A Demand Theory of the Price Level

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Main Objective

- Bewley-Huggett-Aiyagari incomplete markets models offer different perspective on price level determinacy.
  - (More) Realistic model of consumption (MPCs, distributions, . . .)
- Assumptions on Policies
  - Monetary Policy sets nominal interest rates (Sargent & Wallace (1975))
  - Fiscal Policy is (partially) nominal

Three Pieces of Price Level Determinacy

- I: Steady State Price Level
  - Key (and unresolved) piece → several puzzles (Cochrane).
  - Adresses Sargent & Wallace interest rate peg.
  - Anchors long-run expectations.

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- II: Local Determinacy. Response to Shocks
  - Taylor rules/principle, ...
  - Behavioral fixes
    (Angeletos et.al., Gabaix, Farhi & Werning ,...)

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  - Taylor rules/principle, ...
  - Behavioral fixes
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- III: Hyperdeflations/Hyperinflations
  - Possible: Obstfeld & Rogoff fix
  - Hyperinflation artefact of fully flexible prices.

Fiscal Theory of the Price Level (FTPL)

- Meaning of FTPL:

  Government budget clears for only one price level

- Price Level Indeterminacy $\Leftrightarrow$ An equation is missing
  - FTPL: Use government budget constraint
  - Here: Asset Market clearing condition

- Not FTPL. To make distinction clear:

  Government budget constraint is fully in nominal terms

  $\hookrightarrow$ Satisfied for all prices

  $\hookrightarrow$ Not FTPL

Steady-State Price Level Determinacy in Incomplete Market Models

Policy rules

- Interest rate rule

$$i' = \Phi(i, \pi, Y, \ldots)$$

- Fiscal policy rules for B' and G:

$$B'(\mathrm{B},\ \mathrm{P},\ \mathrm{Y},\ \ldots)$$
$$G(\mathrm{B},\ \mathrm{P},\ \mathrm{Y},\ \ldots)$$

- Taxes balance the budget

$$T := (1 + i)B + G(\ldots) - B'(\ldots).$$

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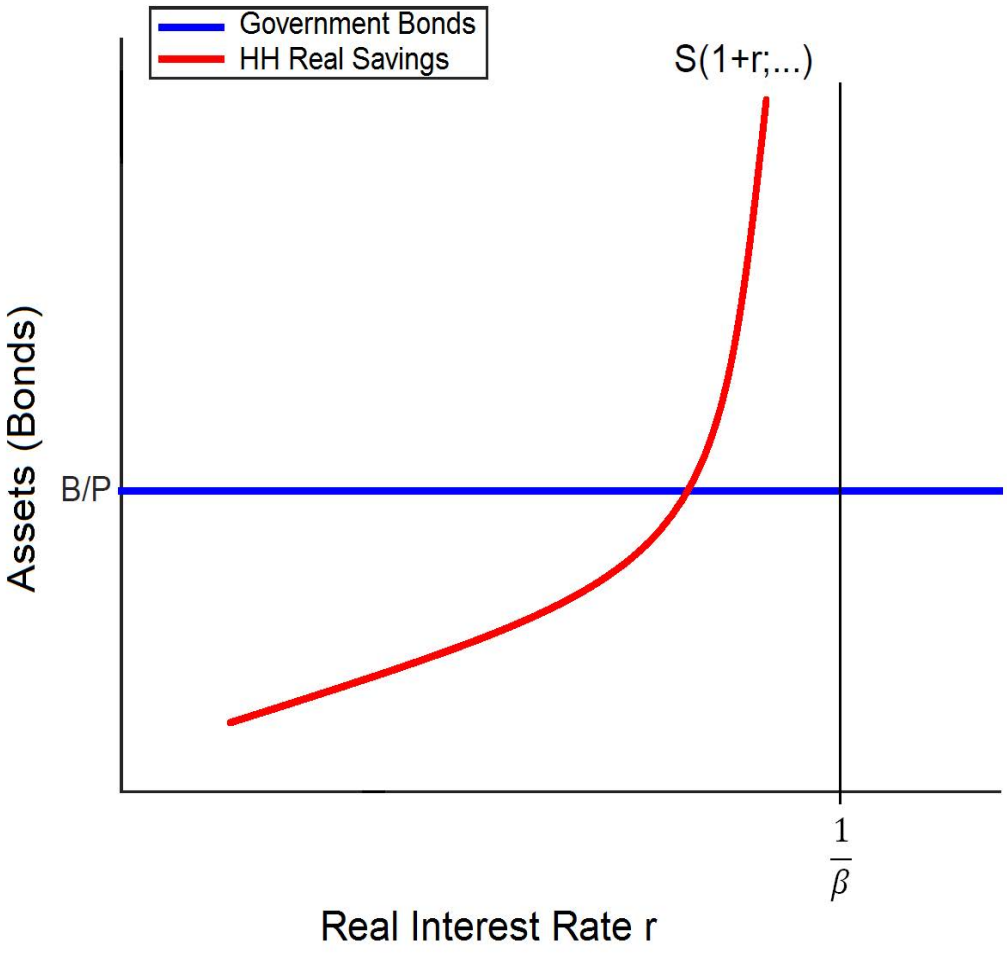
- FIRST: Steady state $\Leftrightarrow$ policies are stationary

$$\frac{B'}{B} = \frac{T'}{T} = \frac{G'}{G} = (1+\gamma), i' = i.$$

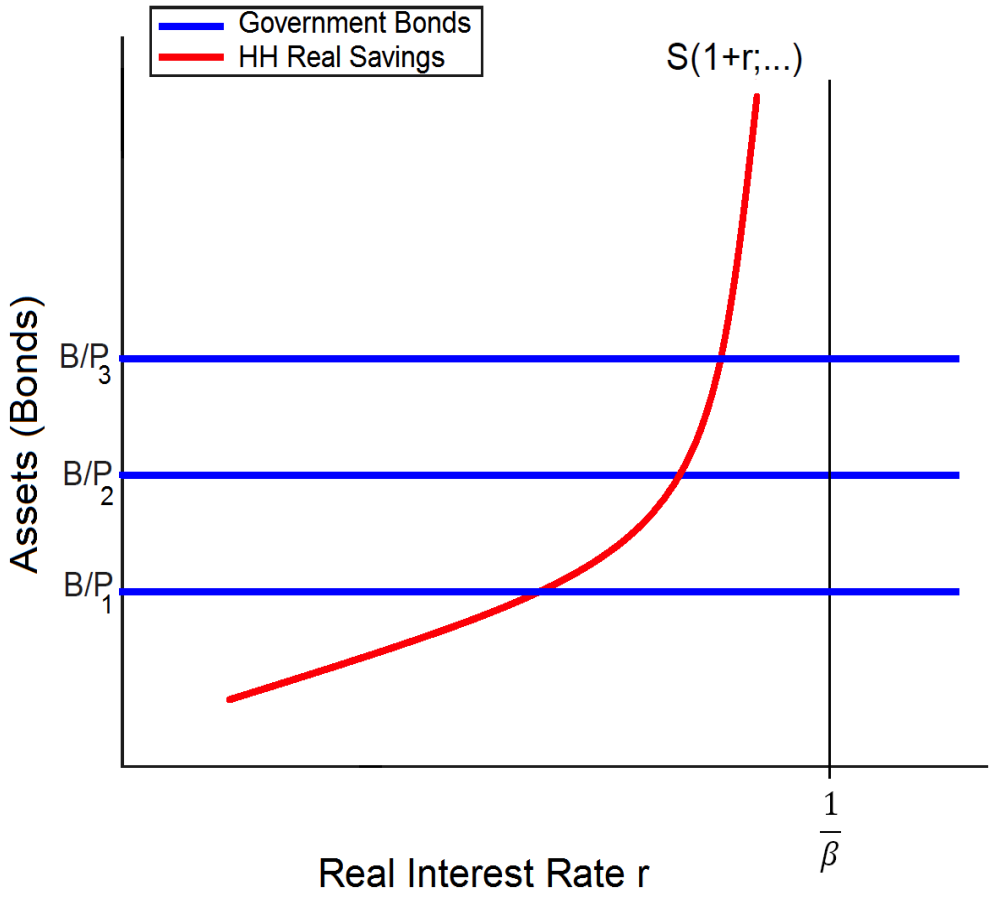
Steady State Price Level

Huggett Economy: Asset Market



Steady State Price Level

Indeterminacy



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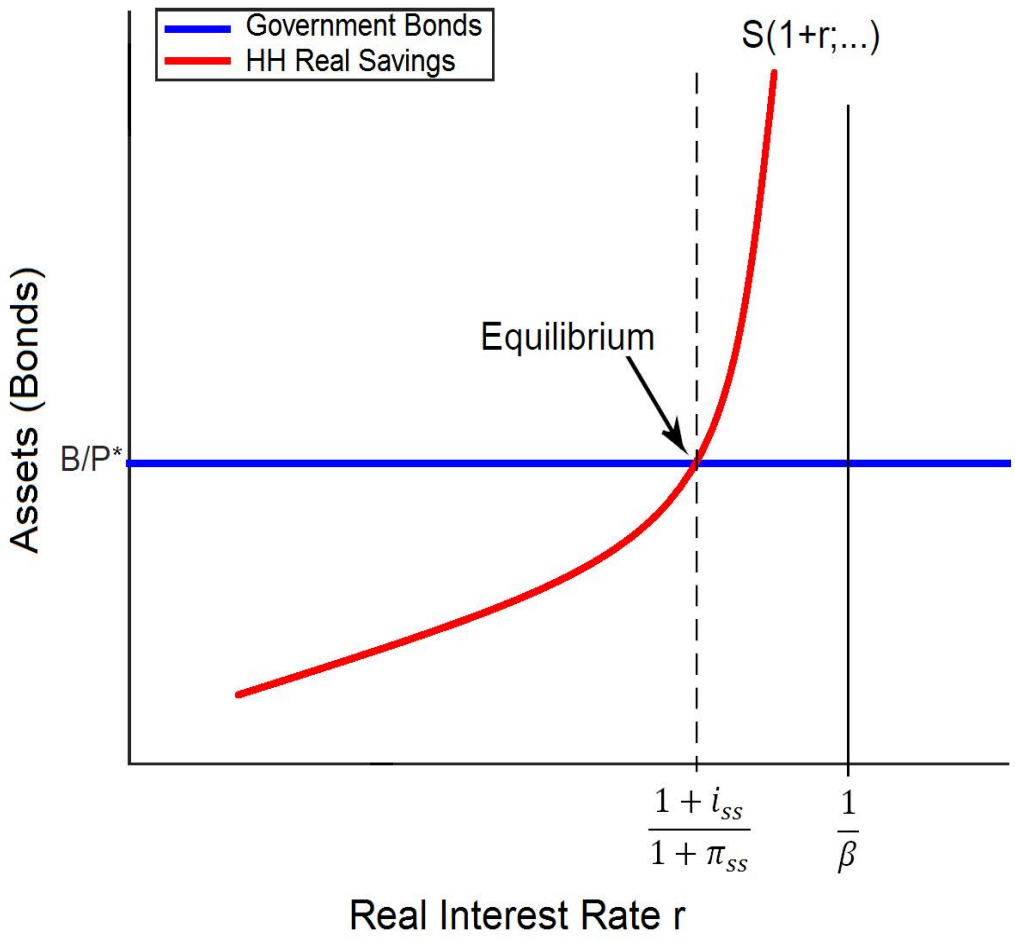

Real Interest Rate:

$$(1+r) = \frac{1+i}{1+\pi}$$

Monetary Policy:

Sets $1+i$

Fiscal Policy:

$$\pi = \frac{B'-B}{B} = \frac{G'-G}{G} = \frac{T'-T}{T}$$

i : nominal interest rate
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Steady-State Inflation with Interest rate rule

- Assume simple interest rate rule:

$$i_t = \max(\bar{i} + \phi(\pi_t - \pi^*), 0)$$

- Inflation target π^*, intercept $\bar{i}$ and $\phi > 0$
- Steady state inflation is still determined by fiscal policy:

$$\pi = \frac{B' - B}{B} = \frac{G' - G}{G} = \frac{T' - T}{T}$$

- Steady-state nominal interest rate:

$$i^{ss} = \max(\bar{i} + \phi(\frac{B' - B}{B} - \pi^*), 0)$$

- Example: $\bar{i} = 0.02$, $\phi = 1.5$ and $\frac{B'-B}{B} = 0.02$.
  - $\pi^* = 0 \Rightarrow i^{ss} = 0.02 + 1.5 * 0.02 = 0.05$.
  - $\pi^* = 4\% \Rightarrow i^{ss} = \max(0.02 + 1.5(0.02 - 0.04), 0) = 0$.

Precautionary Savings

- Failure of the permanent income hypothesis (Campbell and Deaton (1989), Attanasio and Davis (1996), Blundell, Pistaferri and Preston (2008), Attanasio and Pavoni (2011)):
  - Precautionary Savings: A permanent income gain does increase household consumption less than one-for-one.

$$\frac{\partial C}{\partial Y^{perm}} < 1$$

  - A permanent decrease in government spending by one dollar and a simultaneous permanent tax rebate of the same amount to private households lowers real total aggregate demand - the sum of private and government demand.

$$\frac{\partial (C + G/P)}{\partial (G/P)}\Big|_{\Delta G = \Delta T} > 0; \quad \frac{\partial S}{\partial (T/P)}\Big|_{\Delta G = \Delta T} < 0.$$

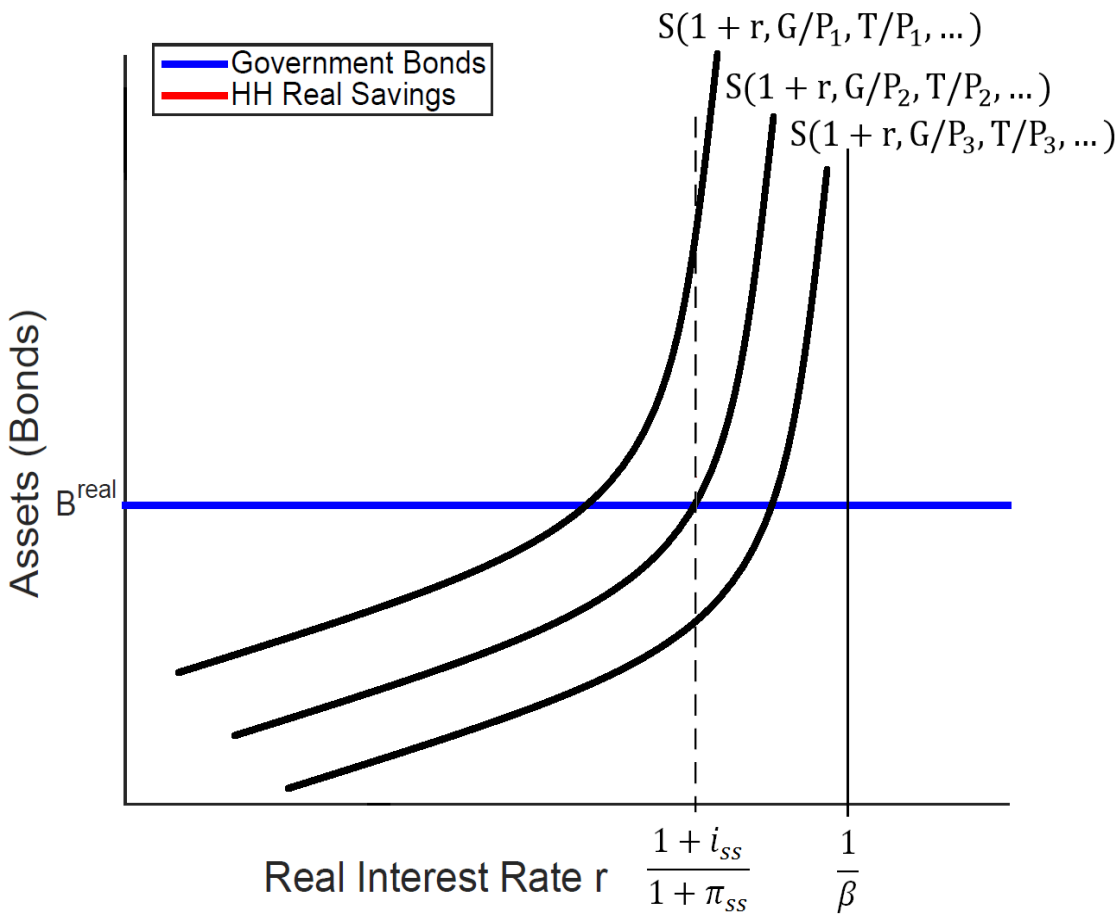
Precautionary Savings and Steady State Prices

- Steady State (fixed real interest rate):
  - Higher steady state price level lowers real government consumption (given monetary and nominal fiscal policy).
  - Lowers the real tax burden for the private sector by the same amount.
  - Private sector demand does not substitute one-for-one for the drop in government consumption (Precautionary savings up).
  - Aggregate demand-price curve is downward sloping.

$$\frac{\partial(C + G/P)}{\partial(P)}\Big|_{G=T} < 0; \quad \frac{\partial S}{\partial(P)}\Big|_{G=T} > 0.$$

  - Steady state price level equates aggregate real demand and real supply.

Steady State Price Level: Fully Price-Indexed Bonds B^{real}



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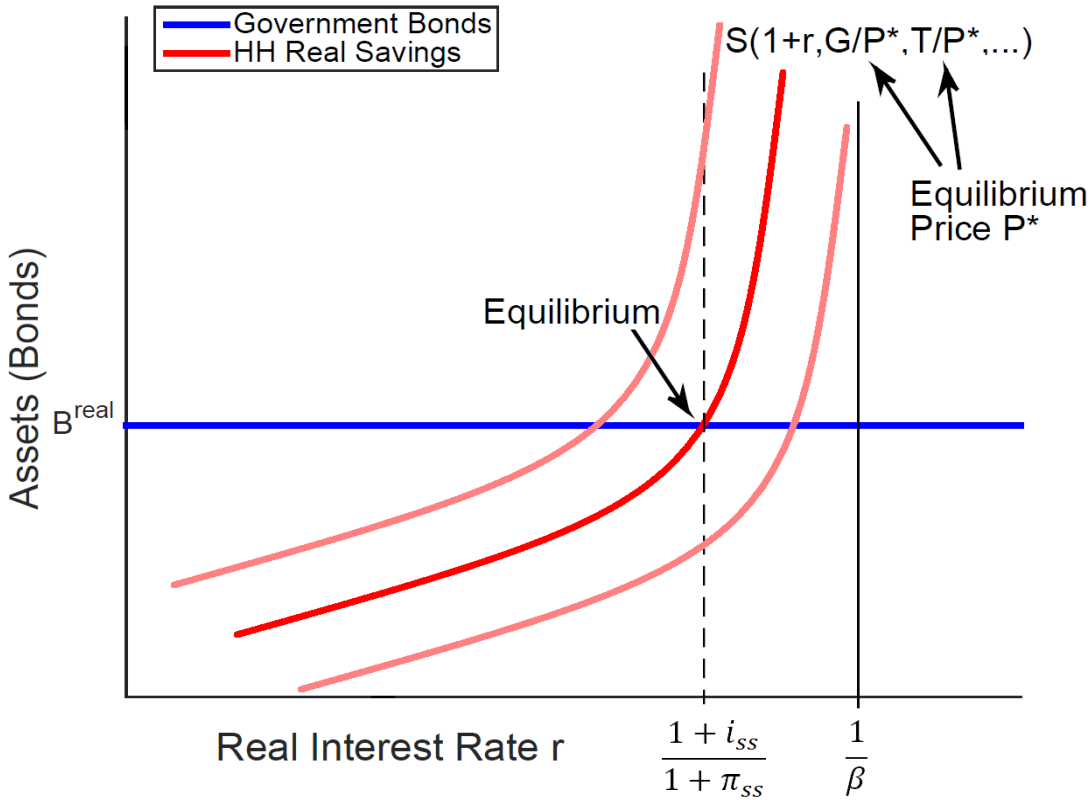

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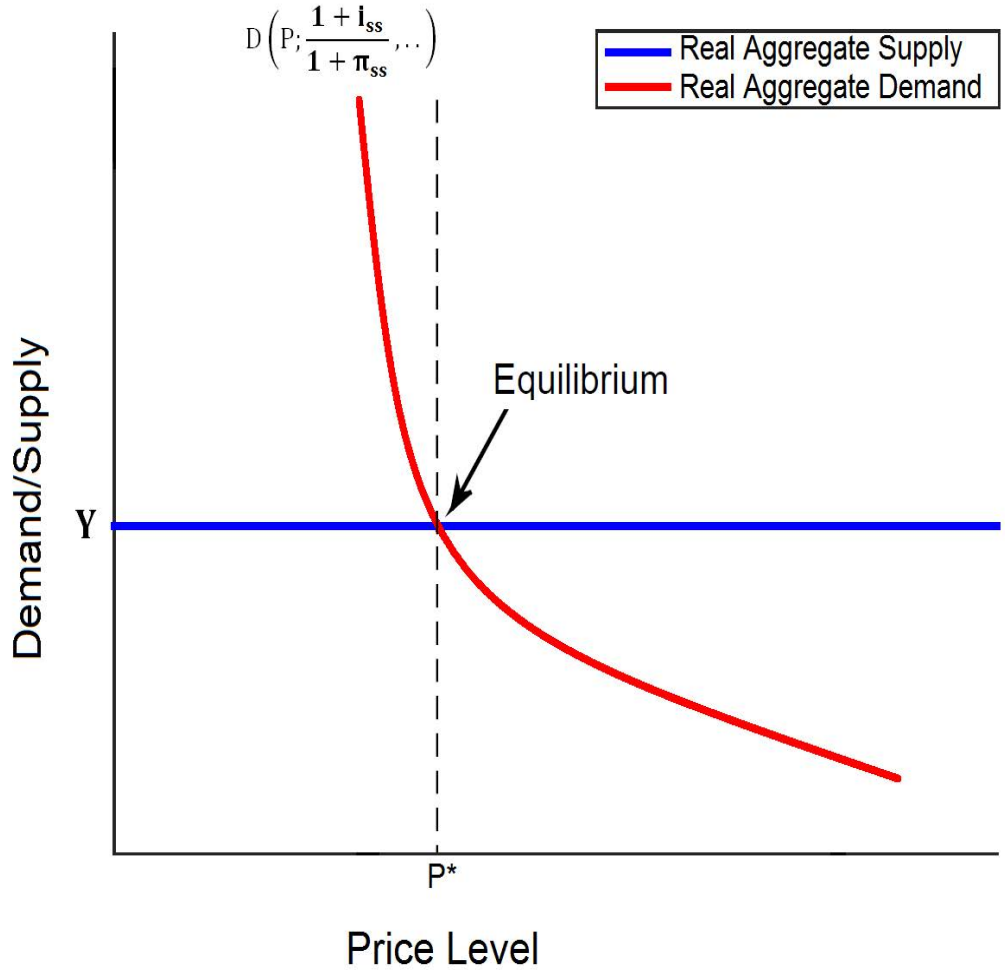
Steady State Price Level: Aggregate (Goods) Demand



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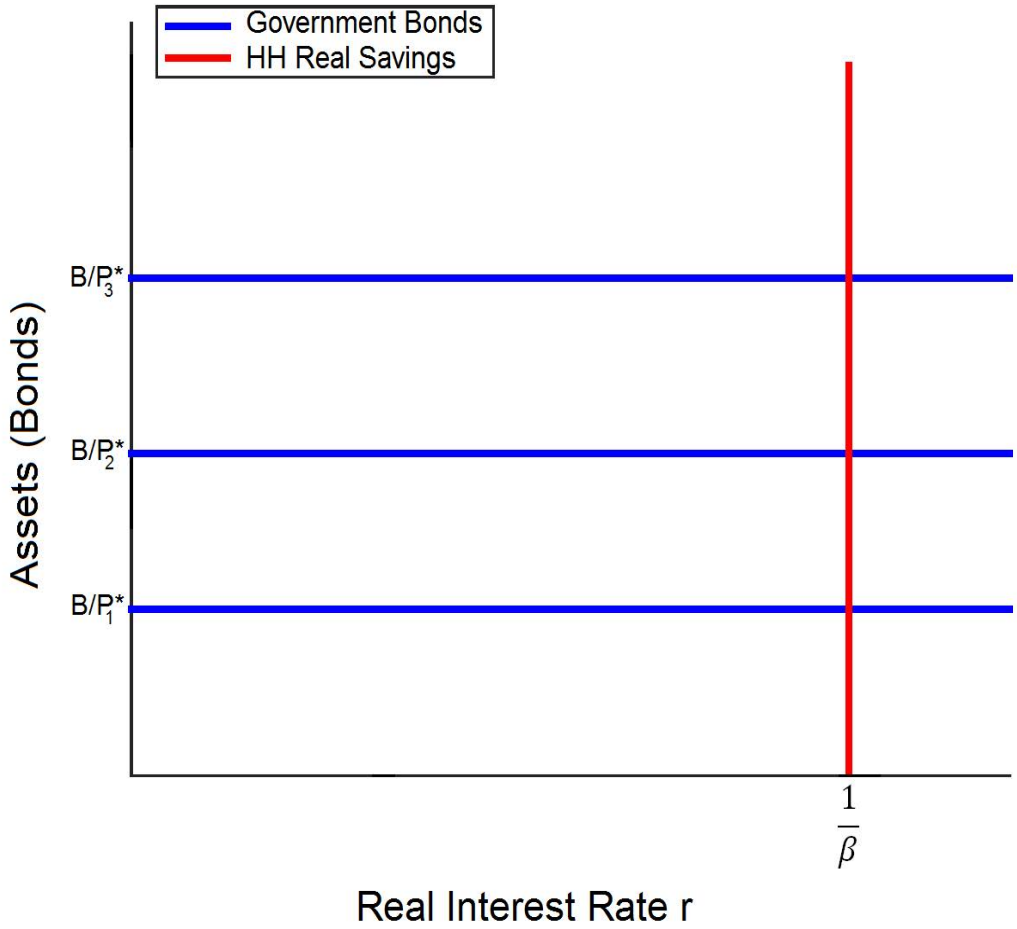
Steady State Price Level: Complete Markets



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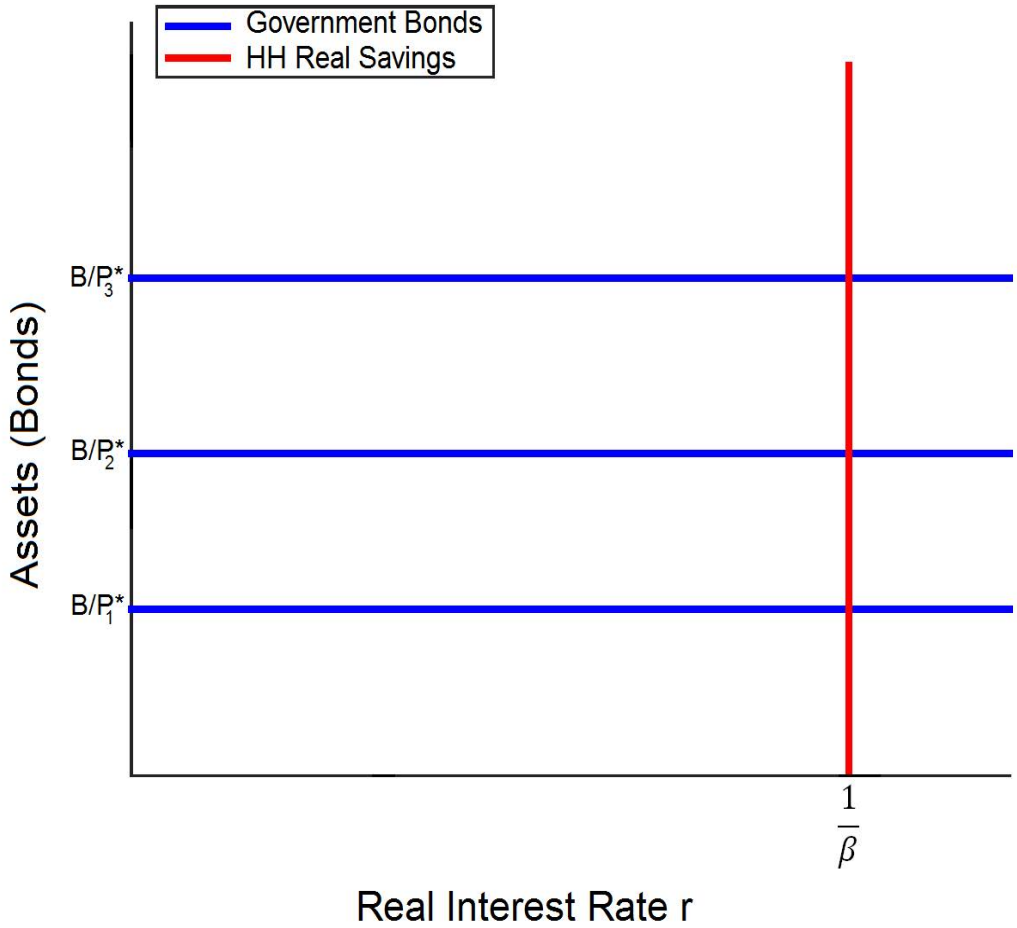
Steady State Price Level: Why TANK does not deliver



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  - Easy to explain and to compute
  - Generalizes to models with capital
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  - TANK
  - Perpetual youth model (Blanchard, Yaari)
  - Aggregate Risk

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  - Aggregate Risk
- Need non-degenerate SS Savings curve
  - Precautionary Savings
  - OLG models

Local Determinacy - Policy Rules

Local Determinacy

- Asset Market Clearing:

$$\frac{B_{t+1}}{P_t} = S_t(1 + r_{t+1}, \ldots).$$

- Linearization:

$$\begin{aligned}
\hat{b}_{t+1} - \hat{p}_t &= \epsilon_{S,r}\hat{r}_{t+1} \quad \text{[Asset Market]} \\
\hat{r}_{t+1} &= \hat{i}_{i+1} + \hat{p}_t - \hat{p}_{t+1} \quad \text{[Fisher]} \\
\hat{i}_{i+1} &= \rho^i \hat{p}_t \quad \text{[MP rule]} \\
\hat{b}_{t+1} &= \rho^b \hat{p}_t \quad \text{[FP rule]}
\end{aligned}$$

- Price Dynamics

$$\hat{p}_{t+1} = \underbrace{\left[1 + \rho^i + \frac{1 - \rho^b}{\epsilon_{S,r}}\right]}_{\text{Eigenvalue}} \hat{p}_t$$

Local Determinacy - II

$$\text{Local Determinacy} \quad \Leftrightarrow \quad 1 + \rho^i + \frac{1 - \rho^b}{\epsilon_{S,r}} > 1$$

Monetary Policy Only $(\rho^b = 0)$: All $\rho^i \geq 0$ work

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Suppose $\rho^b > 1$ and $\hat{p}_t > 0$:

$\Longrightarrow$ Real bonds $\hat{b}_{t+1} - \hat{p}_t = (\rho^b - 1)\hat{p}_t > 0$

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Joint Policies $\rho^b > 1$ requires sufficiently high $\rho^i > 0$.

Hyperinflations
&
Hyperdeflations

Obstfeld and Rogoff (1983)

- Obstfeld and Rogoff (1983): Even if M'/M finite

  Price level determinacy requires to
  - rule out hyperdeflations
  - rule out hyperinflations

- Speculative Hyperdeflations:

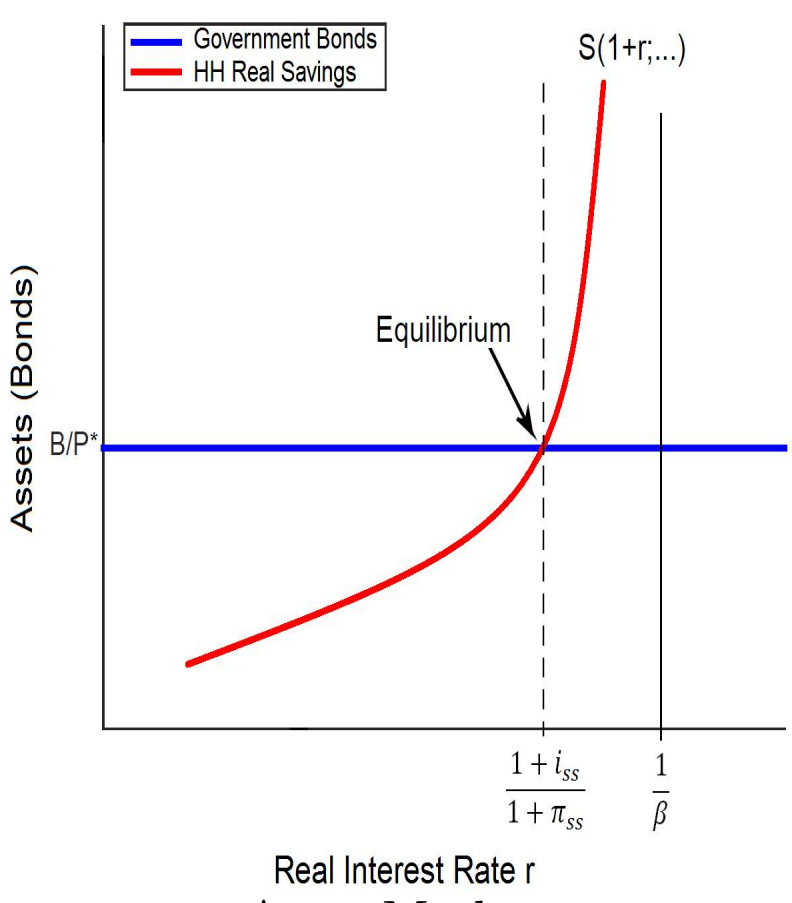
  Several possibilities, e.g. transversality condition.

- Speculative Hyperinflations:
  - Again several possibilities.
  - Obstfeld and Rogoff: Have to rule out that P jumps to ∞.
  - Difficult with flexible prices (money has to be essential).
  - Easy with the smallest amount of price stickiness (Calvo, Rotemberg).

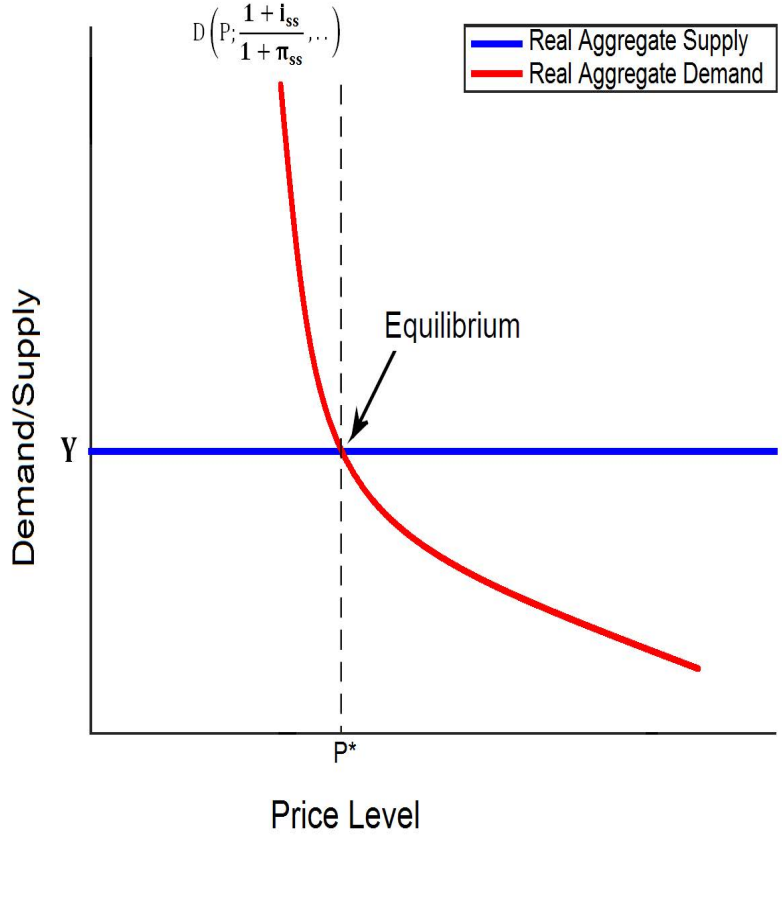
- No satiation

Monetary and Fiscal Policy

Steady State Price Level: Asset and Goods Market

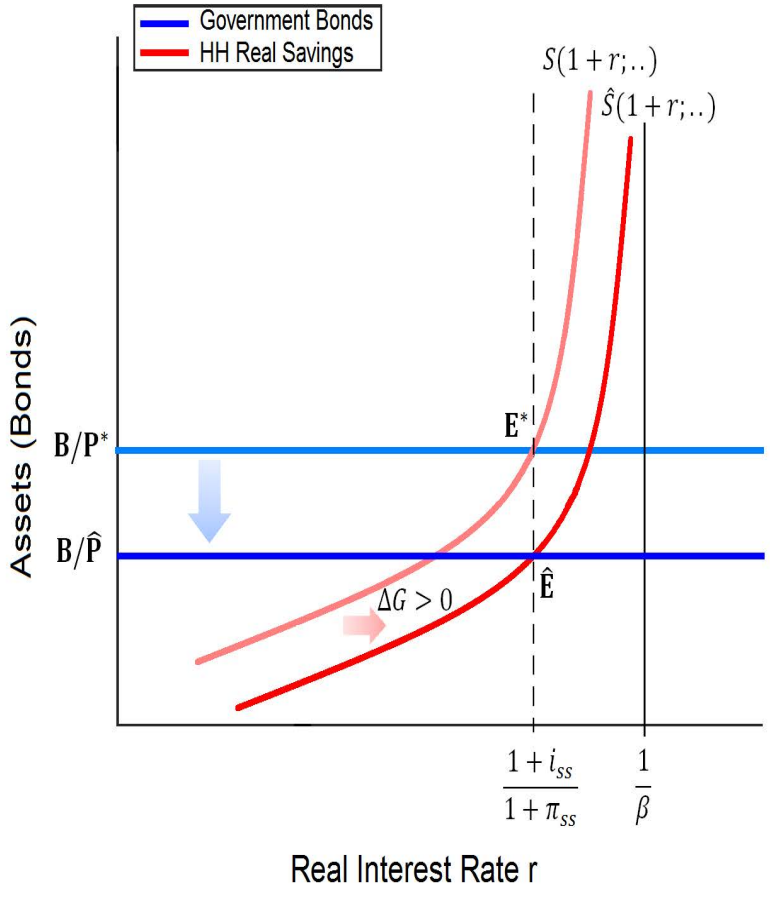


Asset Market



Goods Market

Steady State Price Level: Expansionary Fiscal Policy $\Delta G > 0$



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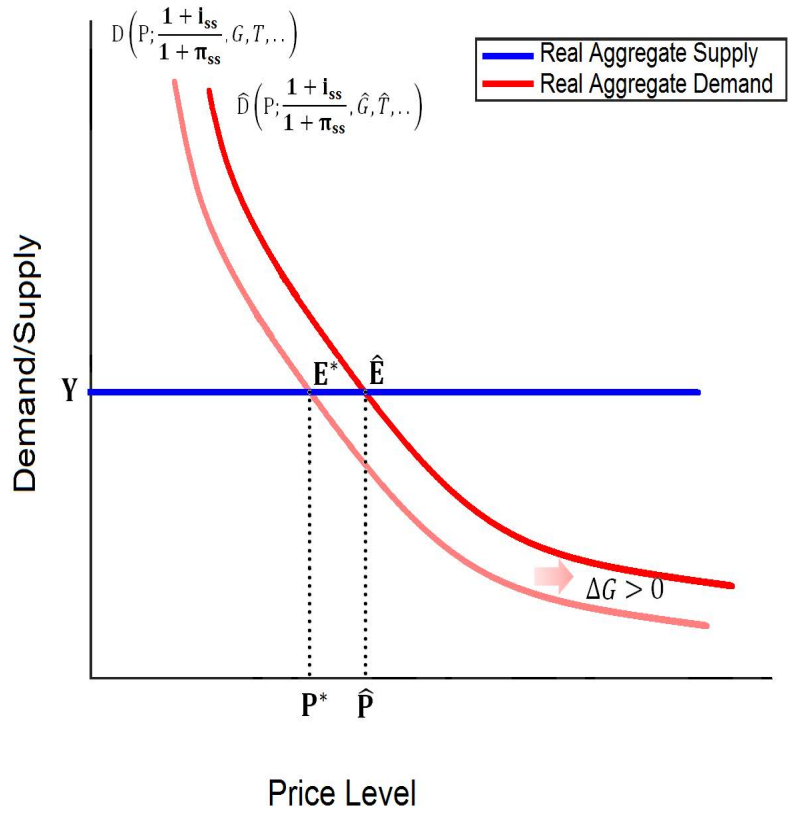
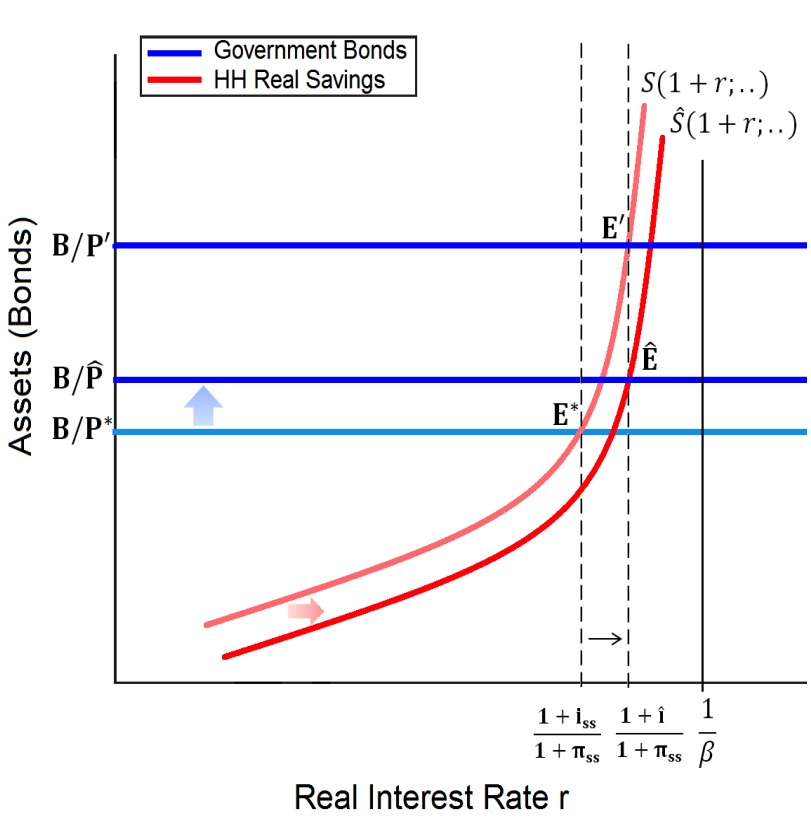


Goods Market

Steady State Price Level: Tighter Monetary Policy $\Delta i > 0$



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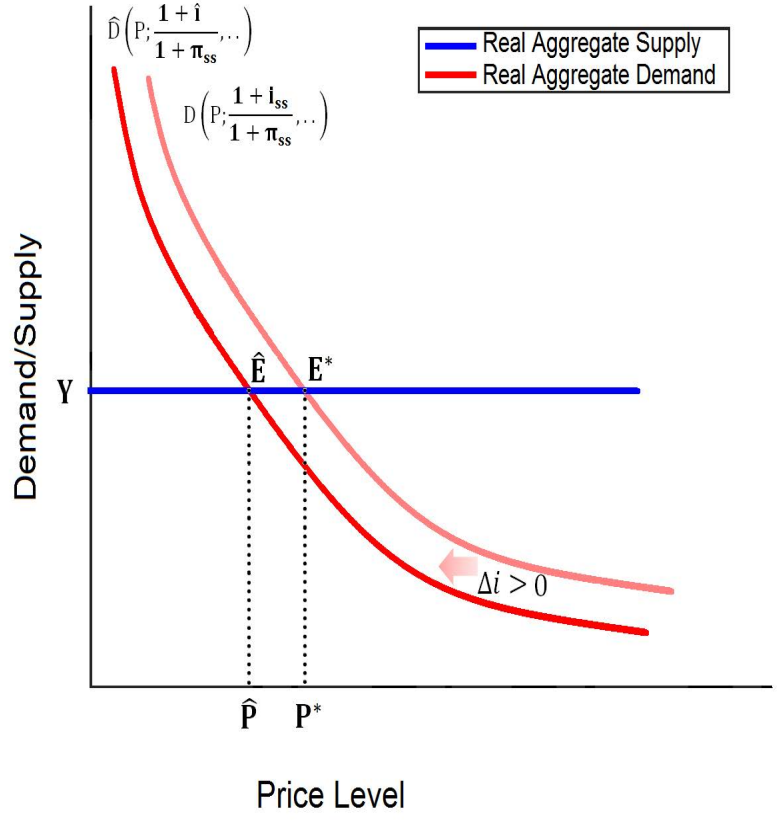
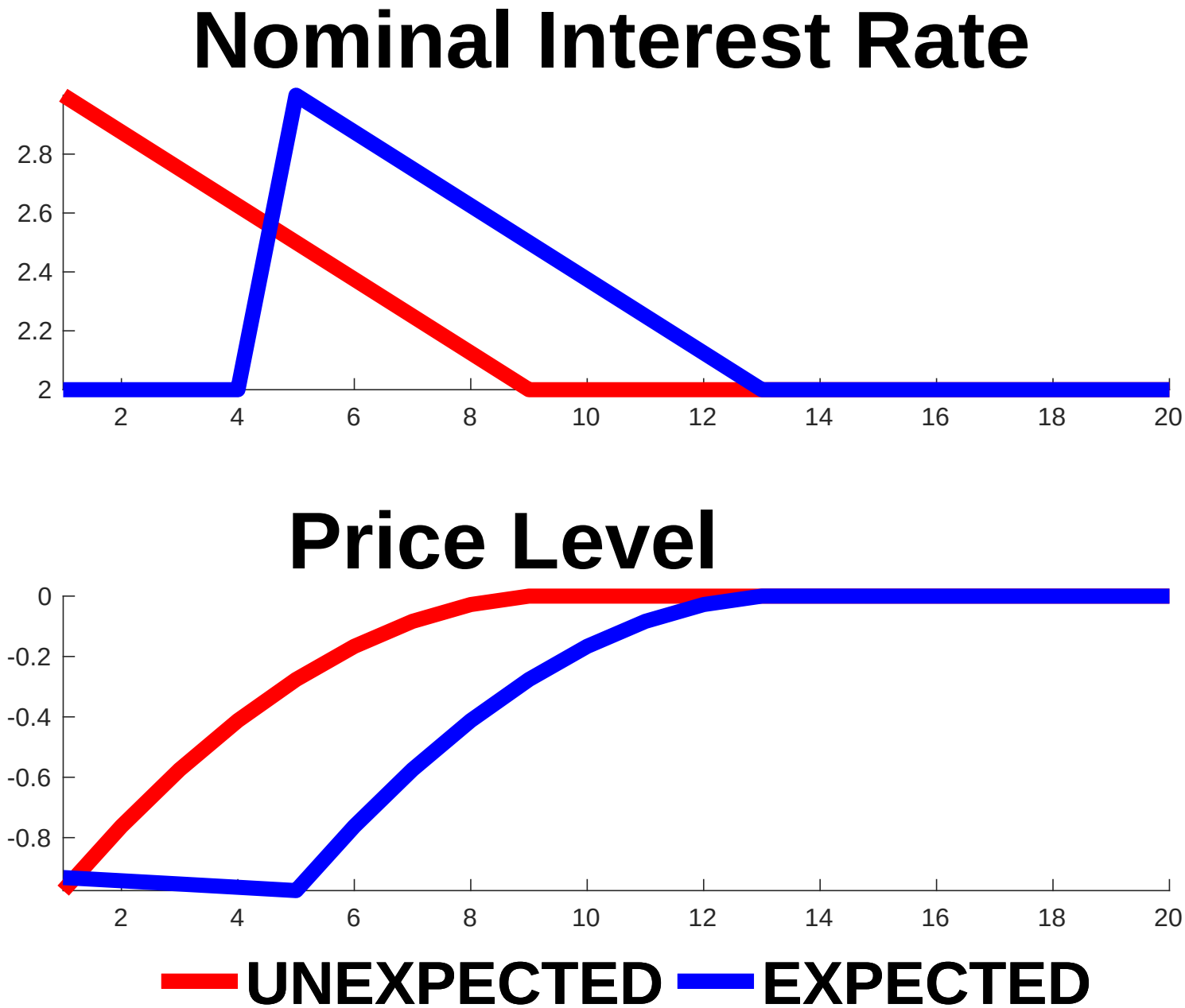


Goods Market

Monetary Policy Shock



Summary: Monetary Policy

- (Expected) Temporary increase in i lowers prices.
  $\hookrightarrow$ Mechanism fits standard policy beliefs

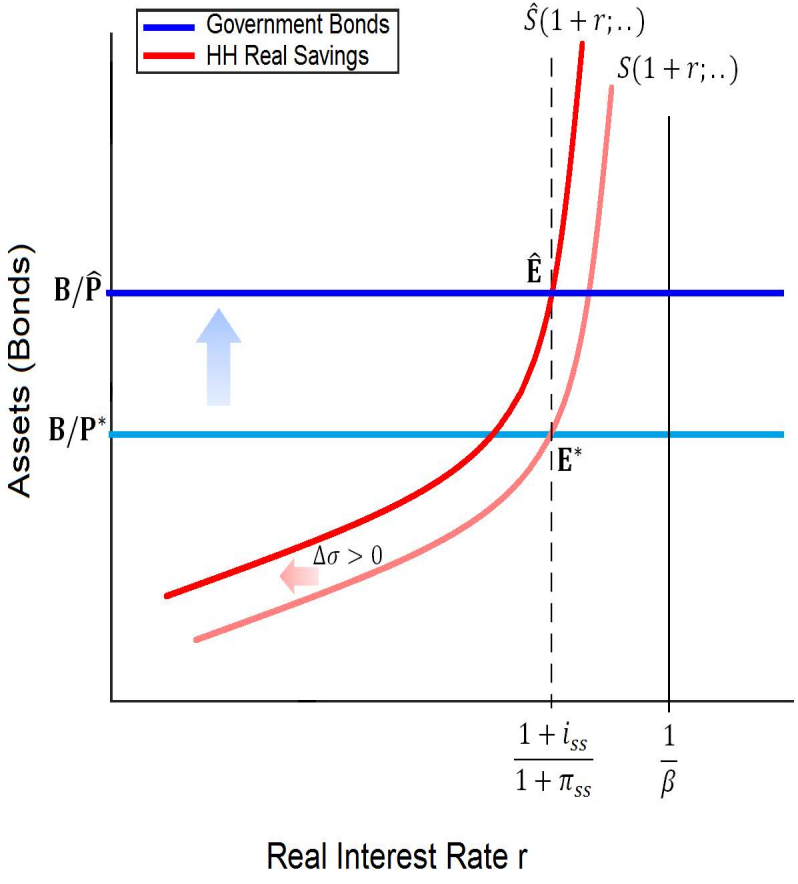
- Interest rate peg: no sunspots, no puzzles, ...

- Permanent increase does not lead to higher inflation but increases debt burden.

- Hagedorn (JME 2011)
  "Optimal disinflation in new Keynesian models":
  Disinflation requires lower nominal interest rates in NK.

- Allows unrestricted coordination of fiscal and mon. policy

Steady State Price Level: Higher Liquidity Demand $\Delta\sigma > 0$



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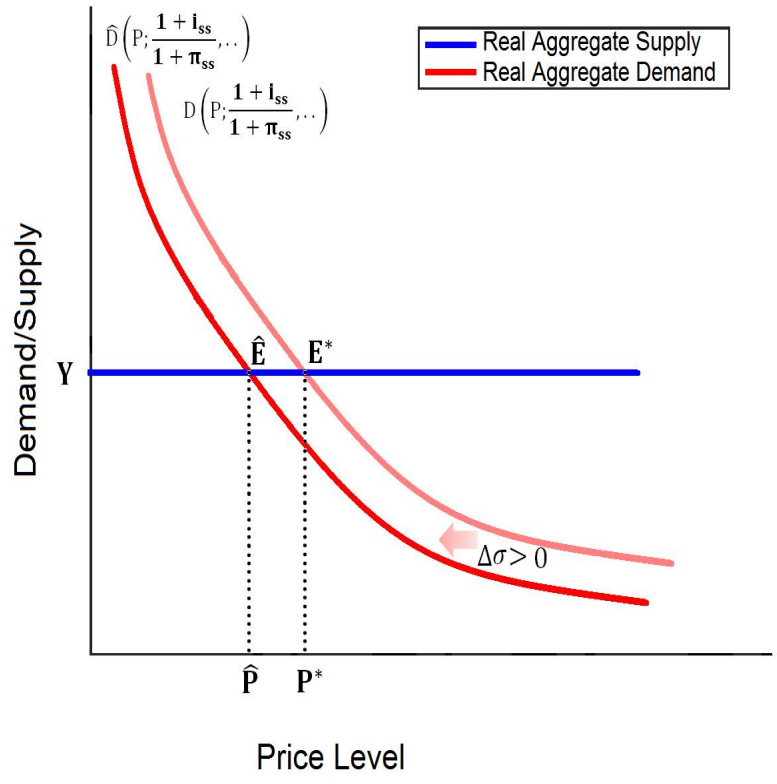

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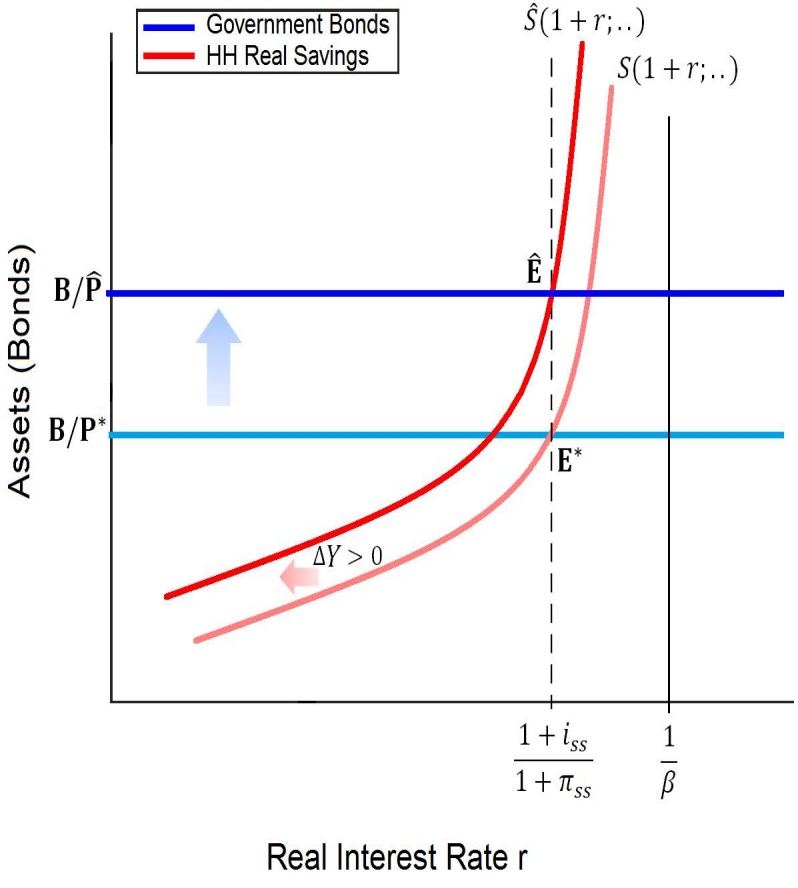
Steady State Price Level: Productivity Increase $\Delta Y > 0$



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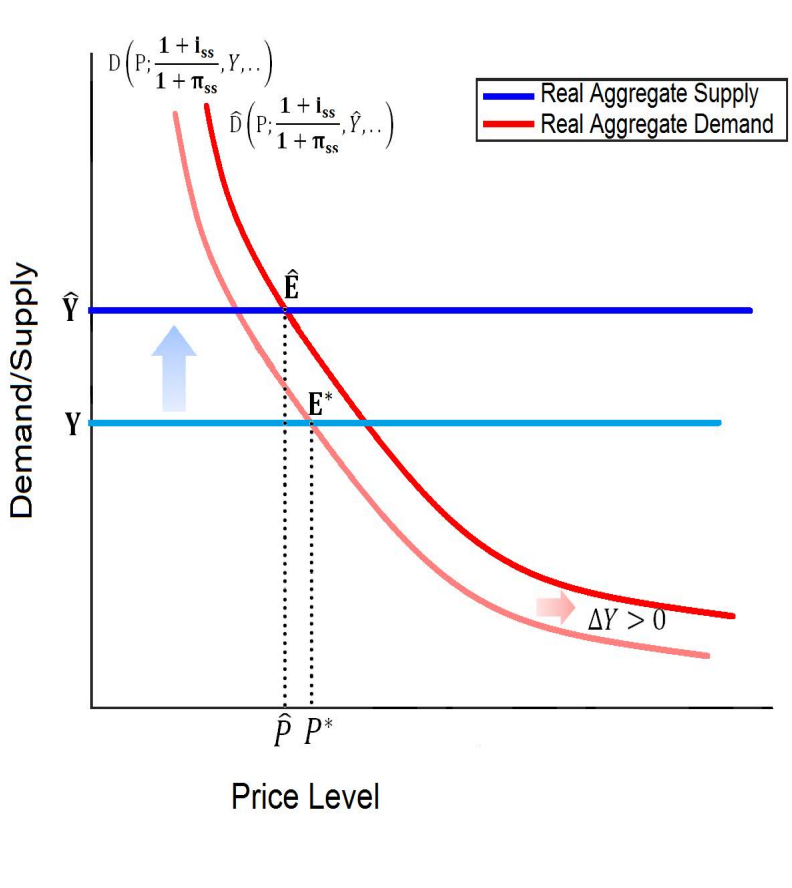

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- Price Level Determinacy in Incomplete Market Models.
  - Steady-state price level determinate
  - Local determinacy
  - No hyperdeflations / hyperinflations
- Monetary Policy
  - Temporary Shock lowers prices
  - Permanent Shock increases debt burden not inflation
  - Unrestricted coordination of fiscal and mon. policy
- Response to Policy and Shocks: Old Keynesian Logic
- Liquidity trap puzzles disappear:
  - Fiscal Multiplier divergence at frictionless limit?
  - Contractionary TFP shocks expansionary?
  - Forward guidance infinitely powerful?

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  - Unrestricted coordination of fiscal and mon. policy ✓
- Response to Policy and Shocks: Old Keynesian Logic ✓
- Liquidity trap puzzles disappear:
  - Fiscal Multiplier divergence at frictionless limit? NO
  - Contractionary TFP shocks expansionary? NO
  - Forward guidance infinitely powerful?

Conclusions

- Price Level Determinacy in Incomplete Market Models.
  - Steady-state price level determinate ✓
  - Local determinacy ✓
  - No hyperdeflations / hyperinflations ✓
- Monetary Policy
  - Temporary Shock lowers prices ✓
  - Permanent Shock increases debt burden not inflation ✓
  - Unrestricted coordination of fiscal and mon. policy ✓
- Response to Policy and Shocks: Old Keynesian Logic ✓
- Liquidity trap puzzles disappear:
  - Fiscal Multiplier divergence at frictionless limit? NO
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Implications

- ECBs attempt to increase inflation in the Euro area:
  - Unlikely to be successful.
  - Instead: Requires expansion of nominal fiscal spending by Euro area members.
  - Naturally assigns role to larger countries.

- Concerns of a permanent US/world liquidity trap (zero nominal and real interest rates for a long time).
  - Conventional Monetary Policy: ZLB.
  - Fiscal Policy: Can increase the growth rate of nominal spending and therefore the inflation rate .

- More general policy analysis
  - No Taylor principle needed for determinacy.
  - Policy analysis at ZLB.
  - Coordination of fiscal and monetary policy.