

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).
- ▶ Addresses 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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 - ▶ Behavioral fixes
(Angeletos et.al., Gabaix, Farhi & Werning ,...)
- ▶ **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

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

- ▶ Fiscal policy rules for B' and G :

$$B'(B, P, Y, \dots)$$

$$G(B, P, Y, \dots)$$

- ▶ Taxes balance the budget

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

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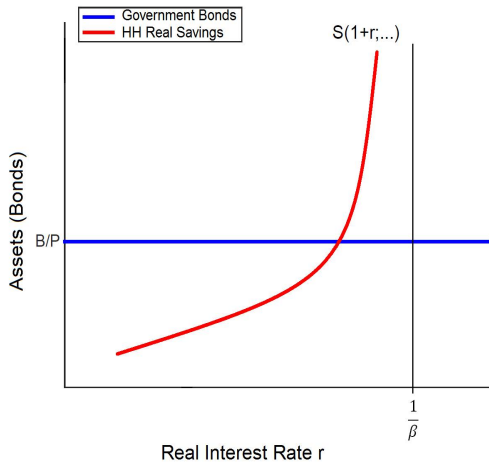
$$T := (1 + i)B + G(\dots) - B'(\dots).$$

- ▶ FIRST: Steady state \Leftrightarrow policies are stationary

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

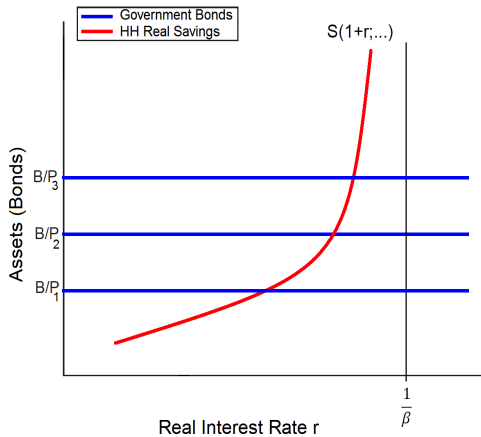
STEADY STATE PRICE LEVEL

HUGGETT ECONOMY: ASSET MARKET

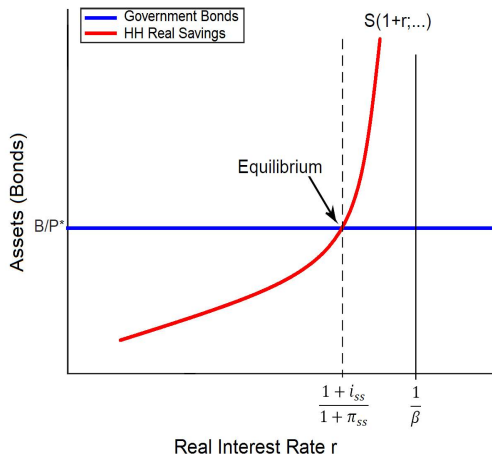


STEADY STATE PRICE LEVEL

INDETERMINACY



STEADY STATE PRICE LEVEL



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

r : real interest rate

π : inflation rate

B : nominal bonds

G : nominal government spending

T : nominal tax revenue

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:

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

- ▶ 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.

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

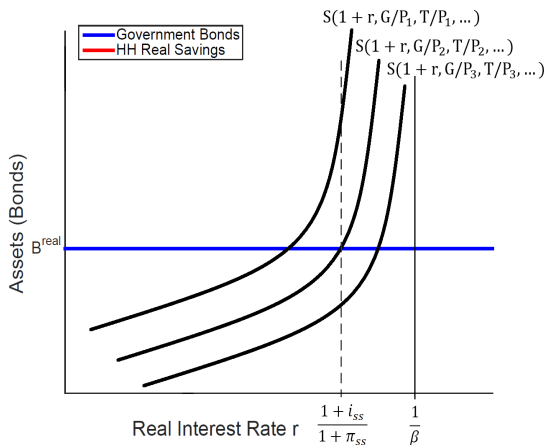
PRECAUTIONARY SAVINGS AND STEADY STATE PRICES

- ▶ 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}



Real Interest Rate:

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

Monetary Policy:

Sets $1+i$

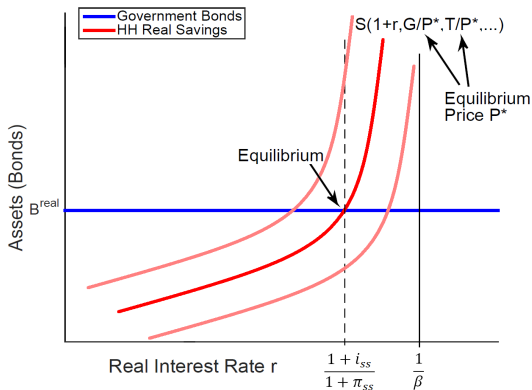
Fiscal Policy:

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

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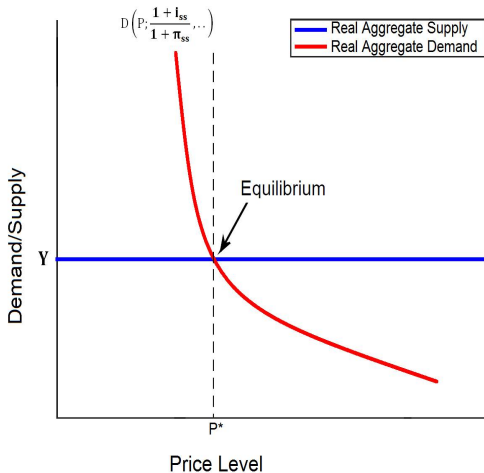
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STEADY STATE PRICE LEVEL: AGGREGATE (GOODS) DEMAND



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Monetary Policy:

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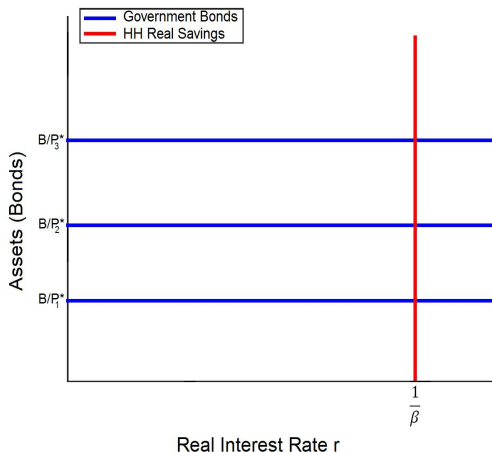
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STEADY STATE PRICE LEVEL: COMPLETE MARKETS



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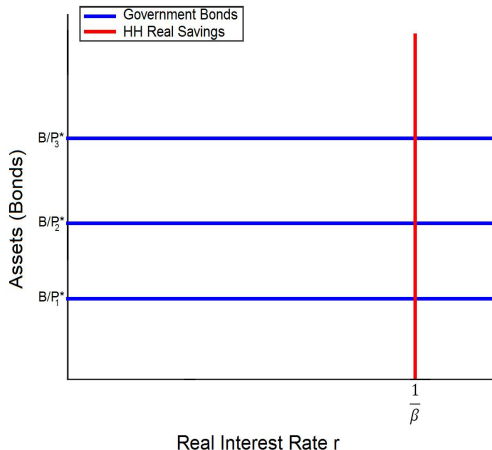
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STEADY STATE PRICE LEVEL: WHY TANK DOES NOT DELIVER



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SUMMARY: STEADY STATE DETERMINACY

- ▶ Nominal Incomplete markets models \Rightarrow **Determinacy**
 - ▶ Easy to explain and to compute
 - ▶ **Generalizes** to models with **capital**
 - ▶ **Generalizes** to models with non-trivial **demand for money**

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 - ▶ **TANK**
 - ▶ **Perpetual youth model** (Blanchard, Yaari)
 - ▶ **Aggregate Risk**

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 - ▶ **Perpetual youth model** (Blanchard, Yaari)
 - ▶ **Aggregate Risk**
- ▶ Need **non-degenerate SS Savings curve**
 - ▶ Precautionary Savings
 - ▶ OLG models

Local Determinacy - Policy Rules

LOCAL DETERMINACY

- ▶ Asset Market Clearing:

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

- ▶ 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

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

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

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Fiscal Policy Only ($\rho^i = 0$) : $\rho^b < 1$ (if realistically $\epsilon_{S,r} > 0$)

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

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

$$\hookrightarrow \hat{r}_{t+1} = \underbrace{\hat{i}_{t+1}}_{=0} + \underbrace{\hat{p}_t}_{>0} - \hat{p}_{t+1} > 0$$

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

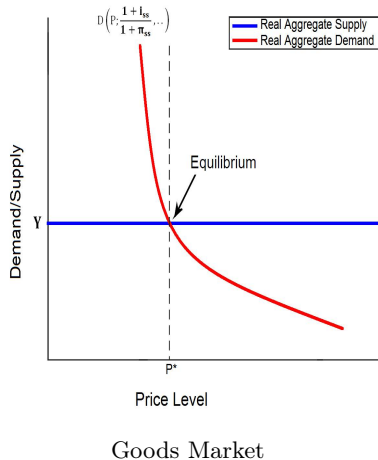
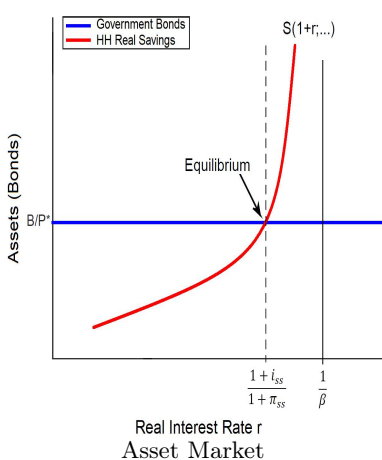
Hyperinflations
&
Hyperdeflations

OBSTFELD AND ROGOFF (1983)

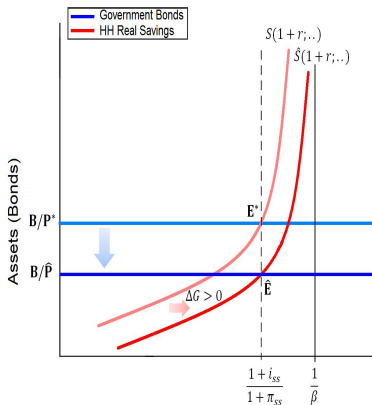
- ▶ Obstfeld and Rogoff (1983): Even if M'/M finite
Price level determinacy requires to
 - ▶ rule out hyperdeflations
 - ▶ rule out hyperinflations
- ▶ Speculative Hyperdeflations:
Several possibilities, e.g. transversality condition.
- ▶ Speculative Hyperinflations:
 - ▶ Again several possibilities.
 - ▶ 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

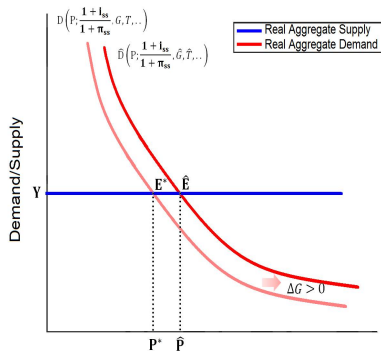
STEADY STATE PRICE LEVEL: ASSET AND GOODS MARKET



STEADY STATE PRICE LEVEL: EXPANSIONARY FISCAL POLICY $\Delta G > 0$

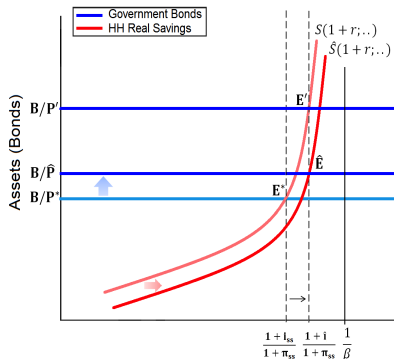


Real Interest Rate r
Asset Market

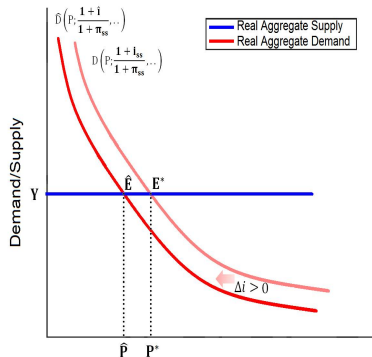


Price Level
Goods Market

STEADY STATE PRICE LEVEL: TIGHTER MONETARY POLICY $\Delta i > 0$



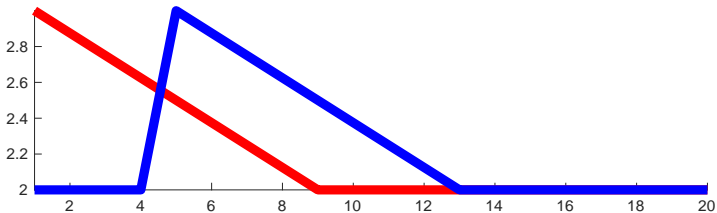
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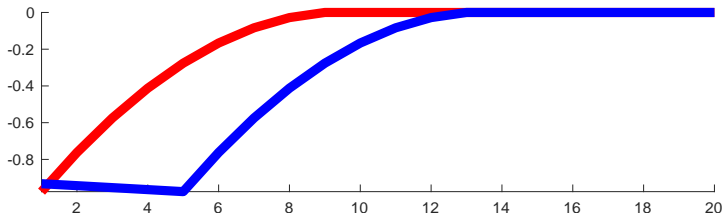
Goods Market

MONETARY POLICY SHOCK

Nominal Interest Rate



Price Level

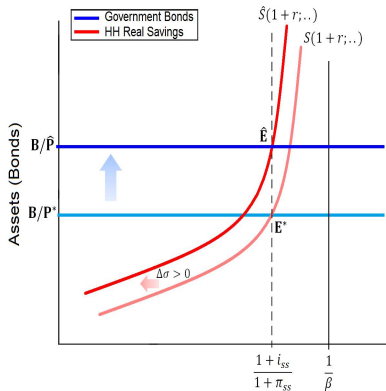


— UNEXPECTED — EXPECTED

SUMMARY: MONETARY POLICY

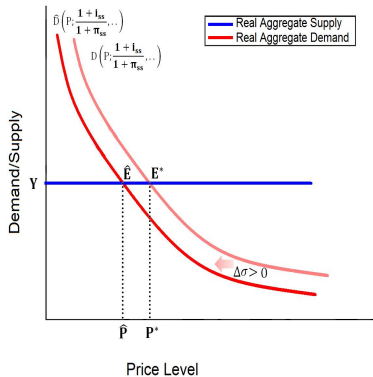
- ▶ (Expected) Temporary increase in i lowers prices.
 ↪ Mechanism fits standard policy beliefs
- ▶ Interest rate peg: no sunspots, no puzzles, ...
- ▶ Permanent increase does not lead to higher inflation but increases debt burden.
- ▶ Hagedorn (JME 2011)
 "Optimal disinflation in new Keynesian models":
 Disinflation requires lower nominal interest rates in NK.
- ▶ Allows unrestricted coordination of fiscal and mon. policy

STEADY STATE PRICE LEVEL: HIGHER LIQUIDITY DEMAND $\Delta\sigma > 0$



Real Interest Rate r

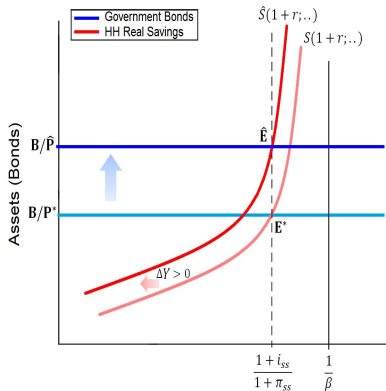
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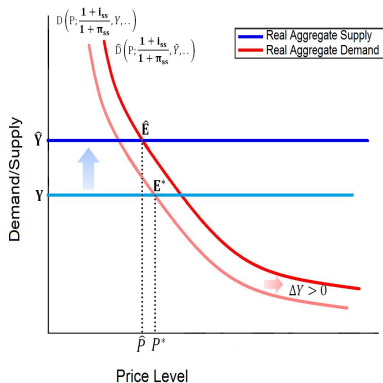
Price Level

Goods Market

STEADY STATE PRICE LEVEL: PRODUCTIVITY INCREASE $\Delta Y > 0$



Real Interest Rate r
Asset Market



Price Level
Goods Market

Conclusions

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?
 - ▶ Contractionary TFP shocks expansionary?
 - ▶ Forward guidance infinitely powerful?

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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.