Fiscal Policy in a Deflation Spiral

Based on work by:

Eggertsson and Woodford, 2003, 'The Zero Interest-Rate Bound and Optimal Monetary Policy,' Brookings Panel on Economic Activity.

Christiano, Eichenbaum, Rebelo, 'When is the Government Spending Multiplier Big?'

Background

- Policy makers anxious to fight the current recession.

- Perception in late 2008: because interest rates were low, traditional monetary policy can't do much more.
  - turn to fiscal policy.

- How much can we hope to get from fiscal policy?
  - Empirical data tends to be ambiguous because
    - movements in *G* tend to be accompanied by other shocks.
    - a priori considerations suggest effects of G depends on state of economy.

  - Approach taken here: investigate what the equilibrium models which fit the data well have to say.

Findings

- What is the size of the fiscal multiplier?
  - Some prominent economists argue (without support) that the multiplier is near zero.
  - We will see that a standard equilibrium model implies:
    - in ‘normal times’ multiplier may be bigger than unity, but depends on the nature of monetary policy.
    - When lower bound on nominal interest rate is binding, multiplier may be quite large.

Outline

- Fiscal multiplier in normal times.

- Fiscal multiplier when non-negativity constraint on nominal rate of interest is binding.

Derivation of Model Equilibrium Conditions

- Households
  - First order conditions
- Firms:
  - final goods and intermediate goods
  - marginal cost of intermediate good firms
- Aggregate resources
- Monetary policy
- Three linearized equilibrium conditions:
  - Intertemporal, Pricing, Monetary policy
- Results

Model

- Household preferences and constraints:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{\left[C_t^{\gamma} (1-N_t)^{1-\gamma} \right]^{1-\sigma} - 1}{1-\sigma} + v(G_t) \right]$$

$$P_t C_t + B_{t+1} \leq W_t N_t + (1 + R_t) B_t + T_t, \; T_t \sim \text{lump sum taxes and profits}$$

- Optimality conditions

$$\overbrace{u_{c,t}}^{\text{marginal cost of giving up one unit of consumption to save}} = E_t \; \overbrace{\beta u_{c,t+1} \overbrace{\frac{1 + R_{t+1}}{1 + \pi_{t+1}}}^{\text{extra goods tomorrow from saving more today}}}^{\text{marginal benefit tomorrow from saving more today}} ,$$

Model

King-Plosser-Rebelo (KPR) preferences.

- Household preferences and constraints:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{\left[C_t^{\gamma} (1-N_t)^{1-\gamma} \right]^{1-\sigma} - 1}{1-\sigma} + v(G_t) \right]$$

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$$\overbrace{\frac{-u_{N,t}}{u_{c,t}}}^{\text{marginal cost (in units of goods) of labor effort}} = \overbrace{\frac{W_t}{P_t}}^{\text{marginal benefit of labor effort}}$$

Firms

- Final, homogeneous good

$$Y_t = \left(\int_0^1 Y_t(i)^{\frac{\varepsilon-1}{\varepsilon}} di \right)^{\frac{\varepsilon}{\varepsilon-1}}, \ \varepsilon > 1$$

  – Efficiency condition:

$$P_t(i) = P_t \left(\frac{Y_t}{Y_t(i)} \right)^{\frac{1}{\varepsilon}}$$

- i-th intermediate good

$$Y_t(i) = N_t(i)$$

  – Optimize price with probability *1*-θ, otherwise

$$P_t(i) = P_{t-1}(i)$$

Aggregate Resources

- Resource relation:

$$C_t + G_t = Y_t = p_t^* N_t$$

  – p_t^* is 'Tak Yun' distortion

  – recall, distortion = 1 to first order:

$$\hat{Y}_t = \hat{N}_t$$

- Log-linear expansion:

$$(1-g)\hat{C}_t + g\hat{G}_t = \hat{Y}_t,\ g \equiv \frac{G}{Y}$$

- Consumption:

$$\hat{C}_t = \frac{1}{1-g}\hat{Y}_t - \frac{g}{1-g}\hat{G}_t$$

Monetary Policy

- Monetary policy rule (after linearization)

$$dR_{t+1} = \rho_R dR_t + (1-\rho_R)\left[\frac{\phi_1}{\beta}\pi_{t+k} + \frac{\phi_2}{\beta}\hat{Y}_{t+l}\right]$$

$$dR_{t+1} \equiv R_{t+1} - R,\ R = \frac{1}{\beta} - 1$$

$$\hat{Y}_t \equiv \frac{Y_t - Y}{Y}$$

$$k, l = 0, 1.$$

Pulling All the Equations Together

- IS equation:

$$\begin{aligned} &\hat{Y}_t + [\gamma(1-\sigma)-1]g\hat{G}_t \\ = \; &\hat{Y}_{t+1} + [\gamma(1-\sigma)-1]g\hat{G}_{t+1} - (1-g)[\beta dR_{t+1} - d\pi_{t+1}] \end{aligned}$$

- Phillips curve:

$$\pi_t = \beta\pi_{t+1} + \kappa\left[\left(\frac{1}{1-g} + \frac{N}{1-N}\right)\hat{Y}_t - \frac{g}{1-g}\hat{G}_t\right]$$

- Monetary policy rule:

$$dR_{t+1} = \rho_R dR_t + (1-\rho_R)\left[\frac{\phi_1}{\beta}\pi_{t+k} + \frac{\phi_2}{\beta}\hat{Y}_{t+l}\right]$$

Results

- Fiscal spending multiplier small, but can easily be bigger than unity (i.e., *C* rises in response to *G* shock)

- Contrasts with standard results in which multiplier is less than unity
  - Typical preferences in estimated models:

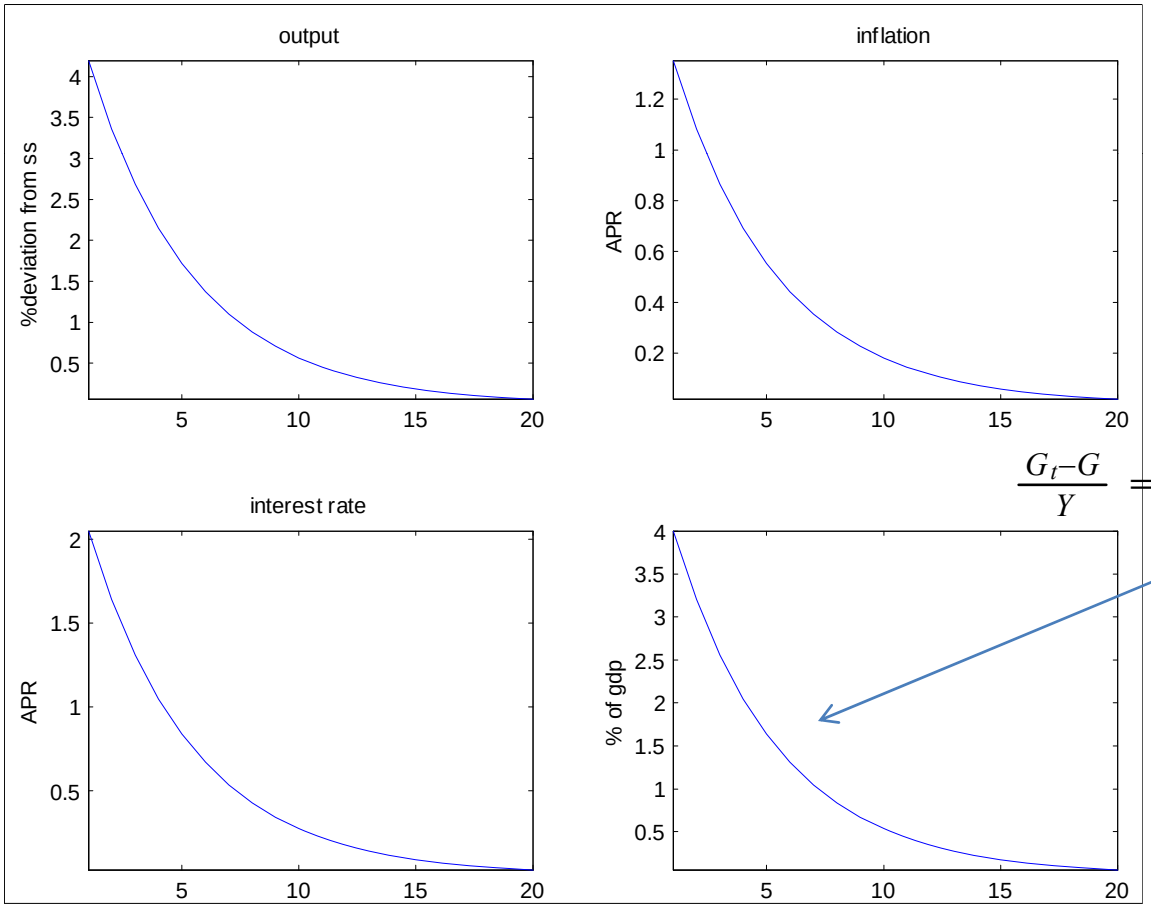
$$E_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{C_t^{1-\sigma}}{1-\sigma} - \psi \frac{N_t^{1+\gamma}}{1+\gamma} + v(G_t) \right], \ \psi, \gamma, \sigma > 0.$$

  - Marginal utility of *C* independent of *N* for CGG
  - Marginal utility of *C* increases in *N* for KPR.

Simulation Results

- Benchmark parameter values:

$$\kappa = 0.035,\ \beta = 0.99,\ \phi_1 = 1.5,\ \phi_2 = 0,\ N = 0.23,\ g = 0.2,\ \sigma = 2,\ \rho = 0.8,\ \rho_R = 0$$



$$\frac{G_t - G}{Y} = \frac{G_t - G}{G}\frac{G}{Y} = \hat{G}_t g$$

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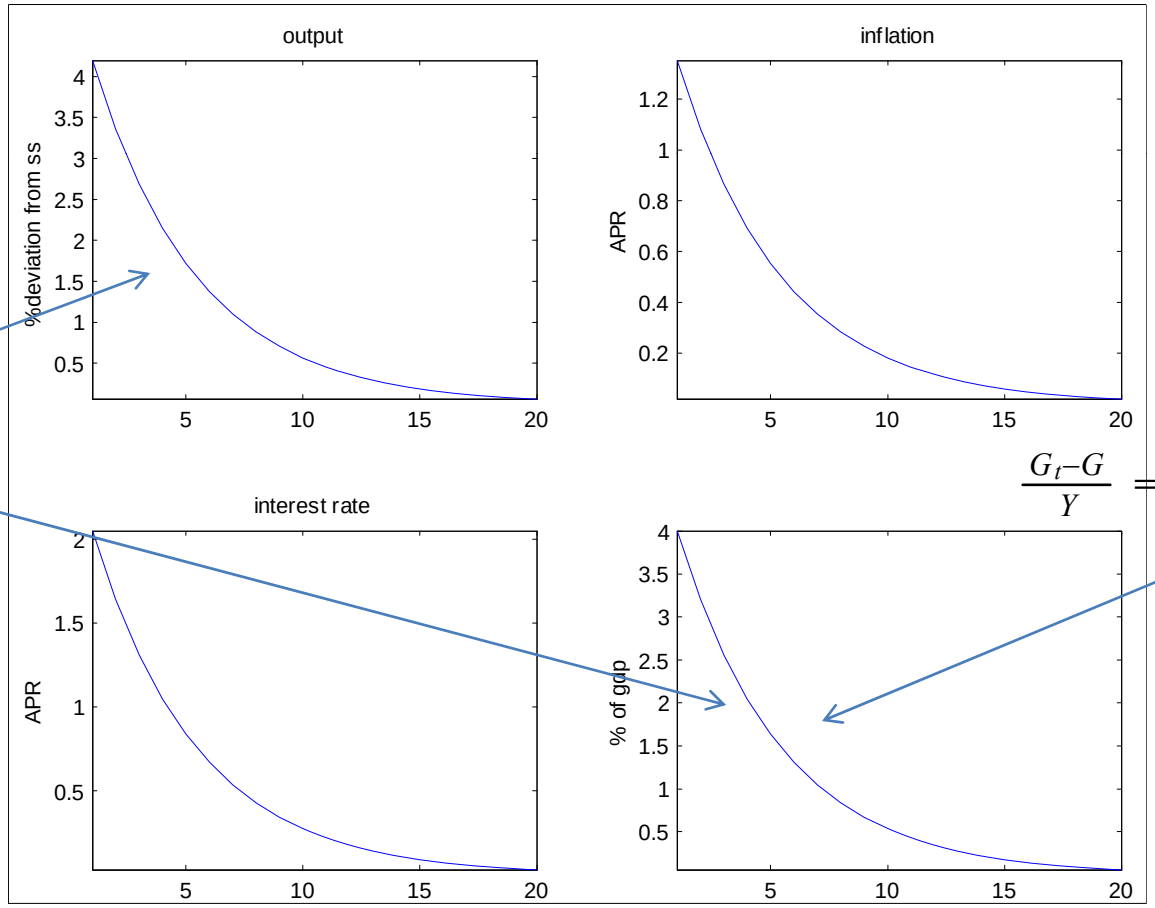
Multiplier = 1.05, constant.



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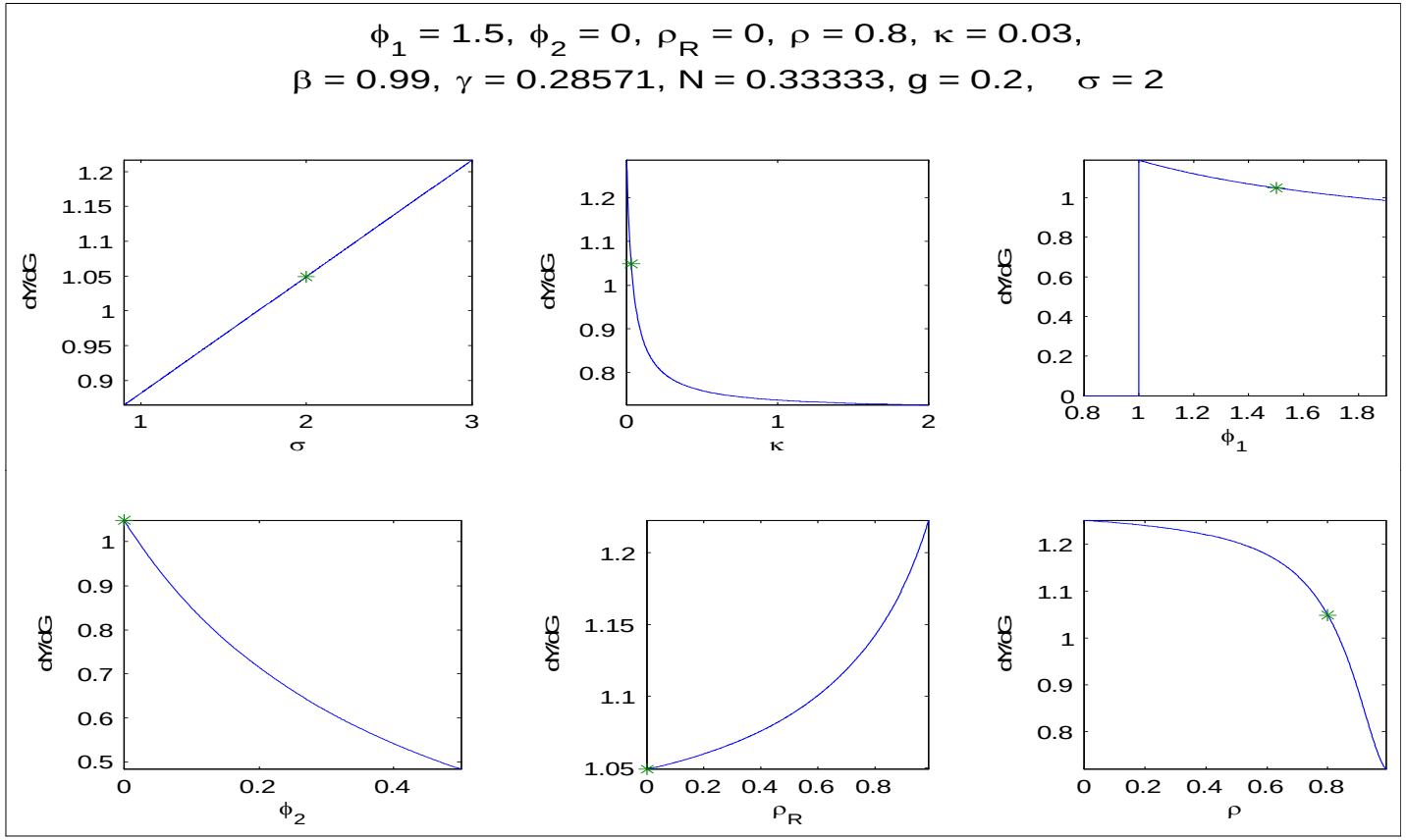
Multiplier for Alternative Parameter Values

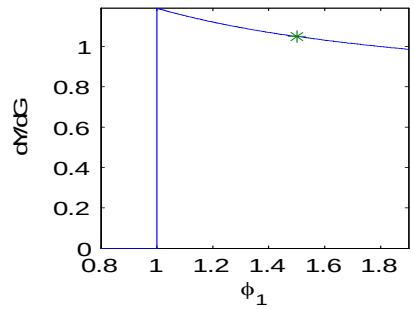


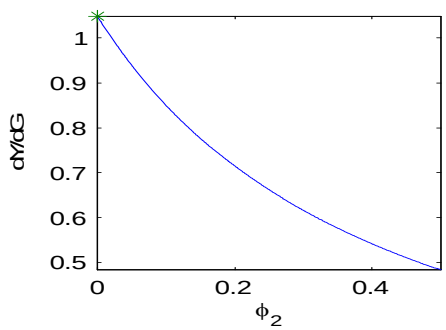
- Results: multiplier bigger
  - the less monetary policy allows *R* to rise.
  - the more complementary are consumption and labor (i.e., the bigger is σ).
  - the smaller the negative income effect on consumption (i.e., the smaller is ρ).
  - smaller values of κ (i.e., more sticky prices)

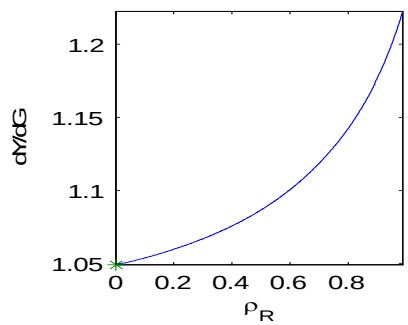
Multiplier for Alternative Parameter Values

$\phi_1 = 1.5,\ \phi_2 = 0,\ \rho_R = 0,\ \rho = 0.8,\ \kappa = 0.03,$
$\beta = 0.99,\ \gamma = 0.28571,\ N = 0.33333,\ g = 0.2,\quad \sigma = 2$

$$dR_{t+1} = \rho_R dR_t + (1-\rho_R)\left[\frac{\phi_1}{\beta}\pi_t + \frac{\phi_2}{\beta}\hat{Y}_t\right]$$







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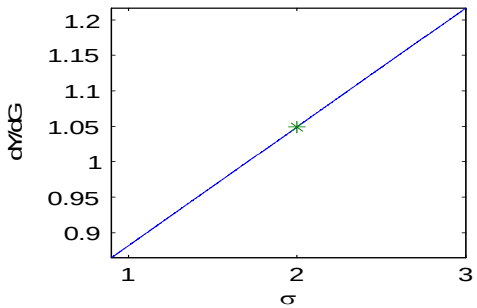

$$u(C_t, N_t) = \frac{\left[C_t^{\gamma}(1-N_t)^{1-\gamma}\right]^{1-\sigma} - 1}{1-\sigma}$$

$$u_{c,t} = C_t^{[\gamma(1-\sigma)-1]}(1-N_t)^{(1-\gamma)(1-\sigma)}$$

- Results: multiplier bigger
  - the more complementary are consumption and labor (i.e., the bigger is σ).

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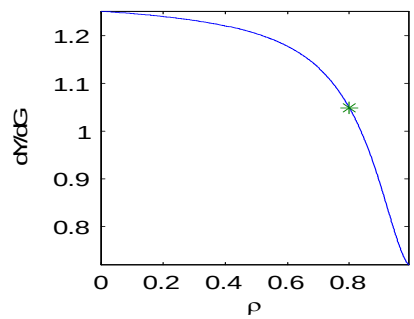
$$\hat{G}_t = \rho \hat{G}_{t-1} + \varepsilon_t$$



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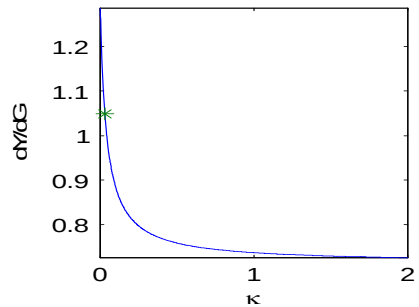


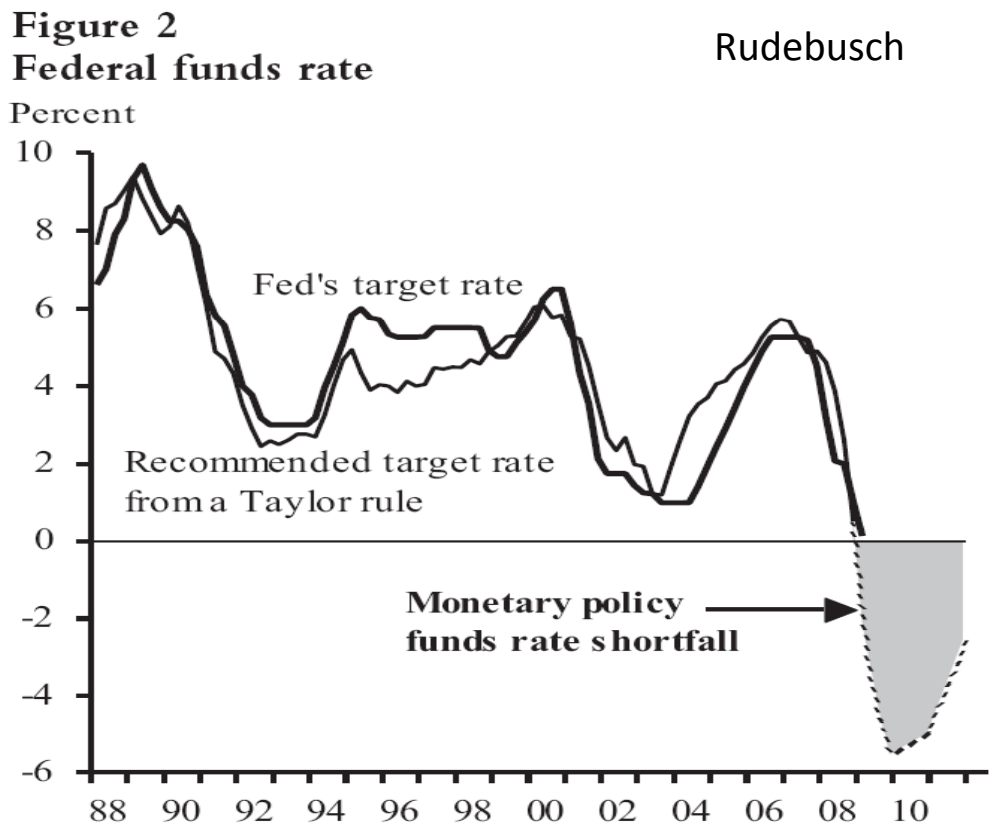
- Results: multiplier bigger
  - smaller values of κ (i.e., more sticky prices)

Analysis of Case when the Non-negativity Constraint on the Nominal Interest Rate is Binding

- Begin with intuition….

Zero Lower Bound (ZLB)

- Arguably, zero lower bound is now binding.



Rudebusch

G Multiplier and Welfare

- Exploiting the big *G* multiplier while in the zero bound may be welfare-improving
  - Rise in output associated with bigger *G* may help correct gross inefficiency in lower bound crisis.
  - This is so, even though high *G* in normal times might be inefficient.

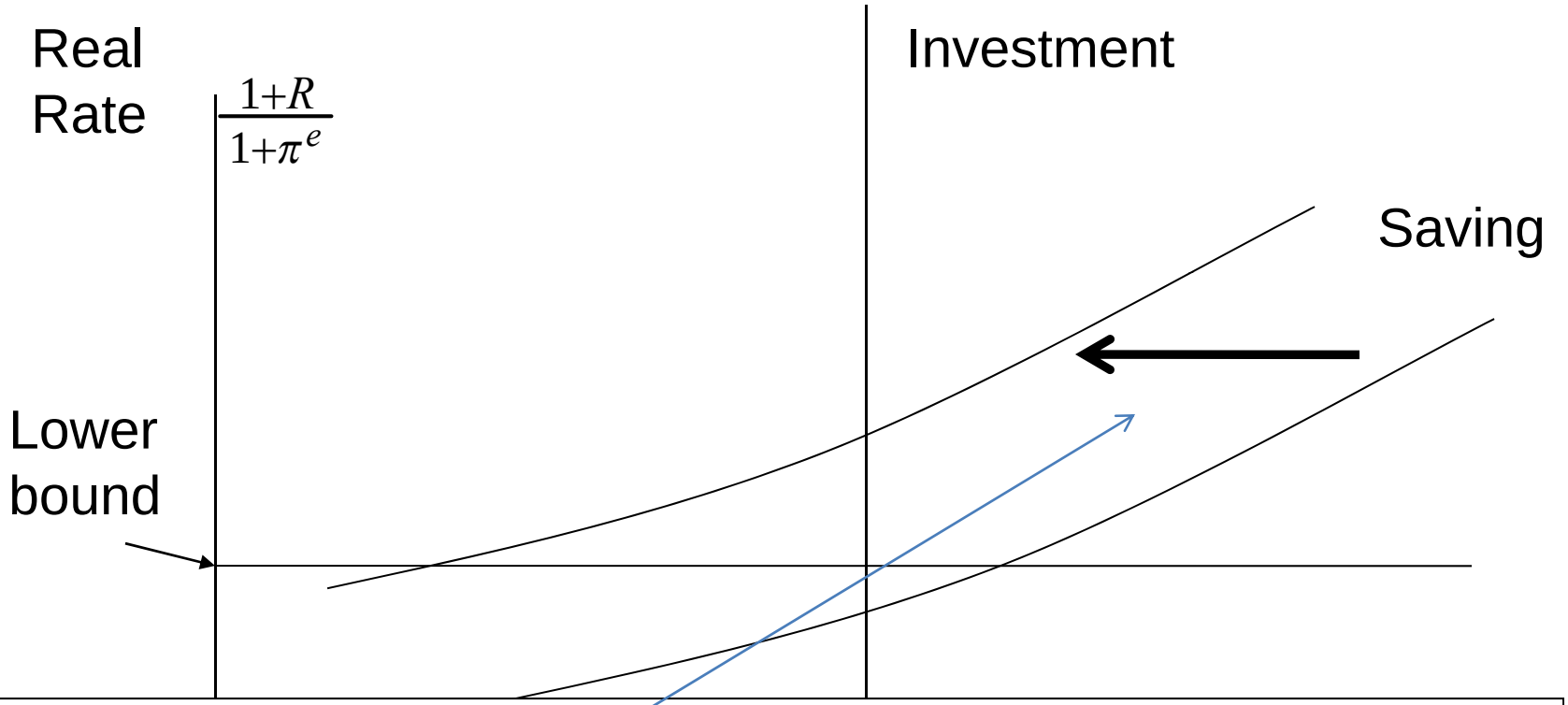
Real Interest Rate

- In New Keynesian model, what matters is real rate. Zero lower bound on nominal rate places no inflexibility on real interest rate.

- Inflation expectations slow to rise implies lower bound on real rate.

- Reasons why expected inflation may not rise soon:
  - Fed officials frequently repeat the credibility of their 'exit strategy' from the recent monetary expansion.
  - In the previous 'zero bound scare', policy of committing to keeping interest rate low extra long (to raise expected inflation) is held responsible for the recent housing bubble and subsequent world financial crisis.
  - Policy makers have learned from the experience of the 1970s that a rise in inflation expectations can lead to a loss of control over inflation.

Consequence of Increase in Saving When there is Lower Bound on Real Interest Rate



- Push back in saving could be accomplished
  - indirectly, by (possibly big) fall in output
  - directly, by rise in *G*
  - taxes have no effect, because have Ricardian equivalence.

Drop in Output May Be Very Large

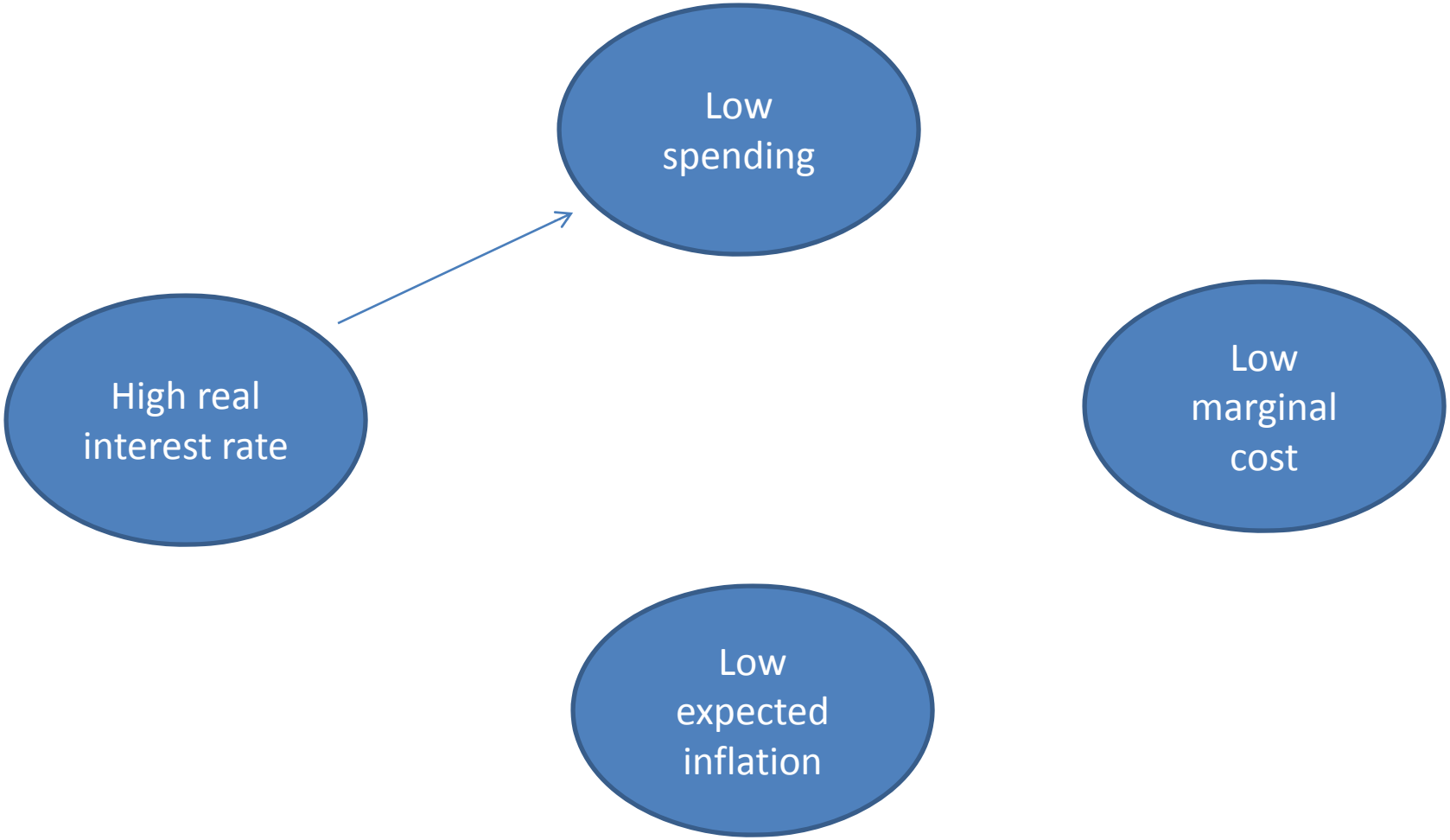
- So far, analysis resembles classic Keynesian analysis of 'Paradox of Thrift'
  - Rationalizes a relatively modest drop in output.

- In NK model, drop in output may be much bigger.

  - A vicious deflationary cycle may trigger a perverse *rise* in the real interest rate.

  - The rise in the real rate of interest makes the excess saving problem worse, increasing the fall in income needed to achieve equilibrium in the loan market.

Vicious Circle in Zero Bound



G Multiplier

- May be big in zero bound, by preventing the zero bound collapse.

- Another way to see the potential for G multiplier…..

Government Spending Multiplier with Constant *R*

- Normal times

$$G \uparrow \Rightarrow Y \uparrow \pi^e \uparrow \Rightarrow R \uparrow R - \pi^e \uparrow$$

  – Effect of G dampened by monetary policy

- Zero bound

$$G \uparrow \Rightarrow Y \uparrow \pi^e \uparrow \Rightarrow R \text{ fixed}, R - \pi^e \downarrow$$

  – Effect of *G* is now amplified

Turning to the formal analysis….

- Need a shock that puts us into the lower bound.

- One possibility: increased desire to save.
  - Other shocks will do it too……

- Discount rate shock.

Monetary Policy

- Monetary policy rule (after linearization)

$$Z_{t+1} = R + \rho_R(R_t - R) + (1 - \rho_R)\left[\frac{\phi_1}{\beta}\pi_t + \frac{\phi_2}{\beta}\hat{Y}_t\right]$$

$$\hat{Y}_t = \frac{Y_t - Y}{Y}, \; R = \frac{1}{\beta} - 1$$

$$R_{t+1} = \begin{cases} Z_{t+1} & \text{if } Z_{t+1} > 0 \\ 0 & \text{if } Z_{t+1} \leq 0 \end{cases}.$$

Eggertsson-Woodford Saving Shock

- Preferences:

$$u(C_0,N_0,G_0)+\tfrac{1}{1+r_1}E_0\left\{u(C_1,N_1,G_1)+\tfrac{1}{1+r_2}u(C_2,N_2,G_1)+\tfrac{1}{1+r_2}\tfrac{1}{1+r_3}u(C_3,N_3,G_3)\ldots\right\}$$

- Before *t<0*
  - System was in non-stochastic, zero inflation steady state,

$$r_{t+1} = R = \frac{1}{\beta} - 1$$

$$R_{t+1} = R$$

$$\hat{G}_t = 0, \text{ for all } t$$

Saving Shock, cnt'd

- At time *t=0,*

$$r_1 = r^l < 0$$
$$\Pr ob[r_{t+1} = r | r_t = r^l] = 1 - p$$
$$\Pr ob[r_{t+1} = r^l | r_t = r^l] = p$$
$$\Pr ob[r_{t+1} = r^l | r_t = r] = 0$$

- "Discount rate drops in *t=0* and is expected to return permanently to its 'normal' level with constant probability, *1-p.*"

Zero Bound Equilibrium

- simple characterization:

$\pi^l, \hat{Y}^l, R = 0,\ Z^l \leq 0$ while discount rate is low

$\pi_t = \hat{Y}_t = 0,\ R = r$ as soon as discount rate snaps back up

Fiscal Policy

- Government spending is set to a constant deviation from steady state, during the zero bound.

- That is,

$$\hat{G}_t \text{ may be nonzero while } r_{t+1} = r^l, \ \hat{G}_t = 0 \text{ when } r_{t+1} = r$$

Equations With Discount Shock

- IS equation:

$$\hat{Y}_t - g[\gamma(\sigma-1)+1]\hat{G}_t = -(1-g)[\beta(R_{t+1}-r_{t+1}) - E_t\pi_{t+1}] + E_t\hat{Y}_{t+1} - g[\gamma(\sigma-1)+1]E_t\hat{G}_{t+1}$$

$$\hat{Y}^l - g[\gamma(\sigma-1)+1]\hat{G}^l = -(1-g)[\beta(0-r^l) - p\pi^l] + p\hat{Y}^l - g[\gamma(\sigma-1)+1]p\hat{G}$$

- Phillips curve:

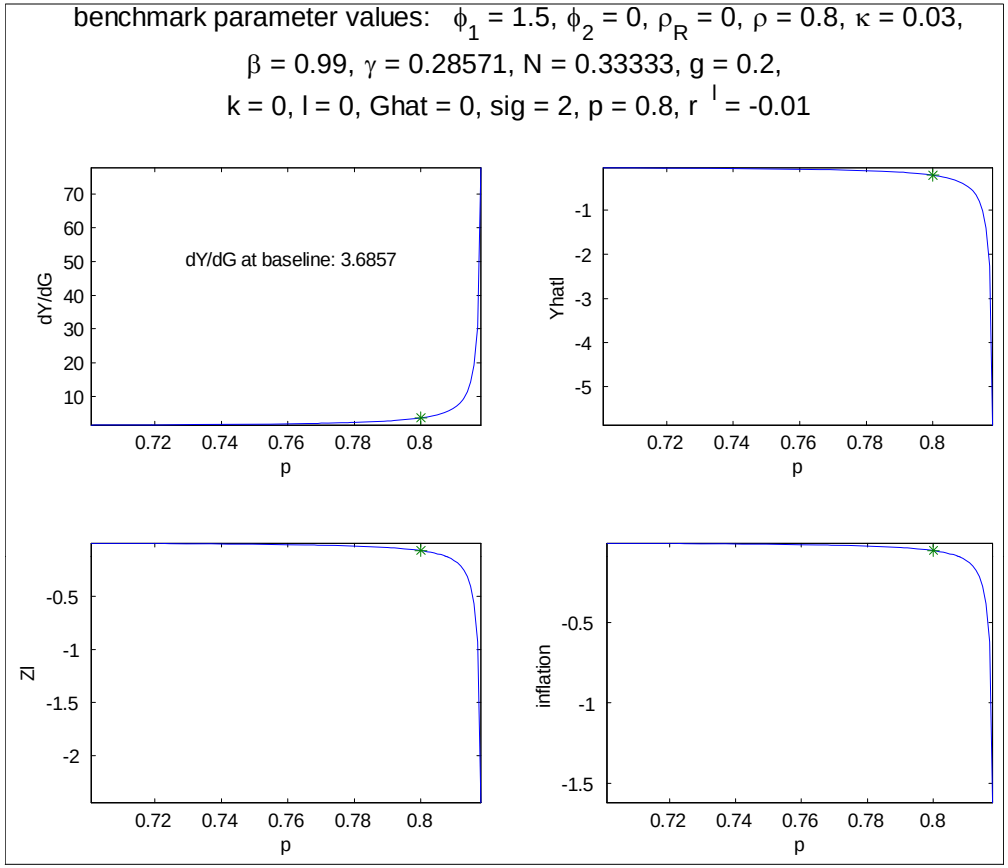
$$\pi_t = \beta E_t\pi_{t+1} + \kappa\left[\left(\frac{1}{1-g} + \frac{N}{1-N}\right)\hat{Y}_t - \frac{g}{1-g}\hat{G}_t\right]$$

$$\pi^l = \beta p\pi^l + \kappa\left(\frac{1}{1-g} + \frac{N}{1-N}\right)\hat{Y}^l - \frac{g}{1-g}\kappa\hat{G}^l$$

- Monetary Policy:

$$R_{t+1} = 0$$

$$Z_{t+1} = R + \rho_R(R_t - R) + (1-\rho_R)\left[\frac{\phi_1}{\beta}\pi_t + \frac{\phi_2}{\beta}\hat{Y}_t\right] \leq 0$$



- As *p* increases, zero-bound becomes more severe…this is because with higher *p*, fall in output is more persistent, and reductions in output have smaller effect on saving.

Fiscal Expansion in Zero Bound Highly Effective, But is it *Desirable*?

- Intuition:
  - *Yes*….
    - the vicious cycle produces a huge, inefficient fall in output
    - in the first-best equilibrium, output, consumption and employment are invariant to discount rate shocks
    - If *G* helps to partially undo this inefficiency, then surely it's a good thing

Fiscal Expansion in Zero Bound Highly Effective, But is it *Desirable*?

- Preferences

$$\sum_{t=0}^{\infty}\left(\frac{p}{1+r^l}\right)^t\left[\frac{\left[(C^l)^\gamma(1-N^l)^{1-\gamma}\right]^{1-\sigma}-1}{1-\sigma}+v(G^l)\right]$$

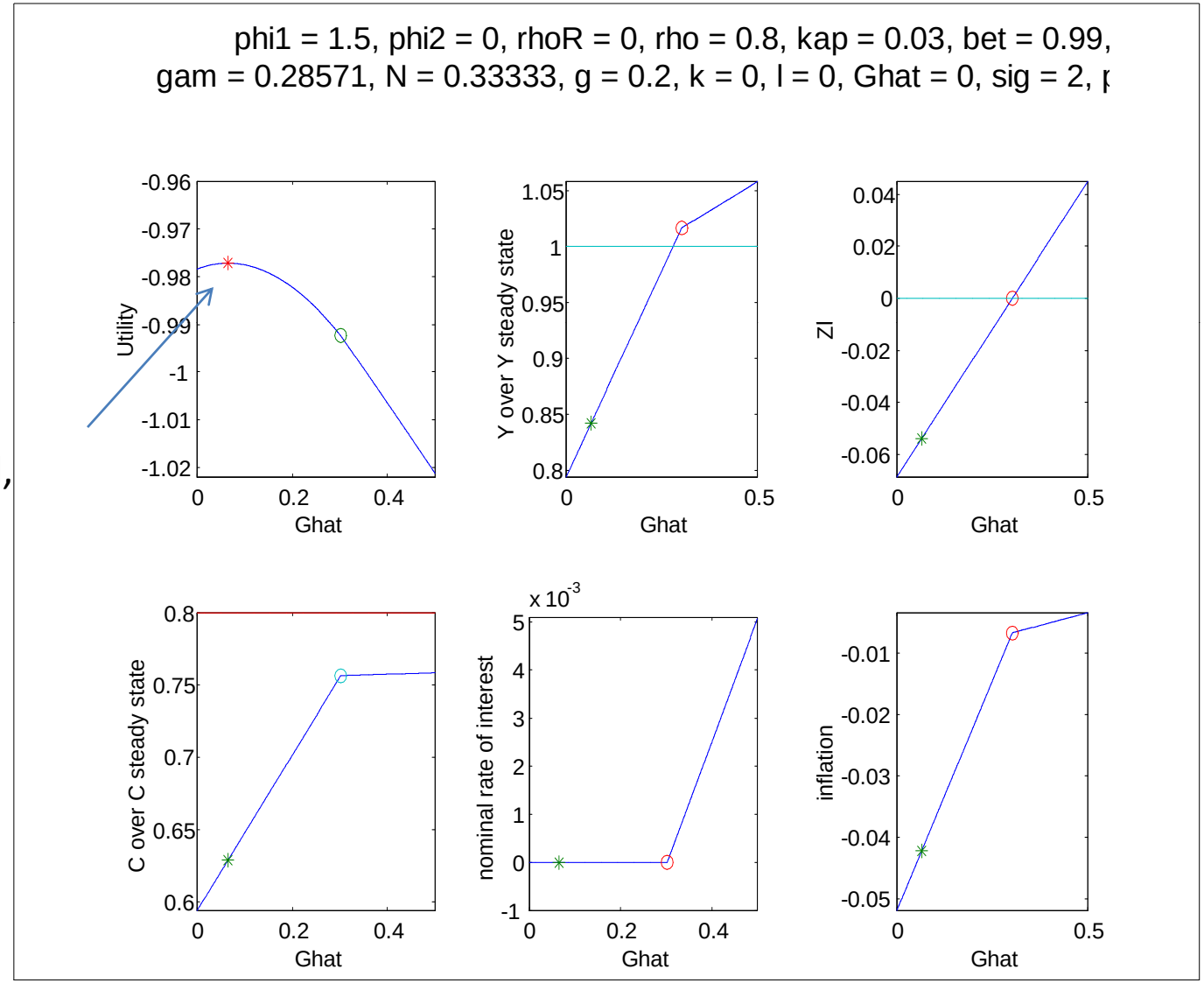
$$=\frac{1}{1-\frac{p}{1+r^l}}\left[\frac{\left[(C^l)^\gamma(1-N^l)^{1-\gamma}\right]^{1-\sigma}-1}{1-\sigma}+v(G^l)\right]$$

$$=\frac{1}{1-\frac{p}{1+r^l}}\left[\frac{\left[\left(N\left(\hat{Y}^l+1\right)-Ng\left(\hat{G}^l+1\right)\right)^\gamma\left(1-N\left(\hat{Y}^l+1\right)\right)^{1-\gamma}\right]^{1-\sigma}-1}{1-\sigma}+v\left(Ng\left(\hat{G}^l+1\right)\right)\right]$$

- Compute optimal $\hat{G}^l$
  - (i) $v(G^l)$ = 0,
  - (ii) $v(G)=\psi_g\frac{G^{1-\sigma}}{1-\sigma}$, ψ_g chosen to rationalize $g=0.2$ as optimal in steady state

Case Where G is not Valued

Optimal *G* is substantial, around 5%.



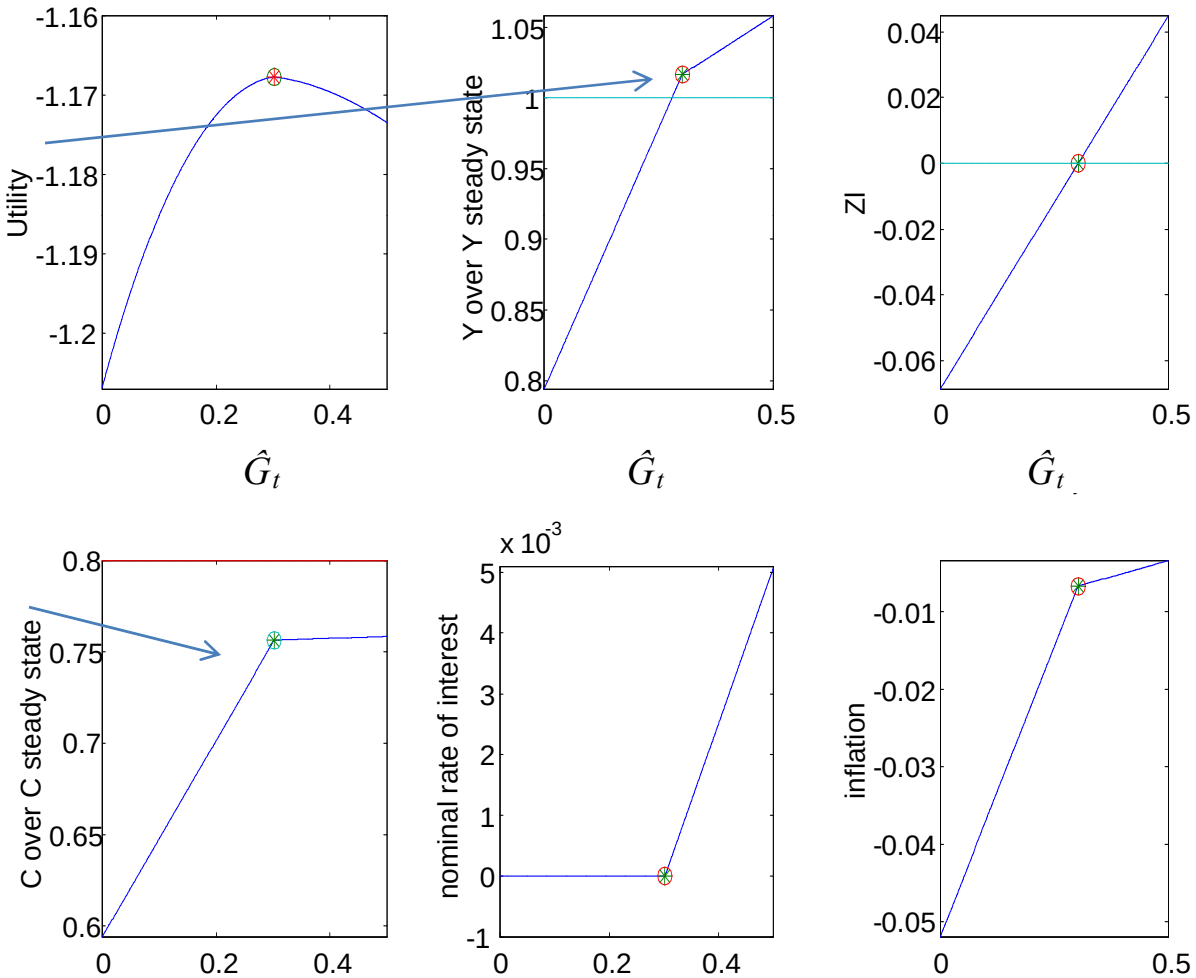
Case Where Gov't Spending is Desirable

phi1 = 1.5, phi2 = 0, rhoR = 0, rho = 0.8, kap = 0.03, bet = 0.99
gam = 0.28571, N = 0.33333, g = 0.2, k = 0, l = 0, Ghat = 0, sig = 2, psi

psig=0.015226

Optimal Y higher than before crisis

The high level of output is necessary to get partial recovery in consumption



Introducing Investment

- Two findings:
  - With investment, likelihood of lower bound reduced (as real rate falls with rise in saving, investment expands to absorb rise in saving).
  - When the lower bound binds, multiplier could be larger because vicious cycle more severe.

Conclusion

- Government spending multiplier in a neighborhood of unity in 'normal times'.
- Multiplier can be large when the zero bound is binding (because *R* constant then).
- Increase in *G* is welfare improving during lower bound crisis.
- Caveat: focused exclusively on multiplier
  - Increasing *G* may be bad idea because hard to reverse.
  - May be other ways of accomplishing similar thing (e.g., transition to VAT tax over time).