Is Government Spending: at the Zero Lower Bound Desirable?

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Government spending at the ZLB

- Recent papers (Christiano, Eichenbaum, Rebelo 2011, Eggertson and Krugman 2011): 
  government spending particularly powerful at ZLB.

  1. In neoclassical model, government spending increases output via a 
     wealth effect on labor supply.
  2. At ZLB with sticky prices, further kick: 
     \[ G = \text{demand facing firms} = \text{marginal cost} \times \text{expected inflation} = \text{real interest rate} \] 
     since \( i = 0 \) = \( r \), implying private consumption increases further, etc.
Government spending at the ZLB

- Recent papers (Christiano, Eichenbaum, Rebelo 2011, Eggertson and Krugman 2011): government spending particularly powerful at ZLB.

- Basic intuition

1. In neoclassical model, government spending increases output via a wealth effect on labor supply.
Government spending at the ZLB

- Recent papers (Christiano, Eichenbaum, Rebelo 2011, Eggertson and Krugman 2011): **government spending** particularly powerful at ZLB.

- Basic intuition

  1. In neoclassical model, government spending **increases output** via a **wealth** effect on labor supply.

  2. At **ZLB** with **sticky prices**, further kick: \( \uparrow G \rightarrow \uparrow \text{demand} \rightarrow \uparrow \text{marginal cost} \rightarrow \uparrow \text{expected inflation} \rightarrow \downarrow \text{real interest rate} \) (since \( i = 0 \)) \rightarrow private consumption increases further, etc.
Yet what about welfare?
Yet what about welfare?

- Negative income effect of taxation makes agents want to **work more** to produce extra output
- Consumption can increase **only** by working more (in these models)
This paper

- Multipliers extremely **large** at ZLB
- Government spending is generally **welfare detrimental** at the ZLB
A Sticky Price Economy
Utility

\[ U(C_t, N_t, G_t) = \frac{C_t^\zeta (1 - N_t)^{1-\zeta}}{1 - \sigma} - 1 + \chi G \frac{G_t^{1-\sigma} - 1}{1 - \sigma} \]

\[ \sigma > 0 \quad 0 < \zeta < 1 \]
Utility

\[ U(C_t, N_t, G_t) = \frac{\left[ C_t^\zeta (1 - N_t)^{1-\zeta} \right]^{1-\sigma} - 1}{1 - \sigma} + \chi_G \frac{G_t^{1-\sigma} - 1}{1 - \sigma} \]

\[ \sigma > 0 \quad 0 < \zeta < 1 \]

- Convex price adjustment costs
- Weight of G in utility \( \chi_G \) computed optimally
Utility Weight of Government Spending

- In the steady state

\[ U_C (Y - G) = U_G (G) \]

→ Derive **optimal** weight

\[
\chi_G = \zeta \left( \frac{G}{Y} \right)^\sigma \left( 1 - \frac{G}{Y} \right)^{\zeta(1-\sigma)-1} \left( \frac{1-N}{N} \right)^{(1-\zeta)(1-\sigma)}
\]
Cyclical vs. Structural Spending

- **Structural** spending: "steady state" spending

  \[ G_t = G \]

- **Cyclical** G is "extra spending" at the ZLB
Wasteful vs Useful Spending

- **Useful** spending: cyclical $G_t$ has weight $\chi_G$ in utility
- **Wasteful** spending: cyclical spending has zero utility weight, "structural" spending enters utility:

\[
\chi_G \frac{(G^{1-\sigma} - 1)}{(1 - \sigma)}
\]
Markovian Shock Process

\[
\begin{align*}
\Pr\{\rho_{t+1} = \rho^L | \rho_t = \rho^L\} &= p \\
\Pr\{\rho_{t+1} = \rho | \rho_t = \rho^L\} &= 1 - p \\
\Pr\{\rho_{t+1} = \rho^L | \rho_t = \rho\} &= 0.
\end{align*}
\]
Monetary Policy

\[ i_t = \max (\rho + \phi_\pi \pi_t, 0) \]
Solution

\[
\begin{align*}
    c_L &= \frac{1 - \beta p}{\Omega} \rho_L + M_c \frac{G}{Y - G} g_L \\
    \pi_L &= \kappa \left( 1 + \frac{N}{1 - N} \frac{Y - G}{Y} \right) \rho_L + M_{\pi} \frac{G}{Y} g_L,
\end{align*}
\]

where \( \Omega \equiv (1 - \beta p) (1 - p) - \kappa p \left( 1 + \frac{N}{1 - N} \frac{Y - G}{Y} \right) \)
Solution

\[ c_L = \frac{1 - \beta p}{\Omega} \rho_L + M_c \frac{G}{Y-G} g_L \]

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where \( \Omega \equiv (1 - \beta p) (1 - p) - \kappa p \left( 1 + \frac{N}{1-N} \frac{Y-G}{Y} \right) \)

- **Consumption and inflation multipliers**

\[ M_c \equiv \frac{\left[(1 - \beta p) (1 - p) \zeta (\sigma - 1) + \kappa p \frac{N}{1-N} \frac{Y-G}{Y}\right]}{\Omega} \]

\[ M_\pi \equiv \frac{(1 - p) \kappa \left[ \left( \frac{Y}{Y-G} + \frac{N}{1-N} \right) \zeta (\sigma - 1) + \frac{N}{1-N} \right]}{\Omega} \]

- **Impose restriction**

\[ \Omega > 0 \]
Welfare gap

\[ \tilde{U}_L(g_L) = 100 \cdot \frac{U_L(g_L) - U_L(0)}{|U_L(0)|} \]

with extra G

with G kept at ss
Understanding the Welfare Effect of Government Spending

\[ C_t + G_t = \frac{N_t}{\Delta_t} \]

\[ \Delta_t \equiv \left( 1 - \frac{\nu}{2} \pi_t^2 \right)^{-1} \geq 1 \]

- Second order approximation to resource constraint

\[ y_L = n_L = \frac{Y - G}{Y} c_L + \frac{G}{Y} g_L + \frac{1}{2} \nu \pi_L^2 \]
Effect of $G$ on welfare

\[
\frac{dU_L}{dG_L} = W_L \Delta_L U_C (C_L, N_L)
\]

\[+ \quad \nu' (G_L) \quad \text{contribution of } G \text{ in utility} \]

\[\left[ \left( \frac{1}{MRS_t/MMT_t} - 1 \right) \frac{dC_L}{dG_L} \right] \quad \text{multiplier channel: } \propto \text{L wedge} \]

\[\left[ - \frac{1}{\Delta_L} \frac{d\Delta_L}{dG_L} \right] \quad \text{income effect} \]

\[\left[ - \frac{C_L}{\Delta_L} \frac{d\Delta_L}{dG_L} \right] \quad \text{inflation distortion} \]
Effect of $G$ on welfare

\[
\frac{dU_L}{dG_L} = W_L \Delta_L U_C (C_L, N_L) + v' (G_L)
\]

- contribution of $G$ in utility

\[
\left( \frac{1}{MRS_t / MRT_t} - 1 \right) \frac{dC_L}{dG_L}
\]

- multiplier channel: $\propto L$ wedge

\[
- \frac{1}{\Delta_L} \frac{d\Delta_L}{dG_L}
\]

- income effect

\[
- \frac{C_L}{\Delta_L} \frac{d\Delta_L}{dG_L}
\]

- inflation distortion

**Welfare effect of $G$: three channels**

1. Multiplier channel
2. Income effect
3. Inflation distortion
Multiplier channel

Multiplier channel:

\[
\left(\frac{1}{\frac{MRS_t}{MRT_t}} - 1\right) \frac{dC_L}{dG_L}
\]

- Requires **positive** consumption multiplier at the ZLB
- High when \( \frac{MRS_t}{MRT_t} \) is low, i.e., **labor wedge** is high
- In NK jargon: when **markup** is high
Multiplier: extreme non-linearity in transition probability \( p \)
Baseline experiment

- Natural real interest rate falls to \(-1\%\) per annum

  → At baseline calibration: GDP falls 4% per annum
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value</th>
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<tbody>
<tr>
<td>$\rho$</td>
<td>transition probability</td>
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<tr>
<td>$\rho_L$</td>
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<td>$\beta$</td>
<td>discount factor in steady state</td>
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<td>$\sigma$</td>
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<td>inverse labor elasticity</td>
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<td>$\phi_\pi$</td>
<td>Taylor rule coefficient</td>
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Government spending and welfare

→ Optimal $G$ is 0.5% of steady state output (baseline calibration) in useful case
Large values of optimal G occur when decline in GDP is exceptionally high
Optimal government spending and slope of PC

Optimal Govt. Spending at the ZLB: Wasteful

Implied Fall in GDP

\( \kappa \)

\[ \frac{100 \cdot (G_L - G)}{Y} \]

\( \rho_L = 0.0025 \)

\( \rho_L = 0.01 \)
Holding constant the decline in GDP
So far: when $p$ is at its maximum admissible level optimal increase in $G$ is about 1.9 percent of steady state GDP

GDP declines by **70 percent** from its steady state

Now: hold size of recession **constant** by changing value of the shock
Optimal government spending and shock persistence
Decline in GDP constant at 4 percent

Optimal increase in G about 0.6% of steady-state GDP
Alternative solution methods
## Optimal G: Alternative Solution Methods

<table>
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<th>(4)</th>
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<th>(7)</th>
<th>(8)</th>
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<tbody>
<tr>
<td>LS, 1st order</td>
<td>$\rho^1_L$</td>
<td>$\rho^2_L$</td>
<td>$\Delta Y^1$</td>
<td>$\Delta Y^2$</td>
<td>$M_C^1$</td>
<td>$M_C^2$</td>
<td>$g_{L,u}^*$</td>
<td>$g_{L,u}^*$</td>
<td>$g_{L,w}^*$</td>
<td>$g_{L,w}^*$</td>
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Great Depression
Reproducing the Great Depression

- GDP collapse of 28.8 percent (annualized)
- Deflation of 10 percent (annualized)

→ Need much higher price stickiness ($\kappa = 0.003147 \rightarrow \text{about 20 qrt}$) and higher shock persistence $p = 0.903$)
Optimal Government Spending: Great Depression Calibration

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<td>$g_{L,w}^*$</td>
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<tr>
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Why Larger Values of Optimal G in the Great Depression?

- GD calibration very close to asymptote and starvation points
- Price stickiness 20 qrts → very high cost of negative output gap
Conclusions

- Standard NK model supports notion of extremely high multiplier of G at the ZLB
- Optimal increase in G is however generally small or zero
- Need setups in which welfare cost of negative output gap at the ZLB is significantly higher