Monetary Policy and Inflation Scares[1]

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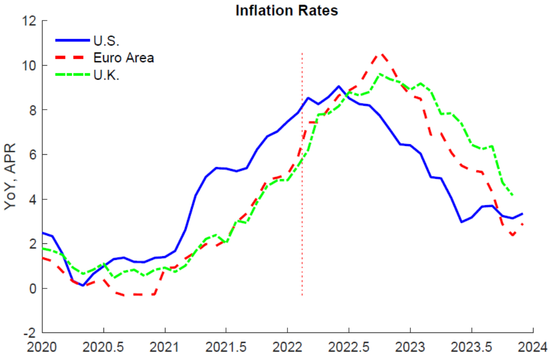
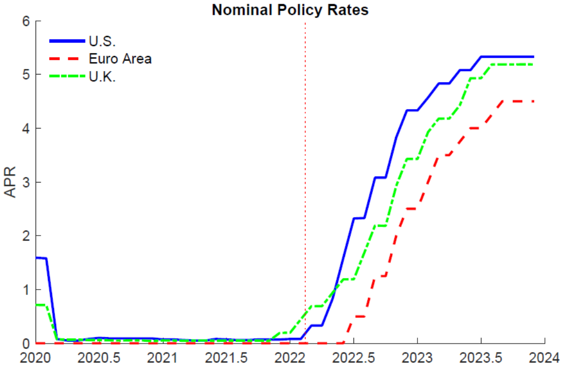
[1] Views expressed are those of the authors and should not be attributed to the IMF, its Executive Board, or its management.

Motivation: The Inflation Surge

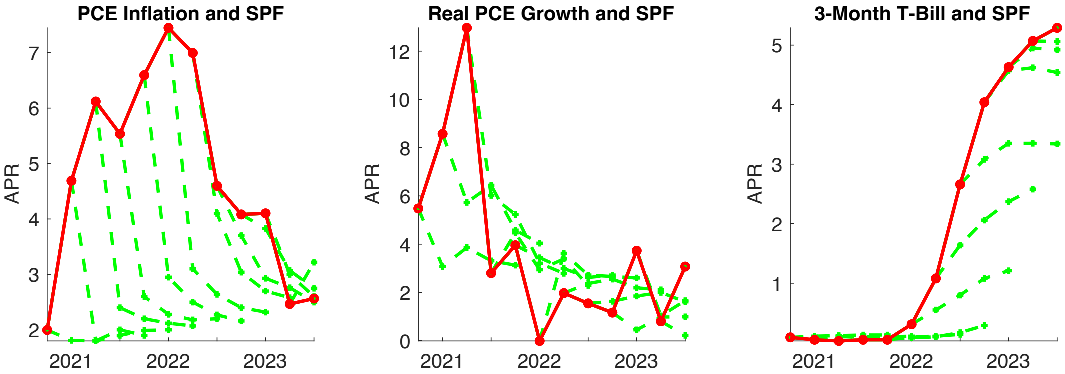
- Major CBs attempted to “look through” a transient inflation surge.





Motivation: U.S. Data

- Professional forecasters underestimated inflationary pressures and growth momentum



Questions

- How can we account for the surge in observed inflation *and* the dynamics of SPF inflation forecasts?

- What are the risks of "looking through" large supply shocks, especially in a hot economy?

- How do Phillips Curve nonlinearities affect the costs of disinflation?

- What are the lessons of post-Covid inflation dynamics for the conduct of monetary policy going forward?

Outline

- Motivation & Questions ✓
- Model Overview
- Model-Data Comparison & Analysis
- Policy Implications and Conclusions

Model Overview

- Starting point: model in Harding, Lindé and Trabandt (2022, 2023).
  - Nonlinear New Keynesian model with sticky prices and sticky wages (Erceg, Henderson and Levin, 2000, EHL) plus Kimball aggregation (1995).
  - Nonlinear price and wage inflation Phillips curves.

- Three new model features:

❶ Unobserved components representation of cost-push shock.

❷ Forecast-targeting Taylor rule.

❸ State-dependent price and wage indexation (rule-of-thumb price/wage setting).

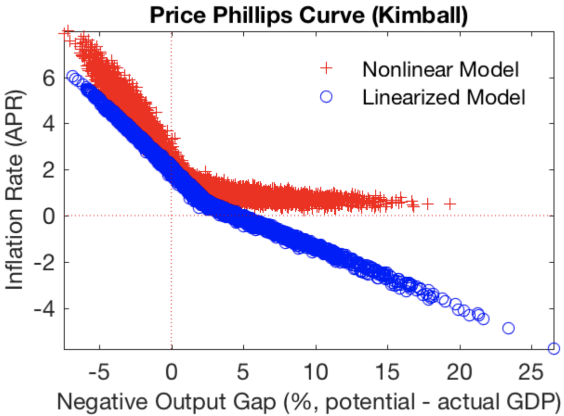
Linearized EHL Model with Kimball Aggregation

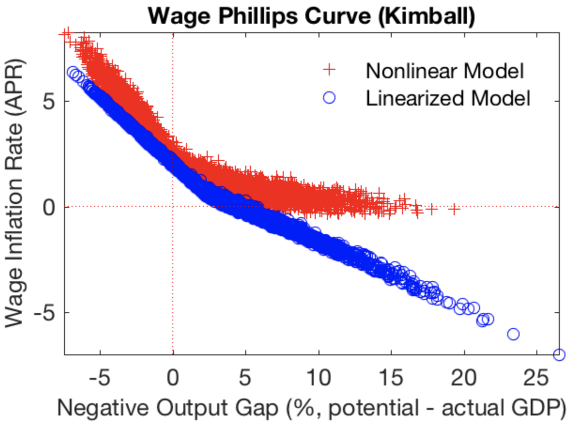
$$
\begin{aligned}
\text{Price Phillips Curve} &: \quad \Pi_t = \beta E_t \Pi_{t+1} + \kappa_p w_t + a_t \\
\text{Wage Phillips Curve} &: \quad \Pi_t^w = \beta E_t \Pi_{t+1}^w + \kappa_w \left(x_t - w_t \right) \\
\text{New IS curve} &: \quad x_t = E_t x_{t+1} - \left(R_t - E_t \Pi_{t+1} \right) - \delta_t \\
\text{Taylor rule} &: \quad R_t = \max\left(-\log R, \gamma_\pi \Pi_t + \gamma_x x_t \right) \\
\text{Wage inflation} &: \quad \Pi_t^w = \Pi_t + w_t - w_{t-1}
\end{aligned}
$$

$$
\kappa_j = \frac{\left(1 - \xi_j\right)\left(1 - \beta \xi_j\right)}{\xi_j} \frac{1}{1 - \left(1 + \theta_j\right) \psi_j} \text{ for } j \in \{p, w\}
$$

- Harding, Lindé and Trabandt (2022, 2023): study effects of cost-push shocks (a_t) and discount factor shocks (δ_t) in **nonlinear** model.

Harding, Lindé and Trabandt (2022, 2023)





Cost-push Shock: Unobserved Components Representation

- Cost-push shock, a_t, consists of an iid part $a_{T,t}$ and a persistent part $a_{P,t}$.
  - Agents can observe a_t but not $a_{T,t}$ or $a_{P,t}$.

- Similar to e.g. Erceg and Levin (2003) and Edge, Laubach and Williams (2007).

- State space system:

$$a_t = \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} a_t^P \\ a_t^T \end{bmatrix}$$

$$\begin{bmatrix} a_{t+1}^P \\ a_{t+1}^T \end{bmatrix} = \begin{bmatrix} \rho_P & 0 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} a_t^P \\ a_t^T \end{bmatrix} + \begin{bmatrix} \sigma_P & 0 \\ 0 & \sigma_T \end{bmatrix} \begin{bmatrix} \varepsilon_{t+1}^P \\ \varepsilon_{t+1}^T \end{bmatrix}$$

- Agents use Kalman filter to predict $a_{T,t|t}$ and $a_{P,t|t}$; Assume $\sigma_T > \sigma_P$.

Forecast-targeting Taylor Rule

- Forecast-targeting Taylor rule:

$$\frac{R_t}{R} = \left\{ \frac{R_{t-1}}{R} \right\}^{\rho} \left\{ \frac{E_t \Pi_{t+4}}{\Pi} \right\}^{(1-\rho)\gamma_\pi} \left\{ \frac{y_t}{y_t^{pot}} \right\}^{(1-\rho)\gamma_x}$$

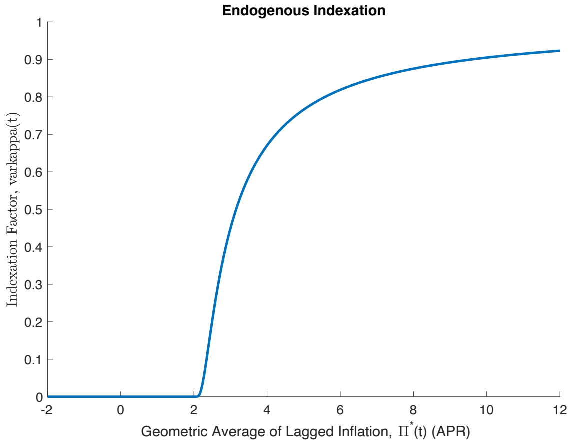
- Baseline: Four-quarter ahead expected inflation (qoq), i.e. $E_t \Pi_{t+4} = E_t \frac{P_{t+4}}{P_{t+3}}$.

- Variations: Π_t or $E_t \Pi_{t+8}$.

State-dependent Indexation

- Non-optimizing (rule-of-thumb) firms set $P_{i,t} = \left(\Pi^{1-\varkappa_t}\Pi_{t-1}^{\varkappa_t}\right) \times P_{i,t-1}$ where

$$\varkappa_t = e^{-\frac{\varrho}{\max\left(\Pi_t^* - \Pi,\ 0.0001\right)}} \text{ and } \Pi_t^* = \left(\Pi_{t-1}^*\right)^{\omega}\left(\Pi_{t-1}\right)^{1-\omega}$$



Shocks and Solution Algorithm

- Shock to persistent cost-push shock component, $a_{P,t}$.

- Standard demand shock (negative discount factor shock), δ_t.

- Solve the nonlinear model with sequential Fair-Taylor (1983) algorithm.

Parameters I

Π	1.005	Steady state gross inflation rate
θ_p	0.1	Net price markup in steady state
ξ_p	$2/3$	Calvo price stickiness parameter
ψ_p	-12	Parameter Kimball aggregator prices
ϱ	0.002	Curvature parameter endogenous indexation
ω	0.8	Parameter in endogenous. indexation
$\varkappa$	0	Inflation indexation parameter in linear model
θ_w	0.1	Net wage markup in steady state
ξ_w	0.75	Calvo wage stickiness parameter
ψ_w	-6	Parameter Kimball aggregator wages

Parameters II

ρ	0.85	Taylor rule: interest rate smoothing
γ_π	1.5	Taylor rule: coef. on expected inflation
γ_x	0.125	Taylor rule: coef. on output gap
β	0.995	Household discount factor
h	0.7	Household consumption habit
χ	0	Inverse Frisch elasticity of labor supply
ρ_P	0.9	AR(1) persistent cost-push shock
ρ_T	0	AR(1) transitory cost-push shock
σ_P	1	Standard deviation persistent cost shock
σ_T	10	Standard deviation transitory cost shock
ρ_δ	0.9	AR(1) discount factor shock

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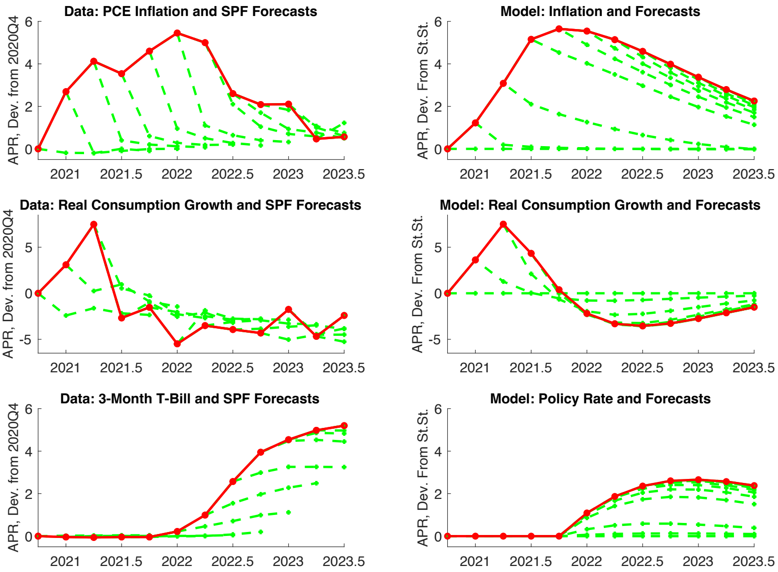
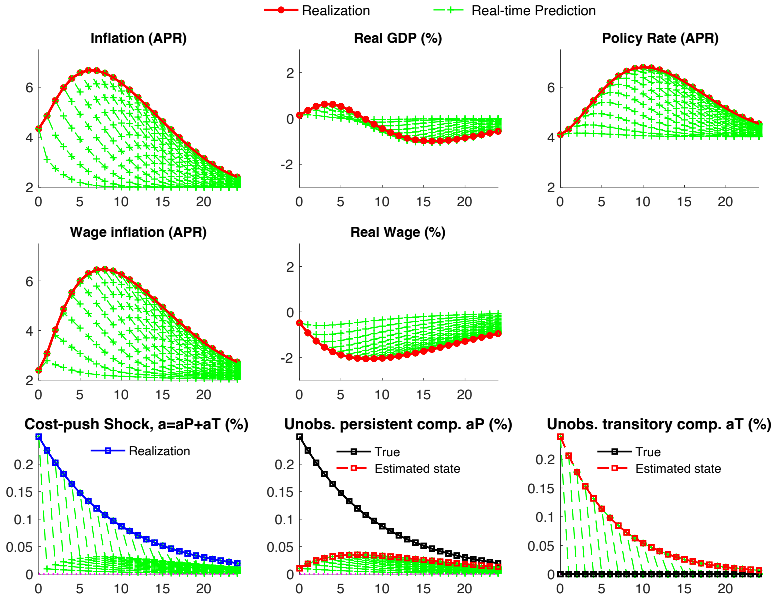
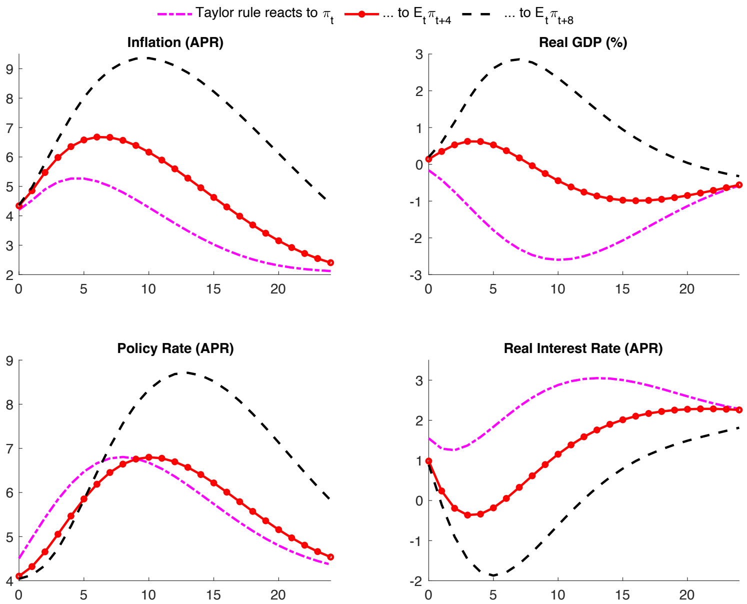
Model-Data Comparison: Nonlinear Model



Effects of Adverse Cost-Push Shock



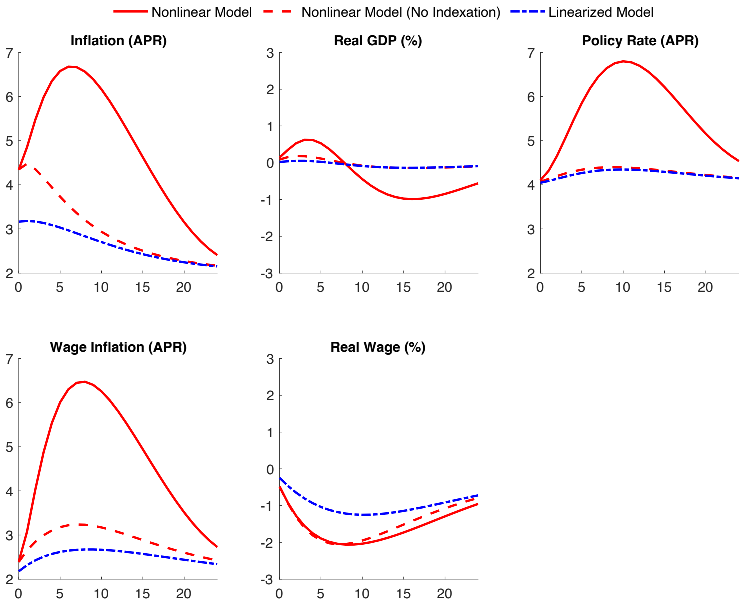
Cost-Push Shock: Role of Inflation Variable in Policy Rule



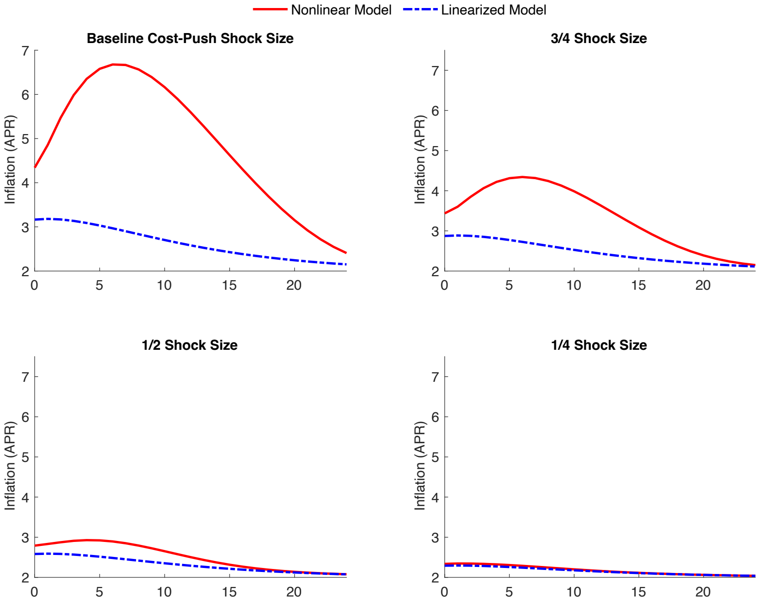
State-Dependent Amplification of Cost-Push Shocks

Baseline: Discount Factor Shock		**Scenario:** Baseline+Same-Sized Cost-Push Shock	State-dependent Effects of Cost-Push Shock
Discount Shock	Inflation Peak	Inflation Peak	Δ Inflation Peak **(Scenario-Baseline)**
-0.0%	2% (Steady State)	6.7%	$\mathbf{4.7}\%$
-0.5%	2.2%	8.0%	$\mathbf{5.8}\%$
-1.0%	2.4%	9.4%	$\mathbf{7.0}\%$
-1.5%	2.7%	10.8%	$\mathbf{8.1}\%$
-2.0%	3.2%	12.2%	$\mathbf{9.0}\%$

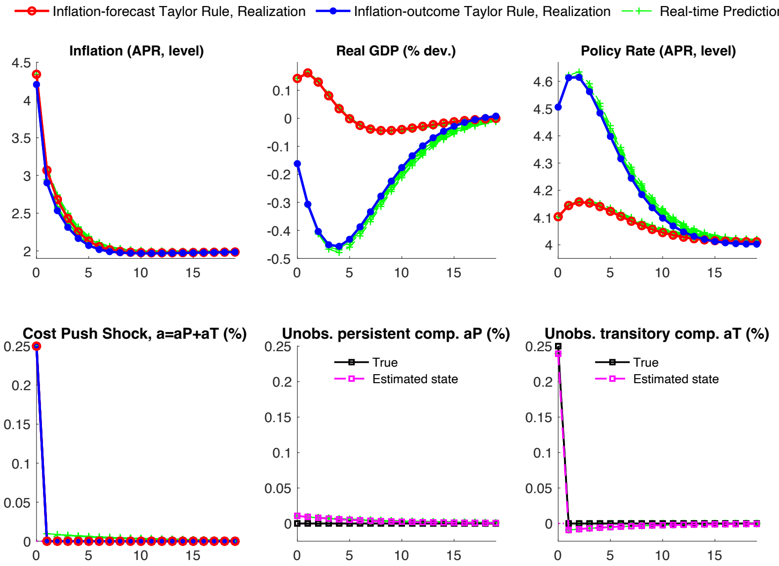
Impact of Nonlinearities: Cost-Push Shock



Impact of Shock Size: Cost-Push Shock

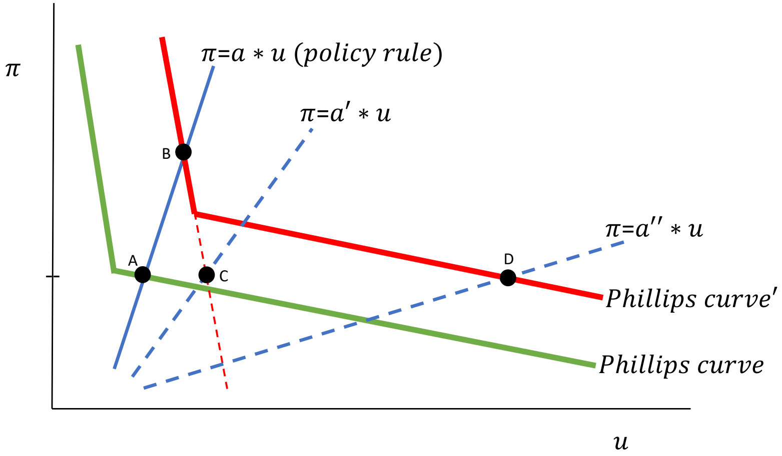


“Looking trough” Transient Cost-Push Shock

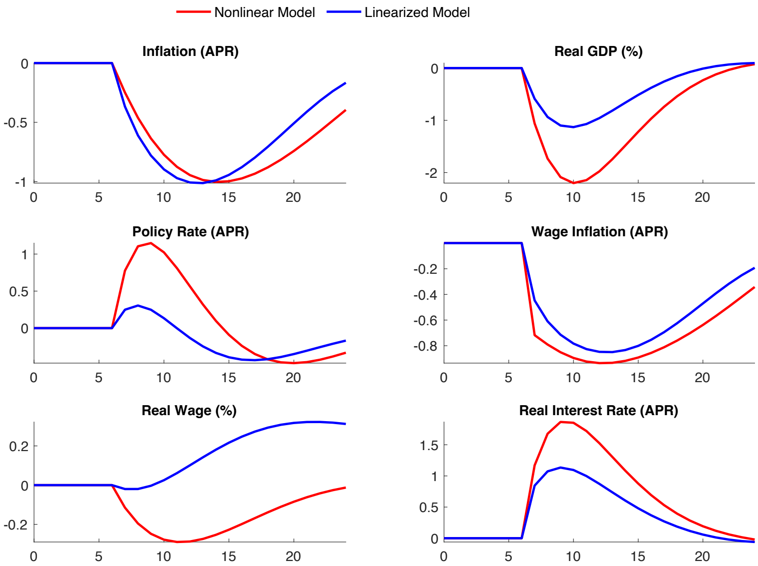


How Costly is the Last Mile?

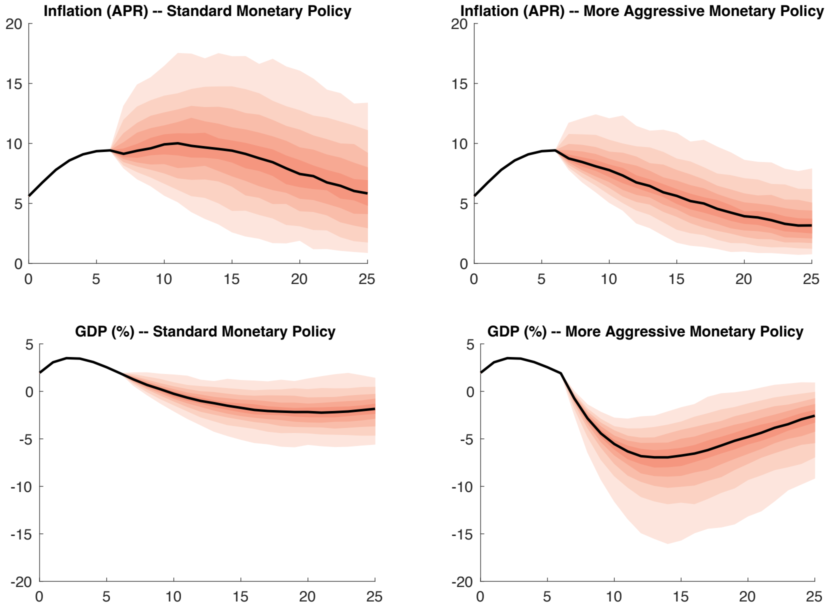
- Adverse shock shifts economy from A to B, but more aggressive policy may bring economy to point D rather than C.



Quantifying the Last Mile – More Monetary Tightening



More Monetary Tightening: Stochastic Simulations



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Policy Implications and Conclusions

- Nonlinear model accounts well for inflation surge and expansion in economic activity.
  - **Key:** central bank misjudges persistence of underlying inflationary pressures. Does not hike policy rate as it (erroneously) expects quickly dissipating inflationary pressures.
  - Ensuing fall in real interest rate boosts economic activity even with inflation being high.
- Nonlinear model accounts for data much better than linearized version.
- Analysis highlights risks of putting too much weight on "point forecasts" of inflation, especially with large forecast uncertainty.
  - Nonlinear model shows "looking through" supply shocks reasonable if inflation is near target; "looking through" risky if inflation is above target.

Policy Implications and Conclusions

- Nonlinear model points to effects of cost-push shocks being state-dependent. A given cost-push shock amplifies inflation by more if inflation is elevated to begin with.
- Costs of returning inflation to target quickly may be amplified considerably if inflation is allowed to persist for some time.
- Analysis suggests that interaction of nonlinearities and more persistent shocks crucial to understand 2021-23 episode and critical to formulate good policy.

Thank you for your attention.

Paper, slides, and codes available at www.mathiastrabandt.com

Annex

Harding, Lindé and Trabandt (2022, 2023)

- Competitive firms aggregate intermediate goods $Y_{i,t}$ into final good Y_t using technology $\int_0^1 G\left(Y_{i,t}/Y_t\right) di = 1$.

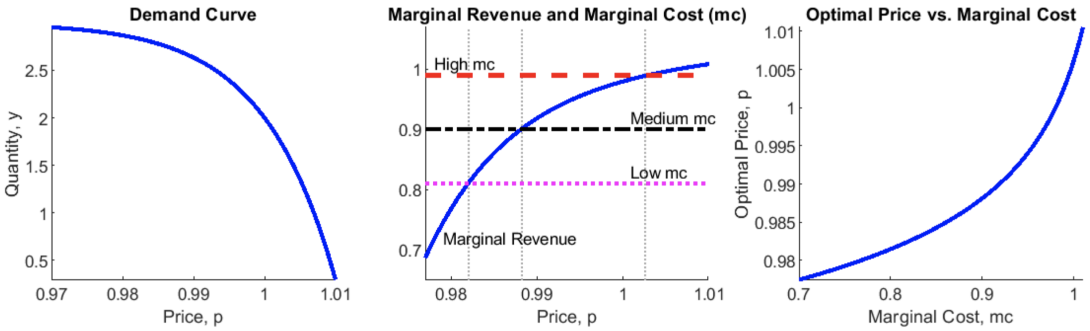
- Following Dotsey-King (2005) and Levin-Lopez-Salido-Yun (2007):

$$G\left(\frac{Y_{i,t}}{Y_t}\right) = \frac{\omega_p}{1+\psi_p}\left[\left(1+\psi_p\right)\left(\frac{Y_{i,t}}{Y_t}\right) - \psi_p\right]^{\frac{1}{\omega_p}} + \frac{1+\psi_p-\omega_p}{1+\psi_p}$$

- $\psi_p < 0$: Kimball (1995), $\psi_p = 0$: Dixit-Stiglitz.

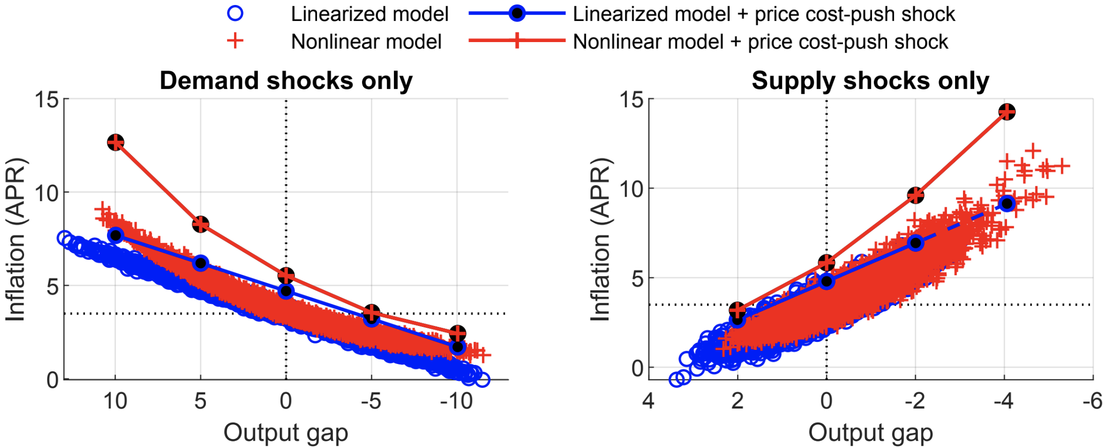
- Kimball aggregator: demand elasticity for intermediate goods increasing function of relative price.
  - Firms increase prices more than they cut prices because of quasi-kinked demand.

Harding, Lindé and Trabandt (2022, 2023)



Harding, Lindé and Trabandt (2022, 2023)

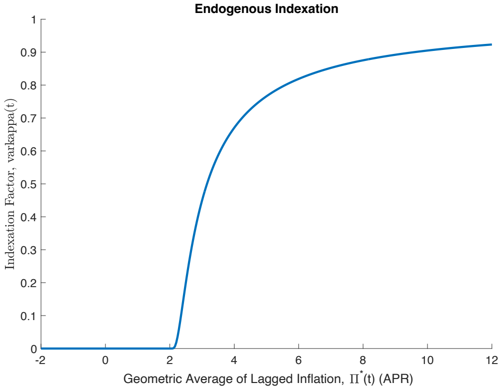
Figure 2: Linear and Nonlinear Phillips Curves with Cost-Push Shocks



State-dependent Indexation

- Non-optimizing (rule-of-thumb) firms set $P_{i,t} = \tilde{\Pi}_t P_{i,t-1}$ where $\tilde{\Pi}_t = \Pi^{1-\varkappa_t} \Pi_{t-1}^{\varkappa_t}$ and

$$\varkappa_t = e^{-\frac{\varrho}{\max\left(\Pi_t^* - \Pi,\, 0.0001\right)}},\ \Pi_t^* = \left(\Pi_{t-1}^*\right)^{\omega} \left(\Pi_{t-1}\right)^{1-\omega}$$



Parameters: $\varrho = 0.002$, $\omega = 0.8$, $\Pi = 1.005$.

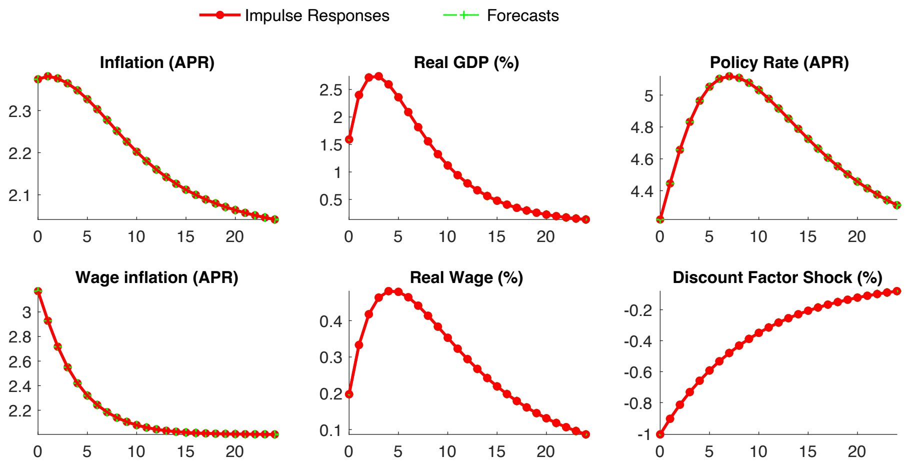
Note: state-dependent indexation disappears upon log-linearization.

Similar setup for wage indexation.

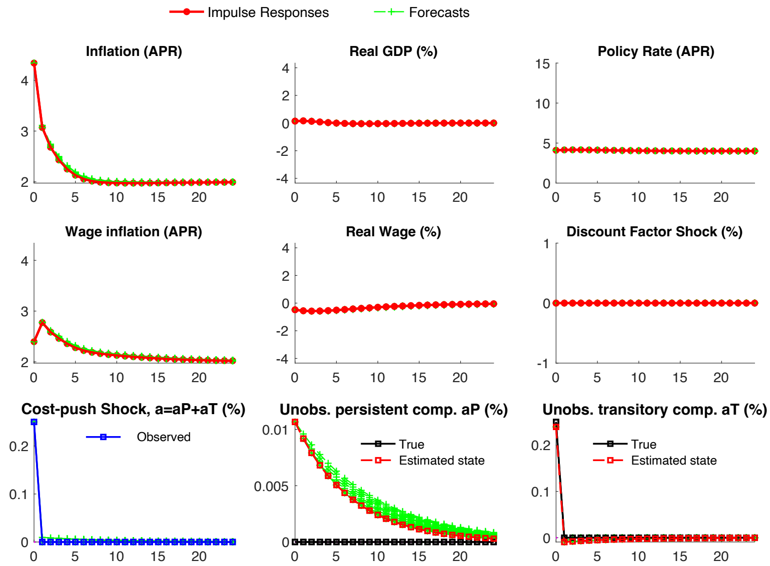
Model-Data Comparison (In Progress)

- Evidence on endogenous indexation/rule of thumb firms (in progress).
- Micro data on frequency of price adjustment (in progress).

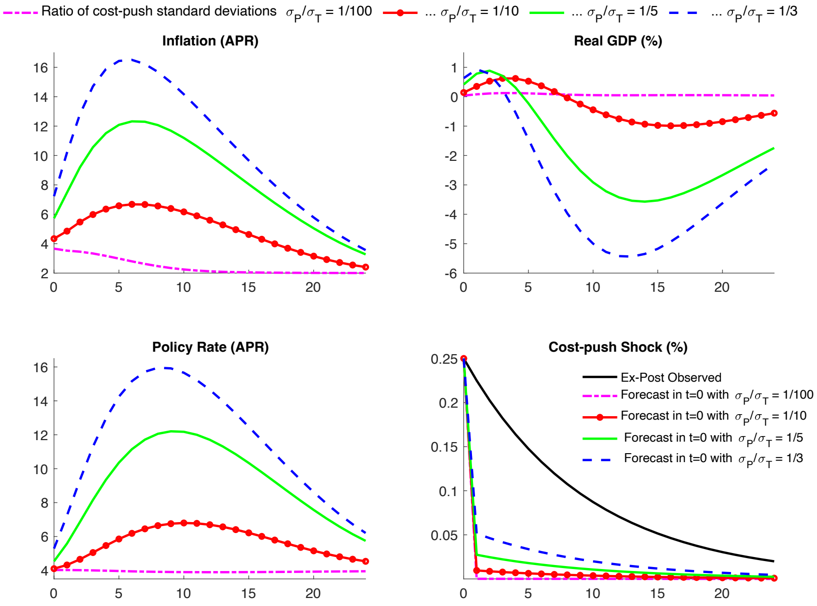
Effects of Discount Factor Shock



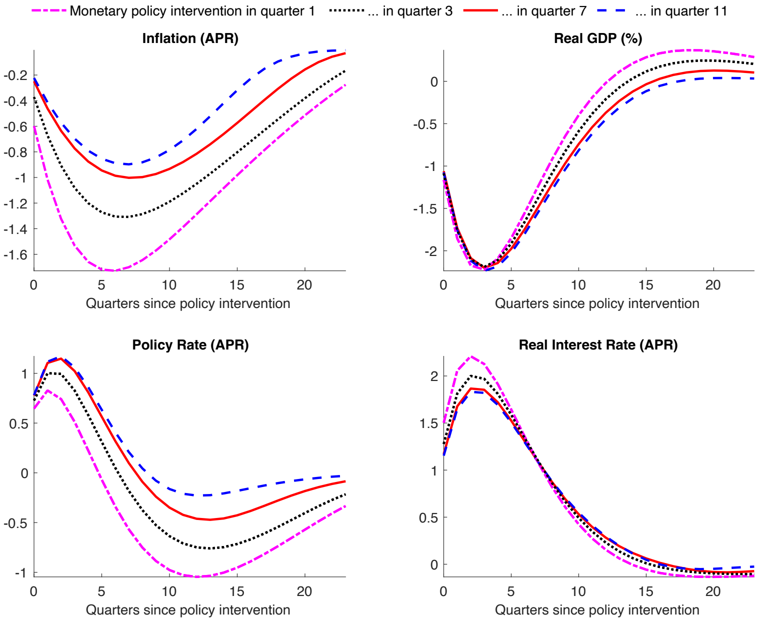
Effects of iid Cost-Push Shock



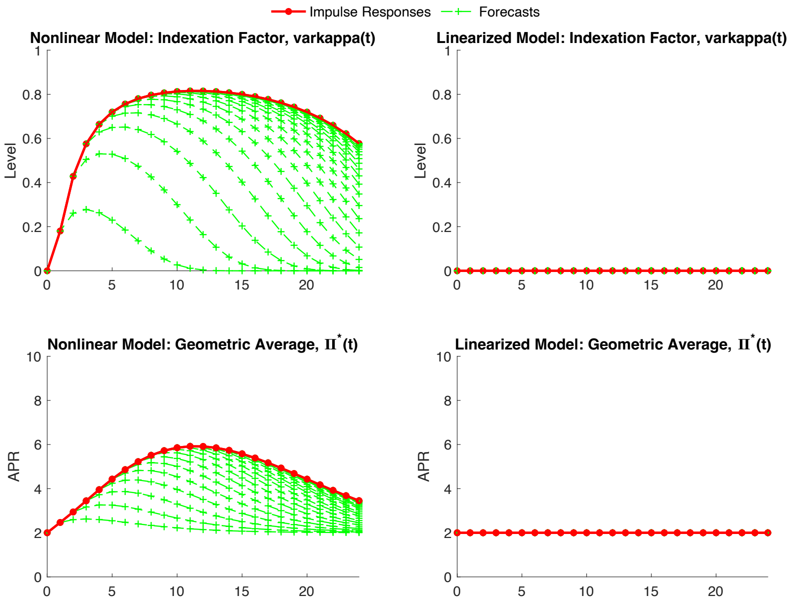
Effects of Unobs. Components Specification



Effects of Timing of Policy Thightening



Cost-Push Shock: Endogenous Indexation Variables



Linear Model vs. Data