Simple Analytics of the Government Expenditure Multiplier

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    - Question especially salient when, as recently, further interest-rate cuts not possible

- Much public discussion based on quite old-fashioned models: unlike contemporary discussions of monetary policy

- Recent years have seen development of a theory of stabilization policy that integrates consequences of price/wage stickiness for output determination with intertemporal optimization

  — implications for fiscal stimulus?

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    — lump-sum taxation
    — taxes guarantee intertemporal solvency
    — monetary policy independent of public debt

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    - Hence path of public debt irrelevant, focus on implications of alternative paths for government purchases

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- Issues to address: how does the size of the multiplier depend on
  - the degree of price or wage stickiness?
  - the monetary policy reaction?
  - the degree of economic slack?
  - whether the federal funds rate has reached the zero bound?
- Also: does countercyclical government spending increase welfare?

A Neoclassical Benchmark

- Multiplier typically predicted to be well below 1 in neoclassical models (flexible wages, prices, full information)

  — here a simple exposition, based on Barro and King (1984)

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- Production technology (capital stock fixed):

$$Y_t = f(H_t), \qquad f' > 0, \quad f'' < 0$$

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where $\tilde{v}(Y) \equiv v(f^{-1}(Y))$ is the disutility of supplying output Y

  - note this is also FOC for welfare-maximizing output
  - can solve for Y_t as function of current G_t only

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- Multiplier is seen to be:

$$\frac{dY}{dG} = \Gamma \equiv \frac{\eta_u}{\eta_u + \eta_v} < 1$$

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- Necessarily less than 1 (government purchases crowd out private spending)

— substantially less than 1, unless $\eta_u >> \eta_v$

— e.g., Eggertsson (2009) parameters: $\Gamma = 0.4$

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- How much the "labor wedge" changes, under any given hypothesis about sticky prices, sticky wages, or sticky information, depends on degree of monetary accommodation

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    - corresponds to the textbook "multiplier" calculation, that determines the size of the rightward shift of "IS curve"

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  - can be achieved, for example, by Taylor rule with suitably time-varying intercept (to be determined)

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- Note result is independent of details of stickiness of prices, wages or information

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- In fact, we can obtain a multiplier of 1 regardless of wage-price block of model

  — can easily specify to be consistent with the procyclical markups found by Nekarda and Ramey: sticky wages and prices, procyclical labor productivity due to overhead labor

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  - labor/supply demand factors that determine Γ still matter, but only to determine how inflationary the hypothesized policy is

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- Doesn't the multiplier depend on the degree of "slack"?
  - Not if real interest rate is held constant! But again, degree of slack may affect plausibility of assuming that central bank will take actions required to hold it constant

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- But while the NK model implies that the multiplier can be higher than the neoclassical prediction, it need not be

  — low multipliers also possible, under other assumptions about monetary policy

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- Result the same under a wide variety of specifications of sticky prices or sticky information: $\pi = 0$ brings about same equilibrium allocation as full-info flex-wage/price model,

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- In any of these models: larger multiplier requires inflation

Alternative Degrees of Monetary Accommodation

- A common monetary policy specification: interest rate determined by a Taylor rule
- Simple case (again consistent with zero-inflation steady state):

$$i_t = \bar{r} + \phi_\pi \pi_t + \phi_y(\hat{Y}_t - \Gamma \hat{G}_t)$$

where $\phi_\pi > 1, \phi_y > 0$ as proposed by Taylor (1993)

— here "output gap" is interpreted as output in excess of flex-price equilibrium output

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- Consider path for government purchases of form $G_t = G_0 \rho^t$, for some $0 \leq \rho < 1$.

— then forward path is same function of current G_t at all times

Monetary Policy Follows a Taylor Rule

- In the Calvo model (purely forward-looking), this implies that equilibrium Y_t, π_t, i_t are all time-invariant functions of G_t
- Can again define a static "multiplier" dY/dG:

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$$\frac{dY}{dG} = \frac{1-\rho+\psi\Gamma}{1-\rho+\psi},$$

where

$$\psi \equiv \sigma\left[\phi_y + \frac{\kappa}{1-\beta\rho}(\phi_\pi - \rho)\right] > 0.$$

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- Note this implies that

$$\Gamma < \frac{dY}{dG} < 1$$

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- Note that multiplier is smaller if
  - prices more flexible (κ larger)
  - marginal cost more sharply increasing (κ larger)
  - response coefficient ϕ_π or ϕ_y greater
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  - prices more flexible (κ larger)
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- In each of these limiting cases ($\kappa \to \infty$, $\phi_\pi \to \infty$, $\phi_y \to \infty$, or $\rho \to 1$), neoclassical multiplier is recovered

Monetary Policy Follows a Taylor Rule

- Arguably more realistic specification:

$$i_t = \bar{r} + \phi_\pi \pi_t + \phi_y \hat{Y}_t$$

— note that central banks' measures of "potential output" aren't typically adjusted in response to government spending

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- Multiplier in this case

$$\frac{dY}{dG} = \frac{1 - \rho + (\psi - \sigma\phi_y)\Gamma}{1 - \rho + \psi}$$

is necessarily smaller; for large enough ϕ_y, can even be smaller than the neoclassical multiplier!

— e.g. Eggertsson (2009) parameters: $\Gamma = 0.4$, but multiplier for Taylor rule with $\phi_\pi = 1.5, \phi_y = 0.25$ is only 0.3

Fiscal Stimulus at the Zero Lower Bound

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Fiscal Stimulus at the Zero Lower Bound

- A case of particular interest: effects of increased government purchases, when central bank's policy rate is at zero lower bound:
  - currently relevant case in many countries
  - interest in fiscal stimulus especially great, because further interest-rate cuts not possible
  - monetary accommodation especially plausible: even if central bank wishes to implement strict inflation target, or follow Taylor rule, it may be constrained by lower bound on interest rate, and this should not change due to modest increase in government purchases

Fiscal Stimulus at the Zero Lower Bound

- How ZLB may sometimes be binding constraint: extend model to allow for a credit spread Δ_t between the CB policy rate i_t and the interest rate that is relevant to aggregate demand determination

- Log-linearized Euler equation then becomes

$$\hat{Y}_t - \hat{G}_t = E_t[\hat{Y}_{t+1} - \hat{G}_{t+1}] - \sigma(i_t - E_t\pi_{t+1} - r_t^{net})$$

where

$$r_t^{net} \equiv -\log\beta - \Delta_t$$

decreases if a disruption of credit markets increases Δ_t (here, exogenously)

— Cúrdia and Woodford (2009) provide more detailed microfoundations

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- Simple example (Eggertsson, 2009):
  - In normal state (low credit spreads), $r_t^{net} = \bar{r} > 0$
  - Shock at date zero lowers r_t^{net} to $r_L < 0$
  - Each period, probability μ that credit spread remains high ($r_t^{net} = r_L$) another period, if still high in last period; with probability $1 - \mu$, reversion to normal level
  - Once r_t^{net} reverts to normal level $\bar{r}$, remains there forever after

Fiscal Stimulus at the Zero Lower Bound

- Assume CB follows Taylor rule when consistent with ZLB:

$$i_t = \max\left\{\bar{r} + \phi_\pi \pi_t + \phi_y \hat{Y}_t,\ 0\right\}$$

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- Policies to consider: $G_t = G_L$ for all $t < T$ (random date at which credit spreads revert to normal), $G_t = \bar{G}$ for all $t \geq T$

  — consider effects of varying G_L (fiscal stimulus during crisis)

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- Markovian structure implies equilibrium in which

$$\pi_t = \pi_L, Y_t = Y_L, i_t = i_L \text{ for all } t < T\text{; and}$$
$$\pi_t = 0, Y_t = \bar{Y}, i_t = \bar{r} \text{ for all } t \geq T.$$

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- Solution: $i_L = 0$ (ZLB continues to bind) for all $G_L \leq G^{crit}$, while $i_L > 0$ (Taylor rule applies) for all $G_L > G^{crit}$

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- For $G_L \leq G^{crit}$,

$$\hat{Y}_L = \vartheta_r r_L + \vartheta_G \hat{G}_L$$

where

$$\vartheta_r \equiv \frac{\sigma(1-\beta\mu)}{(1-\mu)(1-\beta\mu)-\kappa\sigma\mu} > 0$$

$$\vartheta_G \equiv \frac{(1-\mu)(1-\beta\mu)-\kappa\sigma\mu\Gamma}{(1-\mu)(1-\beta\mu)-\kappa\sigma\mu} > 1$$

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- Solution: $i_L = 0$ (ZLB continues to bind) for all $G_L \leq G^{crit}$, while $i_L > 0$ (Taylor rule applies) for all $G_L > G^{crit}$

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$$\hat{Y}_L = \vartheta_r r_L + \vartheta_G \hat{G}_L$$

  where

$$\vartheta_r \equiv \frac{\sigma(1-\beta\mu)}{(1-\mu)(1-\beta\mu)-\kappa\sigma\mu} > 0$$

$$\vartheta_G \equiv \frac{(1-\mu)(1-\beta\mu)-\kappa\sigma\mu\Gamma}{(1-\mu)(1-\beta\mu)-\kappa\sigma\mu} > 1$$

- For $G_L > G^{crit}$, equilibrium same as above for Taylor rule: $dY/dG < 1$, possibly less than Γ

Fiscal Stimulus at the Zero Lower Bound

- Eggertsson (2009) parameter values:

β	0.997
κ	0.00859
σ	0.862
Γ	0.425

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Implications: multiplier $= 2.29$ for $G < G^{crit}$, 0.32 for $G > G^{crit}$

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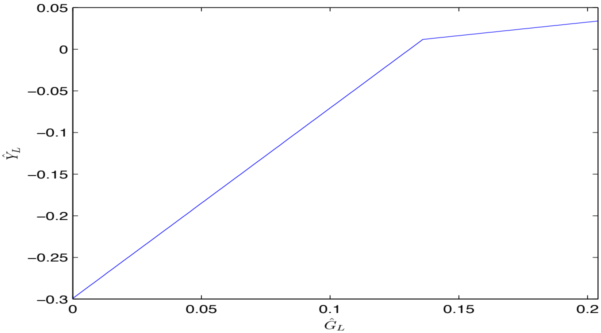

- Here $\hat{G}^{crit} = 13.6$ percent of steady-state GDP

Fiscal Stimulus at the Zero Lower Bound

- In this example, multiplier is necessarily greater than 1

  — fiscal stimulus increases inflation (reduces deflation); if $\mu > 0$, this means higher expected inflation, so lower real interest rate

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- This is precisely the case in which risk of output collapse is greatest in absence of fiscal stimulus: for dY/dr becomes very large as well

  — so fiscal stimulus highly effective exactly in case where most badly needed ("Great Depression" case)

Fiscal Stimulus at the Zero Lower Bound

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- Important difference: Cogan *et al.*, Erceg and Lindé assume increase in government purchases that extends beyond the time when ZLB ceases to bind, interest rates set by Taylor rule

  — Expectation of higher government purchases after period for which ZLB binds can reduce output when it does!

Fiscal Stimulus: The Importance of Duration

- Why expectation that high government spending will continue after ZLB ceases to bind can reduce output during the crisis:
    - if Taylor Rule determines monetary policy post-crisis (or inflation target), higher G then will crowd out private spending $\Rightarrow$ higher expected marginal utility of income $\Rightarrow$ less desired spending during crisis

Fiscal Stimulus: The Importance of Duration

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  - if Taylor Rule determines monetary policy post-crisis (or inflation target), higher G then will crowd out private spending $\Rightarrow$ higher expected marginal utility of income $\Rightarrow$ less desired spending during crisis
  - higher G then can also reduce inflation then $\Rightarrow$ lower expected inflation $\Rightarrow$ zero nominal rate implies higher real interest rate $\Rightarrow$ less desired spending during crisis

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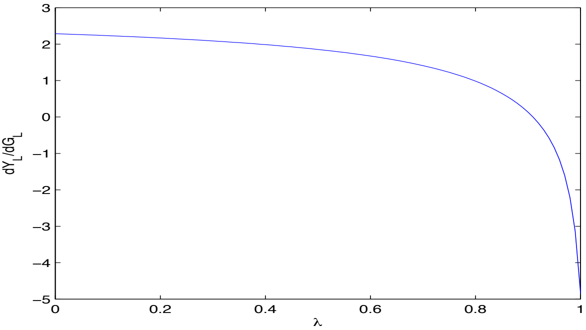

- Multiplier below 1 for $\lambda > 0.8$, negative for $\lambda > 0.91$

Government Purchases and Welfare

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— additive separability implicit in previous calculations

— $\eta_g \equiv -g'' \bar{G} / g' \geq 0$ a measure of degree of diminishing returns to government expenditure

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- Simple principle: choose government purchases to ensure efficient composition of aggregate expenditure: maximize $u(Y_t - G_t) + g(G_t)$, for given aggregate expenditure Y_t

  — Note this principle requires no consideration of effects of government purchases on economic activity

Government Purchases and Welfare

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- But: effective monetary policy should minimize the importance of this additional consideration!

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- Then optimal monetary policy maintains zero inflation at all times (assuming ZLB not a problem)

  — this achieves the flex-price equilibrium allocation, which is efficient, regardless of path $\{G_t\}$
- So optimal choice of $\{G_t\}$ is same as in neoclassical model!

  — determined purely by principle of efficient composition

Fiscal Stabilization at the Zero Lower Bound

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- 2-state Markov example: assume that $\bar{G}$ is optimal steady-state level, and that central bank targets zero inflation except when constrained by ZLB

- Quadratic approximation to expected utility varies inversely with

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[\pi_t^2 + \lambda_y (\hat{Y}_t - \Gamma \hat{G}_t)^2 + \lambda_g \hat{G}_t^2 \right]$$

$$= \frac{1}{1 - \beta\mu} \left[\pi_L^2 + \lambda_y (\hat{Y}_L - \Gamma \hat{G}_L)^2 + \lambda_g \hat{G}_L^2 \right]$$

— choose $\hat{G}_L$ to minimize this

Fiscal Stabilization at the Zero Lower Bound

- Optimal level:

$$\hat{G}_L = -\frac{\xi(\vartheta_G - \Gamma)\vartheta_r}{\xi(\vartheta_G - \Gamma)^2 + \lambda_g}\, r_L > 0$$

where

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- Optimal to choose $\hat{G}_L > 0$, even though principle of efficient composition would require $\hat{G}_L < 0$ (since $\hat{C}_L < 0$)

— but optimal $\hat{G}_L$ is less than the level required to "fill the output gap" (ensure that $\hat{Y}_L - \Gamma\hat{G}_L = 0$)

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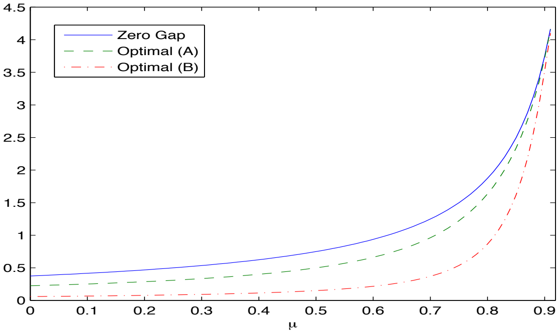

- Case (A): $\eta_g = 0$; Case (B): same diminishing returns as for private expenditure

Fiscal Stabilization at the Zero Lower Bound

- Here the case for fiscal stabilization policy again depends on assuming a suboptimal monetary policy

  — optimal policy would instead involve commitment to subsequent reflation (Eggertsson and Woodford, 2003)

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  — optimal policy would instead involve commitment to subsequent reflation (Eggertsson and Woodford, 2003)

- But the sub-optimality is of a plausible kind: inability to commit to history-dependent policy

  — becomes much more problematic when ZLB binds

Conclusions

- Under "Great Depression" circumstances (ZLB reached, μ large), multiplier should be large, and it is optimal to increase government purchases aggressively, nearly to extent required to "fill the output gap"

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- If ZLB reached, but μ is small, multiplier should still be greater than 1, and it is optimal to increase G beyond point consistent with efficient composition, though probably only a small fraction of what would "fill the gap"

- When ZLB is not a constraint, output-gap stabilization should largely be left to monetary policy; decisions about government purchases governed by the principle of efficient composition of aggregate expenditure

Conclusions

- When ZLB binds, effective fiscal stimulus (and welfare-maximizing policy) require that government purchases be increased for as long as ZLB still binds, but not longer