Targeted Taylor Rules: Some Evidence and Theory

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Federal Reserve statements: weaker response to supply-driven inflation

*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.* (Powell (2023))

Monetary policy deliberations devote time to assess demand/supply conditions (FOMC transcripts):

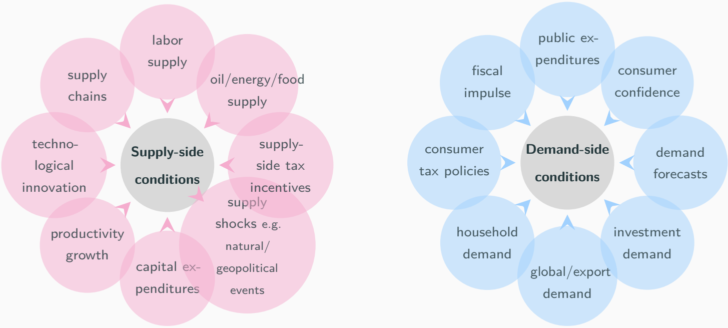

Figure 1: Recurrent topics during the assessment of supply/demand conditions of the U.S. economy

Taylor rules: one-size-fits-all response to inflation

- The Taylor rules used to describe the monetary policy reaction function in macro models and central banks' tool-kits assume a one-size-fits-all reaction to inflation regardless of its drivers:

$$i_t = \rho\, i_{t-1} + (1-\rho)\Big[i^* + \boldsymbol{\phi_\pi}(\pi_t - \pi^*) + \phi_y(y_t - y_t^*)\Big]$$

- **Flexible inflation targeting** (FIT) regimes are usually described by such rules:
  - Under FIT, the central bank aims to fulfill its objectives (π^*, y_t^*) on the medium-run,
  - ... while allowing short-run deviations of inflation and real activity from targets (Svensson (2010)).

In this paper ...

- We refine existing monetary policy rules to allow for a different (targeted) response to demand– versus supply–driven inflation $\Rightarrow$ **targeted** Taylor rules:

$$i_t = \rho i_{t-1} + (1-\rho)\left(i^* + \phi_\pi^d \widehat{\pi}_t^d + \phi_\pi^s \widehat{\pi}_t^s + \phi_y \widehat{y}_t\right)$$

- We estimate this rule for the US and embed it into a textbook monetary model (Galí (2015)).

Key findings:

1. Baseline estimates US: fourfold stronger reaction to demand– than to supply–driven inflation.
2. According to the model, compared to the conventional rule, under the targeted rule inflation is driven to a larger extent by supply factors, and output is less volatile.
3. The new type of rule can approximate better optimal policy than a standard Taylor rule when the economy is subject to both demand and supply shocks if: (i) inflation expectations remain anchored, (ii) measurement error of demand/supply inflation is not excessively large.

Related literature

- Empirical literature on simple policy rules

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

- Normative theoretical literature on robust simple policy rules

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

- Monetary policy trade–offs and flexible inflation targeting

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

- State-dependent policy rules (monetary-fiscal interactions literature)

  Bianchi and Melosi (2019), Bianchi et al. (2023), Smets and Wouters (2024)

Roadmap

1. Revisiting Fed's Policy Reaction Function: targeted Taylor rules
2. Business cycle fluctuations: targeted Taylor rule vs Taylor rule
3. Welfare evaluation: targeted Taylor rule vs Taylor rule

Revisiting Fed's Policy Reaction Function: targeted Taylor rules

Econometric specifications: Taylor rule versus targeted Taylor rule

Taylor rule:

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

where i_t : fed funds rate, π_t : year-on-year core PCE inflation, π^* : inflation target, $\widehat{y}_t$: output gap constructed using the CBO estimate of potential GDP. Baseline estimation sample: 1979Q3:2007Q4.

Econometric specifications: Taylor rule versus targeted Taylor rule

Targeted Taylor rule:

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

where i_t: fed funds rate, π_t^d/π_t^s: demand/supply components year-on-year core PCE inflation, π^*: inflation target, $\widehat{y}_t$: output gap constructed using the CBO estimate of potential GDP. 1979Q3:2007Q4.

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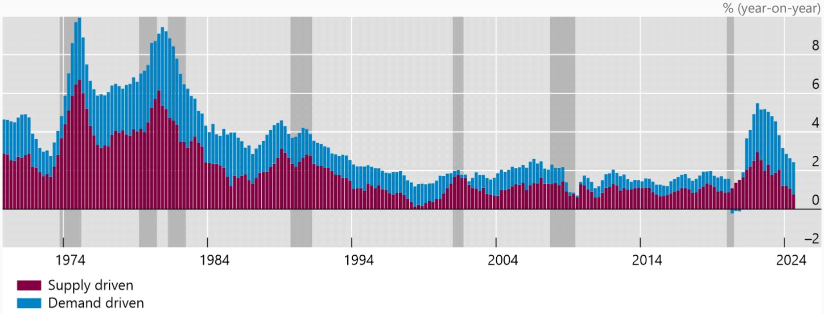
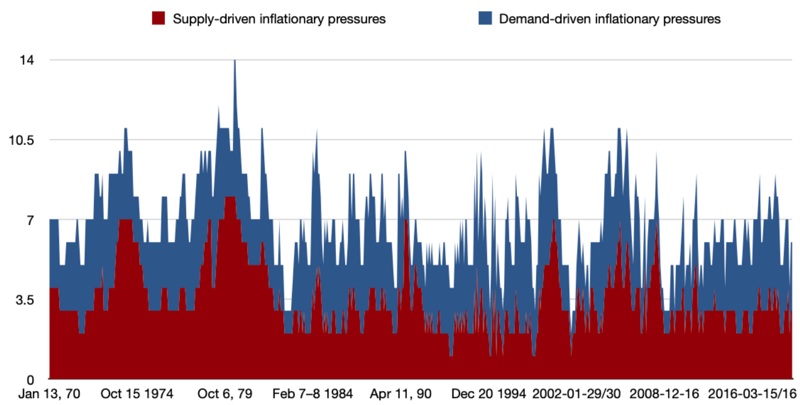
where i_t: fed funds rate, π_t^d/π_t^s: demand/supply components year-on-year core PCE inflation, π^*: inflation target, $\widehat{y}_t$: output gap constructed using the CBO estimate of potential GDP. 1979Q3:2007Q4.



Source: Shapiro (2024). Robustness checks with the series in Eickmeier and Hofmann (2022) ▸ Graph

Link to FOMC transcripts



Notes: Supply- and demand-driven inflationary pressures on a scale from one to ten according to FOMC statements for the period 1970 to 2019. Evaluation based on a Large Language Model (LLM) with advanced reasoning.

Estimated Taylor coefficients

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

Notes: Values expressed in quarterly rates. Standard errors derived by the Delta method are reported in parentheses. Statistical significance at 5%/1% level indicated with **/***. The difference between the estimated responses to demand– and supply–driven inflation in the targeted Taylor rule specification is statistically significant at 1% level. The null that the simple rule provides a better fit than the targeted rule rejected at a significance level $\ll$ 1%.

- Taylor rule coefficients are similar to those in Carvalho et al. (2021).
- Estimated response to demand–driven inflation almost fourfold that to supply–driven inflation.

Robustness checks

- Varied samples: subsamples within our baseline sample, longer sample with most recent period (ZLB: funds rate $> 0.5\%$, shadow rate WU-XIA/Krippner), pre-Volcker sample ▸ Table results
- Time-varying intercept, R_t^*
- Headline instead of core inflation ▸ Table results
- Eickmeier and Hofmann (2023) demand/supply inflation decomposition ▸ Table results
- Alternative measures real activity: unemployment (gap), demand/supply-driven output gap ▸ Table results
- Backward-looking specification
- Transitory nature of supply shocks: correlations of the the Greenbook/Consensus Forecasts with the supply component of inflation/additional regressors in the targeted Taylor rule ▸ Table results
- Other IT jurisdictions (BIS Quarterly Review Special Feature) ▸ Results

Business cycle fluctuations: targeted Taylor rule vs Taylor rule

Model

- Basic New Keynesian model with sticky prices and wages (Galí (2015), Ch. 6)
- Both supply and demand shocks: demand preference shocks and technology shocks (baseline)

  Parametrization: textbook non-policy parameters

- We compare the business cycle dynamics of the model for a given sequence of shocks under a:
  1. Targeted Taylor rule
  2. Taylor rule

▸ Parametrization

Non-policy block

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

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \chi_p \tilde{y}_t + \lambda_p \tilde{\omega}_t \quad (2)$$

$$\pi_t^w = \beta E_t\{\pi_{t+1}^w\} + \chi_w \tilde{y}_t - \lambda_w \tilde{\omega}_t \quad (3)$$

$$\tilde{\omega}_t \equiv \tilde{\omega}_{t-1} + \pi_t^w - \pi_t^p - \Delta\omega_t^n \quad (4)$$

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

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

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

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

Monetary policy – two alternative regimes:

1. Targeted Taylor rule:

$$i_t = \rho + \phi_\pi^d \pi_t^d + \phi_\pi^s \pi_t^s + \phi_y \widehat{y}_t$$

where $\widehat{y}_t = \widetilde{y}_t + \widehat{y}_t^n$, $\widehat{y}_t^n = \psi_{ya} a_t$; $\pi_t \equiv \pi_t^d + \pi_t^s$: π_t^d, π_t^s the demand and supply components of inflation, i.e. inflation in the *shadow economies* with demand/supply shocks only.

Parametrization: $\sim$ estimated targeted rule $\phi_\pi^d = 4$, $\phi_\pi^s = 1.01$, $\phi_y = 0.2$

2. Taylor rule:

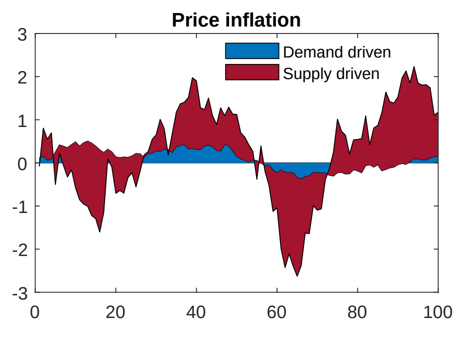
$$i_t = \rho + \phi_\pi \pi_t + \phi_y \widehat{y}_t,$$

Parametrization: $\sim$ estimated rule $\phi_\pi = 2$, $\phi_y = 0.2$

▶ Equilibrium under a targeted Taylor rule ▶ Summary parametrization policy rules

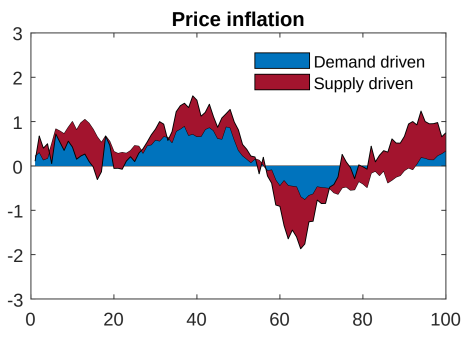
Inflation more largely supply-driven under the targeted Taylor rule

Targeted Taylor rule



X-axis: quarters, Y-axis: percent.

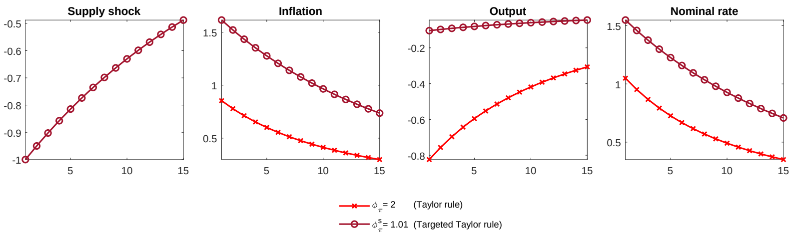
Taylor rule



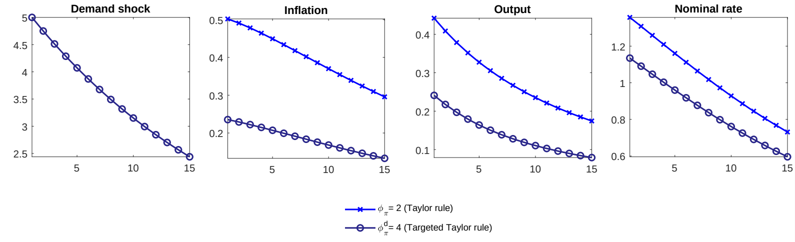
▸ Parametrization demand and supply shocks ▸ Shock series

Dynamic responses to supply and demand shocks

Adverse supply shock:



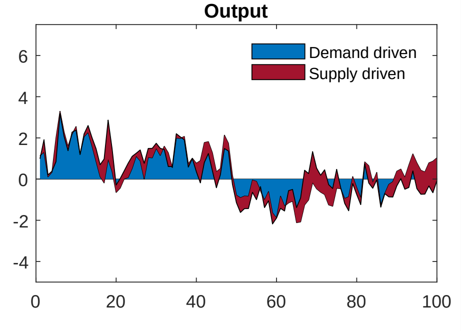
Expansionary demand shock:



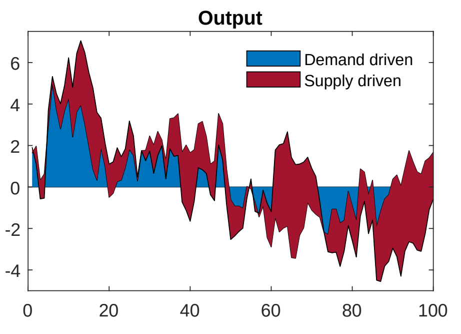
Volatility table

Less volatile output under the targeted Taylor rule

Targeted Taylor rule



Taylor rule



X-axis: quarters, Y-axis: percent.

Same findings with interest rate smoothing ▸ Simulated dynamics ▸ Volatility table

⇒ Postulating a Taylor rule may bias estimation results in DSGE models if the targeted specification provides a better description of the actual policy reaction function.

Welfare evaluation: targeted Taylor rule vs Taylor rule

Welfare analysis

1. Benchmark: optimal monetary policy subject to both shocks occurring simultaneously
   - economy insulated from demand shocks, inflation deviates from target due to supply shocks

2. Simple rules:
   - Taylor rules: $i_t = \rho + \phi_\pi \pi_t + \phi_y \widehat{y}_t$
     - strict inflation targeting (SIT): $\phi_\pi = +\infty$, $\phi_y = 0$
     - flexible inflation targeting (U-FIT): optimal $\phi_\pi \geq 0$, $\phi_y \geq 0$
   - targeted Taylor rules: $i_t = \rho + \phi_\pi^d \pi_t^d + \phi_\pi^s \pi_t^s + \phi_y \widehat{y}_t$
     - targeted flexible inflation targeting (TA-FIT): optimal $\phi_\pi^d = +\infty$, $\phi_\pi^s \geq 0$, $\phi_y \geq 0$

▸ Welfare criterion ▸ Optimal policy under commitment

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

	Optimal (commitment)	Taylor rule		Targeted Taylor rule
		SIT	U-FIT	TA-FIT
Technology shocks				
$\sigma(\pi^p)$	0.11	0	0.15	0.15
$\sigma(\pi^w)$	0.03	0.27	0.11	0.11
$\sigma(\tilde{y})$	0.04	3.42	0.83	0.79
$\mathbb{L}$	0.033	0.80	0.13	0.12
Demand shocks				
$\sigma(\pi^p)$	0	0	0.02	0
$\sigma(\pi^w)$	0	0	0.04	0
$\sigma(\tilde{y})$	0	0	0.96	0
$\mathbb{L}$	0	0	0.05	0
Both shocks				
$\sigma(\pi^p)$	0.11	0	0.15	0.15
$\sigma(\pi^w)$	0.03	0.27	0.12	0.11
$\sigma(\tilde{y})$	0.04	3.42	1.27	0.79
$\mathbb{L}$	0.033	0.80	0.17	0.12

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

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

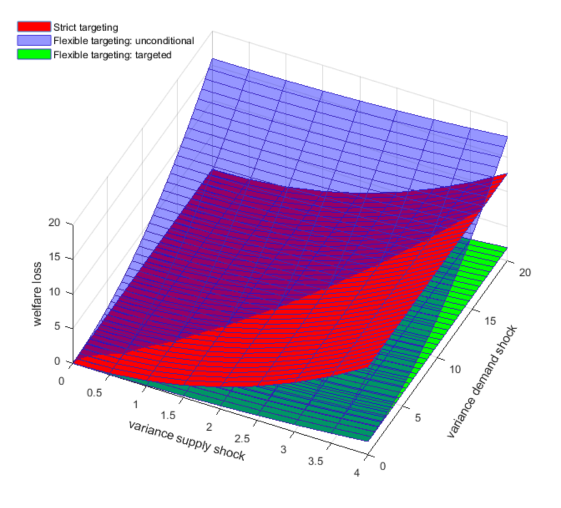


Figure 2: Welfare losses and the variances of demand and supply shocks

Imperfect measure of demand– and supply–driven inflation

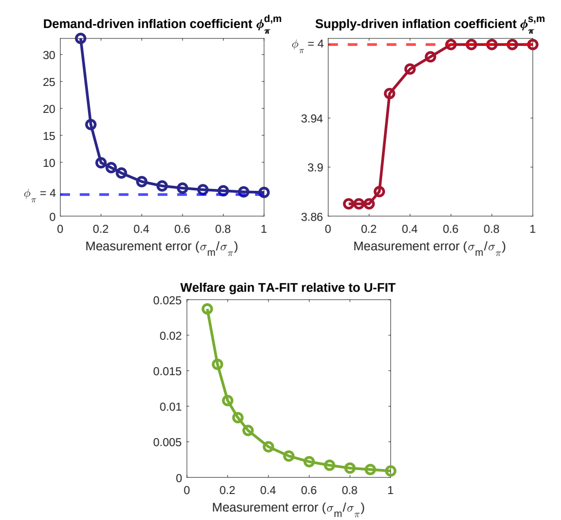
- Assume the central bank can only observe the demand and supply components of inflation up to a measurement error:

$$i_t = \rho + \phi_\pi^{d,m} \pi_t^{d,m} + \phi_\pi^{s,m} \pi_t^{s,m} + \phi_y \widehat{y}_t$$

where $\pi_t \equiv \pi_t^{d,m} + \pi_t^{s,m}$ with $\pi_t^{d,m}$ and $\pi_t^{s,m}$ the *measured* demand and supply components of inflation, with measurement error defined by $m_t = \rho_m m_{t-1} + \varepsilon_t^m$.

- How does the welfare gain of TA-FIT and its optimal coefficients vary with measurement error?

As measurement error increases, TA-FIT converges to U-FIT



$\Rightarrow$ TA-FIT remains optimal as long as the measurement error is not excessively large.

Take-aways

1. We introduce Taylor–type rules which allow for a different (targeted) reaction to demand- versus supply-driven inflation. $\rightarrow$ **targeted Taylor rule**.
2. According to estimates of this rule, **the Federal Reserve conducted monetary policy in a targeted fashion** by reacting much more strongly to demand– than to supply–driven inflation.
3. Provided inflation expectations remain anchored and the measurement error is not excessively large, this new type of rule can approximate better optimal monetary policy.
4. Targeted Taylor rules could become a **new useful policy rule benchmark** in central banks' toolkit, alongside other Taylor–type rules that already serve this purpose.

Backup slides

	ρ	ϕ_π	ϕ_π^d	ϕ_π^s	ϕ_y
Baseline sample 1979Q3-2007Q4					
Taylor rule	0.74^{***}	2.11^{***}			0.26^{***}
	(0.04)	(0.18)			(0.05)
Targeted Taylor rule	0.72^{***}		3.75^{***}	1.02^{**}	0.22^{***}
	(0.04)		(0.60)	(0.40)	(0.05)
Volcker-Greenspan 1979Q3-2005Q4					
Taylor rule	0.74^{***}	2.10^{***}			0.27^{***}
	(0.04)	(0.19)			(0.06)
Targeted Taylor rule	0.72^{***}		3.73^{***}	1.03^{**}	0.22^{***}
	(0.04)		(0.62)	(0.42)	(0.05)
Greenspan-Bernanke 1987Q3-2007Q4					
Taylor rule	0.80^{***}	2.18^{***}			0.38^{***}
	(0.02)	(0.22)			(0.04)
Targeted Taylor rule	0.83^{***}		4.62^{***}	1.26^{**}	0.34^{***}
	(0.02)		(0.95)	(0.42)	(0.04)
Full-sample 1979Q3-2024Q2					
Taylor rule	0.88^{***}	2.14^{***}			0.35^{***}
	(0.02)	(0.37)			(0.13)
Targeted Taylor rule	0.82^{***}		3.79^{***}	1.37^{**}	0.30^{***}
	(0.03)		(0.85)	(0.59)	(0.08)
Pre-Volcker 1969Q4-1979Q2					
Taylor rule	0.84^{***}	0.83^{***}			0.33^{***}
	(0.06)	(0.26)			(0.13)
Targeted Taylor rule	0.69^{***}		-0.65	1.69^{***}	0.37^{***}
	(0.0)		(1.14)	(0.50)	(0.09)

Back to robustness checks

Robustness analysis: alternative variables

	ρ	ϕ_π	ϕ_π^d	ϕ_π^s	ϕ_y
Headline inflation					
Taylor rule	0.84***	1.89***			0.26**
	(0.03)	(0.29)			(0.10)
Targeted Taylor rule					
Shapiro (2024)	0.83***		3.36***	1.09**	0.22**
	(0.03)		(0.94)	(0.54)	(0.09)
Eickmeier and Hofmann (2022)	0.85***		3.45***	1.13**	0.10
demand/supply inflation series	(0.03)		(0.66)	(0.57)	(0.12)

Back to robustness checks

Demand/supply inflation decomposition: Eickmeier and Hofmann (2022)

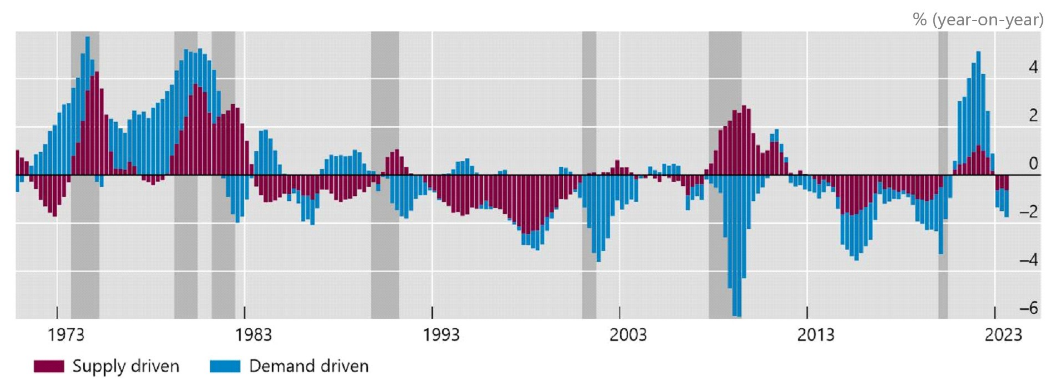


Figure 3: Decomposition of demeaned year-on-year headline PCE inflation in demand and supply factors

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Back to robustness checks alternative variables

Estimated Taylor rules: real activity decomposition

	ρ	ϕ_π	ϕ_π^d	ϕ_π^s	ϕ_y^d	ϕ_y^s
Targeted Taylor rule 1: output gap	0.80*** (0.04)	1.86*** (0.30)			1.81*** (0.58)	0.76*** (0.27)
Targeted Taylor rule 2: inflation and output gap	0.79*** (0.04)		3.12*** (.60)	0.99* (0.59)	1.64*** (0.53)	0.61** (0.25)

◂ Back to robustness checks

Demand/supply gdp growth decomposition: Eickmeier and Hofmann (2022)

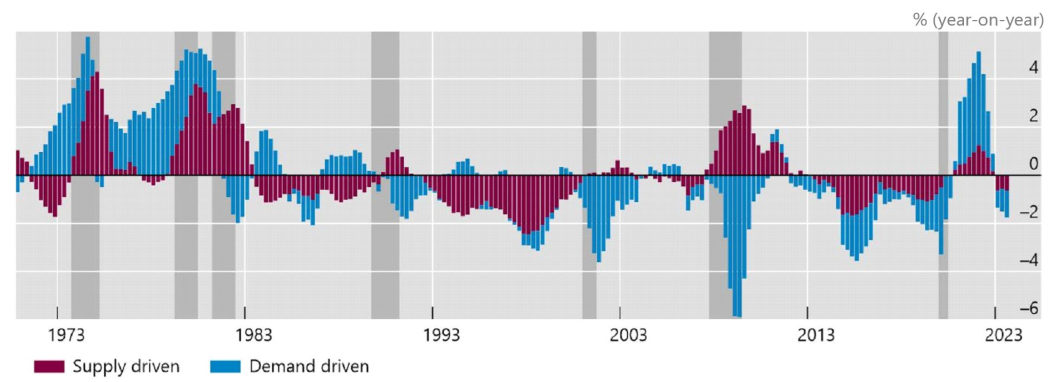


Figure 4: Decomposition of demeaned quarterly gdp growth in demand and supply factors

Back to robustness checks

Correlation demand and supply factors core PCE inflation with inflation forecasts

	Inflation forecasts		
	Consensus	Greenbook	
Inflation component	1 year ahead	1 quarter ahead	1 year ahead
Demand–driven	0.739***	0.801***	0.817***
Supply–driven	0.743***	0.789***	0.716***

Back to robustness checks

Empirical evidence for other jurisdictions

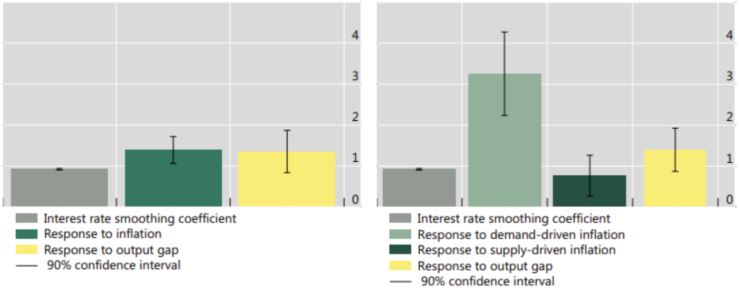
Conventional and targeted Taylor rules: panel estimates[1]

In percentage points

Graph 3

A. Conventional Taylor rule[2]

B. Targeted Taylor rule[3]



[1] Panel estimates for AU, CA, EA, GB, KR, SE and US. [2] Estimated coefficients of ρ, α, β in the conventional Taylor rule in equation (1). [3] Estimated coefficients of $\rho, \alpha^d, \alpha^s, \beta$ in the targeted Taylor rule in equation (2).

Sources: Eickmeier and Hofmann (2022); Shapiro (2022); OECD; national data; authors' calculations.

Source: Hofmann, Boris, Cristina Manea, and Benoit Mojon. "Targeted Taylor rules: monetary policy responses to demand-and supply-driven inflation." BIS Quarterly Review (2024): 19.

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Central bank statements: weaker response to supply-driven inflation

Institution	Communications
Reserve Bank of Australia	• A central bank may "look through" the price effects of a supply shock if it is expected to be short-lived and inflation expectations remain anchored (RBA (2023)). • Life is more complicated in a world of supply shocks; an adverse supply shock increases inflation and reduces output and employment (Lowe (2022)). • If inflation expectations do increase and wage- and price-setting behaviour responds to the higher inflation, an interest rate response is required (Lowe (2023)).
Bank of England	• The orthodox monetary response to a global shock to energy prices is to "look through" them. • When the economy is hit by temporary cost shocks, policymakers face a trade-off [between] output and inflation (Tenreyro (2022)). • If inflation expectations drift away, monetary policy needs to lean against inertia to return inflation to target (Bandera et al (2023)).
Federal Reserve Board	• Standard monetary prescription is to "look through" commodities price shocks (Brainard (2022)). • The response to the inflationary effects of supply shocks should be attenuated. Supply shocks tend to move prices and employment in opposite directions (Powell (2023)). • Supply shocks that drive inflation high enough can affect the longer-term inflation expectations. Monetary policy must forthrightly address risks of de-anchoring of expectations (Powell (2023)).
European Central Bank	• When faced with supply shocks, central banks can, in principle, "look through" them, as these shocks will usually leave no lasting imprint on inflation. • The appropriate policy response will depend on the type of shock. For a supply shock, price stability may conflict with the contractionary impact of the shock. (Papademos (2003)). • In situations where inflation expectations can de-anchor, central banks must then react forcefully to prevent above-target inflation becoming entrenched (Lagarde (2024)).
Bank of Canada	• The bank's framework for inflation targeting allows temporary supply shocks to be largely ignored, as long as they do not feed into inflation expectations (Dodge (2002)). • Supply shocks present central banks with a difficult trade-off between growth and inflation. We focus on balancing the upside risks to inflation with the downside risks to growth (Macklem (2024)).
Sveriges Riksbank	• Supply shocks such as shortage of snow that restricted the supply of hydroelectric power can occasion deviations from the inflation target (Bäckström (2002)). • Supply shocks present a challenge: policymakers want to prevent inflation from becoming entrenched at a high level but want to avoid exacerbating the downturn. (Thedéen (2023)). • If there is a risk that inflation exceeds 2 percent for a long time, a tighter monetary policy may be necessary to maintain confidence in the inflation target (Löf and Stockhammar (2024)).
Bank of Korea	• If inflation is projected to exceed the target but the real sector faces supply shocks, the central bank should decide whether to adjust interest rates to ensure price stability (Bank of Korea (2017)).

Source: Hofmann, Boris, Cristina Manea, and Benoit Mojon. "Targeted Taylor rules: monetary policy responses to demand-and supply-driven inflation." BIS Quarterly Review (2024): 19.

Equilibrium under a targeted Taylor rule

- Assume the central bank can observe inflation in a shadow economy with supply shocks only and denote the inflation level in this economy by π_t^s.

- Using $\pi_t \equiv \pi_t^d + \pi_t^s$, we can rewrite the targeted policy rule as

$$\widehat{i}_t = \phi_\pi^d \pi_t + (\phi_\pi^s - \phi_\pi^d)\pi_t^s + \phi_y \tilde{y}_t + \nu_t \tag{5}$$

where π_t^s solves the following dynamic system of equations describing the shadow economy with supply shocks only (and $\nu_t \equiv \phi_y \widehat{y}_t^n$).

Back to main

Shadow economy with supply shocks only

$$\widetilde{y}_t^s = E_t\{\widetilde{y}_{t+1}^s\} - \frac{1}{\sigma}\left(\widehat{i}_t^s - E_t\{\pi_{t+1}^s\} - \widehat{r}_t^{n,s}\right) \tag{6}$$

$$\pi_t^s = \beta E_t\{\pi_{t+1}^s\} + \chi_p \widetilde{y}_t^s + \lambda_p \widetilde{\omega}_t^s \tag{7}$$

$$\pi_t^{w,s} = \beta E_t\{\pi_{t+1}^{w,s}\} + \chi_w \widetilde{y}_t^s - \lambda_w \widetilde{\omega}_t^s \tag{8}$$

$$\widetilde{\omega}_t^s \equiv \widetilde{\omega}_{t-1}^s + \pi_t^{w,s} - \pi_t^s - \Delta\omega_t^{n,s} \tag{9}$$

$$\widehat{i}_t^s = \phi_\pi^s \pi_t^s + \phi_y \widetilde{y}_t^s + \nu_t^s \tag{10}$$

where $\widehat{r}_t^{n,s} = \sigma\psi_{\omega a}(1-\rho_a)a_t$, $\nu_t^s = \phi_y\psi_{ya}a_t$.

Back to main

Equilibrium solution

- Equations (1) – (10) describe a linear system of ten difference equations with ten unknowns, and can be solved numerically or analytically with the method of undetermined coefficients.
- One can show that the equilibrium of the aggregate economy can be written as the sum of equilibria of the shadow economies with supply and demand shocks only.
- The solution method is akin to that used in the monetary-fiscal interaction literature (Bianchi et al. (2023), Smets and Wouters (2024)) to allow the monetary-fiscal policy mix to react differently to certain type of fiscal shocks ("unfounded fiscal shocks").

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Nominal determinacy under a targeted Taylor rule

Proposition

The equilibrium of the model is unique if the response coefficients to both demand– and supply–driven inflation (ϕ_π^d, ϕ_π^s) satisfy the Taylor principle given the response coefficient to the output gap (ϕ_y).

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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

Notes: : Values are shown in quarterly rates.

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Parametrization: monetary policy rules

Parameter	*Description*	*Value*
Taylor–type rule:		
ϕ_π	Response to aggregate inflation	2
ϕ_y	Response to the output gap	0.2
Targeted Taylor–type rule:		
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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Baseline parametrization: demand and supply shocks

Parameter	*Description*	*Value*
ρ_z	Persistence demand preference shock	0.95
ρ_a	Persistence technology shock	0.95
σ_z	Standard deviation demand preference shock	0.05
σ_a	Standard deviation technology shock	0.01

Notes: : Values are shown in quarterly rates.

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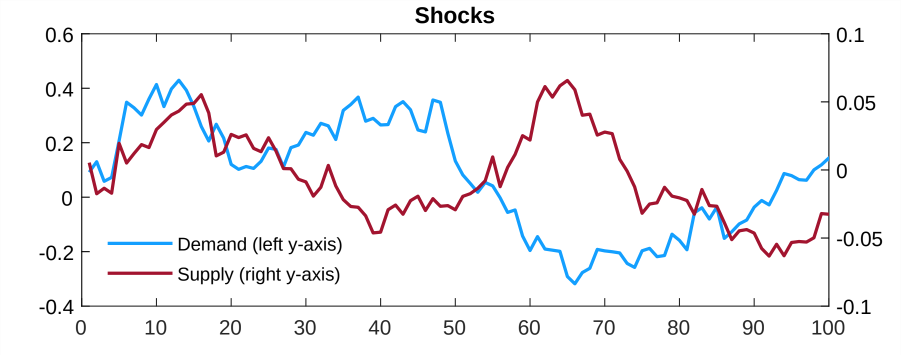
Simulated dynamics: demand and supply shocks



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Volatility of output, inflation and policy rates

	σ^2_y	σ^2_π	$\sigma^2_{\pi^d}$	$\sigma^2_{\pi^s}$	$\sigma^2_{y,d}$	$\sigma^2_{y,s}$	σ^2_i	$\sigma^2_{\pi^s}/\sigma^2_\pi$
Targeted Taylor rule	0.17	1.61	0.02	0.95	0.24	0.06	2.23	60%
Taylor rule	2.33	0.52	0.12	0.21	0.97	3.39	1.66	40%

Notes: Model-based variances of macroeconomic variables under the targeted Taylor–type rule versus the conventional Taylor–type rule. Variables expressed in percent. σ^2 stands for variance. Its subscript denotes a specific macroeconomic variable.

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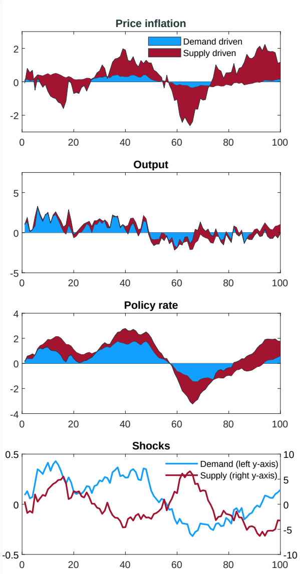
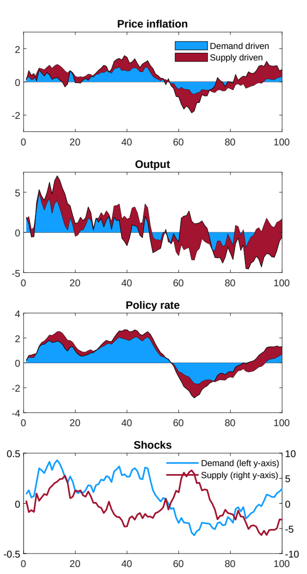
Simulated dynamics: case with interest rate smoothing





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Volatility of output, inflation and policy rates: interest rate smoothing

	σ^2_y	σ^2_π	$\sigma^2_{\pi^d}$	$\sigma^2_{\pi^s}$	$\sigma^2_{y,d}$	$\sigma^2_{y,s}$	σ^2_i	$\sigma^2_{\pi^s}/\sigma^2_\pi$
Targeted Taylor rule	0.78	0.9	0.02	0.73	0.65	0.35	1.46	82%
Taylor rule	2.55	0.43	0.09	0.19	1.6	3.10	1.41	45%

Notes: Model with interest rate smoothing. Model-based variances of macroeconomic variables under the targeted Taylor–type rule versus the conventional Taylor–type rule. σ^2 stands for variance. Its subscript denotes a specific macroeconomic variable.

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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 (1)–(4).

- Conditions (1)–(4) 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 $\widehat{r}_t^n = (1 - \rho_z) z_t + \sigma \psi_{\omega a} (1 - \rho_a) a_t$.

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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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