CENTER FOR
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13. I-HANK

Adv. Macro: Heterogenous Agent Models

Jeppe Druedahl

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Danmarks
Grundforskningsfond
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Research Foundation

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International HANK

- **Baseline RANK model:** Gali and Monacelli (2005)
- **Exchange rate shocks:**
  Auclert, Rognlie, Souchier and Straub (2021),
  »Exchange Rates and Monetary Policy with Heterogeneous Agents:
  Sizing up the Real Income Channel«
- **Foreign demand shocks:**
  Druedahl, Ravn, Sunder-Plassmann, Sundram, Waldstrøm (2023),
  »The Transmission of Foreign Demand Shocks«

Overview of model

- **Small-open-economy** $\Rightarrow$ *trading partner is exogenous*
- **Goods:** *Home* and *foreign*
- **Households:** Standard + CES demand

  (initially households only hold domestic stocks $\Rightarrow$ no reevaluation effects)
- **Production of home goods:** Flexible prices with mark-up μ
  1. Production: $Y_t = Z_t N_t$
  2. Wage from FOC: $W_t = \frac{1}{\mu} P_{H,t} Z_t$
  3. Dividends: $D_t = P_{H,t} Y_t - W_t N_t$
- **Unions:** Sticky wages $\Rightarrow$ NKWPC
- **Financial markets:** Floating exchange rate + UIP condition
- **Central bank:** Constant real rate rule

Household problem

- **Nominal exchange rate:** E_t (domestic per foreign currency)
- **Real exchange rate:** $Q_t = E_t \frac{P_t^*}{P_t}$ (depreciation $\equiv Q_t \uparrow$)
- **Domestic CES demand:**

$$C_{H,t} = (1-\alpha)\left(\frac{P_{H,t}}{P_t}\right)^{-\eta} C^{hh}\left(\boldsymbol{Y}^{hh}\right)$$

$$C_{F,t} = \alpha\left(\frac{E_t P_t^*}{P_t}\right)^{-\eta} C^{hh}\left(\boldsymbol{Y}^{hh}\right)$$

$$P_t = \left[\alpha\left(E_t P_t^*\right)^{1-\eta} + (1-\alpha) P_{H,t}^{1-\eta}\right]^{\frac{1}{1-\eta}}$$

- **Real income:**

$$Y_t^{hh} = \frac{W_t N_t + D_t}{P_t} = \frac{P_{H,t} Y_t}{P_t} \Rightarrow$$

$$dY_t^{hh} = dY_t - (dP_t - dP_{H,t}) = dY_t - \frac{\alpha}{1-\alpha} dQ_t$$

Foreign economy and market clearing

- **Armington demand for home goods:**

$$C^*_{H,t} = \alpha \left(\frac{P_{H,t}}{E_t P^*_t} \right)^{-\gamma} C^*_t$$

- **Market clearing:**

$$Y_t = C_{H,t} + C^*_{H,t} \Rightarrow$$
$$dY_t = (1-\alpha) dC_t + \alpha dC^*_t + \frac{\alpha}{1-\alpha} \chi dQ_t$$

Composite trade elasticity: $\chi \equiv \eta(1-\alpha) + \gamma$

Real exchange rate shock

- **Real exchange rate shock:** $d\boldsymbol{Q}_t$
- **Consumption satisfies:**

$$d\boldsymbol{C} = \underbrace{\boldsymbol{M} d\boldsymbol{Y}}_{\text{multiplier}} - \underbrace{\frac{\alpha}{1-\alpha} \boldsymbol{M} d\boldsymbol{Q}}_{\text{real income}}$$

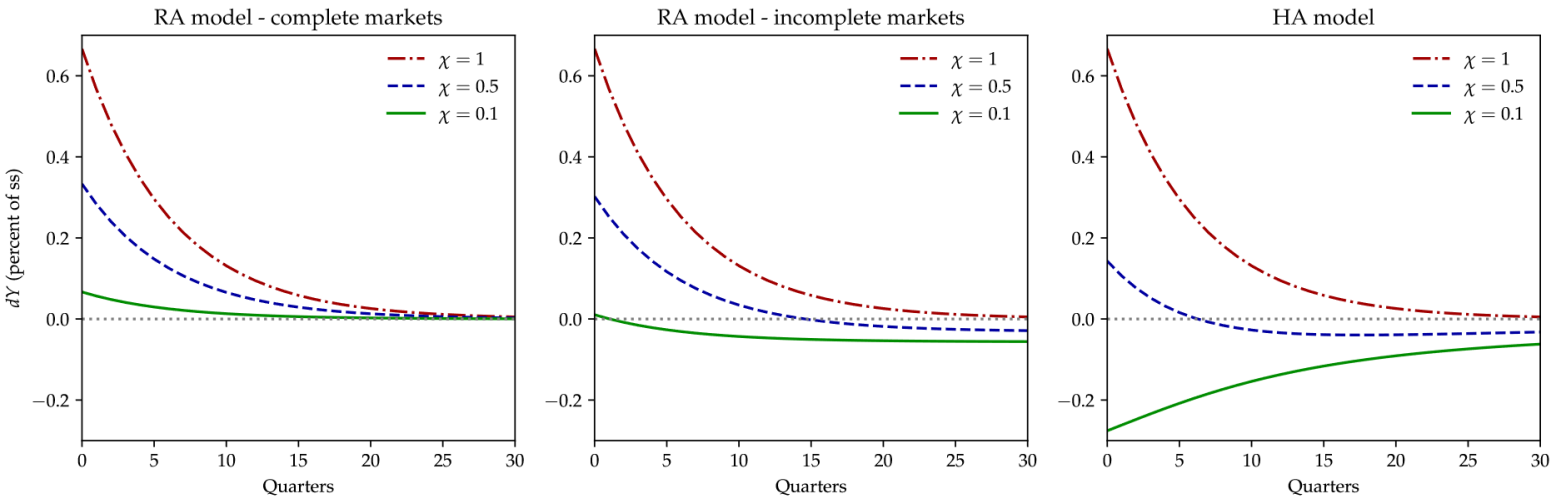
- **Intertemporal Keynesian Cross:**

$$\begin{aligned} d\boldsymbol{Y} = & \underbrace{\frac{\alpha}{1-\alpha} d\boldsymbol{Q}}_{\text{expenditure switching}} - \underbrace{\alpha \boldsymbol{M} d\boldsymbol{Q}}_{\text{real income}} + \underbrace{(1-\alpha) \boldsymbol{M} d\boldsymbol{Y}}_{\text{multiplier}} \\ & = \mathcal{M} \left(\frac{\alpha}{1-\alpha} \chi d\boldsymbol{Q} - \alpha \boldsymbol{M} d\boldsymbol{Q} \right) \end{aligned}$$

  - Expansion: For high χ
  - Contraction: For low χ

Contractionary depreciation

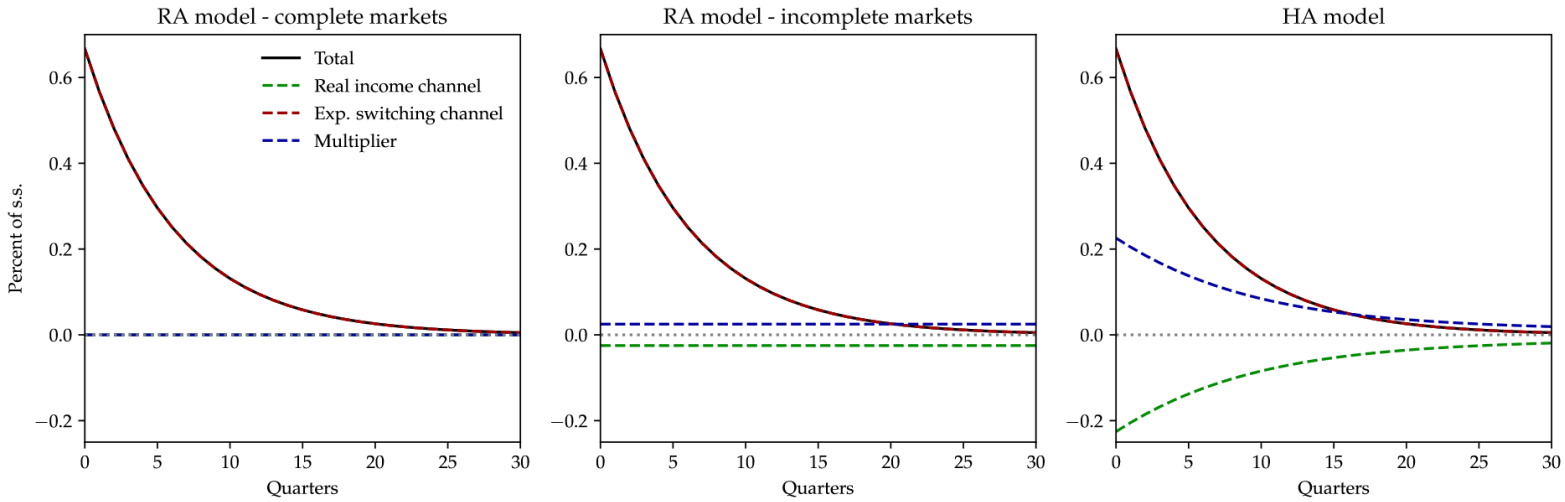
Figure 2: Effect of exchange rate shocks on output for various χ's



Note: impulse response in all three models to the shock to i_t^* displayed in Figure 1. χ is the trade elasticity (the sum of the import and export elasticity to the exchange rate). The HA model generates a contraction on impact for $\chi < \chi^* = 0.37$.

Equivalence and decomposition

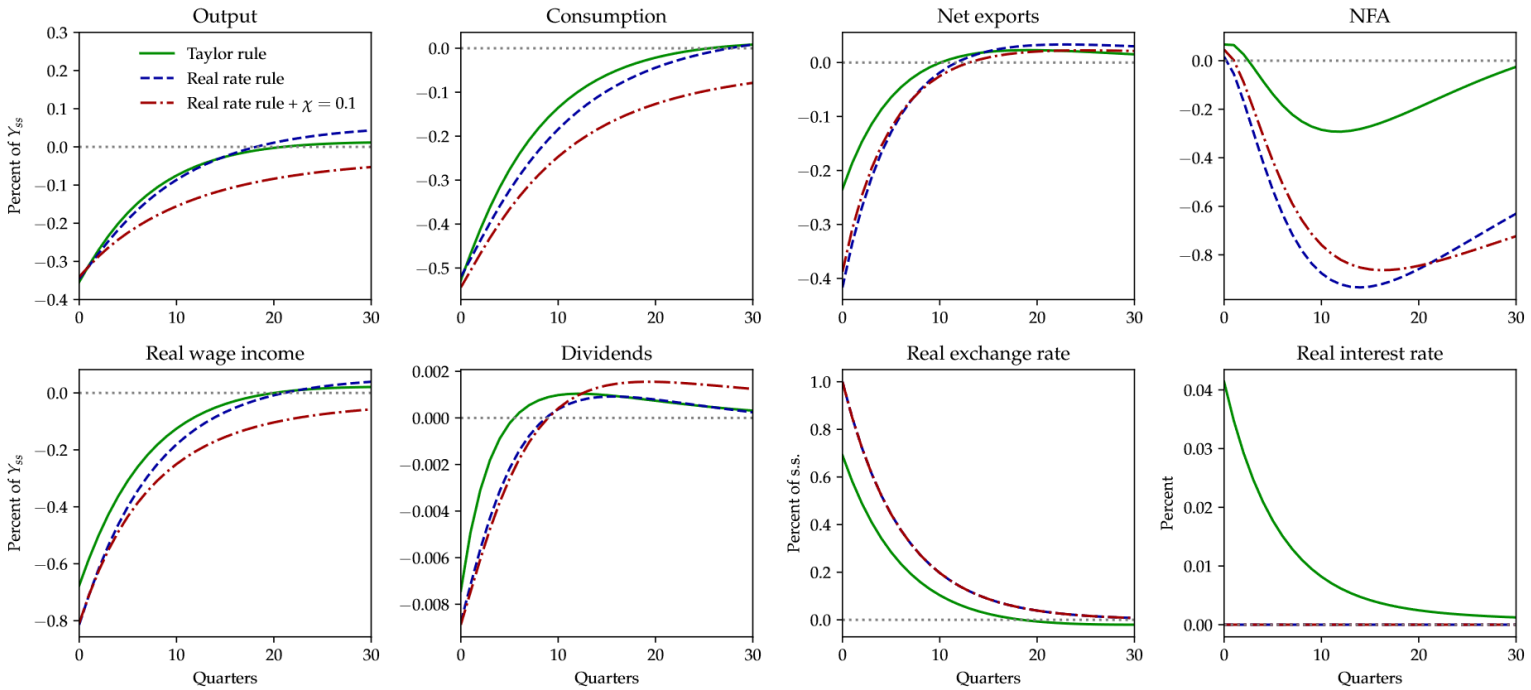
Figure 3: Exchange rate shock when $\chi = 1$ and its transmission channels



Note: impulse response in all three models to the shock to i_t^* displayed in Figure 1, with decomposition from proposition 2.

Quantitative model

Figure 9: Contractionary depreciations



Note: impulse response in the quantitative model to the shock to i_t^* displayed in Figure 1. The model with Taylor rule is our quantitative model; the one with real rate rule is our quantitative model without the Taylor rule; the model with real rate and $\chi = 0.1$ drops delayed substitution and allows households to immediately adjust their consumption baskets across countries.

Add-ons: Non-homothethic preferences, sticky prices , imperfect exchange rate pass-through, delayed substitution, dollar currency pricing, UIP deviations

Foreign demand shocks

The Transmission of Foreign Demand Shocks

Jeppe Druedahl Søren Hove Ravn Laura Sunder-Plassmann
Jacob Marott Sundram Nicolai Waldstrøm

September, 2023

Regional Keynesian Cross

The Regional Keynesian Cross

Proposition

The first-order response of employment $d\boldsymbol{L}_j$ to a monetary shock $d\boldsymbol{r}_j$ and tradable goods demand shock $d\boldsymbol{C}^T$ solves

$$d\boldsymbol{L}_j = \underbrace{\rho_j \left(\boldsymbol{M}_j^r d\boldsymbol{r}_j + \boldsymbol{M}_j d\boldsymbol{L}_j \right)}_{\text{Regional exposure}} + \underbrace{(1-\rho_j) d\boldsymbol{C}^T}_{\text{National exposure}} - \underbrace{\frac{\nu}{\eta}(1-\rho_j)\left(d\boldsymbol{L}_j - d\boldsymbol{C}^T \right)}_{\text{Expenditure switching}}$$

ν: elasticity of subs. between c^{NT} & c^T

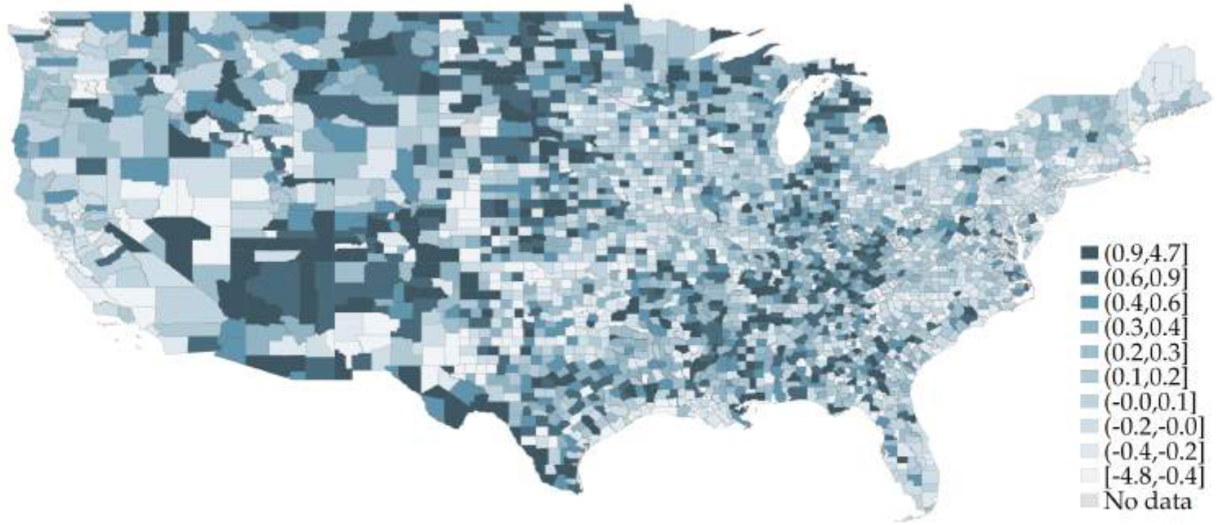
η: elasticity of subs. between ℓ^{NT} & ℓ^T

Source: Bellifemine, Couturier, and Jamilov (2023),

»The Regional Keynesian Cross«

Regional employment effects of MP

Figure 1: Regional Heterogeneity in the Effects of U.S. Monetary Policy



Note: This figure plots the 3-year ahead county-specific cumulative employment responses to a 1 standard deviation expansionary monetary policy shock $\beta_{j,36}$, estimated from the panel local projection (1). The coefficients are in percentage points and represent deviations from the (population weighted) average response.