Secular Stagnation and Non-standard Policy Measures

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Secular Stagnation Hypothesis

Original hypothesis:

- Alvin Hansen (1938): Suggests a permanent demand recession
- Reduction in population growth and investment opportunities
- Concerns of insufficient demand ended with WWII and subsequent baby boom

Secular stagnation resurrected:

- Lawrence Summers (2013)
- Highly persistent decline in the natural rate of interest
- Chronically binding zero lower bound

Goal here:

- Formalize these ideas in a simple model
- Propose a OLG model in the spirit of Samuelson (1958)
- How does this change our view about policy?
- How does it change our view on non-standard policy measures?

Why are we so confident interest rate will rise soon?

Last time interest rate dropped in the US:

- Started falling in 1929 (reach zero 1932)....
- ..... only to increase in 1947

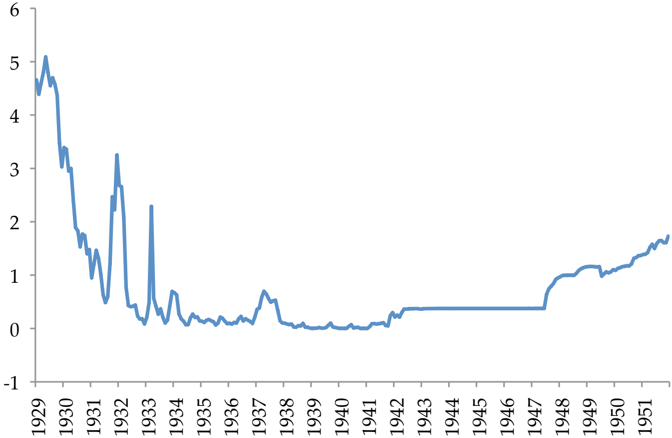
Started droppin in Japan in 1994:

- still at zero today....

Why are we so confident interest rate are increasing in the next few years?

US Interest Rates, 1929-1951

Interest rate on 3-month Treasury bills



Source: NBER Macrohistory Database

Shortcomings of Some Existing Models

Representative agent models:

$$r_{ss} = \frac{1}{\beta}$$

- Real interest rate must be positive in steady state
- Households problem not well defined if $\beta \geq 1$
- ZLB driven by temporary shocks to discount rate (Eggertsson and Woodford (2003))

Patient-impatient agent models:

- Steady state typically pinned down by the discount factor of the representative saver (Eggertsson and Krugman (2012))
- Deleveraging only has temporary effect

This paper

Overlapping generation model

- No representative saver.
- People change from being borrower to being saver over the lifecycle
- The steady state real interest rate no longer tied to anybodies discount fact, can be positive or negative
- Deleveraging shock has permanent effects
- A permanent slump theoretically possibile

Preview of Results

Negative natural rate of interest can be triggered by

- Deleveraging shock
- Slowdown in population growth
- Increase in income inequality
- Fall in relative price of investment

Unemployment steady state

- Permanently binding zero lower bound
- Permanent shortfall in output from potential

Policy responses

- Forward guidance of much more limited value.
- Law of the excluded middle – inflation better be high enough – too low inflation target does nothing
- High enough inflation target by itself does not exclude the secular stagnation equilibrium
- Fiscal expansions (debt or spending) – unconventional monetary/fiscal policy should aim at increasing the supply of "safe" assets.

Outline for Presentation

1. **Model**
   - **Endowment economy**
   - Endogenous production
2. Monetary and fiscal policy
3. Capital

Economic Environment

Endowment economy

- Time: $t = 0, 1, 2, ...$
- Goods: consumption good (c)
- Agents: 3-generations: $i \epsilon \{y, m, o\}$
- Assets: riskless bonds (B^i)
- Technology: exogenous borrowing constraint D

Households

Objective function:

$$\max_{C_{t,}^{y},C_{t+1}^{m},C_{t+2}^{o}} U = \mathbb{E}_t \left\{ \log\left(C_t^y\right) + \beta \log\left(C_{t+1}^m\right) + \beta^2 \log\left(C_{t+2}^o\right) \right\}$$

Budget constraints:

$$\begin{aligned} C_t^y &= B_t^y \\ C_{t+1}^m &= Y_{t+1}^m - (1+r_t)B_t^y + B_{t+1}^m \\ C_{t+2}^o &= Y_{t+2}^o - (1+r_{t+1})B_{t+1}^m \\ (1+r_t)B_t^i &\leq D_t \end{aligned}$$

Consumption and Saving

Credit-constrained youngest generation:

$$C_t^y = B_t^y = \frac{D_t}{1 + r_t}$$

Saving by the middle generation:

$$\frac{1}{C_t^m} = \beta \mathbb{E}_t \frac{1 + r_t}{C_{t+1}^o}$$

Spending by the old:

$$C_t^o = Y_t^o - (1 + r_{t-1}) B_{t-1}^m$$

Determination of the Real Interest Rate

Asset market equilibrium:

$$N_t B_t^y = -N_{t-1} B_t^m$$
$$(1+g_t) B_t^y = -B_t^m$$

Demand and supply of loans:

$$L_t^d = \frac{1+g_t}{1+r_t} D_t$$
$$L_t^s = \frac{\beta}{1+\beta}\left(Y_t^m - D_{t-1}\right) + \frac{1}{1+\beta}\frac{Y_{t+1}^o}{1+r_t}$$

Determination of the Real Interest Rate

Expression for the real interest rate:

$$1 + r_t = \frac{1+\beta}{\beta} \frac{(1+g_t)D_t}{Y_t^m - D_{t-1}} + \frac{1}{\beta} \frac{Y_{t+1}^o}{Y_t^m - D_{t-1}}$$

Determinants of the real interest rate:

- Tighter collateral constraint reduces the real interest rate
- Lower rate of population growth reduces the real interest rate
- Higher middle age reduces real interest rate
- Higher old income increases real interest rate

Effect of a Deleveraging Shock

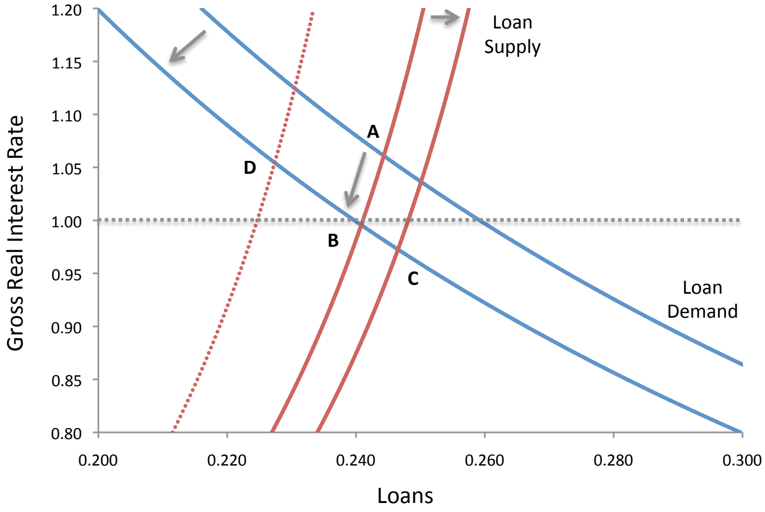
Impact effect:

- Collateral constraint tightens from D_h to D_l
- Reduction in the loan demand and fall in real rate
- Akin to Eggertsson and Krugman (2012)

Delayed effect:

- Next period, shift out in loan supply
- Further reduction in real interest rate
- Novel effect from Eggertsson and Krugman (2012)
- Potentially powerful propagation mechanism

Effect of a Deleveraging Shock



Income Inequality

Does inequality affect the real interest rate?

- Our result due to intergeneration inequality that triggers borrowing and lending
- What about inequality across a given cohort?

Generalization of endowment process:

- High-type households with high income in middle period
- Low-type households with low income in middle period
- Both types receive same income in last period

Income Inequality and Real Interest Rate

Credit constrained middle income:

- Fraction η_s of middle income households are credit constrainted
- True for low enough income in middle generation and high enough income in retirement
- Fraction $1 - \eta_s$ lend to both young and constrained middle-generation households

Expression for the real interest rate:

$$1 + r_t = \frac{1+\beta}{\beta} \frac{(1 + g_t + \eta_s) D_t}{(1 - \eta_s)\left(Y_t^{m,h} - D_{t-1}\right)} + \frac{1}{\beta} \frac{Y_{t+1}^{o}}{(1 - \eta_s)}\left(Y_t^{m,h} - D_{t-1}\right)$$

Price Level Determination

Euler equation for nominal bonds:

$$\frac{1}{C_t^m} = \beta E_t \frac{1}{C_{t+1}^o}(1+i_t)\frac{P_t}{P_{t+1}}$$
$$i_t \geq 0$$

Bound on steady state inflation:

$$\bar{\Pi} \geq \frac{1}{1+r}$$

- If steady state real rate is negative, steady state inflation must be positive
- No equilibrium with stable inflation
- But what happens when prices are NOT flexible and the central bank does not tolerate inflation?
- Then the central bank's refusal to tolerate high enough inflation will show up as a permanent recession.

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Endogenous Production

Production and income:

$$Y_t = L_t^{\alpha}$$

- Labor as sole variable factor of production
- Firms are perfectly competitive
- Profits paid to middle-generation households

Labor supply:

- Constant inelastic labor supply from households
- Assume only middle-generation household supplies labor
- Possibility of unemployment due to wage rigidity

Aggregate Supply

Output and labor demand:

$$Y_t = L_t^{\alpha}$$
$$\frac{W_t}{P_t} = \alpha L_t^{\alpha-1}$$

Labor supply:

- Middle-generation households supply a constant level of labor $\bar{L}$
- Implies a constant market clearing real wage $\bar{W} = \alpha \bar{L}^{\alpha-1}$
- Implies a constant full-employment level of output: $Y_{fe} = \bar{L}^{\alpha}$

Downward Nominal Wage Rigidity

Partial wage adjustment:

$$W_t = \max\left\{\tilde{W}_t, P_t \alpha \bar{L}^{\alpha-1}\right\}$$
$$\text{where} \quad \tilde{W}_t = \gamma W_{t-1} + (1-\gamma) P_t \alpha \bar{L}^{\alpha-1}$$

Wage rigidity and unemployment:

- $\tilde{W}_t$ is a wage norm
- If real wages exceed market clearing level, employment is rationed
- Unemployment: $U_t = \bar{L} - L_t$
- Similar assumption in Kocherlakota (2013) and Schmitt-Grohe and Uribe (2013)

Derivation of Aggregate Supply

With inflation:

$$w_t = \bar{W} = \alpha \bar{L}^{(\alpha-1)}$$
$$Y_t = Y_{fe}$$

With deflation:

$$w_t = \gamma \frac{w_{t-1}}{\Pi_t} + (1-\gamma)\,\bar{W}$$
$$w_t = \alpha L_t^{\alpha-1}$$
$$Y_t = L_t^{\alpha}$$

Steady State Aggregate Supply Relation

For positive steady state inflation:

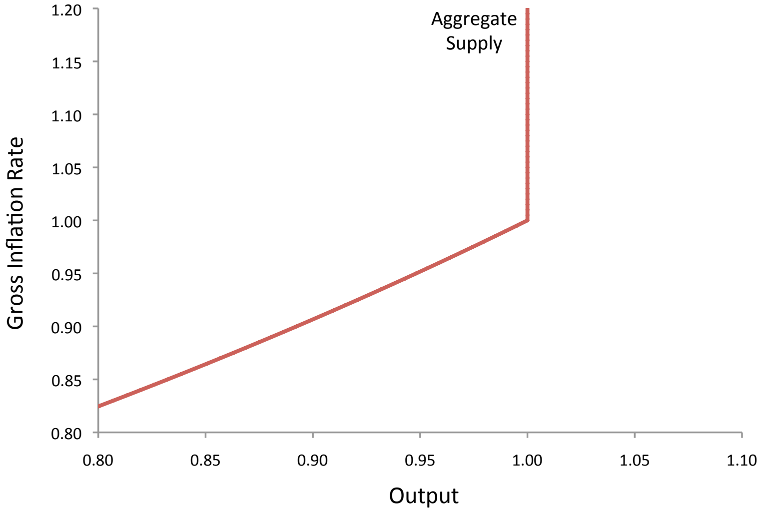
$$Y = Y_{fe} = \bar{L}^{\alpha}$$

For steady state deflation:

$$\frac{Y}{Y_{fe}} = \left(\frac{1 - \frac{\gamma}{\Pi}}{1 - \gamma} \right)^{\frac{\alpha}{1-\alpha}}$$

- Upward sloping relationship between inflation and output
- Vertical line at full-employment

Aggregate Supply Relation



Derivation of Aggregate Demand

Monetary policy rule:

$$1 + i_t = \max\left(1, (1 + i^*)\left(\frac{\Pi_t}{\Pi^*}\right)^{\phi_\pi}\right)$$

Above binding ZLB:

$$\frac{1 + i^*}{\Pi_{t+1}}\left(\frac{\Pi_t}{\Pi^*}\right)^{\phi_\pi} = \frac{1 + \beta}{\beta}\frac{(1 + g_t)D_t}{Y_t - D_{t-1}}$$

Binding ZLB:

$$\frac{1}{\Pi_{t+1}} = \frac{1 + \beta}{\beta}\frac{(1 + g_t)D_t}{Y_t - D_{t-1}}$$

Steady State Aggregate Demand Relation

Above binding ZLB:

$$\frac{1+i^*}{\Pi}\left(\frac{\Pi}{\Pi^*}\right)^{\phi_\pi} = \frac{1+\beta}{\beta}\frac{(1+g)D}{Y-D}$$

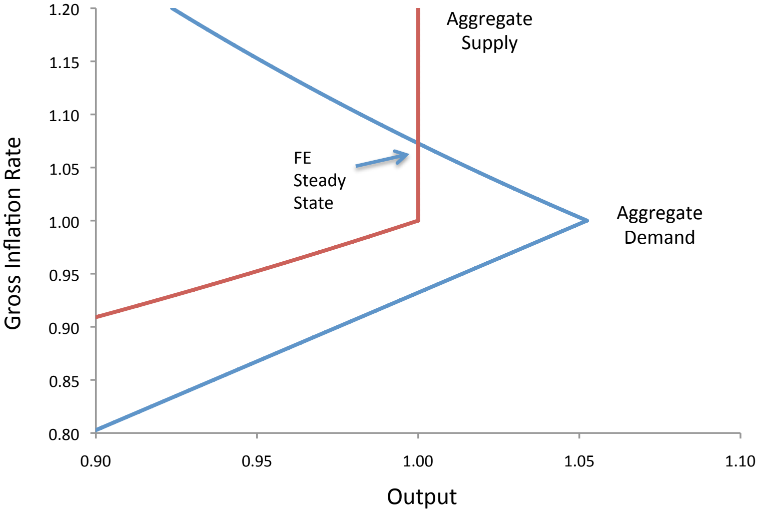
Binding ZLB:

$$\frac{1}{\Pi} = \frac{1+\beta}{\beta}\frac{(1+g)D}{Y-D}$$

Inflation rate at which ZLB binds:

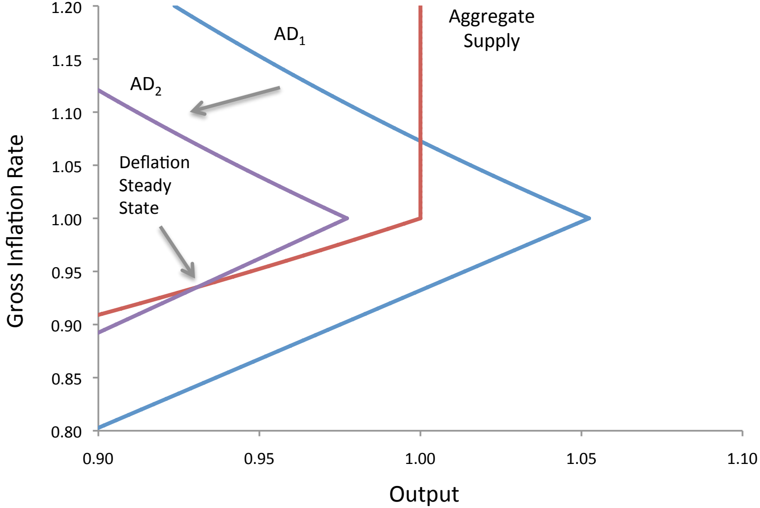
$$\Pi_{kink} = \Pi^*\left(\frac{1}{1+i^*}\right)^{\frac{1}{\phi_\pi}}$$

Full Employment Steady State



Parameter Values

Effect of a Collateral Shock



Properties of the Stagnation Steady State

Long slump:

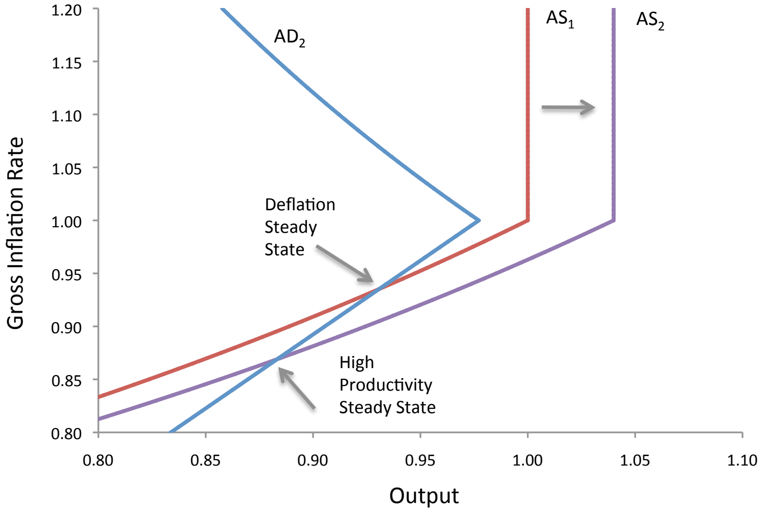
- Binding zero lower bound so long as natural rate is negative
- Deflation raises real wages above market-clearing level
- Output persistently below full-employment level

Existence and stability:

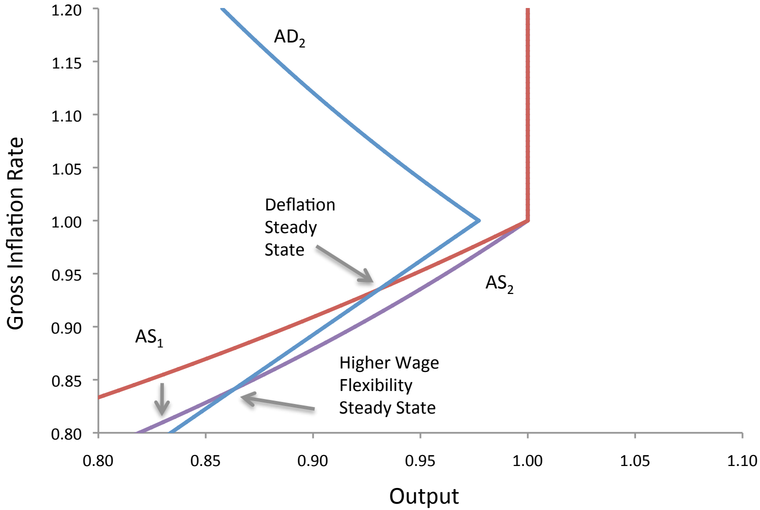
- Secular stagnation steady state exists so long as $\gamma > 0$
- If $\Pi^* = 1$, secular stagnation steady state is unique and determinate
- Contrast to deflation steady state emphasized in Benhabib, Schmitt-Grohe and Uribe (2001)

Linearized Conditions

Paradox of Toil



Paradox of Flexibility



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Monetary Policy Responses

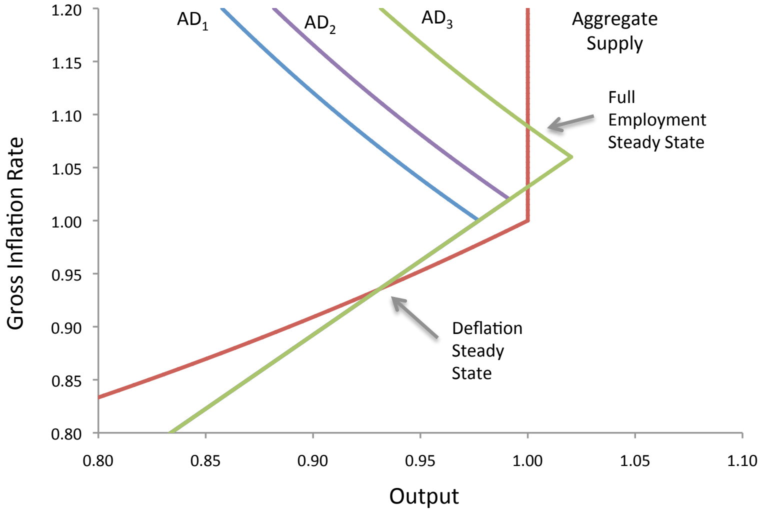
Forward guidance:

- Extended commitment to keep nominal rates low?
- Ineffective if households/firms expect rates to remain low indefinitely

Raising the inflation target:

- For sufficiently high inflation target, full employment steady state
- Timidity trap (Krugman (2014))
- Multiple steady states

Raising the Inflation Target



Fiscal Policy

Fiscal policy and the real interest rate:

$$L_t^d = \frac{1+g_t}{1+r_t} D_t + B_t^g$$

$$L_t^s = \frac{\beta}{1+\beta}\left(Y_t^m - D_{t-1} - T_t^m\right) - \frac{1}{1+\beta}\frac{Y_{t+1}^o - T_{t+1}^o}{1+r_t}$$

Government budget constraint:

$$B_t^g + T_t^y\left(1+g_t\right) + T_t^m + \frac{1}{1+g_{t-1}} T_t^o = G_t + \frac{1+r_t}{1+g_{t-1}} B_{t-1}^g$$

Fiscal instruments:

$$G_t, B_t^g, T_t^y, T_t^m, T_t^o$$

Temporary Increase in Public Debt

Under constant population and set $G_t = T_t^y = B_{t-1}^g = 0$:

$$T_t^m = -B_t^g$$
$$T_{t+1}^o = (1 + r_t)\, B_t^g$$

Implications for natural rate:

- Loan demand and loan supply effects cancel out
- Temporary increases in public debt ineffective in raising real rate
- Temporary monetary expansion equivalent to temporary expansion in public debt at the zero lower bound
- Effect of an increase in public debt depends on beliefs about future fiscal policy

Permanent Increase in Public Debt

Consider steady state following fiscal rule:

$$
\begin{aligned}
T^o &= \beta\,(1+r)\,T^m \\
L^d &= \frac{1+g}{1+r}D + B^g \\
L^s &= \frac{\beta}{1+\beta}\,(Y^m - D) - \frac{1}{1+\beta}\frac{Y^o}{1+r}
\end{aligned}
$$

Implications for natural rate:

- Changes in taxation have no effects on loan supply
- Permanent rise in public debt always raises the real rate
- Equivalent to helicopter drop at the zero lower bound
- Public debt circumvents the tightening credit friction (Woodford (1990))

Government Purchases Multiplier

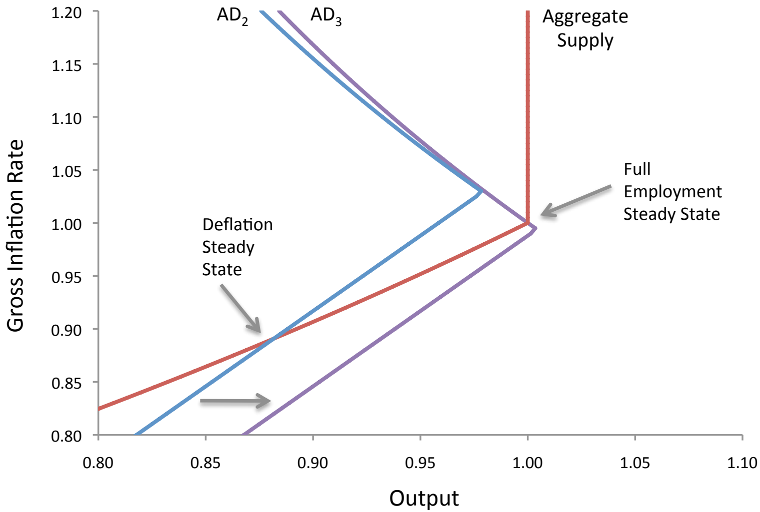
Slope of the AD and AS curves:

$$\psi = \frac{1+\beta}{\beta}(1+g)D$$
$$\kappa = \frac{1-\alpha}{\alpha}\frac{1-\gamma}{\gamma}$$

Purchases multiplier at the zero lower bound:

Financing	Multiplier	Value
Increase in public debt	$\frac{1+\beta}{\beta}\frac{1}{1-\kappa\psi}$	> 2
Tax on young generation	0	0
Tax on middle generation	$\frac{1}{1-\kappa\psi}$	> 1
Tax on old generation	$-\frac{1+g}{\beta}\frac{1}{1-\kappa\psi}$	< 0

Expansionary Fiscal Policy



Outline for Presentation

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Households

Objective function:

$$\max_{C_{t,}^{y},C_{t+1}^{m},C_{t+2}^{o}} U = \mathbb{E}_t \left\{ \log\left(C_t^y\right) + \beta \log\left(C_{t+1}^m\right) + \beta^2 \log\left(C_{t+2}^o\right) \right\}$$

Budget constraints:

$$\begin{aligned} C_t^y &= B_t^y \\ C_{t+1}^m + p_{t+1}^k K_{t+1} + \left(1 + r_t\right) B_t^y &= w_{t+1} L_{t+1} + r_{t+1}^k K_{t+1} + B_{t+1}^m \\ C_{t+2}^o + \left(1 + r_{t+1}\right) B_{t+1}^m &= p_{t+2}^k \left(1 - \delta\right) K_{t+1} \end{aligned}$$

Dynamic Efficiency

Characterization

Capital supply (perfect foresight):

$$\left(p_t^k - r_t^k\right)\frac{1}{C_t^m} = \beta p_{t+1}^k \left(1-\delta\right)\frac{1}{C_{t+1}^o}$$

Loan supply and demand:

$$L_t^d = \frac{1+g_t}{1+r_t} D_t$$

$$L_t^s = \frac{\beta}{1+\beta}\left(Y_t - D_{t-1}\right) - \frac{\beta}{1+\beta}\left(p_t^k + p_{t+1}^k \frac{1-\delta}{\beta\left(1+r_t\right)}\right) K_t$$

Capital and Secular Stagnation

Rental rate and real interest rate:

$$r_t^k = p_t^k - p_{t+1}^k \frac{1-\delta}{1+r_t} \geq 0$$

$$r_{ss} \geq -\delta$$

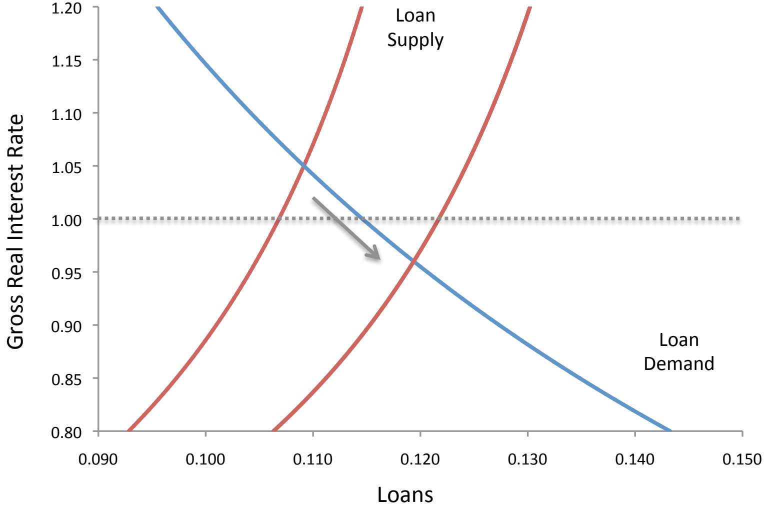
- Negative real rate now constrained by fact that rental rate must be positive

Relative price of capital goods:

- Decline in relative price of capital goods lowers the real rate
- Global decline in price of capital goods (Karabarbounis and Neiman, 2014)
- Consistent with argument proposed by Summers (2014)

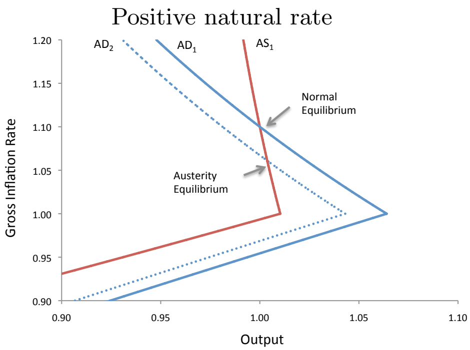
Land

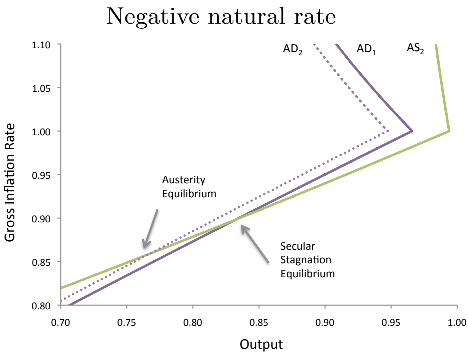
Effect of a Shock to Price of Capital Goods



Paradox of Thrift

Effect of a discount rate shock





Conclusions

Policy implications:

- Higher inflation target needed
- Limits to forward guidance
- Role for fiscal policy
- Possible implications for financial stability

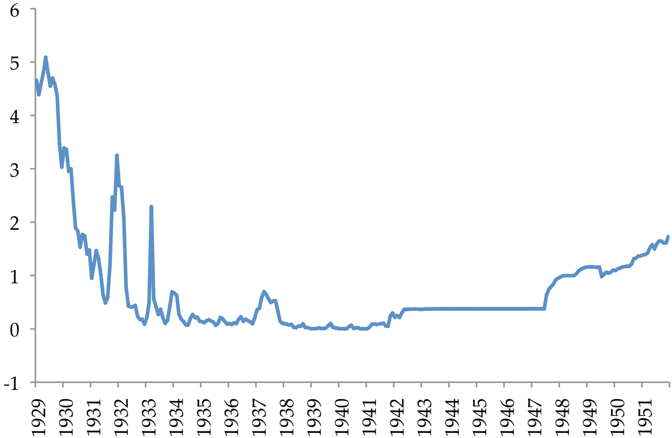
Key takeaway:

- NOT that we will stay in a slump forever
- Slump of arbitrary duration
- OLG framework to model interest rates

Additional Slides

US Interest Rates, 1929-1951

Interest rate on 3-month Treasury bills



Source: NBER Macrohistory Database

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Parameter Values in Numerical Examples

Description	Parameter	Value
Population growth	g	0.2
Collateral constraint	D	0.28
Discount rate	β	0.77
Labor share	α	0.7
Wage adjustment	γ	0.3
Taylor coefficient	ϕ_π	2
Gross inflation target	Π^*	1.01
Labor supply	L	1
Depreciation	δ	0.79

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Dynamic Efficiency

Planner's optimality conditions:

$$\frac{C_o}{C_m} = \beta\left(1+g\right)$$

$$\left(1-\alpha\right)K^{-\alpha} = 1 - \frac{1-\delta}{1+g}$$

$$D\left(1+g\right) + C_m + \frac{1}{1+g}C_o = K^{1-\alpha}\bar{L}^{\alpha} - K\left(1 - \frac{1-\delta}{1+g}\right)$$

Implications:

- Competitive equilibrium does not necessarily coincide with constrained optimal allocation
- If $r > g$, steady state of our model with capital is dynamically efficient
- Negative natural rate only implies dynamic inefficiency if population growth rate is negative

Dynamic Efficiency

Is dynamic efficiency empirically plausible?

- Classic study in Abel, Mankiw, Summers and Zeckhauser (1989) says no
- Revisited in Geerolf (2013) and cannot reject condition for dynamic inefficiency in developed economies today

Absence of risk premia:

- No risk premia on capital in our model
- Negative short-term natural rate but positive net return on capital
- Abel et al. (2013) emphasize that low real interest rates not inconsistent with dynamic efficiency

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Land

Land with dividends:

$$p_t^{land} = D_t + \frac{p_{t+1}^{land}}{1 + r_t}$$

- Land that pays a real dividend rules out a secular stagnation

Land without dividends:

- If $r > 0$, price of land equals its fundamental value
- If $r < 0$, price of land is indeterminate and land offers a negative return r

Absence of risk premia:

- No risk premia on land
- Negative short-term natural rate but positive net return on capital

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Linearized Equilibrium Conditions

Linearized AS and AD curves:

$$i_t = E_t\pi_{t+1} - s_y\left(y_t - g_t\right) + \left(1 - s_w\right)E_t\left(y_{t+1} - g_{t+1}\right) + s_w d_t + s_d d_{t-1}$$

$$y_t = \gamma_w y_{t-1} + \gamma_w \frac{\alpha}{1-\alpha}\pi_t$$

Elements:

- Exogenous shocks: g_t, d_t
- Retains forward-looking intertemporal IS curve of New Keynesian model
- IS curve is "less" forward-looking" than New Keynesian version

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