FISCAL POLICY IN AN UNEMPLOYMENT CRISIS

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June 16, 2015
**The new-Keynesian view**

1. $G_t \uparrow \Rightarrow P_t \uparrow$
2. Only a small fraction of firms can adjust prices, with a larger mass able to do so in the future (Calvo pricing)
3. $P_{t+1} > P_t$.
4. Real interest rate $r_t \approx -\pi_t \downarrow$
5. Private spending $C_t \uparrow \Rightarrow Y_t \uparrow$
The new-Keynesian view

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1. Rinse and repeat
1. $G_t \uparrow \Rightarrow P_t \uparrow$

2. Downward nominal wage rigidity:

3. $\Rightarrow W_t / P_t \downarrow$.

4. NPV profits $J_t \uparrow$

5. $u_t \downarrow$ and $u_{t+1} \downarrow$

6. Since $u_{t+1} \sim C_{t+1}$, consumption smoothing implies $C_t \uparrow \Rightarrow Y_t \uparrow$
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1. Rinse and repeat
Differences

- Transmission mechanism
  - Spending out of lower real interest rate
  - Spending out of getting a job that lasts
A stylized model

- A useful starting point

\[ u'(c_t) = \beta(1 + i_{t+1}) \frac{p_t}{p_{t+1}} u'(c_{t+1}) \]

- Assumptions
  - Predetermined price level in \( t \).
  - Cash in advance price level in \( t + 1 \): \( p_{t+1} = m_{t+1}/y_{t+1} \).
  - Natural interest rate
  - Exogenous \( y_{t+1} \).
  - \( EIS < 1 \).
  - Potential output in \( t, y = 1 \)
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\[ u'(y_t - g_t) = \beta(1 + i_{t+1}) \frac{p_t}{p_{t+1}} u'(y_{t+1}) \]

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A STYLIZED MODEL

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- (If \( EIS < 1 \) then \( y_{t+1} \downarrow \Rightarrow i_{t+1} \downarrow \))

- For some \( \beta^* \), \( \beta \geq \beta^* \Rightarrow i_{t+1} = 0 \) and \( y_t < y = 1 \).
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\[ u'(y_t - g_t) = \beta \frac{y_{t+1}}{m_{t+1}} u'(y_{t+1}) \]

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- If \( \beta \uparrow \Rightarrow i_{t+1} \downarrow \)
- (If \( EIS < 1 \) then \( y_{t+1} \downarrow \Rightarrow i_{t+1} \downarrow \))
- For some \( \beta^* \), \( \beta \geq \beta^* \) \( \Rightarrow i_{t+1} = 0 \) and \( y_t < y = 1 \).
- Krugman’s (1998) results follow
A stylized model

- Suppose that output is produced as $y_t = n_t$.
- Assume further that employment is inertial such that $n_{t+1} = n_t^\alpha$
- ($\alpha = 0$ collapses the model to that of Krugman (1998))
Then for $\beta > \beta^*$ we have

$$u'(y_t - g_t) = \beta \frac{y_{t+1}}{m_{t+1}} u'(y_{t+1})$$
Then for $\beta > \beta^*$ we have

$$u'(y_t - g_t) = \beta \frac{y_t^\alpha}{m_{t+1}} u'(y_t^\alpha)$$
A stylized model

- With CRRA preferences

\[
\frac{\partial y_t}{\partial g_t} = \frac{1}{1 - \alpha (1 - \frac{1}{\gamma})} \in [1, \gamma]
\]

- Thus

\[
\lim_{\alpha \to 1} \frac{\partial y_t}{\partial g_t} = \gamma > 1
\]
A stylized model

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- Thus

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\]

- And one can show

\[
\sum_{s=0}^{\infty} \frac{\partial y_{t+s}}{\partial g_t} \geq \frac{1}{1 - \alpha} \frac{\partial y_t}{\partial g_t}
\]
The model largely follows the previous framework but with equilibrium unemployment and endogenous $\alpha$

- Continuum of households of measure one
- Continuum of potential firms
- A government
Model

- One sector model, $y_t = n_t$
- Cashless limit. Prices $p_t$
- Time is discrete, $t = 0, 1, 2, \ldots$, and the horizon infinite
- Investments, but no capital
MODEL: HOUSEHOLDS

- Households search for jobs inelastically
- Employment denoted $n_t$, so $u_t = 1 - n_t$
- Nominal wage-rate is denoted $w_t$
- Total income, $W_t$, is labor income, $n_t \times w_t$, and profits, $\Pi_t$. 
MODEL: HOUSEHOLDS

- Period budget constraint

\[ B_t (1 + i_t) + W_t - T_t = C_t + B_{t+1} \]

with \( C_t = p_t c_t \)
Model: Households

Problem: Given prices and taxes pick feasible \( \{c_t, B_{t+1}\} \) to maximize

\[
U(\{c_t\}_{t=0}^\infty) = E \sum_{t=0}^{\infty} \beta^t u(c_t)
\]

\( E \) denotes the (mathematical) expectations over future processes.
MODEL: HOUSEHOLDS

- First order condition

\[ u'(c_t) = \beta(1 + i_{t+1}) E_t \left[ \frac{p_t}{p_{t+1}} u'(c_{t+1}) \right]. \]

- Plus TVC
The asset values of an operating firm is

\[ J_t = 1 - \frac{w_t}{p_t} + \beta E_t \left[ \frac{u'(c_{t+1})}{u'(c_t)} (1 - \delta)J_{t+1} \right]. \]

Post vacancy gives match with probability \( h_t \) and costs \( \kappa \).

Free entry

\[ \kappa = h_t J_t \]  \hspace{1cm} (1)
MODEL: LABOR MARKET

- The labor market is frictional with matching function

\[ M_t = M(v_t, \hat{u}_t), \quad \hat{u}_t = 1 - n_{t-1} + \delta n_{t-1} \]

- Job-filling rate, and job-finding probability

\[ h(\theta_t) = \frac{M_t}{v_t}, \quad f(\theta_t) = \frac{M_t}{\hat{u}_t}, \quad \text{with} \quad \theta_t = \frac{v_t}{\hat{u}_t} \]

- Law of motion for employment

\[ n_t = \hat{u}_t f(\theta_t) + (1 - \delta) n_{t-1} \]
Model: Households

Nominal wages are rigid, $w_t = w$. But useful benchmark to define flexible wages.

\[ V_t = \hat{w}_t + \beta E_t \left[ \frac{u'(c_{t+1})}{u'(c_t)} \left\{ [1 - \delta(1 - f_{t+1})]V_{t+1} + \delta(1 - f_{t+1})U_{t+1} \right\} \right], \]

and

\[ U_t = z + \beta E_t \left[ \frac{u'(c_{t+1})}{u'(c_t)} \left[ f_{t+1}V_{t+1} + (1 - f_{t+1})U_{t+1} \right] \right], \]
Model: Households

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- Nash bargaining

$$\hat{w}_t = \text{argmax} \{ J_t^{1-\omega} (V_t - U_t)^\omega \}$$
Model: Monetary policy

- **Nominal interest rate**

\[ i_{t+1} = \max\{i^*_t, 0\} \]

- Implies prices outside of a liquidity trap

\[ p_t = \frac{w}{\hat{w}_t}, \quad (2) \]
**Model: Government**

- Government’s budget constraint

\[ T_t + D_{t+1} = G_t + (1 + i_t)D_t \]

as well as the no-Ponzi condition

\[
\lim_{n \to \infty} \frac{D_{n+1}/p_{n+1}}{\Pi_{s=t}^{n} R_{s+1}} \leq 0,
\]

with \( R_{s+1} = (1 + i_{s+1})p_s/p_{s+1} \).

- But Ricardian equivalence holds, so \( G_t = T_t \) works as well
MODEL: EQUILIBRIUM

Given a fiscal plan \( \{D_t, G_t, T_t\} \), an equilibrium is a process of prices \( \{w_t, p_t, i_{t+1}, J_t\} \) and allocations \( \{c_t, y_t, n_t, \theta_t, B_{t+1}\} \) such that

1. The above equations are satisfied
2. Bond market clears; \( B_t = D_t \)
3. Goods market clears; \( Y_t = p_t n_t = C_t + G_t + I_t \), with \( I_t = p_t \kappa v_t \)
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Profits are then,

\[
\Pi_t = n_t (p_t - w_t) - p_t \kappa v_t
\]
**Proposition**

There exist a unique steady-state equilibrium.
\[ u'(c_t) = \beta (1 + i_{t+1}) E_t \left[ \frac{p_t}{p_{t+1}} u'(c_{t+1}) \right], \]
\[ J_t = 1 - \frac{\omega}{p_t} + \beta E_t \left[ \frac{u'(c_{t+1})}{u'(c_t)} (1 - \delta) J_{t+1} \right]. \]

- Two key equations.
- \( \beta \uparrow \) does really nothing as long as \( i_{t+1} \downarrow \).
- If anything, it creates a small expansion.
- Liquidity trap dynamics are very different.
\[ u'(c_t) = \beta E_t \left[ \frac{p_t}{p_{t+1}} u'(c_{t+1}) \right], \]
\[ J_t = \frac{1}{p_t} \left( p_t - \omega + E_t \left[ p_{t+1} (1 - \delta) J_{t+1} \right] \right). \]

- \( \beta \uparrow \) means demand below supply \( (c^d_t \downarrow) \), so \( p_t \downarrow \) to lower the real interest rate.
- With \( p_t \) down, \( J_t \) falls and equilibrium output contracts.
- Search frictions: \( \Delta n_{t+1} \approx 0.25 \Delta n_t \), and \( \Delta c_{t+1} \sim \Delta n_{t+1} \).
- With \( c_{t+1} \downarrow \), the economy is set on a downward spiral.
\[
u'(c_t - g_t) = \beta E_t \left[ \frac{p_t}{p_{t+1}} u'(c_{t+1}) \right],
\]
\[
J_t = \frac{1}{p_t} (p_t - w + E_t [p_{t+1} (1 - \delta) J_{t+1}]).
\]

- \(g_t \uparrow\) means demand exceeds supply \(((c_t^d + g_t) \uparrow)\), so \(p_t \uparrow\) to raise the real interest rate.
- With \(p_t\) up, \(J_t\) increases and equilibrium output expands.
- Again, search frictions: \(\Delta n_{t+1} \approx 0.25 \Delta n_t\), and \(\Delta c_{t+1} \sim \Delta n_{t+1}\).
- With \(c_{t+1} \uparrow\), the economy enters a virtuous cycle.
The economy is in its steady state in period $t$

- Unexpectedly the discount factor rises to $\hat{\beta} = \beta + 0.015$.
- With probability $q$ it reverts back in the subsequent period, but with $1 - q$ it remains high.
- If it reverts back, it does so for perpetuity.
- $\Rightarrow$ liquidity trap with expected duration $1/q$
Government may or may not increase spending in response.

If it does, it remains high with probability $\rho$ in the subsequent period.

With probability $1 - \rho$ it reverts back to its steady state instead, and remains there for perpetuity.
Useful parameter

\[ \zeta = \frac{1}{1-(1-q)\rho} - 1 = \frac{q\rho}{1-(1-q)\rho} \]

Fiscal multiplier defined as

\[ \mu(q, \zeta) = \frac{\sum_{s=0}^{\infty} E_t[\Delta y_{t+s}]}{\sum_{s=0}^{\infty} E_t[\Delta g_{t+s}]} . \]
## Calibration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Interpretation</th>
<th>Value</th>
<th>Source/steady state target</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\gamma$</td>
<td>Inverse of EIS</td>
<td>2</td>
<td>Convention</td>
</tr>
<tr>
<td>$\beta$</td>
<td>Discount factor</td>
<td>0.993</td>
<td>Annual real interest rate of 3%</td>
</tr>
<tr>
<td>$\varphi$</td>
<td>Efficiency of matching</td>
<td>0.704</td>
<td>Unemployment rate of 6%</td>
</tr>
<tr>
<td>$\delta$</td>
<td>Separation rate</td>
<td>0.152</td>
<td>Time to convergence of 5 months</td>
</tr>
<tr>
<td>$\omega$</td>
<td>Workers bargaining power</td>
<td>0.767</td>
<td>Steady state profit margin of 3%</td>
</tr>
<tr>
<td>$\eta$</td>
<td>Elasticity of $f(\theta)$</td>
<td>0.5</td>
<td>Petrongolo and Pissarides (2001)</td>
</tr>
<tr>
<td>$\kappa$</td>
<td>Vacancy posting cost</td>
<td>0.134</td>
<td>Steady state $\theta$ normalized to one</td>
</tr>
<tr>
<td>$z$</td>
<td>Unemployment benefits</td>
<td>0.5</td>
<td>Chetty (2008)</td>
</tr>
<tr>
<td>$g$</td>
<td>Steady state fiscal spending</td>
<td>0.188</td>
<td>20% of steady state output</td>
</tr>
</tbody>
</table>

*Notes.* This table lists the parameter values of the model. The calculations and targets are described in the main text. One period in the model corresponds to one quarter.
RESULTS, $q = 1$
RESULTS, $q = 1$

**Price level**

**Profit margin**

**Job finding rate**

**Unemployment**
**Results, q = 1**

- **Output**
  - Time (quarters): $-1, 0, 1, 2, 3, 4, 5, 6$
  - Absolute deviation: $-0.25, -0.20, -0.15, -0.10, -0.05, 0.17, 0.05$

- **Fiscal multiplier**
  - Time (quarters): $-1, 0, 1, 2, 3, 4, 5, 6$
  - Contemp.: $1.2, 1.5$
  - Cumulative: $1.2, 0.35, 1.5$
RESULTS, $q = 0.1$, $\zeta = 1$
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Price level

Profit margin

Job finding rate

Unemployment

Time (quarters)
Welfare and multipliers

Define

\[ v(n; g, q, \zeta) = u[c(n; g, q, \zeta)] + \hat{\beta}E[v(n'; g, q, \zeta)], \]

Define \( \hat{c}(g; q, \zeta) \) as

\[ \hat{c}(g; q, \zeta) = \left[ (1 - \beta)(1 - \gamma)v(n_{ss}; g, q, \zeta) \right]^{\frac{1}{1-\gamma}} \]

Welfare

\[ W(q, \zeta) = [1 - (1 - q)\rho] \times \frac{\partial \hat{c}(g; q, \zeta)}{\partial g} \times \frac{1}{1 - \beta} \]
WELFARE AND MULTIPLIERS

Fiscal multiplier

Welfare multiplier

Duration of spending

Duration of spending

q=0.9
q=0.1
q=1
Conclusions

- In a liquidity trap with downwardly nominal wages and persistent unemployment the fiscal multiplier can be large.
- The associated welfare effects can be positive and sizeable.
- Fiscal policy is not efficacious, however, because the government pays out income to workers (hole-digging policy not viable).
- But because the government create jobs that lasts:
  - Government spending should therefore focus on goods and services that would be provided in the economy had the crisis not interfered with the macroeconomic equilibrium.
A TINY BIT OF DATA

Lehman Brothers

Real cost

Year
Percent (2008-Q3 = 0%)
-1 -0.5 0 0.5 1 1.5 2 2.5 3

Year
Index (2007-Q4=100)
85 90 95 100 105 110 115

PCE deflator
Output/worker
Empl. cost ind.
A TINY BIT OF DATA
A tiny bit of data

Asset prices

Labor market tightness

Profits

Price level

Year

Year