Understanding Post-Covid Inflation Dynamics

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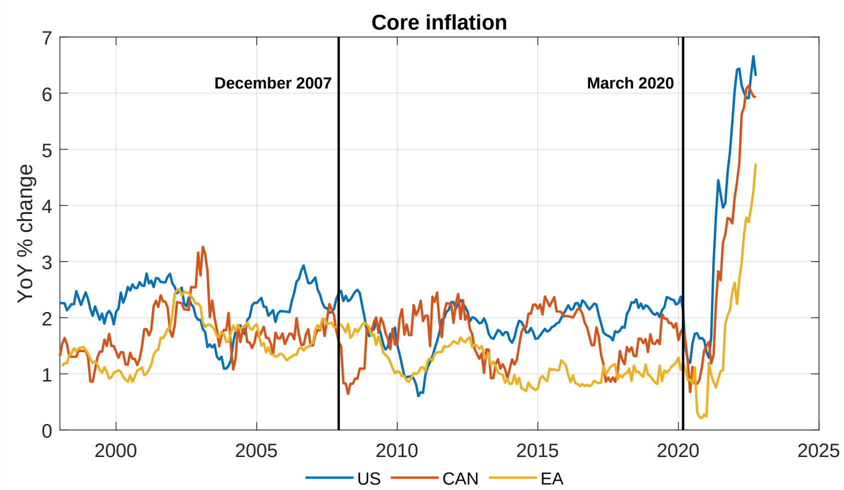
Inflation increased rapidly after COVID shock



Understanding inflation: from the Great Recession to COVID

- Challenge: reconcile the "missing deflation puzzle" of the Great Recession with the recent surge in inflation
- Study recent US inflation and output dynamics using the workhorse Smets–Wouters (SW) New Keynesian model
  - Key feature: Kimball (1995) state-dependent demand elasticity
  - State-dependent Phillips curve slope and propagation of shocks

Preview of results

- Our variant of the SW model explains the modest decline in inflation during the Great Recession and its recent post-COVID surge better than the original SW model
  - Nonlinear formulation especially helpful
- Phillips curve steeper during booms, flattened during recessions
- Cost-push shocks amplified in booms, muted in recessions
- Policy tradeoff to stabilize inflation becomes larger as baseline inflation increases

The workhorse macroeconomic model

- Nonlinear formulation of Smets–Wouters (2007) model
- Following Dotsey-King (2005), Levin-Lopez-Salido-Yun (2007)

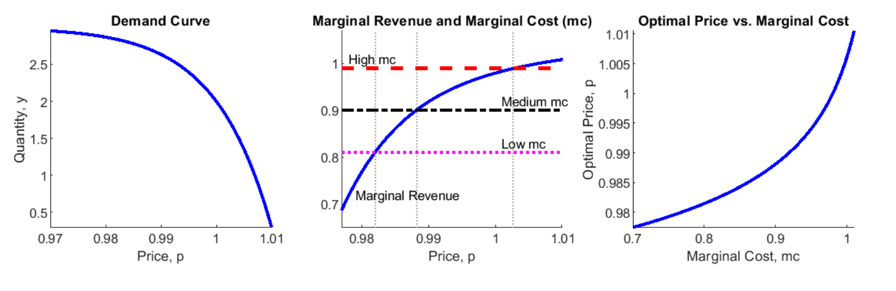
$$G_Y\left(\frac{Y_t(f)}{Y_t}\right) = \frac{\phi}{1-\psi}\left[\left(\frac{\phi-\psi}{\phi}\right)\frac{Y_t(f)}{Y_t} + \frac{\psi}{\phi}\right]^{\frac{1-\psi}{\phi-\psi}} + \left[1 - \frac{\phi}{1-\psi}\right]$$

- $\psi > 0$: Kimball (1995), $\psi = 0$: Dixit-Stiglitz case

▸ Details

Intuition: asymmetric price setting with quasi-kinked demand

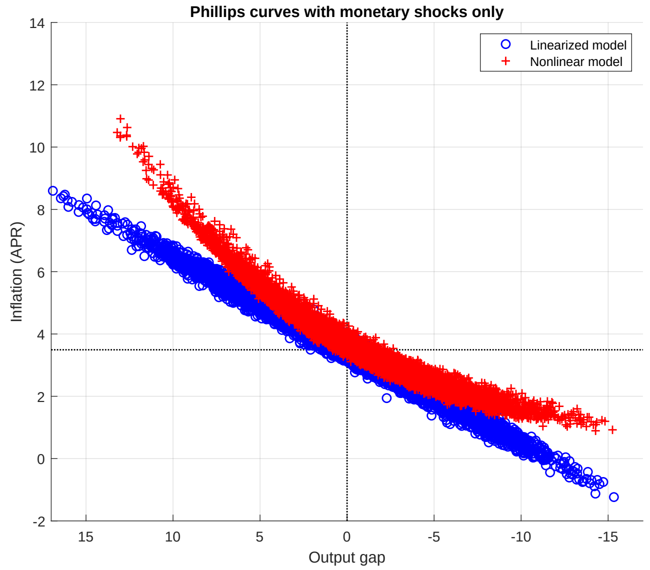
- Strategic complementarities imply that firms face **quasi-kinked demand**
  - Demand elasticity is an increasing function of price
- Firms increase prices sharply when marginal costs increase but do not cut prices as much when marginal cost falls



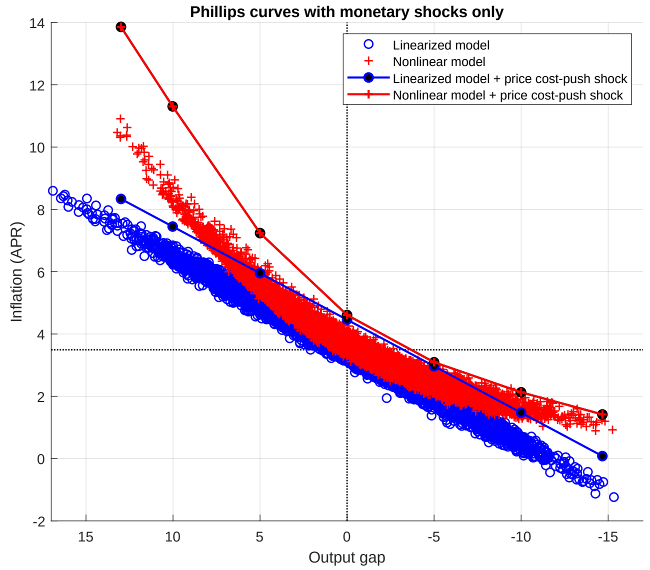
Parameterization and Solution

- We follow Harding, Lindé & Trabandt (JME, 2022) to parameterize model
  - Estimate linearized model on pre GFC data
  - Impose tighter prior for steady state markup, Calvo price parameter set in line with micro evidence
  - Estimate price Kimball parameter
- Solution and filtering also follows HLT
  - Solve model with extended path method in Dynare (Fair–Taylor)
  - Stochastic simulation under certainty equivalence teases out difference between linear and nonlinear solutions

Phillips curves in linearized and nonlinear model



Effect of a cost-push shock on Phillips curves

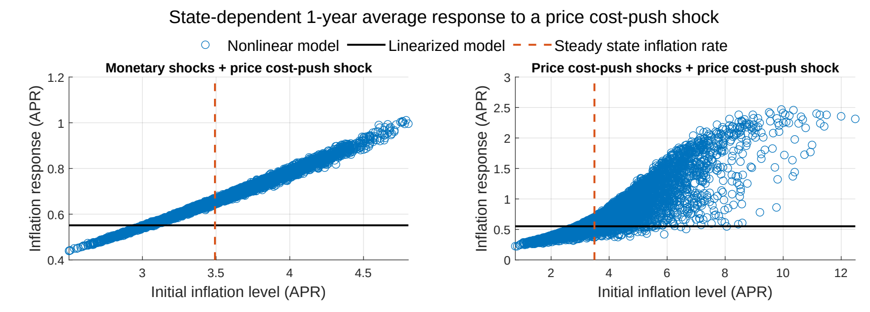


What are the implications for shock propagation?

- Simulate model with shocks evaluated at estimated standard deviations
  - Do this shock by shock, then for all shocks combined
- Feed a 1 σ_p price cost-push shock at each period during the simulations
- Compute the average 1 year effect of the shock across different states

State-dependent effects of cost-push shocks on inflation

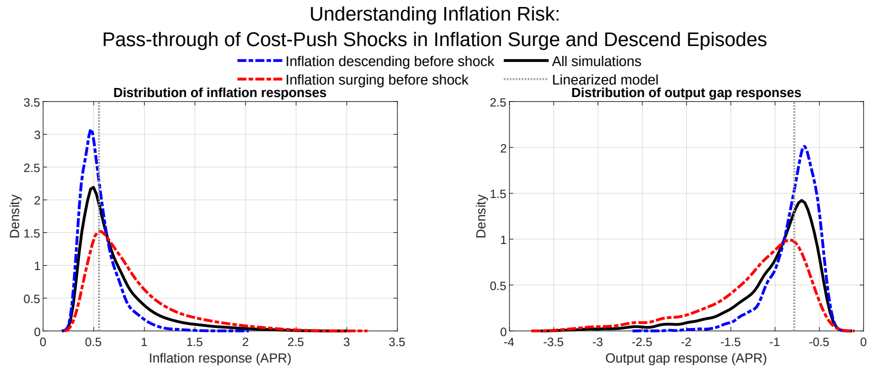
- Cost-push shocks amplified when initial inflation is high, irrespective of which shock drives underlying model dynamics
  - Similar results for output gap responses
- Cost-push shocks are main driver of inflation in the model
  - Produce substantial inflation risk



▸ More ▸ GDP effects

What explains the increased inflation risk?

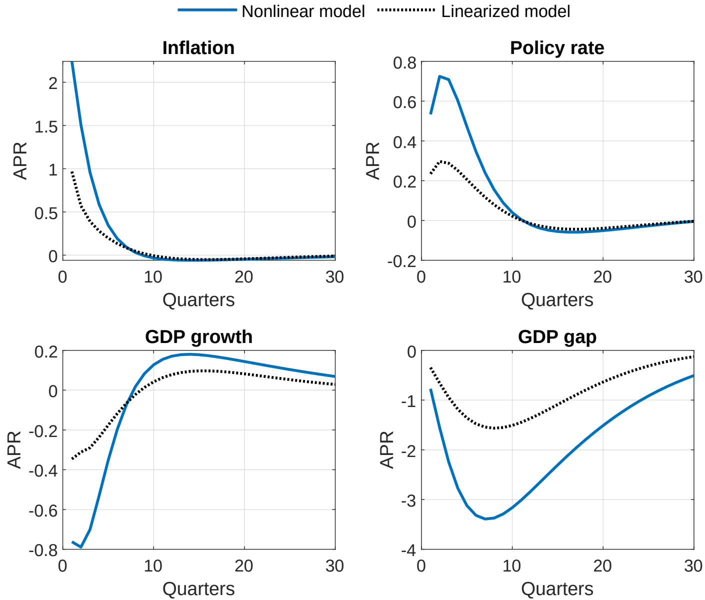
- Whether inflation is surging or descending is key
- Inflation risk substantially higher when inflation is surging



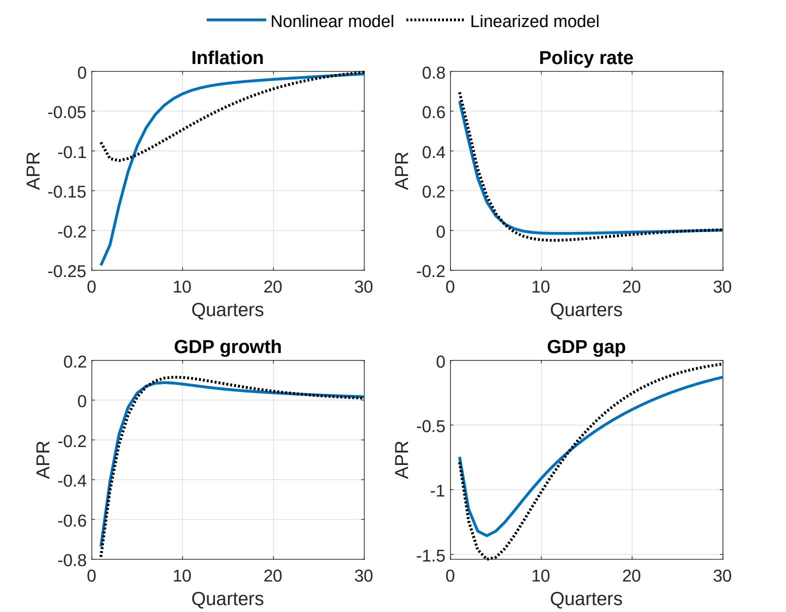
Monetary policy trade-offs during the post-Covid period

- What is the policy trade-off at the current juncture?
- Compute IRFs to cost-push and monetary shocks in nonlinear and linearized model conditional on 2022Q1 filtered state
- Compute the cost of full inflation stabilization in response to a cost-push shock for different levels of initial inflation

IRFs to a 1 σ_p price cost-push shock in 2022Q1

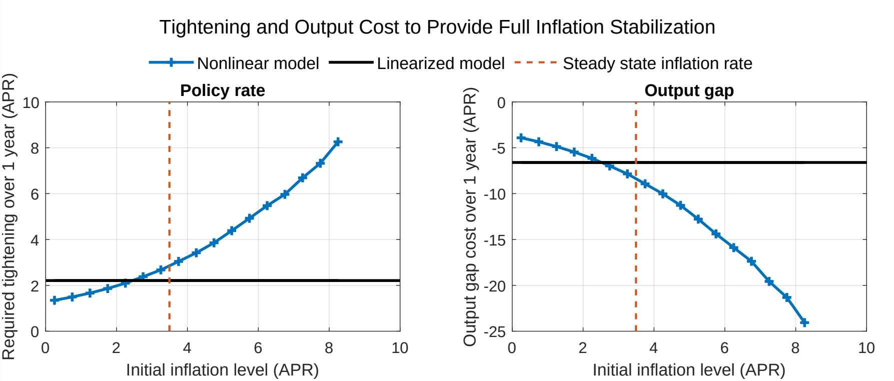


IRFs to a 1 σ_r monetary shock in 2022Q1

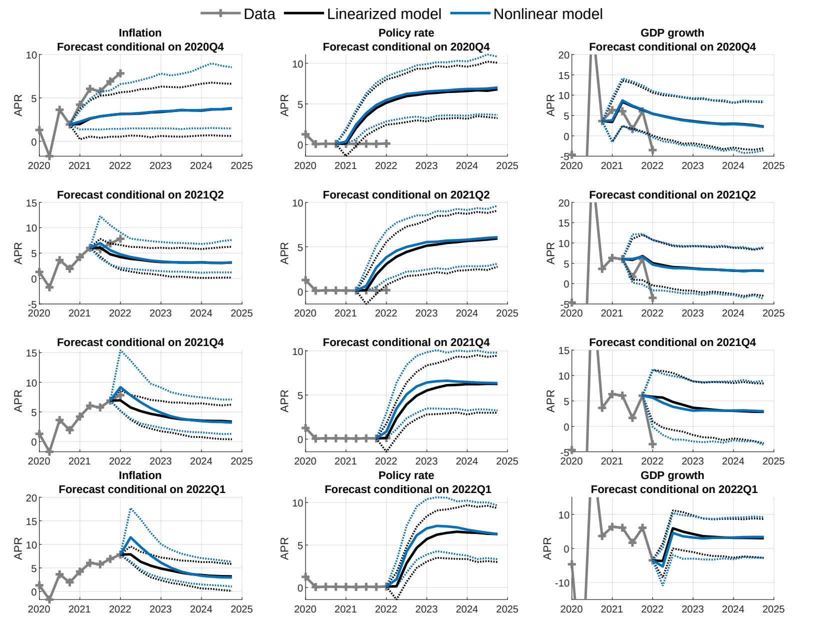


Inflation stabilization cost in response to a 1 σ_p cost-push shock

- Compute the policy contraction that would be necessary to undo the effects of a cost-push shock over 1 year
  - Monetary policy trade-off increasingly larger as inflation increases



Conditional forecasts given filtered state in linearized model



Key takeaways

- Our model explains the modest decline in inflation during the Great Recession and its recent post-COVID surge better than the standard workhorse macro model
- Nonlinear Phillips curve and state-dependent propagation of cost-push shocks key to understand post-Covid inflation dynamics
- Inflation risk is much higher when inflation is already elevated, implying large policy tradeoffs if cost-push shocks truly exogenous

APPENDIX

Kimball aggregator

- Competitive firms aggregate intermediate goods $Y_t(f)$ into final goods Y_t using technology $\int_0^1 G(Y_t(f)/Y_t)df = 1$
- Kimball aggregator:

$$G_Y\left(\frac{Y_t(f)}{Y_t}\right) = \frac{\phi}{1-\psi}\left[\left(\frac{\phi-\psi}{\phi}\right)\frac{Y_t(f)}{Y_t} + \frac{\psi}{\phi}\right]^{\frac{1-\psi}{\phi-\psi}} + \left[1 - \frac{\phi}{1-\psi}\right]$$

with $\psi = (\phi - 1)\varepsilon$

- $\varepsilon > 0$ governs demand curvature; $\varepsilon = 0$ is Dixit-Stiglitz case

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Linear pricing curves in model

- The linearized model features the following standard NK Phillips curve

$$\begin{aligned}\widehat{\pi}_t - \iota_p \widehat{\pi}_{t-1} &= \beta \left(\mathrm{E}_t \widehat{\pi}_{t+1} - \iota_p \widehat{\pi}_t\right) + \kappa \widehat{mc}_t + \hat{\varepsilon}_{p,t}, \quad \text{(A.1)} \\ \kappa &= \frac{(1-\xi_p \beta)(1-\xi_p)}{\xi_p (1 + (\phi_p - 1)\epsilon_p)},\end{aligned}$$

  - $1 - \xi_p$ is the probability of each firm to re-optimize its price
  - ϵ_p is the curvature of the Kimball aggregator function
  - ϕ_p is the steady state gross price markup
  - Cost-push, or markup, shock $\hat{\varepsilon}_{p,t}$ has been re-scaled with $1/\kappa$ to enter the Phillips curve with a unit coefficient

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Nolinear pricing equations in model

- The corresponding nonlinear block is given by

$$\frac{1+\phi_p\epsilon_p}{1+\epsilon_p} p_t^* \gamma_{1,t}^p = \phi_p \gamma_{2,t}^p + \frac{\epsilon_p(\phi_p - 1)}{1+\epsilon_p} (p_t^*)^{\frac{\phi_p(1+\epsilon_p)}{\phi_p - 1}+1} \gamma_{3,t}^p$$

$$\gamma_{1,t}^p = (\delta_t^p)^{\frac{\phi_p(1+\epsilon_p)}{\phi_p-1}} y_t + \left(\beta\gamma^{1-\sigma}\right) \xi_p E_t \frac{\xi_{t+1}}{\xi_t} \left(\frac{\pi^{1-\iota_p}\pi_t^{\iota_p}}{\pi_{t+1}}\right)^{-\frac{1+\phi_p\epsilon_p}{\phi_p-1}} \gamma_{1,t+1}^p$$

$$\gamma_{2,t}^p = (\delta_t^p)^{\frac{\phi_p(1+\epsilon_p)}{\phi_p-1}} mc_t \varepsilon_{p,t} y_t + \left(\beta\gamma^{1-\sigma}\right) \xi_p E_t \frac{\xi_{t+1}}{\xi_t} \left(\frac{\pi^{1-\iota_p}\pi_t^{\iota_p}}{\pi_{t+1}}\right)^{-\frac{\phi_p(1+\epsilon_p)}{\phi_p-1}} \gamma_{2,t+1}^p$$

$$\gamma_{3,t}^p = y_t + \left(\beta\gamma^{1-\sigma}\right) \xi_p E_t \frac{\xi_{t+1}}{\xi_t} \left(\frac{\pi^{1-\iota_p}\pi_t^{\iota_p}}{\pi_{t+1}}\right) \gamma_{3,t+1}^p$$

- Cost-push shock $\varepsilon_{p,t}$ enters block multiplicatively with $mc_t y_t$

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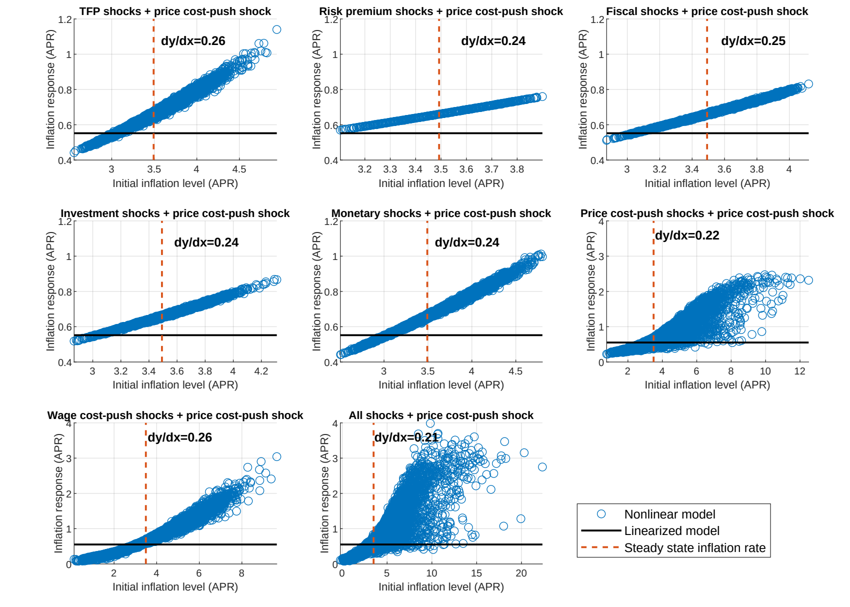
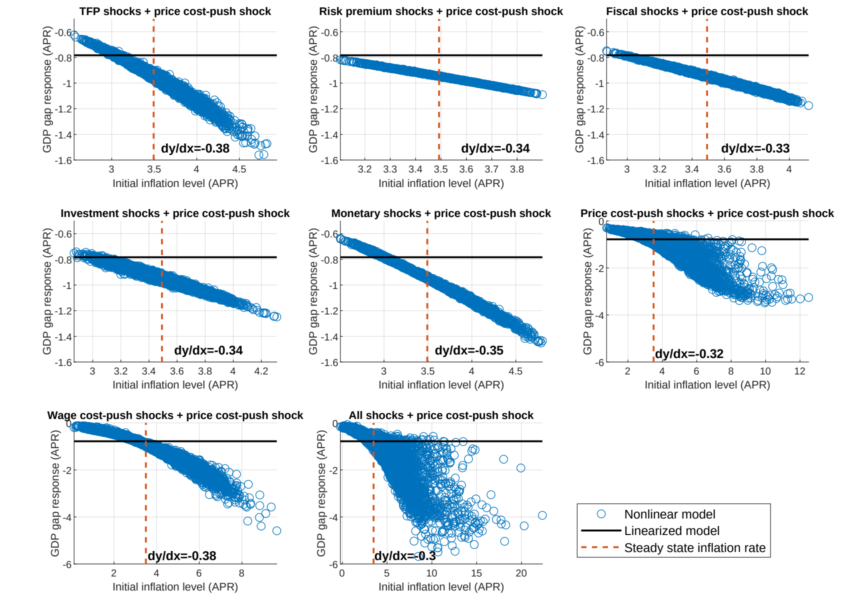
State-dependent effects of cost-push shocks on inflation



State-dependent effects of cost-push shocks on GDP gap



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