The International Medium of Exchange

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Motivation

- USD assets play a special role in international financial system
  - serve as the main *international medium of exchange*
  - USD invoices 5 times US world trade share (Gopinath, 2015)
  - 60% of international debt securities issued in USD (BIS)

- US has a unique external position (“exorbitant privilege”)
  - world’s largest net debtor, but *positive* net investment income
  - excess return on foreign assets: \( r_A^{US} - r_L^{US} \in [0.5\%, 3\%] \)
  - could fund sizeable trade deficit
    \(-\) current positions/returns imply benefit up to 3% of GDP

- This paper: a framework where both arise endogenously
  - ex-ante identical countries and assets
  - persistent coordination and currency regimes
A Theory of Currency Dominance and EP

- **Key friction**: limited contract enforceability across borders
  - international transactions require collateral (on both sides)
  - borrowed in local search and matching credit markets
- Feedback between H.H. asset positions and trading sector
  
  wide availability of asset $\iff$ use as medium of exchange

- **Key insight**: asset availability matters for medium of exchange

- Embed in dynamic model
  - multiple steady-states, correspond to currency regimes
  - unique equilibrium paths – asset availability serves as coord. device
Implications

1. Empirically appealing model of the international monetary system
   - Persistent currency regimes, typically a single dominant currency
   - Prolonged, but unstable “mixed” regime periods

2. Dollar dominant steady state matches many features of the data
   - negative NFA, excess returns, trade deficit, portfolio home bias

3. Most welfare benefits accrue during transition
   - steady state welfare differs by only 10bp, but overall by 60bp

4. Trade wars worst for central country
   - wants to foster free trade among third parties

5. Importance of financial openness
   - Eichengreen and Flandreau (2010) evidence on 1920s
   - Euro area vs Chinese Road and Belt Initiative
Literature

- **Exorbitant privilege in the data:** Gourinchas and Rey (2007), Gourinchas, Rey and Govillot (2010), Hassan (2013), Du, Im and Schreger (2018)

- **Dollar dominance in the data:** Portes and Rey (1998), Goldberg (2011), Gopinath (2016)

- **Models of exorbitant privilege:**
  - **Store of Value:** Caballero, Farhi, and Gourinchas (2008), Gourinchas, Rey and Govillot (2010), Hassan (2013), Farhi and Maggiori (2016), He and Krishnamurthy (2016), Maggiori (2017)
  - **Unit of Account:** Gopinath and Stein (2018)
  - **Medium of Exchange:** this paper

- **Models of trade invoicing/currency dominance:** Engel (2006), Gopinath, Itskhoki, and Rigobon (2010), Goldberg and Tille (2013), Doepke and Schneider (2015)

- **Money Theory:** Kiyotaki and Wright (1989), Lagos and Wright (2005), Matsuyama et al. (1993), Wright and Trejos (2001), Rey (2001), Ravkumar and Wallace (2002), Devereux and Shi (2013)
Outline

1 Toy Model
   ▶ Steady-state analytical solutions

2 Full Model and Quantitative Results
   ▶ Steady-state
   ▶ Dynamics

3 Welfare

4 Counterfactuals
**Simple Model Overview**

- **Goods trade**
- **Collateral payments**
- **Continuum of small countries (RoW)**
  - Households
  - Firms

**Financial assets**

**Import/Export Sector**
- Funding fees
- Imports exports

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Two types of agents:

1. **International trade firms**
   - Engage in international transaction (within RW) with surplus $2\pi$
   - To carry out international transactions need safe asset as collateral
   - **Borrow** assets from household in search and matching markets
     - e.g. letter of credit

2. **Households**
   - Trade assets (in fixed supply $\bar{B}$) in international financial markets
   - Lend safe assets to local firms from their portfolios, earn fee $r > 0$
Case 0: Classic Coordination Game

- Firms choose whether to search for USD or EUR letter of credit
- Expected profit of choosing dollars relative to euros for firm $i$:

$$V_j^\$ = \min\left(\frac{p_j^\$}{p_j^\varepsilon}, \frac{p_j^\varepsilon}{p_j^\$}\right) \left[\pi - r - \kappa(1 - \bar{X})\right] - p_j^\varepsilon \left[\pi - r - \kappa\bar{X}\right]$$

where

- $\pi - r$ - profit from trading net of financing costs
- $\bar{X} \equiv \frac{1}{\mu_{rw}} \int_0^{\mu_{rw}} X_j \, dj$ - average dollar use among international trade firms
- $\kappa$ - currency mismatch cost (e.g. liquidity mgmt/transaction cost)

- Suppose $p_j^\$ = p^\$ and $p_j^\varepsilon = p^\varepsilon$ for all $j$ and exogenous

Proposition 1

The economy has multiple equilibria (dollar, euro, mixed) if and only if

$$\kappa \geq \kappa_{sunspot} \equiv (1 - \min(\frac{p^\varepsilon}{p^\$}, \frac{p^\$}{p^\varepsilon}))\pi$$
Case 1: Endogenous $p_j^s$ and $p_j^c$

- Search and matching funding markets: households match with firms
- Probability of obtaining each type of funding (for a firm):

$$p_j^s = \frac{B_j^s}{B_j^s + X_j} \quad \text{and} \quad p_j^c = \frac{B_j^c}{B_j^c + 1 - X_j}$$

- Funding choice strategic substitute within countries
- Assuming $B_j^s = B^s$ and $B_j^c = B^c$ for all $j$

Proposition 2

Multiple (sunspot) equilibria if and only if

$$\kappa \geq \frac{1}{\min\{B^s, B^c\} + 1} \pi$$

- Sunspot equilibria existence depends on bond holdings
  - Lower availability of liquid assets $\Rightarrow$ harder to sustain sunspot equilibria
Case 2: Endogenous Asset Holdings

- Household Problem:

\[
\max_{C_{jt}, B_{jt}^$, B_{jt}^€} E_0 \sum_{t=0}^{\infty} \beta^t \frac{C_{jt}^{1-\sigma}}{1 - \sigma}
\]

s.t.

\[
C_{jt} + (Q_{jt}^$ - \Delta_{jt}^$) B_{jt}^$ + (Q_{jt}^€ - \Delta_{jt}^€) B_{jt}^€ = B_{jt-1}^$ + B_{jt-1}^€ + Y_{jt} + \Pi_{jt}
\]

- Safe assets pay one unit of the final good
- Earn liquidity premia due to borrowing fees paid by trading firms

\[
\Delta_{jt}^$ = \text{Prob}(\text{Lending $ bond}) r = \frac{X_{jt}}{B_{jt}^$ + X_{jt}} r = \Delta_{jt}^$
\]

\[
\Delta_{jt}^€ = \text{Prob}(\text{Lending € bond}) r = \frac{1 - X_{jt}}{B_{jt}^€ + X_{jt}} r = \Delta_{jt}^€
\]
Case 2: Steady State

- Steady state Euler equations imply

\[
\frac{1}{Q^S - \Delta^S} = \frac{1}{Q^E - \Delta^E}
\]

- Imposing market clearing in bond markets

\[
\frac{B_j^S}{B_j^E} \propto \frac{X_j}{1 - X_j}
\]

- Summarizes feedback between HH holdings and firm currency choices

- Note: endogenous liquidity premia solve bond indeterminacy issue
Case 2: Steady-State Multiplicity

![Graph showing equilibrium portfolio share of dollar bonds given X and equilibrium X given portfolio share of dollar bonds.](graph.png)
Case 2: Key Insights

Bond holdings ⇒ $X_j$ ⇒ Bond holdings

Coordinated steady-state characteristics:

1. Higher liquidity premium on coordinated asset

   \[ \Delta^S = \frac{\mu^S}{B + \mu^S} r > \frac{\mu^E}{B + \mu^E} r = \Delta^E \]

2. Excess returns (UIP violation)

3. Could support indefinite trade deficit

   \[ TB_{us} = (\mu_{eu} B^S_{eu} + \mu_{rw} B^S_j - \mu_{us} B^E_{us}) r^E - \left( \mu_{eu} B^S_{eu} + \mu_{rw} B^S_j \right) (r^E - r^S) \]

4. Coordinated steady state stable iff $\kappa > \bar{\kappa}

   - $\bar{\kappa} < \kappa^{sunspot}$ ⇒ mechanism can support multiplicity without sunspots
Full Model Overview

U.S.
- Households
- Firms
- Government
  - Issues US safe asset

E.U.
- Households
- Firms
- Government
  - Issues EU safe asset

Continuum of small countries (RoW)

Financial assets

Contractual friction

Goods trade

Collateral

Imports, Exports

Payments, Funding, Fees

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Full Model

- Calibration
  - Most parameters fixed to standard, *symmetric* values
    - mismatch cost $\kappa = 0.01$, small, outside sunspot region
  - Calibrate $\bar{B}, r, \phi, a_h, \sigma^2_{\epsilon}, \varepsilon_F$ targeting:
    - Debt/GDP, US ex. privilege, import markups, RW trade share, funding prob., USD usage in RW.

## Calibration Targets

<table>
<thead>
<tr>
<th>Concept</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROW USD invoice share</td>
<td>89%</td>
</tr>
<tr>
<td>Exorbitant privilege $(i^e - i^$)</td>
<td>1.50% annually</td>
</tr>
<tr>
<td>Gross debt</td>
<td>60% of GDP</td>
</tr>
<tr>
<td>ROW trade share</td>
<td>55% of GDP</td>
</tr>
<tr>
<td>Funding prob</td>
<td>99%</td>
</tr>
<tr>
<td>Import Markup</td>
<td>25% over production cost</td>
</tr>
</tbody>
</table>
Steady-State Moments

- 3 steady states (Dollar-centric, Euro-centric, multi-polar)
- showing USD and symmetric, EUR is mirror image of USD

<table>
<thead>
<tr>
<th>Moments</th>
<th>USD Coord.</th>
<th></th>
<th></th>
<th>Symmetric</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>US</td>
<td>EU</td>
<td>RW</td>
<td>US</td>
<td>EU</td>
<td>RW</td>
</tr>
<tr>
<td>Dollar Share ($X_j$)</td>
<td>0.90</td>
<td>0.10</td>
<td>0.89</td>
<td>0.90</td>
<td>0.10</td>
<td>0.50</td>
</tr>
<tr>
<td>annualized ($r^e - r^s$)</td>
<td>1.50</td>
<td>1.50</td>
<td>1.50</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Implied revenue/GDP %</td>
<td>1.01</td>
<td>0.13</td>
<td>-</td>
<td>0.57</td>
<td>0.57</td>
<td>-</td>
</tr>
<tr>
<td>NFA/GDP</td>
<td>-0.37</td>
<td>-0.15</td>
<td>0.27</td>
<td>-0.31</td>
<td>-0.31</td>
<td>0.33</td>
</tr>
<tr>
<td>Portfolio Home Bias</td>
<td>0.58</td>
<td>0.91</td>
<td>0.00</td>
<td>0.80</td>
<td>0.80</td>
<td>0.00</td>
</tr>
<tr>
<td>Trade balance/GDP %</td>
<td>0.32</td>
<td>0.40</td>
<td>-0.38</td>
<td>0.56</td>
<td>0.56</td>
<td>-0.59</td>
</tr>
<tr>
<td>Consumption</td>
<td>0.962</td>
<td>0.961</td>
<td>0.896</td>
<td>0.959</td>
<td>0.959</td>
<td>0.898</td>
</tr>
</tbody>
</table>
Dynamic Stability and Regions of Attraction
Degree of Dollarization

![Degree of Dollarization Graph]

- **RW EUR holdings (\(\% \bar{B}\))**
- **RW USD holdings (\(\% \bar{B}\))**

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Degree of Dollarization

- RW EUR holdings (% $\hat{B}$)
- RW USD holdings (% $\hat{B}$)

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Welfare Implications

<table>
<thead>
<tr>
<th>Consumption Equivalent gain relative to symmetric SS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>US</td>
</tr>
<tr>
<td>Coordinated Steady State</td>
</tr>
<tr>
<td>Including Transition</td>
</tr>
</tbody>
</table>

- Net gains of $\approx 0.6\%$ of consumption relative to non-dominant country.
  - $\approx 1\%$ of consumption relative to a model with no contracting friction
- Rest of the world loses out in coordinated steady state
- Deadweight losses associated with coordinated equilibrium!
  $\leftrightarrow$ crowding in on a single funding/liquidity source wasteful.
**Trade War Scenario**

- Introduce 20% tariffs in all countries on all imports
## New Steady-State Moments

<table>
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<th>Moments</th>
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<td>US</td>
<td>EU</td>
<td>RW</td>
<td></td>
</tr>
<tr>
<td>Dollar Share</td>
<td>0.90</td>
<td>0.10</td>
<td>0.98</td>
<td>0.90</td>
<td>0.10</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>annualized ($r^e - r^$)</td>
<td>1.26</td>
<td>-</td>
<td>-</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Implied revenue/GDP %</td>
<td>0.76</td>
<td>0.01</td>
<td>-</td>
<td>0.38</td>
<td>0.38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trade balance/GDP %</td>
<td>0.60</td>
<td>0.21</td>
<td>-0.43</td>
<td>0.77</td>
<td>0.77</td>
<td>-0.80</td>
<td></td>
</tr>
<tr>
<td>NFA/GDP</td>
<td>-0.38</td>
<td>-0.06</td>
<td>0.23</td>
<td>-0.32</td>
<td>-0.32</td>
<td>0.33</td>
<td></td>
</tr>
<tr>
<td>Home Bias</td>
<td>0.49</td>
<td>0.93</td>
<td>0.00</td>
<td>0.80</td>
<td>0.80</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Consumption</td>
<td>0.942</td>
<td>0.946</td>
<td>0.878</td>
<td>0.940</td>
<td>0.940</td>
<td>0.882</td>
<td></td>
</tr>
<tr>
<td>(Im. + Ex)/GDP</td>
<td>0.287</td>
<td>0.285</td>
<td>0.371</td>
<td>0.287</td>
<td>0.287</td>
<td>0.368</td>
<td></td>
</tr>
</tbody>
</table>
Welfare Implications

### Consumption Equivalent loss

<table>
<thead>
<tr>
<th></th>
<th>US</th>
<th>EU</th>
<th>RW</th>
</tr>
</thead>
<tbody>
<tr>
<td>New vs old steady state</td>
<td>-2.08%</td>
<td>-1.56%</td>
<td>-2.01%</td>
</tr>
<tr>
<td>Including Transition</td>
<td>-2.09%</td>
<td>-1.87%</td>
<td>-1.71%</td>
</tr>
</tbody>
</table>

- The dominant country loses the most out of a trade war
  - Especially relative to the other major country
- We can also use the model to quantify the additional deadweight loss of trade frictions due to lost exorbitant privilege revenue
  - $\approx 0.5\%$ of SS consumption
  - could also be much higher: $>4\%$ if tariffs are asymmetric
US-RW trade war
Inertia: Emergence of the Euro

- A switch in currency dominance pre-supposes the existence of a viable alternative.

- In 1999, many viewed the Euro as the first legitimate challenger of the USD in terms of economic size.

- Still, it was puzzling that the formation of the Euro did not seem to do much to erode the USD’s position.
  - Similarly US economy overtook UK back in late 1800s, USD did not gain dominance until after WWII.

- Key: steady state multiplicity leads to inertia and path dependence.
  - Existence of two large currencies does not necessarily lead to multi-polar world.
    - Symmetric steady state is not stable, emergency of alternative currency only allows for the possibility of a switch in who is dominant.
  - For Euro to take over, it needs to grow significantly bigger than the US.
Inertia: Emergence of the Euro

Growth of EUR safe assets
- **EUR introduction**
- **EUR continued growth**

USD use by firms ($X_{\text{rw}}$)

Rusd - Reur

RW USD Portfolio Share

US Net Foreign Assets

EU Net Foreign Assets

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Conclusion

- Model with endogenous international medium of exchange and EP
  - complementarity between portfolio holdings and firms’ currency choice
  - endogenous states ⇒ serve as coordination device
  - model captures several long-run features of int. financial markets

- Model highlights importance of asset availability/financial openness
  - contrasts with trade openness and country size channels

- Welfare gains of dominance at steady state are modest, because endogenously dominance leads to large negative NFA
  - Significantly larger welfare gains once you take transition into account
  - Similarly, large losses of losing dominance

- While currency regimes are persistent, they are not permanent
  - Policy changes or availability of alternative currency can lead to change