International Asset Pricing in Segmented Markets

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International asset pricing in complete markets

- Real exchange rate q_j: price of U.S. basket in terms of basket j.
- Key condition:
  $$m_{US,t+1} = m_{j,t+1} \frac{q_{j,t+1}}{q_{j,t}},$$
  or in logs
  $$\hat{m}_{US,t+1} = \hat{m}_{j,t+1} + \Delta \hat{q}_{j,t+1}.$$
  Can use any agent's SDF to price other assets.
- Macro typically assumes tastes, technologies, and endowments. Jointly solves for exchange rate and allocations (trade).
- Finance often assumes exogenous process for SDFs. Uses above condition to pin down (change in) exchange rate.

Challenges in complete markets

- Backus and Smith 1993: with identical CRRA preferences,

$$\Delta\hat{c}_{US,t+1} - \Delta\hat{c}_{j,t+1} = -\psi\Delta\hat{q}_{j,t+1}.$$

- Brandt et al. 2006:

$$Var(\Delta q_{j,t+1}) = Var(m_{US,t+1}) + Var(m_{j,t+1}) - 2Cov(m_{US,t+1}, m_{j,t+1}).$$

- Can consumption-based SDFs account for risk premia? E.g., for currency risk premia:
  - in time-series, need high relative vol and negative correlation with relative means (Backus et al. 2001).
  - in cross-section, need low interest rate countries to have highest loadings on global shocks (Lustig et al. 2011).

Introducing asset market segmentation

- Evidence suggests specialized investors, not households, are marginal in FX markets. E.g.:
  - deviations from CIP and dealer balance sheet constraints (Du et al. 2018).
  - home (currency) bias in portfolios (Coeurdacier and Rey 2012, Maggiori et al. 2020).
  - intermediary health and currency returns (Adrian et al. 2010, Haddad and Muir 2021).
- Recent work at frontier explores theoretical implications.

Questions I'll focus on today

- Accounting for segmentation, what drives exchange rates?
- What is the scope of asset market segmentation?
- What are the implications for macroeconomic policy?
- Will offer perspectives based on three recent papers:
  - Kekre and Lenel 2024: *Exchange Rates, Natural Rates, and the Price of Risk*.
  - Kekre and Lenel 2026a: *A Model of U.S. Monetary Policy and the Global Financial Cycle*.
  - Kekre and Lenel 2026b: *What Do Asset Prices in April 2025 Say About Demand for the Dollar?*
- Conclude with many open questions for future work.

Outline

Big picture

- Recent literature: “shocks” to UIP drive exchange rate.
  - intermediation capacity (Gabaix and Maggiori 2015).
  - noise traders (Itskhoki and Mukhin 2021).
  - convenience yields (Jiang et al. 2024).
- Kekre and Lenel 2024 embraces segmentation as in these papers, but reaches a distinct conclusion:
  - UIP shocks important at high frequencies, but persistent “macro demand” shocks are main driver of dollar/G10 exchange rate.
  - incomplete markets still important for their transmission.

Model

- Two countries, U.S. and Foreign.
- U.S. representative household:
  - disc. factor β_t, CRRA, home bias ς, trade elasticity σ.
  - endowment z_t, trades bond denom. in U.S. bundle paying r_t.
- Foreign representative household similarly has β_t^*, z_t^*, and trades in bond denominated in Foreign bundle paying r_t^*.
- Arbs which trade both bonds and intermediate capital flows:
  - mean-variance preferences over wealth w. risk aversion γ_t.
  - transfer each period's profits to U.S. households.
- Driving forces: $\{\beta_t, \beta_t^*, z_t, z_t^*, \gamma_t\}$, multivariate AR(1) in logs.

Key theoretical result

- Defining $ex_{t+1} \equiv \frac{q_t}{q_{t+1}}(1+r_t^*) - (1+r_t)$, arb optimality:

$$\mathbb{E}_t ex_{t+1} = \gamma_t \left(q_t^{-1} b_t^{a*} \right) Var_t ex_{t+1}.$$

- To first order around SS with $\gamma Var\, ex_{+1} \to \Gamma$,

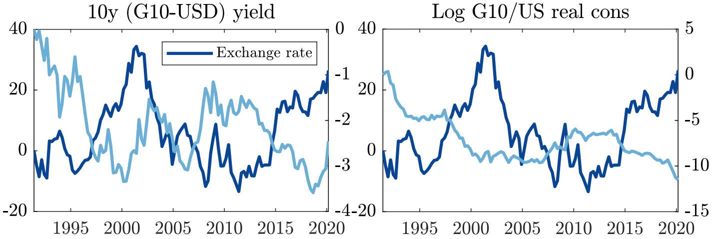
$$\hat{r}_t^* - \mathbb{E}_t \Delta \hat{q}_{t+1} - \hat{r}_t = \Gamma \hat{b}_t^{a*} + ex \hat{\gamma}_t$$

$$\Rightarrow \frac{1}{\psi} \mathbb{E}_t \Delta \left(\hat{c}_{t+1}^* - \hat{c}_{t+1} \right) = \mathbb{E}_t \Delta \hat{q}_{t+1} + \Gamma \hat{b}_t^{a*} + ex \hat{\gamma}_t - \hat{\beta}_t + \hat{\beta}_t^*.$$

$\Rightarrow$ **Prop**: given small Γ and each set of shocks alone:

	$\epsilon_t^z, \epsilon_t^{z^*}$	$\epsilon_t^\beta, \epsilon_t^{\beta^*}$	ϵ_t^γ
$Cov(\hat{q}_t, \hat{r}_t^* - \hat{r}_t)$	$(-)$	$(-)$	$(+)$
$Cov(\hat{q}_t, \hat{c}_t^* - \hat{c}_t)$	$(+)$	$(-)$	$(-)$

Dollar/G10 exchange rate in data



- Strong dollar when U.S. yields, consumption high.
- Robust to inference with near unit roots.

$\Rightarrow$ Demand shocks appear main driver of exchange rate.

- if (trans.) supply shocks, hard to explain comovement with cons.
- if UIP shocks, hard to explain comovement with yields.

Role of persistence and incomplete markets

- Can demand shocks explain high exchange rate vol?
  near random walk behavior?

- **Prop**: yes, as β_t gets more persistent, à la Engel and West 2005.

- Persistently higher U.S. rates implies larger appreciation today:

$$\hat{q}_t = \sum_{h=0}^{\infty} \mathbb{E}_t \left(\hat{r}_{t+h} - \hat{r}^*_{t+h} \right) + \sum_{h=0}^{\infty} \mathbb{E}_t \left(\hat{r}^*_{t+h} - \Delta \hat{q}_{t+h+1} - \hat{r}_{t+h} \right).$$

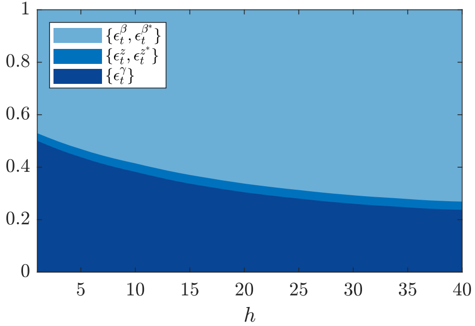
  Future shocks similarly affect $q_{t+1} \Rightarrow$ predictability R^2 falls.

- Incomplete markets essential, as in Corsetti et al. 2008.
  ... distinguishes from Colacito and Croce 2011:
  - here, growth news propagates like β, β^* shocks.
  - but in LRR, growth news *depreciates* q, *lowers* c (and raises r).

Variance decomposition of the dollar/G10 exchange rate

- Discipline $\{z, z^*\}$ using output per capita,
  $\{\beta, \beta^*\}$ using 10y yields priced by households (EH),
  γ using EBP (Gilchrist and Zakrajsek 2012), up to scale.

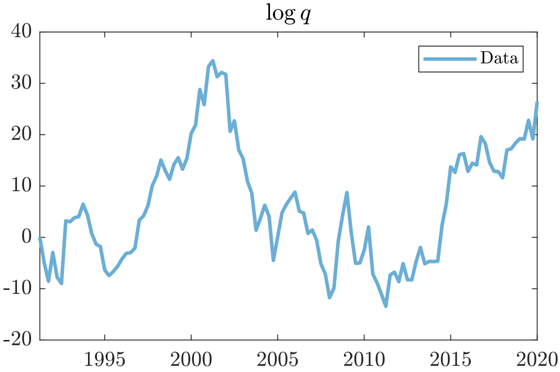
$\Rightarrow$ $\rho^{\beta}, \rho^{\beta *} = 0.98$ vs. $\rho^{\gamma} = 0.85$.



- Robust to replacing EBP with VIX, Treasury basis, etc., or simply targeting $\rho(\Delta \hat{q}_t, \Delta(\hat{r}_t^* - \hat{r}_t))$, $\rho(\hat{q}_t, \hat{r}_t^* - \hat{r}_t)$.

Exchange rate over 1991–2020

- Recover $\{\epsilon_t^{\beta}, \epsilon_t^{\beta *}, \epsilon_t^{z}, \epsilon_t^{z^*}, \epsilon_t^{\gamma}\}$ from $\{r_t^{(40)}, r_t^{(40)*}, y_t, y_t^*, EBP_t\}$.



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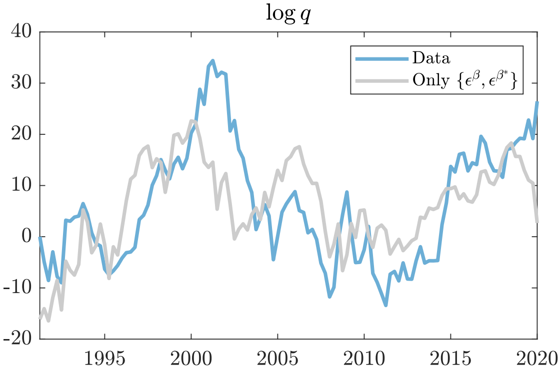

- β shocks account for trend, cycles, vol.

Exchange rate over 1991–2020

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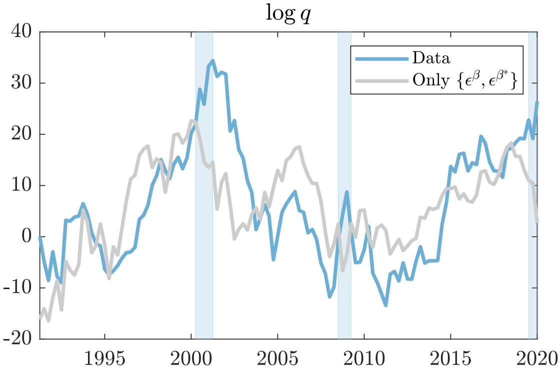

- β shocks account for trend, cycles, vol.
- But they miss dollar appreciation at recession onset when r low.

Exchange rate over 1991–2020

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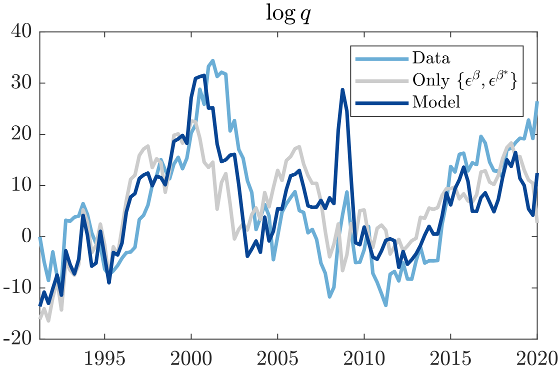


- β shocks account for trend, cycles, vol.
- But they miss dollar appreciation at recession onset when r low.
- With γ shocks matching EBP, better account for recessions.

Outline

Is risk pricing across asset markets integrated?

- Kekre and Lenel 2024 challenges "FX disconnect": common drivers of FX and bonds (and broader economy).
- But is *risk pricing* in FX and bond market integrated? And what about risk pricing along cross-section of FX?
- Recent work examining these questions:
  - PE: Greenwood et al. 2023, Gourinchas et al. 2025.
  - GE: Kekre and Lenel 2026a, Kekre and Lenel 2026b.
- First describe theory, and then present evidence suggesting integrated risk pricing in FX and bonds:
  - QE/QT surprises.
  - April 2 tariff announcement.
  - U.S. monetary surprises (later).

Arbitrageurs in multiple FX, long-term bonds

- Extend model from last section so that:
  - $n > 2$ countries.
  - arbs trade short bond paying $r_{j,t}$, consol at price $p^{\delta}_{j,t}$, decay δ.
  - households freely trade local short bond but take inelastic positions (perhaps zero) in all other bonds.
- Define $ex_{j,t+1} = \frac{q_{j,t}}{q_{j,t+1}}(1 + r_{j,t}) - (1 + r_{1,t})$,
  $$ex^{\delta}_{j,t+1} = \frac{q_{j,t}}{q_{j,t+1}} \left(\frac{1+\delta p^{\delta}_{j,t+1}}{p^{\delta}_{j,t}}\right) - (1 + r_{1,t}).$$
- Arb optimality conditions are now

$$\mathbb{E}_t ex_{j,t+1} = \gamma_t \Big[\sum_{k=2}^{n} q^{-1}_{k,t} b_{ak,t} Cov_t \left(ex_{j,t+1}, ex_{k,t+1}\right) + \sum_{k=1}^{n} q^{-1}_{k,t} b^{\delta}_{ak,t} Cov_t \left(ex_{j,t+1}, ex^{\delta}_{k,t+1}\right) \Big]$$

and analog for $\mathbb{E}_t ex^{\delta}_{j,t+1}$.

Arbitrageurs in multiple FX, long-term bonds

$\Rightarrow$ To first order around SS (again with $\gamma\sigma^2 \to \Gamma$),

$$\mathbb{E}_t \hat{ex}_{j,t+1} = ex_j \hat{\gamma}_t + \sum_{k=2}^{n} Cov\left(ex_{j,+1}, ex_{k,+1}\right) q_k^{-1} \hat{b}_{ak,t} + \ldots$$

and analog for $\mathbb{E}_t ex^{\delta}_{j,t+1}$.

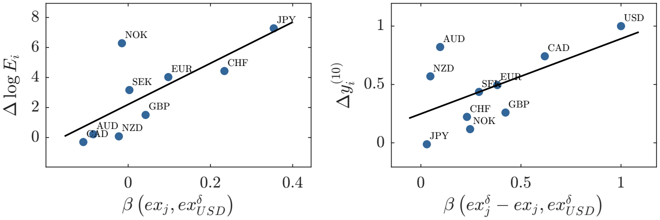
- Implications of integrated risk pricing:
  - asset supply shocks spill over according to $Cov\left(\cdot\right)$.
  - arb risk aversion shocks affect prices according to ex_j, ex_j^{δ}.

Global effects of QE/QT

- Consider increase in arbitrageur position in long-term dollar bonds, $b^{\delta}_{aUSD,t}$ (say, due to U.S. QT).
- Effect on exchange rate depends on $Cov_t\left(ex_{j,t+1}, ex^{\delta}_{USD,t+1}\right)$.
    - if foreign currency appreciates at same time U.S. bonds pay well, then $E_t ex_{j,t+1}$ must rise.
- Effect on foreign term premium similarly depends on $Cov_t\left(ex^{\delta}_{j,t+1} - ex_{j,t+1}, ex^{\delta}_{USD,t+1}\right)$.
    - note $ex^{\delta}_{j,t+1} - ex_{j,t+1} = \frac{q_{j,t}}{q_{j,t+1}}\left(\frac{1+\delta p^{\delta}_{j,t+1}}{p^{\delta}_{j,t}} - (1 + r_{j,t})\right)$.
- "Portfolio balance" mechanism of Tobin 1969, Kouri 1976.

Global effects of QE/QT

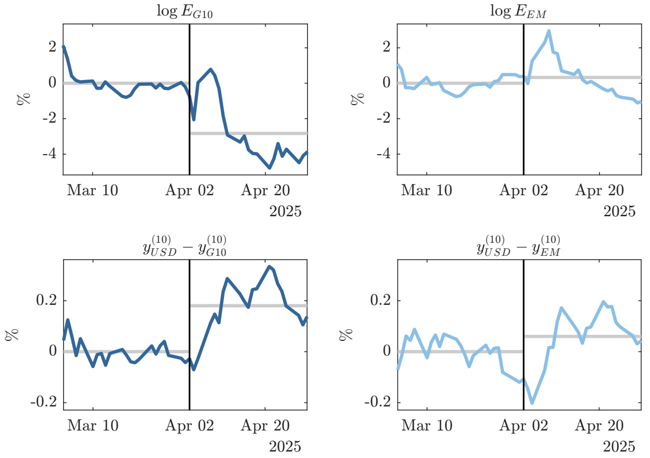
- Kekre and Lenel 2026a compare responses to Swanson 2021 QE/QT surprises versus estimated $Cov(\cdot)$:



- Consistent with portfolio balance under integrated risk pricing.

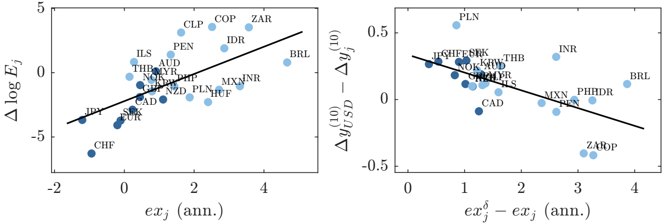
Responses to April 2 tariff announcement

- USD depreciated at the same time USD yields rose.
- Less well known: responses vs. EMs were much smaller:



Responses to April 2 tariff announcement

- Kekre and Lenel 2026b document that cross-sectional responses line up with ex_j, ex_j^{δ}:



- Consistent w/ higher risk aversion under integrated risk pricing.

Outline

Taking stock so far

- So far: asset pricing in intermediated global financial markets.
- Findings:
  - risk pricing across assets is integrated.
  - shocks driving asset prices also matter for consumption.
- Kekre and Lenel 2026a, Kekre and Lenel 2026b study implications for policy:
  - balance sheet policy is non-neutral, and spills over across assets and countries.
  - even conventional policy may affect risk pricing if it affects risk-bearing capacity of marginal agents.

Balance sheet policy is non-neutral

- j's govt selling dollar bonds for j's bonds affects allocations.

  $\Rightarrow$ $b_{aUSD,t}$ rises, $b_{aj,t}$ falls.

- j's govt selling long bonds for short bonds affects allocations.

  $\Rightarrow$ $b^{\delta}_{aj,t}$ rises, $b_{aj,t}$ falls.

- In both cases, changes in asset prices affect real economy.
  - change in exchange rate affects intratemporal expenditure.
  - change in interest rate affects consumption/savings.

How big are the effects?

- In Kekre and Lenel 2026b, we answer reverse question: how big must portfolio flows be to rationalize exchange rate movements, as around April 2?

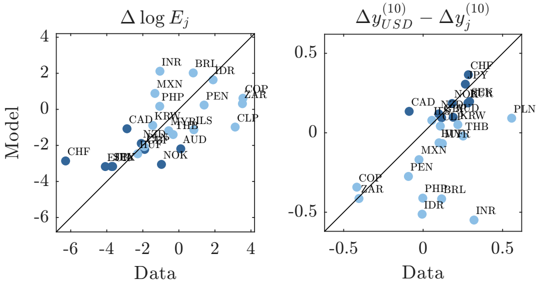
- Recall

$$E_t \hat{ex}_{j,t+1} = \Gamma \sum_{k=2}^{n} Cov(ex_{j,+1}, ex_{k,+1}) \hat{b}_{ak,t} + \ldots.$$

- Magnitude of flows to match asset prices depends on:
  1. Γ, governing response of risk premia to flows;
  2. persistence, since prices depend on expected path of risk premia.

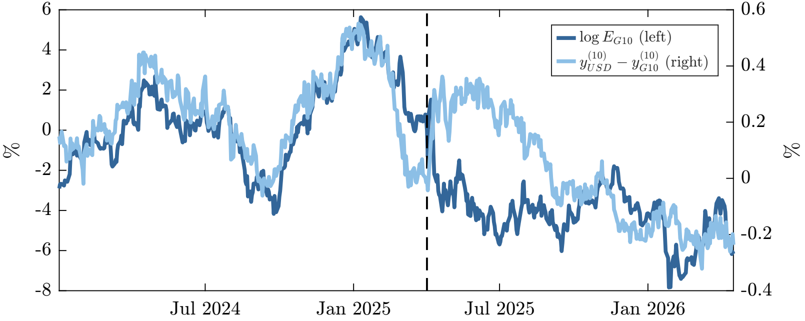
- We discipline Γ to match effect of U.S. QE1, and consider range of assumptions on persistence.

$\Rightarrow$ $3 - 12\%$ decline in demand for dollar bonds (vs. U.S. GDP). Simultaneous increase in risk aversion, explaining cross-section.



- Consistent w/ (news of) USD hedging (Shin et al. 2025). Only a fraction of foreign-owned portfolio in national accts.
- Rebalancing can be gradual — *news* has price impact.
- Meaningful macro effect: U.S. consumption falls $0.3 - 0.4$*pp*.

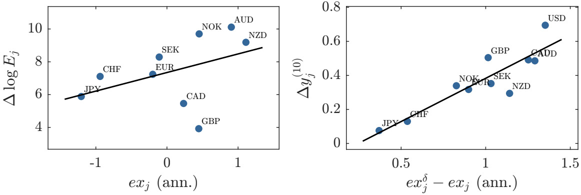
(Ex-post, shocks appear to have reverted)



- News about interest rate differentials again appear dominant driver of dollar/G10 exchange rate.

U.S. monetary policy transmission

- In Kekre and Lenel 2026a, we use similar framework to understand global transmission of conventional monetary policy.
- Prior work: U.S. monetary policy has disproportionate effects on global risky asset prices (e.g., Rey 2015).
- We show global FX, bond yield responses to Bauer and Swanson 2023 surprises line up with ex_j, ex_j^δ:



Consistent w/ higher arb risk aversion (not portfolio balance).

Arbitrageurs' wealth revaluation

- Why might U.S. monetary policy affect arb risk aversion?
- We propose an explanation based on revaluation of arb wealth:
  - assume arbs dividend out only a fraction of profits, so wealth is add'l state variable.
  - further modify arb preferences to be

    $$\mathbb{E}_t \pi^a_{t+1} - \frac{\gamma_t}{2 w_{a,t}} Var_t \pi^a_{t+1},$$

    which implies portfolio choice like CRRA (vs. CARA).
  - key idea: if arbs hold foreign currency assets financed in USD, USD appreciation lowers $w_{a,t}$ and raises price of risk.
- Extends Kekre and Lenel 2022, Kekre et al. 2026 to open economy.

Arbitrageur portfolios

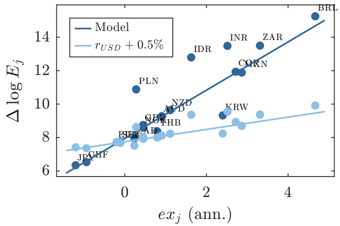
- Are arbs short the dollar? — who are they? derivatives?
- Complementary approach: exploit mean-variance efficiency. Since $\boldsymbol{ex} = \frac{\Gamma}{w_a}\boldsymbol{C}\boldsymbol{b_a}$, we have $\frac{1}{w_a}\boldsymbol{b_a} = \frac{1}{\Gamma}\boldsymbol{C}^{-1}\boldsymbol{ex}$.
- Mean-variance efficient portfolio shares (per currency):

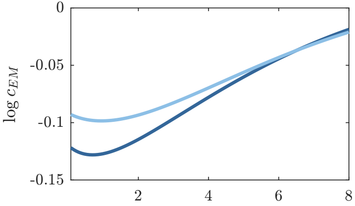
	USD	CHF, EUR, JPY	Other G10	EM
$\Gamma = 1$	-3.1	-0.7	-0.4	1.0
$\Gamma = 1$, G10 avg as base	-5.2	-1.5	-0.3	1.4
$\Gamma = 1$, G10 IBOR yields	-1.4	-1.0	-0.1	0.7
$\Gamma = 1$, no 10-year bonds	-4.4	-0.3	-0.5	1.0
$\Gamma = 1$, 2008-2024	-2.4	-1.2	-0.4	1.0

- USD return *and* residual risk to USD funding are low.

Insights from model

- Responses to ECB surprises do not line up with $\{ex_j, ex_j^\delta\}$ b/c arbs not as exposed to euro.
- Heterogeneous spillovers through risk dominate trade.
- Effect on risk pricing $\Rightarrow$ "sudden stop" in EMs vs. G10.
- Higher dollar interest rates would imply weaker spillovers:





Outline

Taking stock

- Segmentation matters, but FX is not "disconnected".
- Risk pricing is integrated across FX and bond markets.
- Balance sheet and conventional policy affect global risk pricing.

Many open questions

- Nature of “macro demand shocks” driving exchange rates (growth news, fiscal policy, credit conditions, uncertainty).
- Structural account of cross-section of FX and bond returns.
- Is risk pricing in FX and bond markets integrated with other markets (e.g., equities)? At what horizon?
- Who are the arbs? Likely different agents at different horizons.
- Optimal policy under segmentation but integrated risk pricing.
- **Please contribute!**

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