Fiscal Policy in an Unemployment Crisis

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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. $\Rightarrow P_{t+1} > P_t$.
4. Real interest rate $r_t \approx -\pi_t \downarrow$
5. Private spending $C_t \uparrow \Rightarrow Y_t \uparrow$
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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 $C_t \uparrow \Rightarrow Y_t \uparrow$
This paper

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Differences

- Transmission mechanism
  - Spending out of lower real interest rate
  - Spending out of getting a job that lasts
- Predictions
DIFFERENCES

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  - Spending out of lower real interest rate
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Differences

Empirical evidence

- Bachmann et al. (2014): Willingness to spend in response to an increase in inflation expectations
  - Statistically insignificant when not in a liquidity trap
  - Statistically significant but negative in a liquidity trap
- Dupor and Li (2014)
  - No link between a forecaster's view of government spending and expected inflation
  - Inflation responds negatively to a rise in government spending
Differences

Empirical evidence

- Bachmann and Sims (2012)
  - Half of the rise in output of government spending due to a causal rise in “confidence”

- Monacelli et al. (2010)
  - Government spending increases employment, labor market tightness, and lowers unemployment

- Chodorow-Reich et al. (2012)
  - $100,000 ARRA spending generated 3.8 job-years
DIFFERENCES

- Joint work with Saleem Bahaj (BoE)
A stylized model

- Starting point: Krugman (1998)

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

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

- With CRRA preferences

\[ y_t = \left( \frac{y_{t+1}}{y^*} \right)^{\frac{\gamma-1}{\gamma}} \]

and

\[ \lim_{\gamma \to \infty} y_t = \frac{y_{t+1}}{y^*} \]
A stylized model

- Suppose that output is produced as $y_t = z_t n_t$, with $z_t = z_{ss} = 1$ and $n_{ss} = 1$
- Then for $z_{t+1} < z^*$ with $z^* = y^*$ the economy is in a liquidity trap with $n_t < 1$
Suppose that output is produced as \( y_t = z_t n_t \), with
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Then for \( z_{t+1} < z^* \) with \( z^* = y^* \) the economy is in a liquidity trap with \( n_t < 1 \)

Assume further that employment is frictional such that
\[ n_{t+1} = n_t^\alpha \]

(\( \alpha = 0 \) collapses the model to that of Krugman (1998))
Then for $z_{t+1} < z^*$ we have

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

- Then for $z_{t+1} < z^*$ we have

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

- With CRRA preferences

\[ y_t = \left( \frac{z_{t+1}}{z^*} \right)^\frac{\gamma-1}{\gamma-\alpha(\gamma-1)}, \]
A stylized model

With CRRA preferences

\[ y_t = \left( \frac{z_t+1}{z^*} \right)^{\frac{\gamma-1}{\gamma-\alpha(\gamma-1)}} , \quad y_t = \left( \frac{z_t+1}{z^*} \right)^{\frac{\gamma-1}{\gamma}} \]
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\[
y_t = \left( \frac{z_{t+1}}{z^*} \right)^{\frac{\gamma-1}{\gamma-\alpha(\gamma-1)}}, \quad y_t = \left( \frac{z_{t+1}}{z^*} \right)^{\frac{\gamma-1}{\gamma}}
\]

\[
\lim_{\gamma \to \infty} y_t = \left( \frac{z_{t+1}}{z^*} \right)^{\frac{1}{1-\alpha}}, \quad \lim_{\gamma \to \infty} y_t = \frac{z_{t+1}}{z^*}
\]
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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\frac{\partial y_t}{\partial g_t} = \frac{1}{1 - \alpha(1 - \frac{1}{\gamma})} \in [1, \gamma]
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- Thus

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

- 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

- Two physical commodities
  - Cash, $m_t$, storable but not edible (numeraire)
  - Output, $y_t$, edible but not storable (trade at $p_t$)
- Cash in fixed supply $m_t = m$
- 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 $\tilde{w}_t$
- Total income, $w_t$, is labor income, $n_t \times \tilde{w}_t$, and dividends $q_t^t \times \tilde{d}_t$
- $q_t^t$ is the quantity of asset held in time $t$ (subscript) purchased in time $t$ (superscript)
Model: Households

- Only a fraction of the firms survive from one period to the next: $q_{t+1} = (1 - \lambda)q_t$
- Interpretation: $q_t$ is a diversified asset portfolio of which $\lambda$ firms go belly-up each period
  - $w_t$ paid out by the end of the period $t$
  - Thus, $w_t$ is disposable first in period $t + 1$
  - Need cash to go out shopping
**Model: Households**

- **Period budget constraint**

\[
b_t(1 + i_t) + p_t J_t (q_t^{t-1} - q_t^t) + (M_{t-1} - p_{t-1} c_{t-1}) + w_{t-1} - T_t = M_t + b_{t+1}
\]

- **With CIA constraint**

\[
p_t c_t \leq M_t
\]

- **For simplicity, define** \( x_{t+1} = M_t - p_t c_t \) (excess cash)
Model: Households

- Period budget constraint

\[ b_t(1 + i_t) + p_t J_t(q_{t-1}^t - q_t^t) + x_t \]

\[ + w_{t-1} - T_t = M_t + b_{t+1} \]

- With CIA constraint

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\[ b_t(1 + i_t) + p_t J_t (q_t^{t-1} - q_t^t) + x_t + w_{t-1} - T_t = p_t c_t + x_{t+1} + b_{t+1} \]

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- With CIA constraint

\[ 0 \leq x_{t+1} \]

- For simplicity, define \( x_{t+1} = M_t - p_t c_t \) (excess cash)
Problem: Given prices and taxes pick feasible \( \{c_t, b_{t+1}, q_t^t, x_{t+1}\} \) 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

- Three first order conditions

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

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

\[ J_t = \beta E_t \left[ \frac{u'(c_{t+1})}{u'(c_t)} \left( \frac{p_t z_t - \tilde{w}_t}{p_{t+1}} + (1 - \delta) J_{t+1} \right) \right] \]

- With \( x_{t+1} \geq 0, \mu_t \geq 0, \) and \( x_{t+1} \times \mu_t = 0 \)
So really only two

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

\[ J_t = \beta E_t \left[ \frac{u'(c_{t+1})}{u'(c_t)} \left( \frac{p_t z_t - \tilde{w}_t}{p_{t+1}} + (1 - \delta) J_{t+1} \right) \right] \]

With \( x_{t+1} \geq 0, i_{t+1} \geq 0, \) and \( x_{t+1} \times i_{t+1} = 0 \)
The asset values of an employed agent and unemployed agent are

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

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

- Nash bargaining

\[ \tilde{w}_t = \arg\max \{ J_t^{1-\omega} (V_t - U_t)^{1-\omega} \} \]

- Law of motion for employment

\[ n_t = (1 - n_{t-1} + \delta n_{t-1}) f(\theta_t) + (1 - \delta) n_{t-1} \]

- Free entry ("equity supply")

\[ \kappa = h(\theta_t) J_t \]
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 \( \{c_t, q_t, x_t, y_t, n_t, \theta_t\} \) such that

1. The above equations are satisfied
2. Bond market clears; \( b_t = d_t \)
3. Equity market clears; \( q_t = n_t \)
4. Goods market clears; \( y_t = z_t n_t = c_t + g_t + I_t \), with \( I_t = \kappa v_t \)

Walras law implies money market clearing \( m \hat{v}_t = p_t y_t \), with
\[
\hat{v}_t = \frac{m - x_{t+1}}{m}
\]
The economy is in its steady state in period $t$.

Unexpectedly agents receive news that labor productivity will fall by 5% in $t + 1$ with probability $q$.

With the complementary probability nothing happens to labor productivity in $t + 1$, but with probability $q$ labor productivity falls by 5% in $t + 2$, and so on.

$\Rightarrow$ liquidity trap with expected duration $1/q$.
Experiment

- Nominal wages are assumed to be downwardly rigid *throughout* the duration of the shock, but not thereafter
- I will analyze the effect of the economy
- and analyze the effect of an increase in government spending:
  - A one-shot burst in spending
  - vs. a committed rise in spending lasting throughout the duration of the shock
# Calibration

Table 1: Calibrated parameters

<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>0.615</td>
<td>Unemployment rate of 6%</td>
</tr>
<tr>
<td>$\delta$</td>
<td>Separation rate</td>
<td>0.136</td>
<td>Literature/JOLTS</td>
</tr>
<tr>
<td>$\omega$</td>
<td>Workers bargaining power</td>
<td>0.7</td>
<td>Steady state profit margin of 3.3%</td>
</tr>
<tr>
<td>$\eta$</td>
<td>Elasticity of $f(\theta)$</td>
<td>0.765</td>
<td>Hall (2005)</td>
</tr>
<tr>
<td>$\kappa$</td>
<td>Vacancy posting cost</td>
<td>0.19</td>
<td>Steady state $\theta$ normalized to one</td>
</tr>
<tr>
<td>$\bar{b}$</td>
<td>Unemployment benefits</td>
<td>0.5</td>
<td>Chetty (2008)</td>
</tr>
<tr>
<td>$\bar{g}$</td>
<td>Steady state fiscal spending</td>
<td>0.188</td>
<td>20% of GDP</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, $q = 1$

Output, $Y_t$

Consumption, $C_t$

Price Level, $P_t$

Investment, $I_t$

Government spending, $G_t$

Fiscal multiplier, $\chi_t$
Results, $q = 1$
Results, $q = 0.1$
RESULTS, $q = 0.1$
Let $c(g)$ denote a constant level of consumption which would render an agent indifferent between experiencing a liquidity trap with policy $g$, or consuming $c(g)$ for perpetuity.

I will then define welfare as

$$W = \frac{\partial c(g)}{\partial g} \frac{1}{1 - \beta}$$
Conclusions

- In a liquidity trap with downwardly nominal wages and persistent unemployment the fiscal multiplier can be large.
- The associated welfare effects are often positive and non-negligible.
- 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.