Can Supply Shocks Be Inflationary with a Flat Phillips Curve?

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Introduction

- Two facts:
  1. **The Phillips curve (PC) is very flat**
     (Housing bubble, Great Recession, QE 1, 2, 3, 4, ...)
     (Del Negro et al. 2020; Hazell et al. 2020)
  2. **Supply shocks are inflationary**
     (1970s, now)
     (Kaenzig 2021; Bunn, Anayi, Bloom et al. 2022)

- Standard models can't account for these two facts
  - Reason: Flat PC $\Longrightarrow$ very rigid price level
    very rigid price level $\Longrightarrow$ no inflation from supply shocks
  - Shortcoming of Calvo, Taylor, Rotemberg, Menu Costs

What Do We Propose in This Paper?

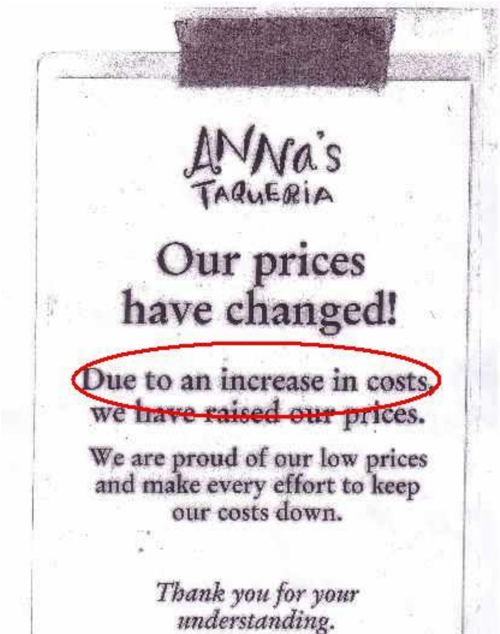
- Data want a model where:
  1. prices are sticky when demand shifts
  2. prices are flexible when supply shifts

  $\longrightarrow$ shock dependence

- Contribution:
  Microfoundation for shock-dependent pricing friction

- Strategic interaction between firms and consumers:
  1. Firms avoid increasing prices when demand increases
  2. But: Firms pass on cost increases to consumers

Behavior Captured by Our Model



Policy Implications

- Inflationary episodes following supply shocks are efficient
  - No price dispersion!

- If central bank raises rates: Creates negative demand shock.

  Two implications:

  1. With flat PC, little or no effect on inflation
  2. This demand shock creates a welfare loss
     (Reason: Demand shock is inefficient)

Supply Shocks in NK Model

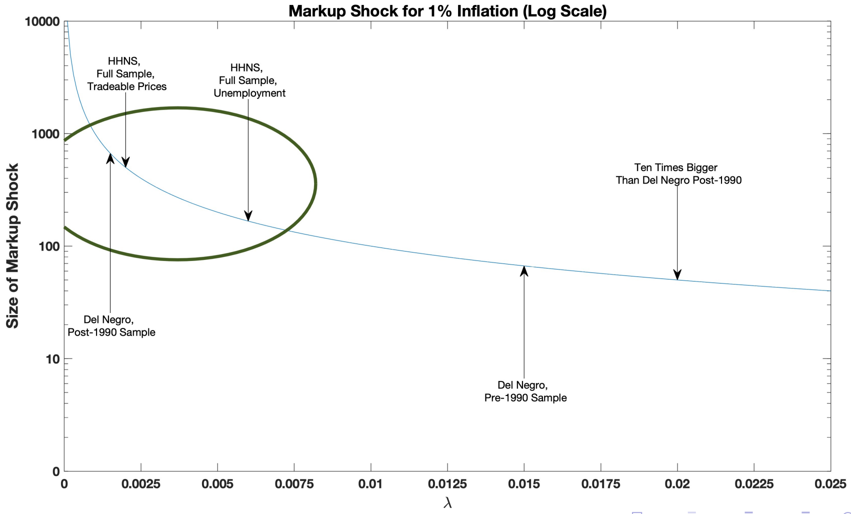
- NK Phillips curve

$$\widehat{\pi}_t = \beta \mathbb{E}_t[\widehat{\pi}_{t+1}] + \kappa \widehat{x}_t + \lambda \hat{z}_t$$

- Estimates for both κ and λ suggest pretty flat PC: $\lambda = 0.0020$ (Del Negro et al. 2020; Hazell et al. 2020)

- Normalization $\nu_t \equiv \lambda \hat{z}_t$:
  - For 1% inc. in $\widehat{\pi}_t$, need $\hat{z}_t = 500\%$
    If ss. markup is 12.5%, desired markup increases to 75.0%.
    Mmmmh.
  - Why? Calvo implies same degree of stickiness for all shocks

Alternative Estimates in the Literature, and Likely Orders of Magnitude



The Model: Some Intuition First

ENVIRONMENT: SUPERIORLY INFORMED FIRMS

Implies strategic interaction with consumers:

- Demand Shocks
  Firms always want to increase prices
  Consumers interpret price increases as "unjustified"
  $\Longrightarrow$ **strategic friction, and price stickiness**

- Supply Shocks
  Firms optimally lower prices when costs are low
  Consumers interpret price increases as "justified"
  $\Longrightarrow$ **no strategic friction, prices flexible**

The Model

- Geography: unit mass of islands, and a mainland
- Two periods: the present (short run); the future (long run)
- Agents: households, firms, Central Bank (CB)
- Focus on the present:
  decentralized trading on the islands, sticky prices
  (Future: centralized trading in the mainland, flexible prices)

Presentation: partial equilibrium

Households

- Unit mass $j \in [0, 1]$ on each island, heterogenous information
- Problem:

$$\max \; \mathbb{E}_j \left[(c_j - c_j^2/2) + \beta(\theta C_j) \right]$$

$$\text{s.t.} \quad pc_j + QC_j = Income$$

  θ is demand shock

- Markets:
  - Good c on islands (decentralized): sticky or flex. prices p
  - Good C in mainland (centralized): numeraire good
    $Q = \frac{1}{1+i}$ is set by CB, Taylor rule

Firms and Supply Shock

- Each firm a monopolist on an island
- Marginal cost z (supply shock)
- Sets price p

Information

- Aggregate state: $s = \{\theta, z\}$
- Households:
  - On each island: fraction α informed, fraction $1 - \alpha$ uninformed
  - Distribution of α over islands: $F(\alpha)$
- Firms: informed

Demand Shocks Only

- State $s = \{\theta, z_0\}$, z_0 fixed
- DEFINE: Flexible price p_s: profit max. when θ is known
  Sticky price p_0: profit max. when no shock ($\theta = 1$)

Proposition

There is $\overline{\alpha}$ such that:

- *if $\alpha \geq \overline{\alpha}$: firms post the flexible price ($p = p_s$)*
- *if $\alpha < \overline{\alpha}$: firms post the sticky price ($p = p_0$)*

- Intuition: Firm incentives.
  Proof: Want to $\uparrow$ prices $\Longrightarrow$ IC constraint
  For low α, the flexible price is not credible. Sticky price emerges as equilibrium.

Supply Shocks Only

- State $s = \{1, z\}$, θ fixed at 1
- DEFINE: Flexible price p_z: profit max. when z is known ($p_z = \frac{1+z}{2}$)

Proposition

For any α, firms post the flexible price p_z.

- Intuition: Incentives "aligned".
  When costs fall: Prices $\downarrow$
  When cost increase: Prices $\uparrow \Rightarrow$ demand $\downarrow$, but necessary due to higher costs. Firms "enjoy" credibility to adjust prices.

Both Shocks

- State: $s = \{\theta, z\}$

Proposition

There is $\overline{\alpha}$ such that if $\alpha < \overline{\alpha}$, the Phillips curve can be written:

$$\widehat{\pi}_t = \kappa \widehat{x}_t + \hat{z}_t$$

where hats denote percentage deviations from steady state, and $\widehat{x}_t$ is the output gap.

- Firms post price $p_{0z} = \frac{1+z}{2}$: demand sticky but supply flexible.

A "Theory" of Cost-Push Shocks

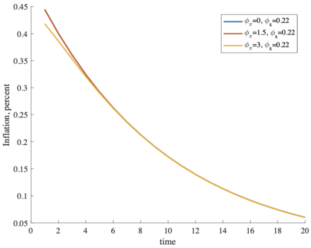
- NK model:
  - Phillips curve in terms of output: $\widehat{\pi}_t = \kappa \widehat{y}_t - \kappa \hat{a}_t$
  - In terms of output gap: $\widehat{\pi}_t = \kappa(\widehat{y}_t - \hat{a}_t) \underbrace{-\kappa \hat{a}_t + \kappa \hat{a}_t}_{=0} = \kappa \widehat{x}_t$
  - Finally: $\widehat{\pi}_t = \kappa \widehat{x}_t$

    Need to appeal to another shock: $\widehat{\pi}_t = \kappa \widehat{x}_t + \hat{\nu}_t$
- In our model, productivity shocks **show up as cost push**:

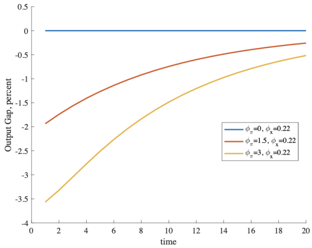
$$\widehat{\pi}_t = \kappa \widehat{x}_t + \hat{a}_t$$

- REASON: Supply shocks don't generate output gaps
  - Output gaps driven only by demand
    Hence model does not need "non-structural" shocks
    (CHARI, KEHOW, MCGRATTAN 2009 CRITIQUE)

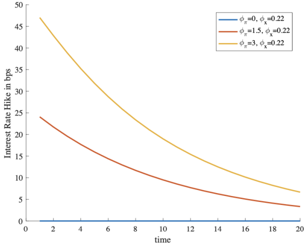
Aggregate Implications: Supply Shock



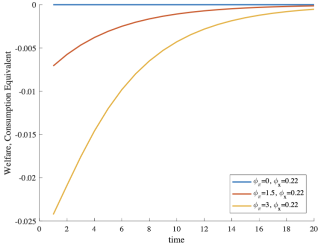
(a) Inflation



(b) Output Gap



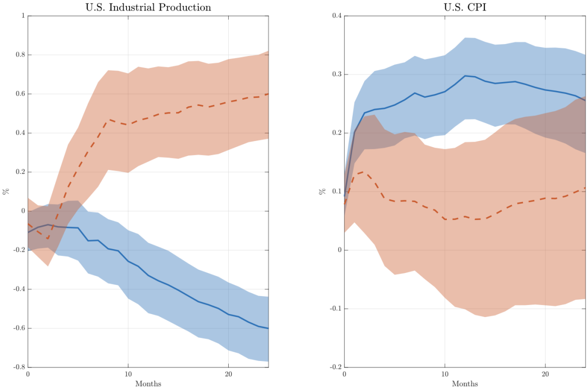
(c) Interest Rate



(d) Welfare (CE)

Empirical Evidence: VARs with External Instruments

Figure: Effects of Supply Versus Demand Shock



Blue: Supply; Orange: Demand

Take Away: Shock Dependence

- Types of pricing frictions:
  1. Time dependent
  2. State dependent
  3. ... Shock dependent?

- Ours is <u>one</u> candidate microfoundation

- Explains why inflation rises rapidly when supply disruptions arise
  Suggests CBs should "look through inflationary shocks"