Monetary Policy and Inflation Scares[1]

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Cleveland Fed - ECB Conference: Inflation: Drivers and Dynamics

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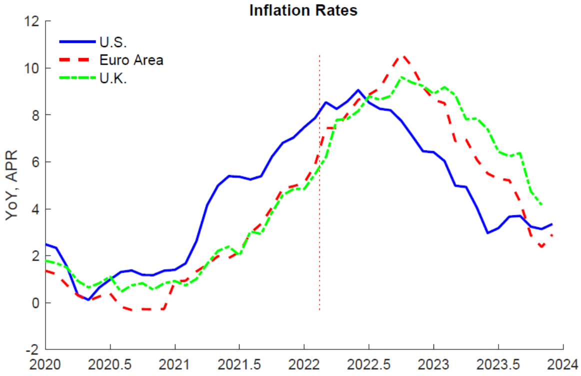
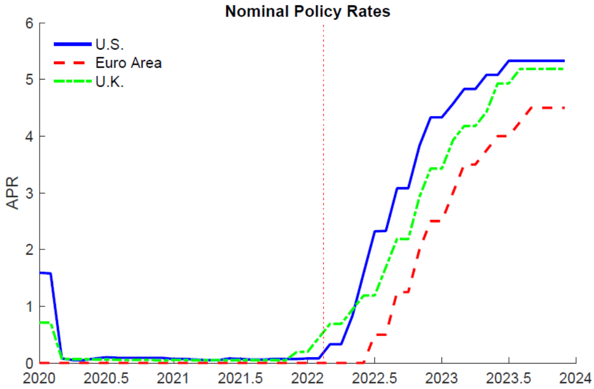
[1] The views expressed herein are those of the authors and should not be attributed to the IMF, its Executive Board, or its management.

Motivation: The Inflation Surge

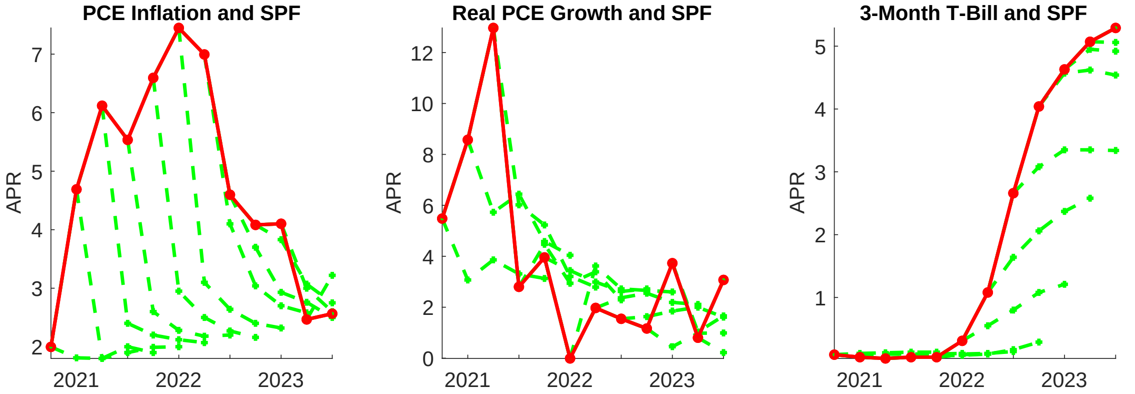
- Major CBs attempted to "look through" a transient inflation surge.





Motivation: U.S. Data

- Also 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
- Transmission of Adverse Cost-Push Shocks
- 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) plus Kimball (1995) aggregation.
  - Nonlinear price and wage inflation Phillips curves.

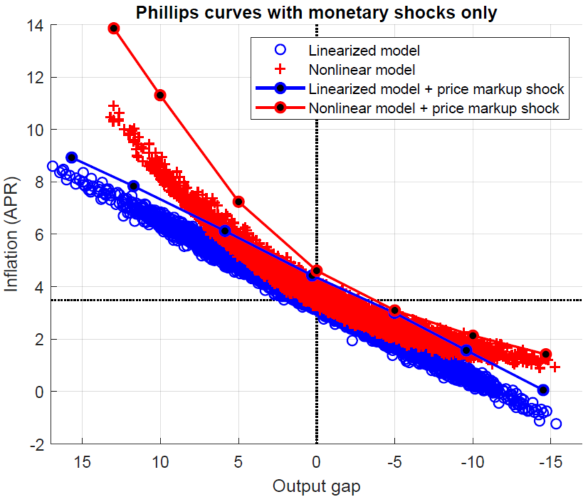
- Three new model features:

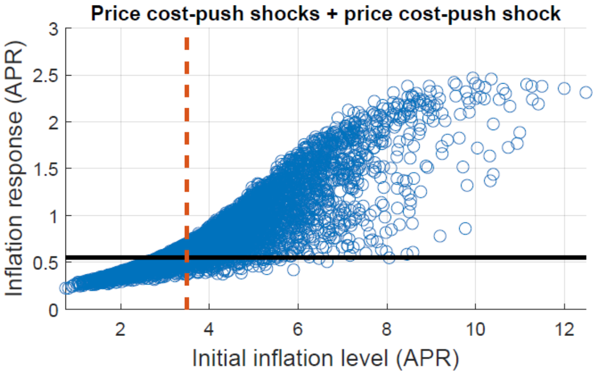
❶ Learning about the nature of cost-push shock.

❷ Forecast-targeting based Taylor rule with smoothing.

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

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 $a_{P,t|t}$ observing a_t for $t = 0, 1, ...,$ assume $\sigma_T > \sigma_P$.

Forecast-targeting Taylor Rule

- Forecast-targeting Taylor rule:

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

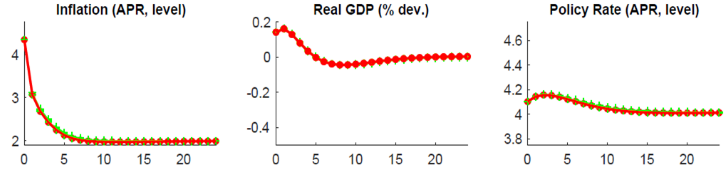
- Baseline: Four-quarter ahead expected inflation (qoq), i.e. $\mathsf{E}_t \Pi_{t+4} = \mathsf{E}_t \frac{P_{t+4}}{P_{t+3}}$.

- Variations: Π_t or $\mathsf{E}_t \Pi_{t+8}$.

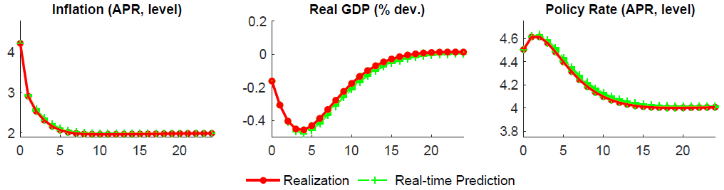
Transient Supply Shock: Actual Vs. Forward-looking Rule

- Forward-looking rule implies "looking trough" transient cost-push ε_t^T.
- Rule responding to π_t implies $y_t \downarrow$ for transient ε_t^T but small inflation gain.

- Forecast-based Taylor Rule with $E_t \pi_{t+4}$



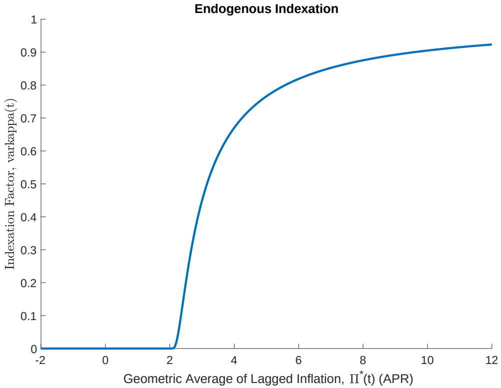
- Taylor Rule with Actual Inflation π_t



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.

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 markup shock
ρ_T	0	AR(1) transitory markup shock
σ_P	1	Standard deviation persistent markup shock
σ_T	10	Standard deviation transitory markup shock
ρ_δ	0.9	AR(1) discount factor shock

Solution Algorithm

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

- Stochastic simulation under certainty equivalence teases out difference between linear and nonlinear solutions.

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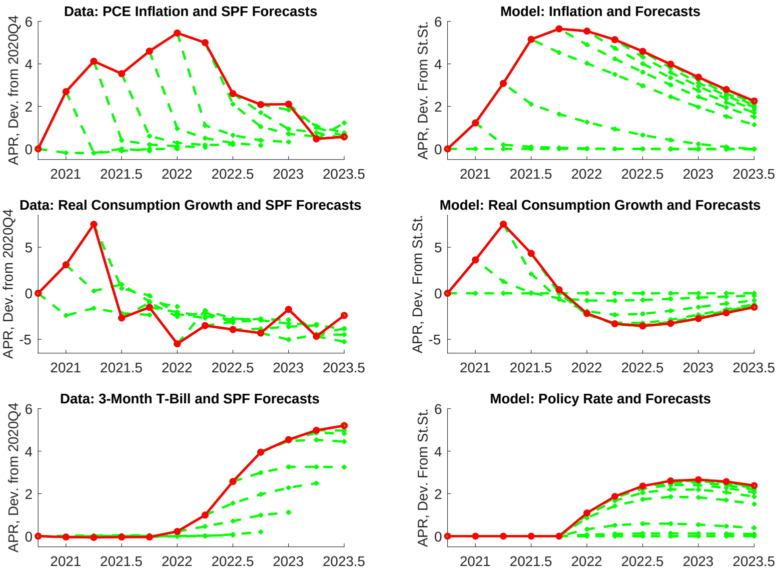
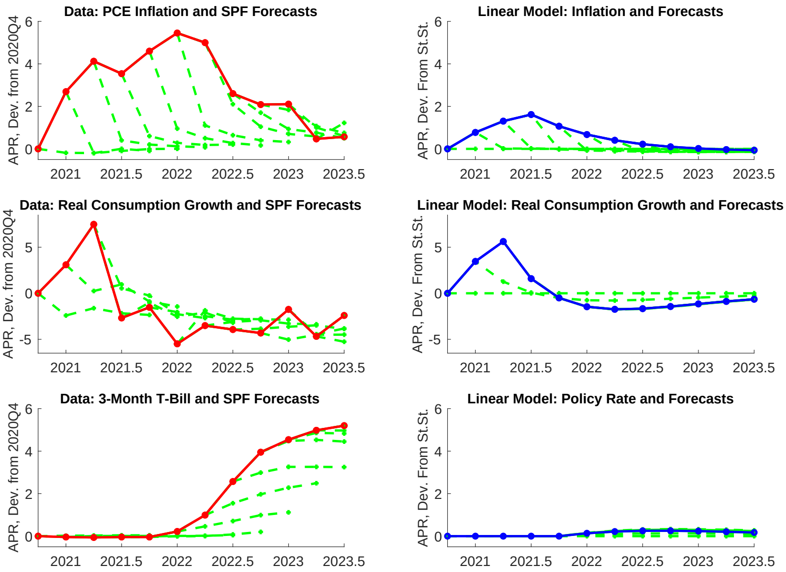
Model-Data Comparison: Model Setup

- Add *Large* shocks ε_t^P to persistent cost-push component, $a_{P,t}$.
- Allow for *Small* positive demand shocks (negative discount factor shocks).
- Phase in shocks over 2-3 quarters.
    - Agents use Kalman filtering for cost-push shocks, demand shocks observed.

Model-Data Comparison: Nonlinear Model



Model-Data Comparison: Linearized Model



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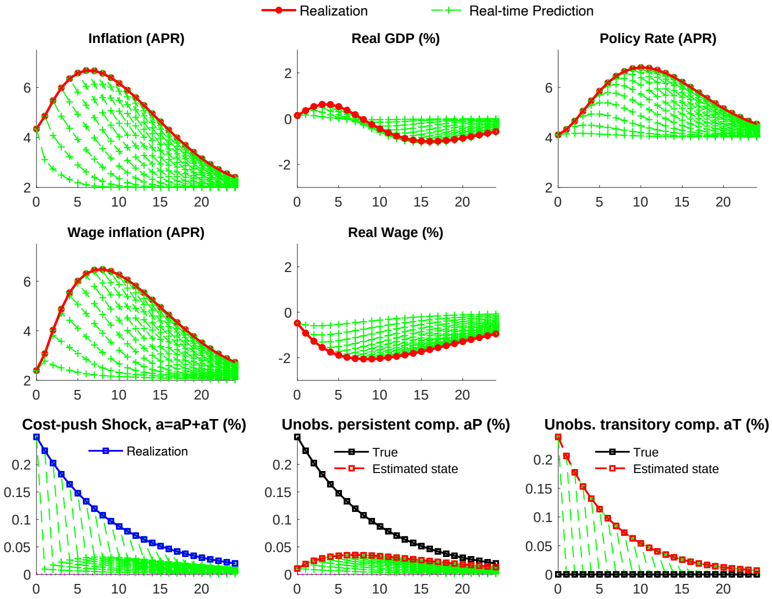
Transmission of Cost-Push Shocks: Model Setup

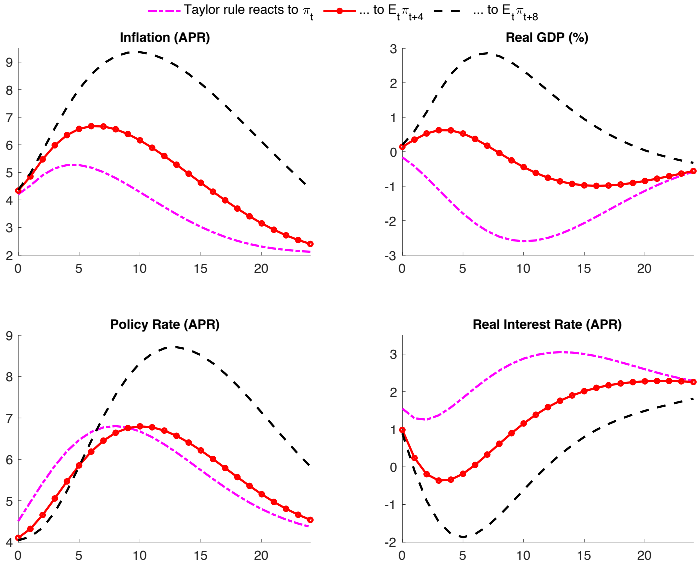
- Now study single large innovation ε_t^P to persistent cost-push shock $a_{P,t}$.
    - As before, agents only observe a_t, use Kalman filtering to calculate $a_{P,t|t}$ and $a_{T,t|t}$.

Transmission of an Adverse Cost-Push Shock



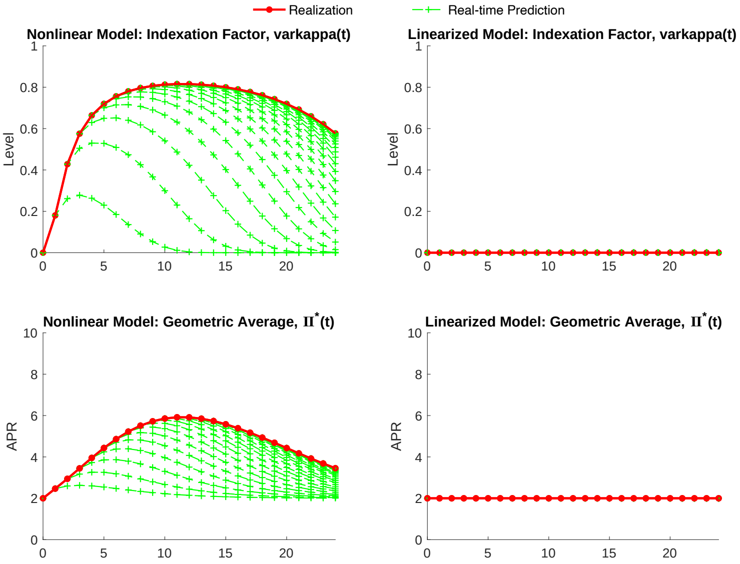
Role of Inflation Variable in the Policy Rule

- Transmission of the same cost-push shock under alternative policy rules.



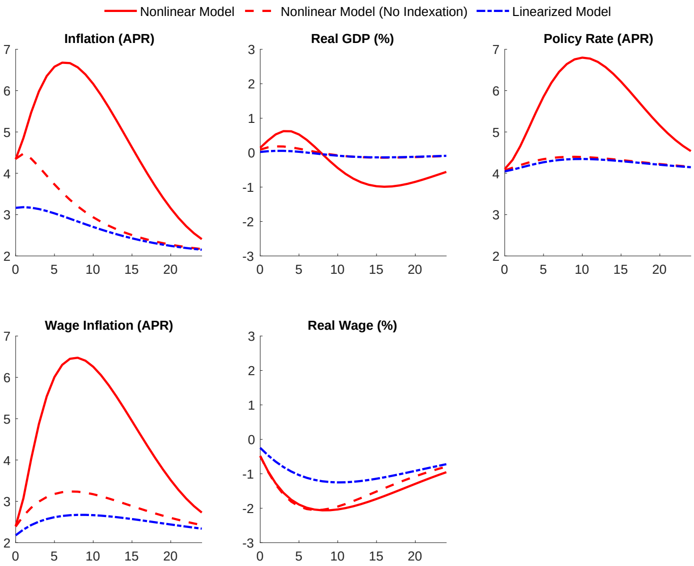
Intrinsic Endogenous Indexation Quantitatively Important

- Amplification via increasing endogenous indexation $\varkappa_t > 0$ in nonlinear model.



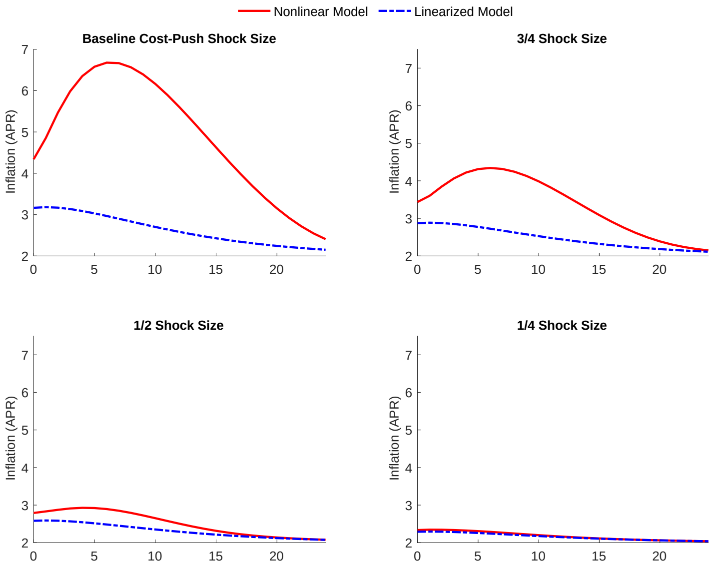
Impact of Nonlinearities and Indexation

- Transmission of same ε_t^P in baseline (nonlin), nonlin with $\varkappa_t = 0$, and linearized models.



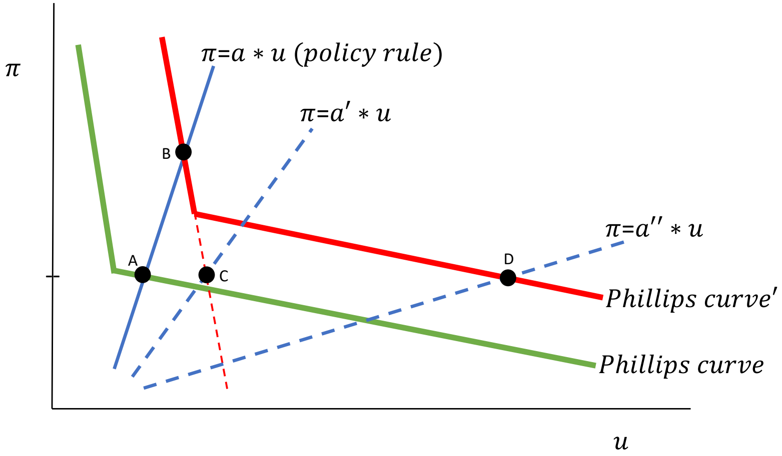
Impact of Shock Size

- Transmission of different realizations of ε_t^P in nonlinear and linearized solutions.



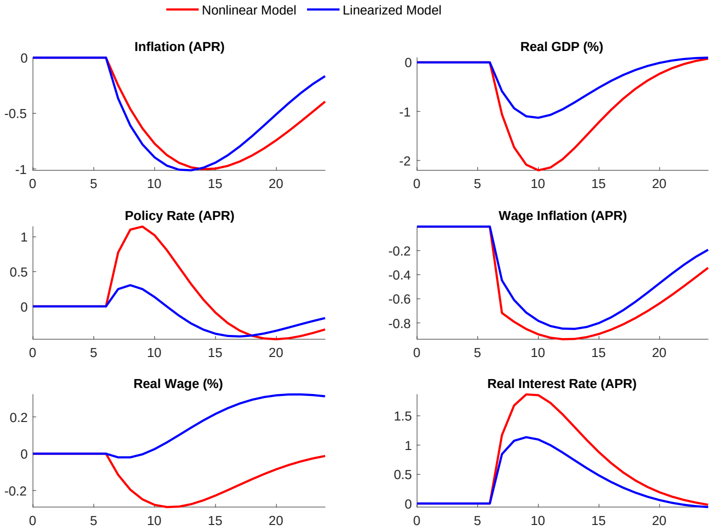
How Costly is the Last Mile?

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



Quantifying the Last Mile – More Monetary Tightening

- PC slope in linear model set to imply same initial $\Delta\pi/\Delta y$ as in nonlinear model.



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Conclusions - Modeling

- Macromodel with 1. Nonlinear Price and Wage Phillips curves, 2. Learning about adverse cost-push shock, 3. Endogenous intrinsic indexation, accounts for persistent inflation surge without severe contraction in economic activity.
  - **Key**: central bank follow forecast-based policy rule and misjudges inflationary pressures, so lower real interest rates boost economic activity initially even as inflation is rising.
  - Model less reliant on large demand shocks to explain the 2021-23 inflation scare.
  - Model implies that sign restricted SVARs likely misleading, at least for this episode.
- Under identical assumptions, a linearized formulation of our model cannot generate inflation cycle.
- Large shocks key, little difference between nonlinear and linearized model for small shocks.

Conclusions - Policy

- Need to rethink standard policy prescription to look-through cost-push shocks.
  - While "Looking through" supply shocks reasonable when inflation is close to target, this policy is risky when inflation rises persistently above target in a unpredictable manner.

- Analysis highlights risks of putting too much weight on "point forecasts" of inflation, especially with large forecast (shock) uncertainty.
- Finally, our analysis implies that the economic costs of "going the last mile" – i.e. aggressive tightening aimed at returning inflation quickly to target once it has peaked and started to recede – can be considerable.

Thank you for your attention.

Annex

Harding, Lindé and Trabandt (2022, 2023)

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

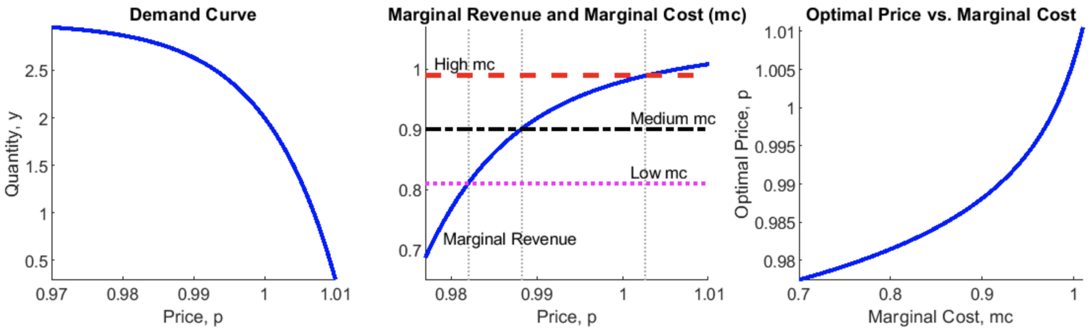
- Following Dotsey-King (2005) and Levin-Lopez-Salido-Yun (2007):

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

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

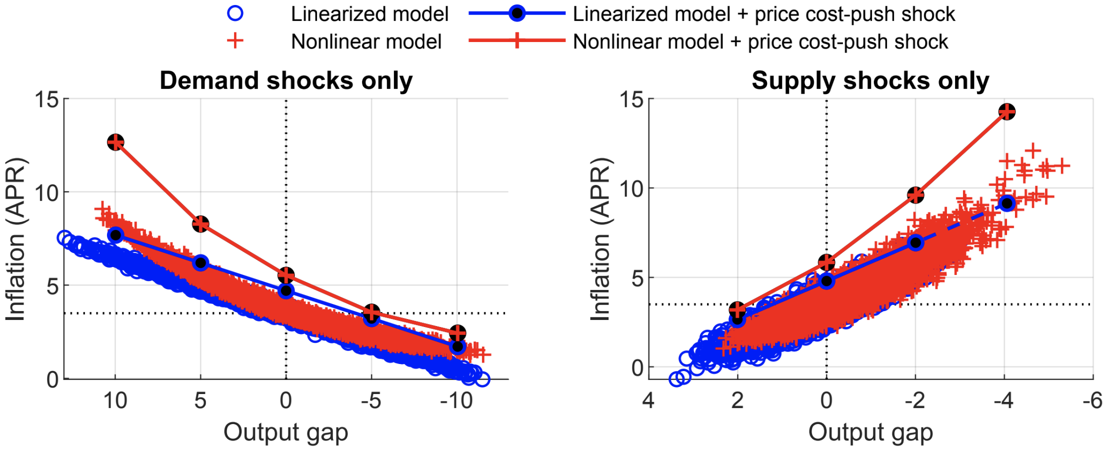
- Kimball aggregator: demand elasticity for intermediate goods increasing function of relative price.
  - Firms increase prices more than they cut prices because of quasi-kinked demand.

Harding, Lindé and Trabandt (2022, 2023)

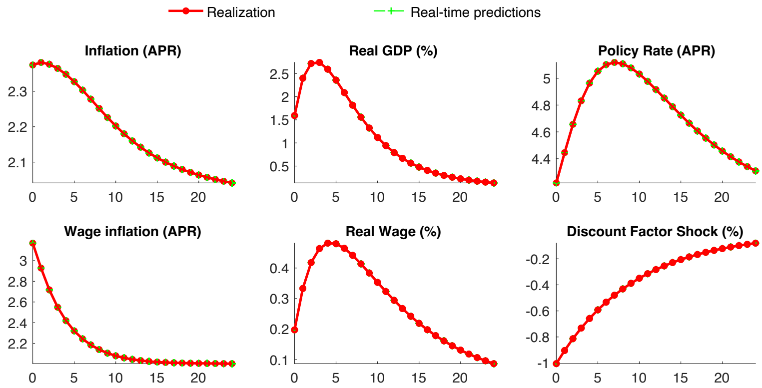


Harding, Lindé and Trabandt (2022, 2023)

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



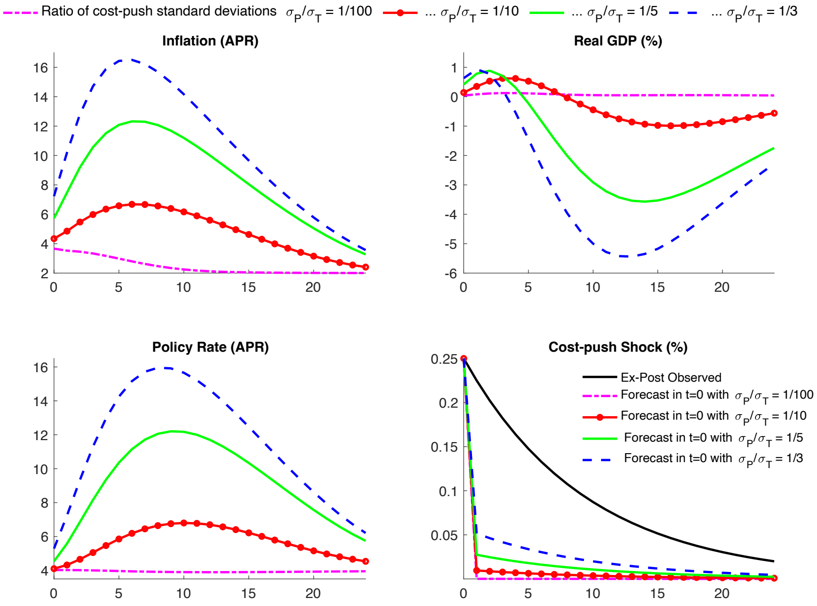
Effects of Discount Factor Shock



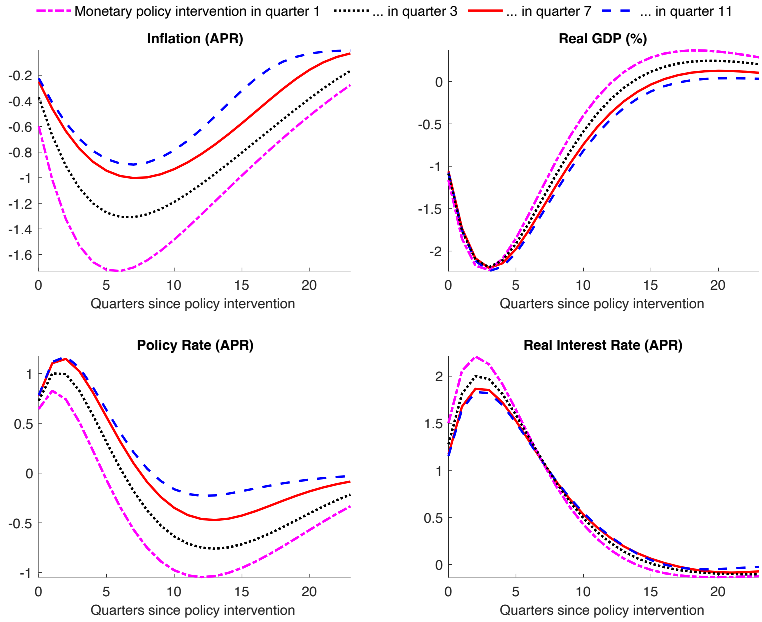
State-Dependent Amplification of Cost-Push Shocks

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%	**4.7%**
−0.5%	2.2%	8.0%	**5.8%**
−1.0%	2.4%	9.4%	**7.0%**
−1.5%	2.7%	10.8%	**8.1%**
−2.0%	3.2%	12.2%	**9.0%**

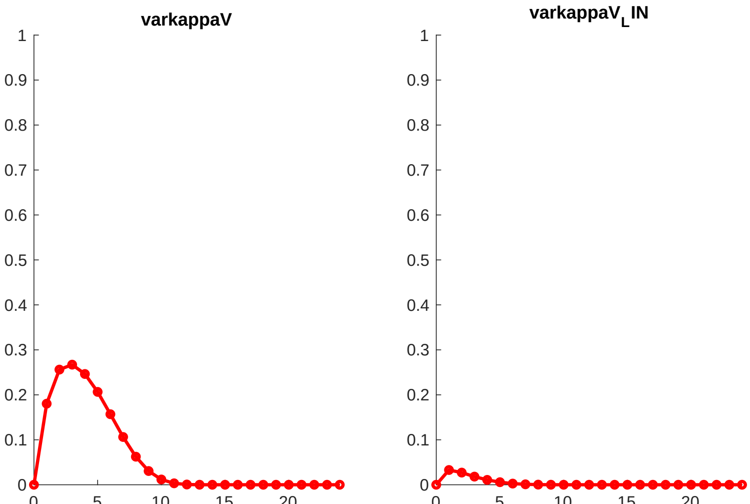
Effects of Unobs. Components Specification



Effects of Timing of Policy Thightening



Cost-Push Shock: Engogenous Indexation Variables in IID Case



Data-Model Comparison

- Macro data for inflation, growth and interest rates, including SPF.
- Evidence on endogenous indexation/rule of thumb firms (in progress).
- Micro data on frequency of price adjustment (in progress).

Linear Model vs. Data