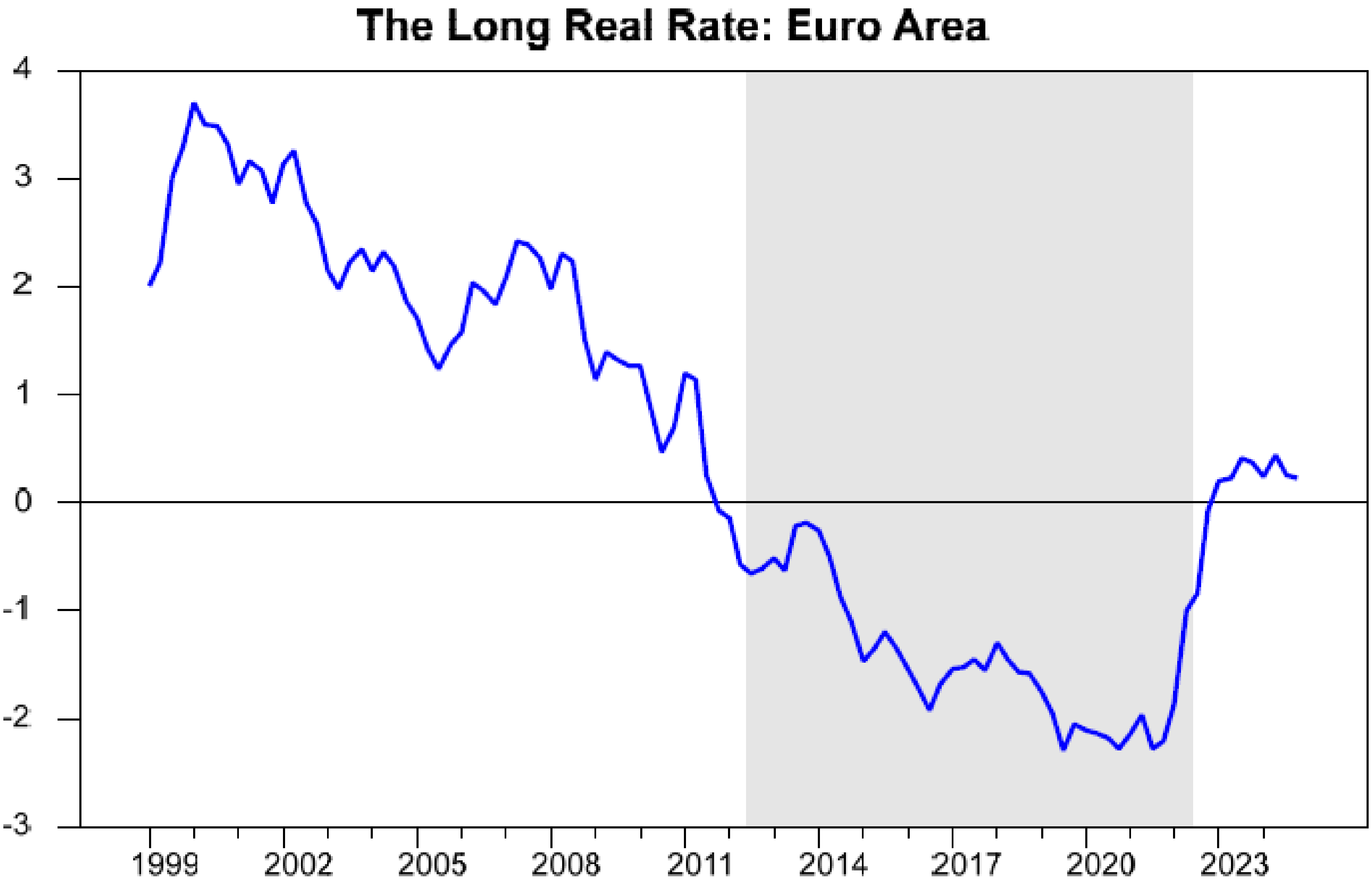
policy rate
long real rate


The Long Real Rate: Euro Area
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2020
2023