Is Government Spending: at the Zero Lower Bound Desirable?

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Government spending at the ZLB

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- 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: $\uparrow G \rightarrow \uparrow$demand facing firms $\Longrightarrow \uparrow$marginal cost $\Longrightarrow \uparrow$ **expected** inflation $\Longrightarrow \downarrow$ **real interest rate** (since $i = 0$) $\Longrightarrow$ private consumption increases further, etc.

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- 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

Economy

- **Utility**

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

$$\sigma > 0 \qquad 0 < \zeta < 1$$

Economy

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

$$\sigma > 0 \qquad 0 < \zeta < 1$$

- Convex **price adjustment costs**
- Weight of G in utility χ_G computed **optimally**

Utility Weight of Government Spending

- In the steady state

$$U_C\left(Y-G\right)=U_G\left(G\right)$$

$\longrightarrow$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 χ_G in utility
- **Wasteful** spending: cyclical spending has zero utility weight, "structural" spending enters utility:

$$\chi_G \frac{\left(G^{1-\sigma} - 1\right)}{(1-\sigma)}$$

Markovian Shock Process

$$
\begin{aligned}
\Pr\{\rho_{t+1} &= \rho^L | \rho_t = \rho^L\} = p \\
\Pr\{\rho_{t+1} &= \rho | \rho_t = \rho^L\} = 1 - p \\
\Pr\{\rho_{t+1} &= \rho^L | \rho_t = \rho\} = 0.
\end{aligned}
$$

Monetary Policy

$$i_t = \max\left(\rho + \phi_\pi \pi_t, 0\right)$$

Solution

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

$$\pi_L = \frac{\kappa\left(1+\frac{N}{1-N}\frac{Y-G}{Y}\right)}{\Omega}\rho_L + M_\pi \frac{G}{Y}\, g_L,$$

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

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- 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

$$\tilde{U}_L(g_L) = 100 \cdot \frac{\overbrace{U_L(g_L)}^{\text{with extra G}} - \overbrace{U_L(0)}^{\substack{\text{with G kept} \\ \text{at ss}}}}{|U_L(0)|}$$

Understanding the Welfare Effect of Government Spending

$$C_t + G_t = \frac{N_t}{\underbrace{\Delta_t}_{\substack{\text{inflation}\\\text{distortion}}}}$$

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

- Second order approximation to resource constraint

$$y_L = n_L = \frac{Y - G}{Y} c_L + \frac{G}{Y} g_L + \underbrace{\frac{1}{2}\nu\pi_L^2}_{\substack{\text{inflation}\\\text{distortion}}}$$

Effect of G on welfare

$$\frac{dU_L}{dG_L} = W_L \Delta_L U_C\left(C_L, N_L\right)\left[\underbrace{\left(\frac{1}{MRS_t / MRT_t} - 1\right)\frac{dC_L}{dG_L}}_{\text{multiplier channel: } \propto \text{ L wedge}} \underbrace{-1}_{\text{income effect}} \underbrace{-\frac{C_L}{\Delta_L}\frac{d\Delta_L}{dG_L}}_{\text{inflation distortion}}\right]$$

$$+ \underbrace{v'\left(G_L\right)}_{\text{contribution of G in utility}}$$

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

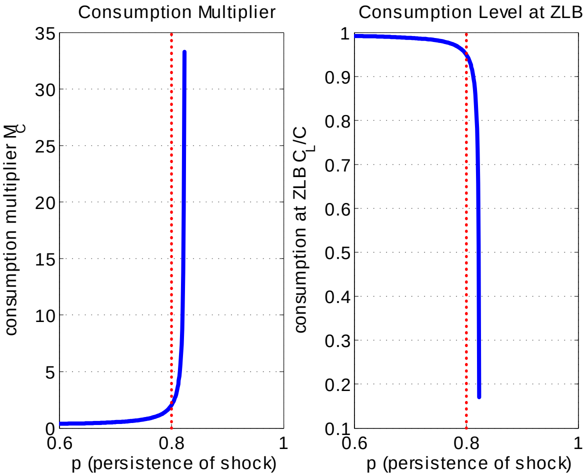
1. Multiplier channel
2. Income effect
3. Inflation distortion

Multiplier channel

$$\text{multiplier channel:} \quad \left(\frac{1}{MRS_t \,/\, MRT_t} - 1 \right) \frac{dC_L}{dG_L}$$

- Requires **positive** consumption multiplier at the ZLB
- High when $MRS_t \,/\, MRT_t$ is low, ie, **labor wedge** is high
- In NK jargon: when **markup** is high

Multiplier: extreme non-linearity in transition probability p



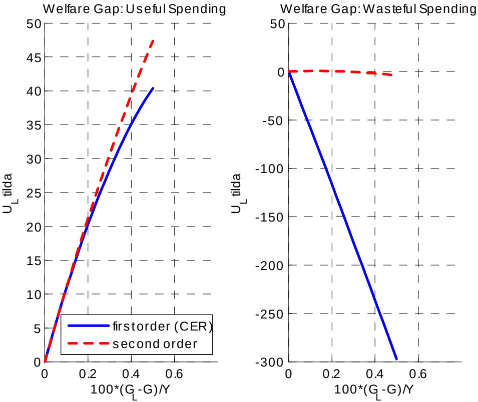
Baseline experiment

- Natural real interest rate falls to **-1% per annum**

→At baseline calibration: GDP falls 4% per annum

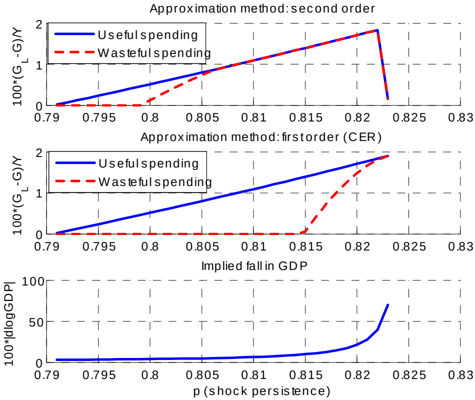
Table 1. Baseline calibration		
Parameter	Description	Value
p	transition probability	0.8
ρ_L	quarterly discount rate	$-.0025$
β	discount factor in steady state	0.99
σ	relative risk aversion	2
φ	inverse labor elasticity	$N/(1-N)$
κ	slope of the Phillips curve	0.028
ϕ_π	Taylor rule coefficient	1.5

Government spending and welfare



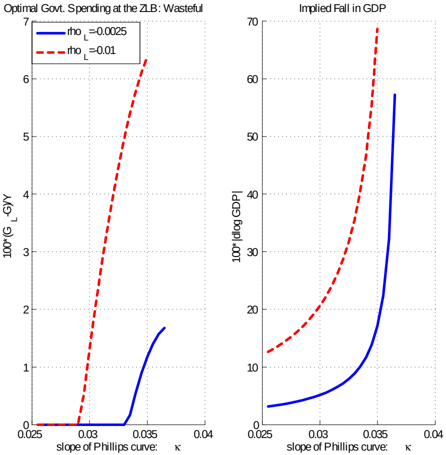
→Optimal G is 0.5% of steady state output (baseline calibration) in useful case

Optimal government spending and shock persistence



→Large values of optimal G occur when decline in GDP is exceptionally high

Optimal government spending and slope of PC



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

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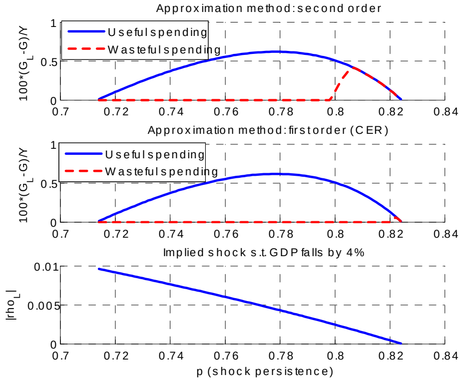


→Optimal increase in G about 0.6% of steady-state GDP

Alternative solution methods

Optimal G: Alternative Solution Methods

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	ρ_L^1	ρ_L^2	ΔY^1	ΔY^2	M_C^1	M_C^2	$g_{L,u}^{*,1}$	$g_{L,u}^{*,2}$	$g_{L,w}^{*,1}$	$g_{L,w}^{*,2}$
LS, 1st order	-0.0025	-0.0025	-4.0	-4.0	2.02	2.02	0.5	0.5	0.0	0.0
LS, 2nd order	-0.0025	-0.0025	-4.0	-4.0	2.02	2.02	0.5	0.5	0.1	0.1
LD, 1st order	-0.0025	-0.0150	-0.7	-4.0	0.60	0.60	0.0	0.4	0.0	0.0
LD, 2nd order	-0.0025	-0.0150	-0.7	-4.0	0.60	0.60	0.0	1.1	0.0	0.0
NLS	-0.0025	-0.0035	-3.0	-4.0	1.10	1.10	0.1	0.8	0.0	0.0

Great Depression

Reproducing the Great Depression

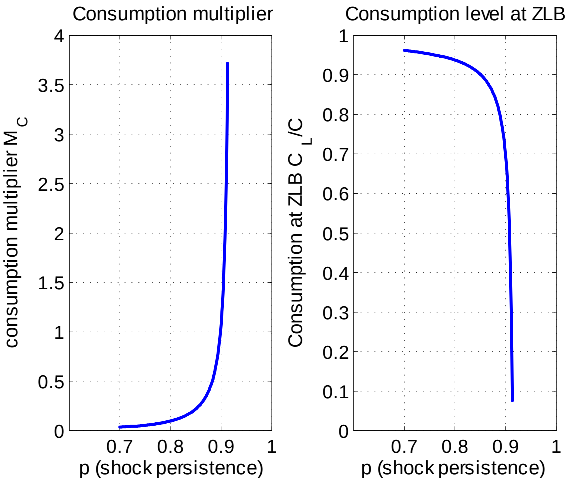
- Woodford (2011), Eggertsson (2010)
- GDP collapse of **28.8** percent (annualized)
- Deflation of **10** percent (annualized)

$\longrightarrow$ Need much higher price stickiness ($\kappa = 0.003147 \rightarrow$ about 20 qrt) and higher shock persistence $p = 0.903$)

Optimal Government Spending: Great Depression Calibration

	(1)	(2)	(3)	(4)	(5)
	ρ_L	ΔY	M_C	$g^*_{L,u}$	$g^*_{L,w}$
LS, 1st order	-0.010	-28.8	1.29	11.5	5.5
LS, 2nd order	-0.010	-28.8	1.29	14.5	13.5
LD, 1st order	-0.055	-28.8	0.25	9.5	0.0
LD, 2nd order	-0.055	-28.8	0.25	10.0	0.0
NLS	-0.017	-28.8	0.55	25.5	0.0

Why Larger Values of Optimal G in the Great Depression?



- GD calibration very close to asymptote and starvation points
- Price stickiness 20 qrts $\longrightarrow$ 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