An Equilibrium Model of Nominal Exchange Rates, Current Accounts and Asset Flows

Marcus Hagedorn

University of Oslo and CEPR

ESSIM 2017

May 26, 2017

Main Objective

I show that three assumptions

1. Asset markets within each country are incomplete.
2. Presence of aggregate risk in each country.
3. Assets are nominal.

imply nominal exchange rate determinacy.

Then: What are the determinants of the nominal exchange rate?
(Total Assets, NFAs, Productivity, Monetary policy, ...)

Exchange Rate Indeterminacy

- The simple type of indeterminacy
  - World (Home and Foreign) is in steady state.
  - Monetary policy sets nominal interest rates i_H and i_F.
  - Nominal exchange rate ϵ.
  - One good. Real exchange rate = 1.
  - Uncovered interest rate parity condition :

$$\frac{E_t \epsilon_{t+1}}{\epsilon_t} = \frac{1 + i_H}{1 + i_F}$$

$\hookrightarrow$ Expected change determined. Level NOT.

- Kareken & Wallace (1981) add more subtle type of indeterminacy. LATER.

Monetary Policy

- Textbook:
  - Sets Money Supply

    + money not freely mobile across countries

    $\hookrightarrow$ Determinacy

- Standard: Sets nominal interest rates

  $\hookrightarrow$ Indeterminacy

- Here:
  - No restrictions to aggressive Taylor rules, to locally determinate equilibria or selected equilibria
  - Can consider interest rate pegs, coordinated monetary/fiscal policy ...
  - Overcomes several puzzles in liquidity trap:
    - Forward guidance puzzle
    - Technological Regress $\Rightarrow$ Output $\uparrow$
    - Price stickiness $\uparrow$ $\Rightarrow$ Fiscal Multiplier $\uparrow$

Why is Determinacy Important?

- Otherwise: Key price in open macro is set by assumption.
  $\Rightarrow$ should be equilibrium response.
  - Nominal rigidities:

    Nominal indeterminacy $\rightarrow$ real indeterminacy.

    $\hookrightarrow$ exports, imports, output, employment at home and abroad.
  - How to manage the equilibrium exchange rate?
  - Exchange Rates $\leftrightarrow$ International Asset Flows.
  - Monetary Unions, Fiscal and monetary policy spillovers, ...

Overview

- Exchange Rate Level Determinacy in Incomplete Market Models with Aggregate Risk
- Overcoming Indeterminacy: Role of Assumptions
- Determinants of the Long-Run Exchange Rate

Exchange Rate Level Determinacy

Remember Main Objective

Show that three assumptions

1. Asset markets within each country are incomplete.
2. Presence of aggregate risk in each country.
3. Assets are nominal.

imply nominal exchange rate determinacy.

Assumption 3: Assets are nominal

Only asset are nominal government bonds
(capital irrelevant for determinacy).

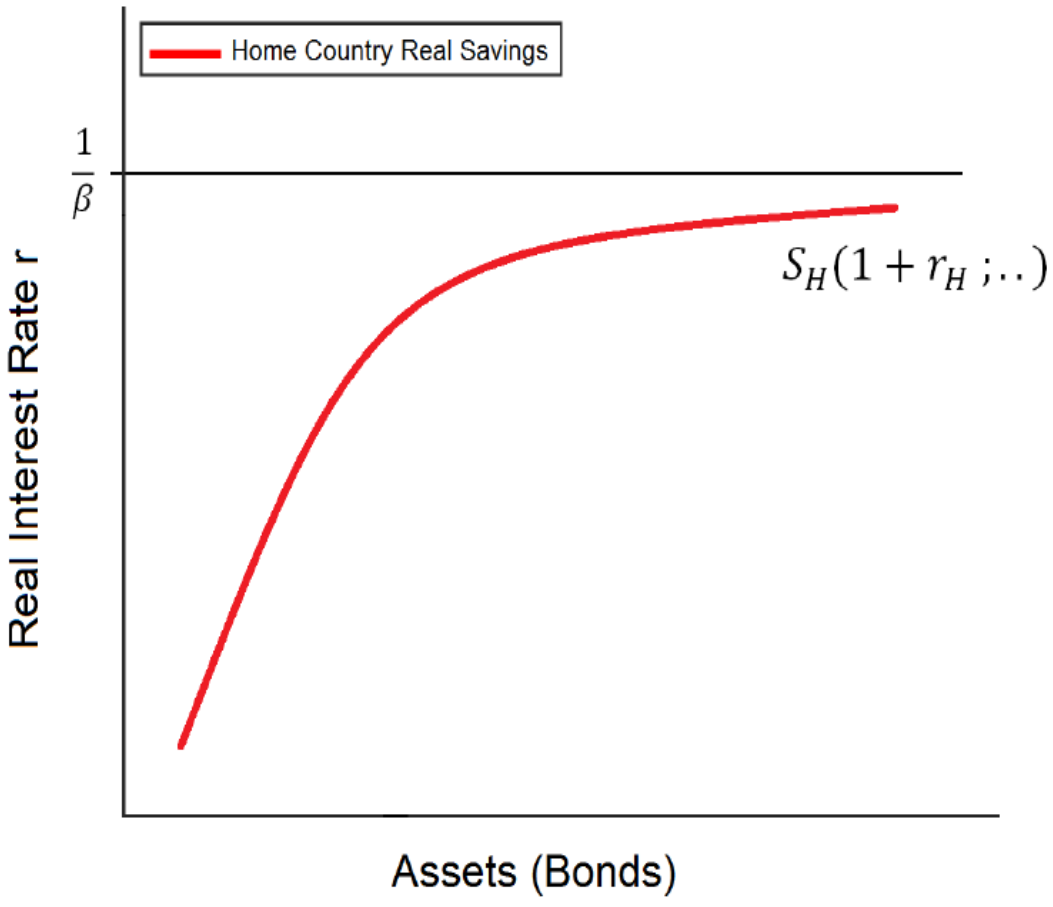
Assumption is clearly necessary:

Fully price-indexed Assets

$\rightarrow$ No role for nominal prices.

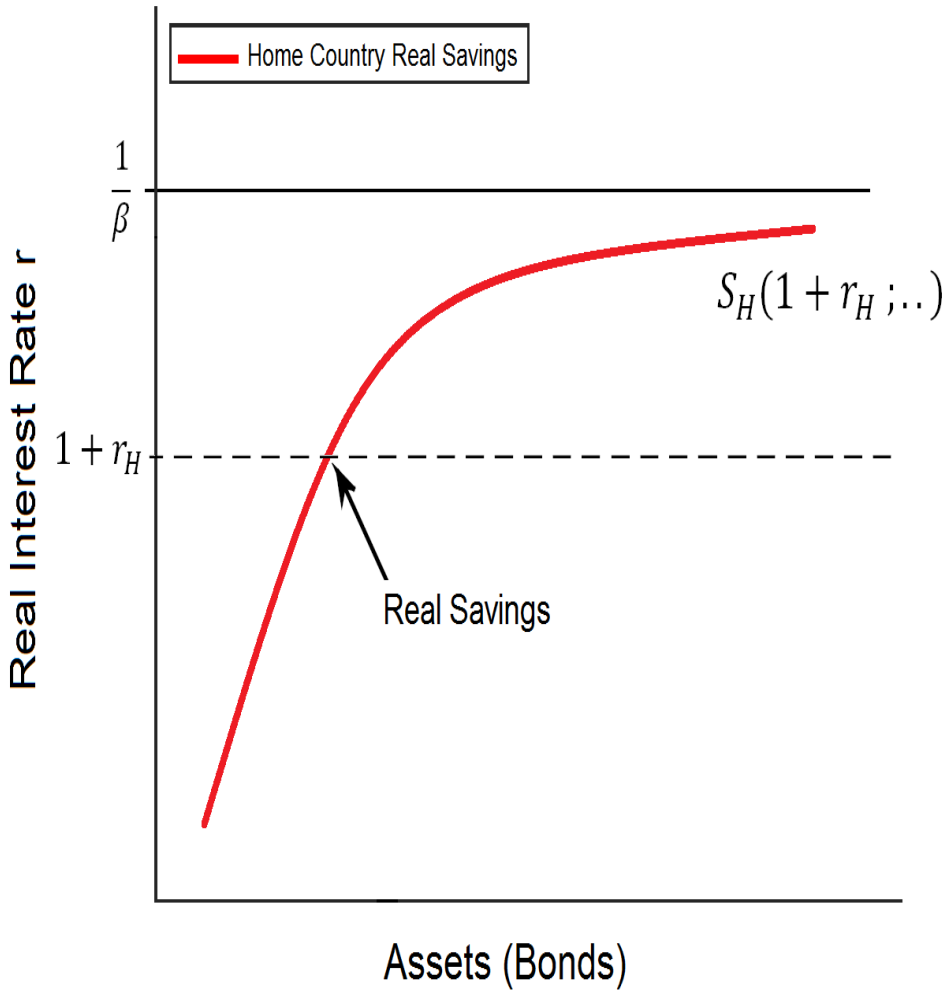
Assumption 2: Markets are incomplete

Huggett Economy: Aggregate Country Savings



Assumption 2: Markets are incomplete

Huggett Economy: Aggregate Country Savings



Real Interest Rate:

$$(1+r_H) = \frac{1+i_H}{1+\pi_H}$$

Monetary Policy:

Sets $1+i_H$

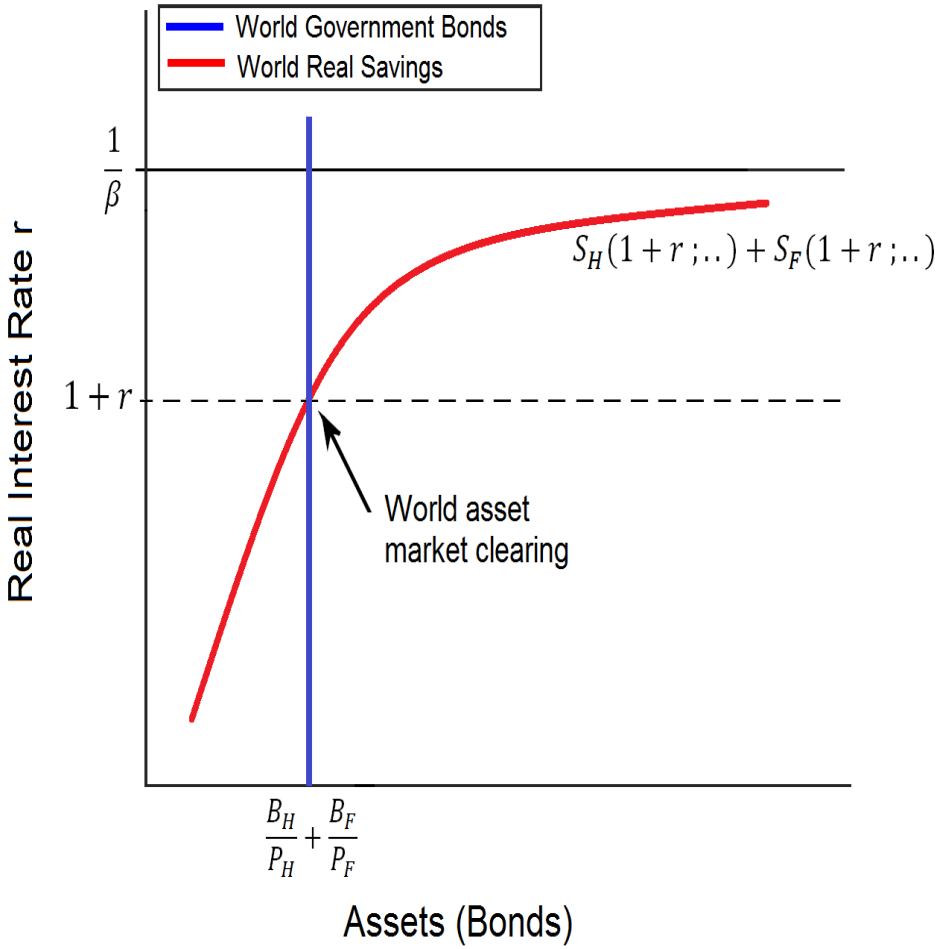
Fiscal Policy:

$$\pi_H = \frac{B'_H - B_H}{B_H} = \frac{T'_H - T_H}{T_H}$$

i : nominal interest rate
r : real interest rate
π : inflation rate
B: nominal bonds
T: nominal tax revenue

Assumption 2: Markets are incomplete

Huggett Economy: Supply Side



Supply of Assets

S_H =???

Foreign: Same Problem

S_F =???

World Asset Market:

$$S_H + S_F = \frac{B_H}{P_H} + \frac{B_F}{P_F}$$

i : nominal interest rate
r : real interest rate
π : inflation rate

B: nominal bonds
T: nominal tax revenue

Assumption 1: Aggregate Country Risk

- Standard finance theory
  $\hookrightarrow$ Well-defined Portfolio Choices
- Here: Consider limit of vanishing aggregate country risk
- Home has demand
  - $S_H^H(\ldots)$ for home bonds.
  - $S_H^F(\ldots)$ for foreign bonds.
- Foreign has demand
  - $S_F^F(\ldots)$ for foreign bonds.
  - $S_F^H(\ldots)$ for home bonds.
- Demand for home bonds:

$$S^H(\ldots) = S_H^H(\ldots) + S_F^H(\ldots).$$

- Demand for foreign bonds:

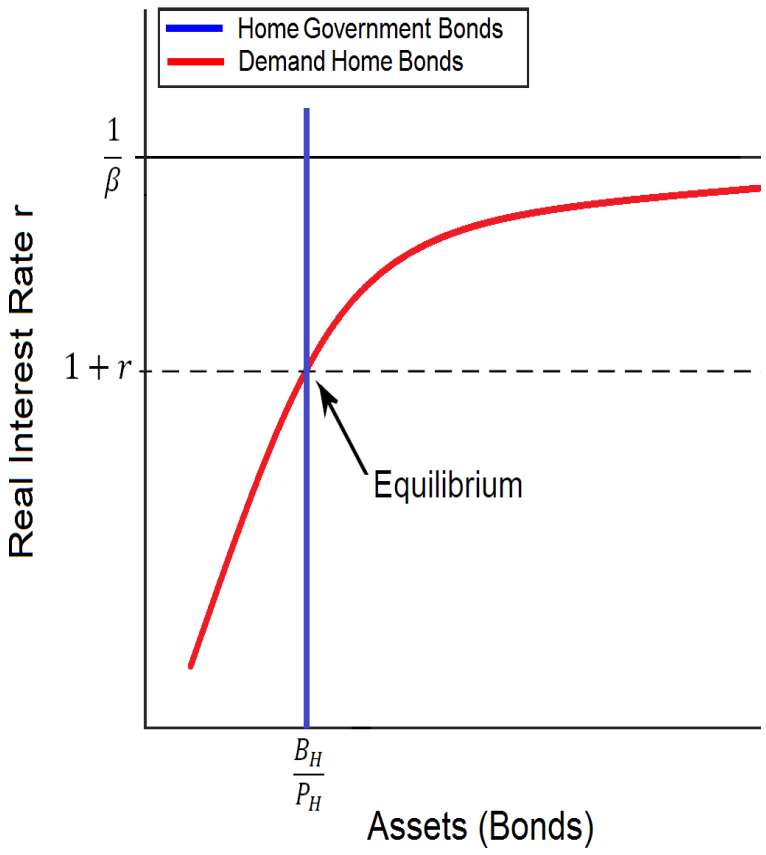
$$S^F(\ldots) = S_F^F(\ldots) + S_H^F(\ldots).$$

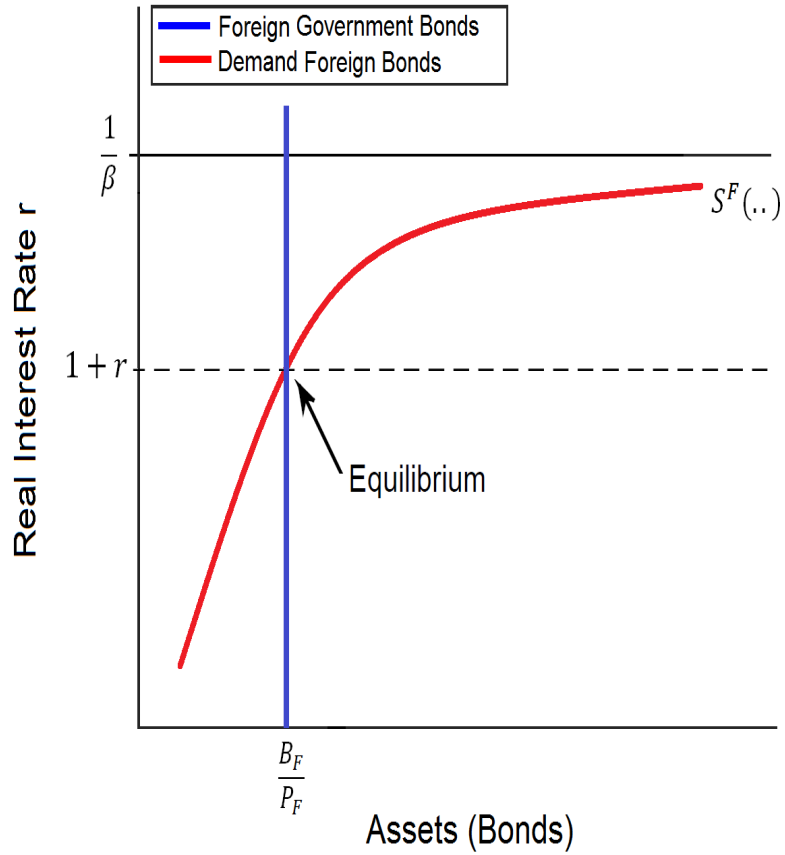
All Assumptions

Home Asset Market $\rightarrow$ Home Price Level: $\frac{B_H}{\mathbf{P_H}} = S^H$.

Foreign Asset Market $\rightarrow$ Foreign Price Level: $\frac{B_F}{\mathbf{P_F}} = S^F$.

Nominal Exchange Rate: $\epsilon = \frac{\mathbf{P_H}}{\mathbf{P_F}}$.





Overcoming Indeterminacy: Role of Assumptions

Equivalent Characterization using NFA

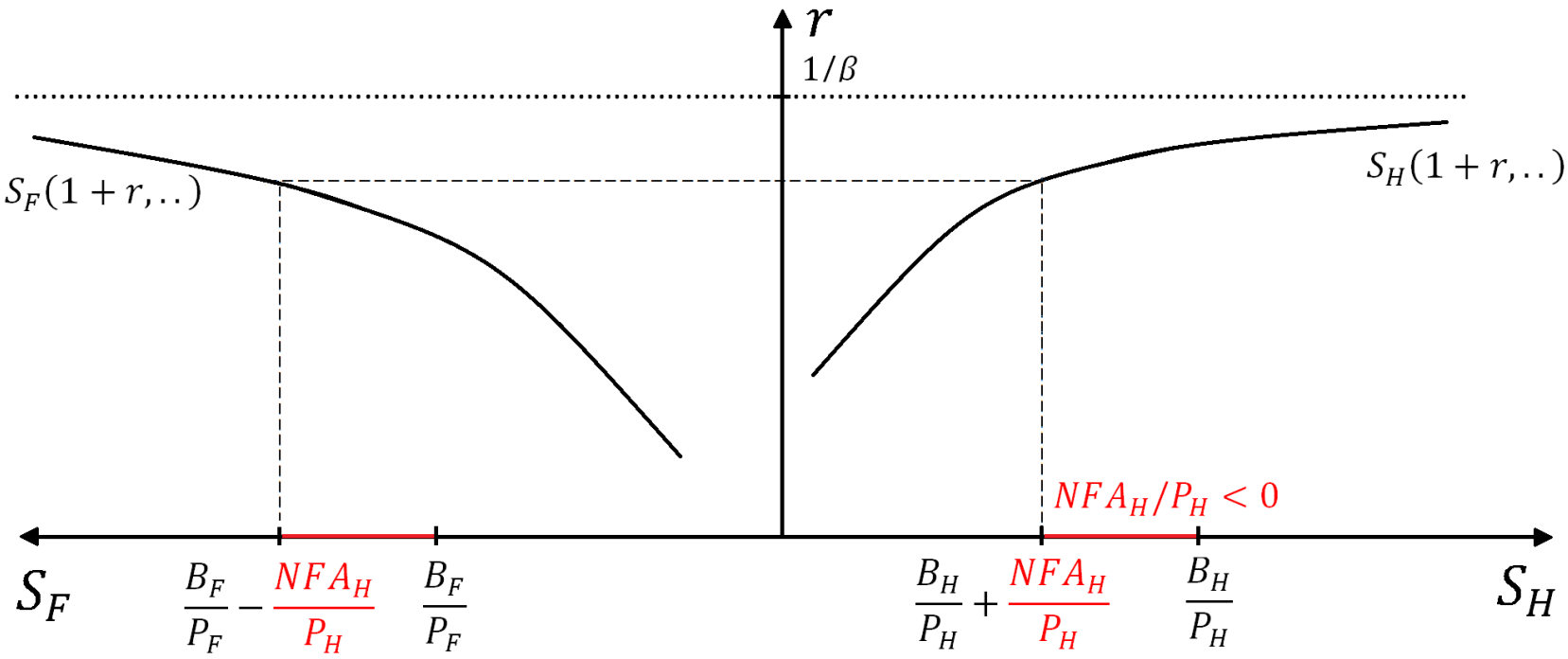
Definitions of Net Foreign Assets (NFA):

$$\begin{aligned}\frac{NFA_H}{P_H} &= S_H^F - S_F^H, \\ \frac{NFA_F}{P_F} &= S_F^H - S_H^F = -\frac{NFA_H}{P_H}.\end{aligned}$$

Country Asset Market clearing:

$$\begin{aligned}\frac{B_H + NFA_H}{\mathbf{P_H}} &= S_H^H + S_H^F = S_H, \\ \frac{B_F + NFA_F}{\mathbf{P_F}} &= \frac{B_F}{P_F} - \frac{NFA_H}{P_H} = S_F^F + S_F^H = S_F.\end{aligned}$$

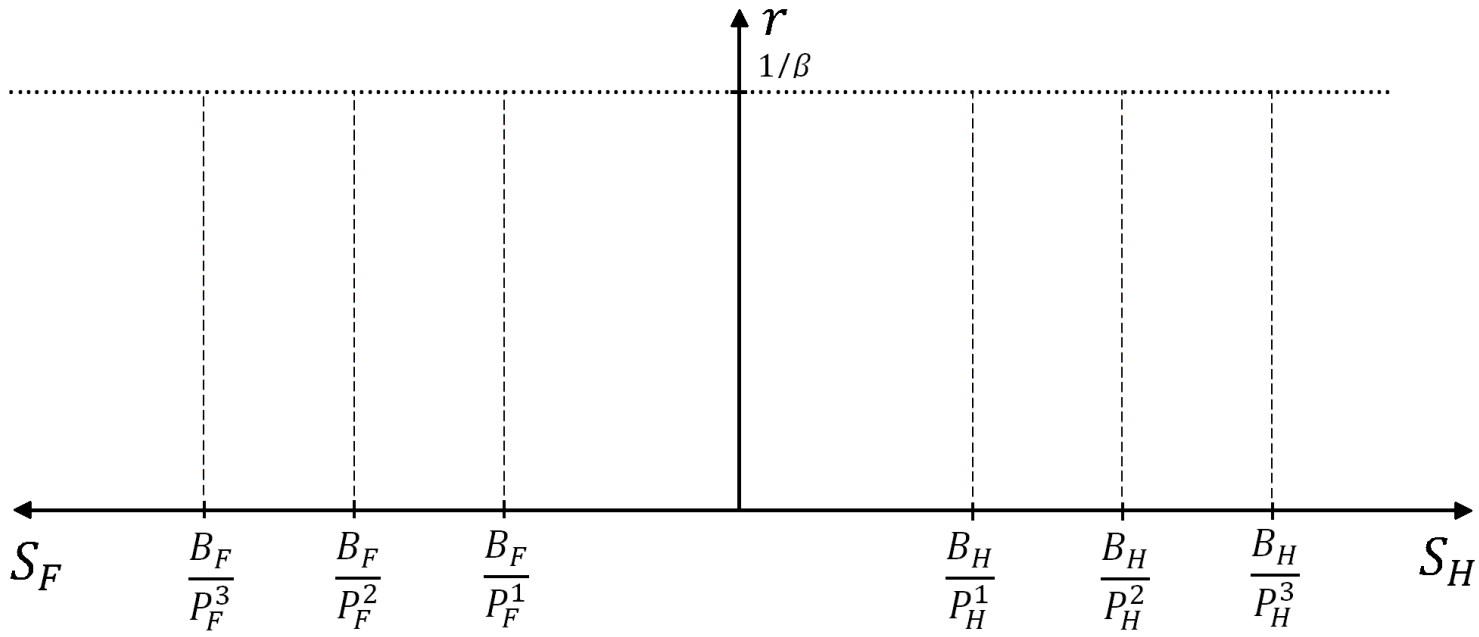
Equivalent Characterization using NFA



$$\frac{B_H + NFA_H}{\mathbf{P_H}} = S_H^H + S_H^F = S_H,$$

$$\frac{B_F + NFA_F}{\mathbf{P_F}} = \frac{B_F}{P_F} - \frac{NFA_H}{P_H} = S_F^F + S_F^H = S_F.$$

Determinacy: Why Incomplete Markets are Needed



Kareken & Wallace (1981) indeterminacy

World Asset Market Clearing:

$$S_H + S_F = \frac{B_H}{P_H} + \frac{B_F}{P_F}$$

Kareken & Wallace (1981) indeterminacy

World Asset Market Clearing:

$$S_H + S_F = \frac{B_H}{P_H} + \frac{B_F}{P_F}$$

Equilibrium Net Foreign Assets

Prices P_H and P_F define NFAs

$$\begin{aligned} \frac{NFA_H}{P_H} &= S_H - \frac{B_H}{P_H} \\ \frac{NFA_F}{P_F} &= S_F - \frac{B_F}{P_F} \end{aligned}$$

Kareken & Wallace (1981) indeterminacy

World Asset Market Clearing:

$$S_H + S_F = \frac{B_H}{P_H} + \frac{B_F}{P_F}$$

Continuum of equilibrium prices!

Equilibrium Net Foreign Assets

Prices P_H and P_F define NFAs

$$\begin{aligned} \frac{NFA_H}{P_H} &= S_H - \frac{B_H}{P_H} \\ \frac{NFA_F}{P_F} &= S_F - \frac{B_F}{P_F} \end{aligned}$$

Kareken & Wallace (1981) indeterminacy

World Asset Market Clearing:

$$S_H + S_F = \frac{B_H}{P_H\uparrow} + \frac{B_F}{P_F\downarrow}$$

Continuum of equilibrium prices!

Equilibrium Net Foreign Assets

Prices P_H and P_F define NFAs

$$\begin{aligned} \frac{NFA_H}{P_H} &= S_H - \frac{B_H}{P_H} \\ \frac{NFA_F}{P_F} &= S_F - \frac{B_F}{P_F} \end{aligned}$$

Kareken & Wallace (1981) indeterminacy

World Asset Market Clearing:

$$S_H + S_F = \frac{B_H}{P_H\uparrow} + \frac{B_F}{P_F\downarrow}$$

Continuum of equilibrium prices!

Equilibrium Net Foreign Assets

Prices P_H and P_F define NFAs

$$\frac{NFA_H}{P_H} = S_H - \frac{B_H}{P_H\uparrow}$$
$$\frac{NFA_F}{P_F} = S_F - \frac{B_F}{P_F\downarrow}$$

Kareken & Wallace (1981) indeterminacy

World Asset Market Clearing:

$$S_H + S_F = \frac{B_H}{P_H\uparrow} + \frac{B_F}{P_F\downarrow}$$

Continuum of equilibrium prices!

Equilibrium Net Foreign Assets

Prices P_H and P_F define NFAs

$$\frac{NFA_H}{P_H} \Uparrow = S_H - \frac{B_H}{P_H\uparrow}$$
$$\frac{NFA_F}{P_F} \Downarrow = S_F - \frac{B_F}{P_F\downarrow}$$

Kareken & Wallace (1981) indeterminacy

World Asset Market Clearing:

$$S_H + S_F = \frac{B_H}{P_H\uparrow} + \frac{B_F}{P_F\downarrow}$$

Continuum of equilibrium prices!

Equilibrium Net Foreign Assets

Prices P_H and P_F define NFAs

$$\frac{NFA_H}{P_H} \Uparrow = S_H - \frac{B_H}{P_H\uparrow}$$
$$\frac{NFA_F}{P_F} \Downarrow = S_F - \frac{B_F}{P_F\downarrow}$$

No aggregate risk $\Longrightarrow$ NFA Indifference $\Longrightarrow$ Many Equilibria

Kareken & Wallace (1981) indeterminacy

World Asset Market Clearing:

$$S_H + S_F = \frac{B_H}{P_H} + \frac{B_F}{P_F}$$

Equilibrium Net Foreign Assets

Prices P_H and P_F define NFAs

$$\begin{aligned} \frac{NFA_H}{P_H} &= S_H - \frac{B_H}{P_H} \\ \frac{NFA_F}{P_F} &= S_F - \frac{B_F}{P_F} \end{aligned}$$

Aggregate risk $\Longrightarrow$ No NFA Indifference $\Longrightarrow$ One Equilibrium

Determinants of the Long-Run Exchange Rate

Long-Run Exchange Rate Effects of

1. Higher Long-Run Government Debt
   - If Absorbed by Home $\Longrightarrow$ Depreciation
   - If Absorbed by Foreign $\Longrightarrow$ Appreciation

2. Productivity Increase

   $\Longrightarrow$ Appreciation

3. Long-Run Portfolio Adjustment

   More NFAs $\Longrightarrow$ Appreciation

Long-Run Exchange Rate Effects of

1. Higher Long-Run Government Debt
   - If Absorbed by Home $\Longrightarrow$ Depreciation
   - If Absorbed by Foreign $\Longrightarrow$ Appreciation

2. Productivity Increase

   $\Longrightarrow$ Appreciation

3. Long-Run Portfolio Adjustment

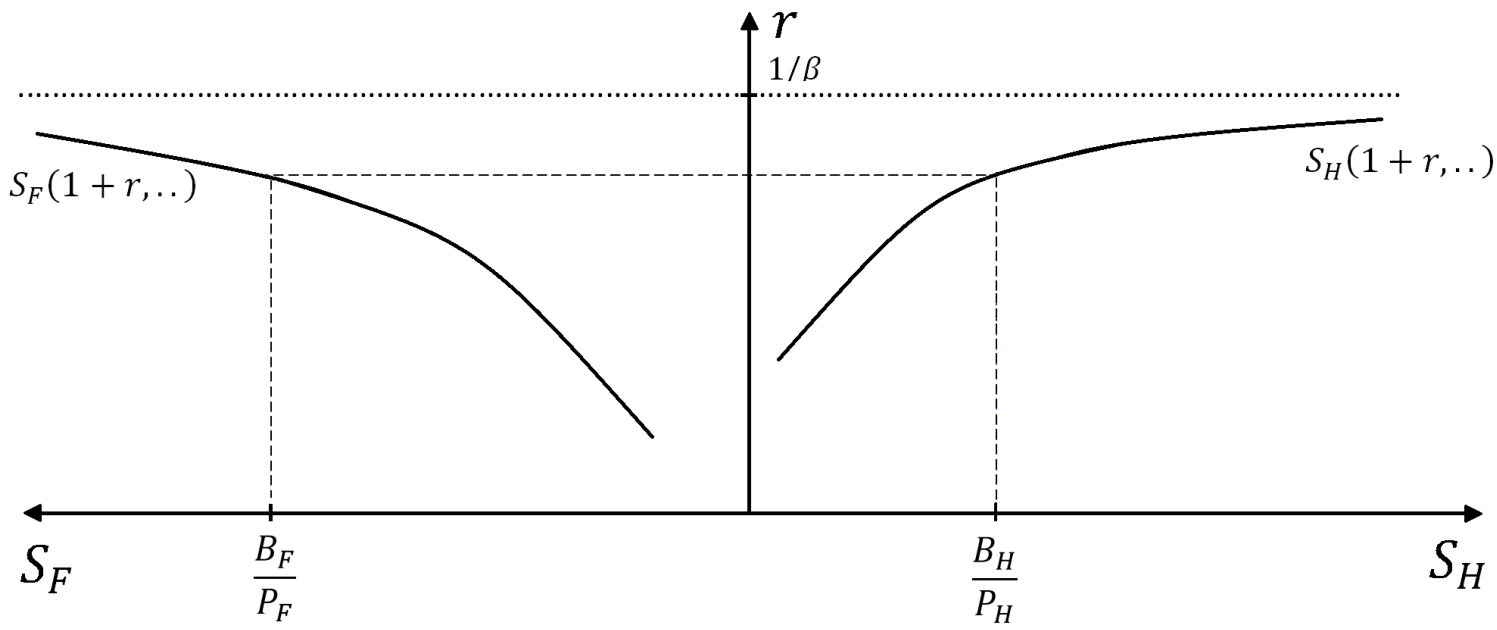
   More NFAs $\Longrightarrow$ Appreciation

IMPORTANT:

All Partial Effects
Comparison Across Steady-States

Long Run: Debt Expansion

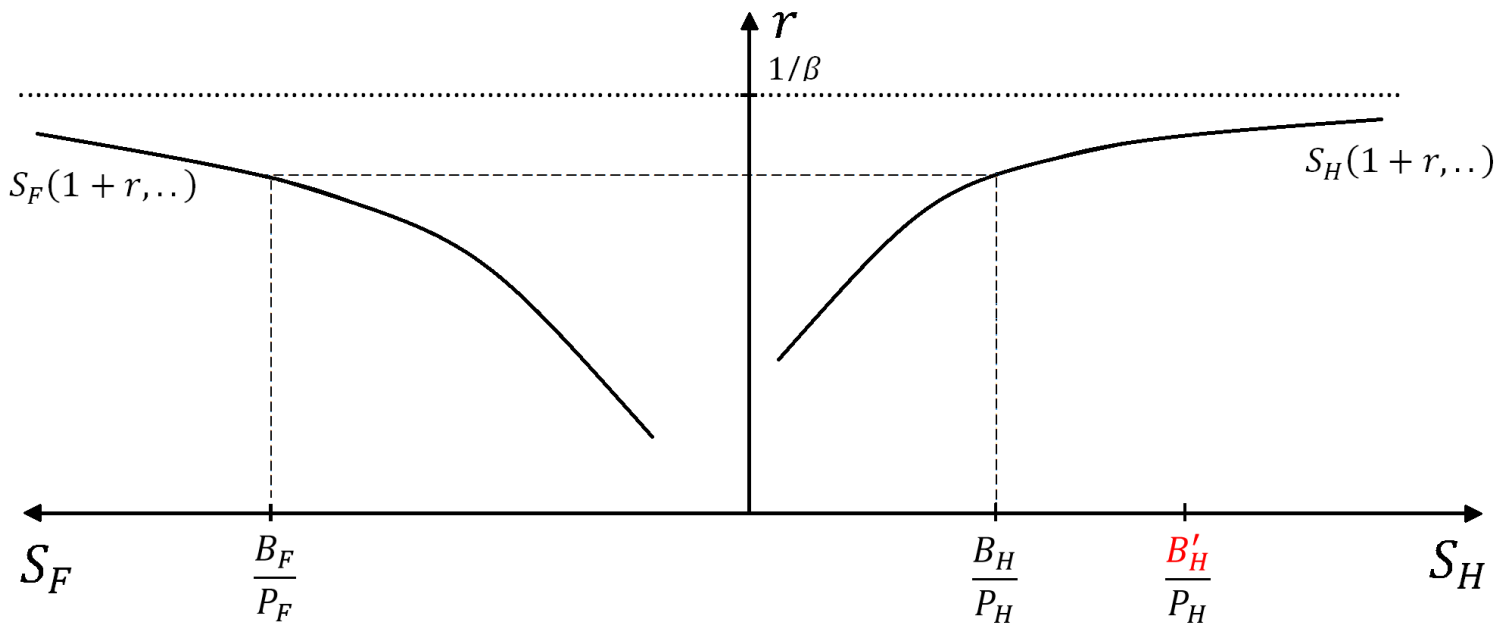
Home Absorption



Long Run: Debt Expansion

Home Absorption

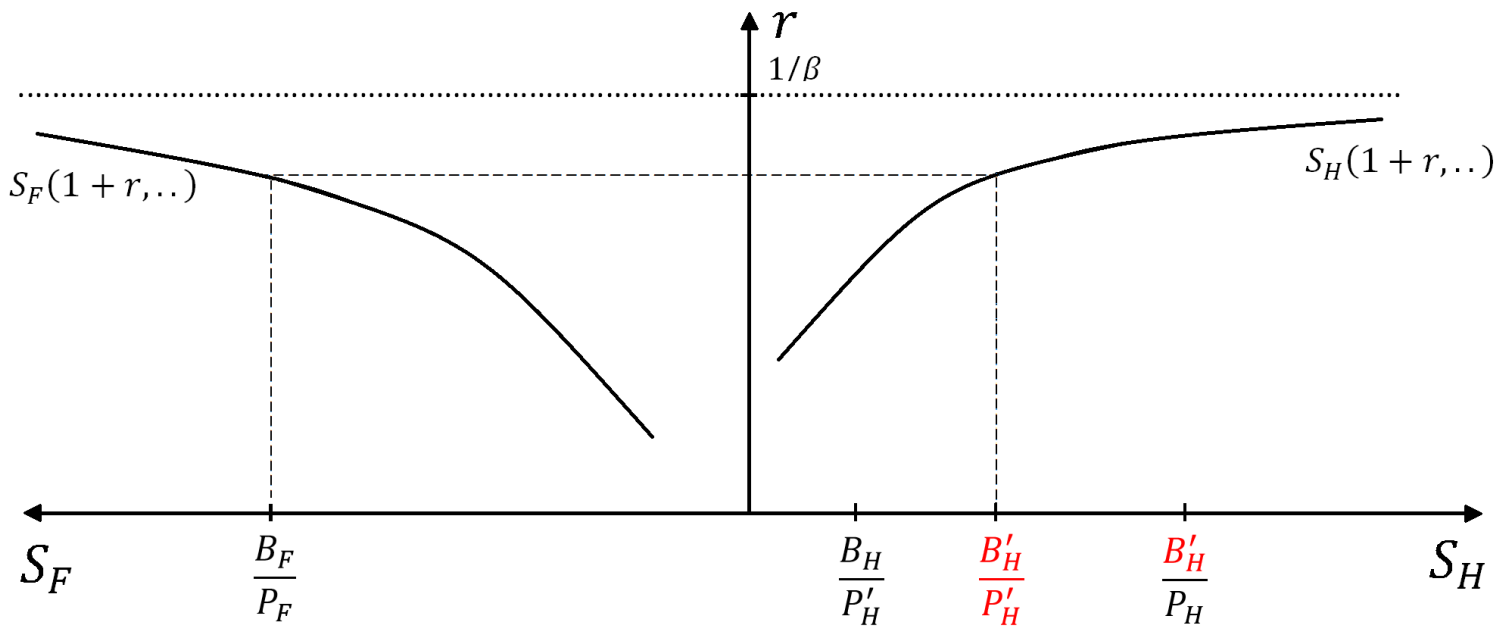
- Home bonds $B'_H > B_H$.
- Nominal NFA_H unchanged (Home Absorption).



Long Run: Debt Expansion

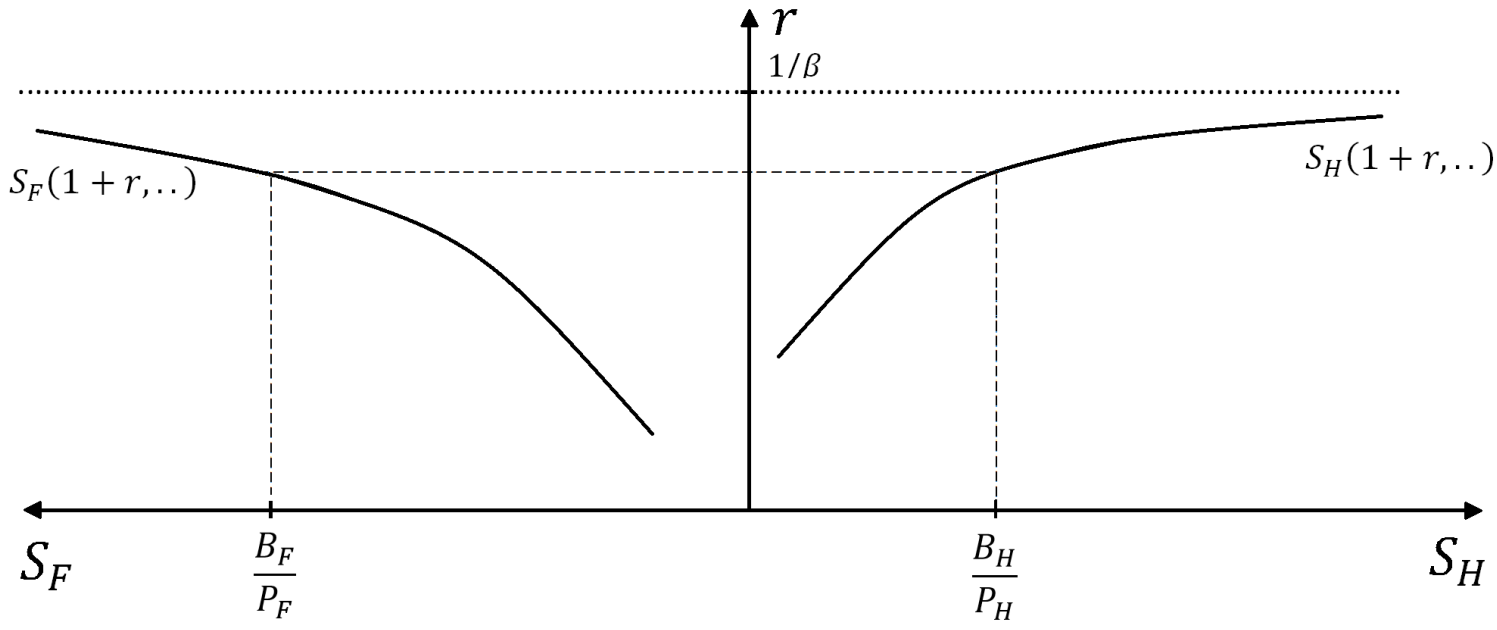
Home Absorption

- Home bonds $B'_H > B_H$.
- Nominal NFA_H unchanged (Home Absorption).
- Home price level $P'_H > P_H$; foreign price level $P'_F = P_F$
- NER $\epsilon' = \frac{P'_H}{P'_F} > \epsilon = \frac{P_H}{P_F}$ (Depreciation).



Long Run: Debt Expansion

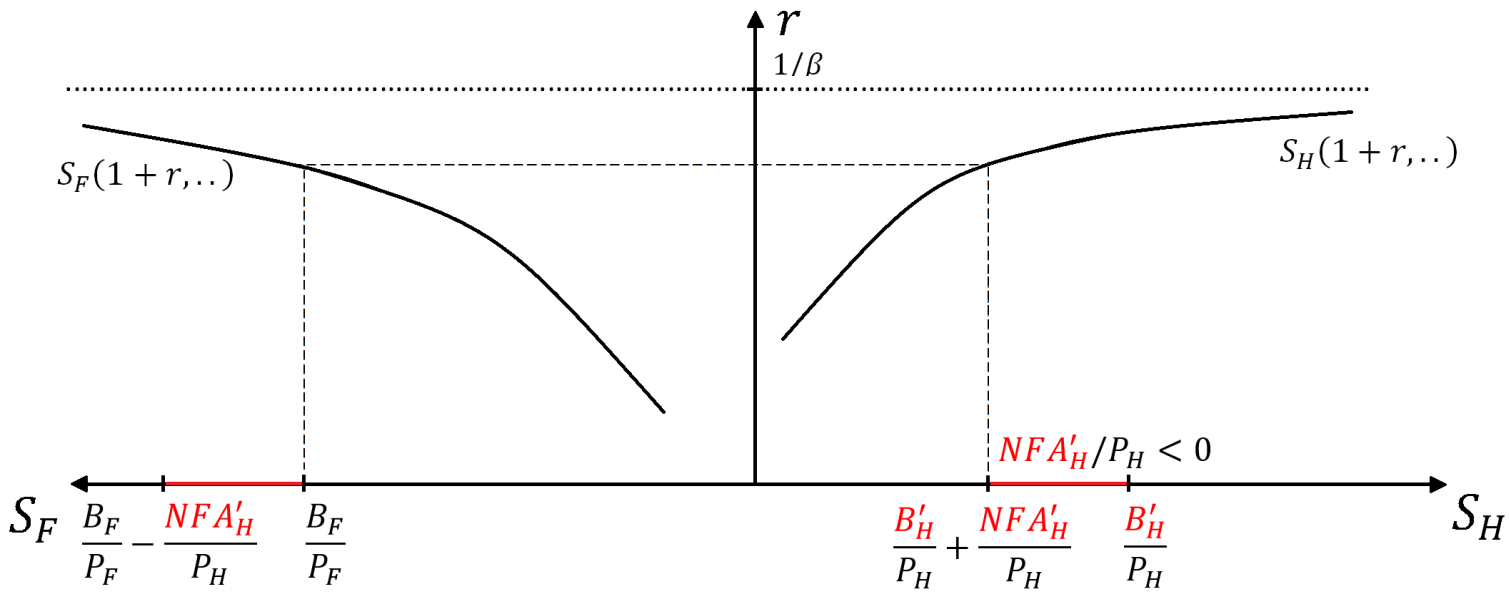
Foreign Absorption



Long Run: Debt Expansion

Foreign Absorption

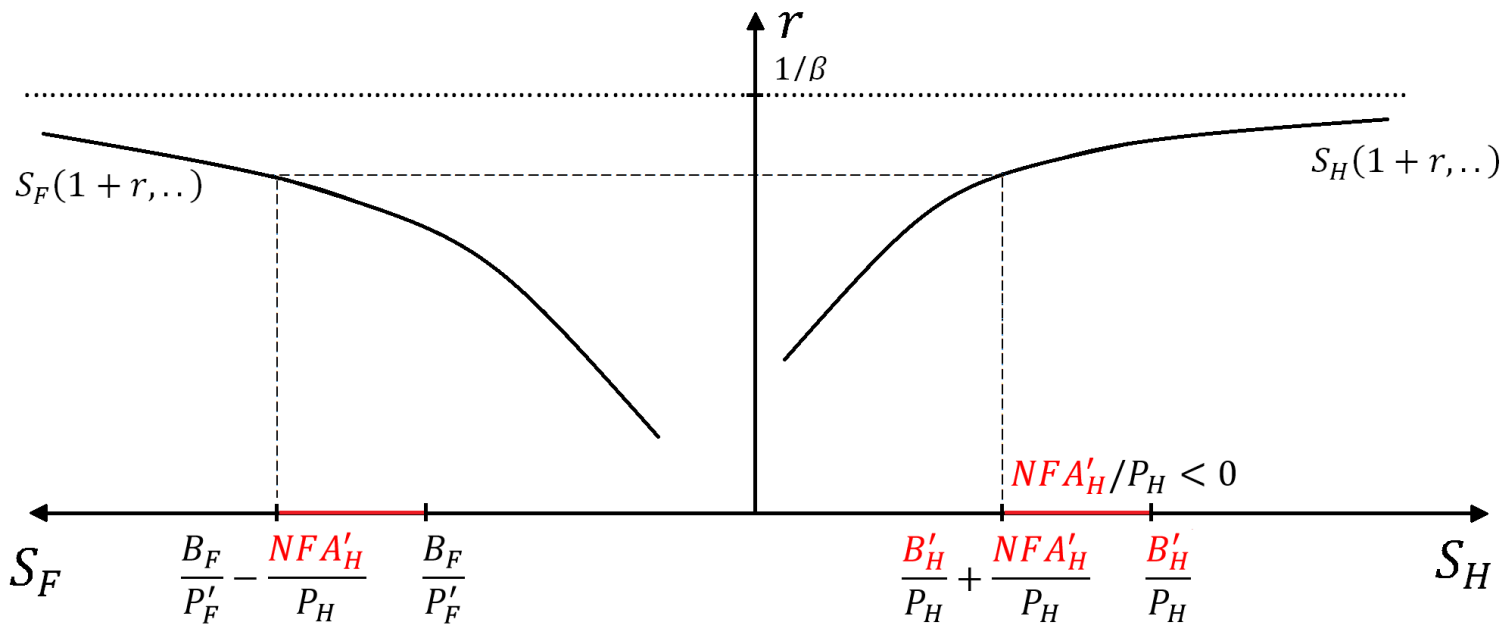
- Home bonds $B'_H > B_H$.
- Nominal $NFA'_H < NFA_H$ falls (Foreign Absorption).



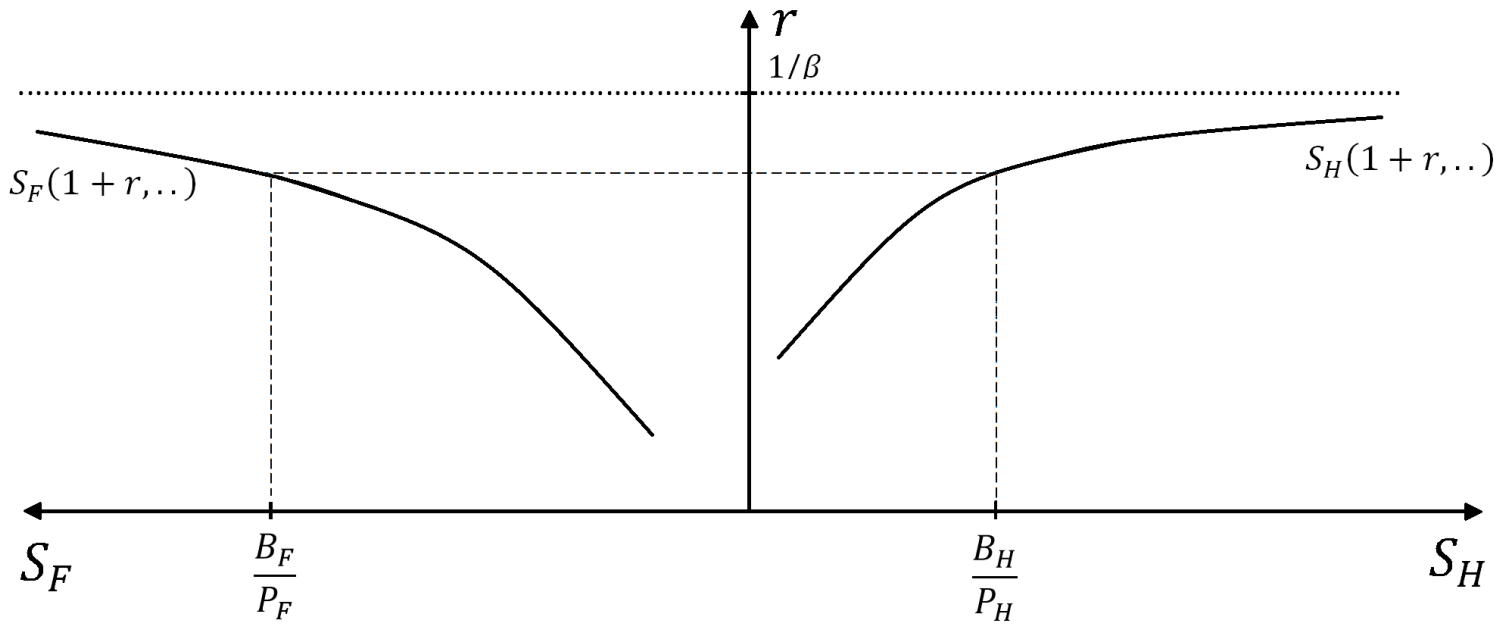
Long Run: Debt Expansion

Foreign Absorption

- Home bonds $B'_H > B_H$.
- Nominal $NFA'_H < NFA_H$ falls (Foreign Absorption).
- Home price level $P'_H = P_H$; foreign price level $P'_F > P_F$
- NER $\epsilon' = \frac{P'_H}{P'_F} < \epsilon = \frac{P_H}{P_F}$ (Appreciation).

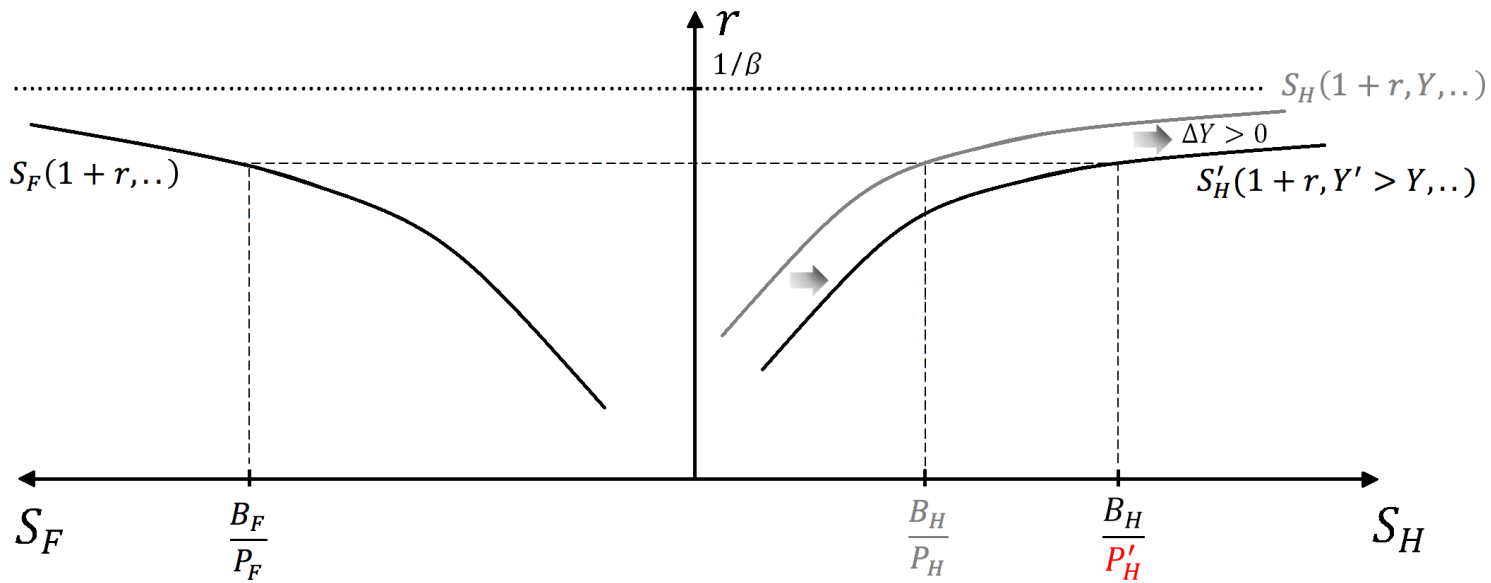


Long Run: Productivity Increase



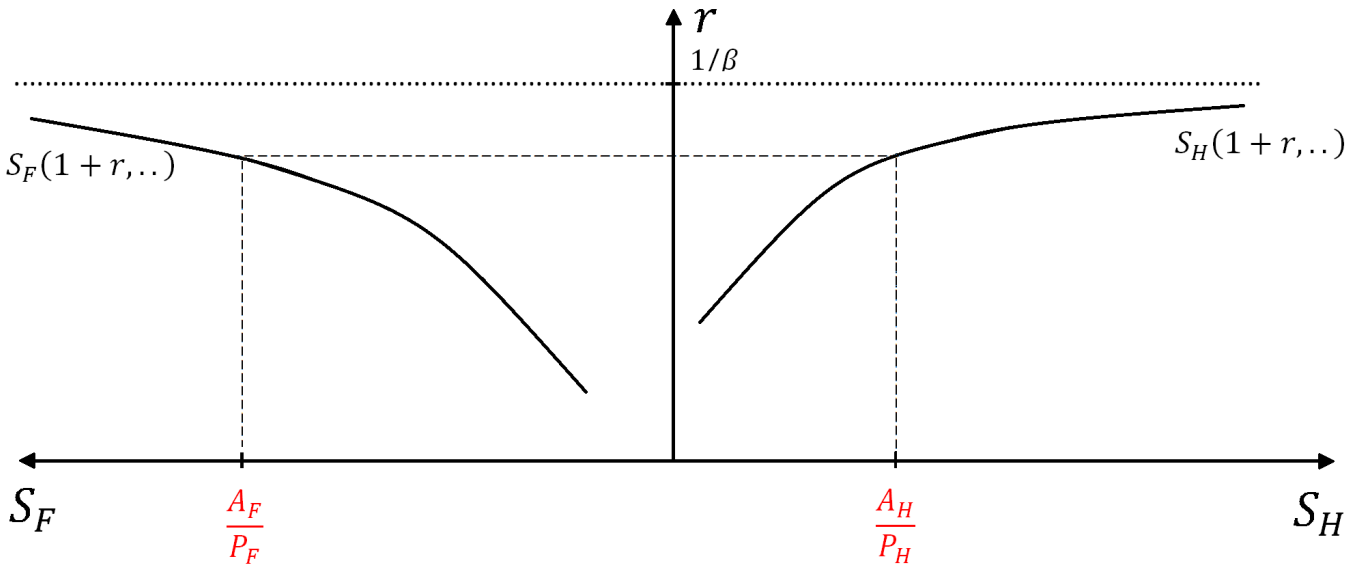
Long Run: Productivity Increase

- Productivity increase $Y' > Y$
- Home Savings Increase: $S'_H(Y', \ldots) > S_H(Y, \ldots)$
- Home price level $P'_H < P_H$; foreign price level $P'_F > P_F$
- NER $\epsilon' = \frac{P'_H}{P'_F} < \epsilon = \frac{P_H}{P_F}$ (Appreciation).



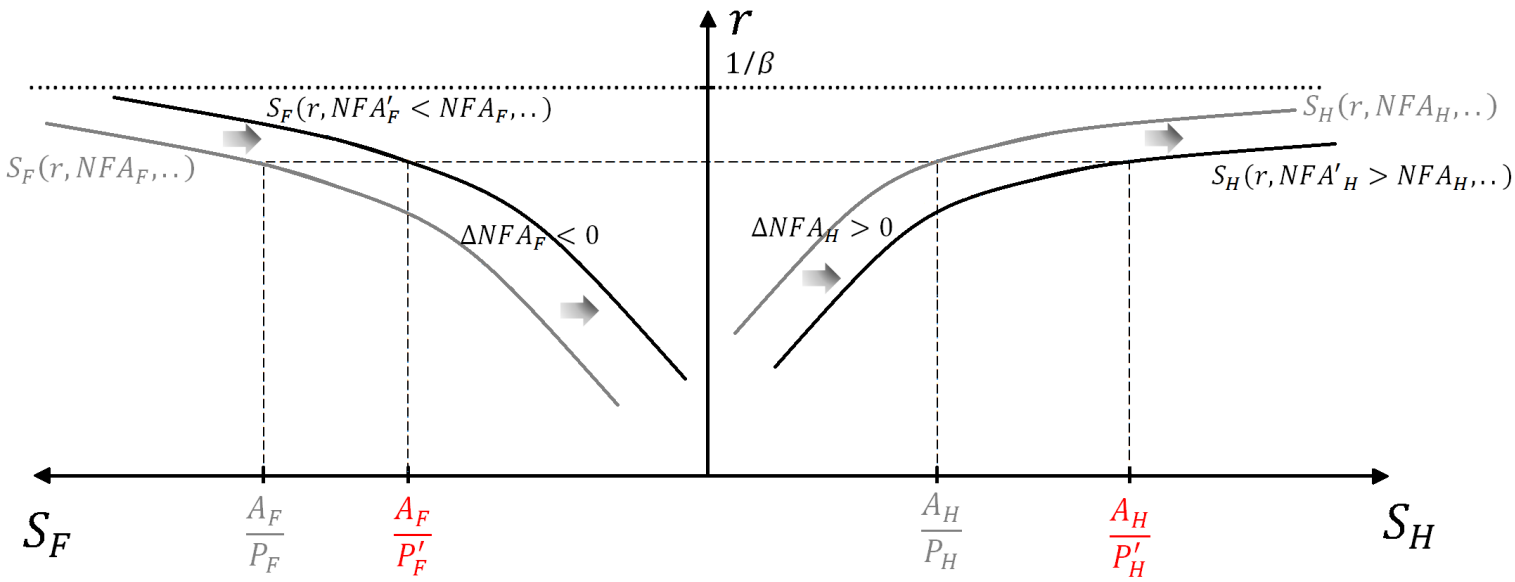
Portfolio Adjustment

- Total Nominal Assets A_H and A_F Unchanged
- Home Portfolio Switch: $NFA'_H > NFA_H$.
- Home Wealth and Savings up.



Portfolio Adjustment

- Total Nominal Assets A_H and A_F Unchanged
- Home Portfolio Switch: $NFA'_H > NFA_H$.
- Home Wealth and Savings up.
- Home price level $P'_H < P_H$; foreign price level $P'_F > P_F$
- NER $\epsilon' = \frac{P'_H}{P'_F} < \epsilon = \frac{P_H}{P_F}$ (Appreciation).



Temporary Shocks and Long-Run Effects

Short-Run $\Longleftrightarrow$ Long-Run

- Interest rate parity condition, $\epsilon_t = \frac{1+i_{F,t+1}}{1+i_{H,t+1}}\epsilon_{t+1}$,

  connects short-run and long-run exchange rate response:

$$\epsilon_t = \Big(\prod_{s=t+1}^{\infty} \frac{1+i_{F,s}}{1+i_{H,s}} \Big) \epsilon_\infty .$$

- Well defined since ϵ_∞ is determinate.

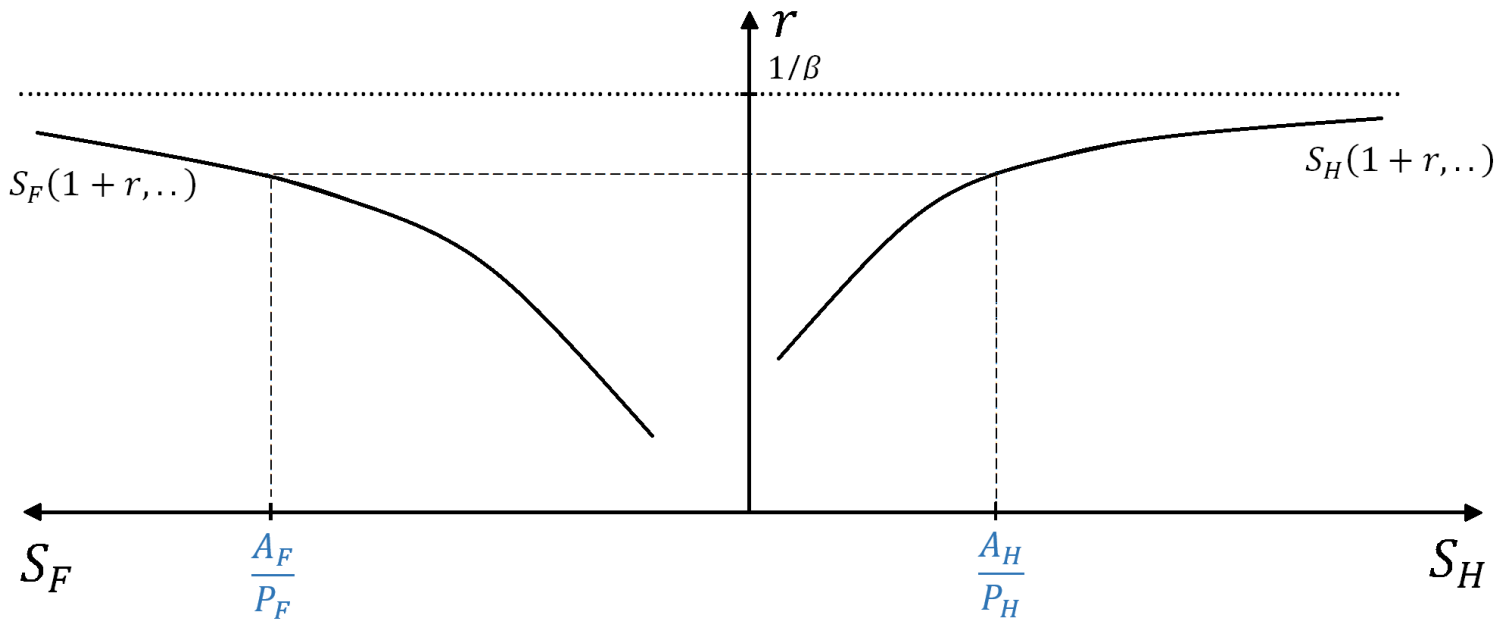
- Two step procedure:

  1. Find effect on long-run exchange rate.
  2. Apply Interest rate parity condition backwards to obtain short-run response.

Some Dilemmas

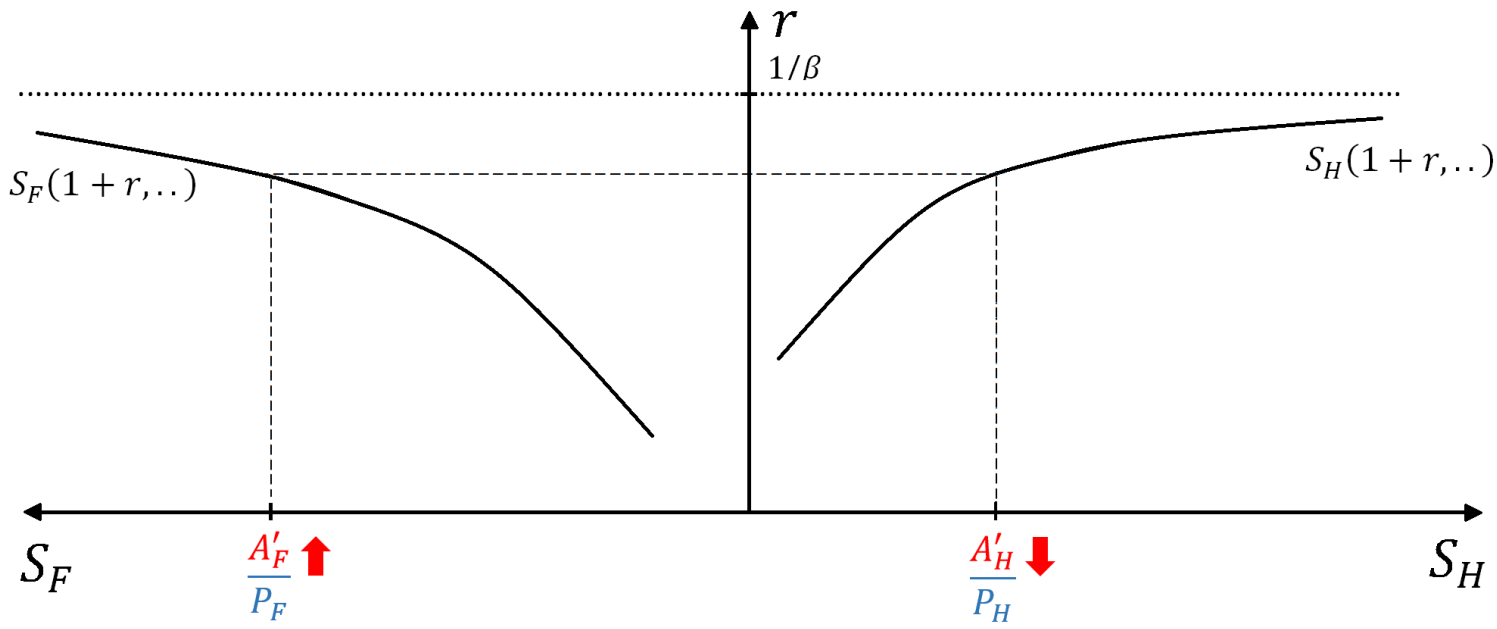
Asset Inflow (Triffin's Dilemma)

- Initial Asset Holdings: A_H and A_F.



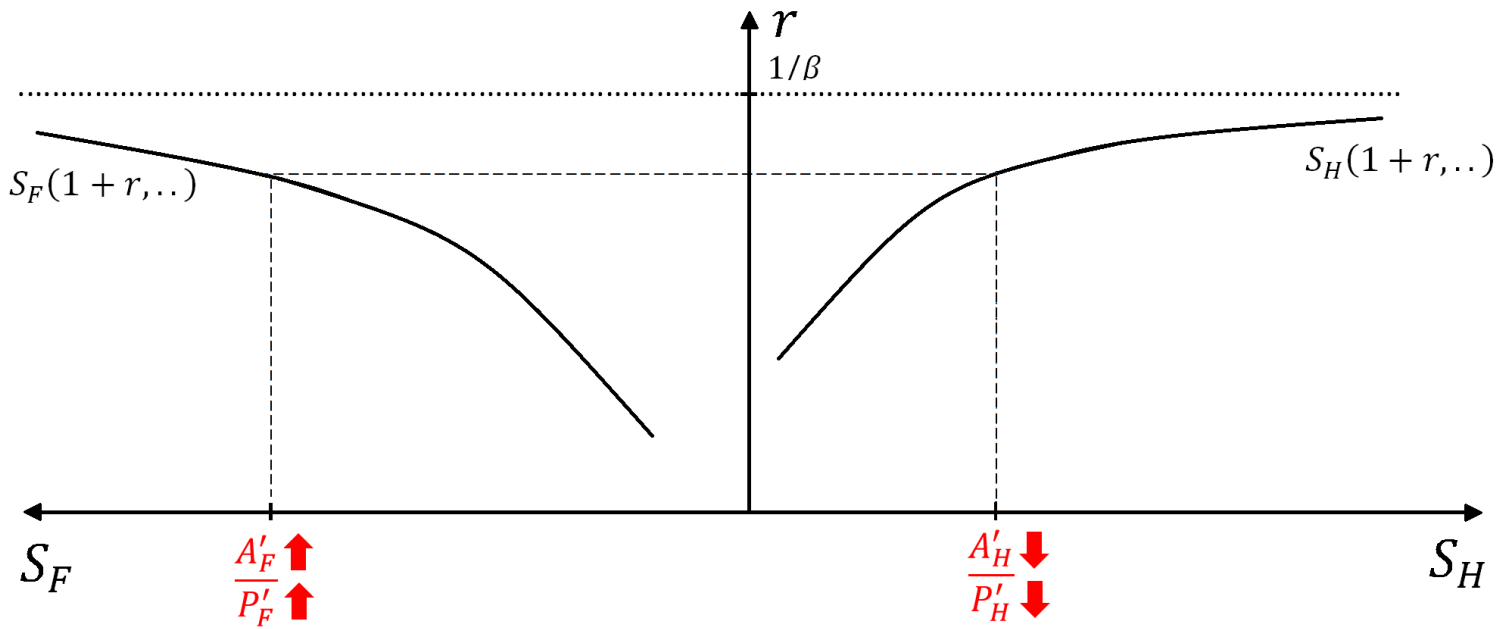
Asset Inflow (Triffin's Dilemma)

- Initial Asset Holdings: A_H and A_F.
- Asset Inflow: Foreign buys home assets. $NFA_H < 0$



Asset Inflow (Triffin's Dilemma)

- Initial Asset Holdings: A_H and A_F.
- Asset Inflow: Foreign buys home assets. $NFA_H < 0$
- Home price level $P'_H < P_H$; foreign price level $P'_F > P_F$
- NER $\epsilon' = \frac{P'_H}{P'_F} < \epsilon = \frac{P_H}{P_F}$ (Appreciation).



Tetralemma: Loss of fiscal policy independence

- Classic policy trilemma in international economics
  - Unrestricted capital mobility
  - Fixed exchange rate

  implies monetary policy independence:

$$1 + i_H = (1 + i_F)\frac{E_t \epsilon_{t+1}}{\epsilon_t} = 1 + i_F.$$

- Unanticipated asset outflow / negative prod. shock

  $\hookrightarrow$ Leads to depreciation.

- How to maintain exchange rate peg?

  $\hookrightarrow$ Monetary policy cannot be used ($i_H = i_F$).

  $\Longrightarrow$ Fiscal policy has to stabilize the exchange rate.

  $\Longrightarrow$ Loss of fiscal policy independence.

Conclusions

Conclusions

- I showed that three assumptions
  1. Asset markets within each country are incomplete.
  2. Presence of aggregate risk in each country.
  3. Assets are nominal.

  imply nominal exchange rate determinacy.
- Discussed Implications for
  - Exchange Rate Management
  - Asset flows and exchange rate
  - Sterilization/Exchange Rate Stabilization
  - Tetralemma: Loss of independent fiscal policy

Temporary Tightening of Home Monetary Policy

- Increase in Home nominal interest rate i_H.

  $\hookrightarrow$ Foreign country accumulates home assets.

  $\hookrightarrow$ Affects long-run asset distribution.

  $\hookrightarrow$ Temporary policy has long-run effects.

$\Longrightarrow$ Leads to long-run appreciation of Home exchange rate.

$\Longrightarrow$ Short-run appreciation.

Temporary Increase of Foreign Liquidity Demand

- Temporary increase in asset demand by Foreign.

  $\hookrightarrow$ Foreign country buys home assets.

  $\hookrightarrow$ Temporary policy has again long-run effects.

  $\hookrightarrow$ Affects long-run asset distribution.

$\Longrightarrow$ Leads to long-run appreciation of Home exchange rate.

$\Longrightarrow$ Short-run appreciation.

Empirical Evidence

Empirical Prediction and Specification

$$\epsilon_t = \mathcal{E}\big(\underset{(+)}{A_{H,t}}, \underset{(-)}{NFA_{H,t}}, \underset{(-)}{R_{H,t}}, \underset{(-)}{Y_{H,t}}\big).$$

- Total Assets $A_H = B_H + NFA_H$.
- B_H: Federal US Total Public Debt.
- NFA_H: US Net Foreign Debt from Gourinchas & Rey.
- R_H: Effective US Federal Funds Rate
- Y_H: US-GDP divided by employment

Specification:

$$\begin{aligned} & \Delta \log(\epsilon_t) \\ = \; & \gamma_0 + \gamma^A \Delta \log(A_{H,t}) + \gamma^{NFA} \Delta \log(NFA^{H,t}) + \gamma^Y \Delta \log(Y_{H,t}) + \gamma^R \log(R_{H,t-1}) \\ + \; & \eta_t \end{aligned}$$

Empirical Prediction and Specification

$$
\begin{aligned}
& \Delta \log(\epsilon_t) \\
= \quad & \gamma_0 + \gamma^A \Delta \log(A_{H,t}) + \gamma^{NFA} \Delta \log(NFA^{H,t}) + \gamma^Y \Delta \log(Y_{H,t}) + \gamma^R \log(R_{H,t-1}) \\
+ \quad & \eta_t
\end{aligned}
$$

Assets A_{US}	NFA_{US}	FFR_{US}	Productivity Y_{US}
0.3497***	-0.1585***	-0.0034***	-0.3687***
(0.0006)	(0.0000)	(0.0000)	(0.0035)

Quarterly Observations: 124, R^2: 0.1749
1973:Q1 to 2004:Q1
Robust pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Empirical Specification: Longer Horizons

– Define: $\Delta_k x_t = x_t - x_{t-k}$

– Specification with $k-$ period difference:

$$\begin{aligned} & \Delta_k \log(\epsilon_t) \\ = \quad & \gamma_0 + \gamma_k^A \Delta_k \log(A_{H,t}) + \gamma^{NFA} \Delta_k \log(NFA^{H,t}) + \gamma_k^Y \Delta \log(Y_{H,t}) + \gamma_k^R \log(R_{H,t-k}) \\ + \quad & \eta_{k,t}. \end{aligned}$$

VARIABLES	(1) k=4q	(2) k=6q	(3) k=8q	(4) k=10q	(5) k=12q
A_{US}	0.3252***	0.3635**	0.3700***	0.3192**	0.3093**
	(0.0035)	(0.0173)	(0.0075)	(0.0269)	(0.0357)
NFA_{US}	-0.1629**	-0.2210**	-0.2604***	-0.3254***	-0.4131***
	(0.0122)	(0.0172)	(0.0081)	(0.0019)	(0.0005)
R_{US}	-0.0122***	-0.0163***	-0.0207***	-0.0210***	-0.0228***
	(0.0000)	(0.0000)	(0.0000)	(0.0016)	(0.0064)
Y_{US}	-0.8464**	-0.9634*	-1.2129*	-1.2454	-1.0771
	(0.0106)	(0.0820)	(0.0986)	(0.1717)	(0.2479)
Observations	121	119	117	115	113
R^2	0.2393	0.2675	0.3281	0.3713	0.4482

Robust pval in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Results 83:Q1 - 04:Q1

$$
\begin{aligned}
& \Delta \log(\epsilon_t) \\
= \quad & \gamma_0 + \gamma^A \Delta \log(A_{H,t}) + \gamma^{NFA} \Delta \log(NFA^{H,t}) + \gamma^Y \Delta \log(Y_{H,t}) + \gamma^R \log(R_{H,t-1}) \\
+ \quad & \eta_t
\end{aligned}
$$

Assets A_{US}	NFA_{US}	FFR_{US}	Productivity Y_{US}
0.4246***	-0.2064***	-0.0048***	-0.5475*
(0.0009)	(0.0005)	(0.0000)	(0.0867)

Observations: 85, R^2: 0.1858
1983:Q1 to 2004:Q1
Robust pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Determinants of Net Foreign Assets

- Theory predicts:

  Changes in nominal interest rate and debt issuance

  $\hookrightarrow$ Accumulation of future net foreign assets

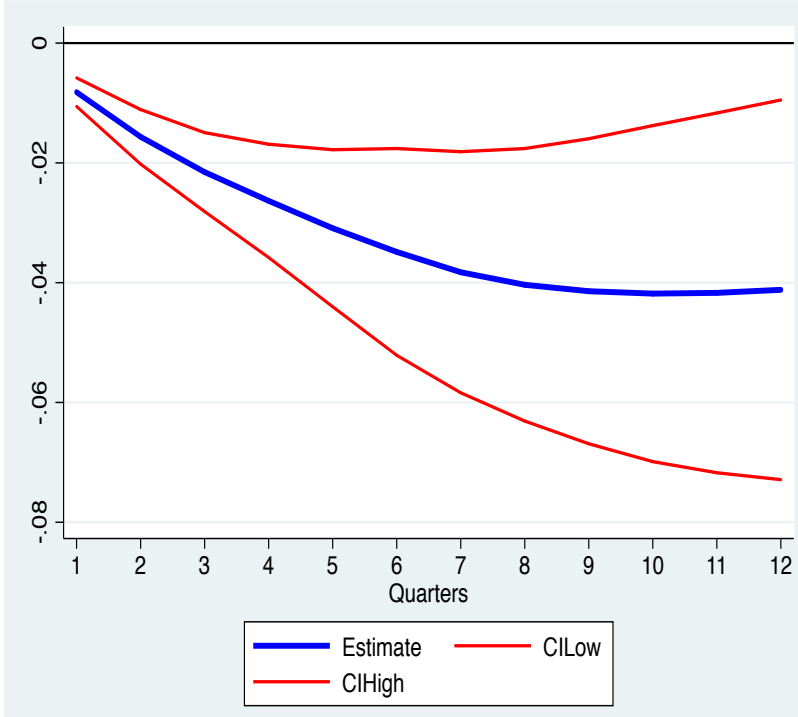
- Empirical specification to test these predictions:

$$\begin{aligned} & \log(NFA_{t+k}) - \log(NFA_t) \\ = \quad & \delta_k + \delta_k^B(\log(B_{t+k}) - \log(B_t)) + \delta_k^R(\log(R_{US,t-1}) - \log(R_{ROW,t-1})) + \mu_{k,t}, \end{aligned}$$

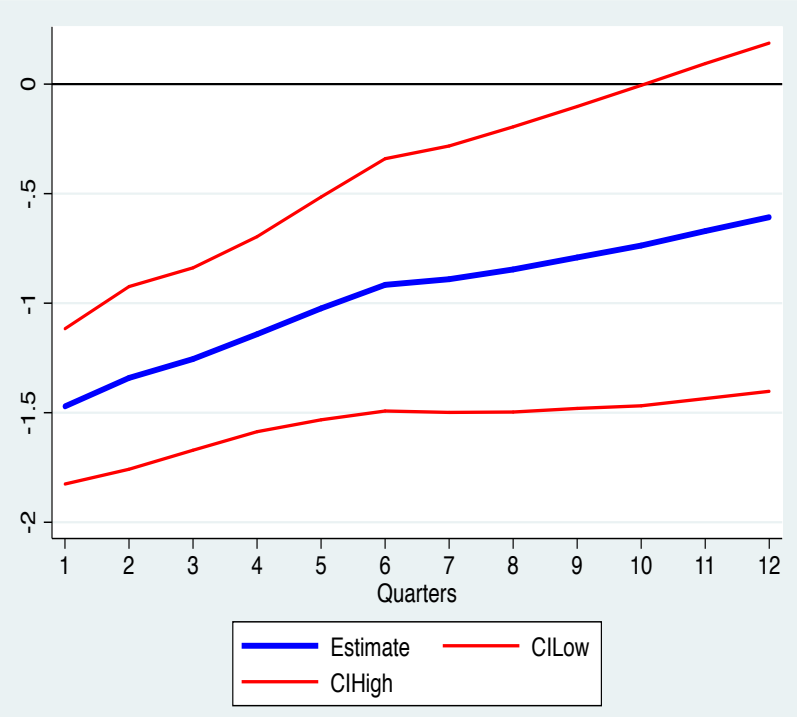
- Theory predicts:
  - $\delta^B < 0$: Foreign buys some of newly issued home debt.
  - $\delta^R < 0$: Foreign buys home debt.

Evidence on the Determinants of the US net foreign asset position

$$\begin{aligned} & \log(NFA_{t+k}) - \log(NFA_t) \\ = \quad & \delta_k + \delta_k^B(\log(B_{t+k}) - \log(B_t)) + \delta_k^R(\log(R_{US,t-1}) - \log(R_{ROW,t-1})) + \mu_{k,t}, \end{aligned}$$



Monetary Policy, $R_{US} - R_{ROW}$



Government Debt, B_{US}

Implications

Implications: Overview

Already seen:

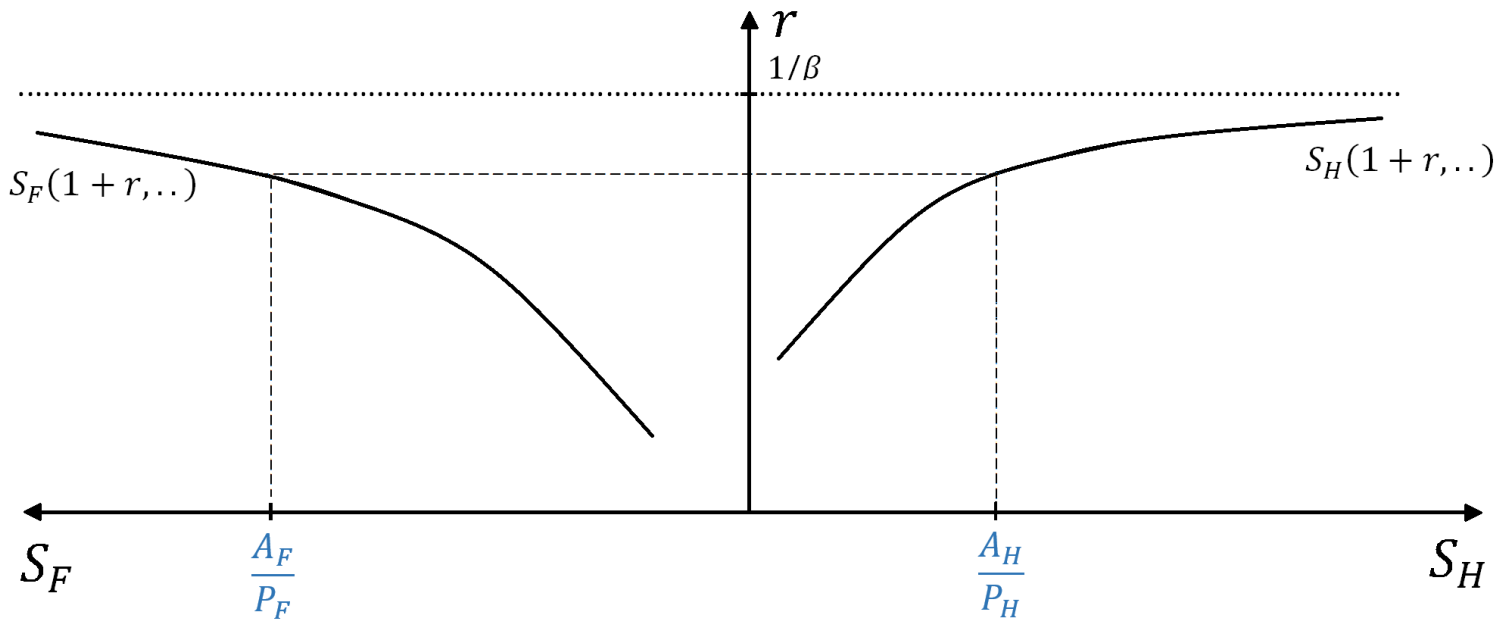
- How to manage the exchange rate:
  - Use increase in govt' bonds to depreciate.
  - Buy foreign assets to depreciate.

Now:

- Effects of asset flows/NFAs on exchange rates.
  - Asset Inflow leads to appreciation.
- Sterilization/Exchange Rate Stabilization
- Tetralemma: Loss of independent fiscal policy

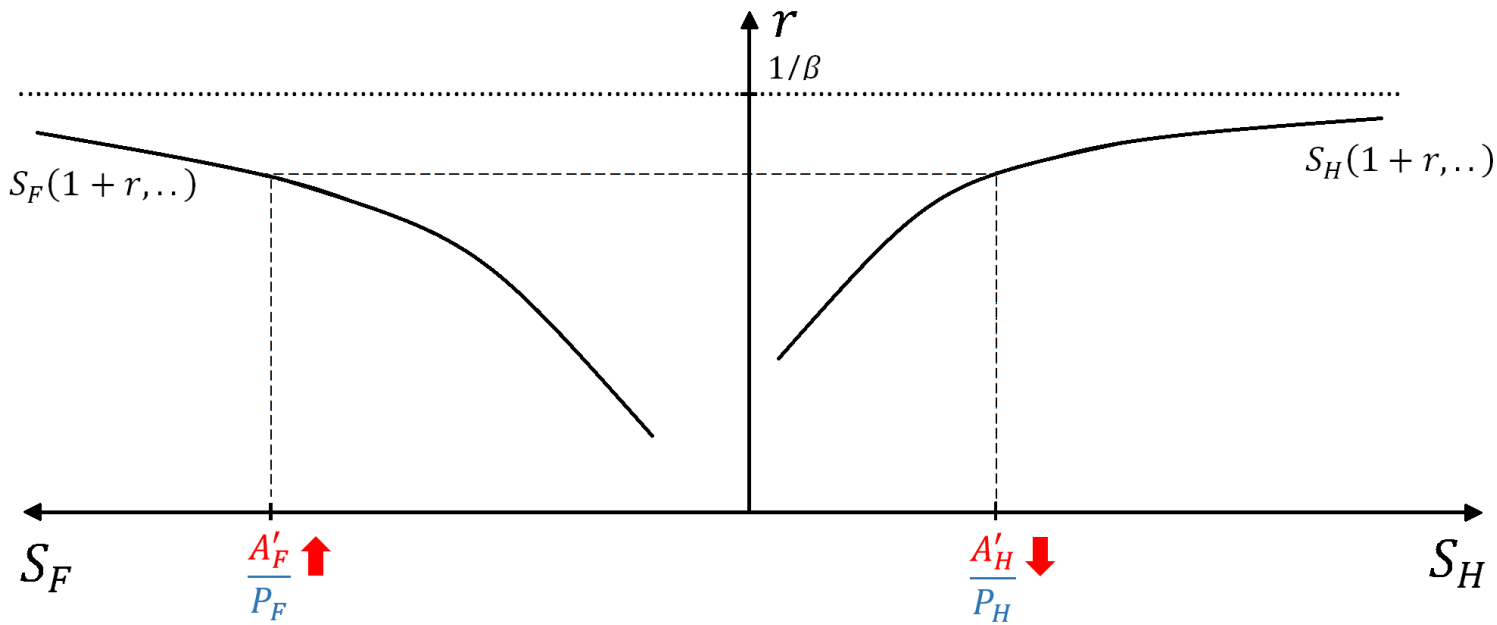
Asset Inflow

- Initial Asset Holdings: A_H and A_F.



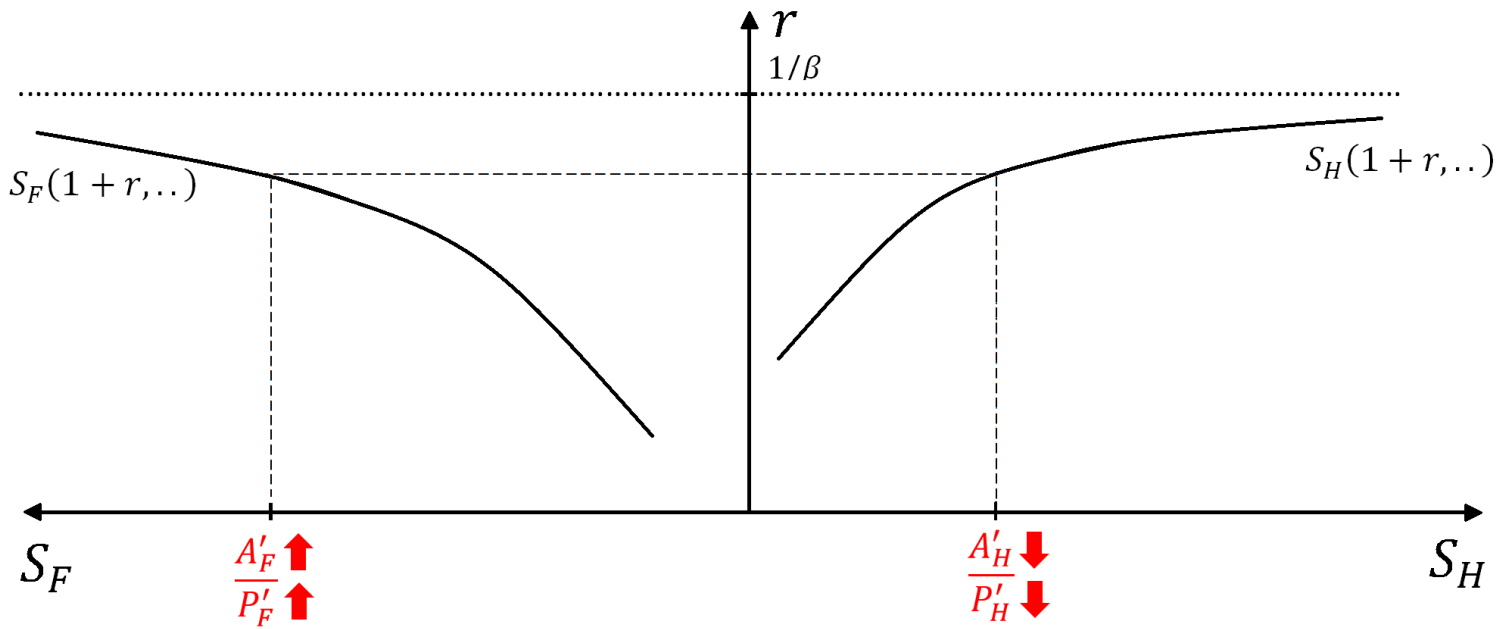
Asset Inflow

- Initial Asset Holdings: A_H and A_F.
- Asset Inflow: Foreign buys home assets. $NFA_H < 0$



Asset Inflow

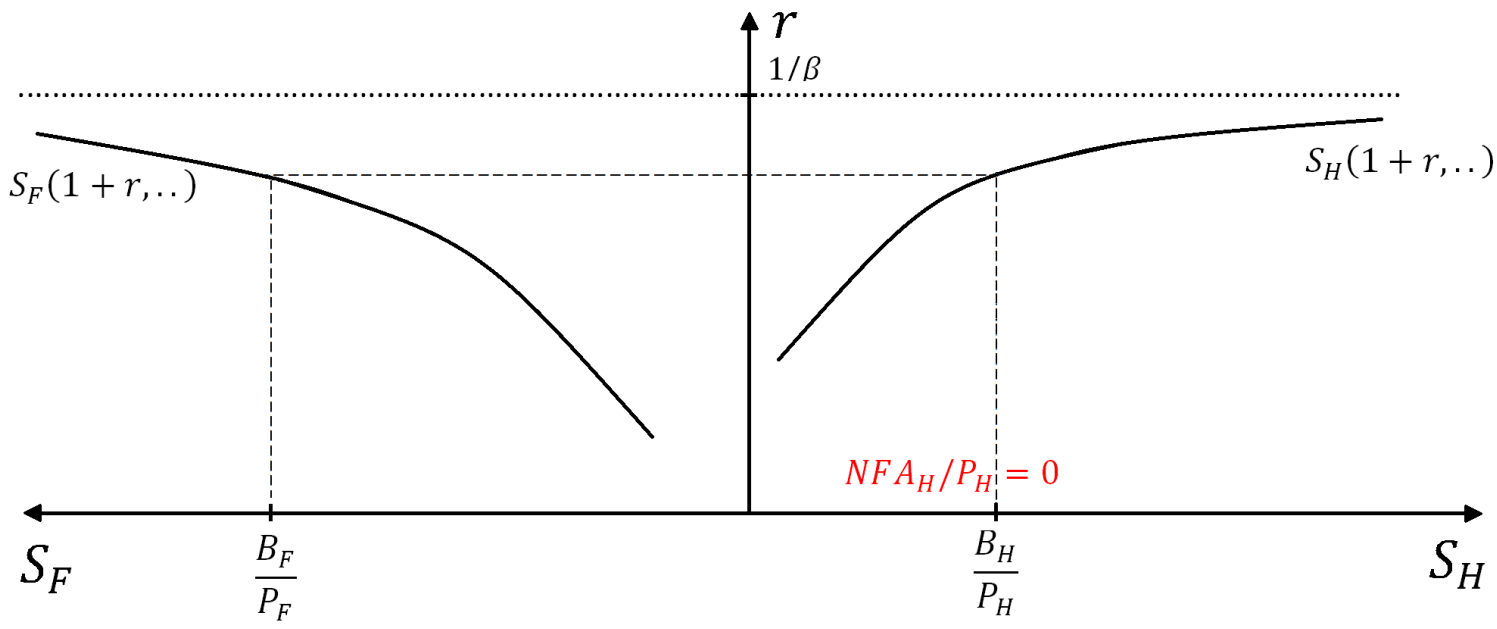
- Initial Asset Holdings: A_H and A_F.
- Asset Inflow: Foreign buys home assets. $NFA_H < 0$
- Home price level $P'_H < P_H$; foreign price level $P'_F > P_F$
- NER $\epsilon' = \frac{P'_H}{P'_F} < \epsilon = \frac{P_H}{P_F}$ (Appreciation).



Exchange Rate Policy

Sterilization

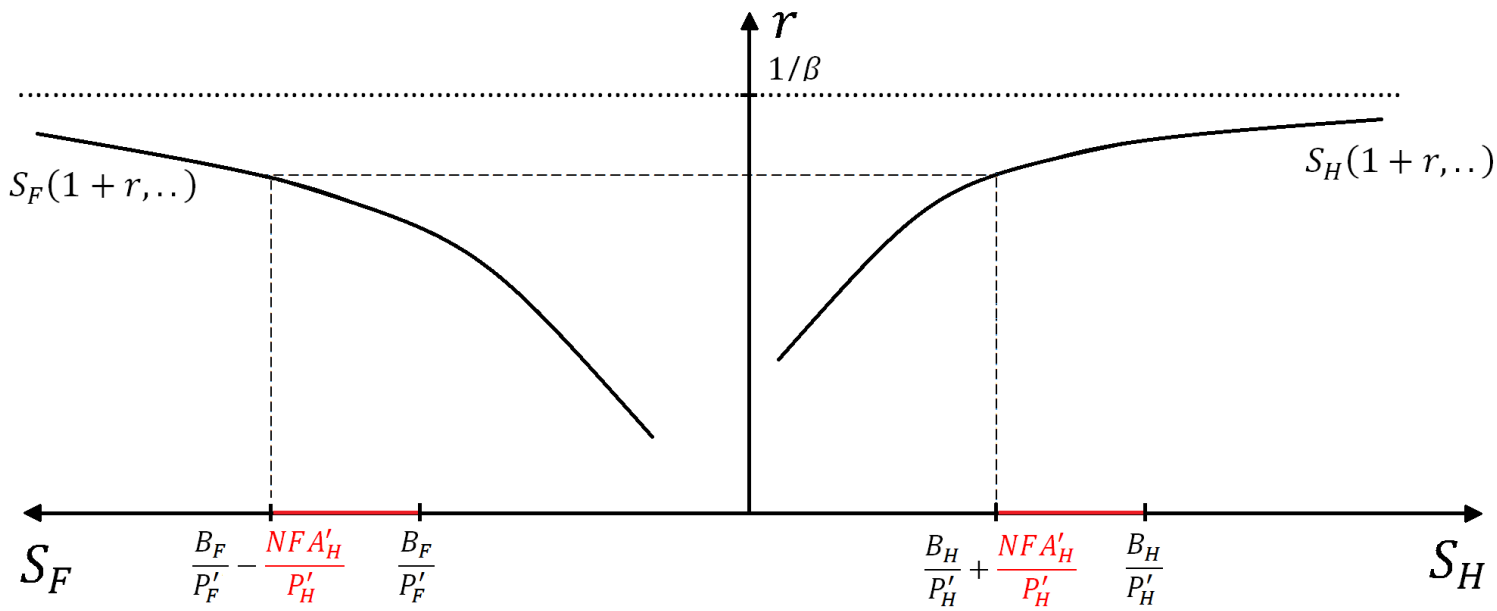
- Initial $NFA_H = 0$. Both Countries hold own assets.



Exchange Rate Policy

Sterilization

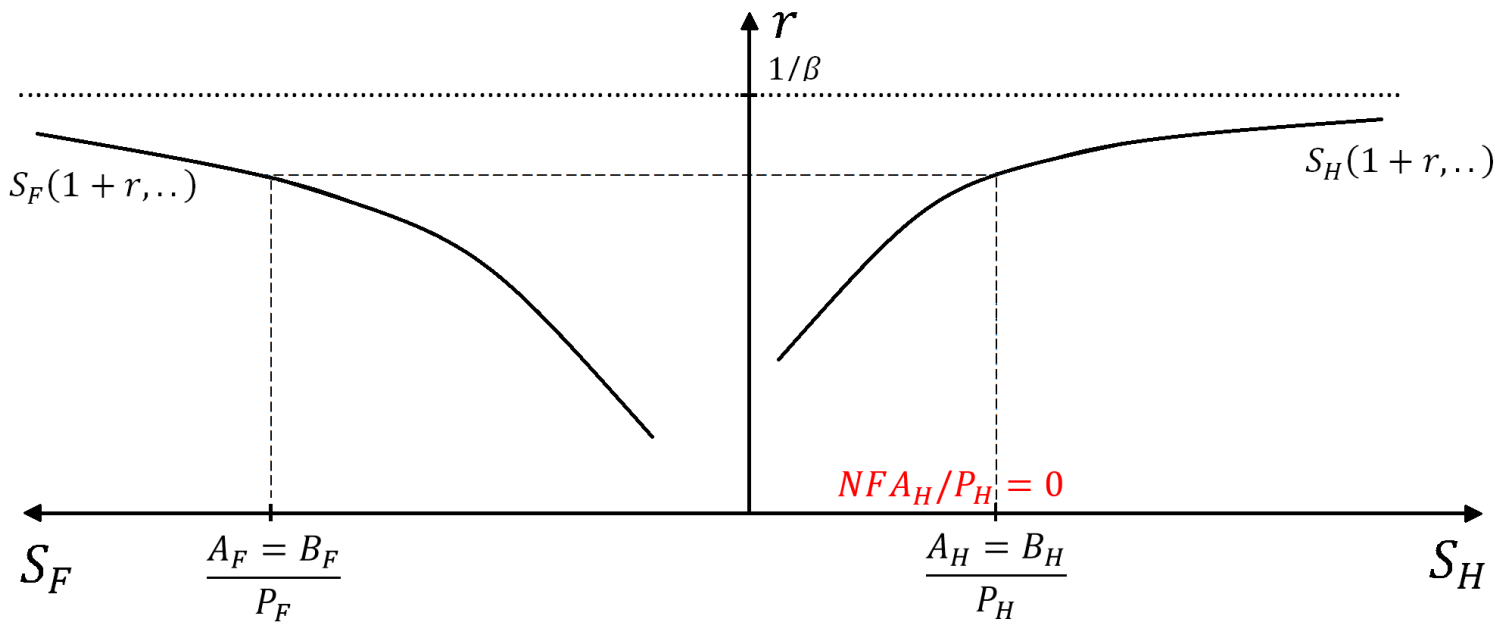
- Initial $NFA_H = 0$. Both Countries hold own assets.
- Next: Asset Inflow, $NFA_H < 0$. Appreciation.



Exchange Rate Policy

Sterilization

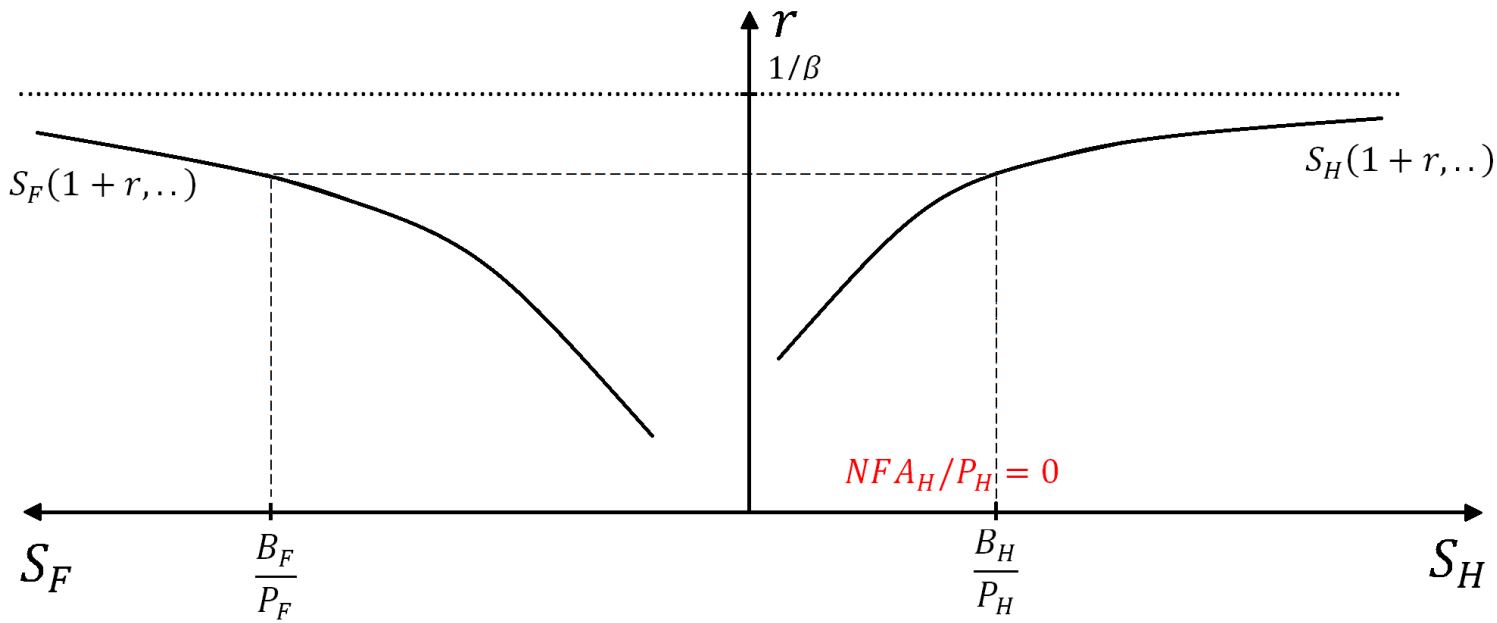
- Initial $NFA_H = 0$. Both Countries hold own assets.
- Next: Asset Inflow, $NFA_H < 0$. Appreciation.
- Full Sterilization: Undo NFA Flows $\Rightarrow NFA_H = 0$.
- All (NER, P_H, P_F, A_H, A_F) unchanged (except portfolio).



Stabilize Exchange Rate

Using Bonds Only

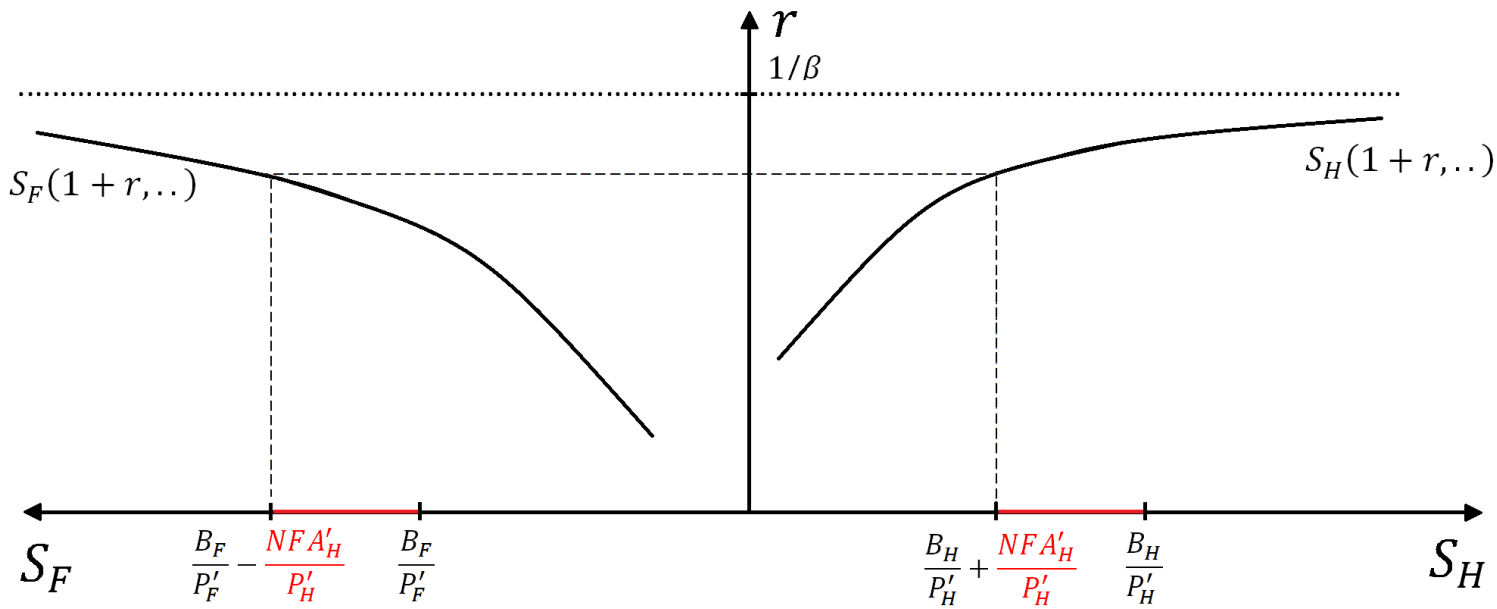
- Initial $NFA_H = 0$. Both Countries hold own assets.



Stabilize Exchange Rate

Using Bonds Only

- Initial $NFA_H = 0$. Both Countries hold own assets.
- Next: Asset Inflow, $NFA_H < 0$. Appreciation.

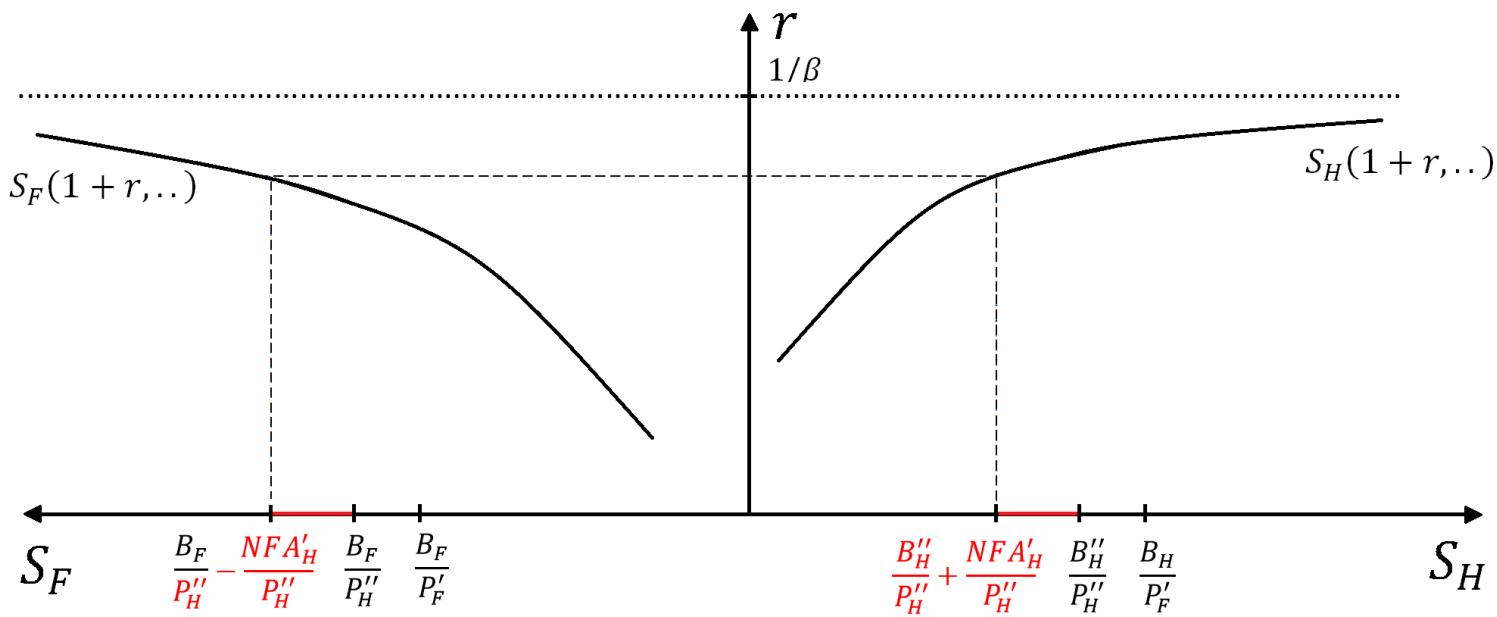


Stabilize Exchange Rate

Using Bonds Only

- Initial $NFA_H = 0$. Both Countries hold own assets.
- Next: Asset Inflow, $NFA_H < 0$. Appreciation.
- Issue bonds $B_H'' > B_H$ (full home absorption) until

$$\epsilon'' = \frac{P_H''}{P_F''} = \frac{P_H}{P_F} = \epsilon.$$



Tetralemma: Loss of fiscal policy independence

- Classic policy trilemma in international economics
  - Unrestricted capital mobility
  - Fixed exchange rate

  implies monetary policy independence:

$$1 + i_H = (1 + i_F)\frac{E_t \epsilon_{t+1}}{\epsilon_t} = 1 + i_F.$$

- Permanent asset outflow / negative prod. shock.

  $\hookrightarrow$ Leads to depreciation.

- How to maintain exchange rate peg?

  $\hookrightarrow$ Monetary policy cannot be used ($i_H = i_F$).

  $\Longrightarrow$ Fiscal policy has to stabilize the exchange rate.

  $\Longrightarrow$ Loss of fiscal policy independence.

Conclusions

Conclusions

- I showed that three assumptions
  1. Asset markets within each country are incomplete.
  2. Presence of aggregate risk in each country.
  3. Assets are nominal.

  imply nominal exchange rate determinacy.
- Discussed Implications for
  - Exchange Rate Management
  - Asset flows and exchange rate
  - Sterilization/Exchange Rate Stabilization
  - Tetralemma: Loss of independent fiscal policy

Additional Slides

Exchange Rate Determination:

Non-Vanishing Aggregate Country Uncertainty

- A measure one of small countries, each subject to aggregate shocks.
- Each country is a Huggett economy.
- Aggregate income of country c is Y_c. Aggregate world income is constant.
- Fiscal policy sets nominal bonds B_c (denominated in their own currency), and nominal taxes T_c.
- SS government nominal budget constraints, $B_{c,+1} - (1 + i_c)B_c = T_c$.
- Bonds are fully mobile across borders and there are no transactions costs.
- In steady-state

$$1 + \gamma_c = \frac{B_{c,t+1} - B_{c,t}}{B_{c,t}} = \frac{T_{c,t+1} - T_{c,t}}{T_{c,t}},$$

Exchange Rate Determination:

World steady state

- Stationary distribution of country inflation rates

$$1 + \pi_c = \frac{P_{c,t+1} - P_{c,t}}{P_{c,t}} \sim \mu_\pi.$$

- Stationary distribution of demand of a country's assets

$$S^c \sim \mu_S.$$

- Asset market clearing for country c bonds:

$$\frac{B_{c,t}}{\mathbf{P_{c,t}}} = S^c.$$

- Induces stationary distribution for P_c (from μ_π and μ_S).
- Delivers stationary distribution of country $c - \tilde{c}$ exchange rates:

$$\epsilon_{c,\tilde{c}} = \frac{P_c}{P_{\tilde{c}}}.$$

Evidence on the Determinants of the US net foreign asset position

$$\begin{aligned} & \log(NFA_{t+k}) - \log(NFA_t) \\ = \quad & \delta_k + \delta_k^B(\log(B_{t+k}) - \log(B_t) + \delta_k^R(\log(R_{US,t-1}) - \log(R_{ROW,t-1})) + \mu_{k,t}, \end{aligned}$$

VARIABLES	k=1	k=4	k=8	k=12
Debt B	-1.4711***	-1.1416***	-0.8460***	-0.6076
	(0.0000)	(0.0000)	(0.0093)	(0.1263)
$R_{US} - R_{ROW}$	-0.0082***	-0.0263***	-0.0404***	-0.0412***
	(0.0000)	(0.0000)	(0.0004)	(0.0093)
Observations	84	81	77	73
R^2	0.3412	0.3866	0.4011	0.2878

Robust pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Forecasting Future Exchange Rates

Past NFAs ⇒ current exchange rate:

$$\log(\epsilon_{t+4}) - \log(\epsilon_t) = \kappa_0 + \kappa_1(\log(NFA_t) - \log(NFA_{t-4})) + \eta_t,$$
$$\log(\epsilon_{t+4}) - \log(\epsilon_t) = \kappa_0 + \kappa_1(\log(NFA_{t-4}) - \log(NFA_{t-8})) + \eta_t.$$

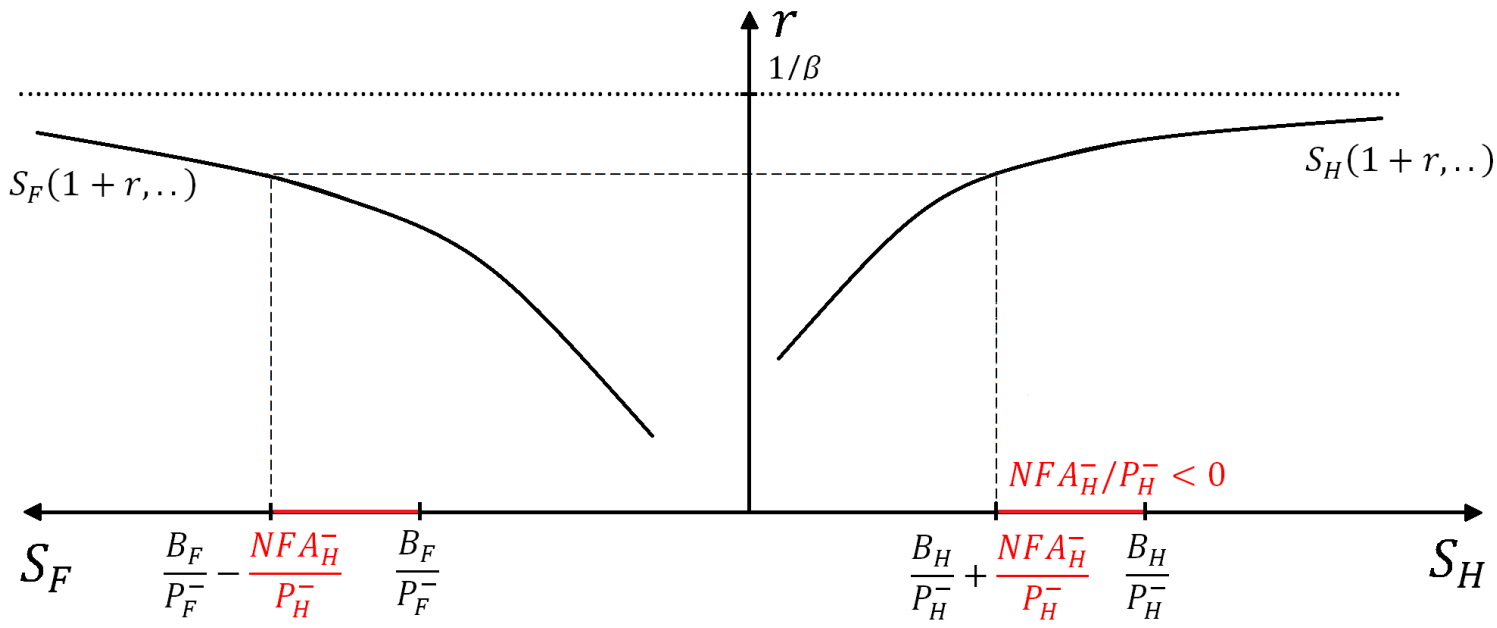
	$\log(\epsilon_{t+4}) - \log(\epsilon_t)$	
$NFA_t - NFA_{t-4}$	-0.2757**	-0.3372**
	(0.0377)	(0.0473)
R^2	0.1805	0.2227
$NFA_{t-4} - NFA_{t-8}$	-0.1143*	-0.2098***
	(0.0958)	(0.0040)
R^2	0.0466	0.0866
Observations	121	85
Time Period	1973:Q1-	1983:Q1-

Robust pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Kareken & Wallace (1981) indeterminacy NFA not determined

$NFA_H^- < 0$, World Asset Market Clears:

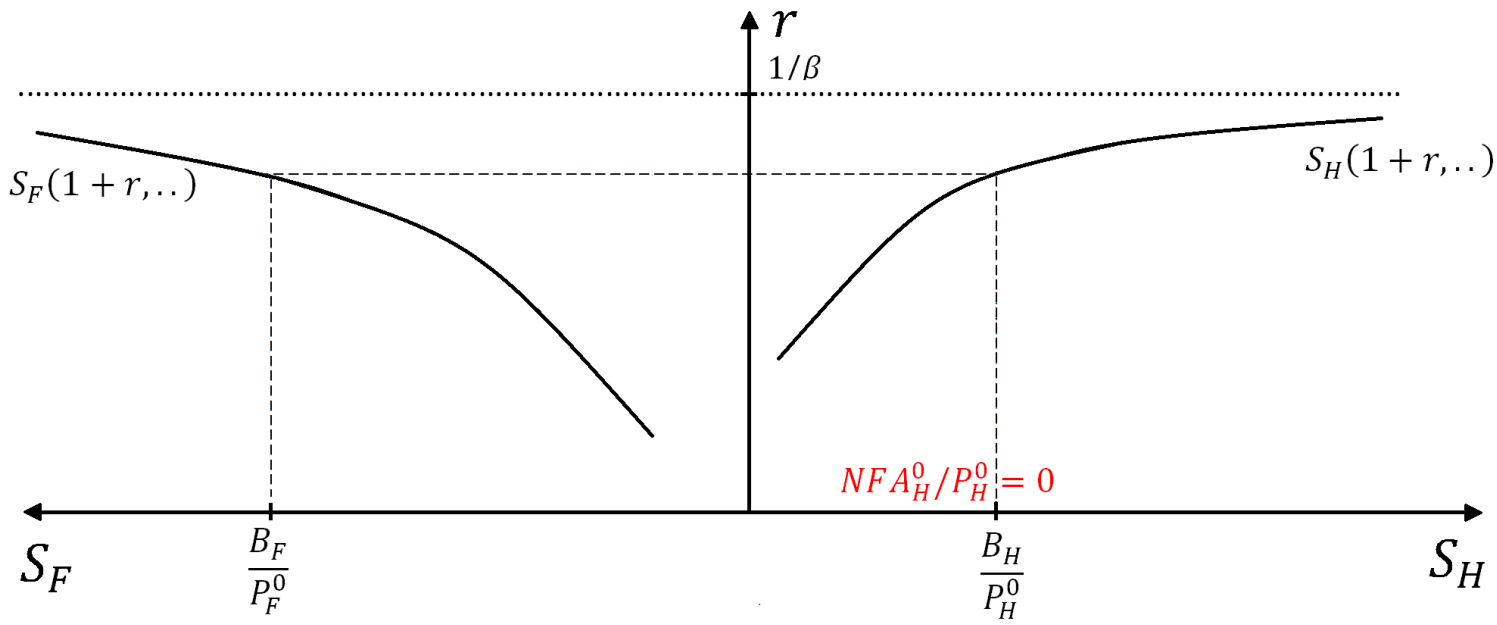
$$S_H + S_F = \frac{B_H}{P_H^-} + \frac{B_F}{P_F^-}$$



Kareken & Wallace (1981) indeterminacy
NFA not determined

$NFA_H^0 = 0$, World Asset Market Clears:

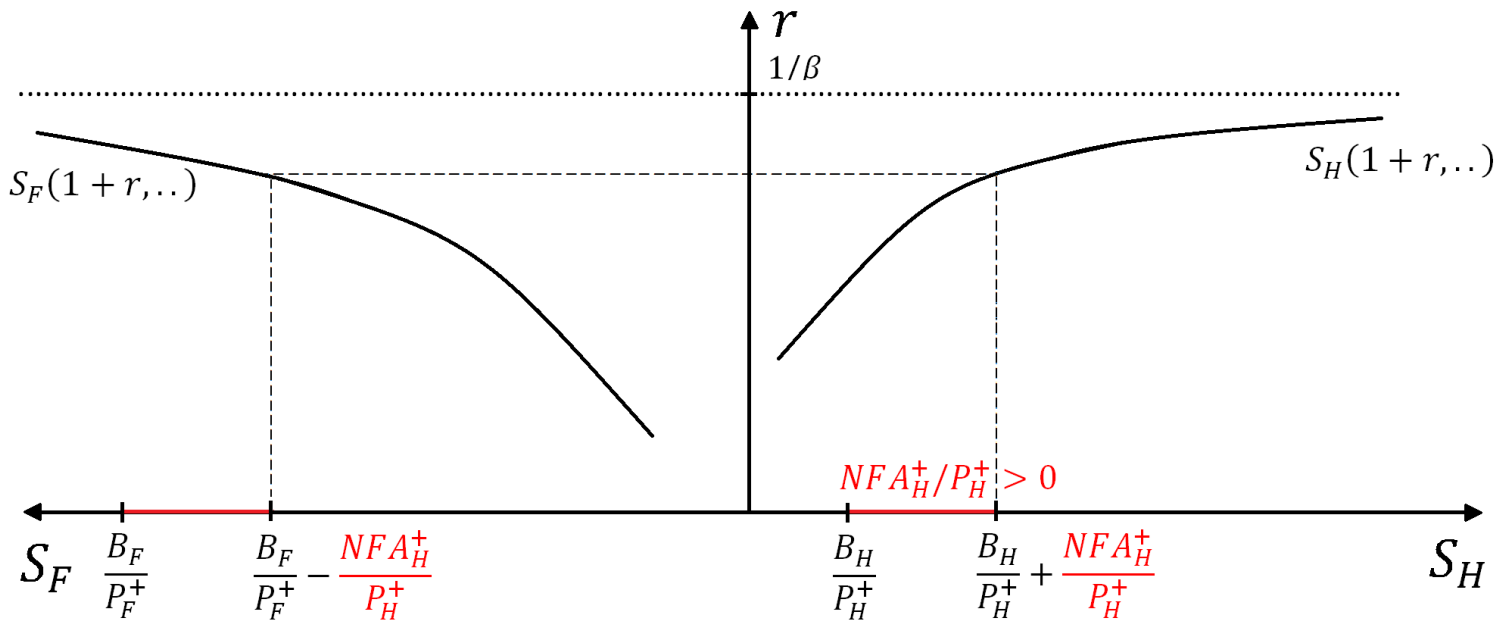
$$S_H + S_F = \frac{B_H}{P_H^0} + \frac{B_F}{P_F^0}$$



Kareken & Wallace (1981) indeterminacy
NFA not determined

$NFA_H^+ > 0$, World Asset Market Clears:

$$S_H + S_F = \frac{B_H}{P_H^+} + \frac{B_F}{P_F^+}$$



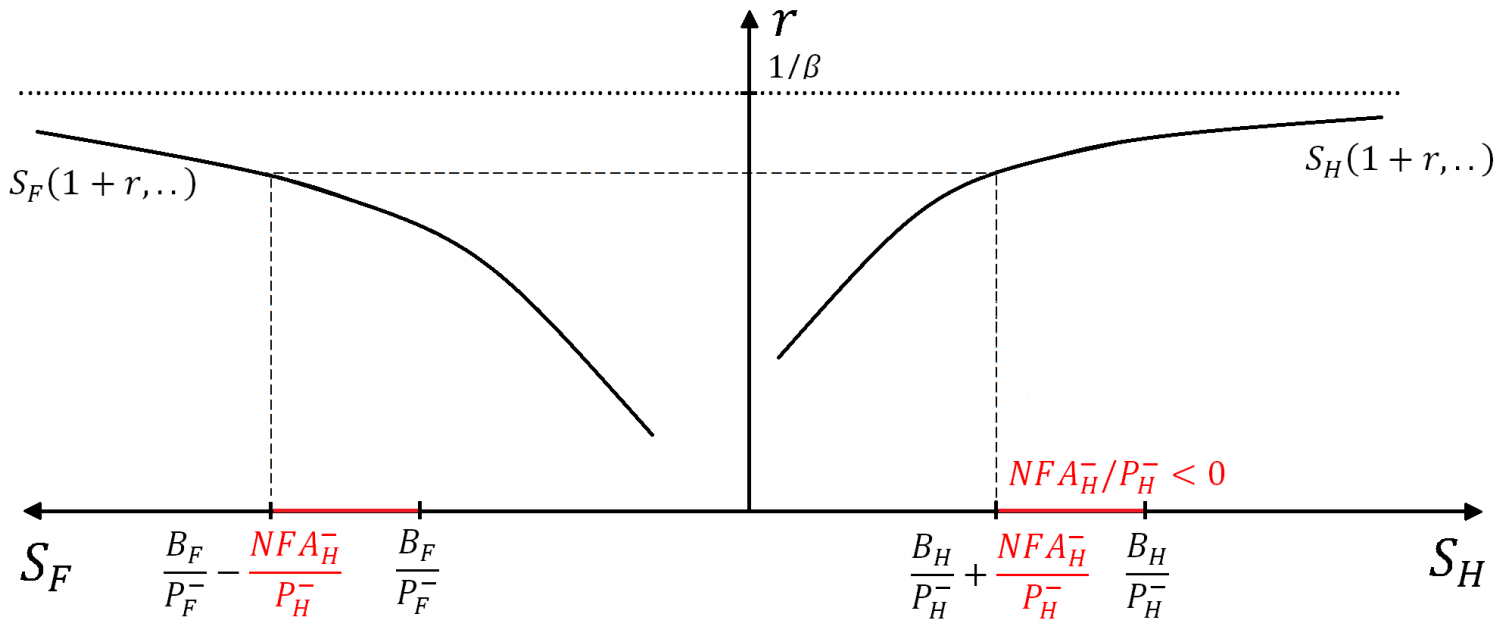
Long Run: NFA

Bonds B_H unchanged

$$NFA_H < 0$$

Exchange Rate : ϵ^-

$$\epsilon^- = P_H^-/P_F^-$$



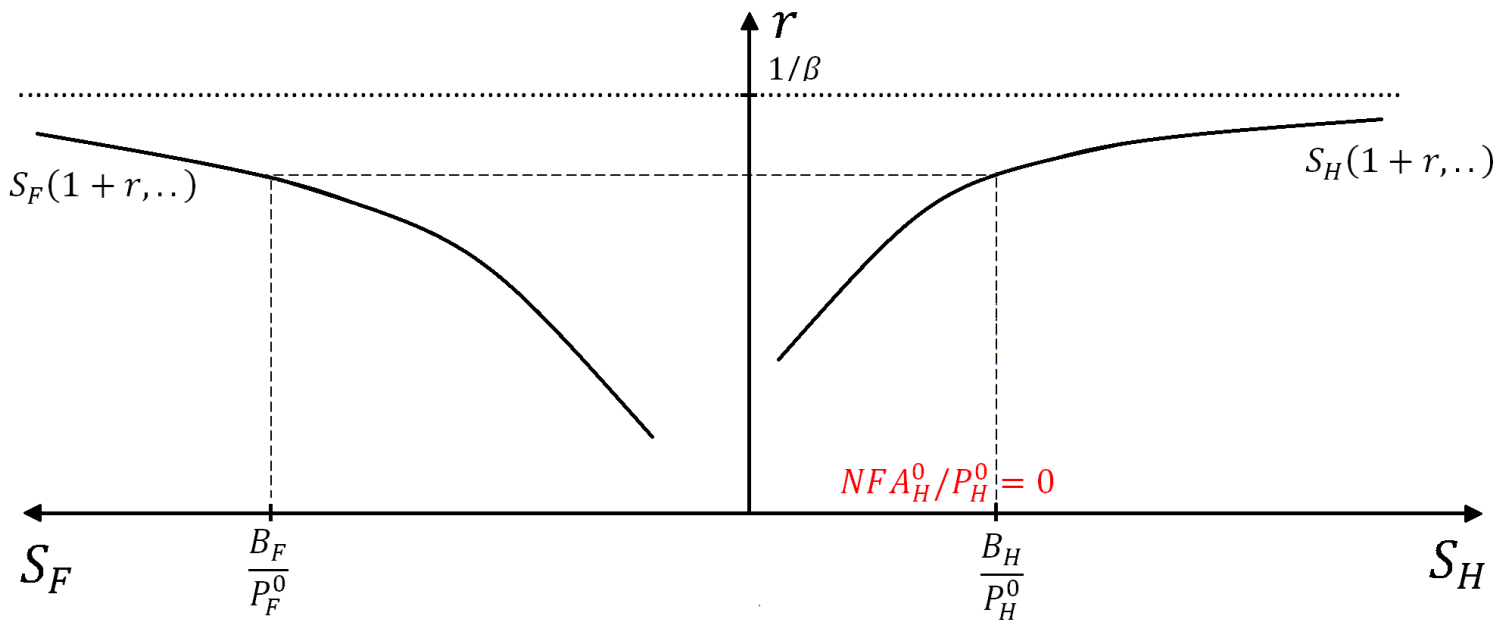
Long Run: NFA

Bonds B_H unchanged

$$NFA_H = 0$$

Exchange Rate : $\epsilon^- < \epsilon^0$

$$\epsilon^- = P_H^0 / P_F^0$$



Long Run: NFA

Bonds B_H unchanged

$$NFA_H > 0$$

Exchange Rate : $\epsilon^- < \epsilon^0 < \epsilon^+$

$$\epsilon^+ = P_H^+ / P_F^+$$