Collateral Advantage: Exchange Rates, Capital Flows, and Global Cycles

Michael B. Devereux

UBC

Charles Engel

U Wisconsin

Steve Pak Yeung Wu

UCSD

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Motivation

- A large recent literature has focused on the liquidity yield or "**convenience yield"** of short-term U.S. government bonds (Krishnamurthy, Vissing Jorgensen 2012)
- The expected return on U.S. government bonds is **lower** than corresponding rates for government bonds from other advanced countries

- Strong empirical evidence support a relationship of "**convenience yield"** of government bonds and exchange rate movements

Engel and Wu (REStud Forthcoming), Jiang, Lustig, Krishnamurthy (JF 2021)

- Many models of the convenience yield are not strongly microfounded

  (e.g., bonds in the utility function, ad-hoc wedges)
- But microfoundations can **matter**!

Goal

- A model with endogenous convenience yield that suits to study exchange rate and external position of the US

1. Exchange rate and convenience yield in **normal times**

2. **Long term** external position of the US (exorbitant privilege)

3. During **global crisis** (GFC, COVID19), dollar appreciate and large wealth transfer and (exorbitant duty)

What we do in this paper

- A NK DSGE model with banks to generate endogenous convenience yield
- Banks as in Gertler Karadi 2011, Gertler Kiyotaki 2010 who face collateral constraint on their asset holding
- Symmetric 2-country model (US and foreign) with one asymmetry

US bond is assumed to be a better collateral

- Demand for an asset not just for interest rate, but as a collateral

What we find

- Solely because the US bond is a better collateral
- In steady state,

1. US is a net debtor (negative NFA)
2. US generates “excess return” on its foreign investment (exorbitant privilege)
3. US’s net foreign income is positive

→ Positive earning from investment despite net borrowing from abroad

- Upon a uniform global financial shock

1. Banks has tight balance sheet constraints→ run to least constraint assets (US bonds)
2. Demand for US bond appreciate the currency
3. Wealth transfer from the US to RoW (exorbitant duty and Maggiori 2017 paradox)
4. Retrenchment for both countries

- Exchange rates

1. Endogenous convenience yield and UIP deviation
2. Reasonably match many untargeted moments

Road map

1. **Quantitative model**
2. IRFs to mimic GFC
3. Exchange rate moments

A two-country New Keynesian model with Treasury convenience

- Goods market

- Home (US) and foreign (Eurozone) goods

- Nominal price stickiness with pricing to market (i.e., local currency pricing – LCP)

- Banking sector

- Gertler Karadi / Gertler Kiyotaki type of Home and Foreign banks

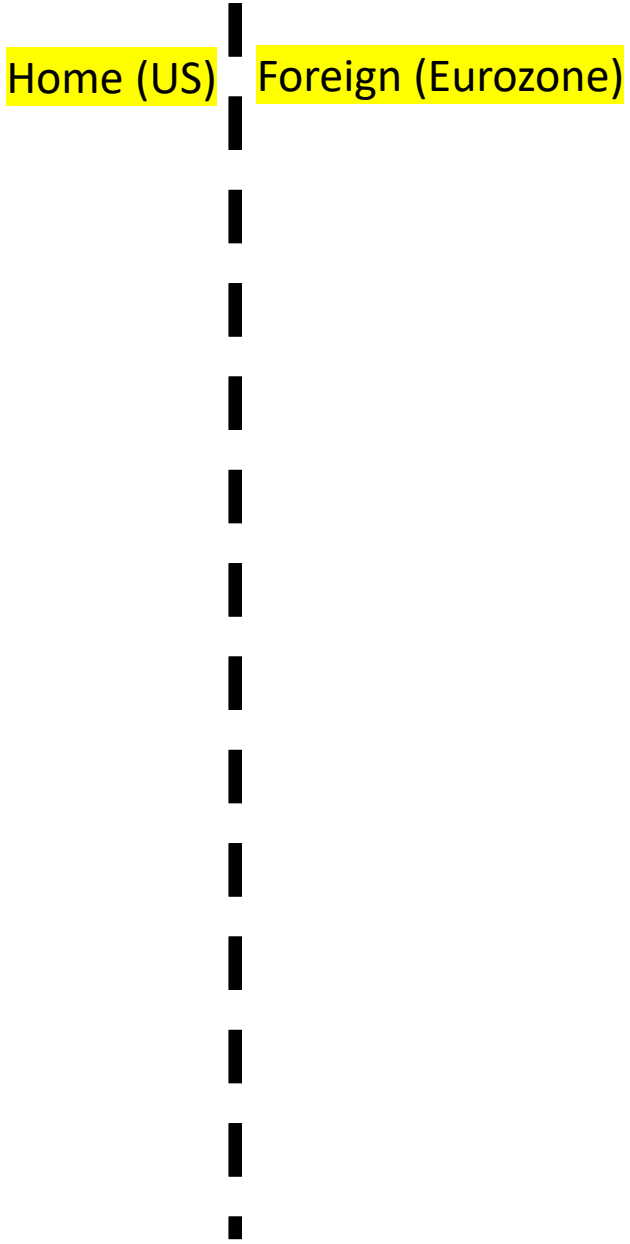
- Moral hazard problem → Incentive constraint on asset holding

- Assets market

- Home bond, foreign bond, home capital, foreign capital

- Key is that home bond is a better collateral

Graphical Setup



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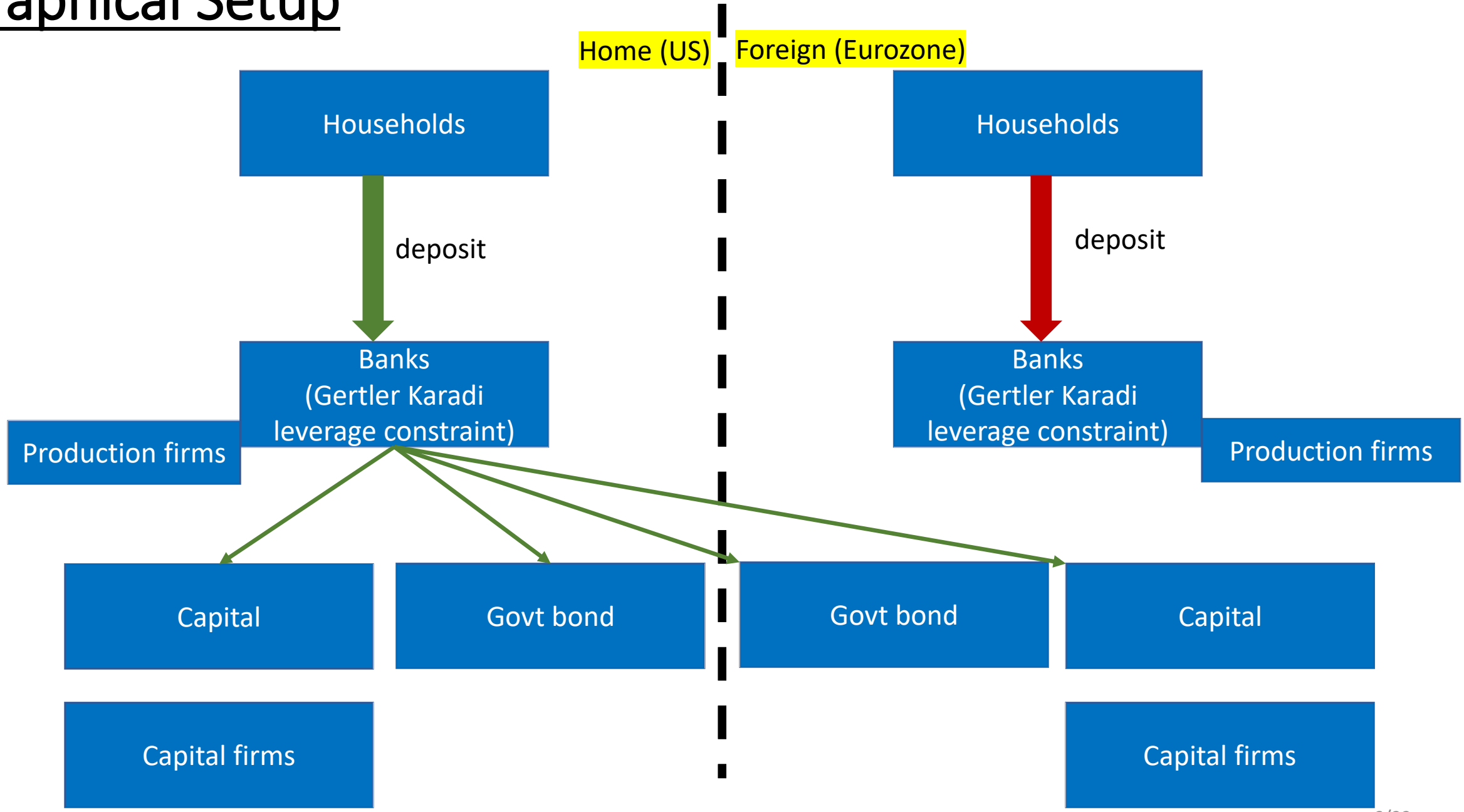

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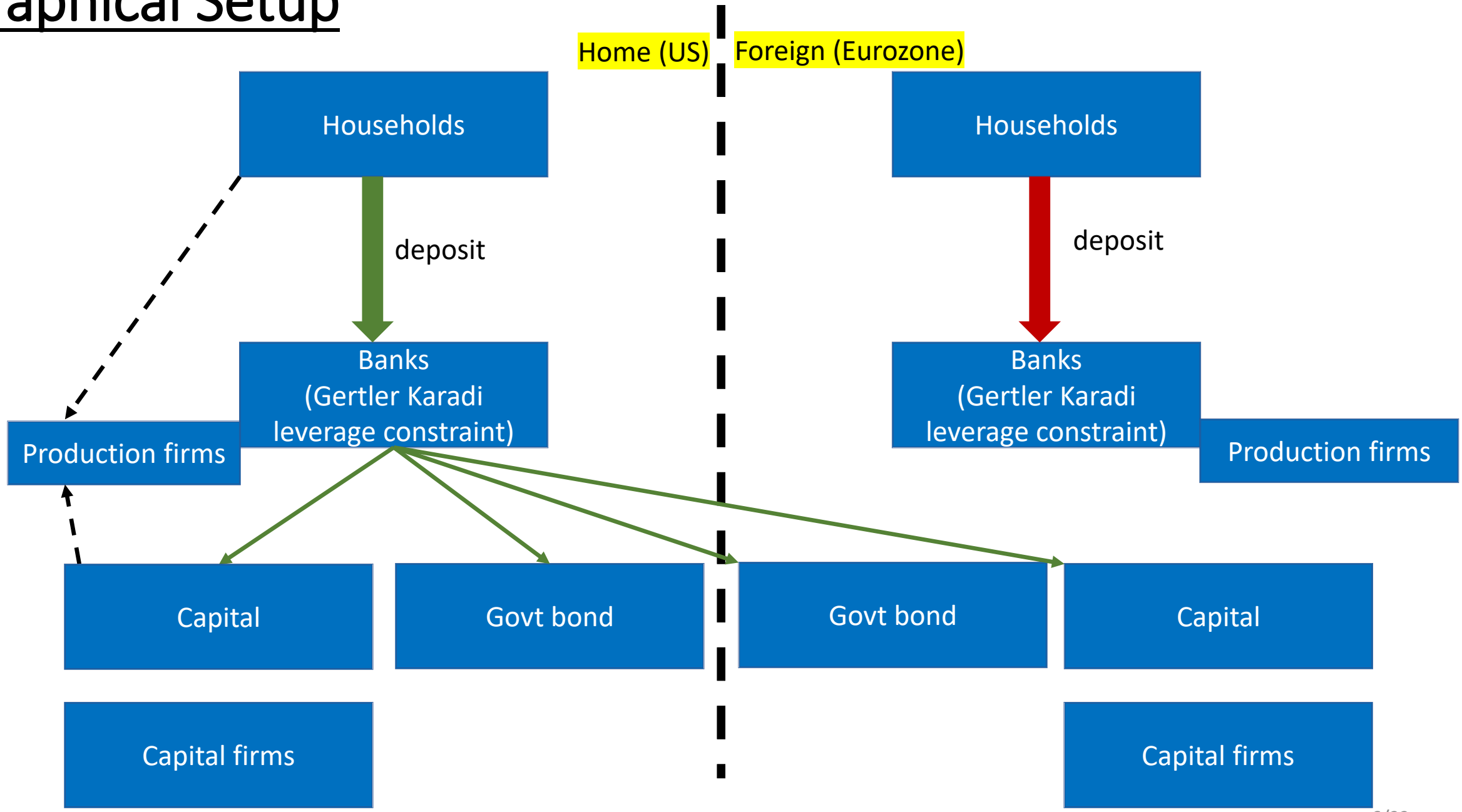

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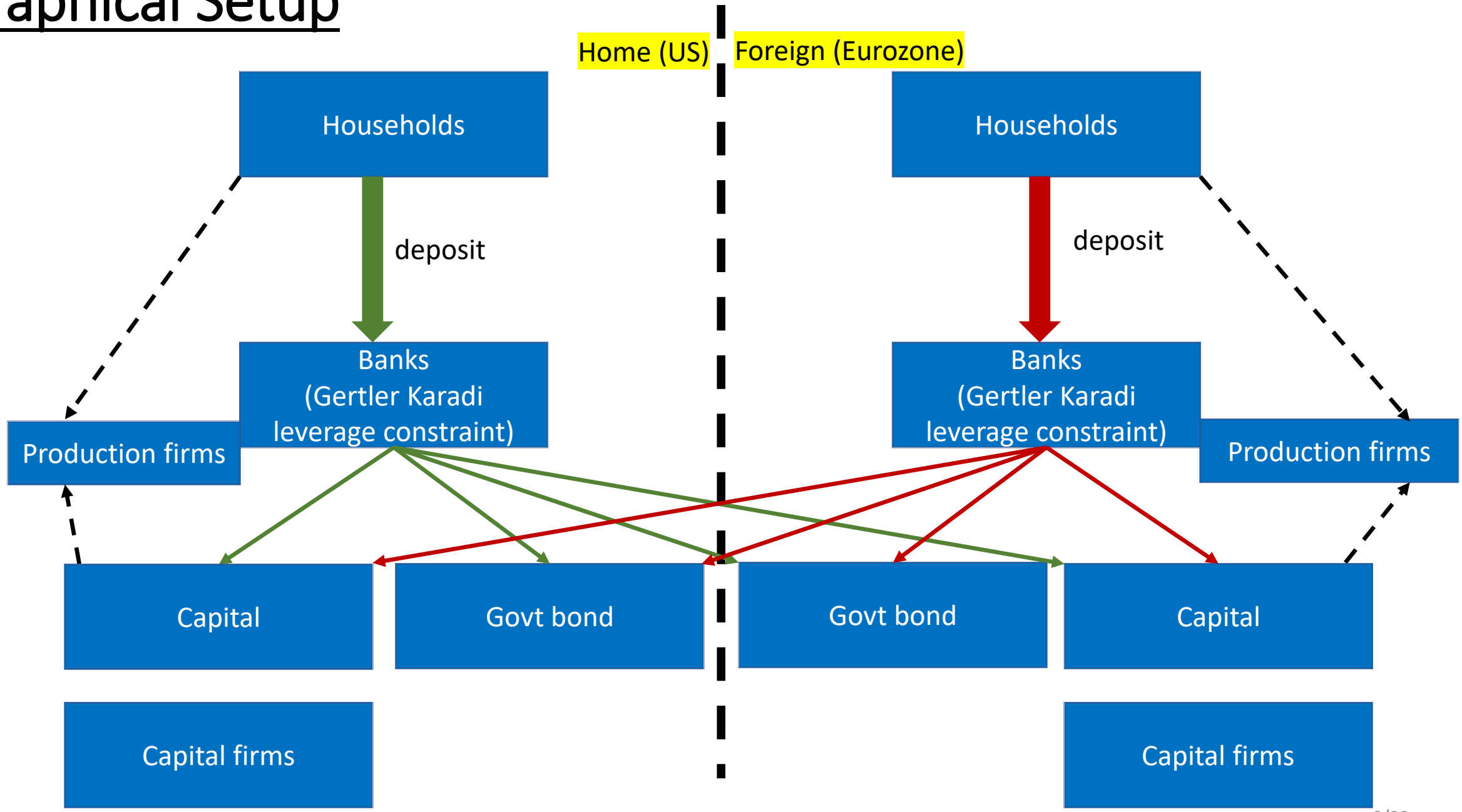

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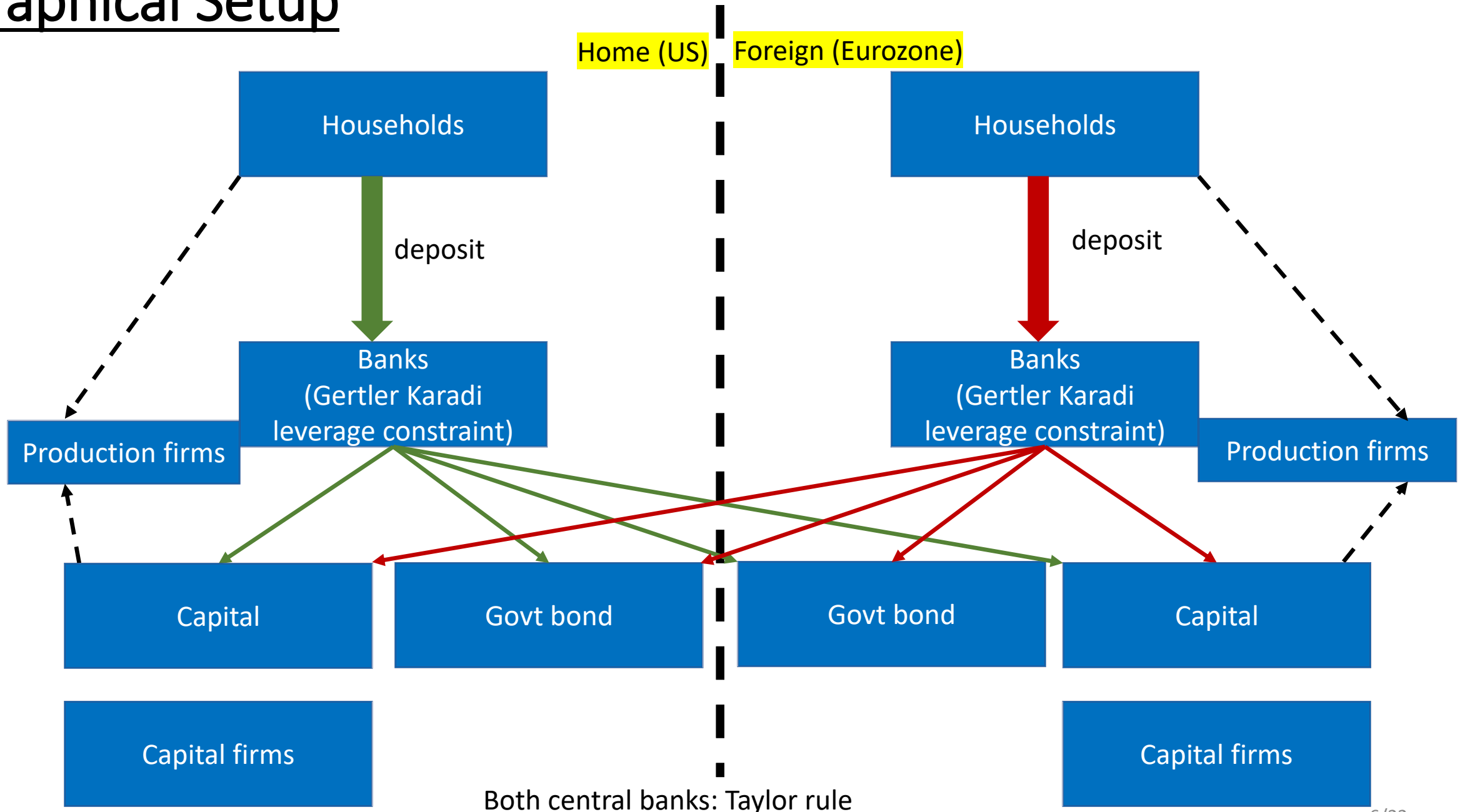

Both central banks: Taylor rule

Both govts: Issue constant bond every period

Banks

- Follows the Gertler and Karadi framework
- A fraction θ of each household becomes a banker each period, and continues with probability θ, and reverts to being a consumer with probability $1-\theta$
- Balance sheet of bank (omitted *i* subscript):

$$N_t + B_t = \left[Q_t K_{h,t+1} + D_{h,t}\right] + S_t\left[Q_t^* K_{f,t+1} + D_{f,t}\right]$$

Net worth + deposit = [investment in Home asset] + [investment in Foreign asset]

where Q_t is the home capital price, S_t is the home price of a foreign currency
K_h is the home bank holding of home capital
K_f is the home bank holding of foreign capital
D_h is the home bank holding of home bond
D_f is the home bank holding of foreign bond

Banks' problem

- Banks' value function is

$$V_t = E_t \Omega_{t+1}[(1-\theta)N_{t+1} + \theta V_{t+1}]$$

- Maximize value function by choosing the four assets (K_h, K_f, D_h, D_f)
- Subject to Gertler-Kiyotaki, Gertler-Karadi type of incentive constraint
- Banker can abscond κ amount of the assets so

$$\text{value of the bank} \geq \kappa(\text{value of the assets})$$

value if stay in business

value if running away

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$$V_t \geq \vartheta\left[\left(\kappa_{K,h} Q_t K_{h,t+1} + \boldsymbol{\kappa_h} D_{h,t}\right) + \left(\kappa_{K,f} S_t Q_t^* K_{f,t+1} + \kappa_f S_t D_{f,t}\right)\right]$$

- The lower the parameter κ, the less it is divertible, or the more it is pledgeable
- **Key assumption:**

Home bond is the best collateral $\boldsymbol{\kappa_h} < \kappa_f \leq \kappa_{K,h} \leq \kappa_{K,f}$

The same for the foreign banks $\boldsymbol{\kappa_h^*} < \kappa_f^* \leq \kappa_{K,f}^* \leq \kappa_{K,h}^*$

First-order conditions

Bank SDF:

$$\Lambda_{t+1} = \Omega_{t+1}((1-\theta) + \theta\nu_{t+1})$$

These are zeros in frictionless models

$$FOC[D_h]: \quad E_t\Lambda_{t+1}\left(R_{h,t+1} - R_{t+1}\right) = \eta_t\vartheta(\kappa_{h,t})$$

$$FOC[D_f]: \quad E_t\Lambda_{t+1}\left(\frac{S_{t+1}}{S_t}R_{f,t+1} - R_{t+1}\right) = \eta_t\vartheta(\kappa_{f,t})$$

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- Combining $FOC[D_h]$ and $FOC[D_f]$ gives

UIP wedge

$$E_t\Lambda_{t+1}\left(\frac{S_{t+1}}{S_t}R_{f,t+1} - R_{h,t+1}\right) = \eta_t\vartheta(\kappa_{f,t} - \kappa_{h,t})$$

- As the constraint tightens, η_t rises

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- As the constraint tightens, η_t rises
- Forward iterating gives

$$S_t = -E_t\left\{\sum_{t=1}^{\infty}\left(R_{h,t} - R_{f,t}\right) + \sum_{t=1}^{\infty}(\tilde{\eta}_t)\right\} + \lim_{k\to\infty} E_t s_{t+k} - k\bar{s}$$

Calibration table

Symbol	Meaning	Value	target
$\overline{D_h} = \overline{D_f}$	Total govt debt	2.7	Debt to GDP of 83%
θ	Bank survival prob.	0.95	Leverage of 3
$\boldsymbol{\kappa_h}$	**Home constraint cost of holding home bond**	**0.025**	**Convenience yield = 1%**
$\boldsymbol{\kappa_h^*}$	**Foreign constraint cost of holding home bond**	**0.05**	**Net foreign income / GDP = 0.0013**
$\boldsymbol{\kappa_f}$	**Home constraint cost of holding foreign bond**	**0.40**	**Foreign holding of US Treasury of 45%**
$\boldsymbol{\kappa_f^*}$	**Foreign constraint cost of holding foreign bond**	**0.32**	**-ve NFA 18.5%**
$\kappa_{Kh}^* = \kappa_{Kf}$	Constraint cost of holding external capital	0.49	Equity premium of 6%
$\kappa_{Kh} = \kappa_{Kf}^*$	Constraint cost of holding own capital	0.41	Home bias of equity of 70%

Steady state

Symbol	Steady state
NFA/GDP	-18.50%
$r_f - r_h$	4.4 - 3.4% = 1%
Net income from abroad / GDP	0.13%

Exorbitant privilege:
+ve Net income from abroad because of convenience yield despite the –ve NFA

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Symbol	Steady state
C, C*	0.6118 , 0.6113
L, L*	0.3317 , 0.3328
Y, Y*	0.8065 , 0.8089
Home, Foreign bank's leverage (asset/equity)	3.01 , 2.99

Living off the privilege, US has a high consumption, despite less L and Y
US bank is more leveraged

Road map

1. Quantitative Model
2. **IRFs to mimic GFC**
3. Exchange rate moments

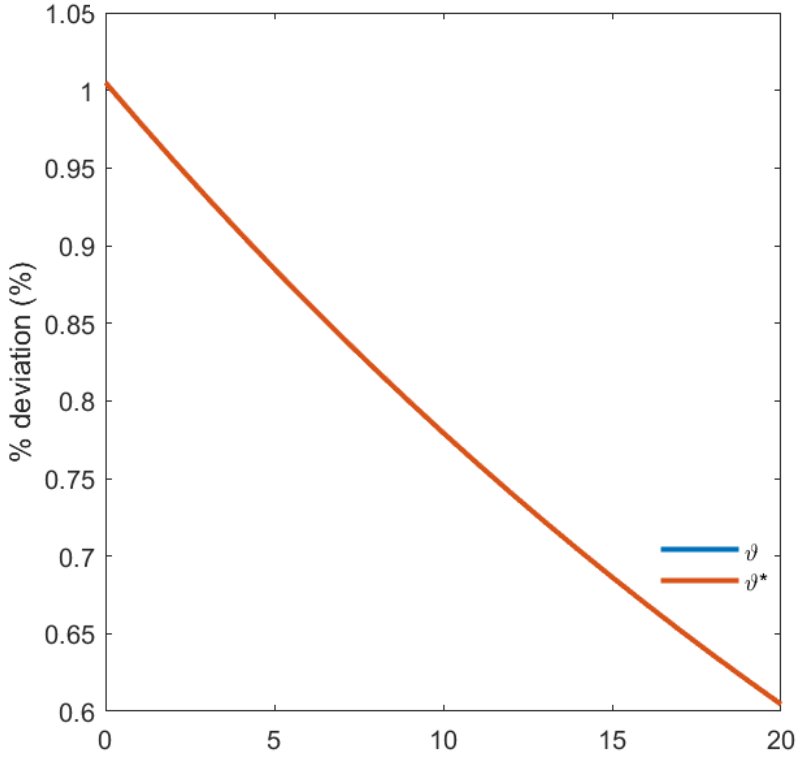
Key takeaways

- Dollar appreciates in crisis due to convenience demand
- Dollar appreciates despite a wealth transfer to the rest of the world (reconcile reserves currency paradox Maggiori 2017)
- Capital flow retrenchment

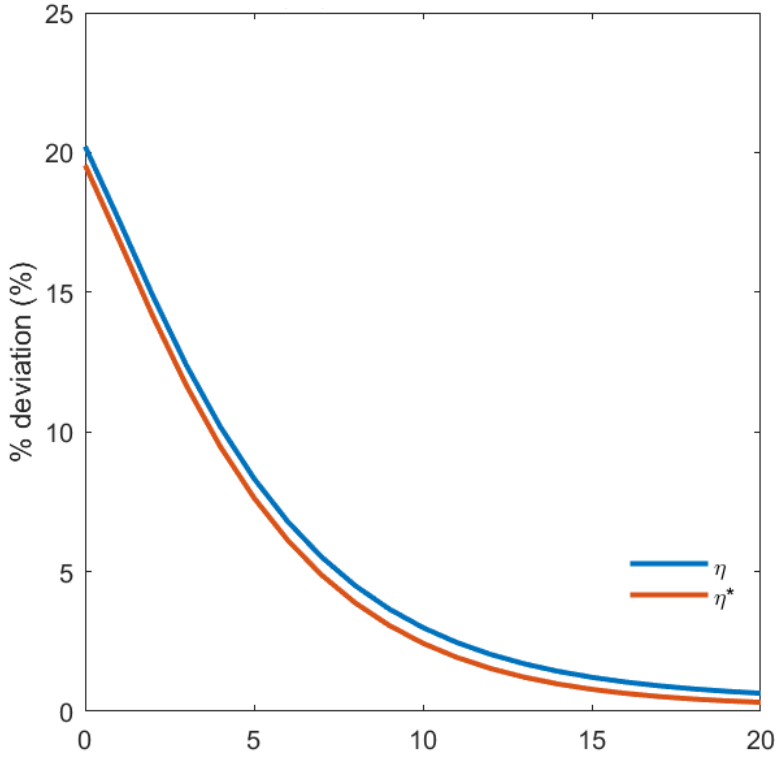
Experiment

- A 1% shock to ϑ and ϑ^* (1% tightening to all assets on incentive constraint)
- The shock is AR1, with persistence of 0.98

Home and Foreign financial shock



Home and Foreign Lagrangian multiplier



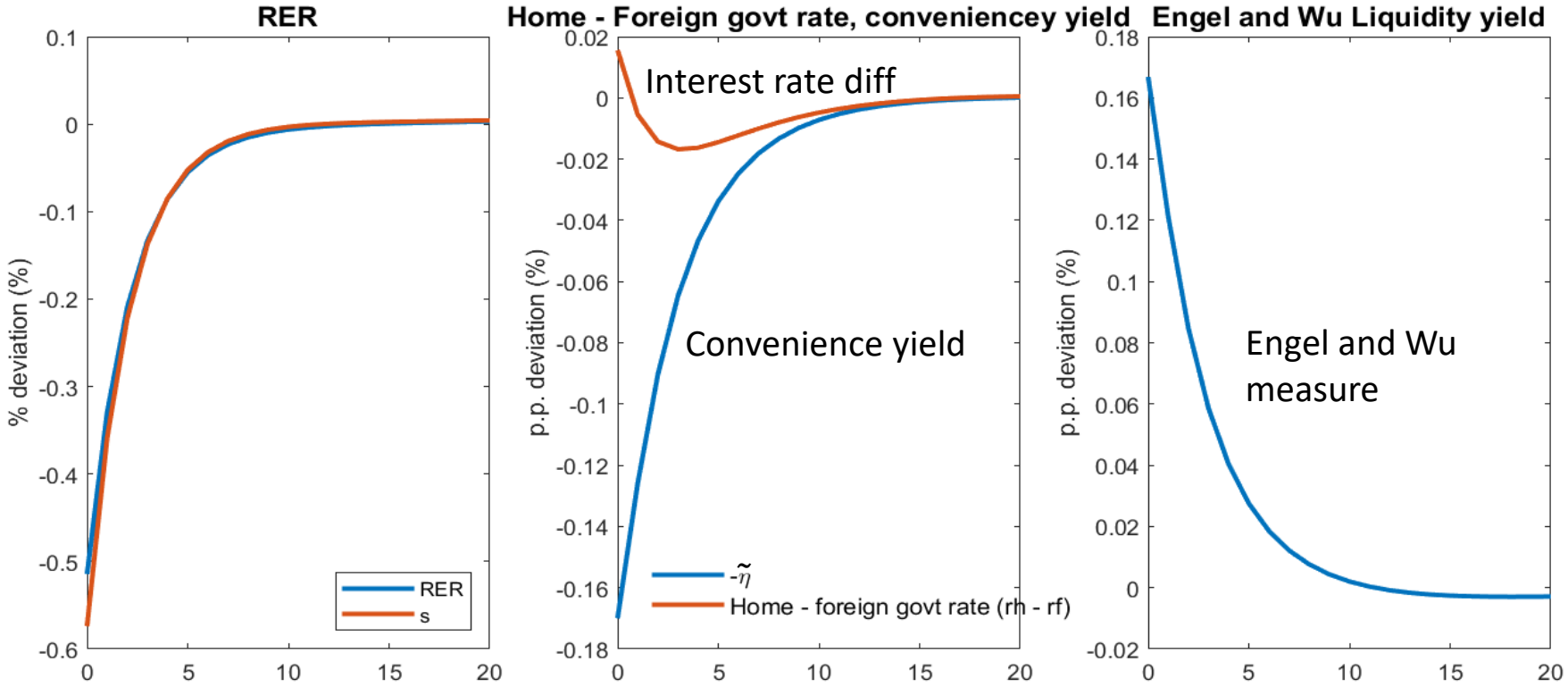
- Symmetric shock but asymmetric effects

IRF of ϑ shock – exchange rate

- Forward iterating gives

$$RER_t = -E_t\left\{\sum_{t=1}^{\infty}\left(r_{h,t} - r_{f,t}\right) + \sum_{t=1}^{\infty}\left(\tilde{\eta}_t\right)\right\} + \lim_{k\to\infty} E_t s_{t+k} - k\bar{s}$$

Convenience yield: $E_t RER_{t+1} - RER_t - \left(r_{h,t} - r_{f,t}\right) \equiv \tilde{\eta}_t$

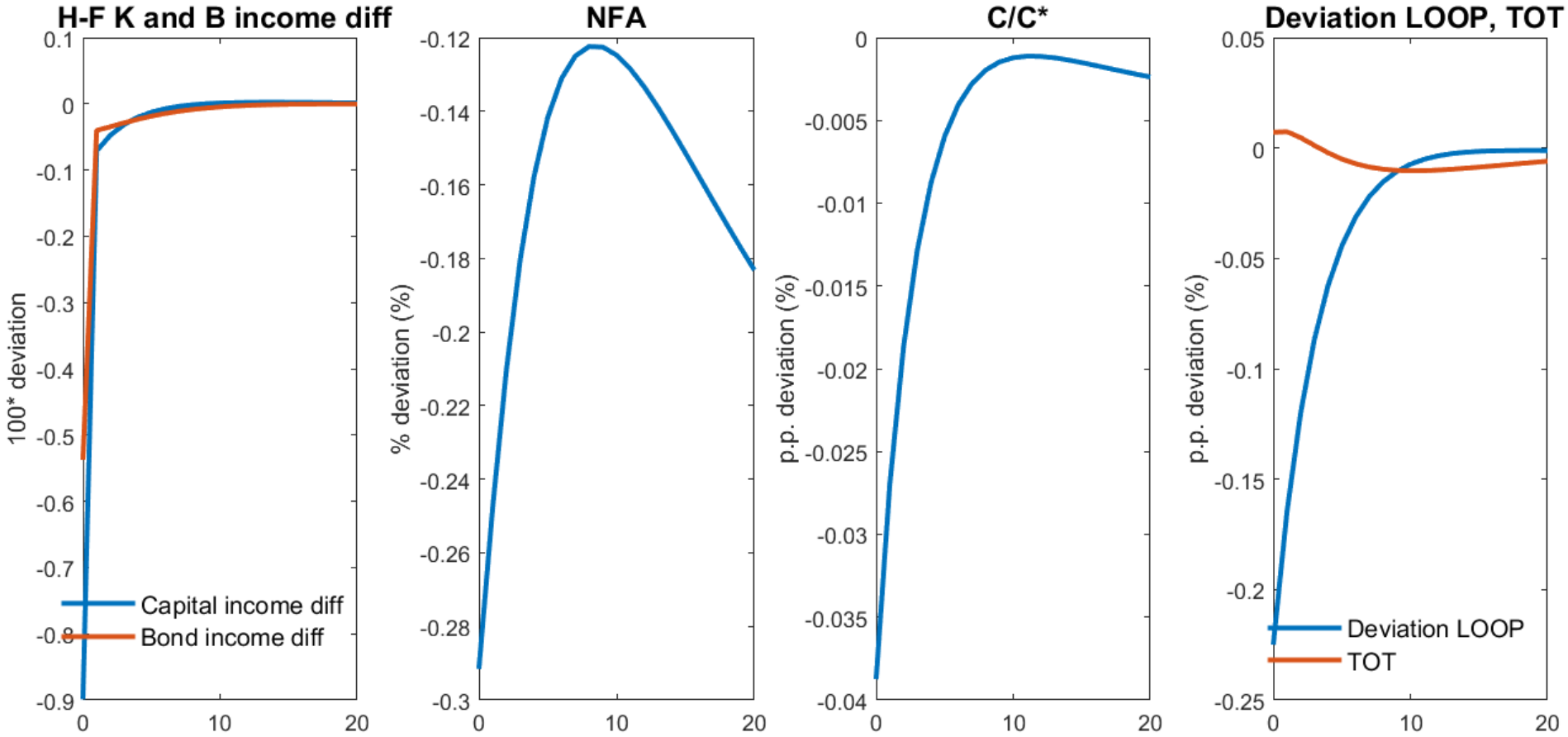


- Despite lower home interest rate r_h, USD appreciates because of strong convenience yield demand

IRF of ϑ shock – reserves currency paradox

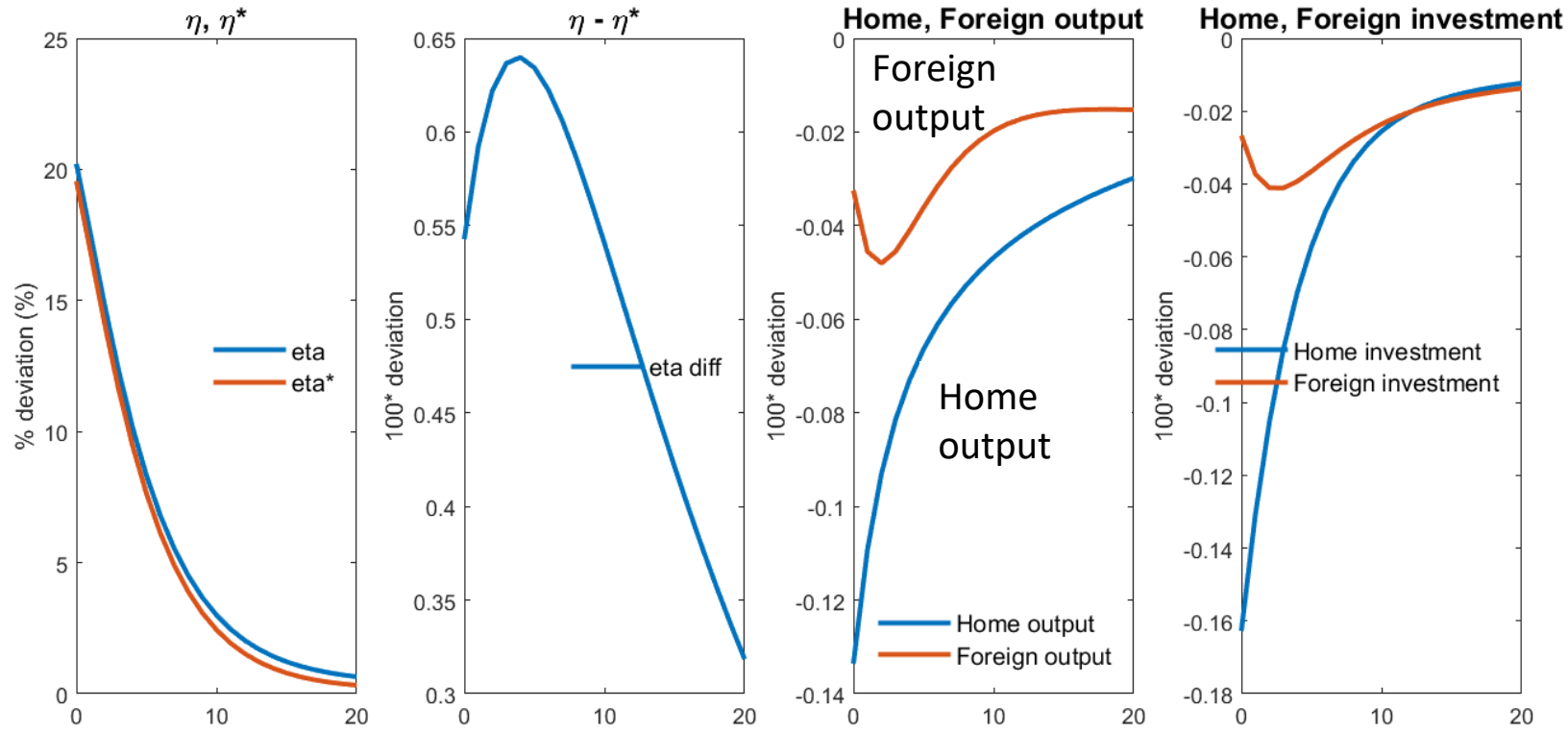
IRF of ϑ shock – reserves currency paradox

- Recall that $RER_t = TOT_t^{2\omega-1} \times D_t$



- Despite a wealth transfer to RoW →rise in TOT, RER appreciation because of deviation of LOOP

IRF of ϑ shock – real outcomes



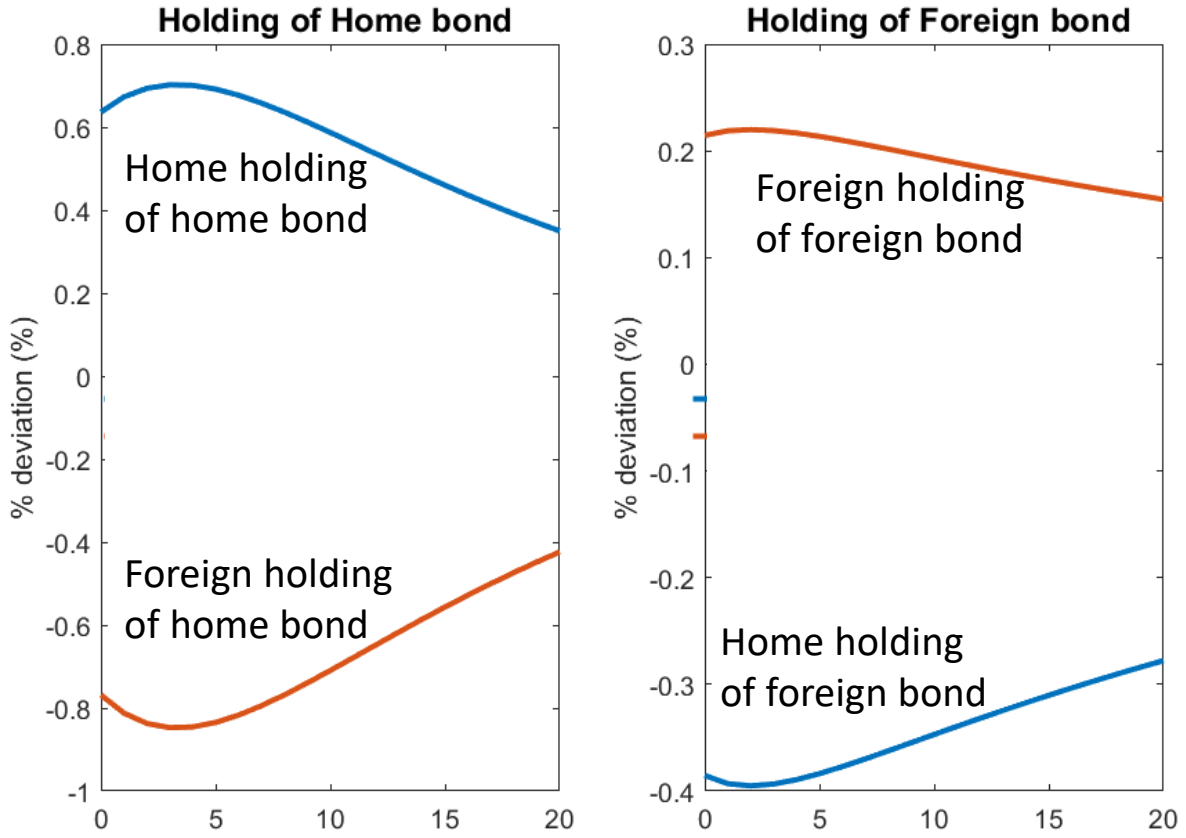
- Intuition:

Home bond is great

→ Home banks shift out from investment more during a crisis

→ Home output drops more

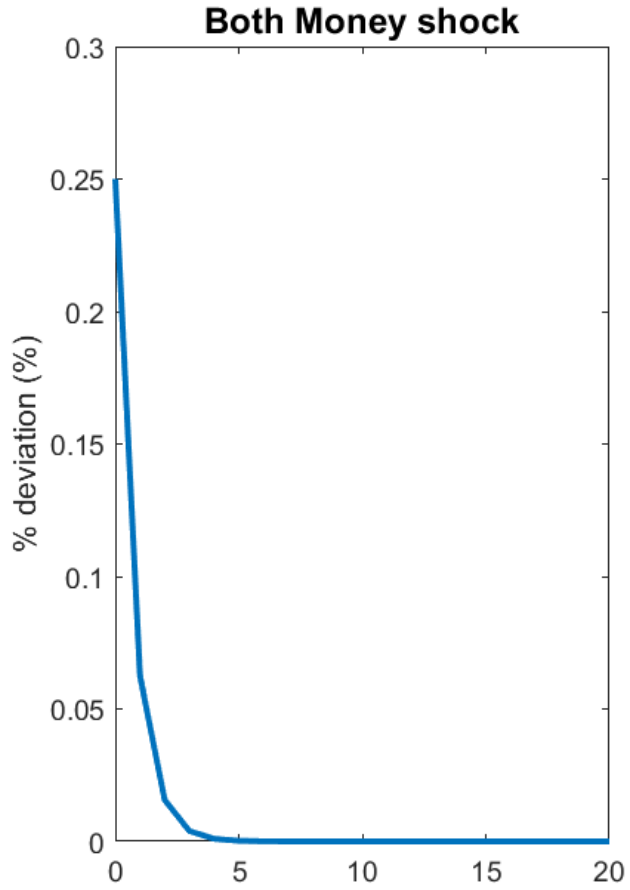
IRF of ϑ shock – capital flows

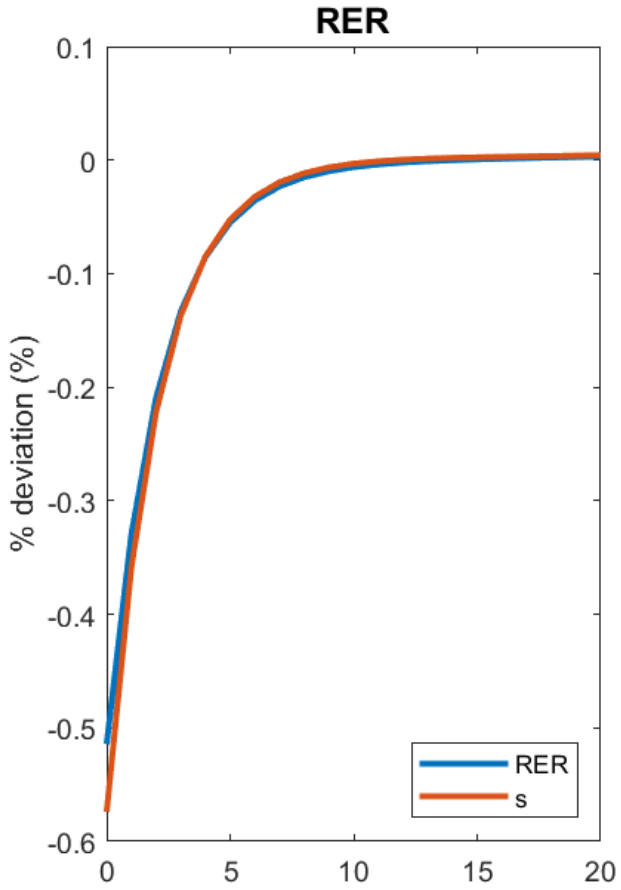


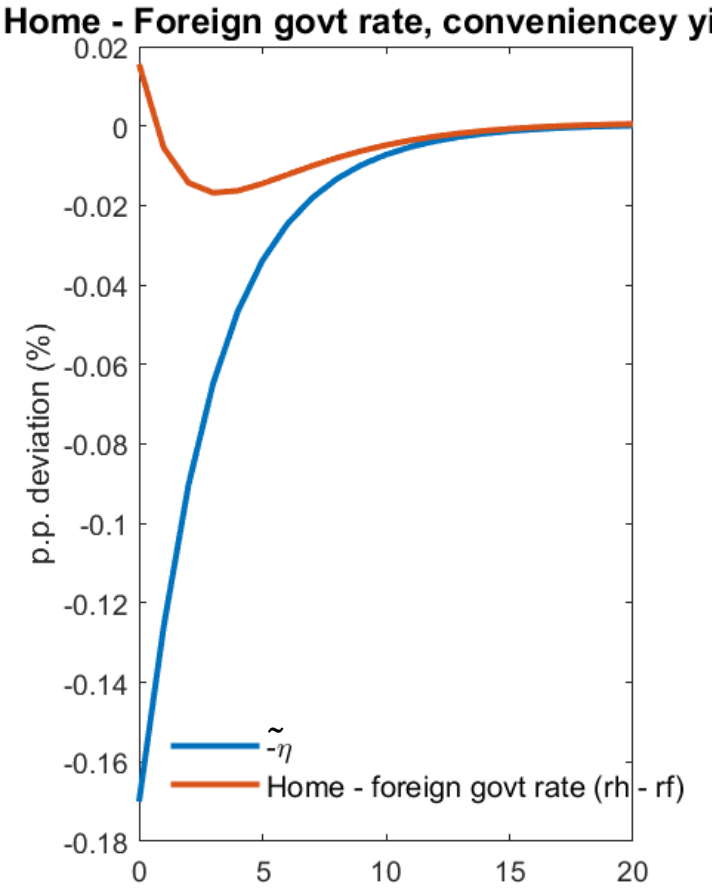
→ Home banks demand more of the least constraint bond
→ Foreign selling home bonds despite they also demand more of the liquid bond
→ Retrenchment of capital flows

Note: direction of capital flows ≠ demand revelation

IRF of symmetric money shock (currency wars?)







- Same size of global tightening results in USD RER appreciation
- Convenience yield demand drives most of the RER appreciation
- In eqm, the US interest rate is lower than the Foreign

→ Home inflation pressure is less than the Foreign

Road map

1. Quantitative Model
2. IRFs to mimic GFC
3. **Exchange rate moments**

2nd moment calibration

- Standard process for TFP and monetary shocks

- Calibrate the financial shock ϑ, ϑ^* persistence and standard deviation for

1) Financial shock explain 90% of exchange rate (Itskhoki and Mukhin 2021, Miyamoto et al F'coming)
2) Corr$(\Delta nx, \Delta RER) \cong 0$

Replicate Engel Wu empirical regression

$$\boldsymbol{\Delta s_{j,t}} = \alpha_j + \beta_0 s_{j,t} + \boldsymbol{\beta_1 \Delta \eta_{j,t} + \beta_2 \Delta (i - i^*)_{j,t}} + \beta_3 \eta_{j,t} + \beta_4 (i - i^*)_{j,t} + u_{j,t}$$

	G10 panel regression	Model implied
$s_{j,t}$	-0.06**	-0.01
	(0.02)	
$\boldsymbol{\Delta \eta_{j,t}}$	**-1.65****	**-1.90**
	(0.76)	
$\boldsymbol{\Delta (i - i^*)_{j,t}}$	**-2.61*****	**-3.04**
	(0.97)	
$\eta_{j,t}$	-2.08**	-0.10
	(0.87)	
$(i - i^*)_{j,t}$	-0.44**	-0.07
	(0.22)	

Note: S.E. cluster by time. Quarterly data

Exchange rate moments

	Data moment (Itskhoki and Mukhin 2021)	Model implied
$\sigma(\Delta NER)/\sigma(\Delta GDP)$	5.2	2
$\sigma(\Delta NER)/\sigma(\Delta c)$	6.3	7
$\rho(RER)$	0.94	0.9
$Fama\ \beta$	<0	-1.4
Corr$(\Delta nx, \Delta RER)$	~0	-0.045

Conclusion

- A DSGE model of endogenous convenience yield
- Convenience yield links to banking friction – no exogenous yield / noise trader
- **One single asymmetry – US bond is a better collateral**
- Matches US external positions and exchange rate dynamics well
- A lot more implications are coming!

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THANK YOU