International Currency Dominance

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Federal Reserve Bank of Philadelphia and University of Pennsylvania
NY Fed International Roles of the U.S. Dollar Conference

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[1]The views expressed in this paper are solely those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System. Any errors or omissions are the responsibility of the author.

Motivation

- Historically, usually just a few international currencies (or one "dominant" currency):
  1. Colonial era-WWI: Spanish dollar, Dutch florin, French franc, pound sterling
  2. Interwar period: Both pound sterling and US dollar used in international trade
  3. Post Bretton-Woods (1947-present): Large share of international trade in US dollars

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- When will a currency circulate internationally as a **medium of exchange**?
  - Why are dominant currency regimes persistent? Room for multiple international currencies?
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  - Role of **fundamentals/policies** vs. **history**?
- This paper: Monetary model to answer these questions

Model: Main ingredients

- Endogenize the **medium of exchange** in a canonical international monetary model
  - Standard preferences, production function (intermediate inputs + labor $\Rightarrow$ output)
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  - E.g., correspondent banking/FX fees, hiring currency traders, legal/accounting
  - Currencies are **imperfect substitutes**: differ in **rate of return** and **liquidity**

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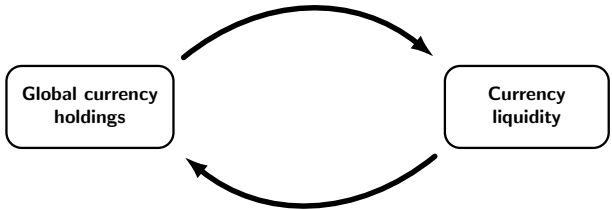
  - Currencies are **imperfect substitutes**: differ in **rate of return** and **liquidity**
- Study long-run outcomes:
  - $\exists$ equilibria where both currencies are widely accepted? Dominant currency equilibria?
  - What policies promote internationalization of a currency?

Preview of results

1. **Analytical**: Stable equilibria with a single **dominant currency**



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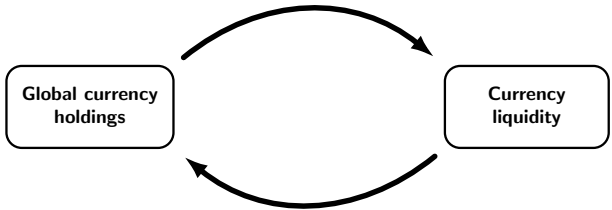

   - Currencies compete via rate of return, but large countries' currencies have an advantage

2. **Quantitative**: Calibration + counterfactual experiments
   - Dominant currencies can emerge even when frictions (fixed investment costs) are small
   - **Trade war**: High and persistent tariffs required to shift away from USD
   - **"Triffin dilemma"**: USD could remain dominant even if emerging economies grow faster

Related literature

- **International monetary models**: Kareken and Wallace (1981); Lucas (1982); Svensson (1985); Trejos and Wright (2001); Liu and Shi (2010); Zhang (2014); Fernández-Villaverde and Sanches (2024)
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- **Global imbalances**: Gourinchas and Rey (2005, 2007, 2022); Caballero and Farhi (2008); Maggiori (2017); Jiang and Richmond (2023); Jiang (2024)
  This paper: Global imbalances + exorbitant privilege emerge from dominant currency.

Roadmap

Setting

- Time $t \in [0, \infty)$, countries $j \in \{1, ..., J\}$ (population shares ξ^j)
  - Half of agents are "buyers" and half are "sellers". Each country has a government.

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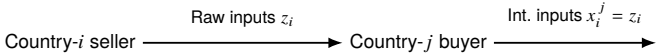
Decentralized Market



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  - Country-i seller: raw inputs z_i. Country-j buyer: converts to intermediate input $x_i^j = z_i$.

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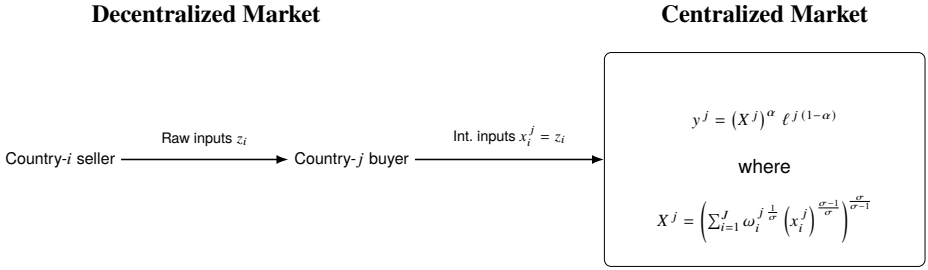

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- "Centralized market" (CM): Intermediate inputs + labor aggregated into output $y^j = c^j$

Preferences

- Agents in country $j \in \{H, F\}$ have preferences over consumption/labor/DM production

$$U^j = \underbrace{\int_0^\infty e^{-\rho t}\left(\frac{c_t^{j\,1-\gamma}-1}{1-\gamma} - \ell_t^j\right) dt}_{\text{CM consumption/labor}} - \underbrace{\sum_{k=1}^{\infty} e^{-\rho T_k} z_{T_k}}_{\text{DM production}}$$

where

- c_t^j is consumption
- ℓ_t^j is labor supplied in the CM
- z_{T_k} is quantity of goods produced in k-th DM meeting (Poisson process)

Assets and the centralized market

- Assets: Liquid nominal government bonds + illiquid privately-issued bonds
  - Private bonds are in zero net supply, pay market-clearing real interest rate r_t
  - $N \leq J$ currencies, where currency j is domestic currency of country j
  - Governments choose nominal rate i_t^n, nominal debt growth rate μ_t^n. Real interest rate is

$$r_t^n = i_t^n - \underbrace{\frac{\dot{P}_t^n}{P_t^n}}_{\text{inflation}}, \quad \text{liquidity premium } l_t^n = r_t - r_t^n$$

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- CM: Walrasian local markets for goods + global financial markets
  - Competitive firms hire labor at wage w_t^j, purchase country-i int. inputs at price ψ_{it}^j
  - Country $j = 1$ final goods are numeraire, real exchange rate of country j is

$$q_t^j = \frac{\text{Price of goods in } j}{\text{Price of goods in } 1}$$

The decentralized market

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  Endogenous fraction of j-sellers who recognize currency n: δ_{nt}^j
- Opportunity to pay utility cost κ to recognize currency n arrives w/Poisson intensity ζ

$$\dot{\delta}_{nt}^j = \zeta\left(I_{nt}^j - \delta_{nt}^j\right), \quad I_{nt}^j dt = \text{ measure who pay cost}$$

Roadmap

Setup

Occasionally impose parametric restrictions for analytical results:

- Two countries: Home and Foreign (H and F)
- Log utility ($\gamma = 1$) and unit elasticity of substitution across intermediates ($\sigma = 1$)
- **Home bias** in consumption:

$$\omega_j^j = \frac{\beta \xi_j}{\beta \xi_j + \xi_{-j}}, \quad \beta > 1$$

Standard equilibrium conditions

- Firm optimization $\Rightarrow$ Input prices

$$w_t^j = \frac{(1-\alpha)y_t^j}{\ell_t^j}, \quad \psi_{i,t}^j = \frac{\alpha y_t^j}{X_t^j}\left(\frac{x_{it}^j}{\omega_i^j X_t^j}\right)^{-1/\sigma}$$

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- Backus-Smith condition $\Rightarrow$ Constant relative wages,

$$\frac{q_t^j {c_t^j}^{\gamma}}{q_t^i {c_t^i}^{\gamma}} = \frac{q^{w,j}}{q^{w,i}} = const.$$

where real exchange rates q_t^j adjust so that countries' budget constraints hold

The HJB equation

- State variable for agents: total assets a_t. Buyers in j solve the optimization problem

$$\rho W_t^j(a) = \max_{c^j, \ell^j, b_i^j, b_l^j} \frac{{c^j}^{1-\gamma} - 1}{1-\gamma} - \ell^j + \dot{a} W_t^{j\prime}(a) + \lambda \Big(\underbrace{V_t^j(\{b_i^j\}, b_l^j)}_{\text{DM val. fn.}} - W_t^j(a) \Big)$$

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$$\text{s.t.} \quad \dot{a} = r_t b_l^j + \sum_{n=1}^{N} r_t^n b_n^j + q_t^j \big(w_t^j \ell^j - c^j - \tau_t^j \big),$$

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- **Proposition**: Agents' value functions are linear in wealth:

$$W_t^j(a) = \hat{W}_t^j + \frac{a}{q_t^j w_t^j}, \quad \hat{W}_t^j = \text{ const.}$$

(don't have to keep track of wealth distribution)

Trade in the decentralized market

- Define per-unit gains from trade between country-i seller and country-j buyer as

$$\Psi_{it}^{j} = \frac{q_t^j \psi_{it}^j}{q_t^i w_t^i} = \frac{\text{Value of inputs to buyer}}{\text{Seller's cost of production}}$$

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$$\mathbb{E}[\text{Buyer surplus}] = \theta \underbrace{(\Psi^j_{it} - 1)}_{\text{gains from trade}} \times \underbrace{\sum_{i=1}^{N} \delta^i_{nt} b^j_n}_{\text{liquid bond holdings}}$$

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- Production function $\Rightarrow$ Inverse relationship btw. Ψ_{it}^{j} and liquid bond holdings

$$\sum_{n=1}^{N} \delta_{nt}^{i} b_{nt}^{j} \geq \underbrace{\frac{\omega_i^j}{1 + \theta(\Psi_{it}^{j} - 1)} \times \alpha q_t^j y_t^j}_{\text{agg. expenditures by } j \text{ on } i}$$

Equilibrium portfolio choice

- Euler equation: Liquidity premium on $n \geq$ Liquidity benefit of holding currency-n bonds

$$I_t^n \geq \lambda\theta \sum_{i=1}^{J} \xi^i \delta_{nt}^i \times (\Psi_{it}^j - 1)$$

Currency demand depends on **rate of return** + **liquidity** in international trade.

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  Currency demand depends on **rate of return** + **liquidity** in international trade.

- **Proposition**: Global holdings of a country's currency are (weakly)
  1. Decreasing in the liquidity premium I^j;
  2. Increasing in country size ξ^j and fraction of non-domestic sellers δ_j who accept it;
  3. Greater for domestic agents than non-domestic agents (**home bias**)

The possible monetary regimes

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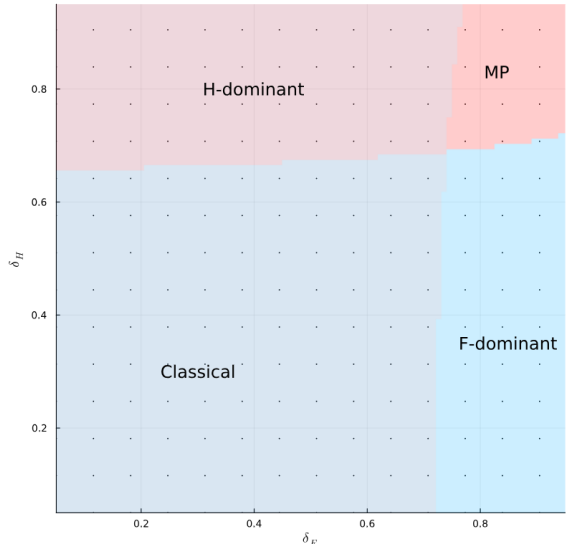
3. **"Dominant currency" regime**: Asymmetric currency holdings
   - E.g., Foreign agents hold both currencies, but Home agents hold only Home currency
   - Dominant currency's share of global trade $>$ goods share of trade by dominant country

Illustrating the international monetary regimes



Sellers' problem

- A country-j seller who gets the opportunity to invest and recognize currency n at time t invests if

$$\kappa \leq V_{nt}^{j} \equiv \int_{0}^{\infty} e^{-(\rho+\zeta)s} v_{n,t+s}^{j} ds,$$

where v_{nt}^{j} = flow value of accepting currency n at time t,

$$v_{nt}^{j} = \frac{\lambda(1-\theta)}{q^{j,w}} \sum_{i=1}^{J} \xi^{i} \underbrace{\left(1 - \frac{1}{\Psi_{jt}^{i}}\right)}_{\text{gains from trade}} \times \underbrace{b_{nt}^{i}}_{\text{agg. bonds}}$$

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Two key forces determine desirability of accepting currency n:

1. Global demand for currency-n bonds b_{nt}^{i}
2. Gains from trade Ψ_{jt}^{i} btw. j and countries that hold n-bonds (trade $\uparrow \Rightarrow$ gains from trade $\downarrow$)

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  1. Gains from trade channel $\Rightarrow$ Substitutes, e.g.

$$\text{More } F\text{-sellers accept } H\text{-currency} \;\Rightarrow\; H \text{ imports of } F\text{-goods} \uparrow \;\Rightarrow\; \Psi_F^H \downarrow$$

  2. Bond demand channel $\Rightarrow$ Complements, e.g.

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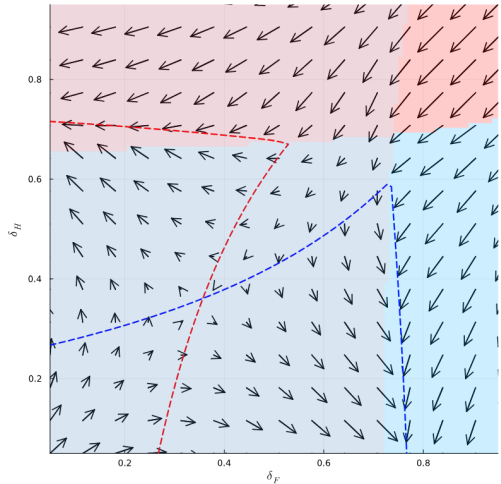
     More F-sellers accept H-currency $\Rightarrow$ H-bonds more liquid $\Rightarrow$ $b_{Ht}^j \uparrow$

- **Prop**: In the classical (multi-polar) regime, country-j sellers' decisions to accept non-domestic currency are overall **complements** (**subtitutes**).

The dynamics of currency adoption



- Blue line = indifference about accepting F, red line = indifference about accepting H
- The interior equilibrium (classical regime) is unstable!

Long-run equilibria

- Three possible types of stable equilibria:
  1. Classical regime: No one accepts non-domestic currency (if κ is high)
  2. Multi-polar regime: Both currencies widely accepted (if κ is low)
  3. Dominant currency regime: One dominant currency

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- In dominant-currency eqm., the other currency isn't internationally liquid at all!
- The role of history-dependence:
  - Which currency becomes dominant is highly sensitive to initial conditions
  - But after a currency becomes dominant, equilibrium is stable

Roadmap

Overview

1. Calibration in model with three regions: US, Euro area, and "rest of the world" (RoW)
   - RoW doesn't have its own currency (continuum of small countries trade w/dollars and euros)
   - Focus on RoW sellers' choice to accept currencies $\delta_{US}^{RoW}, \delta_{EU}^{RoW}$ (hold fixed acceptance patterns for US, EU sellers)
   - Calibrate to steady state where the dollar is the dominant currency
2. "Trade war" counterfactual: US levies tariffs on imports
3. "Triffin dilemma" counterfactual: RoW bond demand outpaces US fiscal capacity

Calibration

Table 1: Externally Calibrated Parameters

Parameter	Description	Value
ξ^{US}	US share of global population	0.25
ξ^{EU}	Euro area share of global population	0.25
ρ	Annual subjective discount rate	0.01
γ^{-1}	Intertemporal elasticity of substitution	1.0
σ	Elasticity of substitution (intermediate inputs)	2.0
θ	Buyer bargaining power	0.5
ζ	Seller investment frequency	0.1
l^j	Liquidity premium (both currencies)	0.003

Calibration

Table 2: Internally Calibrated Parameters

Parameter	Description	Value
β	Home bias	5.0
α	Intermediate input share	0.23
λ	Meeting rate	0.58
κ	Cost of accepting non-domestic currency	0.004
$q^{w,EU}$	EU relative wage	1.00
$q^{w,RoW}$	RoW Relative wage	1.02

Calibration

Table 3: Model and Data Moments

Moment	Model value	Target
U.S. Debt/GDP	50%	50%
δ_{US}^{RoW}	0.70	0.70
U.S. Imports/GDP	16%	15%
U.S. Trade Deficit	3.7%	4.0%
RoW Trade/GDP	40%	40%

Counterfactual #1: Trade war

- US imposes a tariff τ_t^I on intermediate inputs from Euro area, RoW
  - Decreases US buyers' demands for imported input goods, drives down bond demand

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- Two-state Markov chain: "trade war" (τ^I=const.) and "normal" states, transition matrix

$$M^\tau = \begin{pmatrix} -\nu^\tau & \nu^\tau \\ \nu^0 & -\nu^0 \end{pmatrix},$$

set $\nu^\tau = 0.02$ (transition *to* trade war), vary ν^0

Counterfactual #1: Trade war

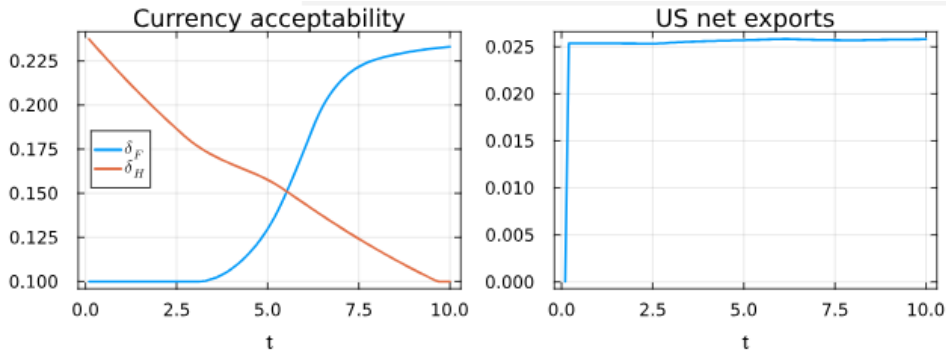
- US imposes a tariff τ_t^I on intermediate inputs from Euro area, RoW
  - Decreases US buyers' demands for imported input goods, drives down bond demand
- Two-state Markov chain: "trade war" (τ^I=const.) and "normal" states, transition matrix

$$M^\tau = \begin{pmatrix} -\nu^\tau & \nu^\tau \\ \nu^0 & -\nu^0 \end{pmatrix},$$

  set $\nu^\tau = 0.02$ (transition *to* trade war), vary ν^0

- Results:
  - Mild trade war ($\tau^I = 0.1$) $\Rightarrow$ Never transition away from Home-currency dominance
  - Can transition away under severe trade war ($\tau^I = 0.2$) w/duration of 8+ years

Loss of currency dominance in a trade war



Counterfactual #2: Fiscal "Triffin dilemma"

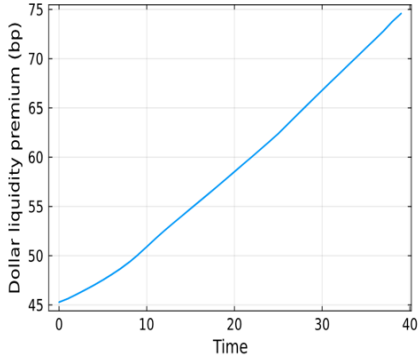
- If US lacks fiscal capacity to sustain global liquid asset demand $\Rightarrow$ Multi-currency world?

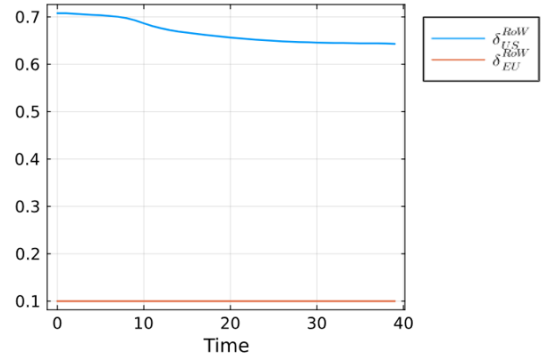
Counterfactual #2: Fiscal "Triffin dilemma"

- If US lacks fiscal capacity to sustain global liquid asset demand $\Rightarrow$ Multi-currency world?
- Fiscal capacity constraint: US/EU cannot raise more than $\overline{\tau}$ taxes per unit time
  - Calibrate $\overline{\tau}$ so that max. sustainable debt level is 200% of GDP in steady state
  - Once maximum debt is reached, US increases liquidity premium to keep debt sustainable (e.g., inflation $\uparrow$)

$$\iota_t^j = \begin{cases} \iota^{j*} & \overline{\tau}^j \geq (r_t - \iota^{j*}) b_t^j \\ r_t - \frac{\overline{\tau}^j}{b_t^j} & \text{otherwise} \end{cases}$$

Dynamics under fiscal capacity constraints





- US hits fiscal capacity constraint $\Rightarrow$ Liquidity premium $\uparrow$ to sustain debt
- But dollar remains dominant despite lower returns

Roadmap

Conclusion

- We endogenize the medium of exchange in a canonical international monetary model.
- Analytical results: A dominant currency tends to emerge in equilibrium.
  - Which currency becomes dominant is path-dependent
  - After a currency becomes dominant, it's hard for others to compete
  - Determinants of currency dominance agree with empirical literature (size, MP, etc.)
- Quantitative results: Model can accommodate several counterfactuals
  - Today: Trade war + Triffin dilemma experiment
  - Others in progress...