A Model of Secular Stagnation

Gauti B. Eggertsson and Neil R. Mehrotra

Brown University

July 12, 2014

NBER Summer Institute

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 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:

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

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

Deflation steady state

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

Paradoxes and policy responses

- Paradox of thrift, toil and flexibility
- Raising the inflation target good but better be high enough
- Fiscal expansions (debt or spending)

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:

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

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 income in the middle-generation reduces real interest rate
- Higher income in the old-generation increases real interest rate

Effect of a Deleveraging Shock

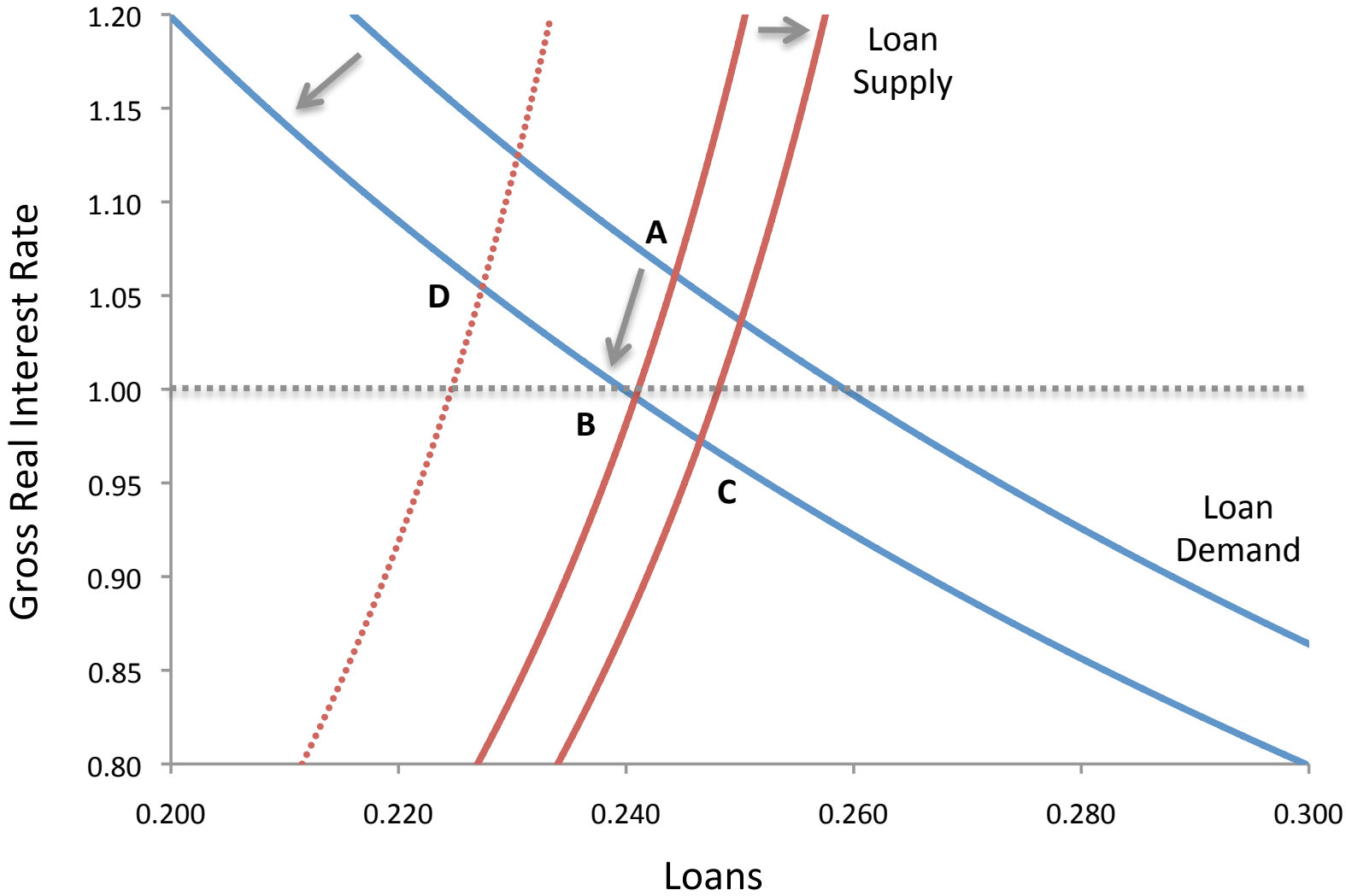
Impact effect:

- 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 intergenerational income 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:

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

Price Level Determination

Euler equation for nominal bonds:

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

Lower 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 central bank does not tolerate inflation?
- Then the central bank's refusal to tolerate high enough inflation will show up as a permanent recession.

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:

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

Derivation of Aggregate Supply

For positive steady state inflation:

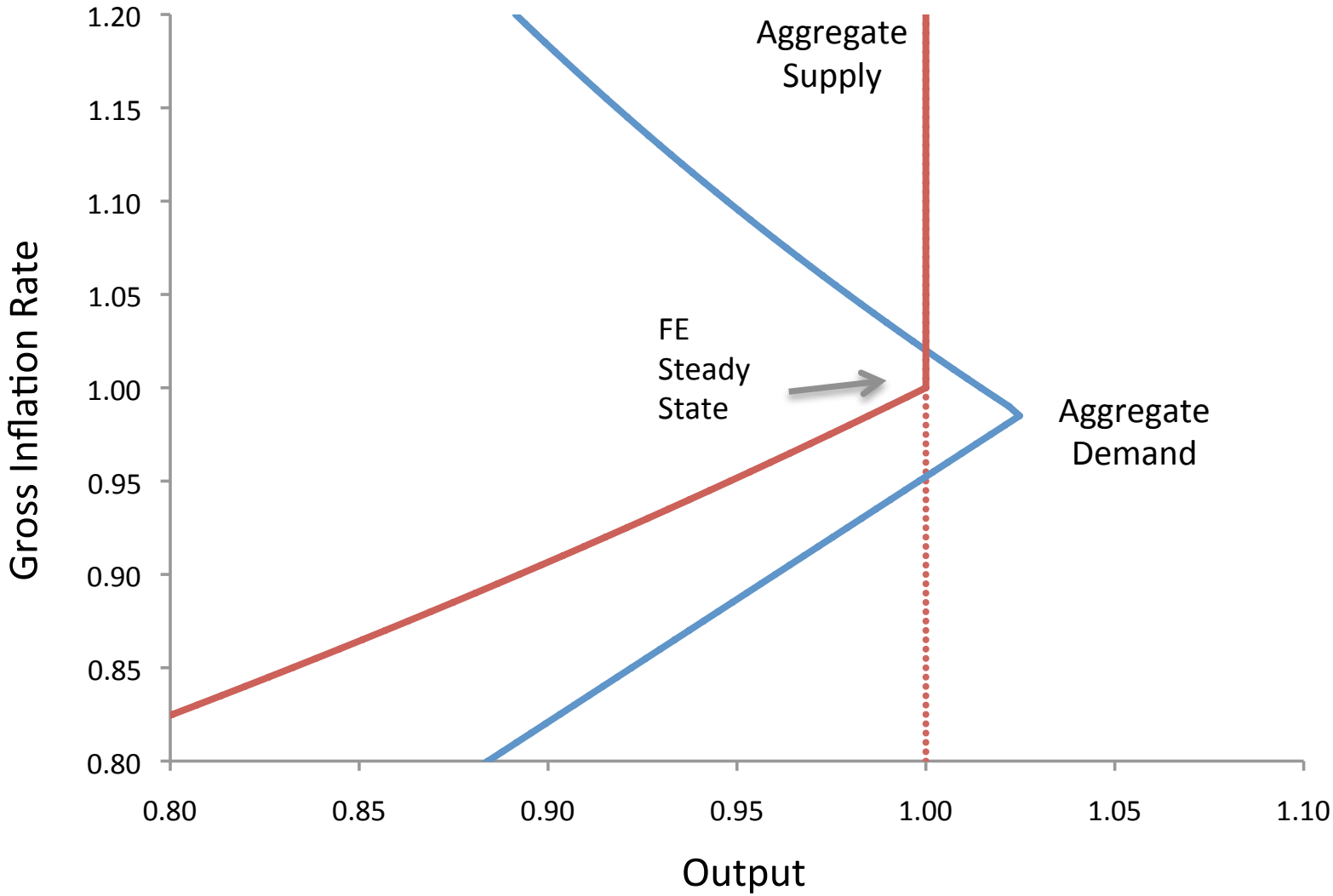
$$w_t = \bar{W} = \alpha \bar{L}^{(\alpha-1)}$$
$$Y_t = Y_{fe}$$

For steady state deflation:

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

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

Full Employment Steady State



Derivation of Aggregate Demand

Monetary policy rule:

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

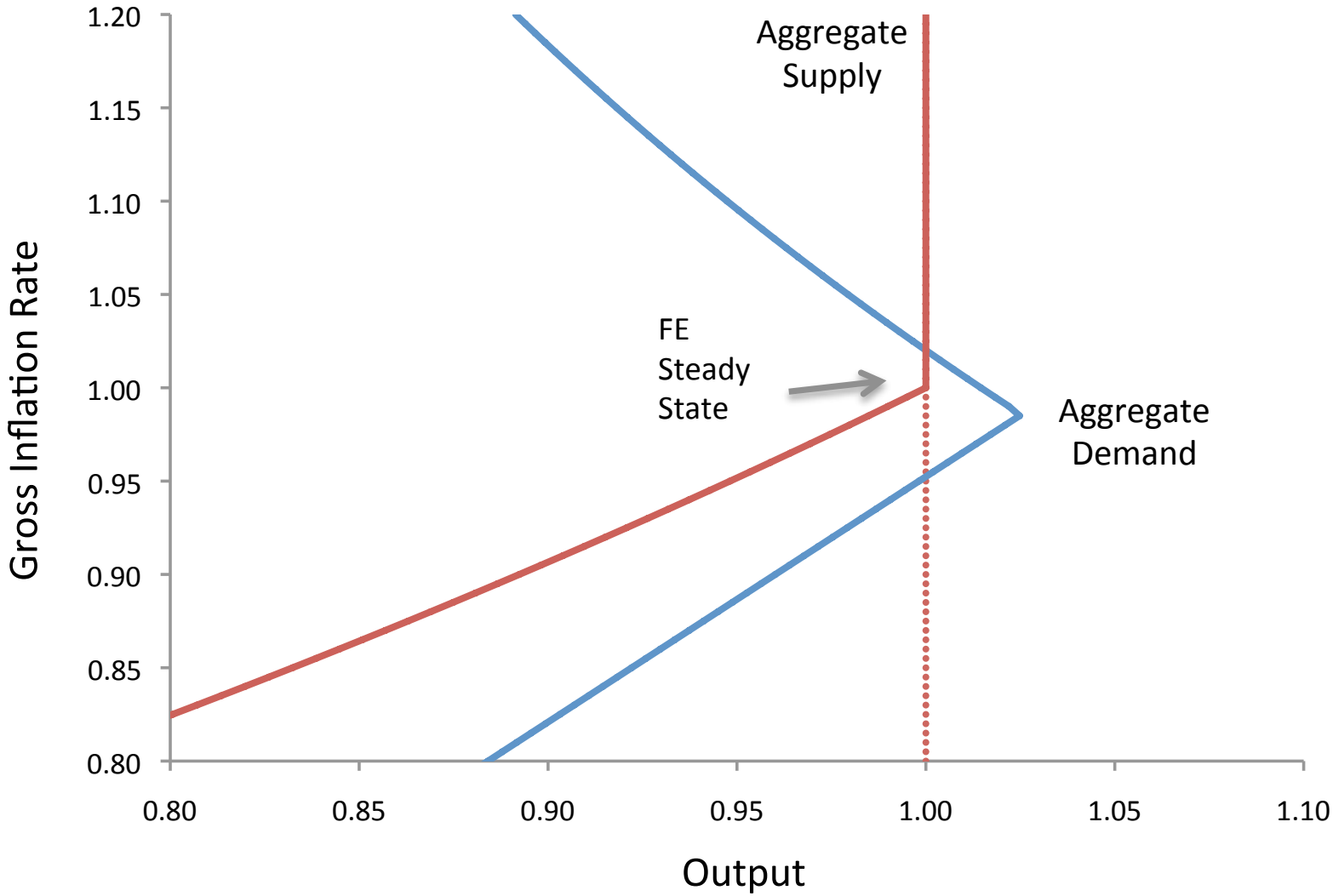
Above binding ZLB:

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

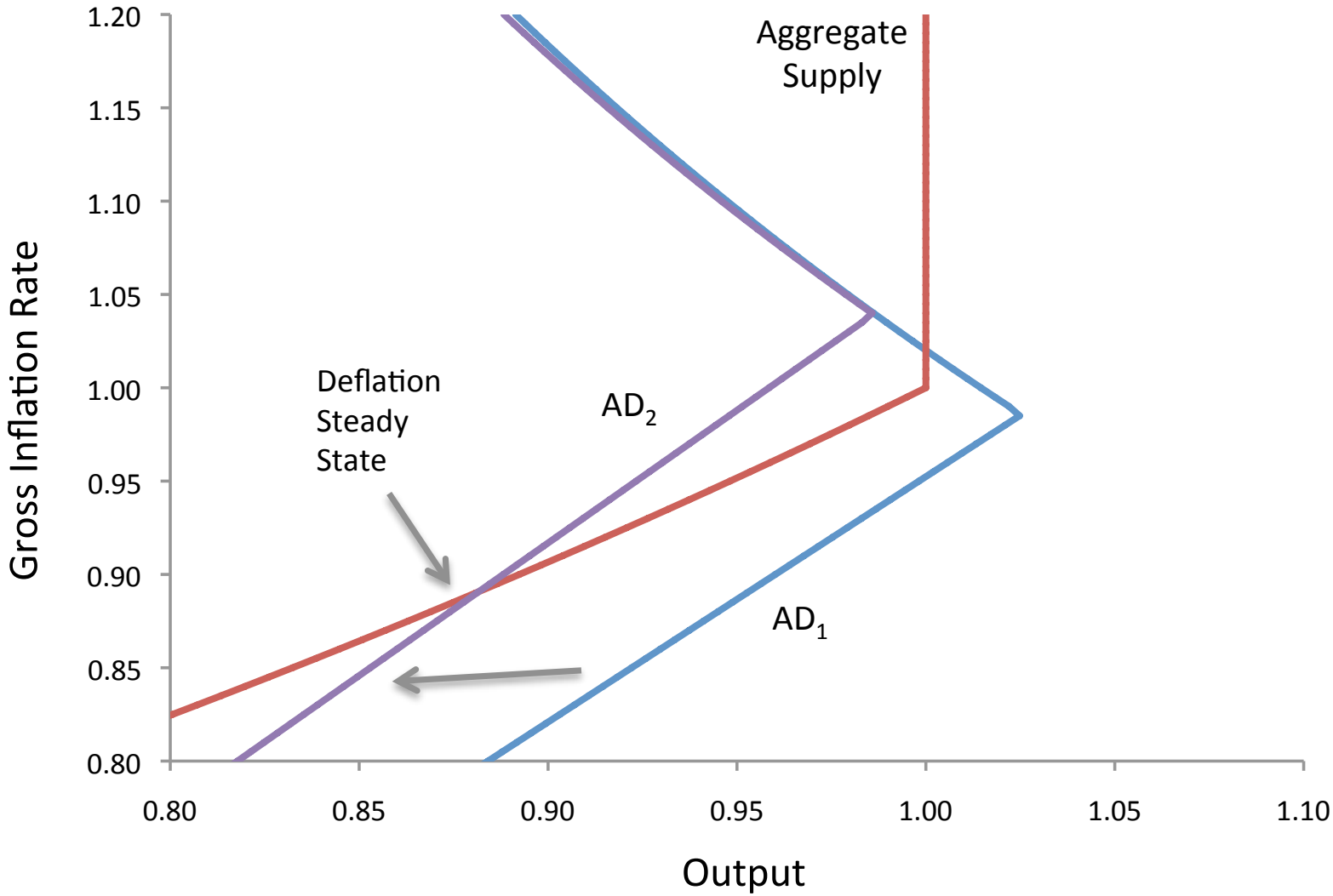
Binding ZLB:

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

Full Employment Steady State



Effect of a Collateral Shock



Properties of the Deflation Steady State

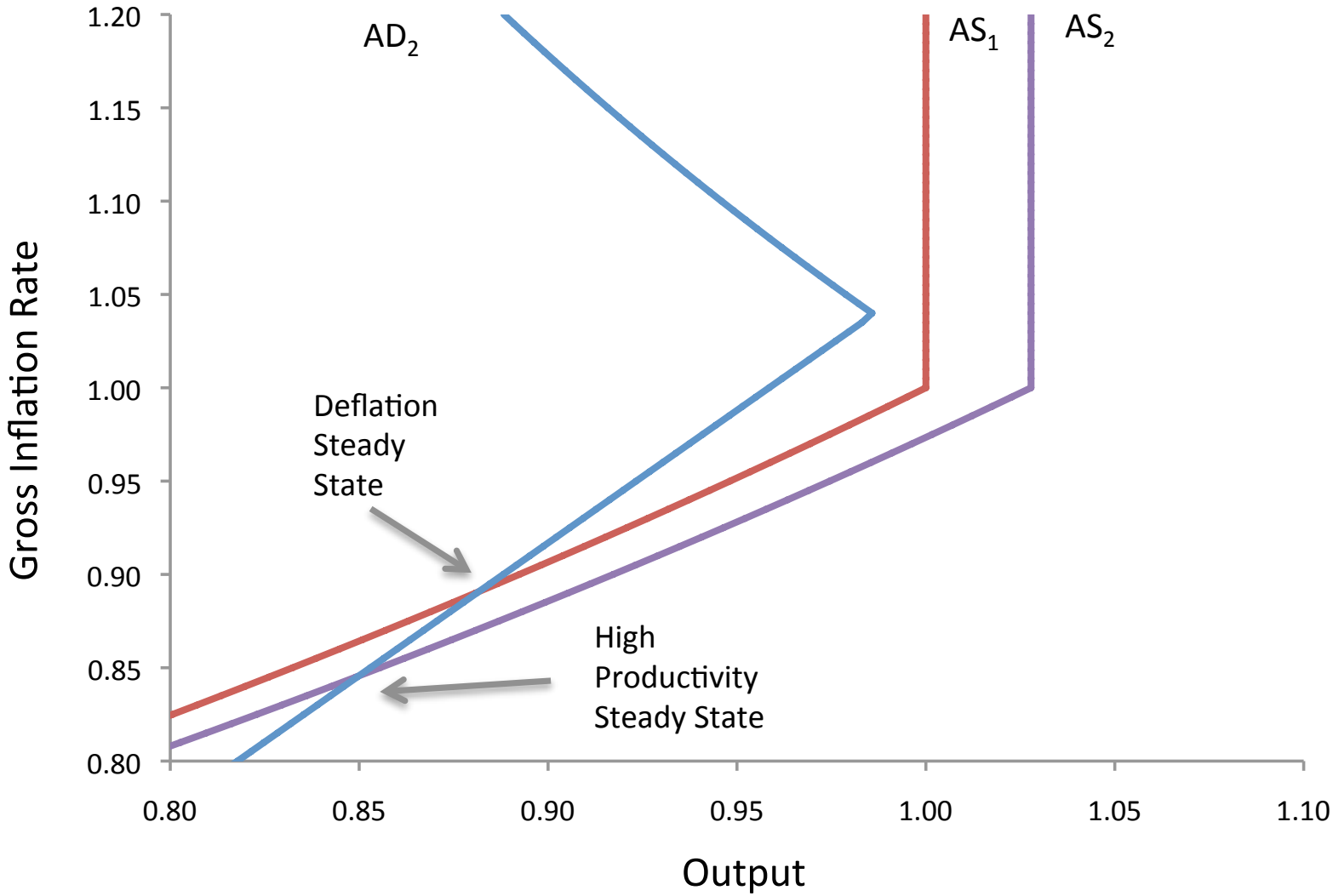
Long slump:

- 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

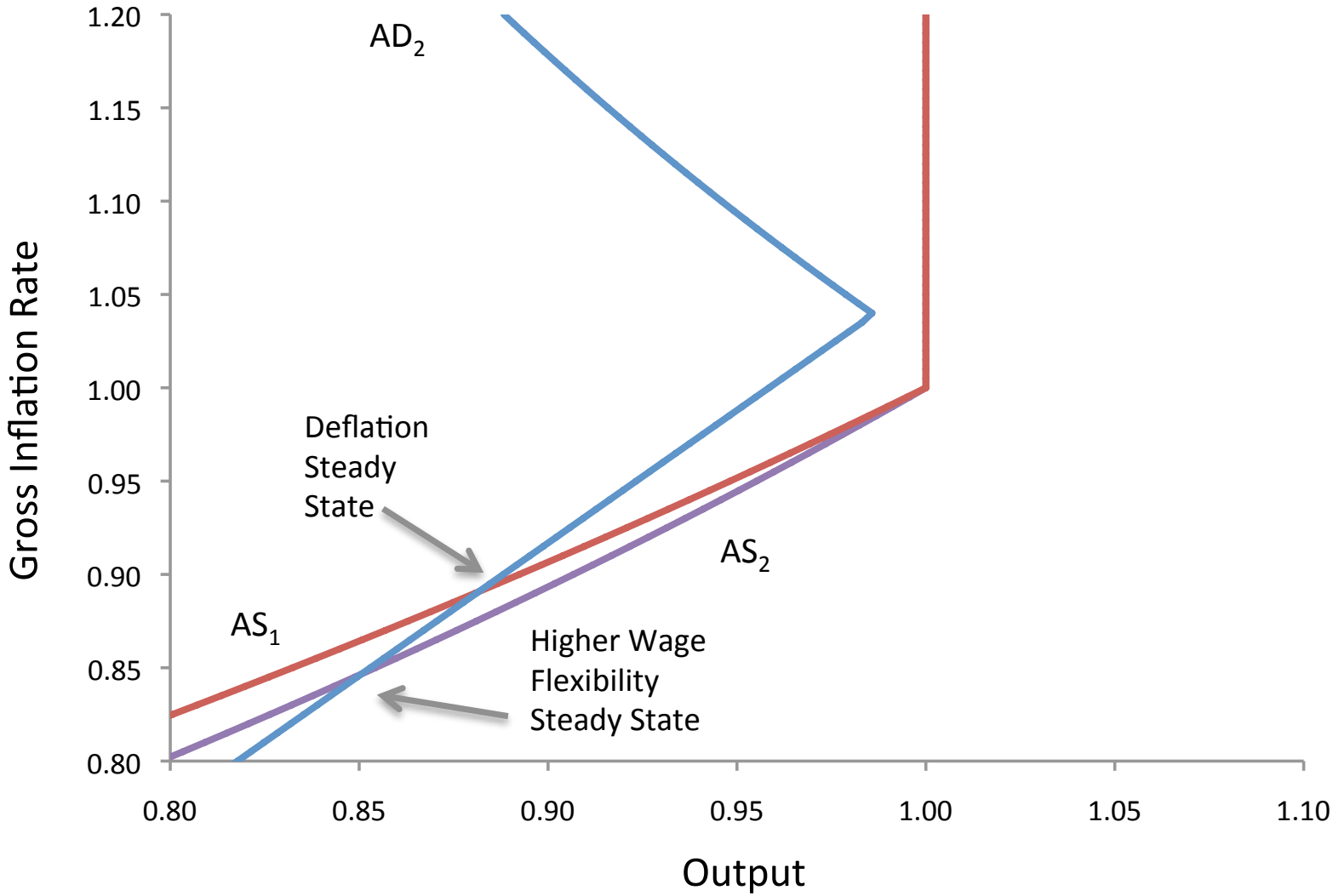
Existence and stability:

- Secular stagnation steady state exists so long as $\gamma > 0$
- Secular stagnation state state is determinate
- Contrast to deflation steady state emphasized in Benhabib, Schmitt-Grohe and Uribe (2001)
- Can do comparative statics!

Paradox of Toil



Paradox of Flexibility



Monetary Policy Responses

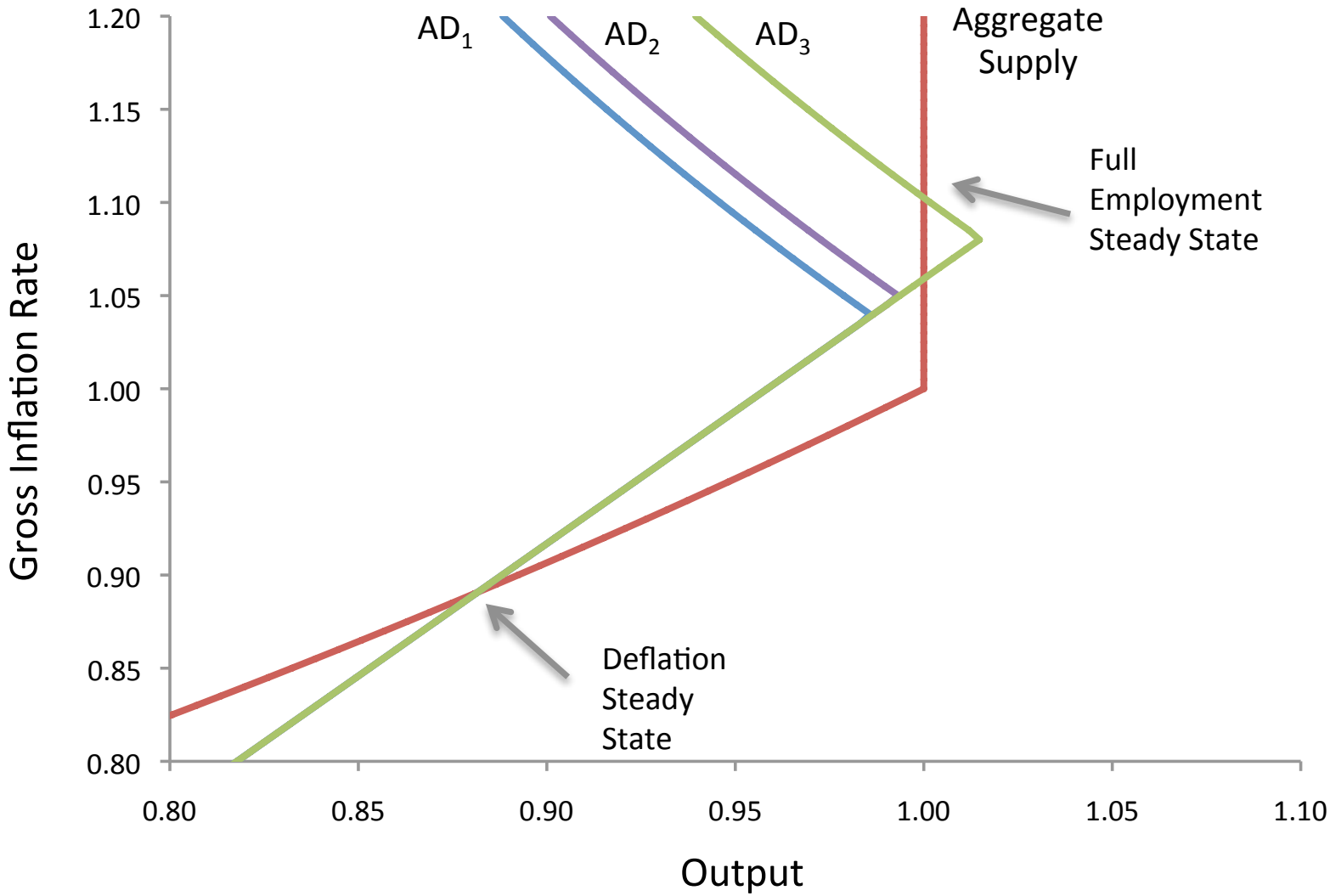
Forward guidance:

- 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
- Law of the excluded middle or the timidity trap (Krugman (2014))
- Multiple steady states (two determinate, one indeterminate)

Raising the Inflation Target



Fiscal Policy Responses

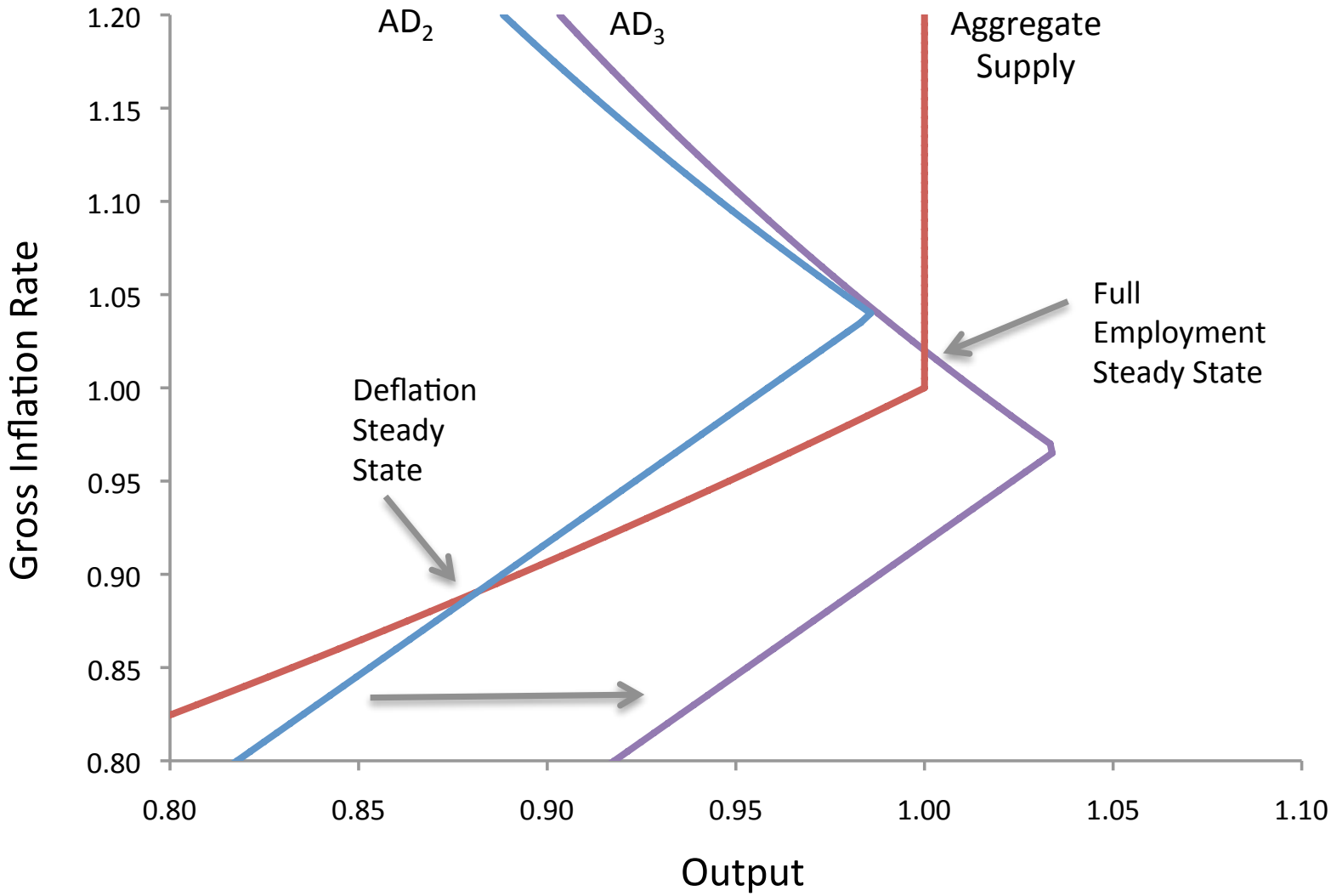
Fiscal policy and the real interest rate:

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

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

- Higher government debt increases the interest rate by increasing demand for bonds
- Taxes on middle aged reducing loan supply: increase r_t
- Expected taxes on old increase loan supply: decrease r_t
- In AD-AS framework, gov. spending financed either by taxes or debt is expansionary

Increasing Government Spending with tax on middle aged



Incorporating Capital

Rental rate and real interest rate:

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

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

- Assume that return on capital is realized in the same period as investment
- 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 interest rate
- Global decline in price of capital goods (Karabarbounis and Neiman, 2014)
- Consistent with argument by Summers (2014)

Conclusions

Policy implications:

- Higher inflation target needed
- Limits to forward guidance
- Role for fiscal policy
- Avoid policies that tighten collateral constraint D? (i.e. capital requirements, etc.)

Key takeaway:

- NOT that we will stay in a slump forever
- Instead, the slump can be of arbitrary duration which has strong policy implications.
- Stakes are even higher for good aggregate demand management.