Deficits, public debt dynamics and tax and spending multipliers

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Questions

- What is the effect of government spending cuts or tax hikes on the budget deficit?
- What is the effect of the budget deficit itself on short-run and long-run outcomes?
- Does the state of the economy matter?
- Objective: Incorporate debt dynamics into NK model.

…..“austerity” vs “deficit spending” debate….

Main findings

- Rules change if interest rate collapse to zero (are "constant")

1. Normally, cutting government spending reduces deficit approximately one to one.
   - But! Much smaller effect at zero interest rates, can even be ***negative*** (spending self-financing)
2. Normally, expectations about future labor and sales taxes and government spending irrelevant for short-term demand
   - But! Very large at zero interest rates rates. Expectation of
     - higher long-run labor taxes contractionary
     - lower government expansionary.

→ Implication: Effect of deficits is policy regime dependent.

Bottom-line

- At zero interest rate economy demand-determined.
- Emphasis should be on stuff that increases spending.
- Short-run demand not only dependents on short-run fiscal policy but also about *expectation about future taxes and spending at zero interest rates*.
- Deficit will have an effect on those expectations.
- But! These expectations are policy regime dependent.
- … can both make a case for and against "austerity", depending on policy regime …
- Will clarify this and quantify in what follows.
- Estimate of "government spending multiplier" depends now on how it is financed ….

Related lit

- Eggertsson (2010), Christiano, Eichenbaum and Rebelo (2010), Woodford (2010), Eggertsson and Krugman (2012)
- Eggertsson and Woodford (2004), Correia, Fahri, Niccolini and Teles (2010).
- Erceg and Linde (2012)
- Villaverde et al, Uhlig et al, Leeper et al, Taylor et al, Bilbie, Monacelli, Perotti …. etc etc

→Goal here to get simple closed for solutions to make sense of all this literature.

Outline of talk

1. Basic model, large shocks, calibration
2. Characterize deficits when large shocks

   a1. SR policy unchanged

   a2. deficits are neutral (LR lump sum taxes)
3. How does SR policy affect deficits?
4. Deficits and the LR and the SR

   i. How do LR taxes/spending affect equilibrium?

   ii. How do deficits affect exp of LR taxes/spending?

   iii.How, then, do deficit change SR demand?

The Model

Households

shock

Utility

$$\max \; E_t \sum_{T=t}^{\infty} \beta^{T-t} \left[u(C_T) + g(G_T) - \int_0^1 v(L_T(j))\,dj \right] \xi_T$$

s.t. budget constraint

Fiscal policy instruments

$$B_t = (1+i_{t-1}) B_{t-1} - (1+\tau_t^s) P_t C_t - T_t$$

$$+ (1-\tau_t^I)[\int_0^1 \Pi_T(i)\,di + \int_0^1 w_T(j) L_T(j)\,dj]$$

Consumption and price indices

Monetary policy instrument

$$C_t \equiv \left[\int_0^1 c_t(i)^{\frac{\theta-1}{\theta}} di \right]^{\frac{\theta}{\theta-1}}, P_t \equiv \left[\int_0^1 p_t(i)^{1-\theta} di \right]^{\frac{1}{1-\theta}}$$

The Model

Firms

Monapolistically competetive firms and linear production function

$$y_t(i) = Y_t(\frac{p_t(i)}{P_t})^{-\theta} \qquad\qquad y_t(i) = L_t(i)$$

Calvo prices. Fraction (1-α) of firms set new prices in each period (exclusive of sales tax). *Commit to produce whatever demanded at the price set.*

$$\max_{p_t^*} E_t\{\sum_{T=t}^{\infty}(\alpha\beta)^{T-t} Q_{t,T}(1-\tau_T^P)[p_t^*(\frac{p_t^*}{P_T})^{-\theta} Y_T - W_T(j)(\frac{p_t^*}{P_T})^{-\theta} Y_T]\} = 0$$

Resource constraint

$$Y_t = C_t + G_t$$

Equilibrium

$$\{Y_t, C_t, p_t^*, P_t\} - \{i_t, \tau_t^I, \tau_t^s, G_t\} - \{\xi_t\}$$

The Model

The Government

- If possible $\pi_t = 0$

..... otherwise $i_t = 0$

- Explore deficit and the marginal effect of

$$\tau_t^I, \tau_t^s, G_t$$

The Model

The Government

- If possible $\pi_t = 0$

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- Explore deficit and the marginal effect of

$$\tau_t^I, \tau_t^s, G_t$$

The Model

Summary

shock

AD $$\hat{Y}_t = E_t \hat{Y}_{t+1} - \sigma(i_t - E_t \pi_{t+1} - r^e(\xi_t))$$
$$+ E_t(\hat{G}_t - \hat{G}_{t+1}) - \sigma E_t(\hat{\tau}_t^s - \hat{\tau}_{t+1}^s)$$

People determine "demand", i.e. overall spending

AS $$\pi_t = \kappa \hat{Y}_t + \beta E_t \pi_{t+1} + \kappa\psi[\hat{\tau}_t^s + \hat{\tau}_t^w] - \kappa\psi\sigma^{-1}\hat{G}_t$$

Firms supply whatever is demanded but demand has effect on their pricing

ZB $$i_t \geq 0$$

$$r_t^e \equiv \log \beta^{-1} + \hat{\xi}_t - E_t \hat{\xi}_{t+1}$$

The Model

Summary

$$\frac{\bar{b}}{\bar{Y}}\hat{b}_t - \frac{\bar{b}}{\bar{Y}}(1+\bar{i})\hat{b}_{t-1} =$$

Deficits

$$\frac{\bar{b}}{\bar{Y}}(1+\bar{i})[i_{t-1} - \pi_t] - (\bar{\tau}^I + \bar{\tau}^s)\hat{Y}_t$$

Endogenous component

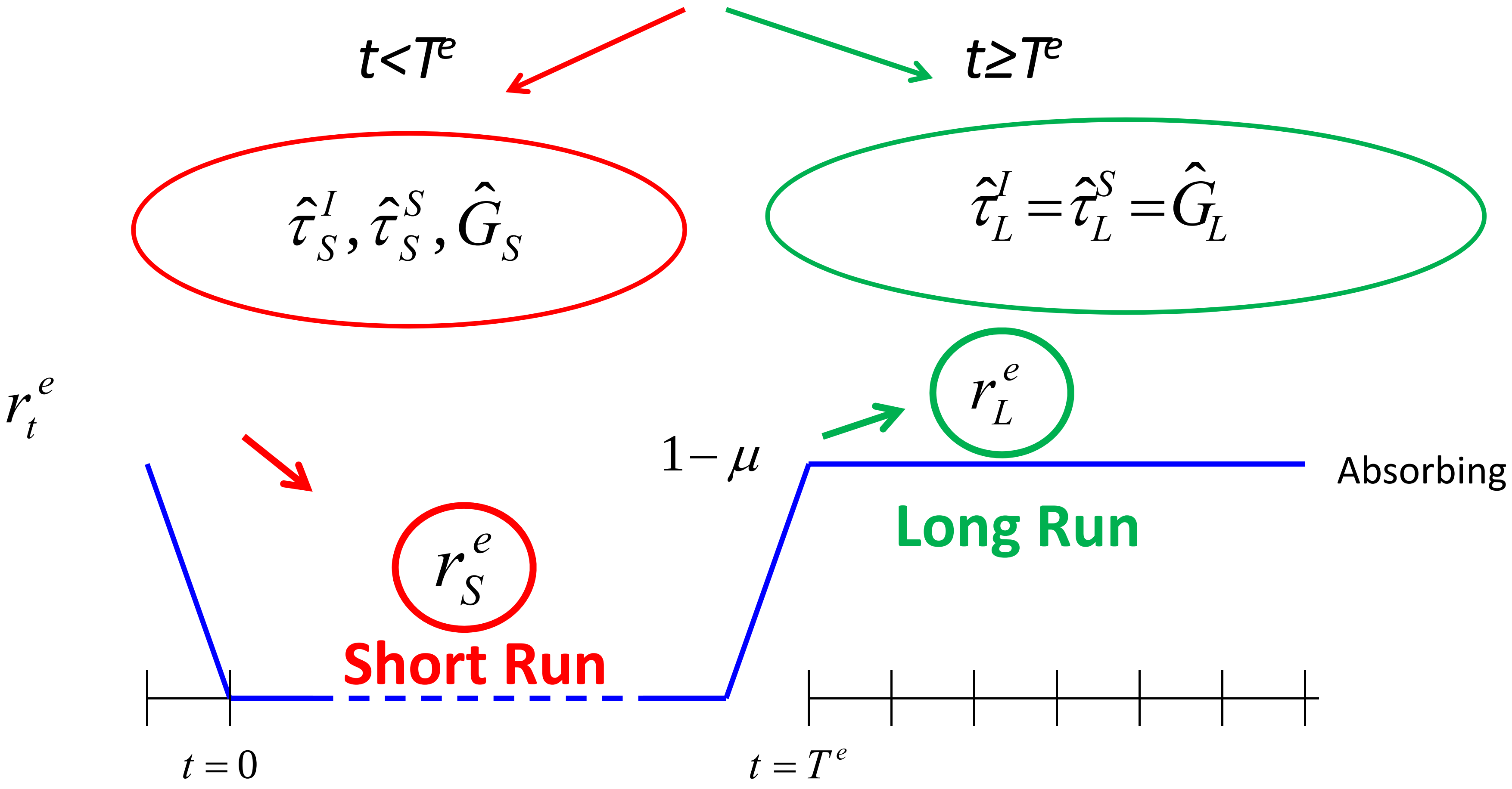
$$+\hat{G}_t - \hat{\tau}_t^s - \hat{\tau}_t^I - \frac{\bar{T}}{\bar{Y}}\hat{T}_t$$

Policy driven component

Two states:

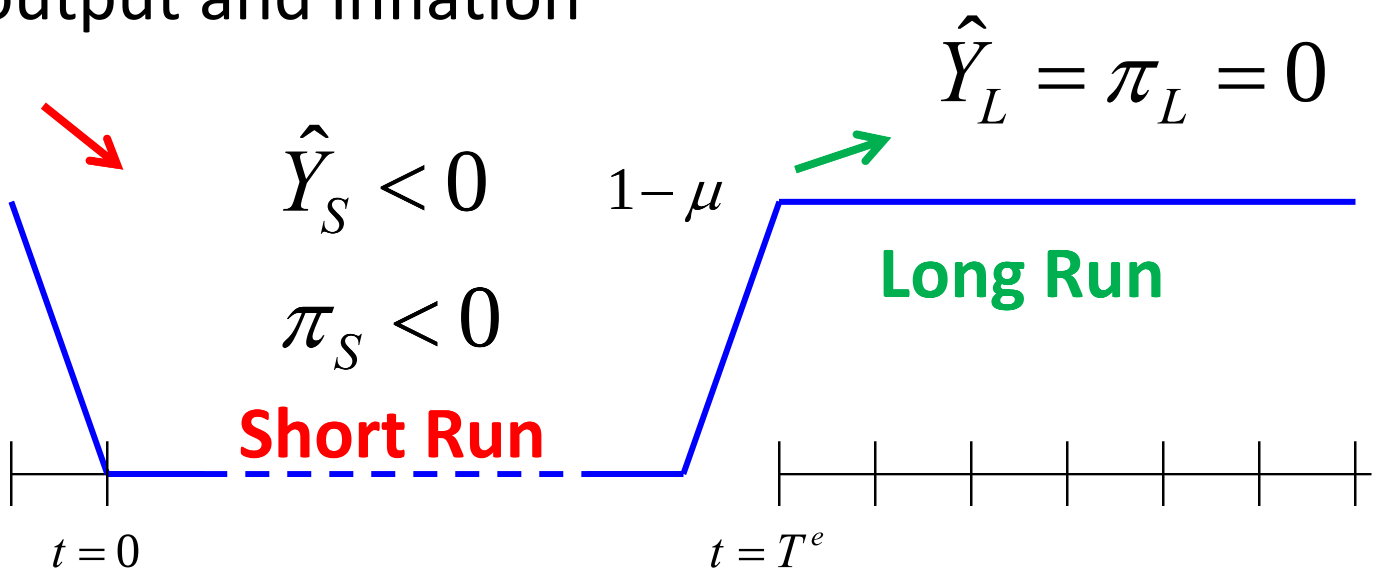
short run and long run

transition prob 1-μ.



Two states:
Outcome in model

- Suppose all spending-taxes rates constant (lump sum taxes adjust).
- For large enough shocks to r_S^e
- Zero bound binding → (potentially) large drop in output and inflation



Constructing numerical examples

- We ask the model go match a scenario using Bayesian Methods

1. Great Depression (GD) scenario

- -30 percent drop in output
- -10 percent deflation

2. Great Recession (GR) scenario

- -10 percent drop in output
- -2 percent drop in inflation
- Main difference between posteriors:

-- Duration of shock longer in GD scenario.

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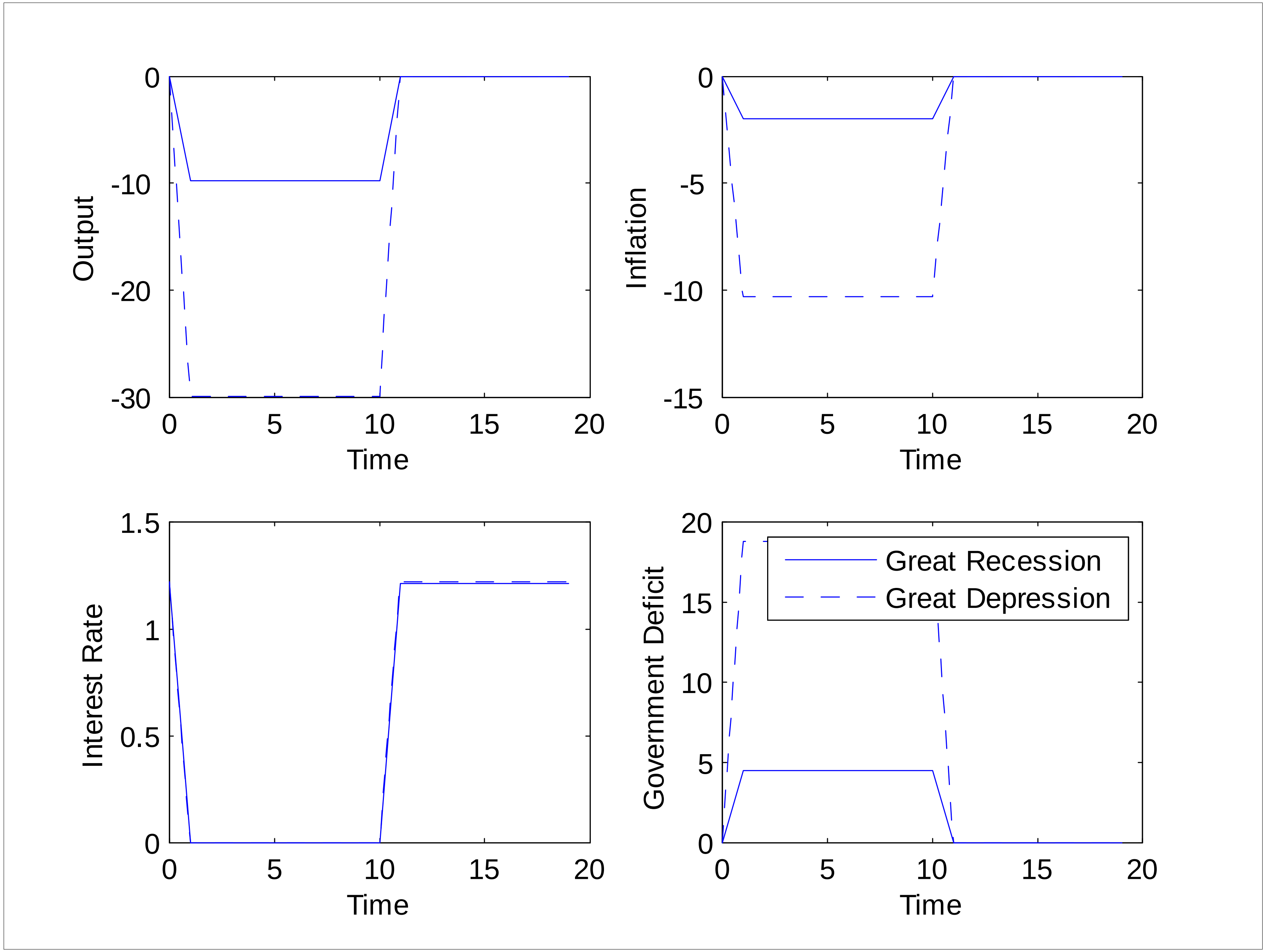
   iii.How, then, do deficit change SR demand?

2. Characterizing deficits when shock

Experiment:

- All taxes at steady state in SR (realistic)
- Only LR lump sum taxes change (not realistic)
- Question: What happens to the deficit?

$$\hat{D}_S = \frac{\bar{b}}{\bar{Y}}(1+\bar{i})[i_S - \pi_S] - (\bar{\tau}^w + \bar{\tau}^s)\hat{Y}_S$$



The Great Depression and the Great Recession in the model.

- Here: Budget deficit irrelevant because future lump sum taxes change.

- Shortly will explicitly model how today deficits affect future taxes → current demand

- Before getting there: What is the effect of various policies on deficits?

- Suppose you just want to “eliminate” deficits. How to do it?

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3. How does SR policy affect deficits?

- At zero interest rates:
  - Government spending multipliers high.
  - Sales tax cuts work well.
  - Increasing income taxes expansionary
- Input into asking: What happens to deficits?

Basic property of model: Multipliers can be large at zero interest rate

- Why?
- Basic reason:
  - Nominal interest rate do not rise/drop to offset policy
  - Expectation of the same thing as long as shock negative

  → Negative spiral (shock)

  → Virtuous spiral (spending/taxes)

	$i > 0$		$i = 0$	
	GD	*GR*	*GD*	*GR*
	[5% , 95%]	[5% , 95%]	[5% , 95%]	[5% , 95%]
$\frac{\Delta \hat{Y}_s}{\Delta \hat{G}_s}$	**0.4** [0.2 , 0.6]	**0.4** [0.3 , 0.6]	**2.2** [1.4 , 3.2]	**1.2** [1.1 , 1.5]
$\frac{\Delta \hat{Y}_s}{\Delta \hat{\tau}_S^s}$	**-0.3** [-0.5 , -0.2]	**-0.3** [-0.5 , -0.2]	**-1.8** [-3, -0.9]	**-0.9** [-1.3, -0.5]
$\frac{\Delta \hat{Y}_s}{\Delta \hat{\tau}_S^I}$	**-0.5** [-0.8 , -0.3]	**-0.5** [-0.7 , -0.3]	**0.4** [0.2 , 0.5]	**0.1** [0.06 , 0.3]

Austerity can be self-defeating

$$\frac{\triangle \hat{D}_S}{\triangle \hat{G}_S} = (1+\bar{\tau}^s)\frac{\triangle \hat{G}_S}{\triangle \hat{G}_S} + \frac{\bar{b}}{\bar{Y}}(1+\bar{\imath})\frac{\triangle[\hat{\imath}_S - \pi_S]}{\triangle \hat{G}_S} - (\bar{\tau}^I + \bar{\tau}^s)\frac{\triangle \hat{Y}_S}{\triangle \hat{G}_S}$$

At positive interest rate always >0

At zero……

$$\frac{\triangle \hat{D}_S}{\triangle \hat{G}_S} < 0 \text{ if } \frac{\triangle \hat{Y}_S}{\triangle \hat{G}_S} > \Gamma = \frac{1+\bar{\tau}^s + \frac{\bar{b}}{Y}(1+\bar{\imath})\frac{\kappa}{1-\beta\mu}\sigma^{-1}\psi}{\bar{\tau}^I + \bar{\tau}^s + \frac{\bar{b}}{Y}(1+\bar{\imath})\frac{\kappa}{1-\beta\mu}}$$

	$i > 0$		$i = 0$	
	GD	*GR*	*GD*	*GR*
	[5% , 95%]	[5% , 95%]	[5% , 95%]	[5% , 95%]
$\frac{\Delta \hat{D}_S}{\Delta \hat{G}_S}$	1.1 [1.03 , 1.3]	1.2 [1.09 , 1.5]	-0.3 [-1 , 0.3]	0.5 [0.2 , 0.6]
$\frac{\Delta \hat{D}_S}{\triangle \hat{\tau}_S^s}$	-1.1 [-1.2 , -1]	-1.2 [-1.3 , -1]	0.3 [-0.3 , 1.1]	-0.4 [-0.5 , -0.1]
$\frac{\Delta \hat{D}_S}{\triangle \hat{\tau}_S^I}$	-0.6 [-0.8 , -0.4]	-0.6 [-0.7 , -0.3]	-1.4 [-1.6 , -1.2]	-1.2 [-1.3 , -1.1]

Discussion

- Usually cutting gov. spending reduces deficit about one to one.
- At zero interest rates: Austerity measures can increase rather than decrease the deficit.
- Same applies to sales tax increases (Laffer type result).
- Income tax increases close the deficit and are expansionary on output.

- **To reduce deficit, government have mainly focused on spending cuts AND sales tax increase ……**

  ….. while "stimulating" via income tax cuts.

So far ….

- Only talked about short run effect of fiscal policy on deficit and output in short run.
- But discussion usually about the long-run
- Can we tie the long-run more closely into the analysis?
- Does the LR analysis potentially change our short-run “multipliers” (Yes! At least at zero!)

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4. Deficits and the LR and the SR

A. How do LR taxes/spending affect equilibrium?

B. How do deficits affect expectation of LR taxes/spending?

C. How, then, do deficit change SR demand?

Long run: $\pi_t = 0 \; \forall \; t$

AD

$$\hat{Y}_t = E_t \hat{Y}_{t+1} - \sigma(i_t - E_t \pi_{t+1} - r_t^e)$$
$$+ E_t(\hat{G}_t - \hat{G}_{t+1}) - \sigma E_t(\hat{\tau}_t^s - \hat{\tau}_{t+1}^s)$$

Pricing equation

AS

$$\pi_t = \kappa \hat{Y}_t + \beta E_t \pi_{t+1} + \kappa \psi [\hat{\tau}_t^s + \hat{\tau}_t^I] - \kappa \psi \sigma^{-1} \hat{G}_t$$

$$\hat{Y}_L = -\psi [\hat{\tau}_L^s + \hat{\tau}_L^I] + \psi \sigma^{-1} \hat{G}_L$$

	$i > 0$	
	GD	GR
	[5% , 95%]	[5% , 95%]
$\frac{\Delta \hat{Y}_L}{\Delta \hat{G}_L}$	0.4 [0.2 , 0.6]	0.4 [0.3 , 0.6]
$\frac{\Delta \hat{Y}_L}{\Delta \hat{\tau}_L^s}$	−0.3 [-0.5 , -0.2]	−0.3 [-0.5 , -0.3]
$\frac{\Delta \hat{Y}_L}{\Delta \hat{\tau}_L^I}$	−0.5 [-0.8 , -0.3]	−0.5 [-0.7 , -0.3]

Short run: if $\pi_t = 0 \; \forall \, t$ -> SR=LR

AD
$$\hat{Y}_t = E_t \hat{Y}_{t+1} - \sigma (i_t - E_t \pi_{t+1} - r_t^e)$$
$$+ E_t(\hat{G}_t - \hat{G}_{t+1}) - \sigma E_t(\hat{\tau}_t^s - \hat{\tau}_{t+1}^s)$$

Pricing equation

AS
$$\pi_t = \kappa \hat{Y}_t + \beta E_t \pi_{t+1} + \kappa \psi [\hat{\tau}_t^s + \hat{\tau}_t^I] - \kappa \psi \sigma^{-1} \hat{G}_t$$

$$\hat{Y}_S = -\psi [\hat{\tau}_S^s + \hat{\tau}_S^I] + \psi \sigma^{-1} \hat{G}_S$$

- To re-iterate
- LR taxes and spending have no effect on SR output with CB that target zero inflation

$$\hat{Y}_S = -\psi[\hat{\tau}_S^s + \hat{\tau}_S^I] + \psi\sigma^{-1}\hat{G}_S$$

SR: If $i_t = 0$

AD
$$\hat{Y}_t = E_t \hat{Y}_{t+1} + \sigma E_t \pi_{t+1} + \sigma r_t^e + E_t(\hat{G}_t - \hat{G}_{t+1}) - \sigma E_t(\hat{\tau}_t^s - \hat{\tau}_{t+1}^s)$$

Pins down output

Expectation of LR policy play a role?

AS
$$\pi_t = \kappa \hat{Y}_t + \beta E_t \pi_{t+1} + \kappa\psi[\hat{\tau}_t^s + \hat{\tau}_t^I] - \kappa\psi\sigma^{-1}\hat{G}_t$$

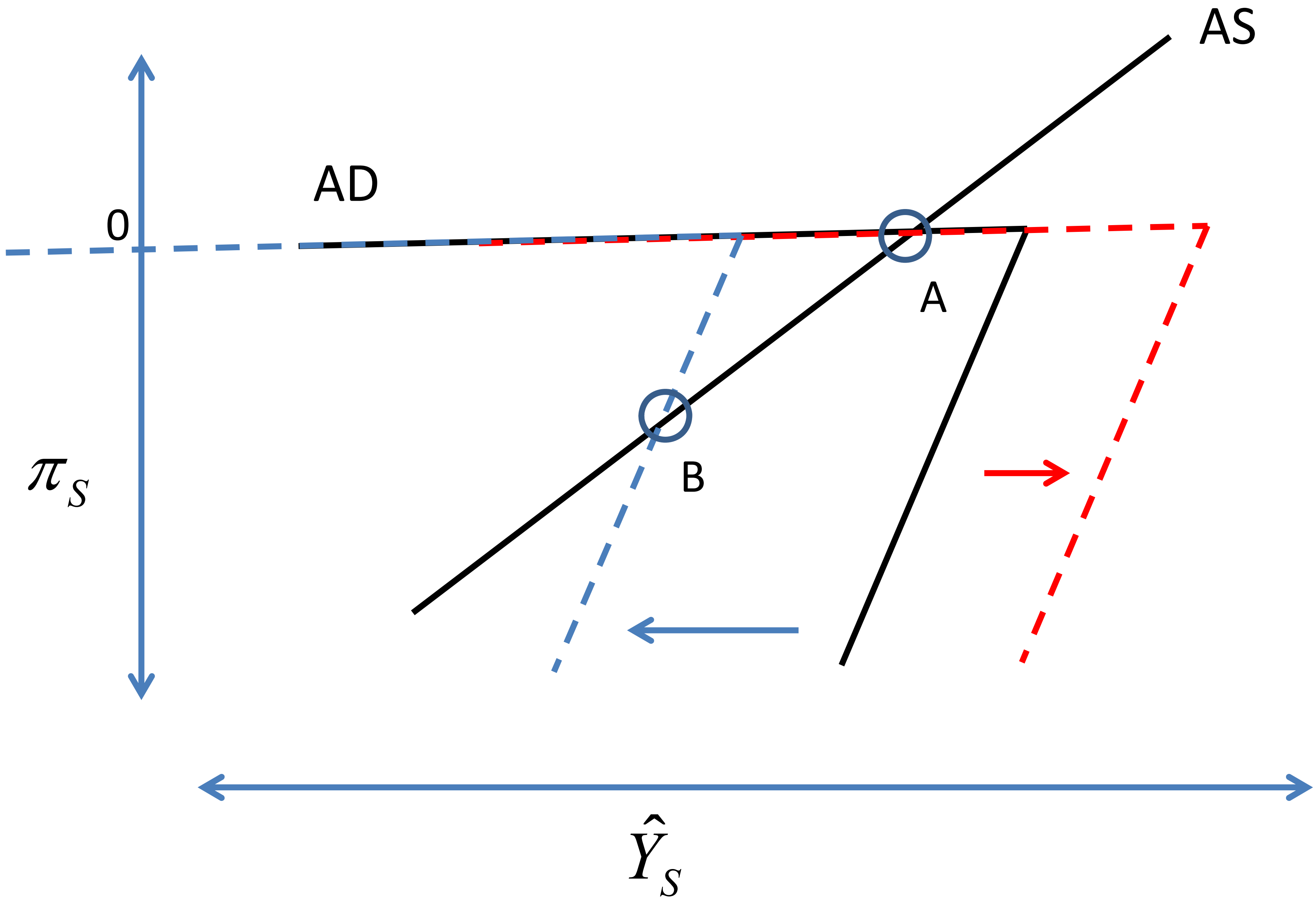
Determines inflation

$$\hat{Y}_S = \hat{Y}_L + \frac{\sigma\mu}{1-\mu}\pi_S + \sigma\pi_L + \frac{\sigma}{1-\mu} r_S^e + \hat{G}_S - \hat{G}_L - \sigma\chi^s\mu\hat{\tau}_S^s + \sigma\chi^s\hat{\tau}_L^s$$

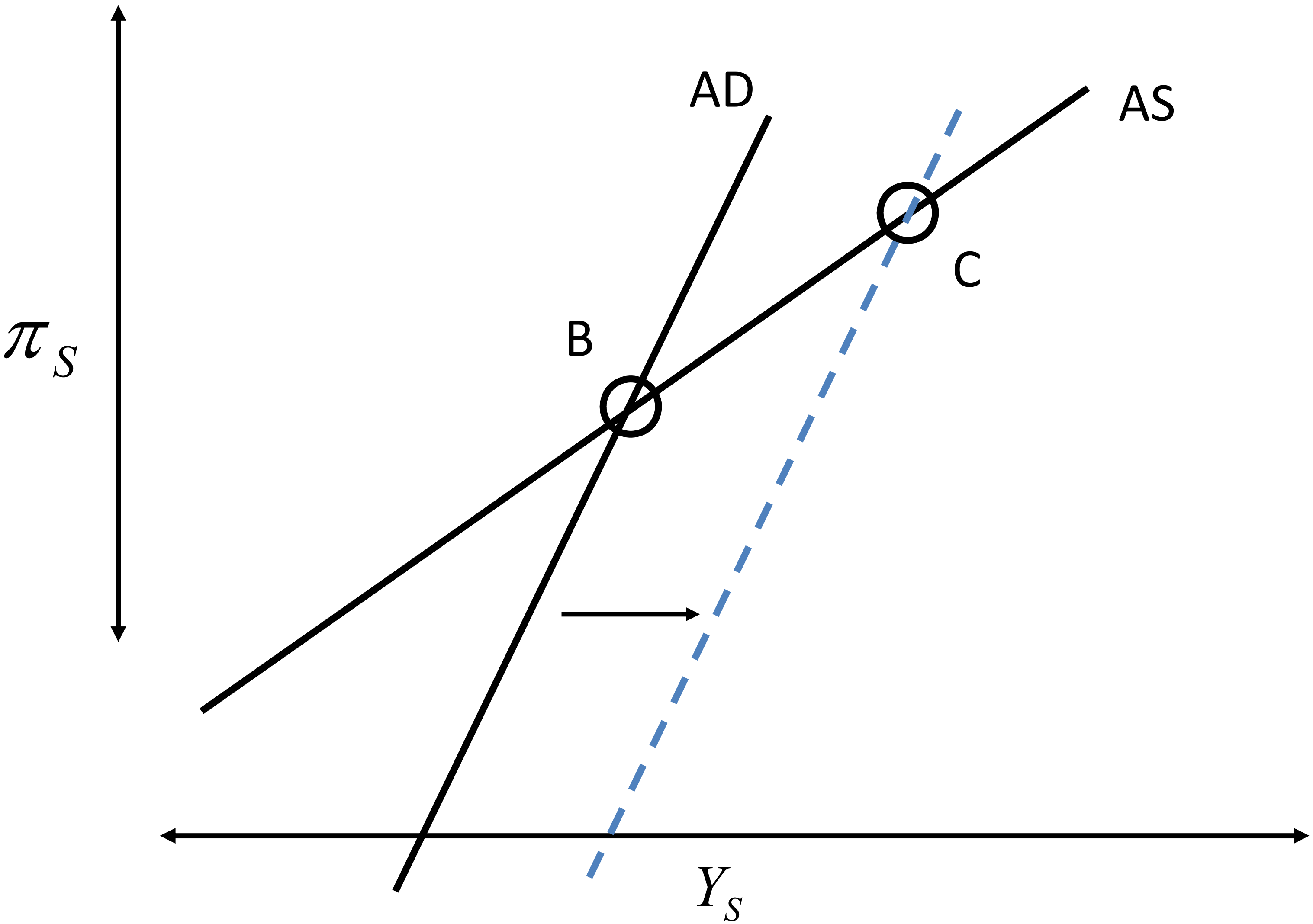
Long run output
→function of future taxes,
→government size, productivity etc.

Long run inflation
→function of debt, taxes?

Long term size of government
and long term sales tax cut
→ Reduce demand



AS
AD
0
A
B
π_S
$\hat{Y}_S$



AD
AS
C
B
π_S
Y_S

Key points

- Expectations of future fiscal policy play a big role at the ZB.
- Usually these policies simply offset by monetary policy.
- ZB is the Pandora box because AD comes into full force.
- “Confidence” matters

	$i > 0$		$i = 0$	
	GD	GR	GD	GR
$\frac{\Delta \hat{Y}_S}{\Delta \hat{G}_L}$	0	0	-1.8	-0.8
$\frac{\Delta \hat{Y}_S}{\Delta \hat{\tau}_L^s}$	0	0	1.4	0.6
$\frac{\Delta \hat{Y}_S}{\Delta \hat{\tau}_L^I}$	0	0	-1.7	-0.7

Key points

- Expectations of future fiscal policy play a big role at the ZB.
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	$i > 0$		$i = 0$	
	GD	GR	GD	GR
$\frac{\Delta \hat{Y}_S}{\Delta \hat{G}_L}$	0	0	-1.8	-0.8
$\frac{\Delta \hat{Y}_S}{\Delta \hat{\tau}_L^s}$	0	0	1.4	0.6
$\frac{\Delta \hat{Y}_S}{\Delta \hat{\tau}_L^I}$	0	0	-1.7	-0.7

What do SR deficit do?

- Can consider this question independently of how deficit created.
- Depends upon how it is financed in the future

$$i)\quad \hat{b}_t = \hat{b}_{t-1} + \epsilon_t \text{ for } t < \tau$$

$$ii)\quad \hat{\tau}_t^s = \hat{\tau}_t^w = \hat{G}_t = 0 \text{ for } t < \tau.$$

$$iii)\quad \hat{b}_t = \delta \hat{b}_{t-1}\, for\; t \geq \tau \text{ where } 0 < \delta < 1$$

Assumption on deficits

- Financed in proportion to taxes on…

.. future consumption γ_s

.. future labor taxes γ_w

.. smaller future government γ_G

(come back to ... nuclear option .. Inflation)

	$i > 0$		$i = 0$	
	GD	GR	GD	GR
$\dfrac{\Delta Y_s}{\Delta b_s / G_L > 0}$	0	0	0.2	0.1
$\dfrac{\Delta Y_s}{\Delta b_s / \tau_L^S > 0}$	0	0	0.2	0.1
$\dfrac{\Delta Y_s}{\Delta b_s / \tau_L^I > 0}$	0	0	-0.2	-0.1

Effect of deficits policy regime dependent

Experiments: Regime matters

- Now we can ask well defined questions such as:
  - Suppose current deficits are paid off by future labor taxes.
  - How big is the multiplier? (much smaller)
  - What if by reduction in future government (much higher)
  - What if by future sale tax increases (much higher)
  - We can (and will) put numbers on this

The effect of increasing government spending netting out effect on budget

$$\underbrace{\frac{\Delta\hat{Y}_s}{\Delta\hat{G}_s}\ (from\ Table\ 4)}+\underbrace{\frac{\triangle\hat{D}_S}{\triangle\hat{G}_S}\ (from\ Table\ 5)}*\underbrace{\frac{\Delta\hat{Y}_{S,t}}{\Delta\hat{D}_S/\hat{G}_{L,t}>0}\ (from\ Table\ 9)}$$

GR (mode)	**1.2**	**0.5**	**0.3**	=	**1.35**
GD (mode)	**2.2**	**-0.3**	**1.8**	=	**1.66**.

The effect of increasing government spending netting out effect on budget

$$\underbrace{\frac{\Delta\hat{Y}_s}{\Delta\hat{G}_s}\ (from\ Table\ 4)}+\underbrace{\frac{\triangle\hat{D}_S}{\triangle\hat{G}_S}\ (from\ Table\ 5)}*\underbrace{\frac{\Delta\hat{Y}_{S,t}}{\Delta\hat{D}_S/\hat{\tau}^I_{L,t}>0}\ (from\ Table\ 9)}$$

GR (mode)	**1.2**	**0.5**	**-0.3**	=	**1.05**
GD (mode)	**2.2**	**-0.3**	**-1.9**	=	**2.77**

Introducing default risk

- Basically introduces a new pricing equation
- Only has an effect via the government budget constraint.
- Can use the analysis we have already seen.

Independent currency vs. common

- Having an independent currency transform "default" risk showing up in the nominal interest rate into ……

- Future inflation risk

$$\pi_L > 0$$

…………Stabilizing

Conclusion

- Austerity can increase deficits rather than reducing them
- “Confidence” matters
- Net effect of future budget adjustment can either increase multipliers or reduce them.
- Policy regimes matter.

Matching scenarios

	distribution	mean	standard deviation	mode (GR)	mode (GD)
α	beta	0.66	0.05	0.784	0.77
β	beta	0.99669	0.001	0.997	0.997
$1-\mu$	beta	1/12	0.05	0.143	0.099
σ^{-1}	gamma	2	0.5	1.22	1.153
ω	gamma	1	0.75	1.69	1.53
θ	gamma	8	3	13.22	12.70
r_L	gamma	-0.010247	0.005	-0.0128	-0.0107