A Model of Secular Stagnation

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Secular Stagnation Hypothesis

I wonder if a set of older ideas . . . under the phrase secular stagnation are not profoundly important in understanding Japan's experience, and may not be without relevance to America's experience — Lawrence Summers

Original hypothesis:

- Alvin Hansen (1938): Suggests a permanent demand depression.
- Reduction in population growth and investment opportunities.
- Concerns about 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:

- Formlize these ideas in a simple model
- Propose a OLG model in the spirit of Samuelson (1958)

Why are we so confident interest rates will rise soon?

Interest rates in the US during the Great Depression:

- Started falling in 1929 (reach zero in 1933) .....
- ..... only to increase in 1947

Started dropping in Japan in 1994:

- Remains at zero today

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

Need a framework where the answer is not baked into the cake – need a model that can account for arbitrary persistence of the recession

Preview of Results

Permanently negative natural rate of interest can be triggered by:

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

Stagnation steady state

- Permanently binding zero lower bound
- Low inflation or deflation
- Permanent shortfall in output from potential – no obvious adjustment mechanism (price flexibility paradox).

Monetary and fiscal policy responses

- Raising the inflation target
- Increases in public debt
- Increases in government purchases

Outline for Presentation

1. **Model**
   - **Endowment economy**
     - deleveraging shocks, income inequality, population slowdown
     - price level determination
   - Endogenous production
2. Monetary and fiscal policy
3. Capital
   - Fall in the relative price of investment

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:

$$\max_{C^y_{t,}, C^m_{t+1}, C^o_{t+2}} U = \mathbb{E}_t \left\{ \log\left(C^y_t\right) + \beta \log\left(C^m_{t+1}\right) + \beta^2 \log\left(C^o_{t+2}\right) \right\}$$

Budget constraints:

$$\begin{aligned} C^y_t &= B^y_t \\ C^m_{t+1} &= Y^m_{t+1} - (1 + r_t) B^y_t + B^m_{t+1} \\ C^o_{t+2} &= Y^o_{t+2} - (1 + r_{t+1}) B^m_{t+1} \\ (1 + r_t) B^i_t &\leq D_t \end{aligned}$$

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 (perfect foresight):

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

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 income reduces real interest rate
- Higher old income increases real interest rate

Effect of a Deleveraging Shock

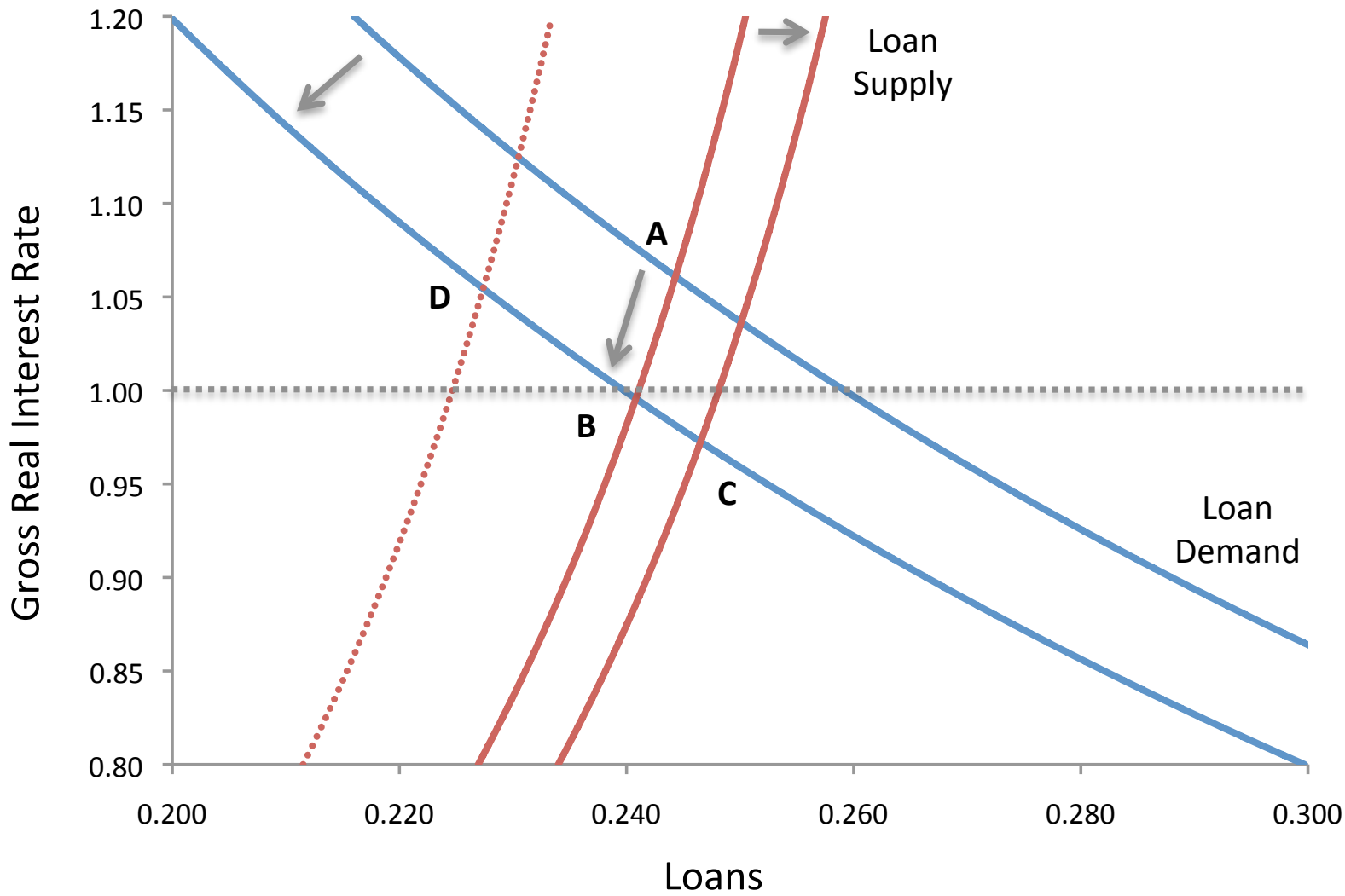
Impact effect:

- 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, a 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 generational inequality that triggers borrowing and lending
- What about inequality within a given cohort?

  - Irrelevant if output of each individual same over time

  - Easy to come up with examples where it matter

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 constrained
- 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:

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

Price Level Determination

Euler equation for nominal bonds:

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

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.

Endogenous Production - Aggregate Supply - Full Employment

Output and labor demand:

- Labor only factor of production (capital coming up)
- Firms are perfectly competitive

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

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:

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

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)

Steady State Aggregate Supply Relation

For positive steady state inflation:

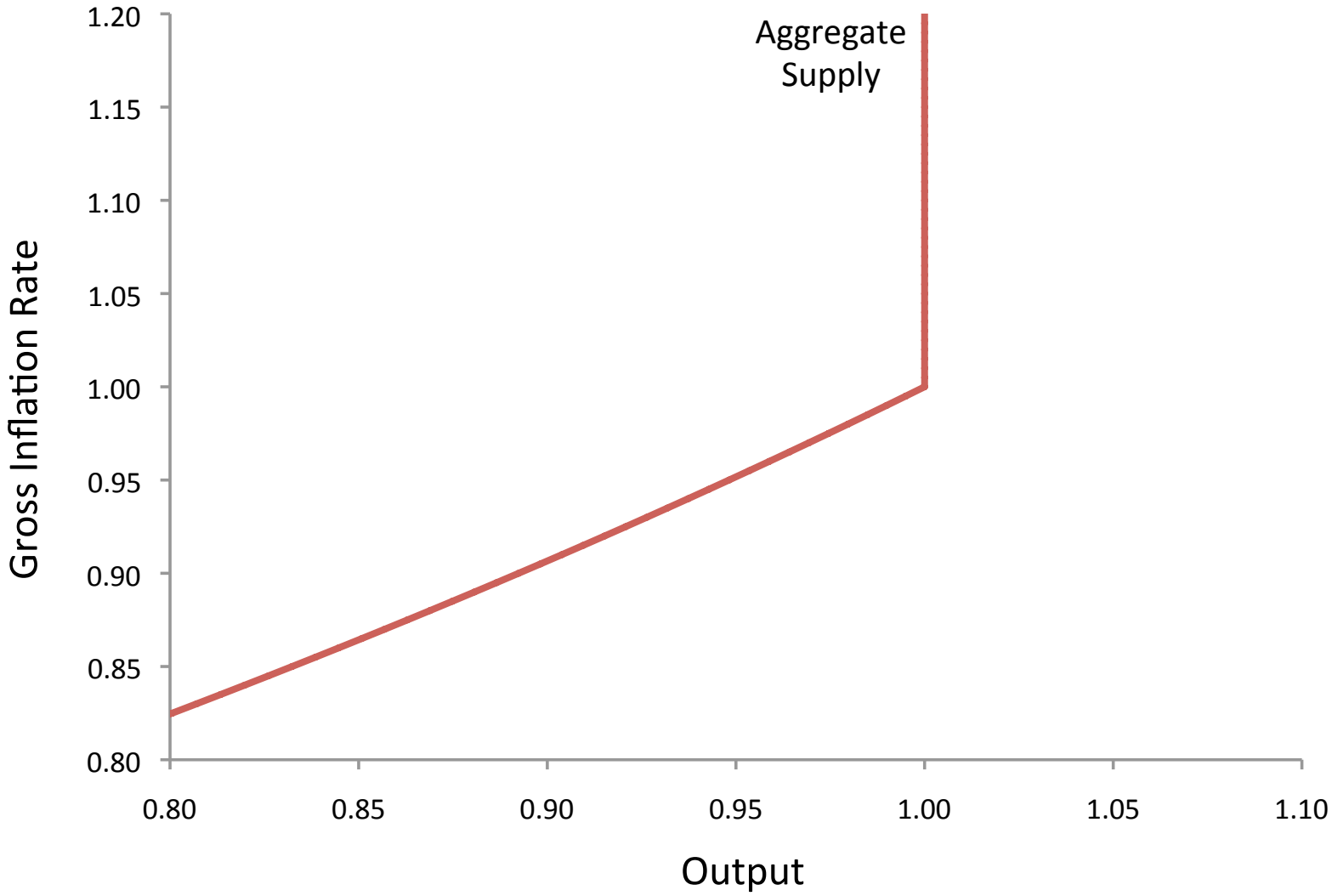
$$Y = Y_{fe} = \bar{L}^{\alpha}$$

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:

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

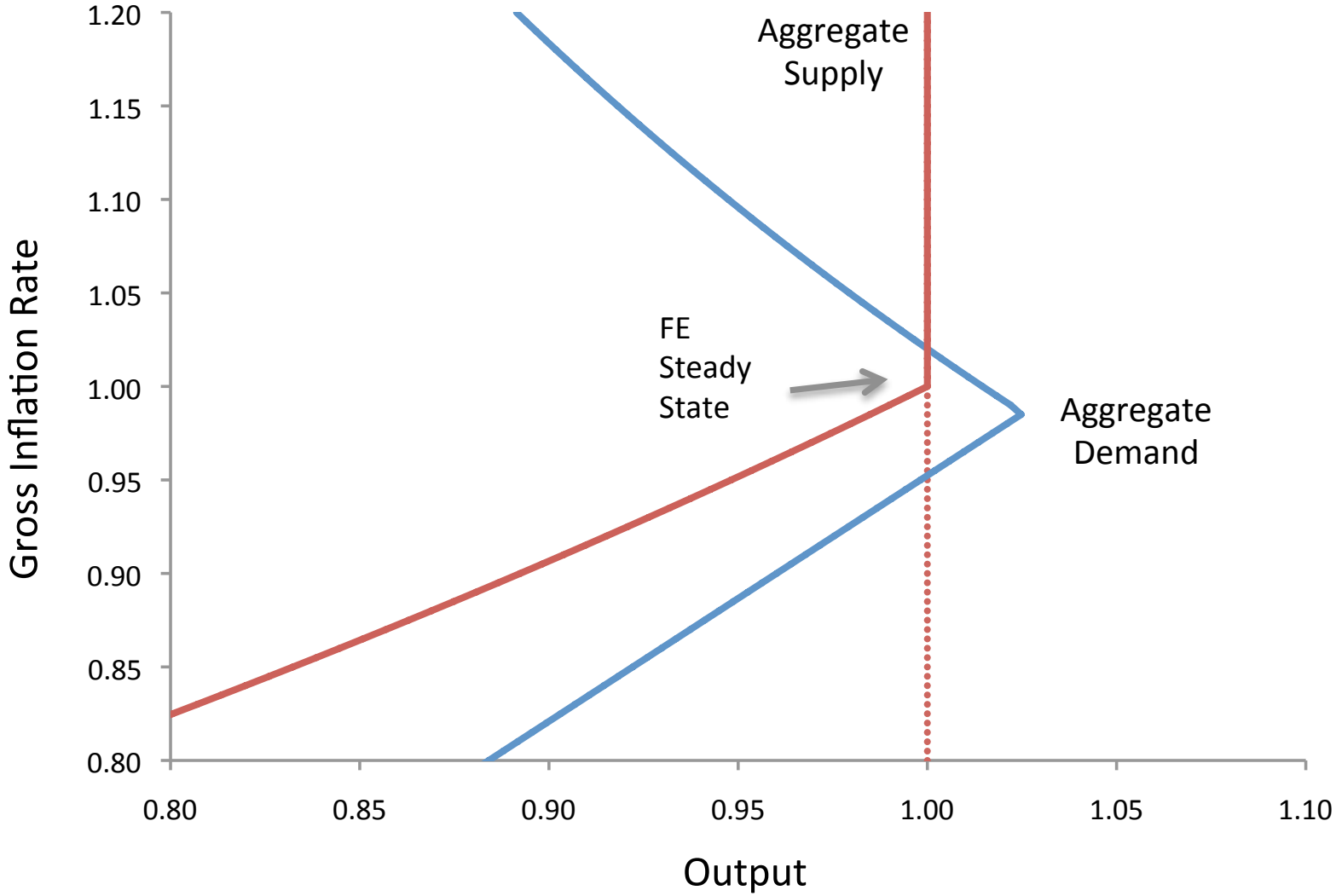
Above binding ZLB:

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

Binding ZLB:

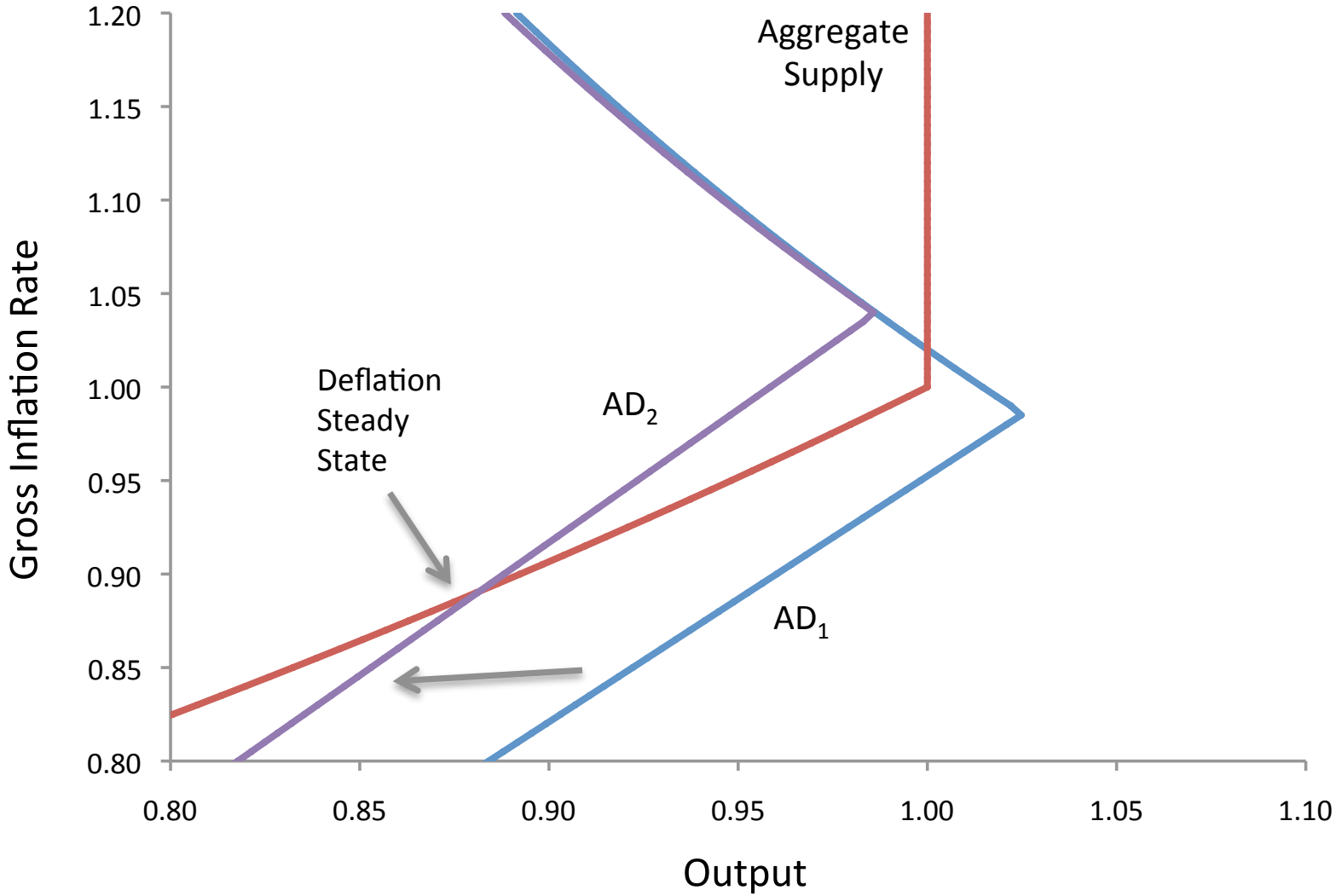
$$\frac{1}{\Pi_{t+1}} = \frac{1 + \beta}{\beta}\frac{(1 + g_t)D_t}{Y_t - D_{t-1}}$$

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

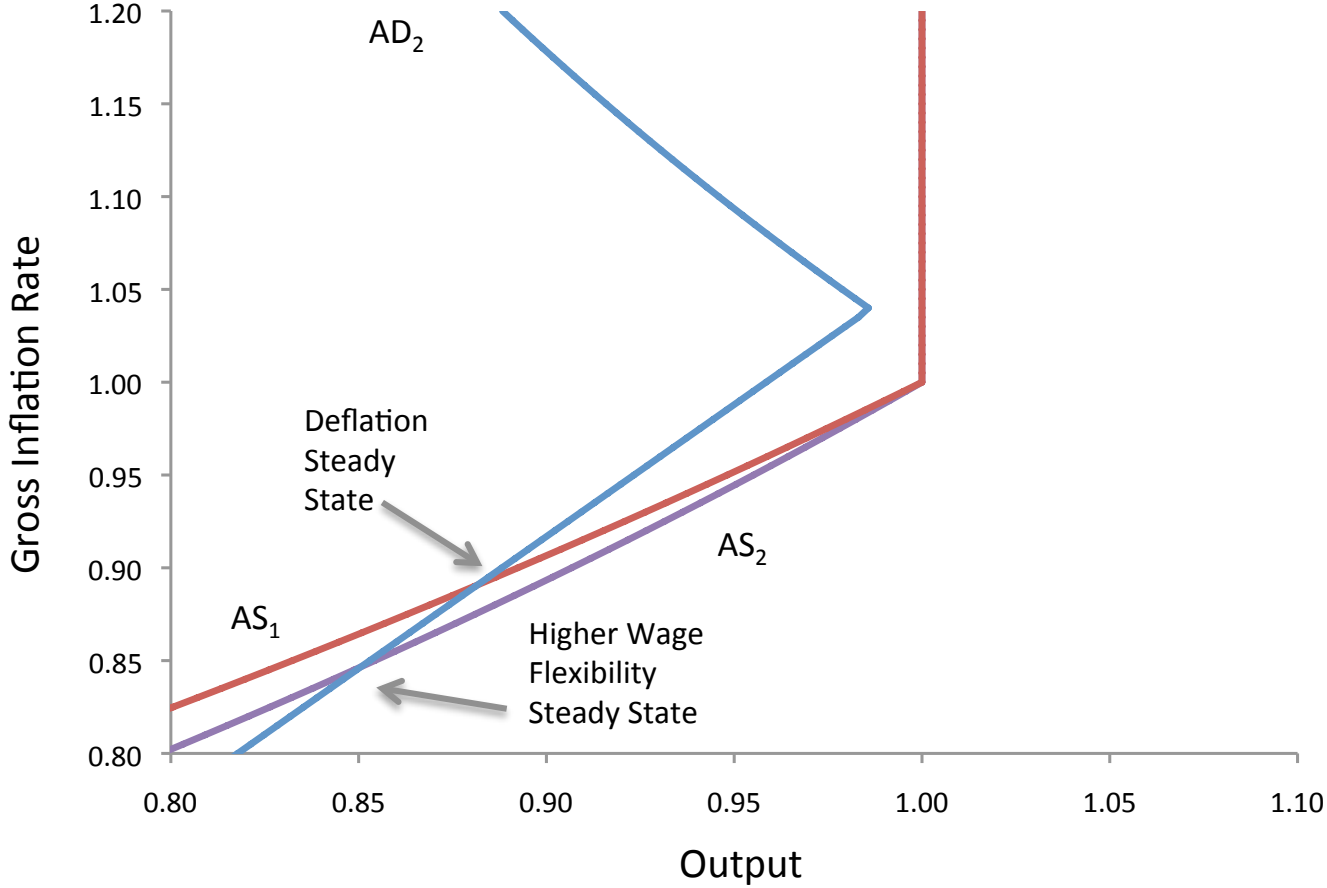
Existence and stability:

- 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)
- Can do comparative statistics!

Linearized Conditions

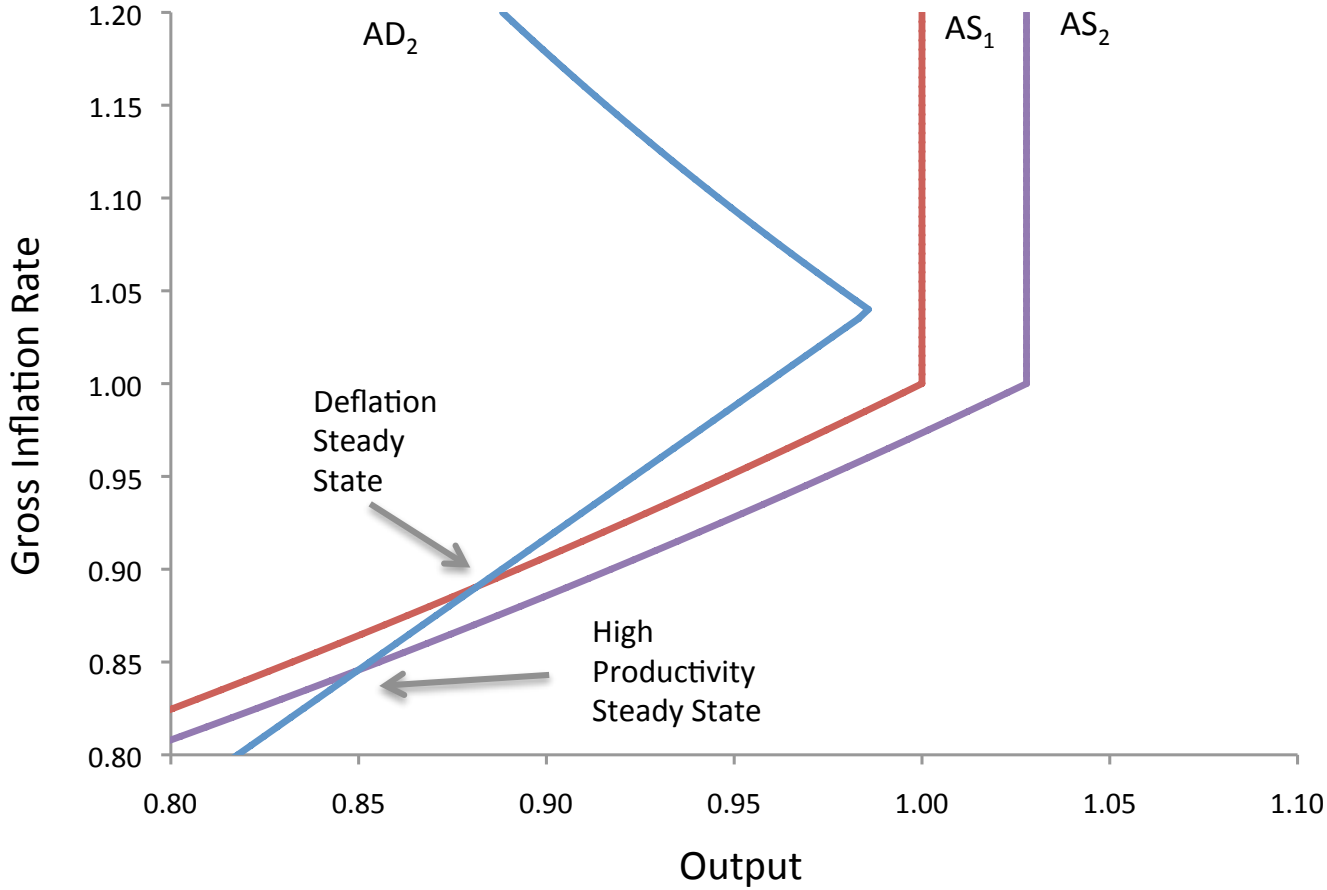
Paradox of Flexibility

- No obvious adjustment mechanisms to full employment
- As wages get more flexible output drops more



Paradox of Toil

- Say's Law inverted: Destroying Aggregate supply creates Aggregate Demand
- Hysteresis/Reduction in labor force participation stabilizing (reduces deflationary pressures)



Monetary Policy Responses

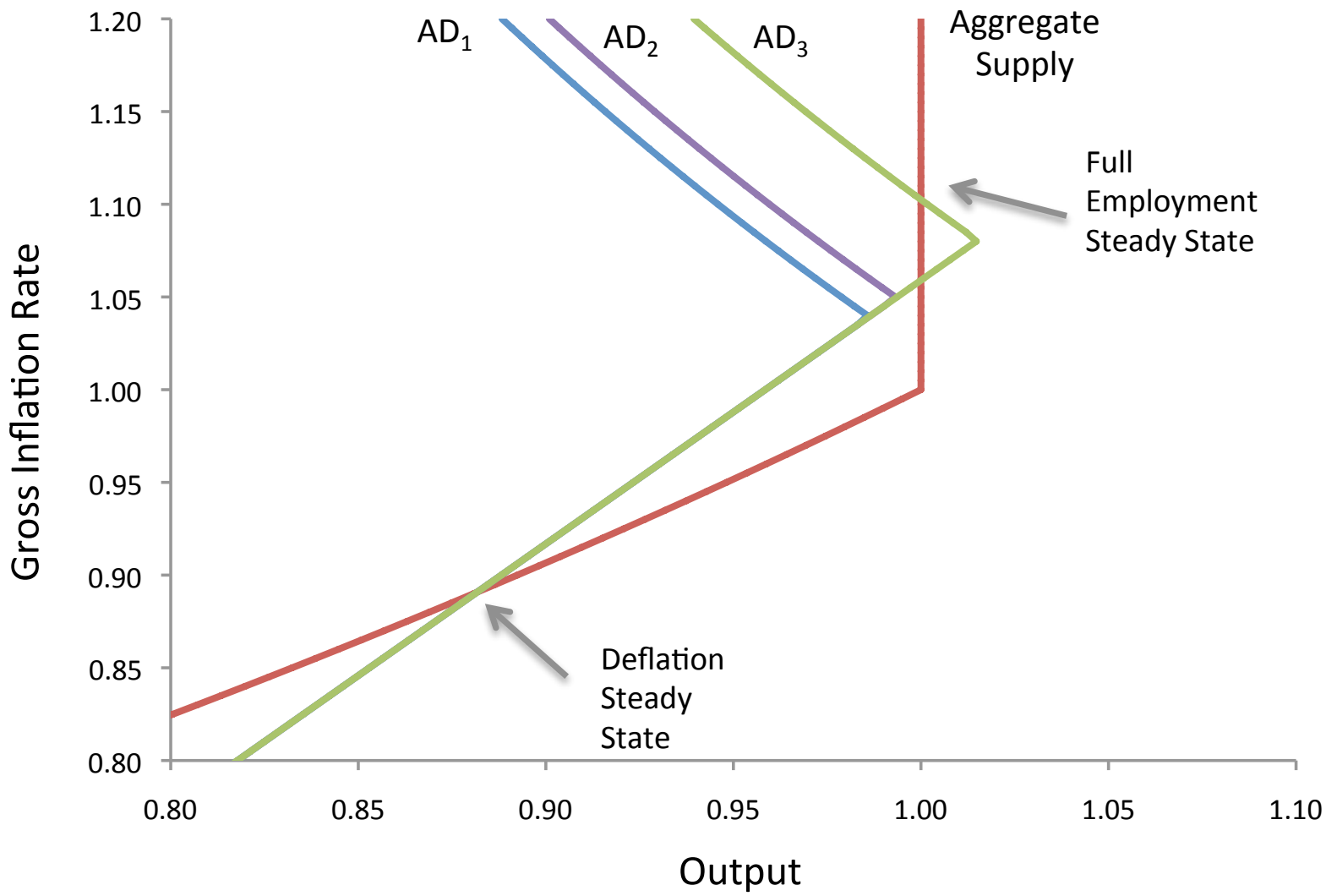
Forward guidance:

- 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 exists.
- Timidity trap (Krugman (2014))
- Multiple determinate steady states (secular stagnation and reflation)
- Monetary policy not as powerful as in earlier models because no way to exclude secular stagnation.

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 (or inversely, austerity measures)

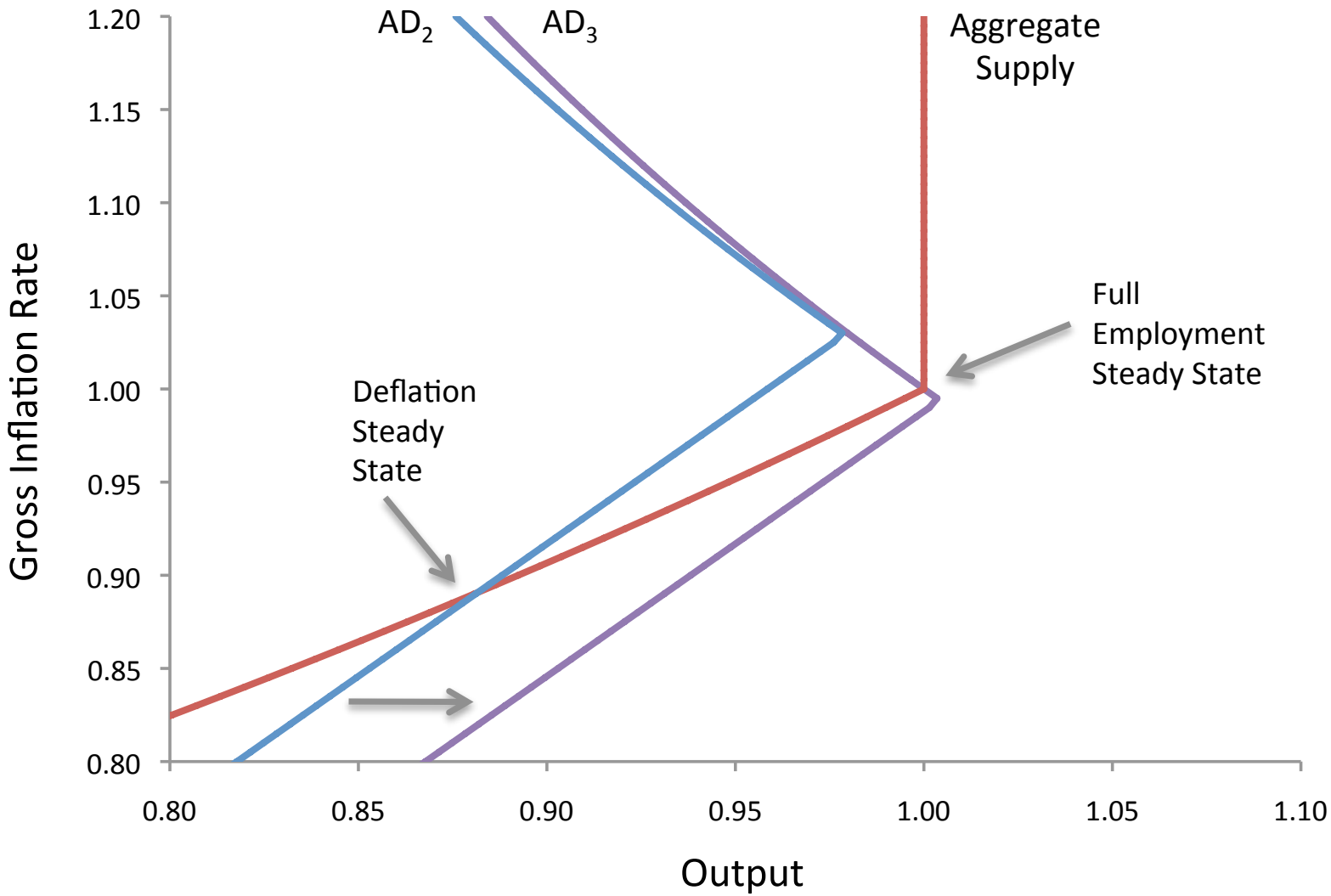
Consider steady state following fiscal rule:

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

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))

Expansionary Fiscal Policy



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

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
- Need less savings to build the same capital stock
- –> downward pressure on the real interest rate.
- Global decline in price of capital goods (Karabarbounis and Neiman, 2014)

Land

Conclusions

Policy implications:

- Higher inflation target needed
- Limits to forward guidance
- Role for fiscal policy
- Possible important 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

Going forward

In progress:

- A quantitative variation of the model: stochastic transitions across age groups.
- Quantitatively decompose the effect of different channels on the real interest rate during the crisis.
- Did the bubble mask a secular stagnation?