Inflation and Competition in an Old Keynesian Model

Yang Liu

Boston College

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Introduction

- **Motivation:** Widespread shortages and rationing during COVID, incompatible with the quasi-Walrasian assumption underneath standard NK models Rationing in the data
- **NK models** are a special case of excess supply (demand-driven).
  - Theoretically incoherent with COVID excess demand. But does it actually matter?
- **This paper:** Revisit inflation & wage dynamics during COVID through an "Old" Keynesian model that allows for rationing

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- A minimalist search-and-matching model + Calvo pricing
  - Rationing = Firms can limit the number of accepted matches
  - CES + LFV aggregator to allow for unavailable (rationed) varieties
  - Only 3 new parameters: Love for variety + Search cost distribution

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  - "Tractable" analysis of rationing Barro and Grossman, 1971, Michaillat and Saez, 2015, Holden, 2024
  - (Micro) strategic complementarities Kimball, 1995, Atkeson and Burstein, 2008
  - Endogenous imperfect competition Rotemberg and Saloner, 1986, Bilbiie et al., 2012

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- Rich predictions + Few parameters = Easy to calibrate

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- **Limited wage-price spirals:** Depressed *real* wages may occur in an overheated economy
  - Some varieties unavailable $\Rightarrow$ High $U'(C_t)$ despite $Y_t \uparrow \Rightarrow$ Real wage aspirations $\downarrow$
  - Independent of frictions (e.g., sticky wages) that lower realized wages

Inflation and Competition in the Data

- Back to the COVID inflation, the Old Keynesian model predicts:
  - ✓ Widespread rationing and shortages Caldara et al., 2025, Cavallo and Kryvtsov, 2023
  - ✓ Higher cost pass-through into prices Amiti et al., 2022, Chin, 2023
  - ✓ Low real wages & limited wage-price spirals Afrouzi et al., 2024, Mongey, 2025, Bernanke and Blanchard, 2023
  - ✓ (Some) positive co-movements between inflation, markups, & profits Bilbiie and Känzig, 2023
- (Future) Quantify the contribution of rationing and endogenous competition to the 2021-2023 inflation surge
- Caveats for micro data analysis: Competition often absorbed by FE

Matching Process

- Each buyer chooses the desired # of varieties and buys one variety from one firm
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- One-period McCall (1970)-style model in each input market
  - Alternative matching schemes may work, so long as firms set both price and quantity

Buyer's Demand

- Generalized CES demand à la Bénassy (1996):

$$C = Z(\|\mathbf{I}\|)\left[\int_{\mathbf{I}} Q(i)^{\frac{\sigma-1}{\sigma}} di\right]^{\frac{\sigma}{\sigma-1}}, \quad \text{where} \quad Z(\|\mathbf{I}\|) = \|\mathbf{I}\|^{\phi - \frac{1}{\sigma-1}}. \tag{1}$$

- $\mathbf{I} \subseteq [0, 1]$ is the variety set.
- LFV-adjusted price for the consumption bundle: $P = \frac{1}{Z(\|\mathbf{I}\|)}\left[\int_{\mathbf{I}} P(i)^{1-\sigma} di\right]^{\frac{1}{1-\sigma}}$
- New parameter (1/3): $\phi \Rightarrow$ Gains from adding one variety
  - Extensive margin: Enter market i only when ϕ per unit $>$ expected search cost per unit
  - Similar to the "shadow" price but more tractable

Buyer's Reservation Price for Goods i

- Each period t, buyer k in market i draws a random (real) fixed cost $\nu_{k,i,t}$
  - Buyer k can search infinite times using the same $\nu_{k,i,t}$
  - ν follows a truncated normal (or any arbitrary) distribution
  - New parameters (2/3 & 3/3): Mean and variance of ν
- Set the reservation price $\bar{P}$ to minimize the expected cost of buying Q units

$$\mathrm{E}[c(Q)] = \min_{\bar{P}} \left[P\nu Q + \int_{P(s)\leq \bar{P}_k} \Omega(s) Q P(s) ds \right. \\ \left. + \left(\int_{P(s)>\bar{P}} ds + \int_{P(s)\leq \bar{P}} (1-\Omega(s)) ds \right) \mathrm{E}[c(Q)] \right], \tag{2}$$

- $P(s)$ and $\Omega(s)$ are the posted price and acceptance rate chosen by seller s

Demand Curve for a Seller Who Posts P_s

- Optimal reservation price: $\bar{P}(\nu) = \check{P}(\nu) + \frac{P \times \nu}{\bar{\Omega}(\nu) \times \text{Prob}(P_j \leq \bar{P}(\nu))}$.
  - $\check{P}(\nu)$: Average competitor price conditional on below $\bar{P}(\nu)$, weighted by their Ω
  - $\bar{\Omega}(\nu)$: Average Ω of effective competitors, i.e., firms with prices below $\bar{P}(\nu)$
  - Expected # of searches: $N(\nu) = [\bar{\Omega}(\nu) \times \text{Prob}(P_j \leq \bar{P}(\nu))]^{-1}$

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- Integrate over $V(\nu)$ (ν's CDF) to get the # of searches M and demand Y^d:

$$M(P_s) = \int_{\nu^*(P_s)}^{\bar{\nu}} N(\nu) dV(\nu), \quad Y^d(P_s) = M(P_s) \left(\frac{P_s}{P}\right)^{-\sigma} C. \tag{3}$$

  - $\nu^*(P_s)$ is the marginal buyer's ν
  - Buyers with $\nu > \bar{\nu}$ do not enter this market at all (expected search cost above ϕ).

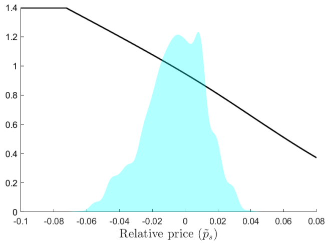
Variable Elasticity: The Analytical Solution

- One can analytically derive the demand elasticity (intensive + extensive):

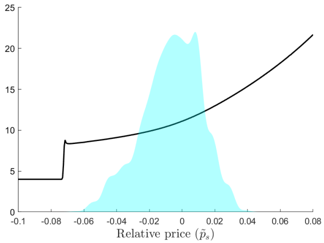
$$\epsilon(P_s) = \sigma + \frac{v(\nu^*)}{M(P_s)} \frac{P_s}{P}, \quad v(\cdot) = V'(\cdot). \tag{4}$$

- Compared to the literature:
  - Superelasticity: $\frac{\partial \epsilon}{\partial P_s} > 0$ $\Rightarrow$ Kimball (1995) aggregator
  - Strategic complementarities: $\frac{\partial \epsilon}{\partial \tilde{P}} < 0$ $\Rightarrow$ Atkeson and Burstein (2008) aggregator
  - Rationing affects market power: $\frac{\partial \epsilon}{\partial \bar{\Omega}} > 0$ $\Rightarrow$ Bilbiie et al. (2012)'s translog demand
- Calibration of $V(\cdot)$ is simple, but endogenous dynamics are rich & nonlinear

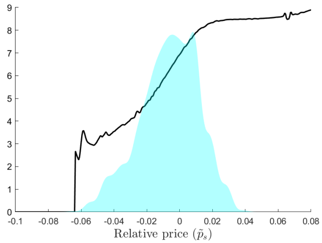
Variable Elasticity: A Numerical Example



(a) Number of Match Requests (M)



(b) Demand elasticity (ϵ)

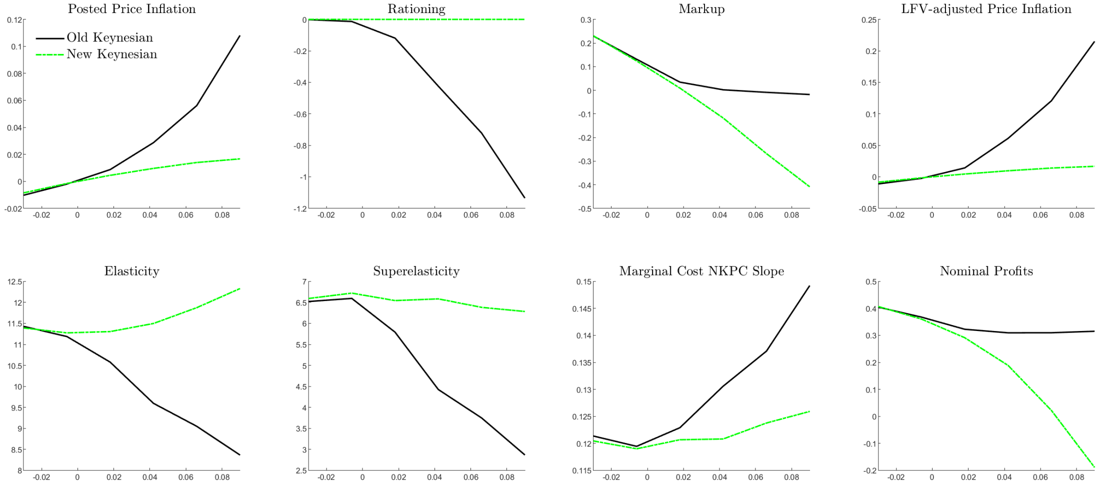


(c) Superelasticity ($\frac{\partial \ln \epsilon}{\partial p}$)

Firm's Problem

- Output: $Y^s = \Omega_s \times Y^d(P_s) = \Omega_s \times M(P_s)\left(\frac{P_s}{P}\right)^{-\sigma} C.$
- Profit-maximizing firms choose the optimal acceptance rate Ω_s^* and the optimal reset price P_s^* under Calvo pricing.
  - When $\Omega_s^* = 1 \Rightarrow$ Excess supply, like standard NK models
  - When $\Omega_s^* < 1 \Rightarrow$ Excess demand, choose Ω_s^* such that markups are always non-negative
- Small quadratic adjustment cost on Ω_s to ensure determinacy

Nominal Demand Shocks under Flexible Wages



Real Wage Aspirations Under Excess Demand

- Flexible wage FOC: $w_t - p_t = \eta n_t + \gamma c_t$. IES $= \gamma$, Frisch elasticity $= \eta$
  - Separate LFV from c_t and p_t by using a variety-neutral CES aggregator to define the observed output y_t^{obs} and price p_t^{post}:

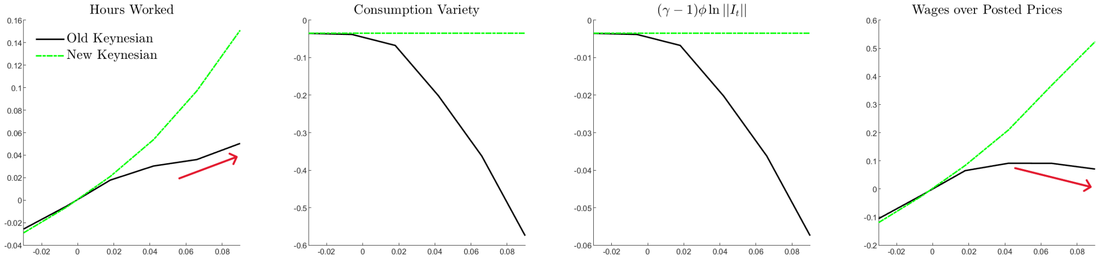
$$c_t = y_t^{obs} + \phi \ln\|\mathbf{I}\|, \quad p_t = p_t^{\text{post}} - \phi \ln\|\mathbf{I}\| \tag{5}$$

  - Rearrange:

$$w_t - p_t^{\text{post}} = \eta n_t + \gamma y_t^{obs} + (\gamma - 1)\phi \ln\|\mathbf{I}\| \tag{6}$$

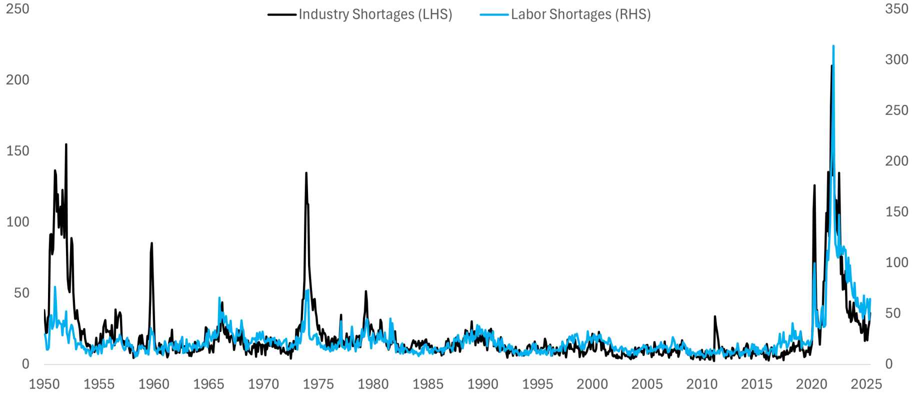
- Lower desired real wages (however deflated) under excess demand because:
  - n_t and y_t^{obs} are constrained by the supply side
  - Rationing $\Rightarrow \|\mathbf{I}\| \downarrow \Rightarrow U'(C_t) \downarrow$ despite high Y_t^{obs} Assume $\gamma > 1$

Real Wage Aspirations after Nominal Demand Shocks



- Rising hours $\Rightarrow$ "Seemingly" tight labor markets
- But rationing, via $U'(C_t)$, can easily lower the desired real wage by 3-6%, despite frictionless labor markets
- Problem: We never directly observe $U'(C)$ or LFV

Rationing



Data from Caldara et al., 2025, "Measuring Shortages since 1900"