Liquidity, Debt Denomination, and Currency Dominance

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Motivation

Currency dominance in global finance:

- US dollar dominance: large share of contracts denominated in $ by a broad cross-section of firms
- Historical precedents: Dutch florin (17^{th}–18^{th} c.), British pound sterling (19^{th}–20^{th} c.)

Question: what explains the emergence, persistence, and fall of these specific currencies?

This paper: **liquidity**-based theory for currency dominance in debt issuance

- Debt obligations are denominated in the unit required to be delivered at settlement
- Obtaining unit for settlement is less costly in more liquid money markets

US $ is attractive for issuance because large, liquid $ stock of instruments benefits settlement

Key mechanism: **complementarity** in liquidity supply (issuance) & demand (settlement)

$\Longrightarrow$ Endogenous positive feedback: issuance begets more liquidity for settlement

Liquidity Force in the First Global Currency

International payments were made in **illiquid metallic coin** for much of history

- Hundreds of types; costly to verify, insure, and transport $\Longrightarrow$ uncertain supply at settlement

Bank of Amsterdam (1609) overcame settlement frictions with **financial technology (bank florin)**

- Standardized unit of account: obtainable with coin deposits for payments via account transfers
- Florin was liquid: at any given time, no limit to florins available in Amsterdam

Florin-denominated "bill on Amsterdam" used internationally

- Yield advantage for florin-denominated assets

Dutch florin used as a financial unit of account rather than **(illiquid) Spanish "pieces of eight"**

- Despite Spain being bigger and wealthier economy with 6$\times$ trade volumes

Overview

Model of complementarity between liquidity supply and liquidity demand

1. Complementarity generates cross-section of debt issuance by different types of firms

Financial market liquidity generates dominance:

2. Unique dominant equilibrium arises from asymmetry in financial market liquidity
   - Historically seeded by large pool of safe government debt
     $\Longrightarrow$ But government debt issuance can *crowd out* other safe debt issuers
   - Economic size and trade volumes not sufficient

Endogenous investment in liquidity generates additional complementarities:

3. Incentives & ability to invest are higher for dominant country
4. Dominant currency pricing (trade invoicing) complements dominant currency financing
5. Welfare: Liquidity provision is a natural monopoly $\rightarrow$ gains from international cooperation
6. Policy tools: Contingent liquidity provision

Related Literature

International monetary system:

- *Dollar world*: Matsuyama Kiyotaki Matsui (1993), Obstfeld Dornbusch McKinnon (1995), Tirole (2002), Gourinchas Rey (2007a,b), Eichengreen Mehl Chitu (2017), Maggiori (2017), Farhi Maggiori (2018), He Krishnamurthy Milbradt (2019), Ilzetzki Reinhart Rogoff (2019), Gopinath Stein (2021), Chahrour Valchev (2021)
- *Historical precedents*: Keynes (1923), Nurske (1944), Dickson (1967), Despres Kindleberger Salant (1969), Lindert (1969), King (1972), Flandreau Jobst (2006), Eichengreen Flandreau (2008), Eichengreen (2008, 2012, 2017), Quinn Roberds (2014a,b), Kynaston (2015a,b), Roberds Velde (2016), Payne Szoke Hall Sargent (2022), Bolt Frost Shin Wierts (2023)

Safe asset shortages:

- Holmstrom Tirole (1998), Caballero Farhi Gourinchas (2008), Caballero Krishnamurthy (2009), Farhi Gourinchas Rey (2011), Krishnamurthy Vissing-Jorgensen (2012), Gorton Lewellen Metrick (2012), Obstfeld (2012), Greenwood Hanson Stein (2015)

US dollar dominance:

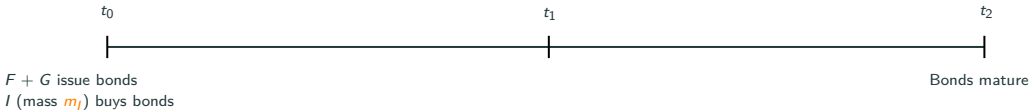
- *Trade invoicing*: Engel (2006), Goldberg Tille (2008), Gopinath Itskhoki Rigobon (2010), Gopinath Boz Casas Díez Gourinchas Plagborg-Møller (2020), Amiti Itskhoki Konings (2022), Mukhin (2022)
- *Global finance*: Krugman (1984), Frankel (1992), Cetorelli Goldberg (2012), Bruno Shin (2015a,b), Ivashina Scharfstein Stein (2015), McCauley McGuire Sushko (2015), Du Tepper Verdelhan (2018), Bahaj Reis (2020, 2021), Koijen Yogo (2020), Maggiori Neiman Schreger (2020), Bianchi Bigio Engel (2021), Jiang Krishnamurthy Lustig (2021), Kekre Lenel (2021), Jiang Richmond Zhang (2022), Correa Du Liao (2022), Eren Malamud (2022), Arslanalp Eichengreen Simpson-Bell (2022), Du Huber (2023)

Search frictions in financial markets:

- Kiyotaki Wright (1989, 1993), Pagano (1989), Trejos Wright (1995), Freeman (1996), Duffie Garleanu Pedersen (2005, 2007), Lagos Wright (2005), Garleanu Pedersen (2007), Vayanos Wang (2007), Vayanos Weill (2008), Weill (2008, 2020), Lagos Rocheteau (2009), Doepke Schneider (2017), Copeland Duffie Yang (2021), Passadore Xu (2022)

Model: Within-Country Setup

Debt Market: Firms and Investors



Preferences (risk neutral):

$$u_i^{F,I} = c_0 + \beta c_1 + \beta^2 c_2, \qquad c_t \geq 0$$

Debt suppliers & demanders at t_0:

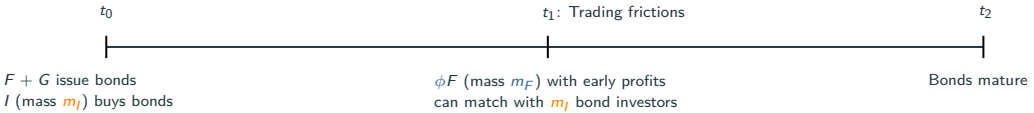
- Entrepreneur-owned Firms (mass F) and Government (mass G) issue bonds at t_0
  - Entrepreneurs borrow to finance project which costs β^2, and generates profits $\pi = 1$
- Investors (mass I) buy bonds, have endowments w; each investor can invest in 1 bond

F and G Bonds:

- Face value 1, mature at t_2, indivisible
- Zero default risk, perfect substitutes $\implies$ same endogenous price P_0

Total bonds mass: $m_I = F + G \leq I$

Timing Mismatch Generates Liquidity Demand at t_1

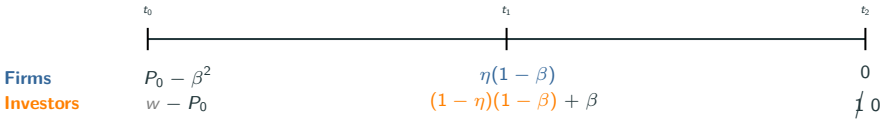


Central element: potential for timing mismatch generates liquidity demand

- Firms receive profits $\pi = 1$ at either t_1 or t_2
- Probability of early profits $\phi \rightarrow$ mass $m_F = \phi F$ of mismatched firms

Gains from asset trade $(1 - \beta)$ possible in the market at t_1 if firm profits arrive early:

Consumption streams:



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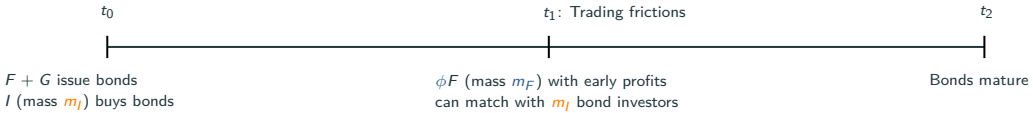

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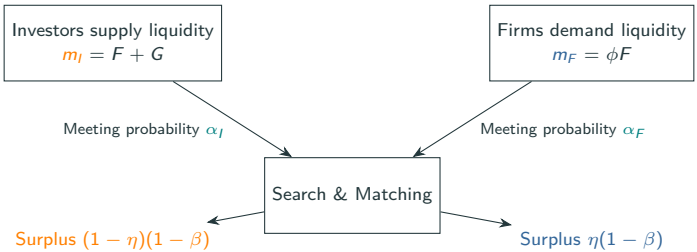
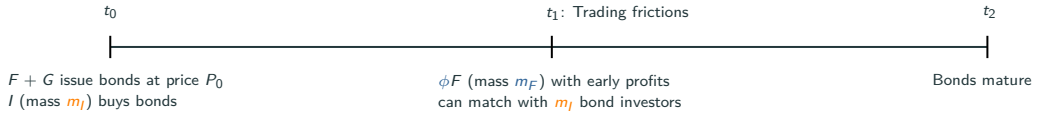


Asset Market Equilibrium and Issuance Benefits



Solving for P_0: market at t_0 is Walrasian, so investor bids result in price

$$P_0 = \underbrace{\alpha_I \beta(\beta + (1-\eta)(1-\beta))}_{P(\text{Matched}) \times \text{PV of Sale Price}} + \underbrace{(1-\alpha_I)\beta^2}_{P(\text{Not Matched}) \times \text{PV of 1}}$$

α_I: probability investor resells bond at t_1

Convenience yield at t_0 captured by $P_0 - \beta^2 = \beta(1-\beta)(1-\eta) \times \alpha_I$

- A fully illiquid bond ($\alpha_I = 0$) would be priced at β^2

Expected utility from debt issuance for firm i is increasing α_I and α_F:

$$\mathbb{E}[u_i^F] = \beta(1-\beta) \times \Big[\underbrace{(1-\eta)\alpha_I}_{\text{Convenience yield at } t_0} + \underbrace{\eta\phi\alpha_F}_{\text{Benefit of settlement at } t_1} \Big]$$

Closing the Model With Search Specification, Complementary Issuance Benefits

Matching function at t_1: number of meetings between firms (demanders) and investors (suppliers) is

$$n = \lambda {m_F}^{\theta} {m_I}^{\theta}, \qquad \lambda > 0, \qquad \underbrace{\theta > 1/2}_{\textbf{Increasing returns}}$$

- Duffie Garleanu Pedersen (2005) case: $\theta = 1$, micro-foundations in Duffie Qiao Sun (2018)

Meeting probabilities:

$$\underbrace{\alpha_F = \frac{n}{m_F} = \lambda {m_I}^{\theta} m_F^{\theta-1}}_{P(\text{Firm finds a bond seller})}, \qquad \underbrace{\alpha_I = \frac{n}{m_I} = \lambda {m_F}^{\theta} m_I^{\theta-1}}_{P(\text{Bond seller finds a firm})}$$

Expected firm utility given equilibrium prices and probabilities (taking $\theta = 1$ case):

$$\mathbb{E}[u_i^F] = \lambda\beta(1-\beta) \times \Big[\underbrace{(1-\eta)m_F}_{\substack{\text{Convenience yield at } t_0, \\ \text{increasing in liquidity demand } m_F}} + \underbrace{\eta\phi m_I}_{\substack{\text{Benefit of settlement at } t_1, \\ \text{increasing in liquidity supply } m_I}} \Big]$$

Investors and Institutional Structure of Money Market at t_1

Investors (m_I) hold liquidity at t_1 that firms (m_F) need. Who are these investors?

$ market today:

- In the US: investors are retail or dealer banks
  - Dealer banks buy Treasuries & MBS (G) at t_0
  - Access reserves via repo markets $\rightarrow$ supply reserves (or deposits) at t_1
- Internationally: investors are central banks or global banks
  - Buy bonds (G, F) at t_0
  - Provide liquidity to domestic firms at t_1

$\Longrightarrow$ Investors hold $ assets in order to provide $ liquidity

Result 1: Issuance Incentive Complementarity Matches Cross-section of Firms

Separate issuance motives into two types of issuers: liquidity suppliers $(+)$ and liquidity demanders $(-)$

Liquidity Suppliers (F^+): no settlement needs ($\phi_i^+ = 0$) but bonds are liquid ($\lambda_i^+ > 0$)

Benefit purely from convenience yield

$$u_i^+ = \frac{\lambda^+ \beta(1-\beta)}{2} \boldsymbol{m_F}$$

$\Longrightarrow$ Issuance contributes to $m_I \Longrightarrow$ raises utility for liquidity demanders m_F

- Example: safe government debt or firms like KFW

Liquidity Demanders (F^-): need settlement ($\phi_i^- > 0$) but bonds have no resale possibility ($\lambda_i^- = 0$)

Benefit purely from settlement ease

$$u_i^- = \frac{\lambda^+ \beta(1-\beta)}{2} \phi \boldsymbol{m_I}$$

$\Longrightarrow$ Issuance contributes to $m_F \Longrightarrow$ raises utility for liquidity suppliers m_I

- Example: lower-rated global corporates

Model: Two-Country Environment

Debt Denomination Choice

Two countries $j = A, B$ with fundamentals $\{G_j, F_j, \lambda_j\}$

Currency denomination choice for firms i in each country

- Fixed cost $\propto K_i$ of foreign denomination
  - Add exchange rate volatility $\Rightarrow$ expected costs of balance sheet currency mismatch or hedging

Endogenous masses $\mathcal{M} = (m_{F,A}, m_{I,A}, m_{F,B}, m_{I,B})$

Four denomination possibilities with expected utility denoted:

$$U_{A\to A}(\mathcal{M}) \qquad U_{A\to B}(\mathcal{M}, K_i)$$

$$U_{B\to B}(\mathcal{M}) \qquad U_{B\to A}(\mathcal{M}, K_i)$$

Firm optimality requires *threshold strategy*: firms issue in foreign currency iff $K_i \leq \bar{K}$

- $H(K_i)$ is the (Pareto) CDF of $K_i \in [\underline{K}, \infty) \to$ share $H(\bar{K})$ issues in foreign currency

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- **Class BA** and class AB equilibria can arise

International Equilibrium Conditions

Define $\hat{K}$ as the equilibrium value of $\bar{K}$, equilibrium characterized by:

1. **Firm optimality**: the *marginal firm* ($K_i = \bar{K}$) has $K_i = \hat{K}$ in equilibrium and satisfies

$$\bar{U}_{j' \to j}(\hat{K}) = \bar{U}_{j' \to j'}(\hat{K})$$

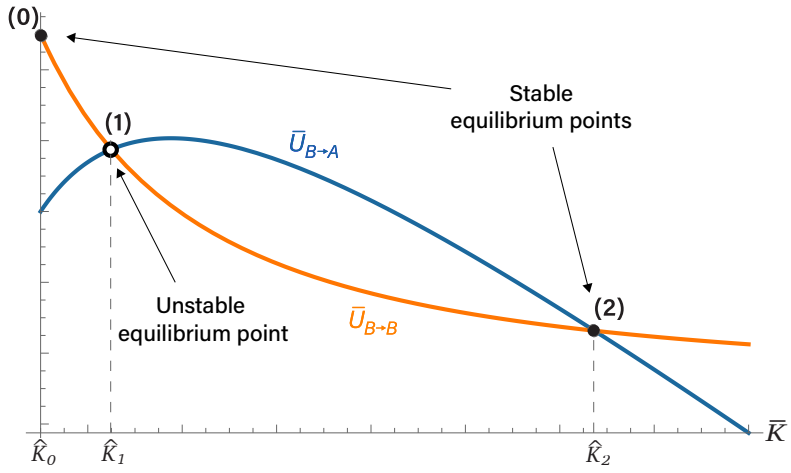
2. **Market clearing:** given $\hat{K}$, masses $\mathcal{M}$ satisfy

$$m_{I,j} = G_j + F_j + H(\hat{K})F_{j'} \qquad m_{I,j'} = G_{j'} + \left[1 - H(\hat{K})\right] F_{j'}$$

$$m_{F,j} = \phi \left[F_j + H(\hat{K})F_{j'}\right] \qquad m_{F,j'} = \phi \left[1 - H(\hat{K})\right] F_{j'}$$

Multiple Equilibria in Case with Symmetric Fundamentals

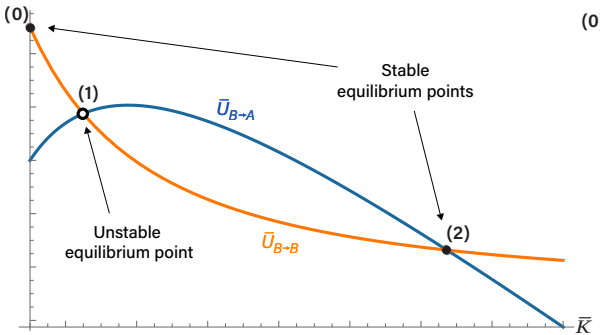
Class (BA) Equilibria: B firms switch to currency A



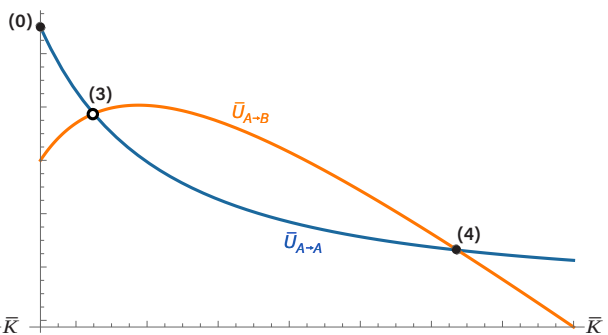
$$\underbrace{\bar{U}_{B\to A} = \lambda_A[m_{F,A}(\bar{K}) + \phi m_{I,A}(\bar{K})] - \bar{K}}_{\text{Expected utility of foreign denomination}} \qquad \underbrace{\bar{U}_{B\to B} = \lambda_B[m_{F,B}(\bar{K}) + \phi m_{I,B}(\bar{K})]}_{\text{Expected utility of home denomination}}$$

Multiple Equilibria in Case with Symmetric Fundamentals

Class (BA) Equilibria: B firms switch to currency A



Class (AB) Equilibria: A firms switch to currency B



Contrast to Other Theories

1. **Costs** of asset & liability mismatch
   - Doepke Schneider (2017): credit chains for production + costly default
     $\longrightarrow$ Socially optimal to coordinate on single denomination in all contracts
   - Gopinath Stein (2021) and Chahrour Valchev (2022): special case for trade transactions
     $\longrightarrow$ Coordinate on denomination of assets (traded goods) and liabilities (debt)

   $\Longrightarrow$ **Benefits** of liquid financial markets as source of dominance
   - Model also features costs of mismatch
   - Adding coordination on asset/liability denomination generates additional complementarity

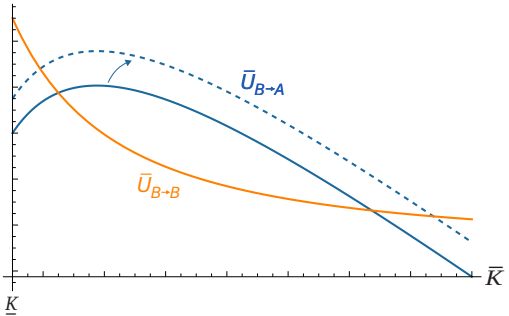
2. **Investor demand** for safety
   - Maggiori (2017), Jiang Krishnamurthy Lustig (2021), Gourinchas Rey (2022): risk aversion in ROW or preference for $ drives demand
     $\longrightarrow$ Incentive for safe issuance to capture convenience yield

   $\Longrightarrow$ **Benefits** accrue to all issuers
   - Results do not depend on payoff heterogeneity or investor demand

Liquidity and Dominance Throughout History

Result 2a: Historical Transitions - Fundamental Asymmetries Generate Dominance

- **Italian city-states** (15th – 16th c.) also prominent in trade and finance, but no dominant currency
- **Amsterdam** disrupted multipolarity; $G_A \uparrow$, $\lambda_A \uparrow$.



$$\bar{U}_{B\to A} = \phi\lambda_A[G_A + 2F_A + 2H(\bar{K})F_B] - \bar{K}$$

Increasing G_A sufficiently leads to unique equilibrium selection

Government Commitment and Financial Technology in Amsterdam

Amsterdam's innovations to deepen florin market

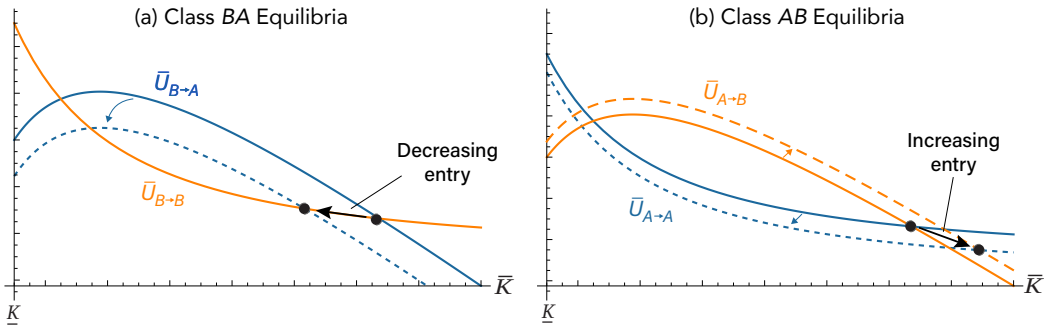
- **Seed**: florin (G) were created because of settlement benefits for trade-intensive economy
  - Trade is settlement-intensive $\rightarrow \phi \approx$ trade/GDP
  - Liquidity benefit for settlement (ϕm_I) increasing in ϕ
  - $\phi_{Amsterdam} > \phi_{Spain}$
- **Confidence** in City of Amsterdam's specie backing for florin was key for takeup
- **Innovations to invest in florin supply**: 1683 florin-for-specie repo facility created way to monetize gold/silver supplies [Figure]
  - Incentive use repo facility: convenience yield generated by liquidity demanders (m_F)
  - Issuance complementarity in cross-section of firms

$\Longrightarrow$ **Increase in G_A**

Result 2b: Historical Transitions - Fundamental Asymmetries Generate Dominance

Transition to British pound:

- Left panel: Bank of Amsterdam collapses in 1791 ($G_{Amsterdam} \downarrow$)
- Right panel: Britain wins Napoleonic Wars ($G_{Britain} \uparrow$) and ($G_{Amsterdam} \downarrow$)



Convenience Yield Dynamics and Crowding Out Safe Issuers

$$\text{Convenience yield}_A = \lambda_A \frac{{m_{F,A}}^{\theta}}{{m_{I,A}}^{1-\theta}}$$

$m_{F,A} = \phi(F_A + H(\hat{K})F_B)$: liquidity demand $\uparrow$ conv yield
$m_{I,A} = G_A + F_A + H(\hat{K})F_B$: liquidity supply $\downarrow$ conv yield

Bounding θ: at $\theta = 1$, liquidity supply channel disappears

$$\text{Convenience yield}_A = \lambda_A m_{F,A}$$

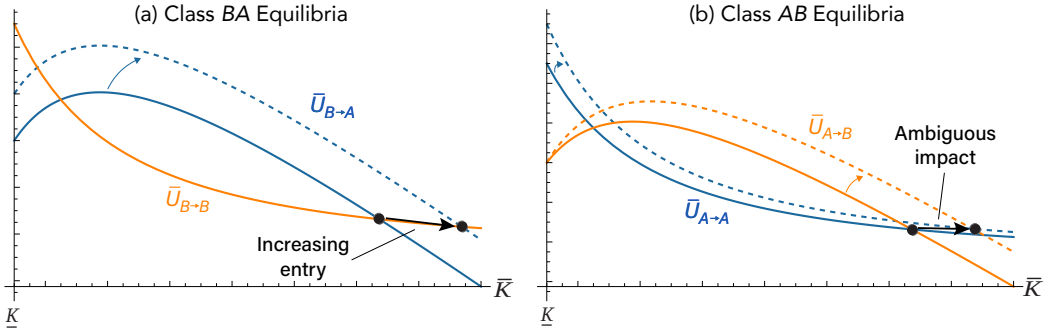
- $\uparrow G_A$ has no direct effect (within BA equilibrium)
- $\uparrow G_A$ has indirect effect through $H(\hat{K})F_B \implies$ raises $m_{F,A}$ and convenience yield [...**counterfactual**]

For $\theta < 1$: increasing G_A can decrease convenience yield within an equilibrium:

$\longrightarrow$ crowds out safe issuers (F^+) who only benefit from conv yield
$\longrightarrow$ crowds in liquidity-demanding firms (F^-) that value settlement

Result 2c: Private Sector Size Has Ambiguous Impact on Dominance

- Left panel: A is dominant currency; $F_A \uparrow$ increases A dominance
- Right panel: B is dominant currency; $F_A \uparrow$ increases B dominance



- Examples: Spain in 17th century, US in 19th century

Result 3a: Persistence - Sovereign Incentives to Supply Liquidity are Increasing in Dominance

Specify the **government's objective** as

$$W_j = \underbrace{G_j\left(P_{0,j} - \beta^2\right)}_{\text{Seignorage conv. yield}} + \underbrace{F_j \int u_{i,j}^F(K_i)\,\mathrm{d}H(K_i)}_{\text{Domestic firm utility}}$$

Consider: $B \to A$ equilibrium with $G_A > G_B$, $\lambda_A = \lambda_B$, $F_A = F_B$

$$W_A = \lambda_A \left[G_A m_{F,A} + F_A(m_{F,A} + \phi m_{I,A})\right]$$
$$W_B = \lambda_B \left[G_B m_{F,B} + F_B(1 - H(\hat{K}))(m_{F,B} + \phi m_{I,B})\right] + U_{B\to A}.$$

1. **Bigger incentive to create liquidity** (G) for the leader (A): $\frac{\partial W_A}{\partial G_A} > \frac{\partial W_B}{\partial G_B}$
2. **Complementarity**: investment incentive reinforced by endogenous rise in entry ($\hat{K}$):

$$\frac{\partial^2 W_A}{\partial G_A\,\partial \hat{K}} > 0, \qquad \frac{\partial \hat{K}}{\partial G_A} > 0$$

Result 3b: Sovereign Incentives to Supply Liquidity are Increasing in Dominance

Improving capacity of **private sector** to issue safe money-like assets also part of financial development

Extend model to include country-specific **pledgeability** parameter ρ_j

- After currency choice, firms find out if revenues are fully pledgeable (probability ρ_j) or not

Ex ante expectation of pledgeability is ρ_j, so equilibrium condition becomes:

$$\rho_A \left[\lambda_A(m_{F,A} + \phi\, m_{I,A}) - \hat{K}\right] = \rho_B \left[\lambda_B(m_{F,B} + \phi\, m_{I,B})\right]$$

As in previous case, sovereign incentives to invest in firm pledgeability **complementary** to dominance:

$$\frac{\partial W_A}{\partial \rho_A} > \frac{\partial W_B}{\partial \rho_B}, \qquad \frac{\partial^2 W_A}{\partial \rho_A \partial \hat{K}} > 0, \qquad \frac{\partial \hat{K}}{\partial \rho_A} > 0$$

Bank of England's changing role

- **Early history**: established in 1693 as private entity given special monopoly rights in return for lending to the crown
  $\longrightarrow$ competed to maximize profits and often restricted market liquidity
- **19th century:**
  - Bank of England notes became legal tender in Bank Charter Act of 1825
  - Established role of Lender of Last Resort after Panic of 1847
    (Alongside legal codification of private bill terms and default procedures)

$\Longrightarrow$ **Commitment** to backstop private bills market: $\uparrow G$, $\uparrow \rho$

International banks monetize trade flows into money market instruments (Xu, 2022)

1. Lend abroad with "banker's acceptances" (collateralized on goods)
2. Remit to London money market as high quality "bank bills"

As in Amsterdam, capturing convenience yield (+ liquidity benefit to firms) is incentive to create bills

Result 4: Trade Invoicing Dominance Follows Financial Dominance

International trade and finance are highly related

- Ex: bills of exchange in Amsterdam both settlement instruments for trade and source of credit

⊙ **So far: Trade/GDP shapes demand for banking and commitment of the bank**

- If more revenues [exogenously] in dominant currency, lower FX mismatch reduces K_i (as in Gopinath Stein 2021)
- Shifting $H(K)$ to the left $\longrightarrow$ **more entry** with $\hat{K}_1 > \hat{K}_0$:

$$\underbrace{\lambda_A \phi \left[2F_A + G_A + 2F_B H(\hat{K}_0)\right] - \hat{K}_0}_{\bar{U}_{B\to A}} = \underbrace{\lambda_B \phi \left[G_B + 2F_B(1 - H(\hat{K}_0))\right]}_{\bar{U}_{B\to B}}$$

- If firms *choose* invoicing currency, generate trade dominance as by-product of financial dominance

$\Longrightarrow$ Additional complementarity that reinforces dominant equilibrium

⊙ **Trade invoicing vs "liability" invoicing: Liabilities 6X trade, with both working in same direction**

Result 5: Welfare and International Cooperation

Global planner has objective:

$$\mathcal{W} = W_A + W_B$$

Socially optimal entry $>$ **competitive equilibrium** because entry carries positive *liquidity externality*

$$\underbrace{K^*}_{\text{Socially optimal entry}} > \underbrace{\hat{K}_{\max}}_{\text{Competitive Equilibrium}}$$

- First best (K^*) is a Pareto improvement over competitive equilibrium (with transfers)
- Optimal policy features subsidy to entry into currency A

Result 5: Welfare & Bretton Woods Arrangements

- Now examine shadow value of increasing liquidity G_A from global and single-country perspective
  - If $\frac{\partial \mathcal{W}}{\partial G_A} > \frac{\partial W_A}{\partial G_A}$, planner wants to increase G_A beyond what privately optimal for A's sovereign

- Direction hinges on relative importance of public (G_B) and private (F_B) borrowing of follower (B):

$$H(\hat{K})\frac{\lambda_A}{\lambda_B} > \frac{1}{2}\frac{G_B}{F_B} + \left[1 - H(\hat{K})\right] \quad \Longleftrightarrow \quad \frac{\partial \mathcal{W}}{\partial G_A} - \frac{\partial W_A}{\partial G_A} = \frac{\partial W_B}{\partial G_A} > 0$$

- If F_B is sufficiently large, there are **gains from international cooperation in liquidity supply**
  - Historical analog: **Bretton Woods** $\rightarrow$ major economies coordinated on US-provided liquidity
  - Response to the classic **Triffin dilemma**: transfers of commitment (gold) to the US

Result 6: Aggregate Risk and State-Contingent Liquidity, Role of Swap Lines

Aggregate risk:

- State at t_1 is $\omega \in \Omega$ with probability $q_\omega \rightarrow$ aggregate liquidity demand shock: ϕ_ω
- State-contingent liquidity supply G^A_ω chosen in advance at t_0

Equilibrium indifference condition now features **moments** of the $(\phi_\omega, G^A_\omega)$ distribution:

$$\lambda_A \left(\mathbb{E}[\phi_\omega] \left(2(F_A + H(\hat{K})F_B) + \mathbb{E}[G^A_\omega] \right) + \text{Cov}[\phi_\omega, G^A_\omega] \right) - \hat{K} = \lambda_B \mathbb{E}[\phi_\omega] \left(2(1 - H(\hat{K}))F_B + G_B \right)$$

- **State-contingent liquidity provision** (positive covariance) induces entry

Policy tool: Central bank swap lines that provide liquidity when it is most demanded

- **Default** makes currency less attractive, particularly if it *negatively covaries* with aggregate demand. **Demise of Euro**

Conclusion

Financial market liquidity is common thread for dominant currencies since 1609

- Seeded by largest pool of safe government-backed debt
- Entrenched by endogenous incentives and ability to invest in safe debt creation
- US dollar dominance today features all the sources of dominance highlighted:
  - Large, liquid, safe stock of T-Bills
  - Financial technologies to make private assets liquid (securitization, collateralization, repo)

20th century arrangements have coordinated on liquidity provision

- Explicit coordination during Bretton Woods
- Swap lines as policy tools today

Renminbi dominance question: current Chinese financial system lacks these elements

Thank you!

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