A Two-Country New-Keynesian Model with Limited Arbitrage in Currency and Bond Markets

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Motivation

Motivation: International Finance Puzzles

- Textbook international macro:
  - Uncovered Interest Parity (UIP) holds
  - The Expectation Hypothesis (EH) holds
- Empirically:
  1. Strong patterns in FX: currency carry trade is profitable $\implies$ deviations from UIP
     [Fama 1984...]
  2. Strong patterns in FI: bond carry trade is profitable $\implies$ deviations from the EH
     [Fama & Bliss 1987, Campbell & Shiller 1991...]
  3. Exchange rates disconnected from fundamentals; but important comovement in term premia and currency risk premia across countries
     [Obstfeld & Rogoff 2001, Itskhoki & Mukhin 2021, Lustig et al 2019, Lloyd & Marin 2019, Chernov & Creal 2020...]
  4. Quantitative easing not only reduced domestic yields, but also had strong effects on exchange rates and foreign yields
     [Bhattarai & Neely 2018...]

Motivation: Macro Consequences

- Recent work has emphasizing the critical role of imperfect financial intermediation:
  - Market segmentation interacts with risk exposure of intermediaries to generate movements in risk premia
    [Gabaix & Maggiori 2015, Itskhoki & Mukhin 2019, Koijen & Yogo 2020, Greenwood et al 2023, Gourinchas, Ray, Vayanos 2025...]
- Key insight: portfolio flows crucial for generating correlated movements in FX and bond premia. Key questions in general equilibrium:
  - What is the role of endogenous portfolio flows induced by real economy (households, import/exports)?
  - How do frictions change monetary policy transmission to the real economy?
- This paper: develops two-country New Keynesian model in which:
  - Asset markets are segmented for households
  - Bond and currency markets are partly integrated by arbitrageurs with limited capital
  - Formally: two-country version of Ray, Droste, Gorodnichenko (2024); GE version of Gourinchas, Ray, Vayanos (2025)

Preview

1. Can reproduce general features regarding the joint behavior of bond and currency risk premia
2. Rich transmission of monetary policy via exchange rate and term premia, contrasting with standard models. Key mechanisms:
   - Shifts in arbitrageurs' risk exposure lead to changes in required risk compensation
   - Hedging behavior of arbitrageurs $\Longrightarrow$ tight linkage between bond term premia and currency risk premia
   - In the presence of market segmentation, policy shocks lead to large shifts in risk exposure
3. Hedging properties of domestic and foreign bonds determined by general equilibrium forces:
   - Endogenous rebalancing within and across countries
   - Endogenous monetary reaction to shocks
4. Real effects of monetary policy (particularly unconventional) depend critically on these rebalancing mechanisms; may have unintended consequences

Model Setup

Model Setup

- Continuous time two-country New Keynesian model with imperfect arbitrage
- **Agents**:
  - Households: supply labor, consume, save via bond markets
  - Firms: monopolistic competitors face nominal frictions
  - Arbitrageurs: imperfect risk-bearing capacity, conduct carry trades
- **Policymakers**:
  - Central bank: conducts short rate and balance sheet (QE) policy
  - Government: issue debt, otherwise passive
- **Bond markets**:
  - Continuum of zero coupon bonds with maturity $0 \leq \tau \leq T \leq \infty$
  - Local currency bond price $\mathcal{P}_{Ht}^{(\tau)}, \mathcal{P}_{Ft}^{(\tau)*}$
  - Nominal exchange rate $\mathcal{E}_t$ (H price of F currency)
  - Yield to maturity $y_{Ht}^{(\tau)} = -\log \mathcal{P}_{Ht}^{(\tau)}/\tau, y_{Ft}^{(\tau)*} = -\log \mathcal{P}_{Ft}^{(\tau)*}/\tau$
  - Nominal short rates: in equilibrium, $i_t = \lim_{\tau \to 0} y_{Ht}^{(\tau)}, i_t^* = \lim_{\tau \to 0} y_{Ft}^{(\tau)*}$

Households

- H HHs choose consumption and labor C_t, N_t in order to solve (analogous for F HHs)

$$V_0 \equiv \max E_0 \int_0^\infty e^{-\varrho t} \Psi_t u(C_t, N_t)\,\mathrm{d}t$$

$$\text{subject to:}\quad \mathrm{d}\mathcal{B}_t = [\mathcal{W}_t N_t - \mathcal{P}_t C_t]\,\mathrm{d}t + \mathcal{B}_t\,\mathrm{d}\tilde{\mathcal{R}}_t + \mathrm{d}\mathcal{F}_t$$

  - Discount factor shock Ψ_t
  - Takes as given CPI $\mathcal{P}_t$, nominal wage $\mathcal{W}_t$, flow transfers $\mathrm{d}\mathcal{F}_t$ (from firms, fiscal authorities, and intermediaries)
- Faces "effective" portfolio returns

$$\mathrm{d}\tilde{\mathcal{R}}_t = \eta_{Ht}(0) i_t\,\mathrm{d}t + \int_0^T \eta_{Ht}(\tau) \frac{\mathrm{d}\mathcal{P}_{Ht}^{(\tau)}}{\mathcal{P}_{Ht}^{(\tau)}}\,\mathrm{d}\tau + \eta_{Ft}(0)\left[i_t^*\,\mathrm{d}t + \frac{\mathrm{d}\mathcal{E}_t}{\mathcal{E}_t}\right] + \int_0^T \eta_{Ft}(\tau) \frac{\mathrm{d}(\mathcal{E}_t \mathcal{P}_{Ft}^{(\tau)*})}{(\mathcal{E}_t \mathcal{P}_{Ft}^{(\tau)*})}\,\mathrm{d}\tau$$

  - Portfolio weights $\eta_{kt}(\tau)$ subject to frictions
  - Benchmark: fixed. Time-variation can capture rebalancing shocks

Key takeaway: asset prices not pinned down by HHs; consumption/savings choices function of "effective" rates

Firms

- Continuum of intermediate goods $j \in [0,1]$ in H (analogous $j' \in [0,1]$ in F)
- CES demand: elasticities ϵ (domestic), μ (cross-border); home-bias terms α, α^*

$$C_{kt}(j) = \left(\frac{\mathcal{P}_{kt}(j)}{\mathcal{P}_{kt}}\right)^{-\epsilon} C_{kt} \quad (k = H, F), \quad C_{Ht} = (1-\alpha)\left(\frac{\mathcal{P}_{Ht}}{\mathcal{P}_t}\right)^{-\mu} C_t, \quad C_{Ft} = \alpha\left(\frac{\mathcal{P}_{Ft}}{\mathcal{P}_t}\right)^{-\mu} C_t$$

- Produce using labor, technology $Y_t(j) = Z_t L_t(j)$. Nominal price $\mathcal{P}_{Ht}(j)$ chosen:

$$U_0^j \equiv \max\; E_0 \int_0^\infty e^{-\varrho t} V_{B,t} \frac{\mathrm{d}\Pi_t(j)}{\mathcal{P}_{Ht} Y}$$

$$\text{where:} \quad \mathrm{d}\Pi_t(j) \equiv [\mathcal{P}_{Ht}(j) Y_t(j) - \mathcal{W}_t L_t(j)]\,\mathrm{d}t - \mathrm{d}\Theta_t(j)$$

- Costs of production: wage bill $\mathcal{W}_t L_t(j)$ and flow deadweight costs:

$$\mathrm{d}\Theta_t(j) = \frac{\vartheta}{2}\left(\pi_{Ht}(j) - \varpi_t\right)^2 \mathcal{P}_{Ht} Y_t\,\mathrm{d}t$$

  - Rotemberg rigidity parameter ϑ and “target” inflation rate ϖ_t (aggregate cost-push shock)

Key takeaway: pricing frictions; marginal costs function of domestic wage

Arbitrageurs

- Mean-variance optimization

$$\max \; E_t\, \mathrm{d}\mathcal{X}_t - \frac{a_t}{2} Var_t\, \mathrm{d}\mathcal{X}_t$$

$$\text{subject to:} \quad \mathrm{d}\mathcal{X}_t = \mathcal{X}_t i_t\, \mathrm{d}t + \mathcal{X}_t^{FX}\left[\frac{\mathrm{d}\mathcal{E}_t}{\mathcal{E}_t} + (i_t^* - i_t)\,\mathrm{d}t\right]$$

$$+ \int_0^T \mathcal{X}_{Ht}(\tau)\left[\frac{\mathrm{d}\mathcal{P}_{Ht}^{(\tau)}}{\mathcal{P}_{Ht}^{(\tau)}} - i_t\,\mathrm{d}t\right]\mathrm{d}\tau + \int_0^T \mathcal{X}_{Ft}(\tau)\left[\frac{\mathrm{d}(\mathcal{E}_t\mathcal{P}_{Ft}^{(\tau)*})}{(\mathcal{E}_t\mathcal{P}_{Ft}^{(\tau)*})} - \left(i_t^*\,\mathrm{d}t + \frac{\mathrm{d}\mathcal{E}_t}{\mathcal{E}_t}\right)\right]\mathrm{d}\tau$$

  - $\mathcal{X}_t^{FX}$: CCT. $\mathcal{X}_{kt}(\tau)$: $\tau, k = H, F$ BCT (H currency positions)
- Risk-return trade-off governed by a_t
  - Risk aversion coefficient (captures all limits to risk-bearing capacity)
  - All gains/losses transferred to HHs
  - Note: $\implies$ CIP holds

Key takeaway: risk averse arbitrageurs' holdings increase with expected return

Asset Returns

- In equilibrium: N_B sources of aggregate risk, vector of Brownian terms $\mathbf{B}_t$
  - Shocks: technology, discount factor, cost-push, rebalancing, supply/QE, ...
- Write bond returns and FX appreciation/depreciation

$$\frac{\mathrm{d}\mathcal{P}_{Ht}^{(\tau)}}{\mathcal{P}_{Ht}^{(\tau)}} = \mu_{Ht}^{(\tau)}\,\mathrm{d}t + \boldsymbol{\sigma}_{Ht}^{(\tau)}\,\mathrm{d}\mathbf{B}_t\,, \quad \frac{\mathrm{d}\mathcal{P}_{Ft}^{(\tau)*}}{\mathcal{P}_{Ft}^{(\tau)*}} = \mu_{Ft}^{(\tau)*}\,\mathrm{d}t + \boldsymbol{\sigma}_{Ft}^{(\tau)*}\,\mathrm{d}\mathbf{B}_t\,, \quad \frac{\mathrm{d}\mathcal{E}_t}{\mathcal{E}_t} = \mu_t^{\mathcal{E}}\,\mathrm{d}t + \boldsymbol{\sigma}_t^{\mathcal{E}}\,\mathrm{d}\mathbf{B}_t$$

- Arbitrageur optimality conditions:

$$\begin{aligned}
\mu_t^{\mathcal{E}} + i_t^* - i_t \equiv \lambda_t^{\mathcal{E}} &= a_t \boldsymbol{\sigma}_t^{\mathcal{E}} \boldsymbol{\Lambda}_t \\
\mu_{Ht}^{(\tau)} - i_t \equiv \lambda_{Ht}^{(\tau)} &= a_t \boldsymbol{\sigma}_{Ht}^{(\tau)} \boldsymbol{\Lambda}_t \\
\mu_{Ft}^{(\tau)*} + \boldsymbol{\sigma}_{Ft}^{(\tau)*} \left[\boldsymbol{\sigma}_t^{\mathcal{E}}\right]^{\top} - i_t^* \equiv \lambda_{Ft}^{(\tau)*} &= a_t \boldsymbol{\sigma}_{Ft}^{(\tau)*} \boldsymbol{\Lambda}_t
\end{aligned}$$

- Market price of risk:

$$\boldsymbol{\Lambda}_t^{\top} = \mathcal{X}_t^{FX} \boldsymbol{\sigma}_t^{\mathcal{E}} + \int_0^T \mathcal{X}_{Ht}(\tau) \boldsymbol{\sigma}_{Ht}^{(\tau)}\,\mathrm{d}\tau + \int_0^T \mathcal{X}_{Ft}(\tau) \boldsymbol{\sigma}_{Ft}^{(\tau)*}\,\mathrm{d}\tau$$

Government

- H debt supply and QE purchases (analogous in F):

$$\mathcal{G}_t \left(\theta_{Ht}(0) i_t \, \mathrm{d}t + \int_0^T \theta_{Ht}(\tau) \frac{\mathrm{d}\mathcal{P}_{Ht}^{(\tau)}}{\mathcal{P}_{Ht}^{(\tau)}} \, \mathrm{d}\tau \right) \equiv \mathcal{G}_t \, \mathrm{d}\check{\mathcal{R}}_t$$

$$\mathcal{QE}_t \int_0^T \theta_{Ht}^{QE}(\tau) \left[\frac{\mathrm{d}\mathcal{P}_{Ht}^{(\tau)}}{\mathcal{P}_{Ht}^{(\tau)}} - i_t \, \mathrm{d}t \right] \mathrm{d}\tau \equiv \mathcal{QE}_t \, \mathrm{d}\check{\mathcal{R}}_t^{QE}$$

  - All gains/losses transferred per-period to domestic HHs
- Market clearing:

$$\mathcal{B}_t \eta_{Ht}(\tau) + \mathcal{E}_t \mathcal{B}_t^* \eta_{Ht}^*(\tau) + \mathcal{X}_{Ht}(\tau) = \mathcal{G}_t \theta_{Ht}(\tau) - \mathcal{QE}_t \theta_{Ht}^{QE}(\tau)$$

$$\mathcal{B}_t \eta_{Ft}(\tau) + \mathcal{E}_t \mathcal{B}_t^* \eta_{Ft}^*(\tau) + \mathcal{X}_{Ft}(\tau) = \mathcal{E}_t \mathcal{G}_t^* \theta_{Ft}^*(\tau) - \mathcal{E}_t \mathcal{QE}_t^* \theta_{Ft}^{QE*}(\tau)$$

$$\implies \mathcal{B}_t \eta_{Ht} + \mathcal{E}_t \mathcal{B}_t^* \eta_{Ht}^* - \mathcal{G}_t = \mathcal{X}_t^{FX}, \;\; \mathcal{B}_t - \mathcal{G}_t = -\mathcal{E}_t \left[\mathcal{B}_t^* - \mathcal{G}_t^* \right]$$

Key takeaway: gov't/HH asset positions affect arbitrageurs risk exposure in equilibrium

Exchange Rate, LOP, Terms of Trade

- LOP (goods):

$$
\begin{aligned}
\mathcal{P}_{Ht}(j) &= \mathcal{E}_t \mathcal{P}^*_{Ht}(j) \;\; j \in H \implies \mathcal{P}_{Ht} = \mathcal{E}_t \mathcal{P}^*_{Ht} \\
\mathcal{P}_{Ft}(j') &= \mathcal{E}_t \mathcal{P}^*_{Ft}(j') \;\; j' \in F \implies \mathcal{P}_{Ft} = \mathcal{E}_t \mathcal{P}^*_{Ft}
\end{aligned}
$$

- LOP (bonds):

$$
\mathcal{P}^{(\tau)}_{Ht} = \mathcal{E}_t \mathcal{P}^{(\tau)*}_{Ht}, \;\; \mathcal{P}^{(\tau)}_{Ft} = \mathcal{E}_t \mathcal{P}^{(\tau)*}_{Ft}
$$

- Terms of trade and real exchange rate

$$
S_t \equiv \frac{\mathcal{P}_{Ft}}{\mathcal{P}_{Ht}}, \;\; Q_t \equiv \frac{\mathcal{P}^*_t}{\mathcal{P}_t} \mathcal{E}_t = \left(\frac{\alpha^* + (1-\alpha^*) S_t^{1-\mu}}{(1-\alpha) + \alpha S_t^{1-\mu}} \right)^{\frac{1}{1-\mu}}
$$

Aggregation

- Symmetric equilibrium: $\mathcal{P}_{k,t}(j) = \mathcal{P}_{k,t}$ for $k = H, F$
  - Simplification: (second-order) Rotemberg costs paid to HHs
- Production, labor, and goods market clearing:

$$Y_t = Z_t L_t = Z_t N_t = C_{Ht} + C^*_{Ht}$$
$$Y^*_t = Z^*_t L^*_t = Z^*_t N^*_t = C_{Ft} + C^*_{Ft}$$

- Aggregate wealth dynamics $B_t = \frac{\mathcal{B}_t}{Y \mathcal{P}_{Ht}}$ (relative to H GDP)

$$\mathrm{d}B_t = \frac{Y_t}{Y} NX_t \,\mathrm{d}t + B_t \left(\mathrm{d}\tilde{\mathcal{R}}_t - \pi_{Ht} \,\mathrm{d}t\right) + \nu \,\mathrm{d}X_t - G_t \,\mathrm{d}\check{\mathcal{R}}_t + QE_t \,\mathrm{d}\check{\mathcal{R}}^{QE}_t$$

  - Net exports $NX_t \equiv 1 - \frac{C_t}{P_{Ht} Y_t}$
  - ν: share of arbitrageurs owned by H HHs

Equilibrium

Equilibrium Macro Dynamics

- "Low risk, low risk-bearing" approximation implies modified NK equations
- Phillips curves

$$E_t\,\mathrm{d}\pi_{Ht} = \left[\varrho\pi_{Ht} - \left(\frac{\epsilon-1}{\vartheta}\right) m_t + u_t\right]\mathrm{d}t\,,\quad E_t\,\mathrm{d}\pi^*_{Ft} = \left[\varrho\pi^*_{Ft} - \left(\frac{\epsilon-1}{\vartheta^*}\right) m^*_t + u^*_t\right]\mathrm{d}t$$

- Consumption Euler equations

$$E_t\,\mathrm{d}c_t = \varsigma^{-1}\left[\tilde{\mu}_{Ht} - \pi_t + v_t\right]\mathrm{d}t\,,\quad E_t\,\mathrm{d}c^*_t = \varsigma^{-1}\left[\tilde{\mu}^*_{Ft} - \pi_t + v^*_t\right]\mathrm{d}t$$

  - u_t, u^*_t, v_t, v^*_t from inflation target shocks, discount factor shocks
  - Marginal costs m_t, m^*_t depend on wages, technology, terms of trade
- Modified Euler equations depend on effective borrowing rates

$$\tilde{\mu}_{Ht} = i_t + \tilde{\lambda}_t,\quad \tilde{\mu}^*_{Ft} = i^*_t + \tilde{\lambda}^*_t,\quad \mu^{\mathcal{E}}_t = i_t - i^*_t + \lambda^{\mathcal{E}}_t$$
$$\mu^{\mathcal{E}}_t = \pi_{Ht} - \pi^*_{Ht} = \pi_{Ft} - \pi^*_{Ft},\quad \pi_t = (1-\alpha)\pi_{Ht} + \alpha\pi_{Ft}$$

Equilibrium Risk Prices

- Aggregate wealth dynamics:

$$\mathrm{d}b_t = [NXy_t + nx_t + (b_t - g_t)\varrho + B\tilde{\mu}_t - G\check{\mu}_t]\,\mathrm{d}t + [B\tilde{\boldsymbol{\sigma}} - G\check{\boldsymbol{\sigma}}]\,\mathrm{d}\mathbf{B}_t$$

- Asset market clearing:

$$\begin{aligned}
x_t^{FX} &= -\eta_F^* g_t + (1 - \eta_{Ft}^*)S(G^* s_t + g_t^*) \\
&\quad + (\eta_H - (1 - \eta_F^*))b_t \\
&\quad - (G + SG^*)\eta_{Ft}^* + B(\eta_{Ht} + \eta_{Ft}^*) \\
x_{Ht}(\tau) &= (\theta_H(\tau) - (1 - \eta_F^*(\tau)))g_t - \theta_H^{QE}(\tau)qe_t - (1 - \eta_F^*(\tau))S(G^* s_t + g_t^*) \\
&\quad - (\eta_H(\tau) - (1 - \eta_F^*(\tau)))b_t \\
&\quad + G(\theta_{Ht}(\tau) + \eta_{Ft}^*(\tau))) + SG^*\eta_{Ft}^*(\tau) - B(\eta_{Ht}(\tau) + \eta_{Ft}^*(\tau)) \\
x_{Ft}(\tau) &= (\theta_F^*(\tau) - \eta_F^*(\tau))S(G^* s_t + g_t^*) - S\theta_F^{QE*}(\tau)qe_t^* - \eta_F^*(\tau)g_t \\
&\quad - ((1 - \eta_H(\tau)) - \eta_F^*(\tau))b_t \\
&\quad + SG^*(\theta_{Ft}^*(\tau) - \eta_{Ft}^*(\tau)) - G\eta_{Ft}^*(\tau) + B(\eta_{Ht}(\tau)) + \eta_{Ft}^*(\tau))
\end{aligned}$$

Equilibrium Characterization I

- Conjecture that bonds prices and the terms of trade are linear functions of state variables (includes forcing variables, supply factors, HH wealth):

$$s_t = -\mathbf{A}_s^\top \mathbf{x}_t, \quad p_t^{(\tau)} = -\mathbf{A}(\tau)^\top \mathbf{x}_t, \quad p_t^{(\tau)*} = -\mathbf{A}^*(\tau)^\top \mathbf{x}_t$$

- Dynamics as a function of state and jump variables $\mathbf{Y}_t$, risk price variables $\mathbf{z}_t$ (includes terms of trade, effective rate/FX premia $\tilde{\lambda}_t, \tilde{\lambda}_t^*, \lambda_t^{\mathcal{E}}$

$$\begin{bmatrix} \mathrm{d}\mathbf{x}_t \\ E_t\, \mathrm{d}\mathbf{y}_t \end{bmatrix} = -\left(\boldsymbol{\Upsilon}_Y \mathbf{Y}_t + \boldsymbol{\Upsilon}_Z \mathbf{z}_t\right) \mathrm{d}t + \begin{bmatrix} \boldsymbol{\sigma} \\ 0 \end{bmatrix} \mathrm{d}\mathbf{B}_t$$

- Fixed point: solve for
  - Risk-adjusted dynamics $\mathbf{M}$ $(N_x \times N_x)$
  - Mapping from state to risk prices $\mathbf{A}_Z$ $(N_x \times N_z)$

Equilibrium Characterization II

- Equilibrium dynamics:

$$\boldsymbol{\Upsilon} = \boldsymbol{\Upsilon}_Y + \begin{bmatrix} \boldsymbol{\Upsilon}_Z \mathsf{A}_Z & 0 \end{bmatrix} \implies \mathrm{d}\mathbf{x}_t = -\boldsymbol{\Gamma}\mathbf{x}_t \,\mathrm{d}t + \boldsymbol{\sigma}\,\mathrm{d}\mathsf{B}_t\,, \quad \mathbf{y}_t = \boldsymbol{\Omega}\mathbf{x}_t$$

- Equilibrium coefficients:

$$\mathsf{A}_S = \mathbf{M}^{-1}\left(\mathbf{e}_{r_H} - \mathbf{e}^*_{r_F}\right), \quad \mathsf{A}_H(\tau) = \int_0^\tau e^{-\mathbf{M}u}\,\mathrm{d}u\,\mathbf{e}_i, \quad \mathsf{A}_F(\tau) = \int_0^\tau e^{-\mathbf{M}u}\,\mathrm{d}u\,\mathbf{e}^*_i$$

  - Equilibrium mapping from state to real/nominal rates $\mathbf{e}_{r_k}, \mathbf{e}_i$
  - Equilibrium mapping from state to quantities $\boldsymbol{\Theta}_k(\tau)$

- Fixed point:

$$\mathbf{L} = \int \boldsymbol{\Theta}_H(\tau)\mathsf{A}_H(\tau)^\top \,\mathrm{d}\tau + \int \boldsymbol{\Theta}_F(\tau)\mathsf{A}_F(\tau)^\top \,\mathrm{d}\tau + \boldsymbol{\Theta}_e \mathsf{A}_S^\top \implies \check{\mathbf{M}} = \boldsymbol{\Gamma}^\top - a \cdot \mathbf{L}\boldsymbol{\Sigma}$$

$$\check{\mathsf{A}}_Z = \begin{bmatrix} -\mathsf{A}_S & a \cdot \mathbf{L}\boldsymbol{\Sigma}\mathsf{A}_S & a \cdot \mathbf{L}\boldsymbol{\Sigma} \int \eta(\tau)\mathsf{A}_H(\tau)\,\mathrm{d}\tau & a \cdot \mathbf{L}\boldsymbol{\Sigma} \int \eta^*(\tau)\mathsf{A}_F(\tau)\,\mathrm{d}\tau \end{bmatrix}$$

Key Mechanisms

Macro Dynamics:

- Macro dynamics are similar to textbook open-economy NK model conditional on:
  - Dynamics of effective borrowing rates $\tilde{\mu}_t, \tilde{\mu}_t^*$ (textbook: $\tilde{\mu}_t = i_t, \tilde{\mu}_t^* = i_t^*$)
  - Dynamics of terms of trade s_t (textbook: from risk-sharing condition)
- Fall in effective rates stimulates domestic consumption for usual NK reasons
- Domestic/foreign output and net export reaction depends on FX movements

Asset Returns:

- Deviations from EH/UIP depends on arbitrageur risk exposure
- Asset position imbalances arise due to
  - Endogenous dynamics of HH wealth
  - HH rebalancing following asset appreciation due to sticky portfolio weights
  - Exogenous changes in supply/QE
- Equilibrium risk pricing depends on endogenous hedging properties of bonds across maturities and countries

Results: Stylized Model

Bond and Currency Returns: Partial Equilibrium Intuition

Partial equilibrium assumptions: suppose

- Short rates $\mathbf{corr}(i_t, i_t^*) \approx 0$ and no supply/QE/bond demand shocks
- HH rebalancing (local) $\frac{\partial b_{jt}(\tau)}{\partial \mathcal{P}_{jt}^{(\tau)}} < 0$, (cross) $\frac{\partial b_{Ft}}{\partial \mathcal{E}_t} < 0$, wealth dynamics $\mathrm{d}b_t \approx 0$

Proposition (Carry Trades)

- Both *CCT* and BCT_H return decrease with i_{Ht}
- ⚠ In addition, BCT_F increases with i_{Ht}

Intuition: Bond and FX Premia Cross-Linkages

- When $i_{Ht} \downarrow$ global arbitrageurs want to invest more in *CCT* and BCT_H
- $\mathcal{E}_t$ and $X_t^{FX} \uparrow$: increased FX exposure (risk of $i_{Ft} \downarrow$)
- Hedge by investing more in BCT_F (since foreign bonds appreciate when i_{Ft} drops)
  $\implies$ BCT_F decreases

QE: Partial Equilibrium Intuition

Following unexpected QE_H (maintaining PE assumptions):

- Home yields decline: $\downarrow y_{Ht}^{(\tau)}$
- ⚠ Also reduces yields in country $F \downarrow y_{Ft}^{(\tau)*}$, and depreciates the Home currency $\uparrow \mathcal{E}_t$

Intuition: Bond and FX Premia Cross-Linkages

- Arbitrageurs decrease H bond exposure (less exposed to risk of $i_{Ht} \uparrow$)
- More willing to hold assets exposed to this risk: increase holdings of F bonds and currency, pushing down F yields and depreciating the H currency

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Limits of partial equilibrium logic

- MP-induced spillovers to asset prices
- But asset price movements $\implies$ changes in consumption, inflation, wealth across countries
- Thus, $\text{corr}(i_t, i_t^*) \neq 0$ and wealth dynamics $\mathrm{d}b_t \neq 0$ which complicates the partial equilibrium hedging logic

Bond and Currency Returns: General Equilibrium Intuition

Simplifying assumptions: suppose

- Fully rigid producer prices ($\vartheta \to \infty$), single global discount risk factor $v_t = -v_t^*$
- Symmetric, zero wealth/supply steady state

Proposition (Macro Dynamics)

If arbitrageur risk aversion $a > 0$ large enough, then relative to $a = 0$:

- Aggregate wealth b_t is stationary; CCT and BCT_H increasing, BCT_F decreasing in b_t
- Terms of trade s_t under-react to discount factor shocks
- Consumption c_t, c_t^* over-reacts iff effective duration $\tilde{\eta}(\tau)$ large enough

Intuition: Bond and FX Premia Cross-Linkages

- When $\uparrow b_t$, arbitrageurs are long CCT, BCT_F; short BCT_H
- Following discount factor shock $\implies \downarrow c_t, \uparrow c_t^*$
- $\implies$ F currency $\uparrow \mathcal{E}_t$ and expected depreciation
- But $\uparrow \mathrm{d}b_t$, thus F currency appreciates by less in order to accommodate higher expected return on CCT

QE: General Equilibrium Intuition

Following unexpected QE_H (maintaining GE assumptions):

- Home yields decline and Home currency depreciates: $\downarrow y_{Ht}^{(\tau)}$ and $\uparrow \mathcal{E}_t$
- ⚠ Also boosts output in country H: $\uparrow y_t$
  - Ambiguous effects in country F
  - If ToT channel and home-bias is large enough, can reduce output in country F $\downarrow y_t^*$

Open Economy Macro Implications:

- Domestic monetary conditions (conventional or QE) affect both yield curves and the exchange rate
- Imperfect insulation even with floating rates

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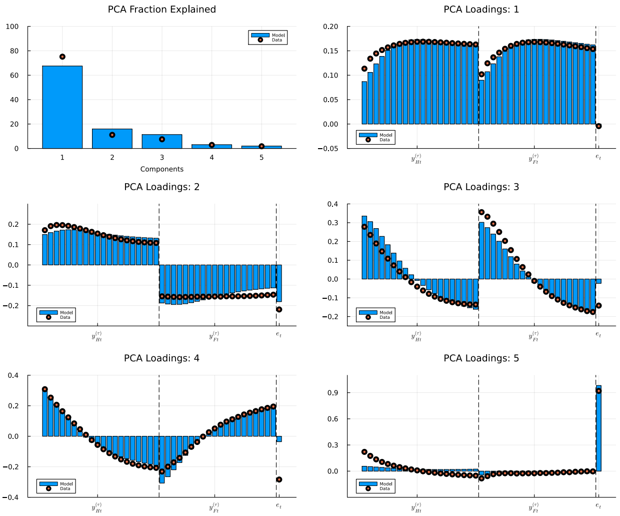
Limits of stylized macro intuition:

- Risk premia function of b_t only
- $\implies$ counter-factual factor structure of asset prices

Asset Return Factor Structure

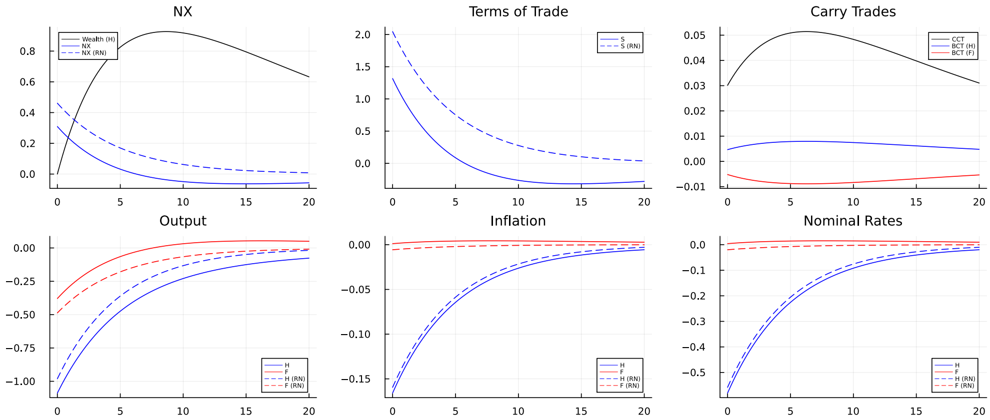


- Additional risk factors necessary to fit data (Gourinchas, Ray, Vayanos 2025)

Adding Additional Risk Factors

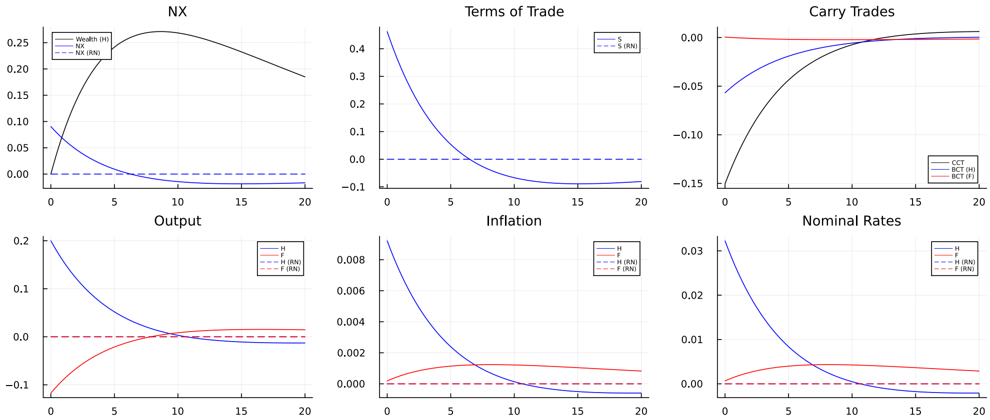
- Illustrative model to better understand qualitative features (work in progress):
  - H/F discount factor shocks v_t, v_t^*
  - H/F supply shocks g_t, g_t^*
  - H/F rebalancing shocks: across maturities β_t, β_t^*; across currencies γ_t
- Compare discount factor shocks and QE shocks
  - Also relative to risk-neutral benchmark

Discount Factor Shock IRFs



- Under-reaction and then over-shooting mean-reversion of ToT
- $\implies$ longer-lasting H recession, eventual F expansion
  - Actually changes sign of conditional $\mathbf{corr}(i_t, i_t^*) \neq 0$ (albeit quantitatively small)

QE Shock IRFs



- QE leads to H expansion, F contraction; inflationary (through ToT movements)
- Over longer horizons, the pattern switches due to H wealth effects
  - Also see Kamdar & Ray (2025) for unintended redistribution effects of QE

Concluding Remarks

- Present an integrated general equilibrium framework to understand macro consequences of term premia, currency risk premia

- Rich transmission of monetary policy domestically and abroad:
    - To asset prices via FX and term premia
    - To real economy via asset market segmentation

Thank You!