Exchange Rates and Asset Prices in a Global Demand System

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Determinants of exchange rates and asset prices

- Global investors.
  - Hold financial assets (short-term debt, long-term debt, and equity) across many countries.
  - Substitute within and across asset classes.
  - Demand depends on exchange rates and macro variables.
- Policy.
  - Short-term rates.
  - Debt quantities through fiscal and monetary policy.
  - Foreign exchange reserves: Central banks hold foreign assets.

This paper

- Data on global financial markets for 2002–2017.
  - Exchange rates, asset prices, and macro variables across 36 countries.
  - Cross-country holdings from IMF's Coordinated Portfolio Investment Survey.
- Asset pricing = Portfolio choice + Market clearing
  - Match cross-country holdings together with asset prices.
- A demand system approach to
  - Decompose variation in exchange rates and asset prices.
  - Interpret events such as the European sovereign debt crisis.
  - Estimate convenience yield on US assets.

Data structure

- Annual data for 2002–2017 across 3 asset classes.
  1. Short-term debt.
  2. Long-term debt
  3. Equity.
- Investors: 88 countries and foreign exchange reserves.
  - Reserves: Central bank holdings of foreign assets.
- 36 issuer countries with complete data on asset prices and characteristics.
  - All 22 countries in the MSCI World Index.
  - 14 of 21 countries in the MSCI Emerging Markets Index.
  - Other countries aggregated as "outside asset" for each asset class.
- Define supply as
  - Debt: Total amount held by foreigners.
  - Equity: Total stock market capitalization.

Market clearing

- Market clearing for each country n and asset class l:

$$P_t(n,l)E_t(n)Q_t(n,l) = \sum_{i=1}^{I} A_{i,t} w_{i,t}(n,l;\mathbf{P}_t,\mathbf{E}_t)$$

- Supply.
  - $P_t(n,l)$: Market-to-book ratio (or price per unit of face value).
  - $E_t(n)$: Exchange rate in US$ per country n's currency unit.
  - $Q_t(n,l)$: Book (or face) value in country n's currency unit.
- Demand.
  - $A_{i,t}$: Investor i's wealth.
  - $w_{i,t}(n,l)$: Portfolio weight in country n and asset class l.

Demand system asset pricing

- Market clearing is a system of equations.
  1. Short-term debt: 26 countries plus euro area.
  2. Long-term debt: 36 countries.
  3. Equity: 36 countries.
- Conditional on short-term rate (central bank policy), the system determines
  1. 26 exchange rates (relative to US$).
  2. 36 long-term yields.
  3. 36 stock prices.
- A model of portfolio weights that
  - Matches cross-country holdings.
  - Easy to estimate demand elasticities.
  - Flexible substitution within and across asset classes.

Portfolio choice

- Mean-variance portfolio: $\mathbf{w}_i = \Sigma_i^{-1}\mu_i$
  - Heterogeneous beliefs about returns.
- Assumptions:
  1. Covariance matrix has factor structure.
  2. Expected returns and factor loadings depend on characteristics.
- Koijen and Yogo (2019) derive a logit model.

$$\log\left(\frac{w_i(n)}{w_i(0)}\right) = \beta p_i(n) + \gamma' \mathbf{x}_i(n) + \epsilon_i(n)$$

- Nested logit to allow for imperfect substitution across asset classes.

$$w_{i,t}(n,l) = \underbrace{w_{i,t}(n|l)}_{\text{within}}\underbrace{w_{i,t}(l)}_{\text{across}}$$

Estimation methodology

- Observed characteristics.
  - Macro: Log GDP, log GDP per capita, inflation, equity volatility, and sovereign debt rating.
  - Bilateral: Export/import shares and distance.
  - Dummies: Own country ("home bias"), year, and US issuance interacted with year ("specialness").
- Identification.
  - Asset characteristics and quantities are exogenous (in the spirit of endowment economies).
  - Factor structure: Demand depends directly on own characteristics and indirectly on characteristics of other assets through price.
  - IV: Nonlinear function of all asset characteristics through market clearing.

Estimated demand within asset class

Variable	Short-term debt	Long-term debt	Equity
Expected return	31.53	9.31	4.29
	(5.55)	(0.61)	(0.46)
Log GDP	0.96	0.87	0.80
	(0.04)	(0.01)	(0.01)
Log GDP per capita	1.79	1.42	0.44
	(0.15)	(0.04)	(0.03)
Inflation	-0.51	-0.22	-0.02
	(0.09)	(0.02)	(0.01)
Volatility	-3.78	-1.83	-4.83
	(0.47)	(0.23)	(0.27)
Rating	0.11	0.23	0.08
	(0.02)	(0.02)	(0.01)
Export share	0.35	0.29	0.32
	(0.04)	(0.02)	(0.02)
Import share	-0.03	0.09	0.09
	(0.04)	(0.02)	(0.02)
Distance	-0.20	-0.17	-0.11
	(0.02)	(0.00)	(0.00)
Dummy: Own country			7.21
			(0.13)
Observations	17,293	31,252	30,202
R^2	0.25	0.44	0.66

Decomposition of exchange rates and asset prices

- Market clearing defines an implicit function for exchange rates and asset prices.

$$\begin{bmatrix} \mathbf{e}_t \\ \mathbf{p}_t(2) \\ \mathbf{p}_t(3) \end{bmatrix} = g(\mathbf{x}_t, \mathbf{z}_t, \mathbf{p}_t(1), \mathbf{Q}_t, \epsilon_t, \xi_t)$$

- Decompose annual changes into
  1. Macro variables (including equity quantities).
  2. Short-term rates.
  3. Debt quantities.
  4. Reserves.
  5. Latent demand.

Variance decomposition of exchange rates and asset prices

Variable	Exchange rate	Long-term debt	Equity
Macro variables	0.26	0.16	0.57
	(0.07)	(0.09)	(0.08)
Short-term rates	0.08	0.09	0.06
	(0.05)	(0.03)	(0.07)
Debt quantities	0.02	0.20	0.03
	(0.01)	(0.02)	(0.00)
Reserves	0.19	0.11	0.03
	(0.04)	(0.03)	(0.01)
Latent demand	0.45	0.43	0.31
	(0.04)	(0.06)	(0.06)
North America	0.08	0.05	0.06
	(0.02)	(0.01)	(0.04)
Europe	0.08	0.28	0.13
	(0.02)	(0.03)	(0.03)
Pacific	0.03	0.04	0.11
	(0.01)	(0.01)	(0.04)
Offshore financial centers	0.25	0.05	-0.01
	(0.02)	(0.02)	(0.01)
Emerging markets	0.01	0.01	0.03
	(0.00)	(0.00)	(0.03)
Other countries	0.01	0.00	0.00
	(0.00)	(0.00)	(0.01)
Observations	375	540	540

Convenience yield on US long-term debt

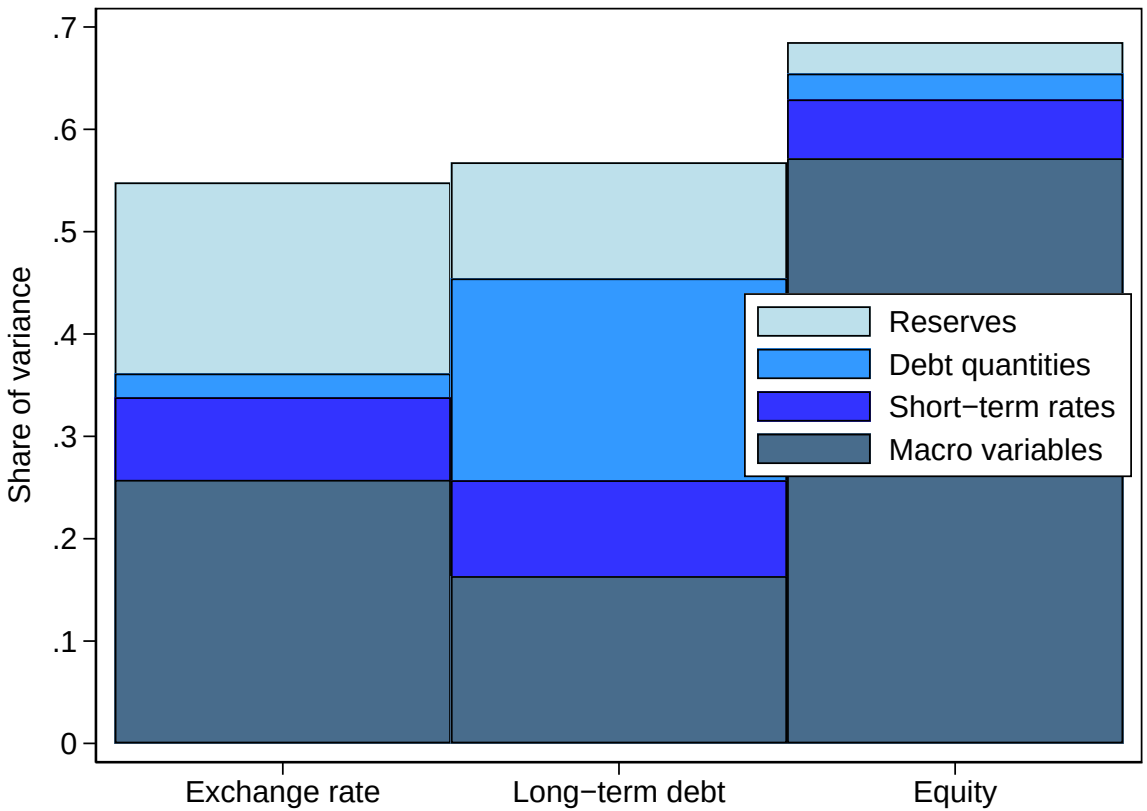
- Special status of the US dollar as reserve currency.
- In the demand system, fixed effects for US issuance interacted with year.
- Estimate the convenience yield on the US dollar, long-term debt, and equity.

Average convenience yield on US assets

Investor	Exchange rate	Long-term debt	Equity
Total	1.28	2.15	1.70
	(0.40)	(0.14)	(0.15)
Reserves	0.06	0.48	-0.07
	(0.14)	(0.02)	(0.01)
North America	0.04	0.02	0.21
	(0.00)	(0.00)	(0.02)
Europe	0.35	0.51	0.69
	(0.06)	(0.03)	(0.04)
Pacific	0.41	0.52	0.37
	(0.06)	(0.05)	(0.03)
Offshore financial centers	0.33	0.53	0.38
	(0.15)	(0.05)	(0.05)
Emerging markets	0.07	0.05	0.09
	(0.01)	(0.01)	(0.02)
Other countries	0.03	0.04	0.03
	(0.01)	(0.00)	(0.00)

Summary

1. Fundamentals account for
   - 55% of variation in exchange rates.
   - 57% of variation in long-term yields.
   - 69% of variation in market-to-book equity.



Summary

2. Inelastic demand. Elasticity of
   - 42 for short-term debt.
   - 4.2 for long-term debt.
   - 1.9 for equity.
3. Case study of the European sovereign debt crisis.
4. Convenience yield on US assets.
   - 1.28% on the dollar, 2.15% on long-term debt, and 1.70% on equity.