

# Managing an Energy Shock with Heterogeneous Agents

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# Background

- ▶ Understanding how open economies respond to shocks remains one of the major challenges in International Macro.
- ▶ Existing literature takes several modelling approaches:
  - ▶ open economies with a representative agent
  - ▶ open economies with exogenous segmentation (participants and non-participants)
  - ▶ open economies with heterogeneous agents
- ▶ This paper focuses on a heterogeneous agent New Keynesian open-economy model.

# Model

Key model features:

- ▶ Small open economy and the rest of the world.
- ▶ Households face a borrowing constraint and idiosyncratic labour income risk
- ▶ Markets are incomplete
- ▶ Sticky wages (and prices)

MIT-style shocks: exchange rate shock, monetary policy shock; energy price shock (today).

# Contributions

- ▶ Isolates several channels of shock transmission to output:
  - ▶ expenditure-switching channel
  - ▶ real income channel
  - ▶ Keynesian multiplier channel
- ▶ Provides a comprehensive assessment of how the strength of these channels is affected by model features and parameters
  - ▶ income channel is larger with low trade elasticity; low degree of consumption home bias; high exchange rate pass-through
- ▶ Develops policy prescriptions to stabilize output after shocks

## This project

- ▶ Small open economy is a net importer of energy
- ▶ Adds energy as an additional goods in the consumption basket
- ▶ Energy is not used in production
  - ▶ shuts down the known negative effect of higher energy prices on output
- ▶ Sticky wages, but full ER pass-through into domestic prices
- ▶ Monetary policy stabilizes real interest rate  $r$ . Foreign  $r^*$  is fixed
- ▶ Studies the effects of a shock to the foreign (world) price of energy

# Intuition: Representative Agent

Higher price of energy leads to the *expenditure-switching* channel:

- ▶ nominal exchange rate depreciates
- ▶ relative price of domestic goods declines
- ▶ households substitute away from foreign goods into domestic goods
  - ▶ the effect is stronger with higher elasticity of substitution
- ▶ output and consumption increase

# Intuition: Representative Agent

When markets are incomplete, there is also an *income effect*:

- ▶ a real exchange rate depreciation reduces the purchasing power of household's labor and domestic dividend income
- ▶ this reduces household's consumption
- ▶ the effect is stronger with lower elasticity of substitution
  - ▶ also reduces the positive expenditure-switching channel
- ▶ has been shown to explain the Backus-Smith puzzle (Corsetti et al (2008) and others)

# Intuition: Heterogeneous Agents

- ▶ *Income effect* is amplified in the HA economy
  - ▶ markets are "more" incomplete at the household level ( $a_i \geq \underline{a} = 0$ )
  - ▶ larger MPCs for poorer households
  - ▶ larger exposure to the shock for poorer households
    - ▶ share of imported tradables in consumption basket declines with income
- ▶ no counterbalancing income effect on labor supply due to GHH preferences



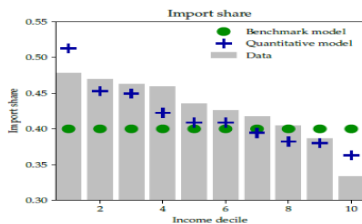
# Comment 1: Role of incompleteness versus heterogeneity?

How important is household heterogeneity relative to market incompleteness?

- ▶ RA model with incomplete markets can produce a large income effect
- ▶ HA model brings in heterogeneity on top of incompleteness
- ▶ Can the effects be disentangled?
  - ▶ shut down some margins of heterogeneity in the calibration
  - ▶ allow for different degree of market incompleteness
- ▶ Emphasise the importance of incompleteness for the results
  - ▶ Use RA model with incomplete markets as a benchmark model for comparisons

## Comment 2: The role of heterogeneity?

- ▶ tight borrowing constraint  $\underline{a} = 0$ 
  - ▶ households can borrow against housing, illiquid assets
- ▶ share of imported tradables in consumption basket declines with income

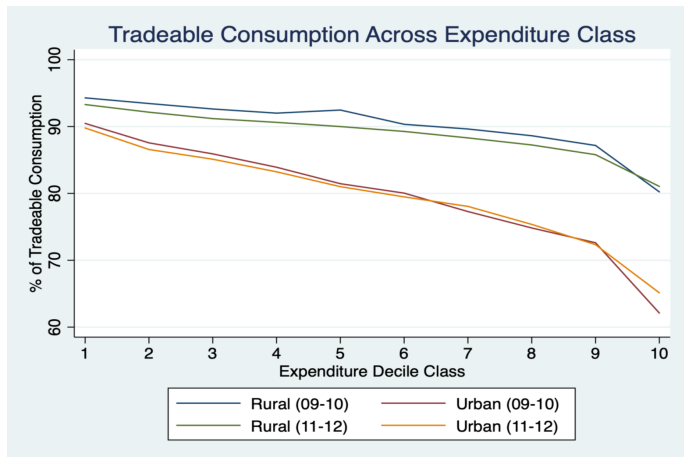


Source: Figure 7 from Auclert et al. (2022)

# Foreign goods share

- ▶ In the paper: foreign good share is higher for poorer households
  - ▶ tradable goods expenditure share declines with income deciles (Mexico)
  - ▶ assume that the share of imports within tradables is the same across the income distribution
  - ▶ obtain that import share declines with income
- ▶ What does the data say? Use India as a case study.
- ▶ Explore the importance of different aspects of heterogeneity.

# Tradable goods share: India

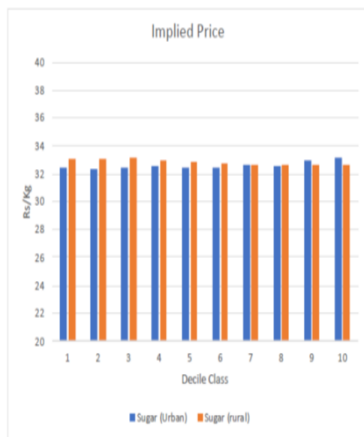
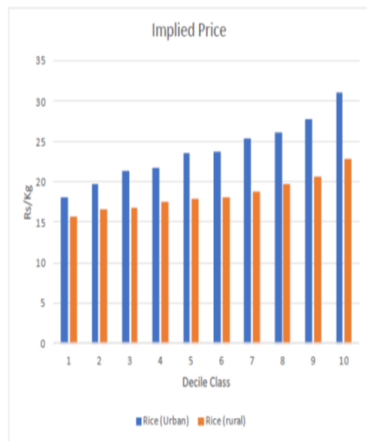


Source: Data is from NSSO Consumption expenditure surveys of India

## Import shares and prices

- ▶ Direct evidence on how import shares change with income is rarely available
- ▶ Can they be inferred indirectly?
- ▶ Simple idea: richer households spend more on quality products, imports tend to be of higher quality and thus more expensive, so richer households tend to pay more for the same product.
  - ▶ poorer countries are net importers of higher-quality goods (Fajgelbaum, Grossman, and Helpman (2011))
  - ▶ unit values of internationally traded goods are heavily influenced by quality (Feenstra and Romalis (2014))
  - ▶ prices of goods consumed are rising in household income (Flam and Helpman (1987))
- ▶ Expect unit prices to increase with income as richer households spend more on imported tradables

# Implicit prices: India



Source: Data is from NSSO Consumption expenditure surveys of India

## Comment 3: Mechanism of the model

- ▶ Model mechanism relies on exchange rate depreciation when energy prices increase

$$C_{Ht} = (1 - \alpha) \left( \frac{P_{Ht}}{P_t} \right)^{-\chi} C_t$$

$$P_t = P(E_t P_{Ft}^*, P_{Ht})$$

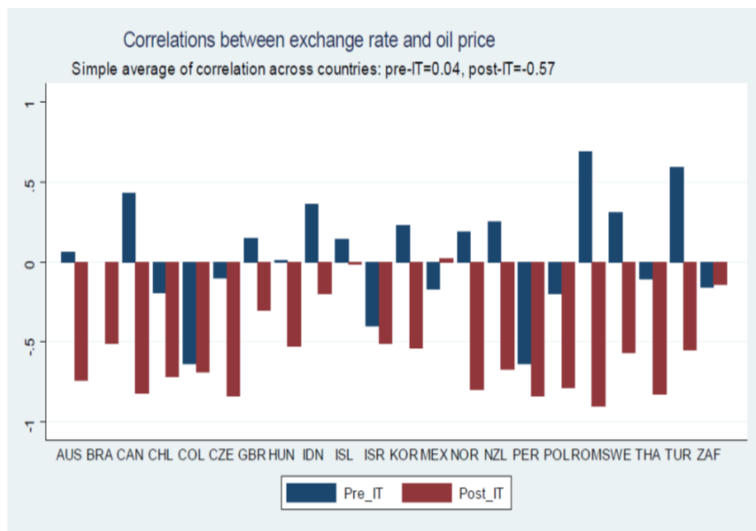
$$P_{Ht} = w_t, \text{ sticky}$$

$$\bar{r} + \Delta P_{t+1} = r^* + \Delta E_{t+1}$$

- ▶  $P_{Ft}^* \uparrow$  leads to  $E \uparrow$  (depreciation)
- ▶ Does the data support this?
- ▶ Evaluate the mechanism of the model empirically.

# Oil prices and exchange rates

Figure: Exchange rates and oil prices



Source: Figure 2 from Beaudry and Lahiri (2020)



# Oil prices and exchange rates

- ▶ Higher oil prices tend to be associated with *appreciated* exchange rates
  - ▶ esp. for inflation targeters
  - ▶ switch occurs after adopting inflation targeting
  - ▶ for both oil net importers and net exporters
  - ▶ robust to a series of controls
- ▶ Monetary policy may matter for this relationship (Beaudry and Lahiri (2020), Devereux and Smith (2021))

## 4. Comments on the quantitative model:

- ▶ the role of investment and physical capital
  - ▶ will exacerbate negative income effects of the shock
- ▶ the role of income effects for the labor supply
  - ▶ could counteract the negative income effect of relative prices

# Conclusions

- ▶ Rich model, encyclopedia for HA new open economy models
- ▶ Would be good to see a test of the model
- ▶ Would be good to disentangle the role of market incompleteness and heterogeneity