Dominant Currency Paradigm

Gita Gopinath
Harvard

CREI Lectures, 2018

Lecture III

Endogenous currency choice

- Engel (JIE, 2006), Gopinath, Itskhoki and Rigobon (AER, 2010)
- Prices are sticky one period ahead.
- firm chooses to price in the local (n) currency as opposed to the producer (i) currency if $\mathbb{E}_{t-1}\Pi(\bar{p}^n_{in,t}) > \mathbb{E}_{t-1}(\Pi(\bar{p}^i_{in,t})$.
- second order approximation to the profit function around the flexible price at date t,

$$\mathbb{E}_{t-1}\left[\Pi(\bar{p}^n_{in,t}) - \Pi(\bar{p}^i_{in,t})\right] \approx \mathbb{E}_{t-1}\frac{1}{2}\tilde{\Pi}_{pp}\left[(\bar{p}^n_{in,t} - \tilde{p}^n_{in,t})^2 - (\bar{p}^i_{in,t} + e_{in,t} - \tilde{p}^n_{in,t})^2\right]$$

$\tilde{\Pi}_{pp} < 0$

$$\mathbb{E}_{t-1}\frac{1}{2}\tilde{\Pi}_{pp}\left[(\bar{p}^n_{in,t} - \bar{p}^i_{in,t} - e_{in,t})(\bar{p}^n_{in,t} + \bar{p}^i_{in,t} + e_{in,t} - 2\tilde{p}^n_{in,t})\right] =$$

$$\mathbb{E}_{t-1}\frac{1}{2}\tilde{\Pi}_{pp}\left[(\mathbb{E}_{t-1}e_{in,t} - e_{in,t})(\bar{p}^n_{in,t} + \bar{p}^i_{in,t} + e_{in,t} - 2\tilde{p}^n_{in,t})\right]$$

The equality follows because $\bar{p}^n_{in,t} = \bar{p}^i_{in,t} + \mathbb{E}_{t-1}e_{in,t}$, $\mathbb{E}_{t-1}(\mathbb{E}_{t-1}e_{in,t} - e_{in,t}) = 0$

$$\mathbb{E}_{t-1}\left[\Pi(\bar{p}^n_{in,t}) - \Pi(\bar{p}^i_{in,t})\right] \approx \frac{1}{2}\tilde{\Pi}_{pp} Cov_{t-1}(-e_{in,t}, e_{in,t} - 2\tilde{p}^n_{in,t})$$

The firm will therefore choose LCP if:

$$\frac{Cov_{t-1}(\tilde{p}^n_{in,t}, e_{in,t})}{Var_{t-1}(e_{in,t})} < \frac{1}{2},$$

- if a firm desires low ERPT, in the short run before it has a chance to adjust prices, the firm is better off choosing local currency pricing that results in 0% pass-through in the short run.
- If short-run desired pass-through is high, the firm should choose producer currency pricing that results in complete (100%) pass-through prior to price adjustment.
- Multiple equilibria.

- Dollar pricing if

$$\frac{Cov_{t-1}(\tilde{p}^{\$}_{in,t}, e_{i\$,t})}{Var_{t-1}(e_{i\$,t})} < \frac{1}{2},$$

- Imported inputs always pushes towards dollar pricing
- Strategic complementarities in pricing mixed

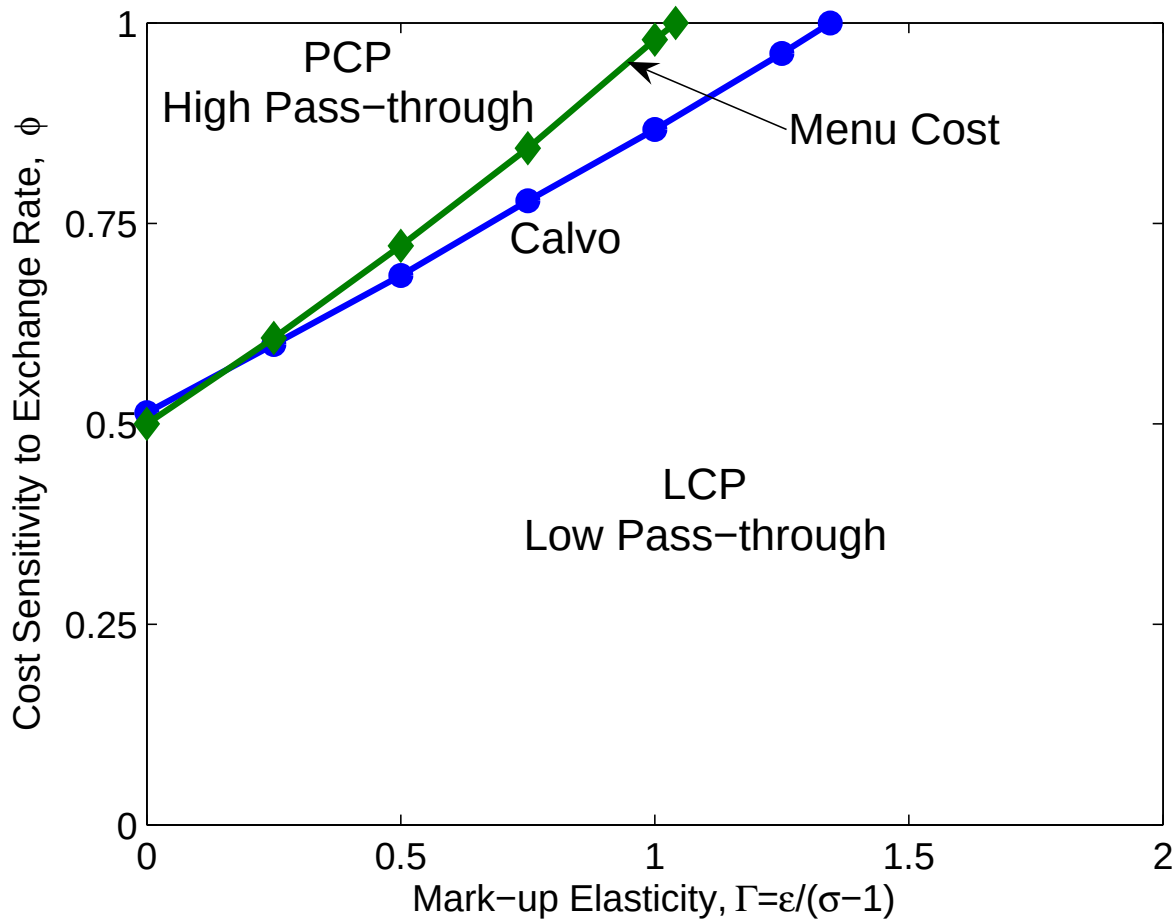

Figure 6: Currency Choice in the (Γ, ϕ)-space

Banking, Trade, and the Making of a Dominant Currency

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What is a “Dominant Currency”?

1. Trade invoicing

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4. 'Exorbitant Privilege'
   - Violation of UIP: Dollar risk-free assets pay lower expected returns (in a common currency)

Literature

- Trade invoicing (unit of account)
  - Friberg (1998), Engel (2006), Devereux et al. (2004), Bacchetta and van Wincoop (2005), Gopinath et al. (2010), Goldberg and Tille (2013), Perez and Drenik (2017), Doepke and Schneider (2017)

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- Safe assets and exorbitant privilege (store of value)
  - Hassan (2013), Gourinchas and Rey (2010); Maggiori (2017); He, Krishnamurthy, Milibradt (2016), Farhi and Maggiori (2016)

What we do

1. Unified theory for dominance in trade invoicing *and* finance
2. Strategic complementarity of unit of account and store of value
3. Dominant currency, despite multiple candidates
4. 'Currency mismatch' and 'exorbitant privilege'

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Eichengreen (2010): *"...experience suggests that the logical sequencing of steps in internationalizing a currency is: first, encouraging its use in invoicing and settling trade; second, encouraging its use in private financial transactions; third encouraging its use by central banks and governments as a form in which to hold private reserves."*

Main Idea

High $ invoicing

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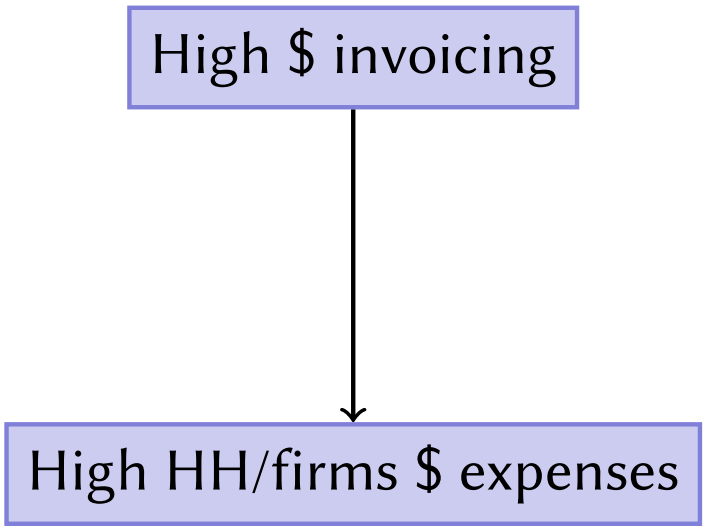

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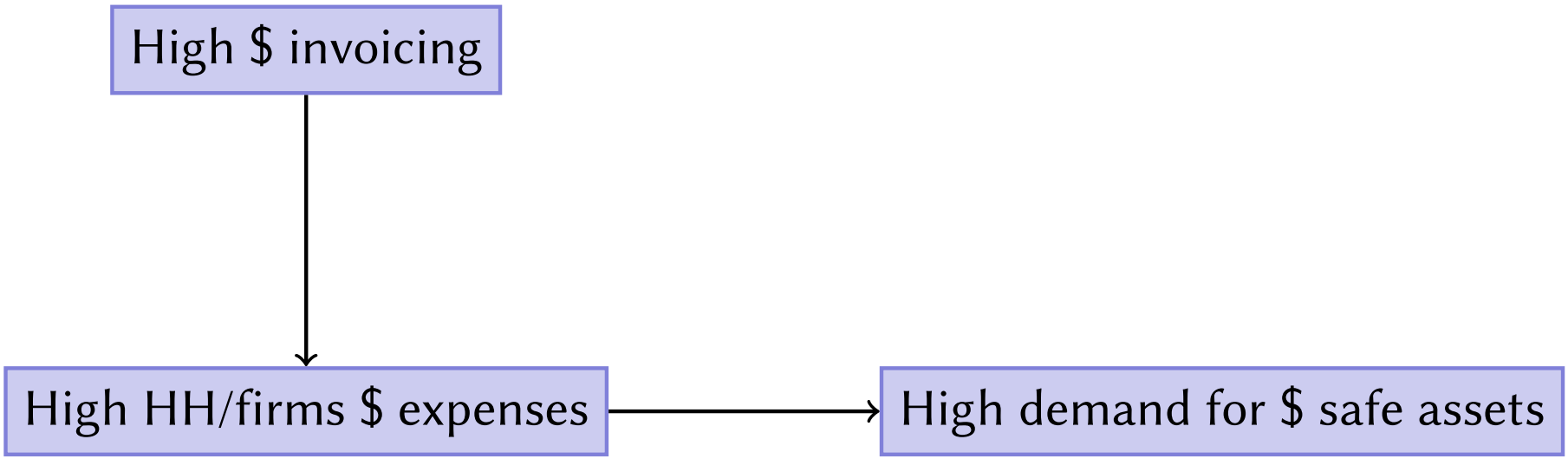
High $ invoicing
High HH/firms $ expenses
High demand for $ safe assets

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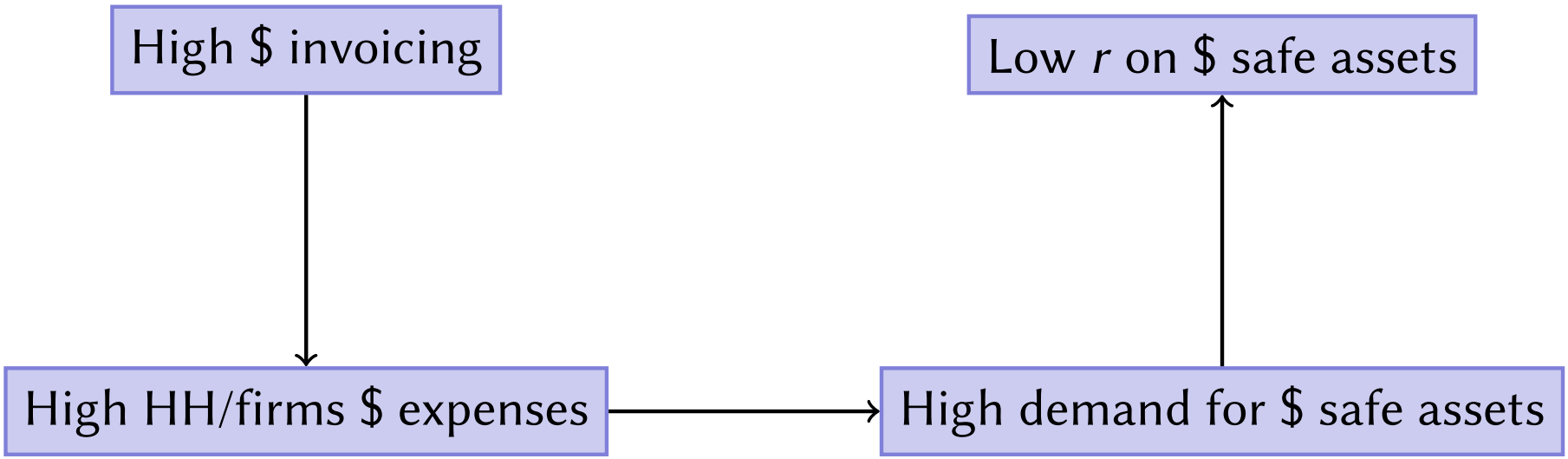
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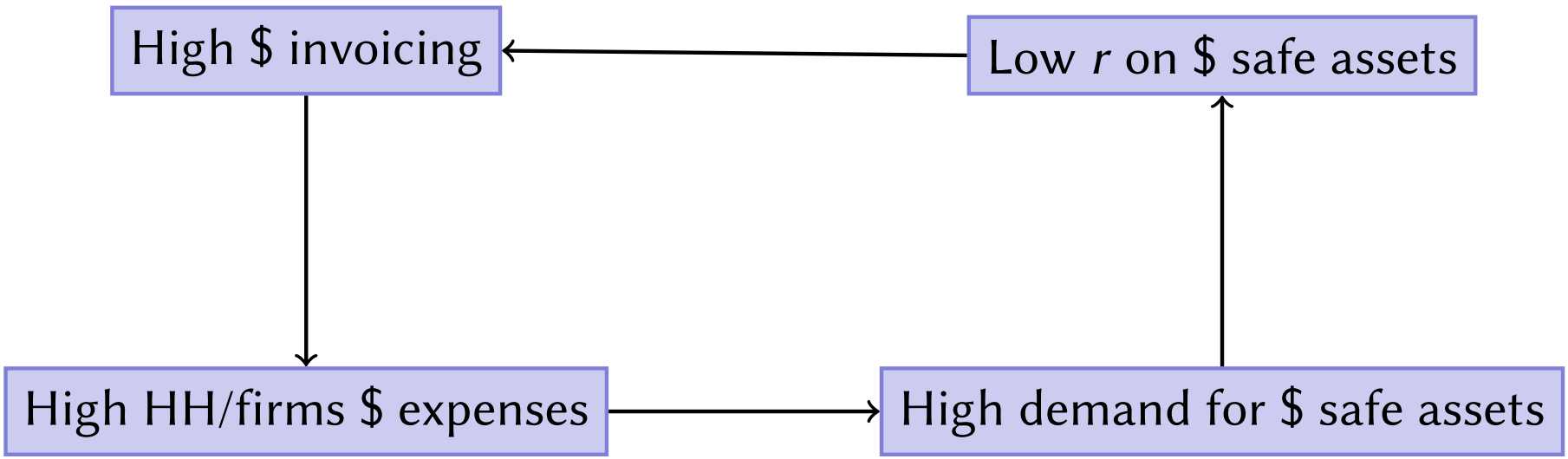
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Outline of Talk

Full model: US, Euro Area, continuum of emerging markets

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   - Single EM and US
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4) Emergence of single dominant currency
   - Continuum of EMs, US and Euro

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Some cross-country evidence

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- Two countries: *U.S* and an *EM*.
- Two dates: 0 and 1
- Two agents: “Importers/Savers” and “Banks/Borrowers”

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- Importers

$$\max_{C_0, D_h, D_\$, A_R} C_0 + \beta \mathbb{E}_0 W_1 + \theta \log(M), \tag{P1}$$

subject to:

$$C_0 \leq W_0 - Q_h D_h - \mathcal{E}_0 Q_\$ D_\$ - Q_R A_R$$

$$W_1 = D_h + \mathcal{E}_1 D_\$ + \xi A_R,$$

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- Preference for safe "money-like" assets, $\theta > 0$

$$M = \left(D_h^{\alpha_h} D_\$^{\alpha_\$} \right)^{\frac{1}{\alpha_h + \alpha_\$}}$$

  - Krishnamurthy and Vissing-Jorgensen (2012), Stein (2012), Sunderam (2014), Greenwood, Hanson and Stein (2015), Nagel (2016)
  - price in invoice currency set at time 0 and sticky through time 1

Model: Exogenous invoicing go

$$Q_h = \beta + \theta \frac{\alpha_h}{(\alpha_h + \alpha_\$) D_h}$$

$$Q_\$ = \beta + \theta \frac{\alpha_\$}{(\alpha_h + \alpha_\$) D_\$}$$

$$Q_R = \beta$$

- $\mathbb{E}_0(\mathcal{E}_1) = \mathcal{E}_0 = 1; \mathbb{E}_0(\xi) = 1$

Model: Exogenous invoicing and banking market structure

- *EM* Banks (agglomeration of banks and borrowing firms)
- *N* local currency *risky* projects

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$$\max_{B_h, B_\$, B_R} \mathbb{E}_0 \left[\gamma N - B_h - \mathcal{E} B_\$ - \xi B_R \right]$$

subject to,

$$Q_h B_h + Q_\$ B_\$ + Q_R B_R \geq N$$
$$\bar{\mathcal{E}} B_\$ + B_h \leq \gamma_L N$$

- Limits to safe asset creation
  - γ_L: Worst case payout of project
  - $\bar{\mathcal{E}}$: Worst case value of EM currency
- Comparative disadvantage in manufacturing dollar safe claims
- $\mathbb{E}_0 \gamma = 1, \mathbb{E}_0 \xi = 1$

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- UIP Violation & Exorbitant Privilege: $Q_{\$} > Q_h > Q_R$

$$\frac{Q_{\$} - \beta}{Q_h - \beta} = \bar{\mathcal{E}}$$

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- Market clearing

$$D_\$ = B_\$ + \underbrace{X_\$}_{exogenous, US} \qquad D_h = B_h$$

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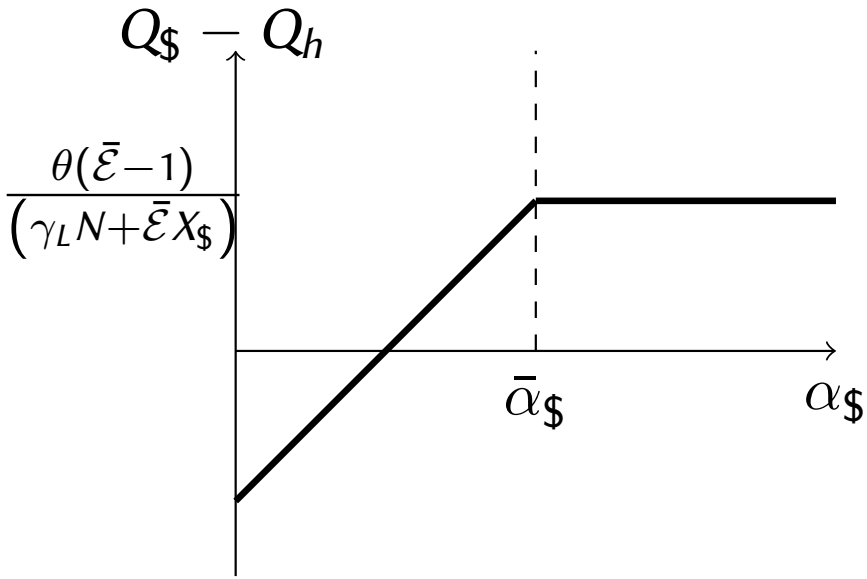
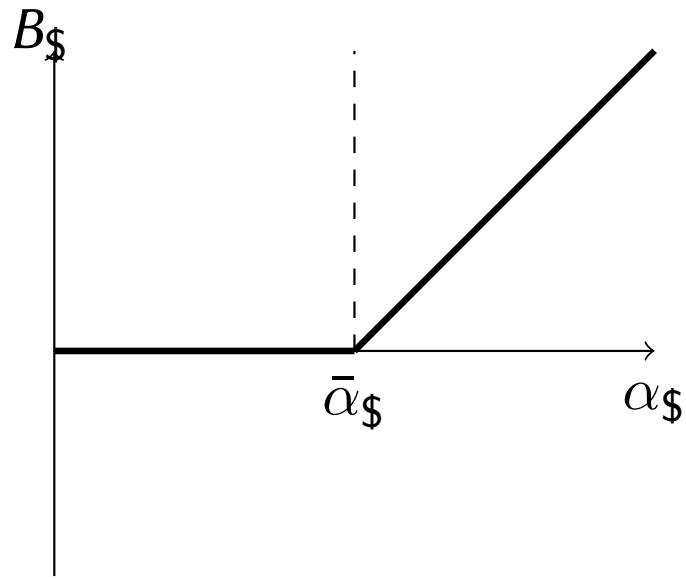
- 'Walking up a supply curve'

$$\begin{aligned}
D_h &= \frac{\alpha_h}{\alpha_\$ + \alpha_h}\left(\gamma_L N + \bar{\mathcal{E}} X_\$\right) \\
D_\$ &= \frac{\alpha_\$}{\alpha_\$ + \alpha_h}\frac{\left(\gamma_L N + \bar{\mathcal{E}} X_\$\right)}{\bar{\mathcal{E}}} > X_\$ \\
Q_h &= \beta + \frac{\theta}{\left(\gamma_L N + \bar{\mathcal{E}} X_\$\right)} \\
Q_\$ &= \beta + \frac{\theta \bar{\mathcal{E}}}{\left(\gamma_L N + \bar{\mathcal{E}} X_\$\right)}
\end{aligned}$$

Model: Invoicing Shares, UIP Deviations, Dollar Borrowing



(a) $Q_\$ - Q_h$



(b) $B_\$$

$$\bar{\alpha_\$} = \frac{\alpha_h \bar{\mathcal{E}} X_\$}{\gamma_L N}$$

High dollar invoicing $\Longrightarrow$ low return on safe dollar claims

Outline of Talk

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2) Endogenous invoicing
3) Strategic complementarity, Multiple Equilibria
4) Emergence of single dominant currency

Model: Endogenous Invoicing

- Invoice fraction η of N in dollars (exports)

$$\max_{B_h, B_\$, B_R, \eta} \mathbb{E}_0 \left[\gamma N_0 + \gamma(1-\eta)N + \mathcal{E}\gamma\eta N - B_h - \mathcal{E} B_\$ - \xi B_R - \frac{\phi}{2} N\eta^2 \right]$$

subject to,

$$\begin{aligned} Q_h B_h + Q_\$ B_\$ + Q_R B_R &\geq N + N_0 \\ \bar{\mathcal{E}} B_\$ + B_h &\leq \gamma_L N_0 + (1-\eta)\gamma_L N + \bar{\mathcal{E}}\eta\gamma_L N \\ B_h &\leq \gamma_L N_0 + (1-\eta)\gamma_L N \end{aligned}$$

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- Comparative disadvantage in manufacturing \$ safe claims
  - Currency mismatch: $\bar{\mathcal{E}}$
  - Invoicing costs: $\frac{\phi}{2}\frac{(\eta N)^2}{N}$; Proxies for risk-aversion of ultimate owners of exporting firms.

Model: Endogenous Invoicing Shares

- Dollar premium (DP):

$$Q_{\$} - Q_h = \beta \left(\mu(\eta)(\bar{\mathcal{E}} - 1) - \kappa \right)$$

- Invoicing choice (IC):

$$\eta = \frac{\gamma_L}{\beta \phi} \left(Q_{\$} - Q_h \right)$$

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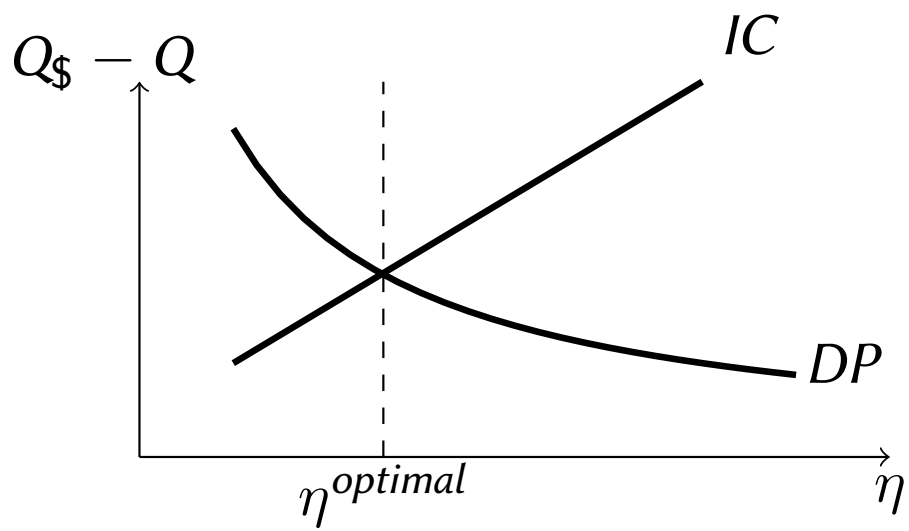

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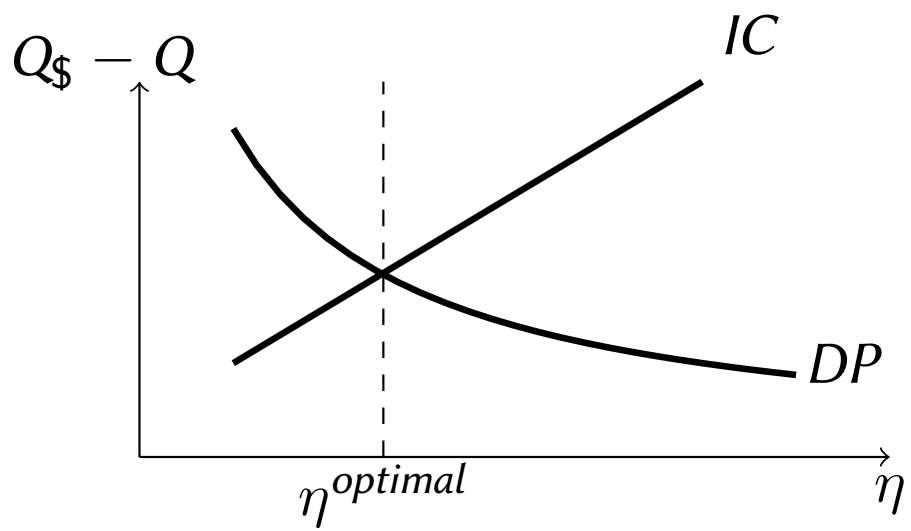
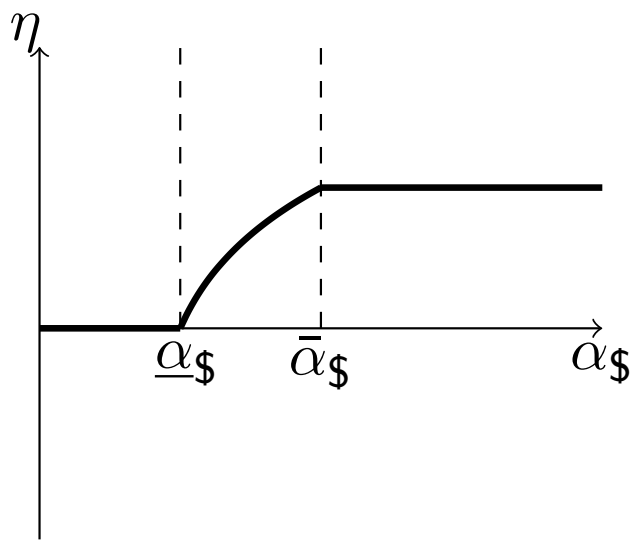
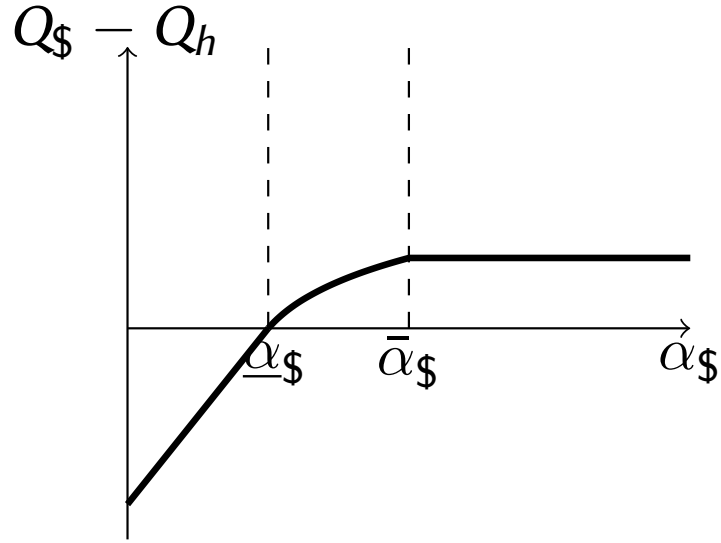


- Why invoice in dollars? To access cheap dollar financing
  - Contrast with arguments based on optimal degree of cost pass-through into prices

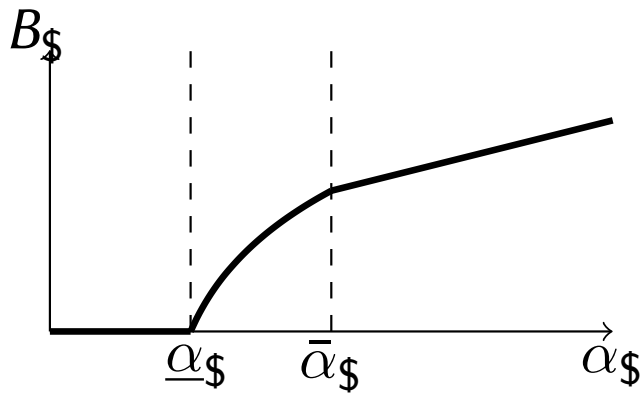
Equilibrium Values As Dollar Invoice Share Varies



(c) Dollar Invoicing



(d) Exorbitant Privilege



(e) Dollar Borrowing

Why Invoicing Relevant if Exporters Can Hedge?

- Invoicing bundles goods-pricing with risk management.
- Why not unbundle?
  - To hedge FX risk need to post collateral, reduces real investment
    - Rampini and Viswanathan (2010, 2013, 2017), Rampini, Sufi and Viswanathan (2014), Rampini, Viswanathan and Vuillemey (2017)

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2) Endogenous invoicing
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Endogenous Invoice Shares and Multiple Equilibria

- Continuum of EMs and US
- Safe asset demand only in own local currency and in dollars

$$M_i = \left(D_{hi}^{\alpha_{hi}} D_{\$i}^{\alpha_{\$i}}\right)^{\frac{1}{\alpha_{hi}+\alpha_{\$i}}}$$

- Invoicing decisions in j effect invoicing shares in i

$$\alpha_{\$i} \equiv a + b \int_{j \neq i} \eta_j dj$$

- $a > 0$: share of U.S. goods
- $b > 0$: share of goods from other EMs; $a + b < 1$

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High η_j

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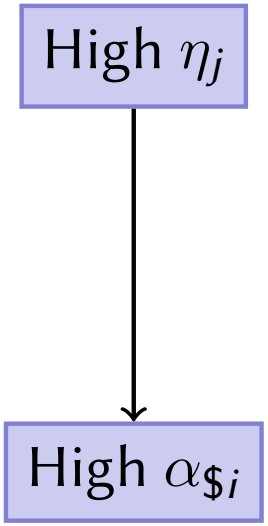

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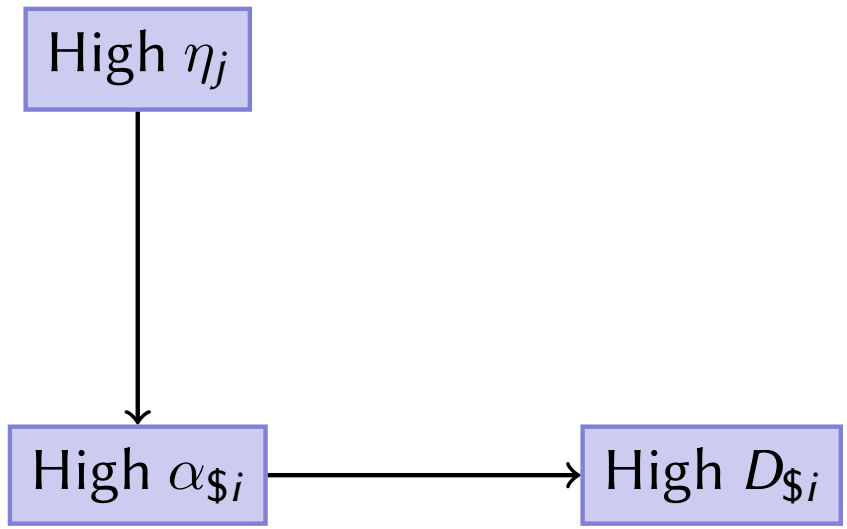

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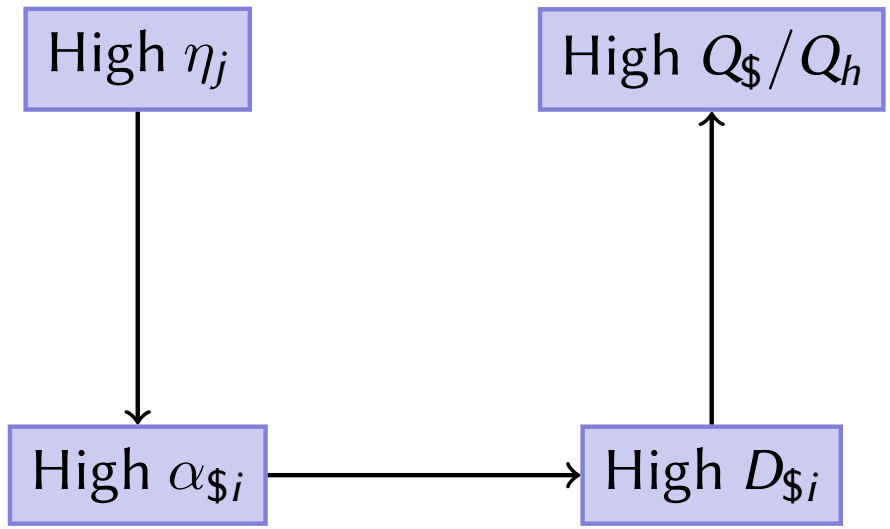

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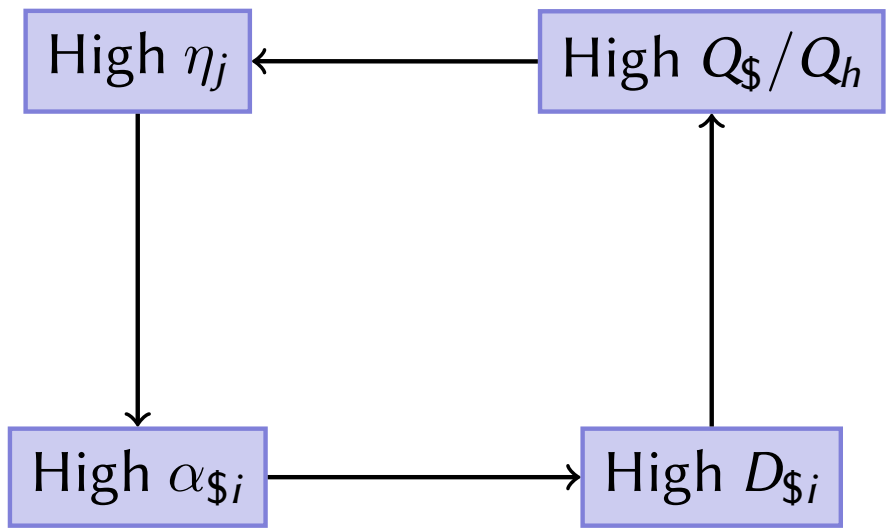
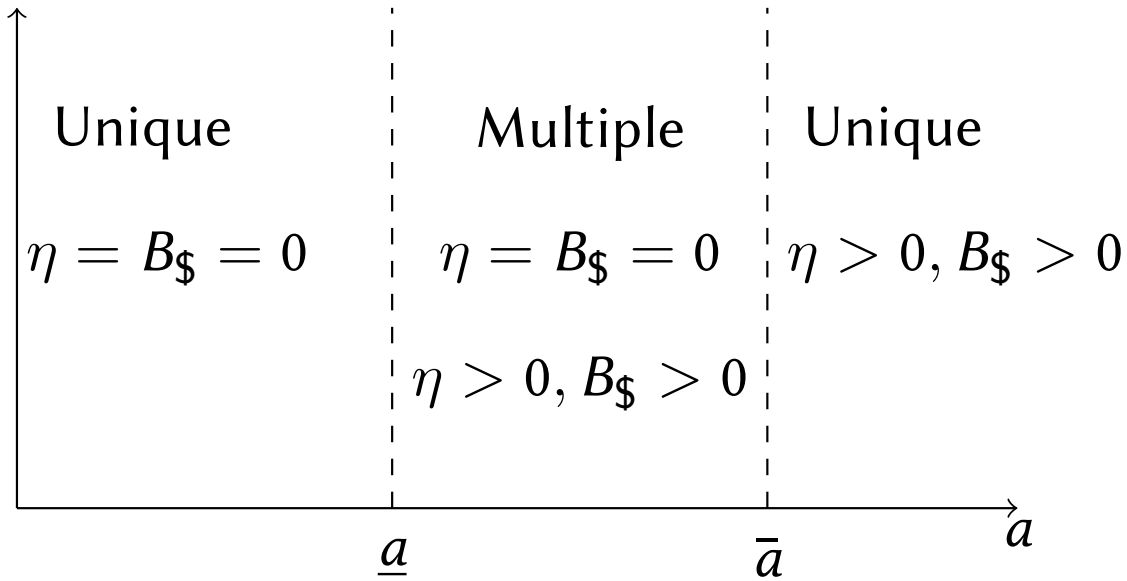
- Strategic complemetarities: b



Simultaneous determination of invoicing and banking

- Integrated markets for dollar deposits, segmented markets for EM currencies.
- Multiple Equilibria with varying degrees of dollar invoicing

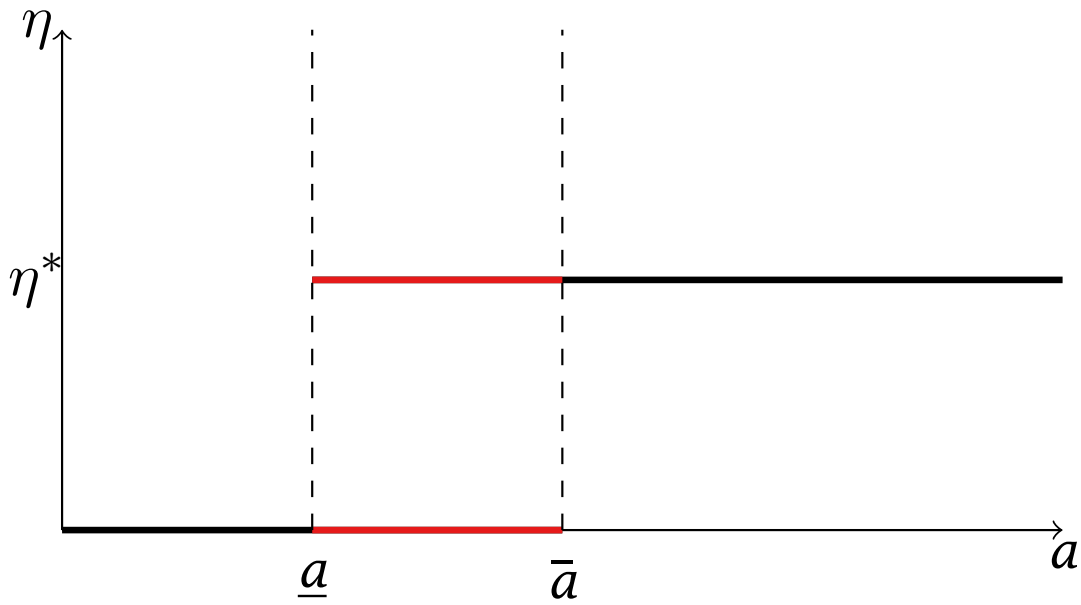


$$\underline{a} \equiv \frac{\alpha_h \bar{\mathcal{E}} \left(\eta^* \gamma_L N + X_\$\right)}{\gamma_L N_0 + (1-\eta^*)\gamma_L N} - b\eta^* \qquad \bar{a} \equiv \frac{\alpha_h X_\$}{\gamma_L (N_0 + N)}$$

$$b > \frac{1}{\eta^*}\left(\frac{\alpha_h \bar{\mathcal{E}} \left(\eta^* \gamma_L N + X_\$\right)}{\gamma_L N_0 + (1-\eta^*)\gamma_L N} - \frac{\alpha_h X_\$}{\gamma_L (N_0 + N)}\right)$$

Simultaneous determination of invoicing and banking

- Multiple Equilibria with varying degrees of dollar invoicing



Simultaneous determination of invoicing and banking

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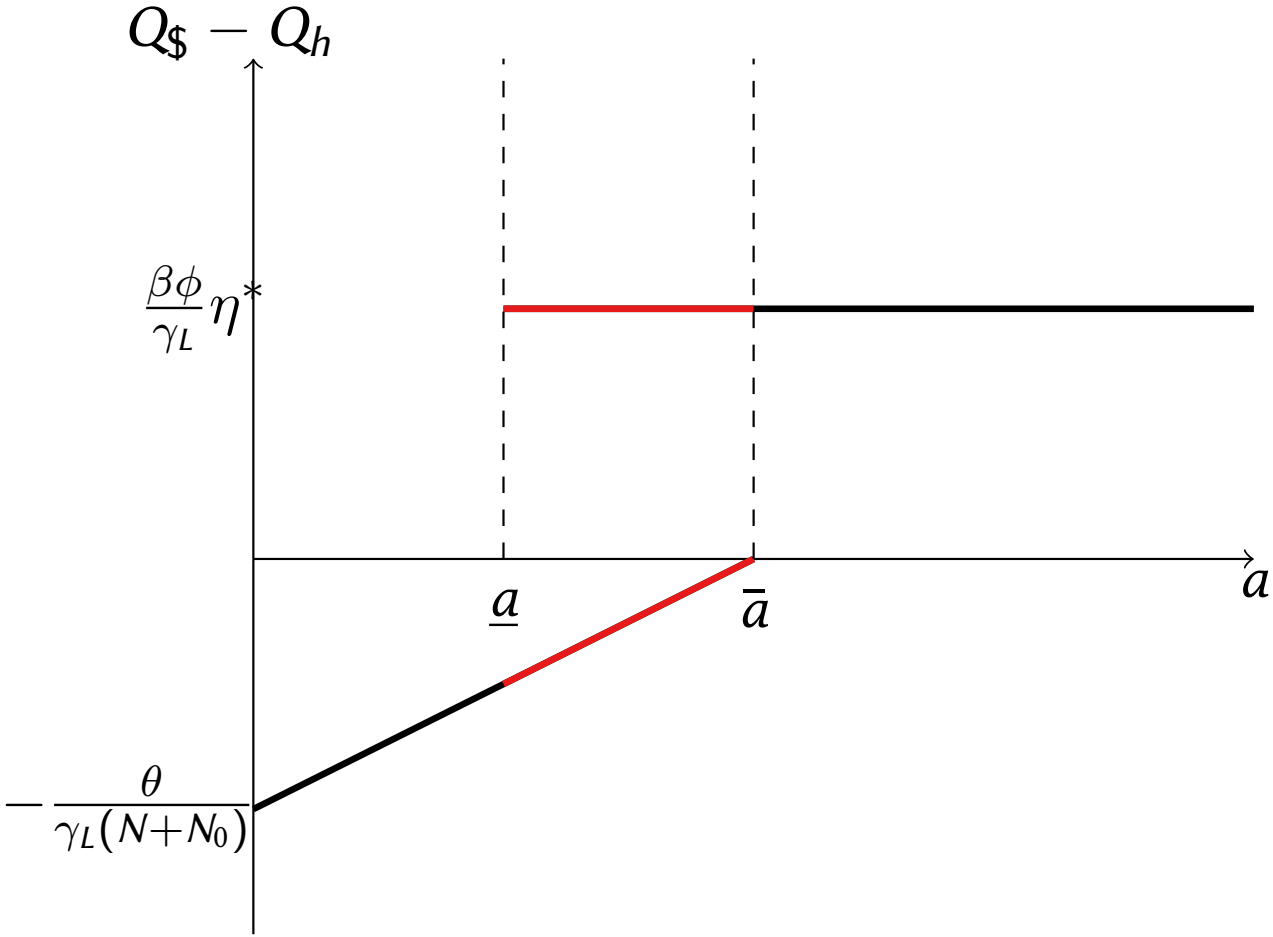

Outline of Talk

1) Exogenous invoicing
2) Endogenous invoicing
3) Strategic complementarity, Multiple Equilibria
4) Emergence of single dominant currency

Dollar vs. Euro: Emergence of a dominant currency

- Two global currencies: Dollar and Euro

Dollar vs. Euro: Emergence of a dominant currency

- Two global currencies: Dollar and Euro
- EM Importers/Savers

$$M_i = \left(D_{hi}^{\alpha_{hi}} D_{\$i}^{\alpha_{\$i}} D_{€i}^{\alpha_{€i}} \right)^{\frac{1}{\sum \alpha_i}}$$

$$\alpha_{\$i} = a + b \int_{j \neq i} \eta_{\$j} dj \qquad \alpha_{€i} = a + b \int_{j \neq i} \eta_{€j} dj$$

Dollar vs. Euro: Emergence of a dominant currency

- Two global currencies: Dollar and Euro
- EM Importers/Savers

$$M_i = \left(D_{hi}^{\alpha_{hi}} D_{\$i}^{\alpha_{\$i}} D_{€i}^{\alpha_{€i}}\right)^{\frac{1}{\sum \alpha_i}}$$

$$\alpha_{\$i} = a + b \int_{j \neq i} \eta_{\$j} dj \qquad \alpha_{€i} = a + b \int_{j \neq i} \eta_{€j} dj$$

- Symmetry: $\bar{\mathcal{E}}_{€i} = \bar{\mathcal{E}}_{\$i} = \bar{\mathcal{E}}$
- Integrated markets for dollar and euro deposits

Dollar vs. Euro: Emergence of a dominant currency

- EM Banks

$$\max \mathbb{E}_0[\gamma(N_0 + N) + \gamma N \eta_{\$i}(\mathcal{E}_{\$i,1} - 1) + \gamma N \eta_{€i}(\mathcal{E}_{€i,1} - 1) - B_{hi} - \mathcal{E}_{\$i,1} B_{\$i} - \mathcal{E}_{€i,1} B_{€i} - \xi B_{Ri} - \frac{\phi}{2} N(\eta_{\$i}^2 + \eta_{€i}^2 + 2c\eta_{\$i}\eta_{€i})]$$

subject to,

$$Q_h B_{hi} + Q_\$ B_{\$i} + Q_€ B_{€i} + Q_{Ri} B_{Ri} \geq N + N_0$$

$$\bar{\mathcal{E}}(B_{\$i} + B_{€i}) + B_i \leq \gamma_L(N_0 + (1 - \eta_{\$i} - \eta_{€i})N) + (\eta_{\$i} + \eta_{€i})\bar{\mathcal{E}}\gamma_L N$$

$$B_i \leq \gamma_L(N_0 + (1 - \eta_{\$i} - \eta_{€i})N)$$

Dollar vs. Euro: Emergence of a dominant currency

- EM Banks

$$\max \mathbb{E}_0[\gamma(N_0 + N) + \gamma N \eta_{\$i}(\mathcal{E}_{\$i,1} - 1) + \gamma N \eta_{\in i}(\mathcal{E}_{\in i,1} - 1) - B_{hi} - \mathcal{E}_{\$i,1} B_{\$i} - \mathcal{E}_{\in i,1} B_{\in i} - \xi B_{Ri} - \frac{\phi}{2} N(\eta_{\$i}^2 + \eta_{\in i}^2 + 2c\eta_{\$i}\eta_{\in i})]$$

subject to,

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$$B_i \leq \gamma_L(N_0 + (1 - \eta_{\$i} - \eta_{\in i})N)$$

- $\bar{\mathcal{E}}_\in = \bar{\mathcal{E}}_\$ = \bar{\mathcal{E}}$
- Integrated markets for dollar and euro deposits, segmented markets for EM currencies.

Dollar vs. Euro: Emergence of a dominant currency

- Invoicing decision

$$\eta_{\$i} = \frac{\gamma_L}{\beta\phi}(Q_{\$} - Q_{hi}) - c\eta_{€i}$$
$$\eta_{€i} = \frac{\gamma_L}{\beta\phi}(Q_{€} - Q_{hi}) - c\eta_{\$i}$$

- Market-clearing:

$$\begin{aligned} D_{hi} &= B_{hi} \qquad \forall i \\ A_{Ri} &= B_{Ri} \qquad \forall i \\ \int_i D_{\$i} &= \int_i B_{\$i} + X \\ \int_i D_{€i} &= \int_i B_{€i} + X \end{aligned}$$

Dollar vs. Euro: Emergence of a dominant currency

- Three possible equilibria
  - No global currency (symmetric)
    - $\eta_{\$} = \eta_{€} = 0, B_{\$} = B_{€} = 0$
  - Single/dominant global currency (asymmetric)
    - $\eta_{\$} > 0, \eta_{€} = 0, B_{\$} > 0, B_{€} = 0$
  - Multiple global currencies (symmetric)
    - $\eta_{\$} > 0, \eta_{€} > 0, B_{\$} > 0, B_{€} > 0$

Dollar vs. Euro: Emergence of a dominant currency

- Single/dominant global currency
  - sufficient safe-asset demand to sustain one global currency, but not two

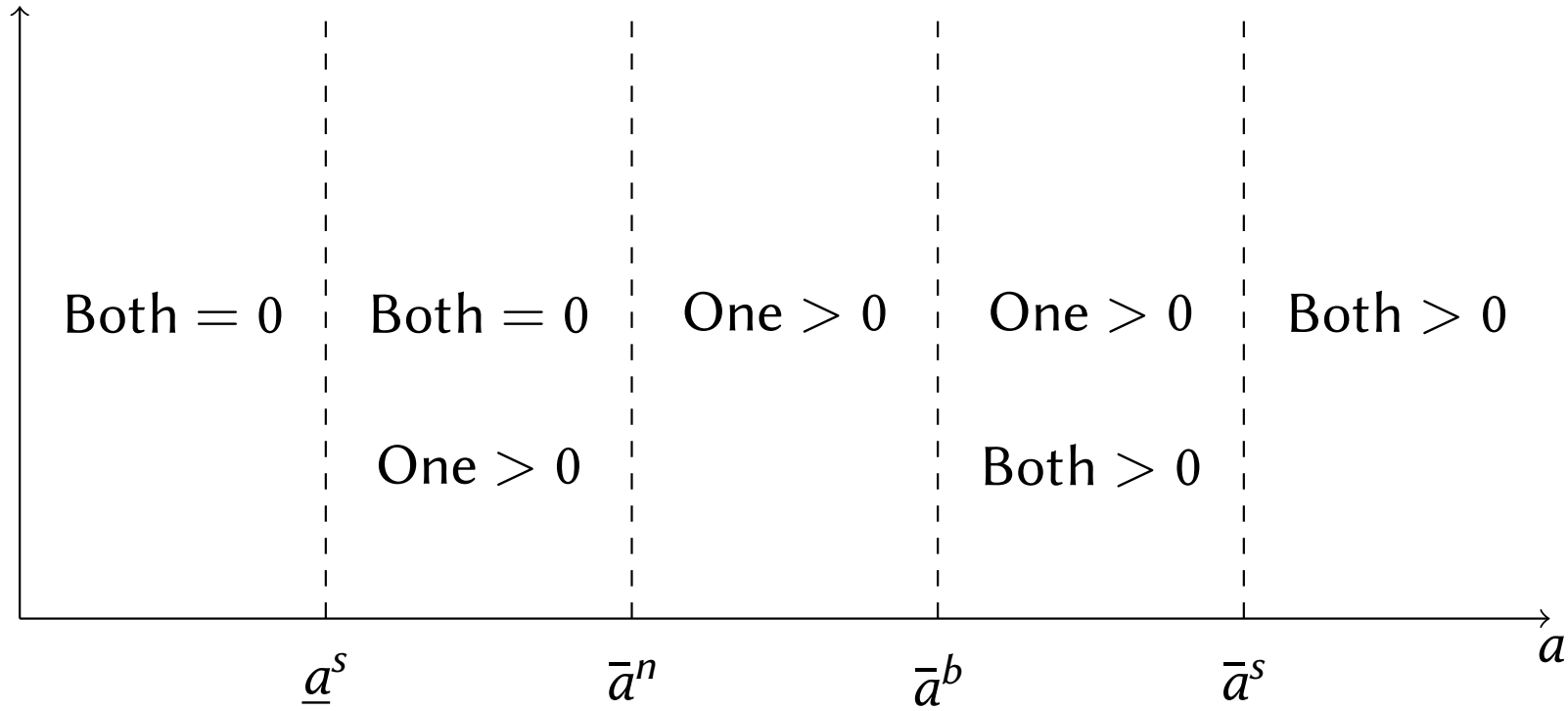
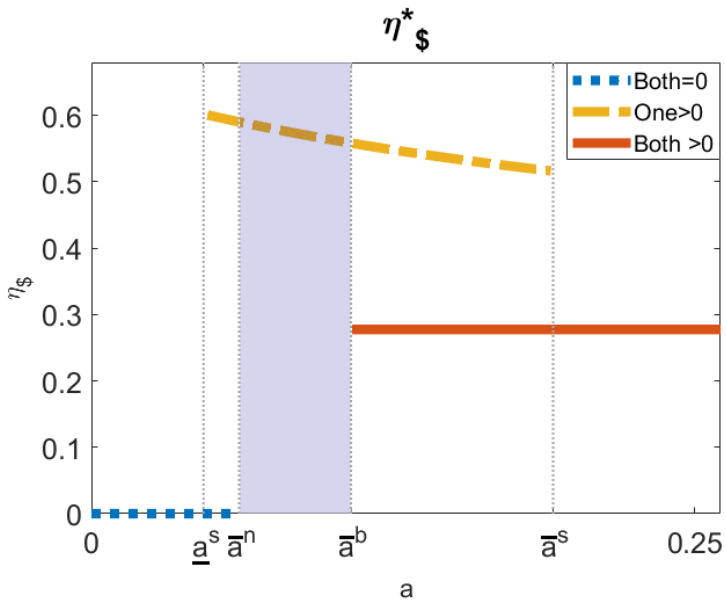
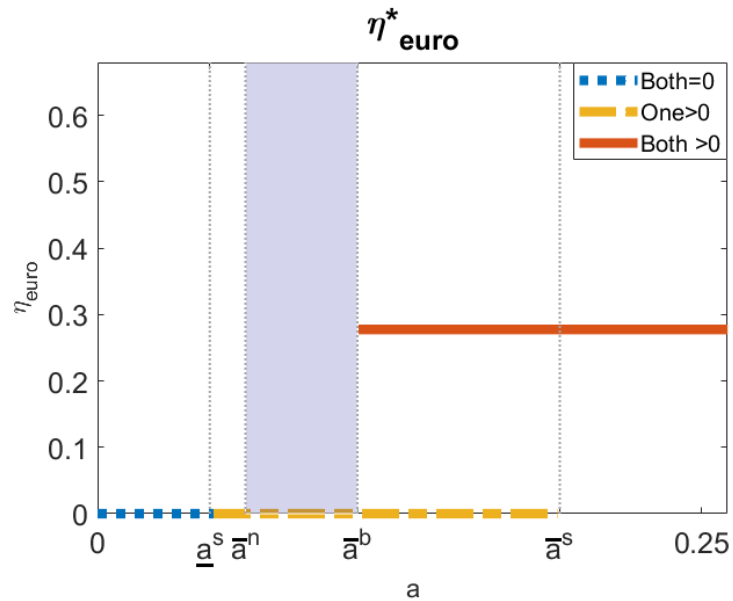


Figure: Equilibria supported as a function of 'a'

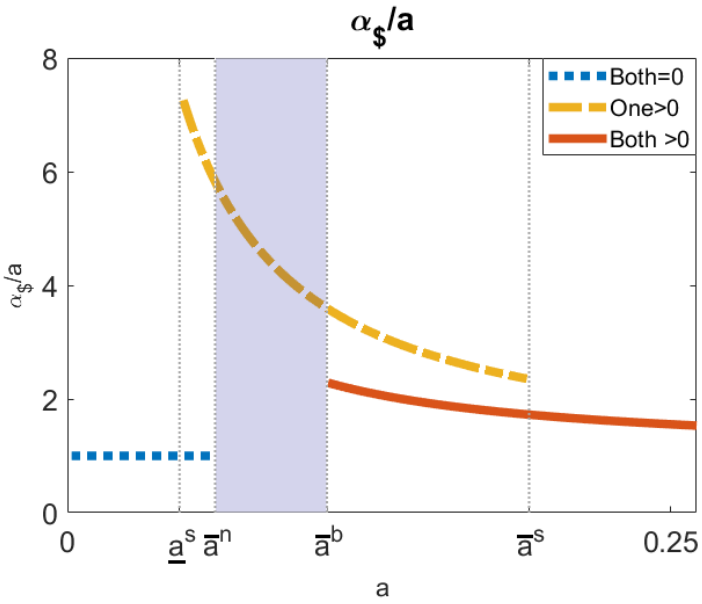
Numerical Example

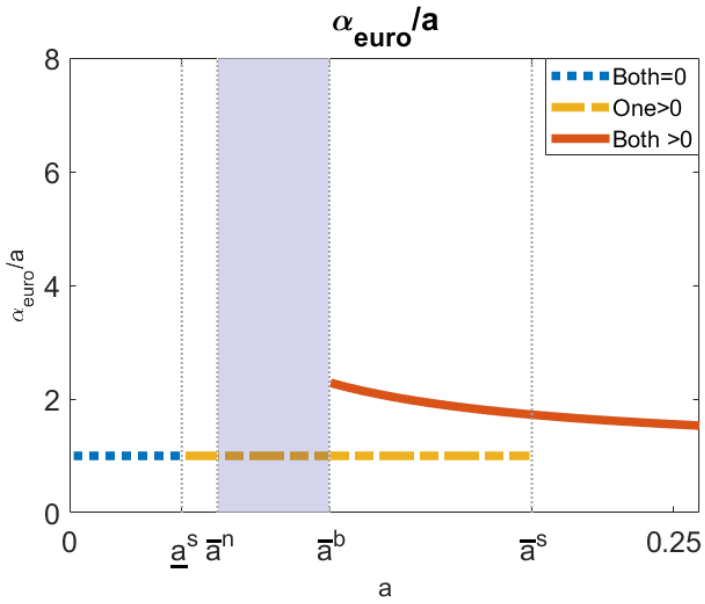
Parameter	N	N_0	X	α_h	ϕ	θ	β	γ_L	$\bar{\mathcal{E}}$	b	c
Value	7	7	3	0.2	0.1	1.4	0.8	0.7	2	0.5	0.8



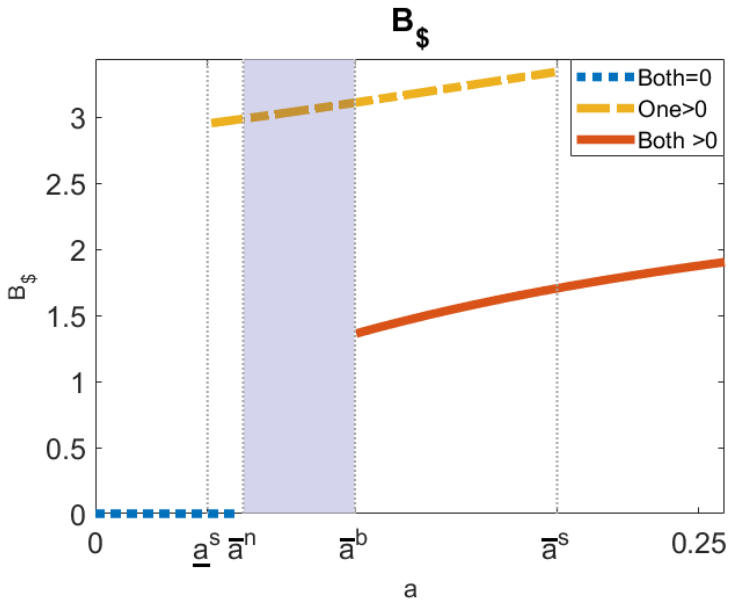


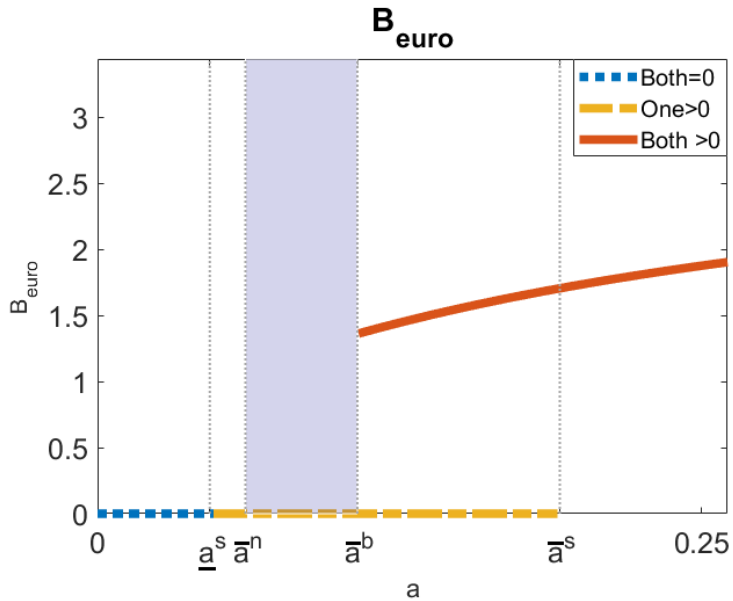
Dominance in Trade Invoicing



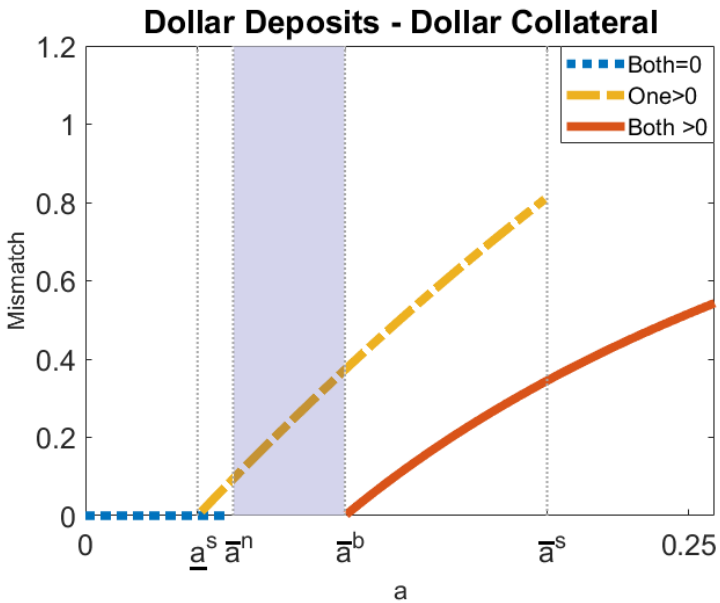


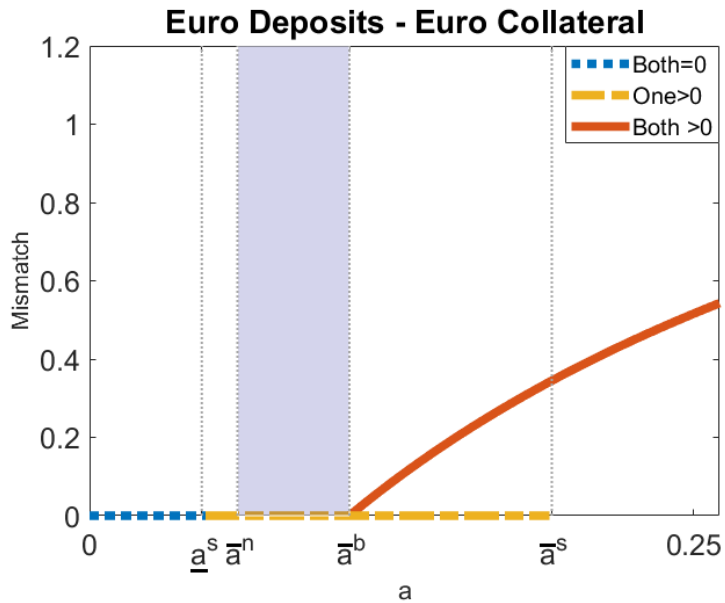
Dominance in Banking



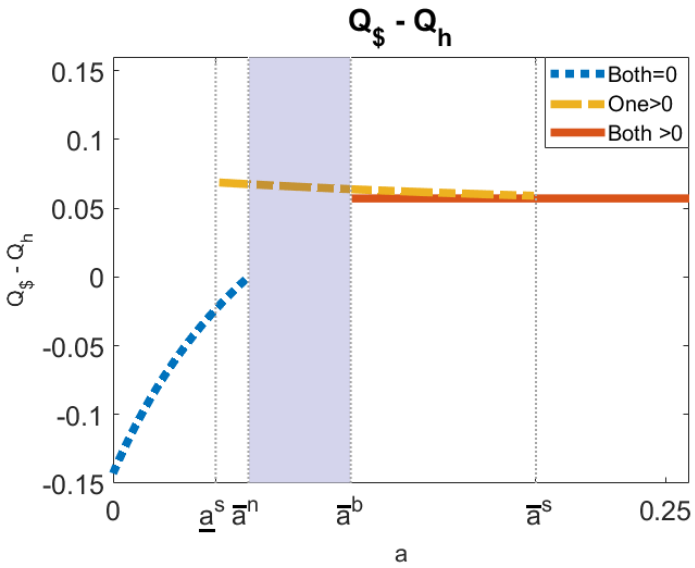


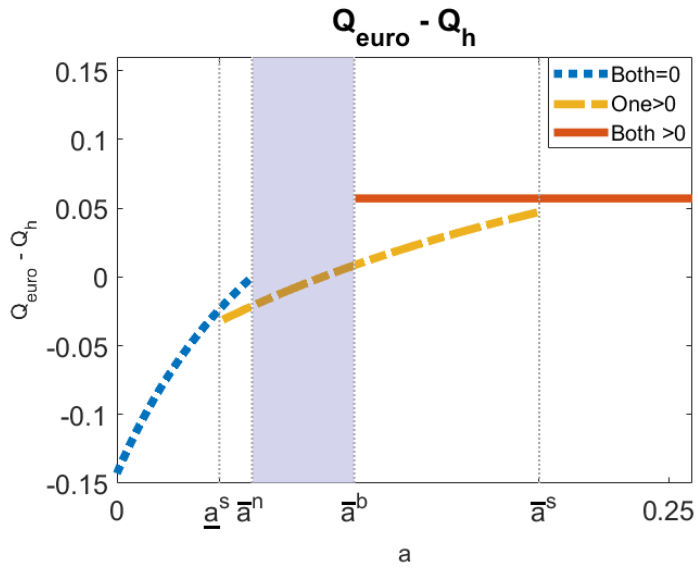
Currency Mismatch





Exorbitant Privilege





Comments

- Which currency dominates? The role of history
  - Pre-1999, $a_{\$} >> a_{€}$, Dollar only dominant currency
  - Post-1999, closer in size, but history picks the dollar
  - Can take a long time to reverse

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- Why dollarization of central bank reserves?
  - Lender of last resort of banks
  - Central bank asset mix mirrors commercial banks liability structure
  - Obstfeld, Shambaugh and Taylor (2010)

Data: Relation between trade invoicing and bank liabilities

$$\frac{D_{\$,i}}{D_{€,i}} = \frac{\alpha_{\$,i}}{\alpha_{€,i}} \cdot \frac{Q_{€} - \beta}{Q_{\$} - \beta}$$

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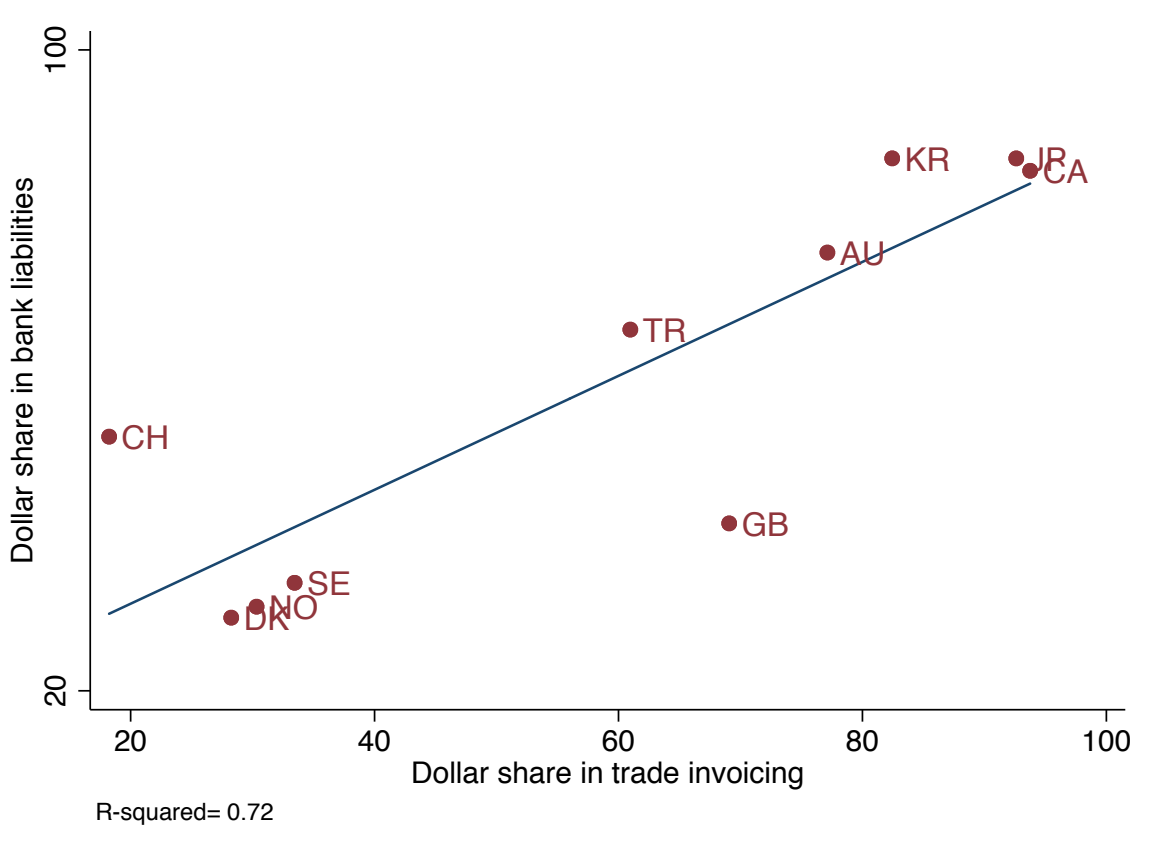
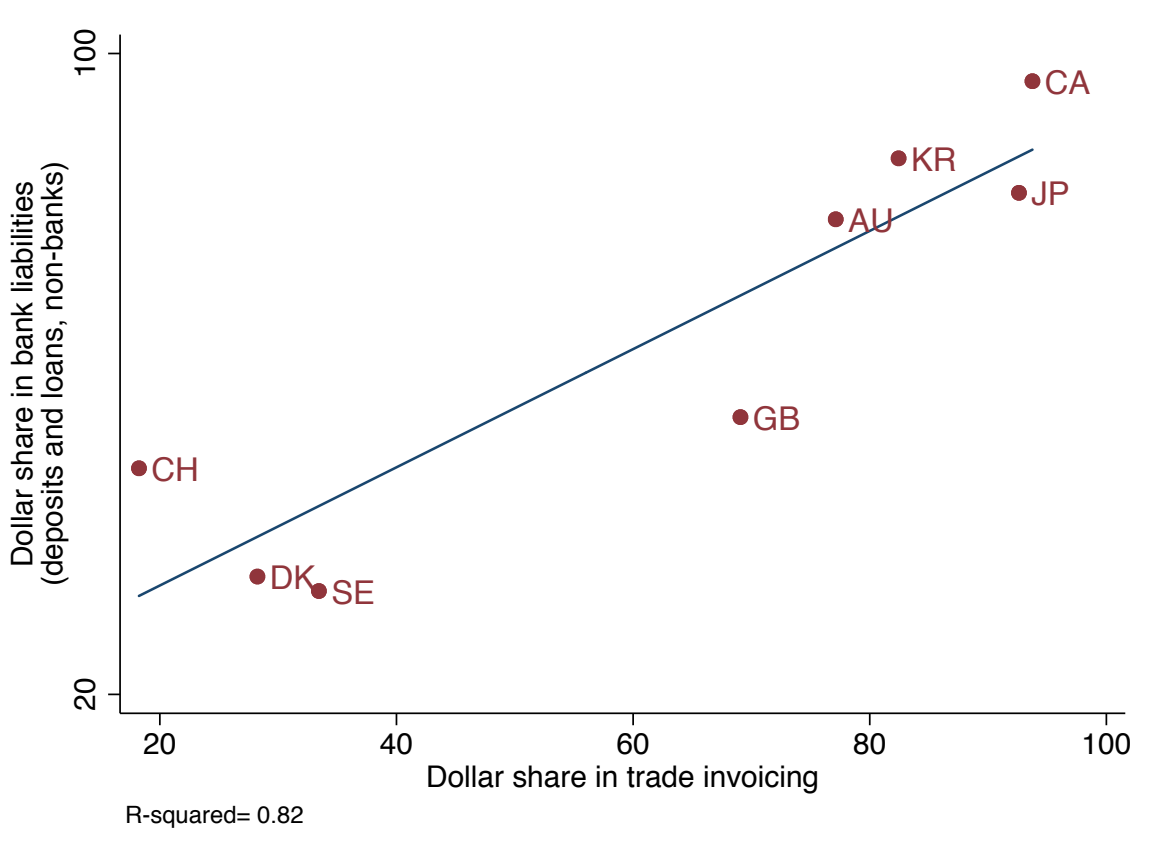


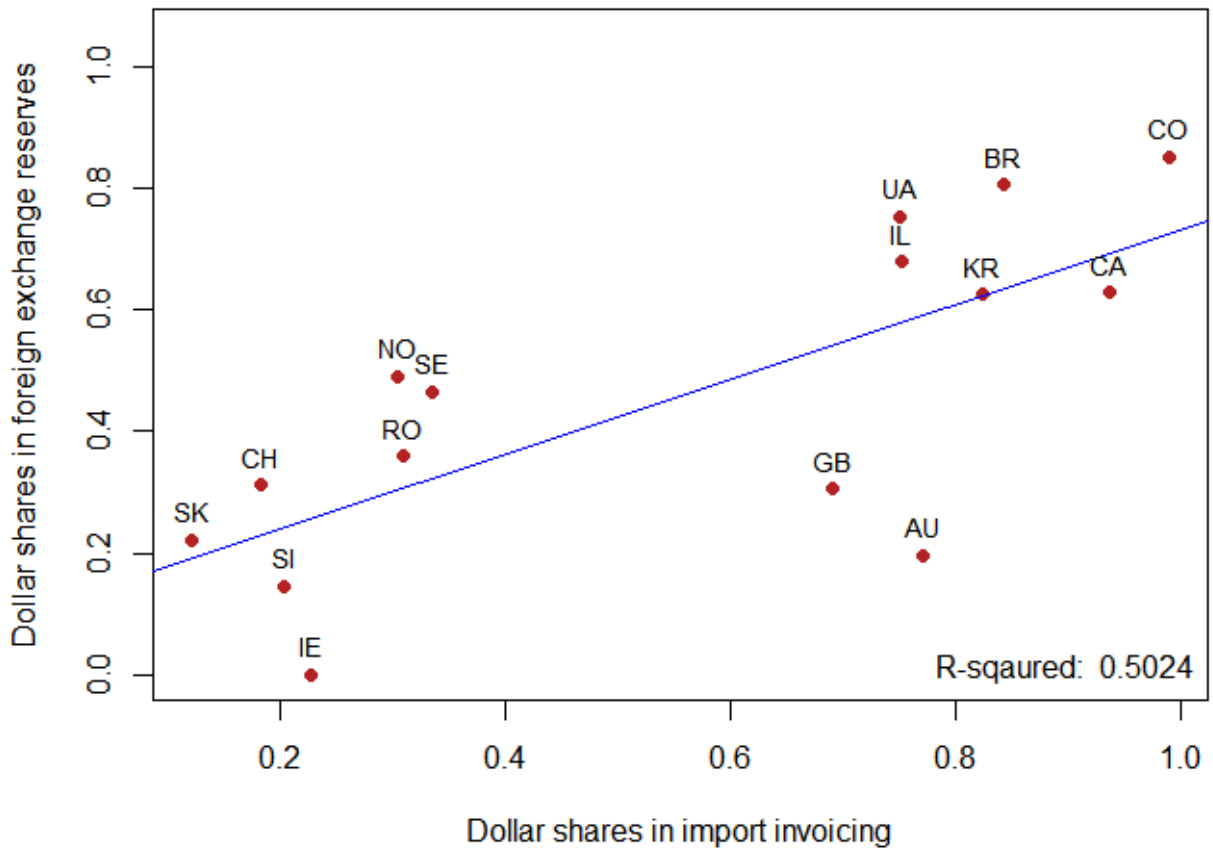
BIS Locational Banking Statistics, Local Liabilities

Data: Relation between trade invoicing and bank liabilities



BIS Locational Banking Statistics, Local liabilities

Data: Relation between trade invoicing and central bank reserves



IMF, Wong (2007), Gopinath & Stein (2018, AER P&P)

Conclusion

1. Unified theory for dominance in trade invoicing *and* finance
   - Invoice in dollars because dollar financing cheap
   - Dollar financing cheap because of invoicing in dollars
2. Strategic complementarity of unit of account and store of value
3. Dominant currency, despite multiple candidates
4. 'Currency mismatch' and 'exorbitant privilege'

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China's Renminbi

- Share as settlement currency: 0% in 2010, 25% in 2015
- Second most widely used currency in global trade finance

Micro-foundation for P1

back

- Risk-Neutral Investors:

$$\max_{C_0^n, C_1^n, D_h^n, D_\$^n, A_R^n} C_0^n + \beta \mathbb{E}_0 C_1^n, \tag{P2}$$

subject to:

$$C_0^n \leq W_0^n - Q_h D_h^n - \mathcal{E}_0 Q_\$ D_\$^n - Q_R A_R^n$$
$$C_1 = D_h^n + \mathcal{E}_1 D_\$^n + \xi A_R^n,$$

$$D_h^n = D_\$^n = 0 \qquad \text{if} \qquad \begin{array}{r} Q_R = \beta, A_R > 0 \\ Q_h > \beta, Q_\$ > \beta \end{array}$$

Micro-foundation for P1 back

- Risk-Averse Importers:

$$\max_{C_1, D_h, D_\$} \mathbb{E}_0 U(C_1), \tag{P3}$$

subject to:

$$W \geq Q_h D_h - \mathcal{E}_0 Q_\$ D_\$$$
$$P_1 C_1 \leq D_h + \mathcal{E}_1 D_\$,$$

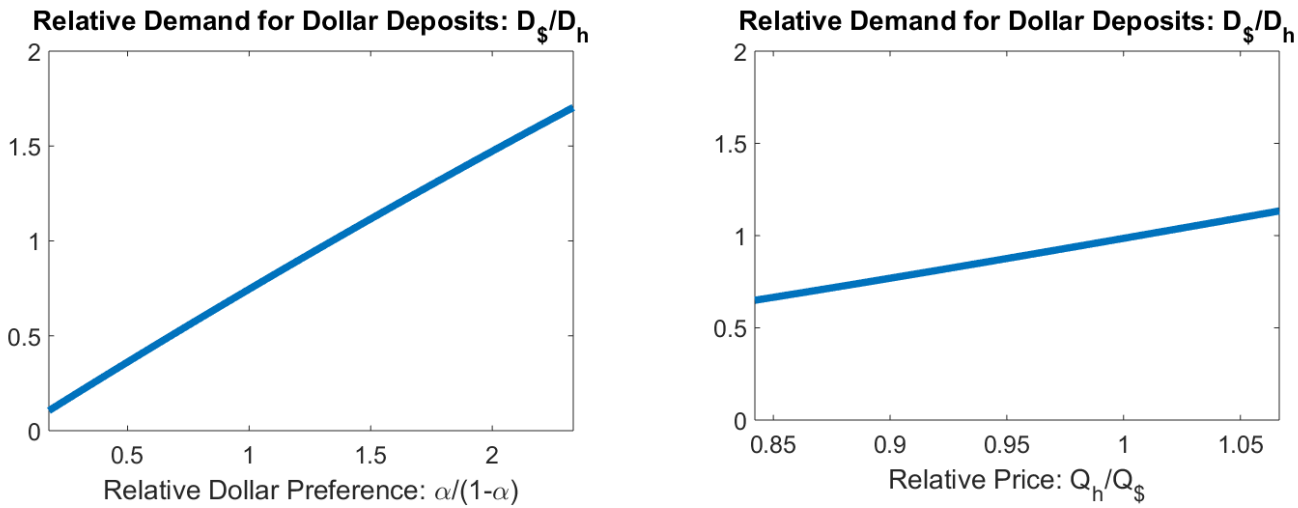
where the consumption aggregator and price level are given by,

$$C = C_h^{1-\alpha} C_\$^{\alpha} \qquad P = \frac{P_h^{1-\alpha} (\mathcal{E}_1 P_\$)^{\alpha}}{\alpha^{\alpha}(1-\alpha)^{1-\alpha}} = \frac{\mathcal{E}_1^{\alpha}}{\alpha^{\alpha}(1-\alpha)^{1-\alpha}} = \nu \mathcal{E}_1^{\alpha}$$

and $\alpha = \frac{\alpha_\$}{\alpha_h + \alpha_\$}$

Micro-foundation for P1

back

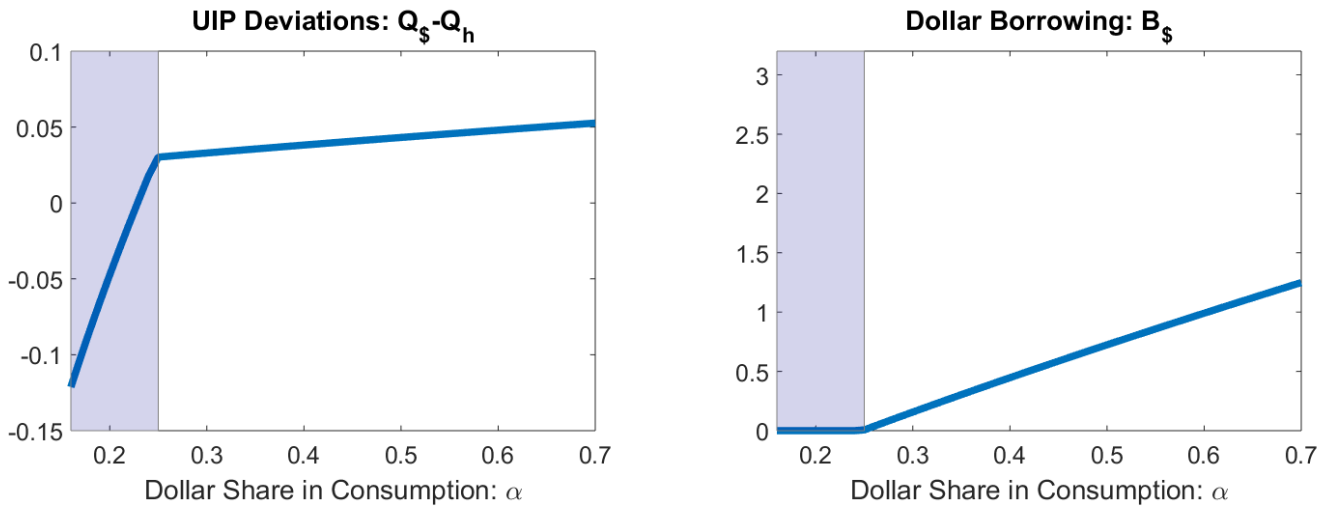


(a) (b)

Figure: Relative demand for dollar deposits (in partial equilibrium)

Micro-foundation for P1

back



(a) (b)

Figure: Full equilibrium