Targeted Taylor Rules: Some Evidence and Theory

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Taylor rules

- Substantial theoretical research has looked for simple *normative* rules to guide the conduct of monetary policy (McCallum (1999), Taylor (2007), Taylor and Williams (2010)).
- One notable simple policy rule derived within this line of research is the Taylor (1993) rule:

$$i_t = i^* + 1.5\,\widehat{\pi}_t + 0.5\,\widehat{y}_t$$

- In parallel, a companion *empirical* literature has estimated simple policy rules to summarise Fed's actual policy reaction function (*e.g.* Clarida et al. (2000), Carvalho et al. (2021)).
- None of these strands of literature allowed the monetary policy rules to depend on the nature of shocks buffeting the economy — and, more specifically, on the nature of underlying inflation.

Fed Statements

- This assumption is at loggerheads with Federal Reserve statements over the years.

  *"The idea that **the response to the inflationary effects of supply shocks should be attenuated** arises, in part, from the **trade-off** presented by those shocks. The response of monetary policy to higher prices stemming from an adverse supply shock should be attenuated because it would otherwise amplify the unwanted decline in employment." (J. Powell (2023))*

This paper

- Provides empirical evidence that US monetary policy has reacted asymmetrically to supply– versus demand–driven inflation:
  - aggressive response to demand–driven inflation: estimated Taylor coefficient around four
  - weak response to supply–driven inflation: estimated Taylor coefficient slightly above one
- Argues that this asymmetry
  - has key implications for the transmission of business cycle shocks
  - is consistent with the optimal monetary policy response prescribed by monetary theory

Related literature

- Normative theoretical literature on robust simple policy rules

  McCallum (1988), Taylor (1993),Taylor (2007), Schmitt-Grohé and Uribe (2007)

- Empirical literature on simple policy rules

  Clarida et al. (2000), Carvalho et al. (2021), Judd and Rudebusch (1998), Clarida et al. (2000), Orphanides (2004), Rudebusch (2002), Coibion and Gorodnichenko (2012)

- Monetary policy trade–offs and flexible inflation targeting

  Erceg et al. (2000), Blanchard and Galí (2007), Bodenstein et al. (2008), Nakov and Pescatori (2010), Bernanke and Mishkin (1997), Posen et al. (1998), Svensson (1999), Lomax (2004), Walsh (2009)

Roadmap

1. Revisiting Fed's Policy Reaction Function: targeted Taylor rules

2. Business cycle fluctuations: Taylor rules vs. targeted Taylor rules

3. Welfare evaluation: Taylor rules vs. targeted Taylor rules

Revisiting Fed's Policy Reaction Function: targeted Taylor rules

Econometric specifications: "Taylor rules" versus "Targeted Taylor rules"

1. Taylor rule:

$$i_t = i^* + \rho i_{t-1} + (1-\rho)\Big[\phi_\pi(\pi_t - \pi^*) + \phi_y \widehat{y}_t\Big] + \varepsilon_t \tag{1}$$

where i_t is the fed funds rate, π_t is year-on-year PCE inflation, π^* is the inflation target and $\widehat{y}_t$ is the output gap constructed using the Congressional Budget Office estimate of potential GDP.

2. Targeted Taylor rule:

$$i_t = \alpha + \rho i_{t-1} + (1-\rho)\Big[\phi_\pi^d(\pi_t^d - \pi^{d,*}) + \phi_\pi^s(\pi_t^s - \pi^{s,*}) + \phi_y \widehat{y}_t\Big] + \varepsilon_t \tag{2}$$

where π_t^d, and π_t^s stand for the the demand and supply components of the year-on-year PCE inflation decomposition.

Demand/supply inflation decomposition: Shapiro (2024)

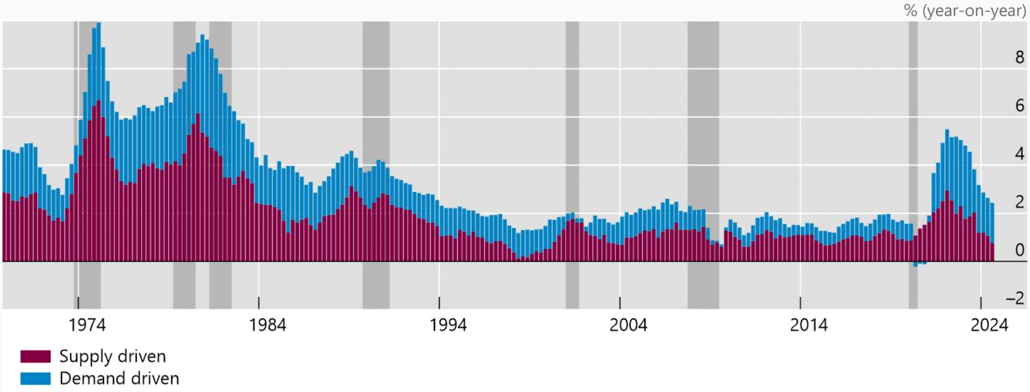


Figure 1: Decomposition of year-on-year core PCE inflation in demand and supply components

Eickmeier and Hofmann (2022)'s inflation decomposition

Estimated Taylor coefficients

	ϕ_i	ϕ_π	ϕ_π^d	ϕ_π^s	ϕ_y
Taylor rule (1)	0.74***	2.11***			0.26***
	(0.04)	(0.18)			(0.10)
Targeted Taylor rule (2)	0.72***		3.75***	1.02**	0.22***
	(0.04)		(.60)	(0.40)	(0.05)

Note: Baseline estimates with the demand/supply core PCE inflation decomposition from Shapiro (2024). Values expressed in quarterly rates. Same post Volker pre-ZLB sample as in Carvalho et al (2021): 1979Q3:2007Q4. Standard errors derived by the delta method reported in parentheses. Difference between estimated responses to demand– and supply–driven inflation in the targeted Taylor rule specification statistically significant at 1% level.

- Taylor rule coefficients are similar to the ones in Carvalho et al (2021).
- In the targeted Taylor rule, the estimated response coefficient to demand–driven inflation is almost four times larger than the one to supply–driven inflation.

Robustness checks

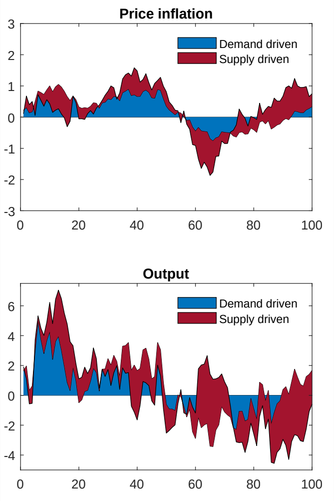
Business cycle fluctuations: Taylor rules vs. targeted Taylor rules

Theoretical exercise

- We simulate the basic New Keynesian model with sticky prices and wages in Galí (2015), Chapter 6 with supply and demand shocks (*simultaneously*).
- Parametrization: textbook non-policy parameters; estimated policy rule parameters
- We compare the business cycle dynamics of the model for a given sequence of shocks under a:
  1. Taylor rule
  2. targeted Taylor rule.

More volatile inflation, and less volatile output under the targeted Taylor rule

Taylor rule



For the same shocks,

- **inflation** is more volatile and largely supply driven under the targeted Taylor rule,
- **output** is less volatile and driven to a larger extent by demand factors

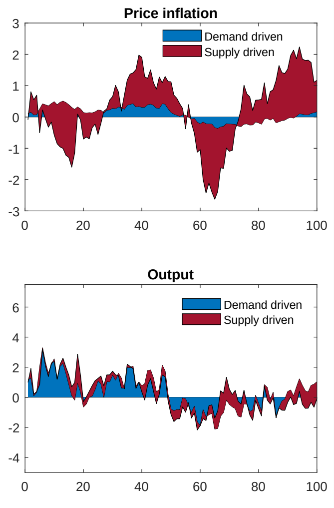
Policy rate and shocks

Table statistics

IRFs to a supply shock

IRFs to a demand shock

Targeted Taylor rule



Welfare evaluation: Taylor rules vs. targeted Taylor rules

Welfare analysis

1. Benchmark: optimal monetary policy subject to both shocks occurring simultaneously
   - under optimal policy with commitment, the economy is insulated from the effect of demand shocks, inflation deviates from target due to supply-driven disturbances

2. Simple rules:
   - Taylor rules: $i_t = \rho + \phi_\pi \pi_t + \phi_y \widehat{y}_t$
     - optimal coefficients demand shocks: $\phi_\pi = +\infty$, $\phi_y = 0$ (strict inflation targeting, SIT)
     - optimal coefficients supply shocks: $\phi_\pi \geq 0$, $\phi_y \geq 0$ (flexible inflation targeting, FIT)

   - Targeted Taylor rules: $i_t = \rho + \phi_\pi^d \pi_t^d + \phi_\pi^s \pi_t^s + \phi_y \widehat{y}_t$
     - optimal response to demand shocks $\phi_\pi^d = +\infty$ and optimal response to supply shocks $\phi_\pi^s \geq 0$, $\phi_y \geq 0$ (targeted flexible inflation targeting, TA-FIT)

Welfare criterion · Optimal policy under commitment

Welfare evaluation: TA-FIT best policy in the presence of both types of shocks

	Optimal	Taylor rule		Targeted Taylor rule
		SIT	FIT	TA-FIT
Technology shocks				
$\sigma(\pi^p)$	0.11	0	0.14	0.14
$\sigma(\pi^w)$	0.03	0.26	0.10	0.10
$\sigma(\tilde{y})$	0.04	3.41	0.78	0.78
$\mathbb{L}$	0.033	0.79	0.12	0.12
Demand shocks				
$\sigma(\pi^p)$	0	0	0.01	0
$\sigma(\pi^w)$	0	0	0.04	0
$\sigma(\tilde{y})$	0	0	0.96	0
$\mathbb{L}$	0	0	0.04	0
Both shocks				
$\sigma(\pi^p)$	0.11	0	0.15	0.14
$\sigma(\pi^w)$	0.03	0.26	0.14	0.10
$\sigma(\tilde{y})$	0.04	3.41	1.74	0.78
$\mathbb{L}$	0.033	0.79	0.16	0.12

Table 1: Welfare outcomes: optimal policy versus simple rules

Notes: The standard deviations of the technology shock and the demand shock both equal 1% as in Galí (2015).

Both types of shocks: ranking of SIT vs. FIT may vary, TA-FIT always the best

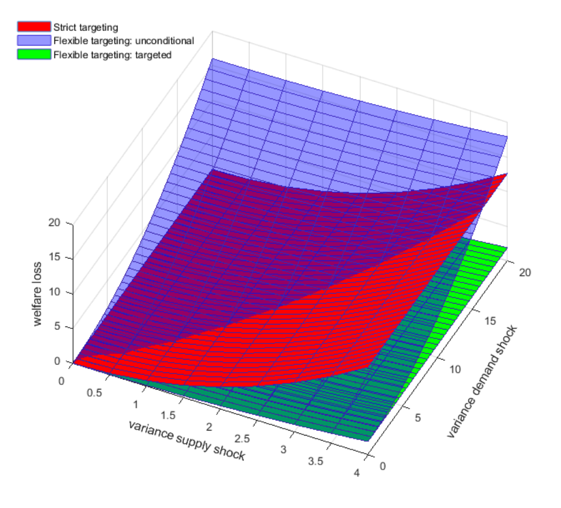


Figure 2: Welfare losses and the variances of demand and supply shocks

Take-aways

1. Taylor–type rules (both theoretical and empirical) traditionally assume monetary policy in the US reacts in the same way to demand and supply shocks.

2. Our analysis suggest that Fed's reaction function may be different, and surprisingly, it may mimic more closely optimal policy than a conventional (unconditional) Taylor-type rule would imply.

3. As business cycle fluctuations depend on the policy rule, describing the monetary policy reaction function by a Taylor rule instead of a targeted version may bias the estimates of DSGE models.

Backup slides

Demand/supply inflation decomposition: Eickmeier and Hofmann (2024)

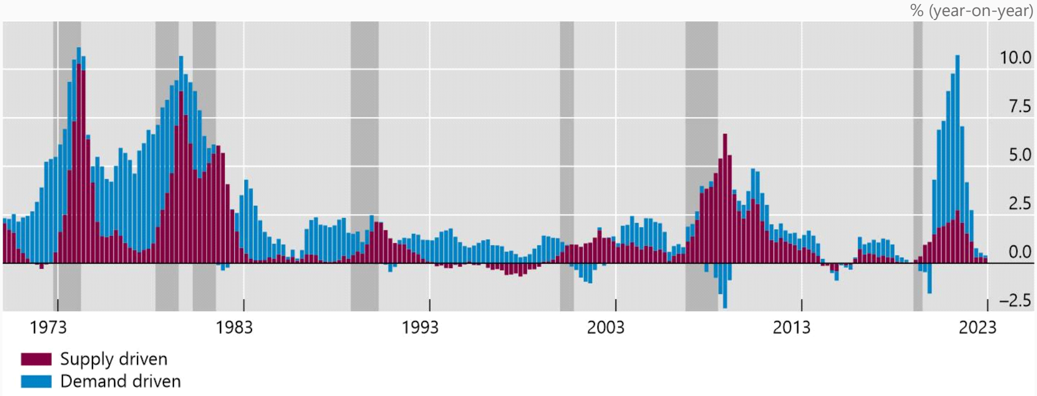


Figure 3: Decomposition of year-on-year headline PCE inflation in demand and supply components

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Robustness checks

- Varied samples: subsamples within our baseline sample, including most recent period (ZLB: funds rate $> 0.5\%$, WU/XIA shadow rate, Krippner shadow rate)
- Headline instead of core inflation
- Eickmeier and Hofmann (2023) demand/supply inflation decomposition
- Consensus forecast as an additional regressor

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Basic NK model with sticky prices and wages

Non-policy block:

$$\widetilde{y}_t = E_t\{\widetilde{y}_{t+1}\} - \frac{1}{\sigma}\left(\widehat{i}_t - E_t\{\pi_{t+1}\}\right) + (1-\rho_z)z_t \tag{3}$$

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \chi_p \tilde{y}_t + \lambda_p \tilde{\omega}_t \tag{4}$$

$$\pi_t^w = \beta E_t\{\pi_{t+1}^w\} + \chi_w \tilde{y}_t - \lambda_w \tilde{\omega}_t \tag{5}$$

$$\tilde{\omega}_t \equiv \tilde{\omega}_{t-1} + \pi_t^w - \pi_t^p - \Delta\omega_t^n \tag{6}$$

$$y_t^n = \psi_{ya} a_t + \psi_{yt}\tau$$

$$\omega_t^n = \psi_{\omega a} a_t + \psi_{\omega t}\tau$$

$\{z_t\}$: demand shock , $\{a_t\}$: supply shock $\sim$ exogenous AR(1) processes:

$$z_t = \rho_z z_{t-1} + \varepsilon_t^z$$

$$a_t = \rho_a a_{t-1} + \varepsilon_t^a$$

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Monetary policy

1. Taylor rule:

$$\widehat{i}_t = \phi_\pi \pi_t + \phi_y \widetilde{y}_t + \nu_t$$

2. Targeted Taylor rule:

$$\widehat{i}_t = \phi_\pi^d \pi_t^d + \phi_\pi^s \pi_t^s + \phi_y \tilde{y}_t + \nu_t$$

For an unique equilibrium to exist under a "targeted Taylor rule", the Taylor principle needs to be satisfied by both the response coefficient to demand–driven inflation and the response coefficient to supply–driven inflation.

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Baseline parametrization: non-policy block

Parameter	*Description*	*Value*
β	Discount factor	0.99
σ	Curvature of consumption utility	1
φ	Curvature of labor disutility	5
$1-\alpha$	Index of decreasing returns to labour	0.25
ϵ_p	Elasticity of substitution of goods	9
ϵ_w	Elasticity of substitution of labor types	4.5
θ_p	Calvo index of price rigidities	0.75
θ_w	Calvo index of wage rigidities	0.75
ρ_z	Persistence demand preference shock	0.9
ρ_a	Persistence technology shock	0.9

Notes: : Values are shown in quarterly rates.

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Parametrization: monetary policy rules

Parameter	*Description*	*Value*
Taylor–type rule:		
ϕ_i	Interest-rate smoothing	0.7
ϕ_π	Response to aggregate inflation	2
ϕ_y	Response to the output gap	0.2
Targeted Taylor–type rule:		
ϕ_i	Interest-rate smoothing	0.7
ϕ_π^d	Response to demand-driven inflation	4
ϕ_π^s	Response to supply-driven inflation	1.01
ϕ_y	Response to the output gap	0.2

Notes: : Values are shown in quarterly rates.

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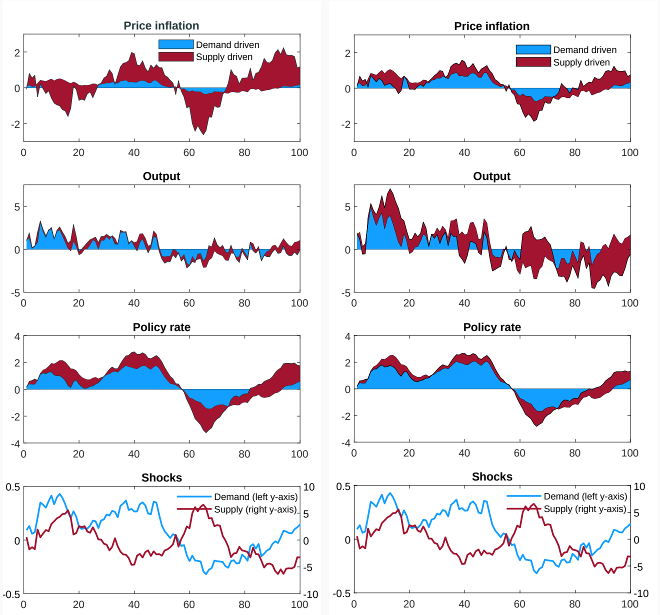

Figure 4: Simulated dynamics: targeted Taylor rule (left) versus Taylor rule (right)

Table 2: Volatility of output, inflation and policy rates

	σ_y^2	σ_π^2	$\sigma_{\pi^{p,d}}^2$	$\sigma_{\pi^{p,s}}^2$	$\sigma_{y,d}^2$	$\sigma_{y,s}^2$	σ_i^2	$\sigma_{\pi^{p,s}}^2/\sigma_\pi^2$
Targeted Taylor rule	2.44	0.26	0.02	0.18	2.69	0.12	0.94	70%
Taylor rule	4.14	0.23	0.07	0.09	5.05	1.21	0.99	39%

Notes: Statistics under the targeted Taylor–type rule versus the conventional Taylor–type rule.

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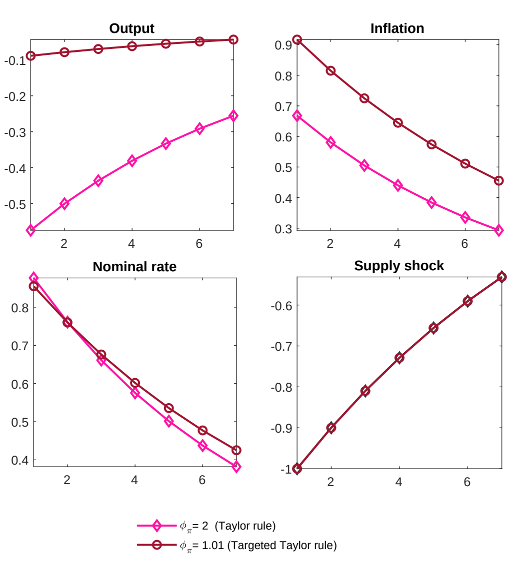
Dynamic responses to a technology shock



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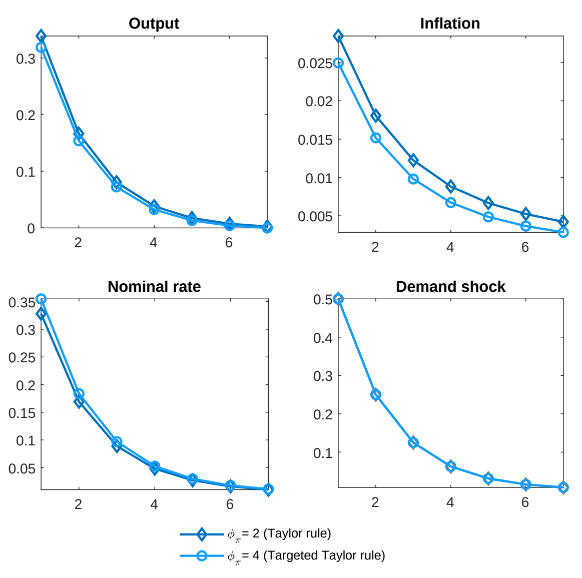
Dynamic responses to a demand preference shock



Welfare trade–offs and optimal policy

- Welfare loss:

$$\mathbb{L} \equiv \frac{1}{2}\left[\left(\sigma + \frac{\varphi + \alpha}{1-\alpha}\right) var(\widetilde{y}_t) + \frac{\varepsilon_p}{\lambda_p} var(\pi_t^p) + \frac{\varepsilon_w(1-\alpha)}{\lambda_w} var(\pi_t^w)\right]$$

- Demand shocks only: equilibrium with $\pi_t^p = 0$, $\pi_t^w = 0$, $\widetilde{y}_t = 0$ => no welfare trade-off
- Supply shocks only: no equilibrium with $\pi_t^p = 0$, $\pi_t^w = 0$, $\widetilde{y}_t = 0$ => welfare trade-off
- Both shocks: no equilibrium with $\pi_t^p = 0$, $\pi_t^w = 0$ and $\widetilde{y}_t = 0$ => welfare trade-off

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Optimal policy with both supply and demand shocks

The problem of optimal policy with commitment when the economy is simultaneously buffeted by both demand and supply shocks is given by

$$\min \frac{1}{2} E_0 \sum_{t=0}^{\infty} \beta^t \left[\left(\sigma + \frac{\varphi + \alpha}{1 - \alpha} \right) \tilde{y}_t^2 + \frac{\epsilon_p}{\lambda_p} (\pi_t^p)^2 + \frac{\epsilon_w (1 - \alpha)}{\lambda_w} (\pi_t^w)^2 \right]$$

subject to equations (3)–(6).

- Conditions (3)–(6) do not depend on the demand shock $\Rightarrow$ the paths of π_t^p, π_t^w, $\tilde{y}_t$, $\tilde{\omega}_t$ under optimal policy in the presence of both demand and supply shocks are identical to those under optimal policy in the presence of supply shocks only.
- Given the optimal paths of the output gap $\tilde{y}_t^*$ and price inflation $\pi_t^{p,*}$, the optimal path of the interest rate $\widehat{i}_t^*$ accounts for demand shocks and is further given by

$$\widehat{i}_t^* = \sigma E_t \{ \Delta \tilde{y}_{t+1}^* \} + E_t \{ \pi_{t+1}^{p,*} \} + \widehat{r}_t^n$$

for $t = 0, 1, 2, \ldots$, where $\widehat{r}_t^n = (1 - \rho_z) z_t + \sigma \psi_{\omega a} (1 - \rho_a) a_t$.

Optimal simple rules

- The optimal monetary policy under commitment does not have a simple characterization, requiring instead that the central bank follows a complicated target rule.

- Thus, it is of interest to know to what extent different simple monetary policy rules — understood as rules that a central bank could arguably adopt in practice (Taylor (2007)) could approximate it.

- To do so, we compare welfare outcomes under simple Taylor-type rules and Targeted Taylor rules, where the policy rule coefficients are chosen optimally so as to minimize welfare losses.

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