

# Can Supply Shocks Be Inflationary with a Flat Phillips Curve?

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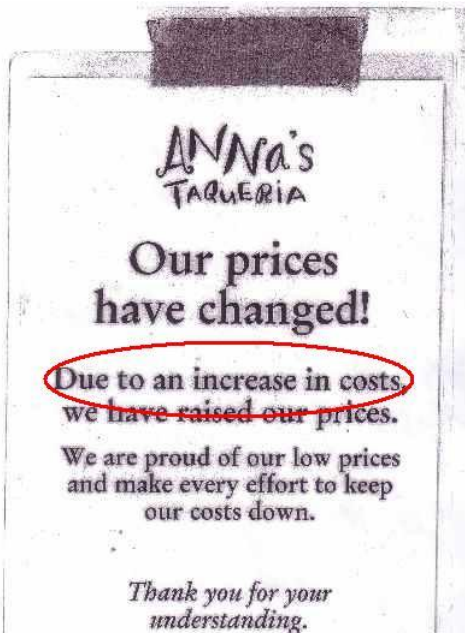
# Introduction

- ▶ 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, Post-COVID)  
(KAENZIG 2021; BUNN, ANAYI, BLOOM ET AL. 2022)
- ▶ Standard models can't account for these two facts
  - ▶ Reason: Flat PC  $\Rightarrow$  very rigid price level  
very rigid price level  $\Rightarrow$  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→ **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



# Aggregate Implications

- ▶ Supply shocks make inflation “come alive”
- ▶ 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)
- ▶ But inflation can come back down seamlessly when supply disruptions normalize

# Supply Shocks in NK Model

- ▶ NK Phillips curve

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

- ▶ Estimates for  $\kappa$  and  $\lambda$  suggest flat PC:  $\lambda = 0.0020$

(DEL NEGRO ET AL. 2020; HAZELL ET AL. 2020)

- ▶ Normalization  $\nu_t \equiv \lambda \hat{z}_t$ :

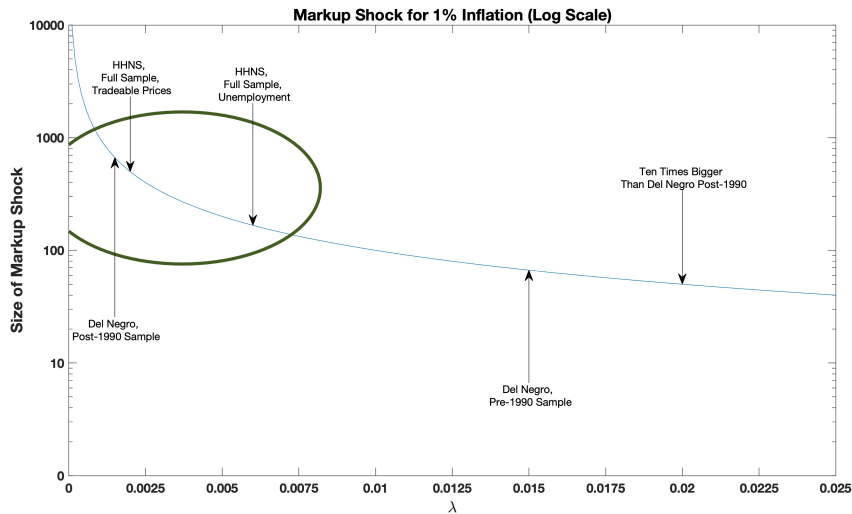
- ▶ For 1 pp. inc. in  $\hat{\pi}_t$ , need  $\hat{z}_t = 500\%$

If ss. markup is 12.5%, new desired markup: 575.0%.

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:

- ▶ **Supply Shocks**

State not payoff relevant to consumers

No strategic friction  $\implies$  **flexible prices**

- ▶ **Demand Shocks**

State **is** payoff relevant to consumers

Firms have incentive to misrepresent the state

Strategic friction  $\implies$  **sticky prices**

(same as in [L'HUILLIER \(2020\)](#), [L'HUILLIER AND ZAME \(2022\)](#))



# 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

- ▶ Unit mass  $j \in [0, 1]$  on each island, heterogeneous information

- ▶ Problem:

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

$$\text{s.t. } p c_j + Q C_j = \text{Income}$$

$\theta$  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
- ▶ Real marginal cost  $z$  (supply shock)
- ▶ Sets price  $p$

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

# Supply Shocks

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

## Proposition

*For any  $\alpha$ , firms post the flexible price  $p_z$ .*

- ▶ No strategic friction, despite information friction

- ▶ Simple and plain profit maximization
- ▶ Reason: Costs not payoff relevant for consumers
  - ▶ Low costs: post low price  
Does not shift demand function and maximizes profits
  - ▶ High costs: post high price  
Maximizes profits  
Demand  $\downarrow$  (along schedule), but necessary due to higher costs
- ▶ Actually, irrelevant if consumers know costs or not  
*(In PBE, consumers will infer costs, firms “enjoy” credibility to adjust prices, and price increases are seen as “acceptable”)*

# Demand Shocks

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

## Proposition

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

- if  $\alpha \geq \bar{\alpha}$ : firms post the flexible price ( $p = p_s$ )
  - if  $\alpha < \bar{\alpha}$ : firms post the sticky price ( $p = p_0$ )
- 
- ▶ Cutoff for price adjustment: fraction of informed consumers

# Intuition (2 states: Low and High demand shock)

- ▶ Strategic friction:  
Firm's **incentives** to misrepresent the state
  - ▶ If can  $\uparrow$  prices credibly, consumers would spend more  
But, rational consumers understand firm's incentives  
And thus price increases are not necessarily credible

- ▶ IC constraint:  
Notation: Profits  $\Pi(p_s, s)$ : price  $p_s$  and beliefs  $s$   
When state is Low, firm will post  $p_L$  if:

$$\Pi(p_L, L) \geq \alpha \Pi(p_H, L) + (1 - \alpha) \Pi(p_H, H)$$

High  $\alpha$ : becomes slack

- ▶ (Consumers “wonder” if price increase is “justified”, price increases “antagonize” consumers)



# Both Shocks: A Shock-Dependent PC

- ▶ State:  $s = \{\theta, z\}$

## Proposition

*The Phillips curve can be written:*

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

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

- ▶ Now  $\hat{z}_t$  moves  $\hat{\pi}_t$  one-to-one
- ▶ 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:  $\hat{\pi}_t = \kappa \hat{y}_t - \kappa \hat{a}_t$

- ▶ In terms of output gap:  $\hat{\pi}_t = \kappa(\hat{y}_t - \hat{a}_t) \underbrace{- \kappa \hat{a}_t + \kappa \hat{a}_t}_{=0} = \kappa \hat{x}_t$

- ▶ Finally:  $\hat{\pi}_t = \kappa \hat{x}_t$

Need to appeal to **another shock**:  $\hat{\pi}_t = \kappa \hat{x}_t + \hat{\nu}_t$

- ▶ In our model, productivity shocks **show up as cost push**:

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

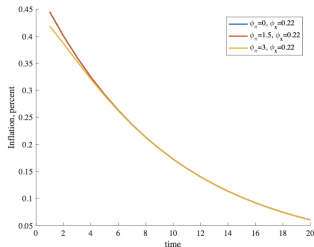
- ▶ **REASON**: Supply shocks don't generate output gaps

- ▶ Output gaps driven only by demand

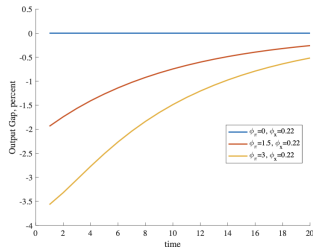
Hence model does not need “non-structural” shocks

(CHARI, KEHOW, MCGRATTAN 2009 CRITIQUE)

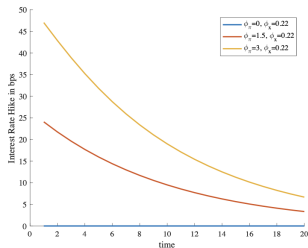
# Aggregate Implications: Supply Shock



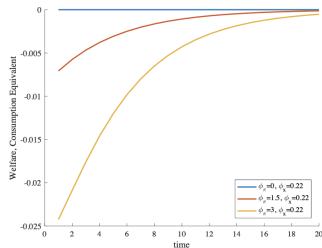
(a) Inflation



(b) Output Gap



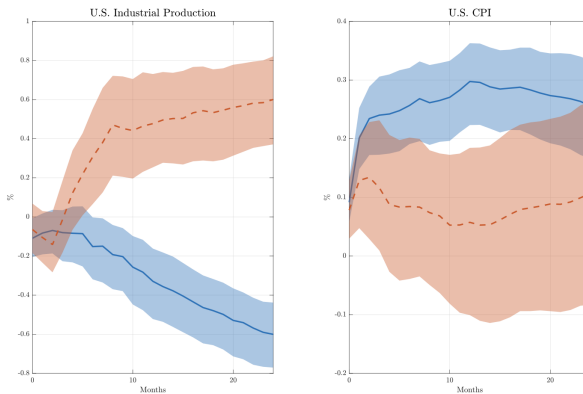
(c) Interest Rate



(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 one candidate microfoundation
- ▶ Explains why inflation rises rapidly when supply disruptions arise