Fiscal Policy in an Expectations Driven Liquidity Trap

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September 3, 2010
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- Relative large output losses and very low inflation
Introduction

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**Policy responses** have included

- Unorthodox monetary policy interventions
- Expansionary fiscal policies - the focus of this paper
- Is there good reason to expect these to have been especially effective given the nature of the recession?
GDP Growth Rates

Percentage Y-o-Y growth rate


EMU  Denmark  Great Britain  United States
Fiscal spending has been one of the favorite policy responses to the financial crisis

- **Obama**: The American Recovery and Investment Plan: $775 billion planned increase in government purchases of goods and services, government infrastructure investment, investment incentives and a “middle class” tax cut (5 percent of one year’s GDP)
- **Obama**: Second stimulus package may be coming
- **Brown**: GBP38 billion increase in government spending during 2009-2011 relative to 2008 according to the April 2009 Budget (around 3 percent of one year’s GDP)
- **Merkel**: A stimulus of around 3.3 percent of GDP during 2009-2010

The hope was (or is?) that aggressive hikes in spending will help stimulating the economy substantially during the current recession
United States Primary Deficit to GDP Ratio

-6 -4 -2 0 2 4 6 8 10
percent
Fiscal Policies in the EU

EU Government Surplus (average)

-8 -6 -4 -2 0 2 4 6


percent of GDP

-8 -6 -4 -2 0 2 4 6

quarter

total surplus  Primary surplus
EU Government Spending and Revenues (average)

percent of GDP

quarter


- Government Revenue
- Government Spending incl. transfers

Mertens and Ravn (UCL)
Introduction

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1. Which shock(s) drove the economy into the recession in the first place?
Introduction

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1. Which shock(s) drove the economy into the recession in the first place?
2. Are fiscal interventions particularly effective in a liquidity trap?
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1. Which shock(s) drove the economy into the recession in the first place?
2. Are fiscal interventions particularly effective in a liquidity trap?
3. Should we implement demand or supply oriented interventions?
Should we expect fiscal multipliers to be large?

1. **Normal times** (positive short-term interest rates):

2. **In a liquidity trap** (constant short term interest rates):
   - Multipliers may be *very large* (Eggertsson, 2009, Christiano, Eichenbaum and Rebelo, 2009, Woodford, 2010)
   - Romer and Bernstein argue in favor of a multiplier around 1.75 with large positive effects on employment

3. **Which instrument?**
   - *Demand management* rather than supply-side policies (Eggertsson, 2009, Woodford, 2010)
Fiscal Policies in a Liquidity Trap

Eggertsson, 2009, Christiano, Eichenbaum and Rebelo, 2009, Woodford, 2010:

- New Keynesian sticky price models
- Monetary policy described by an interest rate rule
- Large shock leads the economy to a liquidity trap where the short-term interest rate is at its lower floor
  - Christiano, Eichenbaum and Rebelo: Huge temporary positive productivity shock or a very large decrease in the rate of time discount
  - Woodford: Very large temporary increase in spread (Eggertsson: Equivalent to large decrease in the rate of time discount)

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Labor Tax Multiplier</th>
<th>Government Spending Multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive interest rate</td>
<td>0.19</td>
<td>0.3</td>
</tr>
<tr>
<td>Zero interest rate</td>
<td>-1.65</td>
<td>2.45</td>
</tr>
</tbody>
</table>
The Canonical New Keynesian Model

Normal times (non-binding lower floor)

\[ \Pi^* \]

\[ Y^* \]
Fiscal Policies in Normal Times

Government spending in normal times

inflation

output
In normal times, an increase in inflation increases the real interest rate through the policy rule

- If a sufficiently large deflationary shock occurs, lower floor on policy rule may become binding
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A Liquidity Trap

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- Two things happen:

1. Large output loss required to equilibrate savings and investment
2. Current demand must depend positively on inflation because of lack of policy response to inflation
A Liquidity Trap

\[ \text{inflation} \quad \text{Liquidity Trap} \quad \text{output} \]

\[ \Pi^{**} \quad \text{EE}_1 \quad \text{EE}_0 \quad \Upsilon^{**} \]

\[ \text{AS} \]
Fiscal Policy in a Liquidity Trap

Government spending in a liquidity trap

inflation

output

EE₀

EE₁

AS
Supply side policy in a liquidity trap

- AS<sub>0</sub>
- AS<sub>1</sub>
- EE
Our Argument

Key difference to above mentioned papers: **The shock:**

- A loss of confidence drives the economy into a deep recession with the lower bound binding - *an expectations driven liquidity trap.*
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2. Demand management become less effective than in normal times
3. Supply side policies become more effective
4. Higher inflation targets are a really bad idea
We look at a standard New Keynesian model:

- **Agents**: Households, intermediate goods producers, final goods producers, a government
The Model: Building Blocks

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- **Zero lower bound**: Equilibrium short-term interest rates must be non-negative in order to prevent an arbitrage.
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- **Zero lower bound**: Equilibrium short-term interest rates must be non-negative in order to prevent an arbitrage.

- **Fiscal policy**: Government has choice of fiscal instruments (spending, labor income taxes, sales taxes). Must observe government budget constraint (Ricardian policies). We do look also at threats of being irresponsible.
The Model: Households

Preferences

\[ V_0 = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t [U(c_t, l_t) + V(m_t)] \]

Budget constraints

\[
(1 + \tau_{c,t}) P_t c_t + M_t + \frac{B_t}{1 + i_t} \leq (1 - \tau_{n,t}) W_t (1 - l_t) + B_{t-1} + M_{t-1} + T_t + \Pi_t
\]

\[ M_{-1} \geq 0, \quad B_{-1} \geq 0 \text{ given} \]

Bounded budget sets:

\[ i_t \geq 0 \]
Final Goods Producers

Technology

\[ y_t = \left( \int_0^1 y_{it}^{1-1/\eta} \, di \right)^{1/(1-1/\eta)} \]

implying demand functions

\[ y_{it} = \left( \frac{P_{it}}{P_t} \right)^{-\eta} y_t \]

where \( P_{it} \) is the date \( t \) price of intermediate good of variety \( i \). \( P_t \) is the price of the final good defined as

\[ P_t = \left( \int_0^1 P_{it}^{1-\eta} \, di \right)^{1/(1-\eta)} \]
Intermediate goods producers:

- Owned by households
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- Each producer sells its product to final goods producers at price $P_{it}$

Face nominal rigidities: Each period they receive the opportunity to reoptimize prices with probability $(1 - \xi)^2 (0, 1]$. The arrival of this event is Poisson.
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- Government pays intermediate goods producers a labor cost subsidy in order to neutralize the steady-state distortion that derives from market power
Intermediate Goods Producers

Technology

\[ y_{it} = n_{it} \]

Profit maximization

\[
\max \mathbb{E}_t \sum_{s=t}^{\infty} \xi^{s-t} Q_{t,s} (P^*_it - (1 - \tau) W_s) \left( \frac{P^*_it}{P_s} \right)^{-\eta} y_s
\]

\[ Q_{t,s} = \beta^{s-t} (U_c(c_s, l_s) / U_c(c_t, l_t)) (P_t / P_s) \]

Assuming \( \tau_r = 1/\eta \), optimality requires

\[
\mathbb{E}_t \sum_{s=t}^{\infty} \xi^{s-t} Q_{t,s} \left[ (P^*_it - W_s) y_{is} \right] = 0
\]
Government Policies and Constraints

Monetary policy

\[ 1 + i_t = \phi \left( \frac{\pi_t}{\tilde{\pi}} \right) \]

- \( \tilde{\pi} \geq 1 \) is the inflation target
- \( \phi(1) = \beta^{-1}\tilde{\pi}, \phi(\cdot) \geq 1 \) for all \( \pi_t \),
- \( \phi'(\cdot) \) is sufficiently large when \( i_t > 0 \)

Fiscal policy

\[ \frac{B_t}{1 + i_t} = B_{t-1} - M_t + M_{t-1} + D_t \]

\[ D_t = P_t g_t + T_t + \frac{1}{\eta} W_t n_t - (\tau_{c,t} P_t c_t + \tau_{n,t} W_t (1 - l_t)) \]

Fiscal policies are Ricardian
In equilibrium, aggregation implies that:

\[ y_t = \frac{1}{\nu_t} n_t = c_t + g_t \]

\[ \nu_t = \int_0^1 \left( \frac{P_{it}}{P_t} \right)^{-\eta} \, di \geq 1 \]

\( \nu_t \) is a price dispersion term: An \textit{inefficiency wedge} that arises due to sticky prices.
Equilibrium

- Putting all together, the equilibrium allocation and relevant prices are the solutions to the following set of stochastic difference equations:

\[
1 = \beta \phi \left( \frac{\pi_t}{\bar{\pi}} \right) \mathbb{E}_t \left[ \frac{\omega_{t+1}}{(1+c_{t+1})\pi_{t+1}} \frac{U_c(y_{t+1} - g_{t+1}, 1 - v_{t+1}y_{t+1})}{U_c(y_{t} - g_{t}, 1 - v_{t}y_{t})} \right]
\]

\[
\rho^*_t \pi_t = \mathbb{E}_t \sum_{s=t}^{\infty} (\beta \xi)^{s-t} \omega_s \frac{U_l(y_s - g_s, 1 - v_s y_s)}{1 - \tau_{n,s}} \left( \prod_{j=0}^{s-t} \pi_{t+j} \right)^{\eta} y_s
\]

\[
\pi_t = \xi \pi_t^{\eta} v_{t-1} + (1 - \xi) \rho^*_{t-1}
\]

\[
1 = \xi \pi_t^{\eta-1} + (1 - \xi) \rho^*_{t-1}
\]

- for a given initial condition \(v_{-1}\) and (Ricardian) fiscal policies and law of motion for the preference shock \(\omega_t\)
We focus on Markov equilibria that can be generated from

\[ u_t = f(s_t) \]

\[ s_{t+1} = h(s_t) + \varepsilon_t, \ s_0 \text{ given} \]

- \( s_t \) vector of state variables, \( u_t \) inflation/output vector, random innovation \( \varepsilon_t \)

- Equilibrium allocations and prices are then computed by using a polynomial approximation and time iteration
Multiple Equilibria

- **Sargent and Wallace, 1975**: Interest rate rules can lead to multiple equilibria
- **Local indeterminacy and Taylor rules**: Local determinacy of the intended equilibrium usually obtained by imposing the Taylor principle on the policy rule
- **Global indeterminacy**: With a lower bound on the interest rate, Taylor type rules leads to global indeterminacy (Benhabib, Schmitt-Grohe and Uribe, 2001 AER & JET, 2002, JPE)
- The global indeterminacy opens the door for **sunspots** (Shell, 1977, Cass and Shell, 1983) and this will be our focus
The Intended and the Unintended Steady-States

The intended steady-state: Inflation is on target and output is efficient:

\[
\begin{align*}
\pi^I &= \tilde{\pi}, \text{ and } \phi(1) = 1/\beta \\
y^I &= n^I = y^E \\
v^I &= 1 \\
U_I \left( y^E, 1 - y^E \right) &= U_c \left( y^E, 1 - y^E \right)
\end{align*}
\]

The unintended steady-state: Interest rate at lower bound and inefficiently low output:

\[
\begin{align*}
\pi^U &= \beta \text{ and } \phi(1/\beta) = 1 \\
y^U &= y^E \\
v^U &= 1 \text{ and } p^* < 1 \\
U_I \left( y^U, 1 - y^U v^U \right) &> U_c \left( y^U, 1 - y^U v^U \right)
\end{align*}
\]

• Price dispersion gives rise to inefficiently low output
We look at temporary liquidity traps modelled as sunspot equilibria: Sunspot variable, $\psi_t$ follows discrete Markov chain $\psi_t \in [\psi_1, \ldots, \psi_n]$ with transition matrix $R$.

Two state example: $\psi_t$ follows a Markov process with transition matrix $R$

$$\psi_t \in [\psi_O, \psi_P] , \quad R = \begin{bmatrix} 1 & 0 \\ 1 - q & q \end{bmatrix} , \quad 0 < q < 1$$
Existence of an Expectations Driven Liquidity Trap

- **In the left picture:** Kink is moderate because of too low persistence of low confidence state - only the intended steady-state prevails.
Existence of an Expectations Driven Liquidity Trap

- **In the left picture**: Kink is moderate because of too low persistence of low confidence state - only the intended steady-state prevails
- **In the right picture**: More persistent low confidence state - we can end up in unintended equilibria
Functional forms:

\[ U(c_t, l_t) = \frac{ct^{1-\sigma} - 1}{1-\sigma} - \frac{\theta}{1+\kappa} (1 - l_t)^{1+\kappa}, \ \sigma, \theta, \kappa > 0 \]

\[ \phi \left( \frac{\pi_t}{\tilde{\pi}} \right) = \max \left( \frac{\pi_t^{\phi_{\pi}}}{\beta}, 1 \right), \ \phi_{\pi} > 1 \]
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Calibration
Numerical Evaluation

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\]

\[
\phi \left( \frac{\pi_t}{\pi_t^\ast} \right) = \max \left( \frac{\pi_t^{\phi_{\pi}}}{\beta}, 1 \right), \phi_{\pi} > 1
\]

Calibration

<table>
<thead>
<tr>
<th>parameter</th>
<th>Mertens-Ravn</th>
<th>CER</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \beta )</td>
<td>0.99</td>
<td>0.99</td>
</tr>
<tr>
<td>Frisch Elasticity</td>
<td>2/3</td>
<td>1.4</td>
</tr>
<tr>
<td>( \sigma )</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>( \zeta )</td>
<td>0.6</td>
<td>0.85</td>
</tr>
<tr>
<td>( \phi_{\pi} )</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>( q^\psi )</td>
<td>0.8</td>
<td>-</td>
</tr>
<tr>
<td>( q^\omega )</td>
<td>-</td>
<td>0.8</td>
</tr>
</tbody>
</table>
Liquidity Traps and Parameters

Inflation

Output

Inflation

Output

Annual %

% Dev.

Utility Curvature $\sigma$

Utility Curvature $\sigma$

Calvo Parameter $\xi$

Calvo Parameter $\xi$
Liquidity Traps and Parameters

Inflation

Output

Inflation

Output

Annual %

% Dev.

0.6 0.7 0.8 0.9 1

Probability q

Annual %

% Dev.

1 2 3 4

Leisure Curvature κ

1 2 3 4

Leisure Curvature κ
Dynamics of a Liquidity Trap

We assume that the economy starts in a low confidence state and then makes a permanent transition to the optimistic state in period $T$.
Dynamics of a Liquidity Trap

Output

% Dev.

-1
-0.8
-0.6
-0.4
-0.2
0

0
T

Inflation

Annual. %

-6
-5
-4
-3
-2
-1
0

0
T

Price Dispersion

Level

1.0055
1.0050
1.0045
1.0040
1.0035
1.0030
1.0025
1.0020
1.0015
1.0010
1.0005
1.0000
1

0
T

Nominal Interest Rate

Annual. %

4
3
2
1
0
-1

0
T
Dynamics of a Liquidity Trap:

$\xi = 0.82, \ \sigma = 0.7$
Blanchard, Dell’Ariccia and Mauro have proposed to increase inflation targets to avoid such liquidity traps.
Blanchard, Dell’Ariccia and Mauro have proposed to increase inflation targets to avoid such liquidity traps. Would it work?
Inflation Target

- Very high targets required to rule out LT entirely
Ex-Ante: Prevention

- Benhabib, Schmitt-Grohe and Uribe: Promise to be fiscally irresponsible in case agents coordinate on deflationary expectations - agents realize that transversality condition does not hold so this cannot be an equilibrium
- Benhabib, Schmitt-Grohe and Uribe: Switch to money growth target if agents coordinate on deflationary expectations
- Atkeson, Chari and Kehoe (QJE, 2010): Sophisticated equilibrium - stochastic switches to money growth rule
- BUT: We ARE in a LT

Ex-Post: What to do in case a LT occurs

- Eggertsson and Woodford: Commit to a higher inflation target for an extended period (also after LT ends) - but serious credibility problems
Fiscal Policy Graphically

Increasing government spending

- **Government Spending**: Marginal increase from 20% of GDP

Cutting taxes
Fiscal Policy Graphically

Increasing government spending

- **Government Spending**: Marginal increase from 20% of GDP
- **Consumption Tax**: Marginal decrease from 10%

Cutting taxes
In the first graph, the **Government Spending** is shown with a marginal increase from 20% of GDP.

In the second graph, the **Consumption Tax** is depicted with a marginal decrease from 10%.

For the **Labor Income Tax Rate**, there is a marginal decrease from 20%.
Spending Multipliers

![Graphs showing the relationship between spending multipliers and various parameters.](image)
Labor Income Tax Rate Multipliers

- **Utility Curvature $\sigma$**
  - Graph with two curves for different values of $\sigma$.
  - Red curve shows a higher multiplier than the blue curve.
  - The multiplier decreases as $\sigma$ increases.

- **Calvo Parameter $\xi$**
  - Graph with two curves for different values of $\xi$.
  - The multiplier increases as $\xi$ increases.

- **Probability $q$**
  - Graph with two curves for different values of $q$.
  - The multiplier decreases as $q$ decreases.

- **Leisure Curvature $\kappa$**
  - Graph with two curves for different values of $\kappa$.
  - The multiplier decreases as $\kappa$ increases.
Conclusions

1. An expectations driven LT can be associated with large output and welfare losses.
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2. In contrast to fundamentals driven LT, increases in government spending lose potency in an expectations driven LT.

Mertens and Ravn (UCL)
Expectations and Fiscal Policy
September 3, 2010
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4. Multipliers quite similar in LT and in normal times for standard parameter values.
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Ruling Out Liquidity Traps Ex Ante

Can fiscal policy be applied to eliminate expectations driven liquidity traps ex-ante?

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- The appropriate transversality condition is:

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\lim_{s \to \infty} \mathbb{E}_t \left[ a_{t+s} \frac{\pi_t}{1 + i_t} \ldots \frac{\pi_{t+s}}{1 + i_{t+s}} \right] = 0
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a_t = \frac{(B_t + M_t)}{P_t}
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- Outcomes that violate this condition cannot be equilibria
- They propose fiscal rules of the type:

\[
\tilde{d}_t = \pi_t \cdot a_{t-1}
\]

\[
x(\beta) > \frac{1}{\beta}
\]

\[
x(\tilde{\pi}) < \frac{1}{\beta}
\]
In a sunspot, the equivalent rule for the LT will require that:

$$\pi(L) > \frac{1}{q_L} \pi > \frac{1}{\beta}$$

Thus, the government must threaten to be potentially extremely irresponsible in a LT.
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**Problem:**

If LT can occur for both fundamental and expectational reasons, then the rule has to be such that:
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    - Transversality condition violated for expectational LT
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- If LT can occur for both fundamental and expectational reasons, then the rule has to be such that:
  - Transversality condition violated for expectational LT
  - Transversality condition holds for fundamentals driven LT
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**Problem:**

- If LT can occur for both fundamental and expectational reasons, then the rule has to be such that:
  - Transversality condition violated for expectational LT
  - Transversality condition holds for fundamentals driven LT
- This might not always be possible