Can Supply Shocks Be Inflationary with a Flat Phillips Curve?

Jean-Paul L’Huillier    Gregory Phelan

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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

Our prices have changed!

Due to an increase in costs, we have raised our prices.

We are proud of our low prices and make every effort to keep our costs down.

Thank you for your understanding.
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

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

 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

Markup Shock for 1% Inflation (Log Scale)

- HHNS, Full Sample, Tradeable Prices
- HHNS, Full Sample, Unemployment
- Del Negro, Post-1990 Sample
- Del Negro, Pre-1990 Sample
- Ten Times Bigger Than Del Negro Post-1990
The Model: Some Intuition First

Environment: Superiorly Informed Firms

Implies strategic interaction with consumers:

- **Supply Shocks**
  Costs not payoff relevant to consumers
  Firms maximize profits
  **No** strategic concerns
  \[\Rightarrow\] **flexible prices**

- **Demand Shocks**
  Now, info. about aggregate demand **is** payoff relevant
  But, firms have incentive to misrepresent the state
  Strategic friction
  \[\Rightarrow\] **sticky prices**
  (same as **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:**

$$\max \ E_j \left[ (c_j - c_j^2/2) + \beta \theta C_j \right]$$

s.t. $pc_j + QC_j = Income$

$\theta$ 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 $p$
Information

- 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
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 $p_z$.

- When costs fall: Prices ↓
  - When cost increase: Prices ↑ ⇒ demand ↓
  - but this is necessary due to the higher costs.
Intuition

- Simple and plain profit maximization

- Costs not payoff relevant for consumers

- From firm’s point of view: irrelevant if consumers know costs or not
  - (in PBE, consumers will infer costs, firms “enjoy” credibility to adjust prices and hence consumers “tolerate” price increases)
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

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

▶ IC constraint (2 states: Low and High demand shock):
  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)
State: $s = \{\theta, z\}$

**Proposition**

There is $\bar{\alpha}$ such that if $\alpha < \bar{\alpha}$, 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: \( \hat{\pi}_t = \kappa (\hat{y}_t - \hat{a}_t) - \kappa \hat{a}_t + \kappa \hat{a}_t = \kappa \hat{X}_t \)
  - 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

J.-P. L’Huillier & G. Phelan