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
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 possible
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: \( t = 0, 1, 2, \ldots \)

- Goods: consumption good \((c)\)

- Agents: 3-generations: \( i \in \{y, m, o\} \)

- Assets: riskless bonds \((B^i)\)

- Technology: exogenous borrowing constraint \( D \)
Households

Objective function:

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

Budget constraints:

$$C_t^y = B_t^y$$
$$C_{t+1}^m = Y_{t+1}^m - (1 + r_t)B_t^y + B_{t+1}^m$$
$$C_{t+2}^o = Y_{t+2}^o - (1 + r_{t+1})B_{t+1}^m$$
$$(1 + r_t)B_t^i \leq D_t$$
Credit-constrained youngest generation:

\[ C^y_t = B^y_t = \frac{D_t}{1 + r_t} \]

Saving by the middle generation:

\[ \frac{1}{C^m_t} = \beta \mathbb{E}_t \frac{1 + r_t}{C^o_{t+1}} \]

Spending by the old:

\[ C^o_t = Y^o_t - (1 + r_{t-1}) B^m_{t-1} \]
**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:

\[ 1 + r_t = \frac{1 + \beta (1 + g_t)D_t}{\beta Y_t^m - D_{t-1}} + \frac{1}{\beta Y_t^m - D_{t-1}} \]

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
Credit constrained middle income:

- Fraction $\eta_s$ 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:

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

Euler equation for nominal bonds:

\[ \frac{1}{C_t^m} = \beta E_t \frac{1}{C_t^o} \left(1 + i_t\right) \frac{P_t}{P_{t+1}} \]

\[ i_t \geq 0 \]

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.
OUTLINE FOR PRESENTATION

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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: \( Y_{fe} = \bar{L}^\alpha \)
Partial wage adjustment:

\[ W_t = \max \left\{ \tilde{W}_t, P_t \alpha \bar{L}^{\alpha-1} \right\} \]

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)
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

![Aggregate Supply Graph]

- Gross Inflation Rate
- Output
- Aggregate Supply
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:

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

Binding ZLB:

\[ \frac{1}{\Pi_t + 1} = \frac{1 + \beta (1 + g_t) D_t}{\beta Y_t - D_{t-1}} \]
Steady State Aggregate Demand Relation

Above binding ZLB:

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

Binding ZLB:

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

Inflation rate at which ZLB binds:

\[
\Pi_{kink} = \Pi^* \left( \frac{1}{1 + i^*} \right)^{\frac{1}{\phi_{\pi}}}
\]
**Full Employment Steady State**

![Graph showing the relationship between Gross Inflation Rate and Output, with aggregate supply and demand lines, and the full employment steady state indicated.](attachment:image.png)
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)
Paradox of Toil

Output

<table>
<thead>
<tr>
<th>Gross Inflation Rate</th>
<th>AS₁</th>
<th>AS₂</th>
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<tbody>
<tr>
<td>0.80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.85</td>
<td></td>
<td></td>
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<tr>
<td>0.90</td>
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<tr>
<td>0.95</td>
<td></td>
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<td>1.00</td>
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<tr>
<td>1.05</td>
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<tr>
<td>1.10</td>
<td></td>
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High Productivity Steady State

Deflation Steady State

AD₂

31 / 54
Paradox of Flexibility

<table>
<thead>
<tr>
<th>Gross Inflation Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS_1</td>
</tr>
<tr>
<td>AS_2</td>
</tr>
<tr>
<td>AD_2</td>
</tr>
</tbody>
</table>

Output:
- Higher Wage Flexibility
- Steady State

Deflation Steady State

AS_2
Outline for Presentation

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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

![Graph showing AD1, AD2, AD3, Aggregate Supply, Full Employment Steady State, Deflation Steady State.]
Fiscal Policy

Fiscal policy and the real interest rate:

\[ L^d_t = \frac{1 + g_t}{1 + r_t} D_t + B^g_t \]

\[ L^s_t = \frac{\beta}{1 + \beta} (Y^m_t - D_{t-1} - T^m_t) - \frac{1}{1 + \beta} \frac{Y^o_{t+1} - T^o_{t+1}}{1 + r_t} \]

Government budget constraint:

\[ B^g_t + T^y_t (1 + g_t) + T^m_t + \frac{1}{1 + g_{t-1}} T^o_t = G_t + \frac{1 + r_t}{1 + g_{t-1}} B^g_{t-1} \]

Fiscal instruments:

\[ G_t, B^g_t, T^y_t, T^m_t, T^o_t \]
Temporary Increase in Public Debt

Under constant population and set $G_t = T^y_t = B^g_{t-1} = 0$:

$$T^m_t = -B^g_t$$
$$T^o_{t+1} = (1 + r_t) B^g_t$$

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
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))
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:

<table>
<thead>
<tr>
<th>Financing</th>
<th>Multiplier</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in public debt</td>
<td>( \frac{1 + \beta}{\beta} \frac{1}{1 - \kappa \psi} )</td>
<td>&gt; 2</td>
</tr>
<tr>
<td>Tax on young generation</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tax on middle generation</td>
<td>( \frac{1}{1 - \kappa \psi} )</td>
<td>&gt; 1</td>
</tr>
<tr>
<td>Tax on old generation</td>
<td>( - \frac{1 + g}{\beta} \frac{1}{1 - \kappa \psi} )</td>
<td>&lt; 0</td>
</tr>
</tbody>
</table>
Outline for Presentation

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Objective function:

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

Budget constraints:

$$C_t^y = B_t^y$$

$$C_{t+1}^m + p_{t+1}k_{t+1} + (1 + r_t)B_t^y = w_{t+1}L_{t+1} + r_{t+1}k_{t+1} + B_{t+1}^m$$

$$C_{t+2}^o + (1 + r_{t+1})B_{t+1}^m = p_{t+2}(1 - \delta)k_{t+1}$$

Dynamic Efficiency
**Characterization**

Capital supply (perfect foresight):

\[(p_t^k - r_t^k) \frac{1}{C^m_t} = \beta p_{t+1}^k (1 - \delta) \frac{1}{C^o_{t+1}}\]

Loan supply and demand:

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

\[L_t^s = \frac{\beta}{1 + \beta} (Y_t - D_{t-1}) - \frac{\beta}{1 + \beta} \left( p_t^k + p_{t+1}^k \frac{1 - \delta}{\beta (1 + r_t)} \right) K_t\]
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)
Effect of a Shock to Price of Capital Goods

The diagram illustrates the interaction between the supply and demand for loans, with the gross real interest rate on the y-axis and loans on the x-axis. The supply curve (blue line) and the demand curve (red line) intersect at a point, indicating an equilibrium price of capital goods. The diagram shows how a shock to the price of capital goods affects the equilibrium point, leading to changes in the demand and supply of loans.
Paradox of Thrift

Effect of a discount rate shock

Positive natural rate

Negative natural rate

Gross Inflation Rate

Output

Austerity Equilibrium

Normal Equilibrium

Secular Stagnation Equilibrium

Austerity Equilibrium
**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
## Parameter Values in Numerical Examples

<table>
<thead>
<tr>
<th>Description</th>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>Population growth</td>
<td>$g$</td>
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<tr>
<td>Collateral constraint</td>
<td>$D$</td>
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</tr>
<tr>
<td>Discount rate</td>
<td>$\beta$</td>
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<tr>
<td>Labor share</td>
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<tr>
<td>Wage adjustment</td>
<td>$\gamma$</td>
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<tr>
<td>Taylor coefficient</td>
<td>$\phi_\pi$</td>
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<tr>
<td>Gross inflation target</td>
<td>$\Pi^*$</td>
<td>1.01</td>
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<tr>
<td>Labor supply</td>
<td>$L$</td>
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</tr>
<tr>
<td>Depreciation</td>
<td>$\delta$</td>
<td>0.79</td>
</tr>
</tbody>
</table>
**Dynamic Efficiency**

Planner’s optimality conditions:

\[
\frac{C_o}{C_m} = \beta (1 + g)
\]

\[
(1 - \alpha) K^{-\alpha} = 1 - \frac{1 - \delta}{1 + g}
\]

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

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
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
Land

Land with dividends:

\[ p_t^{\text{land}} = D_t + \frac{p_{t+1}^{\text{land}}}{1 + r_t} \]

- 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
Linearized Equilibrium Conditions

Linearized AS and AD curves:

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

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

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