When is the Government Spending Multiplier Large?

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What is the size of the government-spending multiplier?

- Empirical estimates:
  - Barro and Redlick (2009): 0.7-1.0.
  - Ramey (2008): 1.2.
  - Obama et al (2009): 1.5.
- Model-based multipliers
  - New-Keynesian models: multipliers can be slightly above or below one.
  - RBC models: multipliers are generally below one.
- Viewed overall hard it's to argue that government-spending multiplier is substantially larger than one.

The government-spending multiplier in the zero bound

- Multiplier can be much larger than one when R doesn't respond to increases in G.
- Multiplier is modest when R follows Taylor rule.
  - R rises in response to an expansionary fiscal policy shock that puts upward pressure on Y and π.

The government-spending multiplier in the zero bound

- Natural scenario where R doesn't respond to increase in G: the zero lower bound on R binds.
- Multiplier is very large when output cost of being in the zero bound state is large.
- It can be socially optimal to substantially raise G in response to shocks that make the zero lower bound on the nominal interest rate binding.
- But timing issues are critical.
- The size of the multiplier depends very much on the fraction of government spending that comes on line when the zero bound is binding.

- Calvo-style price frictions, no capital, zero state inflation.
- Ricardian equivalence holds
- Monetary policy:

$$R_{t+1} = \max(R^T_{t+1}, 0),$$

- R^T_{t+1} is nominal interest rate implied by Taylor rule:

$$R^T_{t+1} = (1/\beta)(1+\pi_t)^{\phi_1}(Y_t/Y)^{\phi_2} - 1.$$

Eggertsson - Woodford Saving Shock

- Preferences

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

- Cumulative discount factor, d_t,

$$d_t = \begin{cases} \frac{1}{1+r_1} \frac{1}{1+r_2} \cdots \frac{1}{1+r_t}, & t \geq 1 \\ 1 & t = 0 \end{cases}.$$

- Value of r_{t+1} is realized at time t.
- Define $\beta = 1/(1+r)$, where r is steady state value of r_{t+1}.
- Before $t < 0$, system is in non-stochastic, zero inflation steady state

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

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

Saving Shock...

- At time $t = 0$, agents find out that

$$r_1 = r^l < 0$$

$$\begin{aligned} \Pr\left[r_{t+1} = r^l | r_t = r^l\right] &= p \\ \Pr\left[r_{t+1} = r | r_t = r^l\right] &= 1 - p \\ \Pr\left[r_{t+1} = r^l | r_t = r\right] &= 0 \end{aligned}$$

- Discount rate drops at $t = 0$ and is expected to return to its normal level with constant probability, $1 - p$.

Fiscal Policy

- Set G to a constant deviation from steady state, as long as zero bound binds.

$$\hat{G}_t \text{ may be non-zero while } r_{t+1} = r^l.$$
$$\hat{G}_t = 0 \text{ when } r_{t+1} = r.$$

- Equilibrium has simple characterization (Eggerston - Woodford)

$$\pi^l, \hat{Y}^l, R = 0, Z^l \leq 0 \text{ while discount rate is low.}$$
$$\pi_t = \hat{Y}_t = 0, R = r \text{ as soon as discount rate snaps back up.}$$

When does the zero bound bind?

- Rise in discount rate (d_t) increases desired savings.
- There is no capital so saving must be zero in equilibrium.
- With completely flexible prices the real interest rate would simply fall to discourage agents from saving.

When does the zero bound bind?...

- Suppose prices are sticky and the discount factor shock is small.

- Y falls.
- There is a fall in marginal cost, π and expected π.
- Taylor rule implies that R falls by more than π, so the real interest rate falls.
- Because the shock is small, we don't need a large drop in the real interest rate to get desired savings equal to zero.
- Since R does not have to fall by a lot, the zero bound does not bind.

When does the zero bound bind?

- Suppose the discount factor shock is large.
- R can't fall by enough to lower the real interest rate so that desired savings are zero. In this case the zero bound binds.
- Only one force remaining to generate zero saving in equilibrium.
  - A transitory fall in Y which induces agents to lower savings so that they can smooth consumption over time.
- As Y falls inflation and expected inflation also fall.
  - With $R = 0$ the real interest rate is rising, which implies an increase in desired saving.
  - This perverse rise in the real interest rate leads to an increase in desired saving which partially undoes the effect of a given fall in Y.
  - So, the total fall in Y required to reduce desired saving to zero is very large.

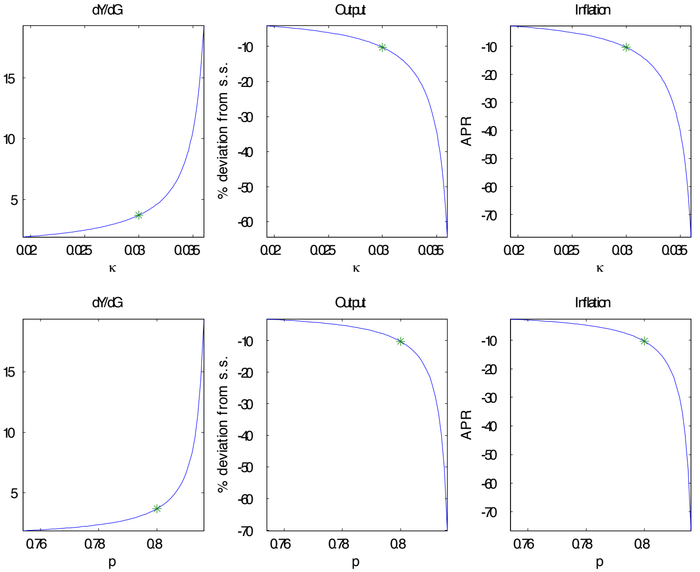
The government-spending multiplier in the zero bound

- Other things equal, a rise in G leads to a rise in $C + G$ even though Ricardian equivalence holds as long as U_c is decreasing in C.
- A rise in aggregate demand leads to a rise in Y, marginal cost and expected π.
- With the zero bound binding $(R = 0)$, the rise in expected π drives down the real interest rate which drives up private spending.
- This rise in spending leads to a further rise in Y, marginal cost, and expected π and a further decline in the real interest rate.
- Net result: large rise in π and Y.

The size of the multiplier in the zero bound

- Exact value of multiplier can depend on a variety of factors.
- But multiplier is large when output cost associated with zero bound problem is large.
    - Multiplier is large for parameter values that imply output loss in zero-bound is large.
    - Multiplier is positively related to how long zero bound is expected to bind.

Output loss in the ZLB and the multiplier



Optimal G in the lower bound

- Superscript L: value of variables in states of the world where discount rate is r^l.

- ZLB may or may not be binding depending on level of G.

- Choose G^L to maximize expected utility of consumer in states of world in which discount factor is high and zero bound is binding.

- In other states of the world $\hat{G}$ is zero.

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

$$V(G) = \frac{\psi_g G^{1-\sigma}}{1-\sigma}$$

Constraints

- Equations defining a private sector equilibrium
- Monetary policy rule

$$R^L = \max\left(Z^L, 0\right),$$

$$Z^L = \frac{1}{\beta} - 1 + \frac{1}{\beta}\left(\phi_1 \pi^L + \phi_2 \hat{Y}^L\right).$$

- Choose ψ_g so that $g = G/Y$ is equal to 0.2.
- It's optimal to raise G to 30 percent of Y in the zero bound.
- In simple example Nakata (2009) shows that it is optimal to raise G when both monetary and fiscal policy are chosen optimally.

Timing is Everything

- Usual objection to G as a tool for fighting recessions: delays in actual spending.
- How does model economy respond at t to knowledge that G will increase in future?
- Experiment
  - At time t, ZLB is binding.
  - G doesn't change at time t.
  - $G^l > G$ for all future periods as long as economy is in zero bound.

$$\frac{dY_{t,1}}{dG^l} = \frac{1-g}{g}\frac{1}{1-p}\frac{d\pi^l}{d\hat{G}^l}$$

  - Subscript 1 denotes presence of a one period delay.

Timing...

- Multiplier is positive and increasing in probability p that economy remains in ZLB.
- Multiplier operates through effect of future increase in G on expected inflation.
  - If economy is in ZLB in future, increase in G increases future output, future inflation.
  - From perspective of time t, this leads to higher expected inflation and a lower real interest rate.
  - Lower real interest rate reduces desired savings and increases consumption and output at time t.
- At benchmark values, multiplier is 1.5 versus no-delay multiplier of 3.7.

Timing...

- Suppose it takes two periods for G to increase in event that ZLB is binding.

$$\frac{dY_{t,2}}{dG^l} = p\frac{1-g}{g}\left[\frac{d\pi_{t,1}}{d\hat{G}^l} + \frac{1}{1-p}\frac{d\pi^l}{d\hat{G}^l}\right].$$

- Evaluating this multiplier at benchmark parameter values we obtain 1.44.

- Rate at which multiplier becomes smaller as we increase the delay in G is relatively low.

The importance of implementation lags

- Key question: in which state of the world does additional G comes on line?
  - If G comes on line when ZLB is binding, there's a large effect on current output.
  - If G comes on line when ZLB isn't binding, there's a small effect on current output.
- Suppose there's a persistent increase in G at $t+1$ if economy emerges from zero bound at time $t+1$.
- Increase in G is governed by: $\hat{G}_{t+j} = 0.8^{j-1}\hat{G}_{t+1}$, for $j \geq 2$.
- Multiplier for this experiment falls to 0.46.

Allowing for investment

- Preferences same as before.
- Household budget constraint

$$P_t\left(C_t + I_t e^{-\psi_t}\right) + B_{t+1} = B_t\left(1 + R_t\right) + W_t N_t + P_t r_t^k K_t + T_t$$

  - ψ_t : capital-embodied technology shock.
  - Price of investment goods in units of consumption is $\exp(-\psi_t)$.
  - Positive shock to ψ_t is associated with a decline in the price of investment goods.

Allowing for investment...

- Capital accumulation equation is given by:

$$K_{t+1} = I_t + (1-\delta)\,K_t - \frac{\sigma_I}{2}\left(\frac{I_t}{K_t} - \delta\right)^2 K_t.$$

- σ_I governs magnitude of adjustment costs.

- As $\sigma_I \rightarrow \infty$, investment and the stock of capital become constant

The effect of investment?

- For a given size shock allowing for I reduces likelihood that zero bound binds.

- When zero bound binds, the presence of I increases the multiplier.
  - In the zero bound the real interest rate rises.
  - I is a decreasing function of the real interest rate.
  - S is an increasing function of the real interest rate.
  - So, S and I diverge.
  - Fall in Y needed to bring S and I into alignment is larger than in model without investment.

What about investment?

- Three kinds of shocks
  - Shock to discount rate
  - Neutral technology shock
  - Capital embodied technology shock.
- For each shock we reach same conclusion
  - Multiplier is large when output cost of being in the zero bound state is large.

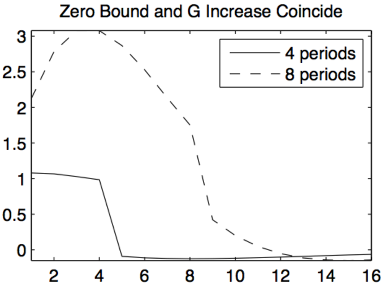
Estimating the zero-bound multiplier

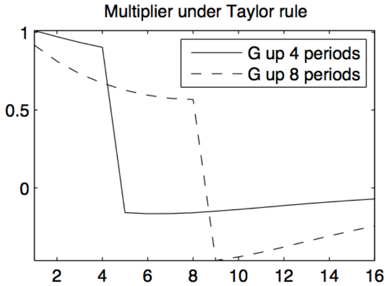
- Obvious approach: use reduced-form methods, such as identified VARs.
- Two difficulties:
  - Can't mix evidence from states where zero bound binds with other states because multipliers are very different.
  - Need to identify exogenous movements in G when zero bound binds.
    - This is hard because G is likely to rise in response to fall in Y associated with zero bound.

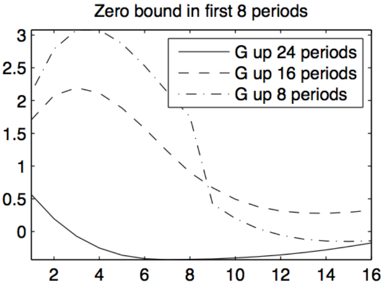
Estimating the zero-bound multiplier

- Calculate size of the multiplier using ACEL (2004).
- Key model features:
  - Price and wage setting frictions;
  - Habit formation in consumption;
  - Variable capital utilization and investment adjustment costs of the sort proposed by CEE.
- ACEL estimate the parameters of their model to match the impulse response function of ten macro variables to a monetary shock, a neutral technology shock, and a capital-embodied technology shock.

Multiplier in ACEL



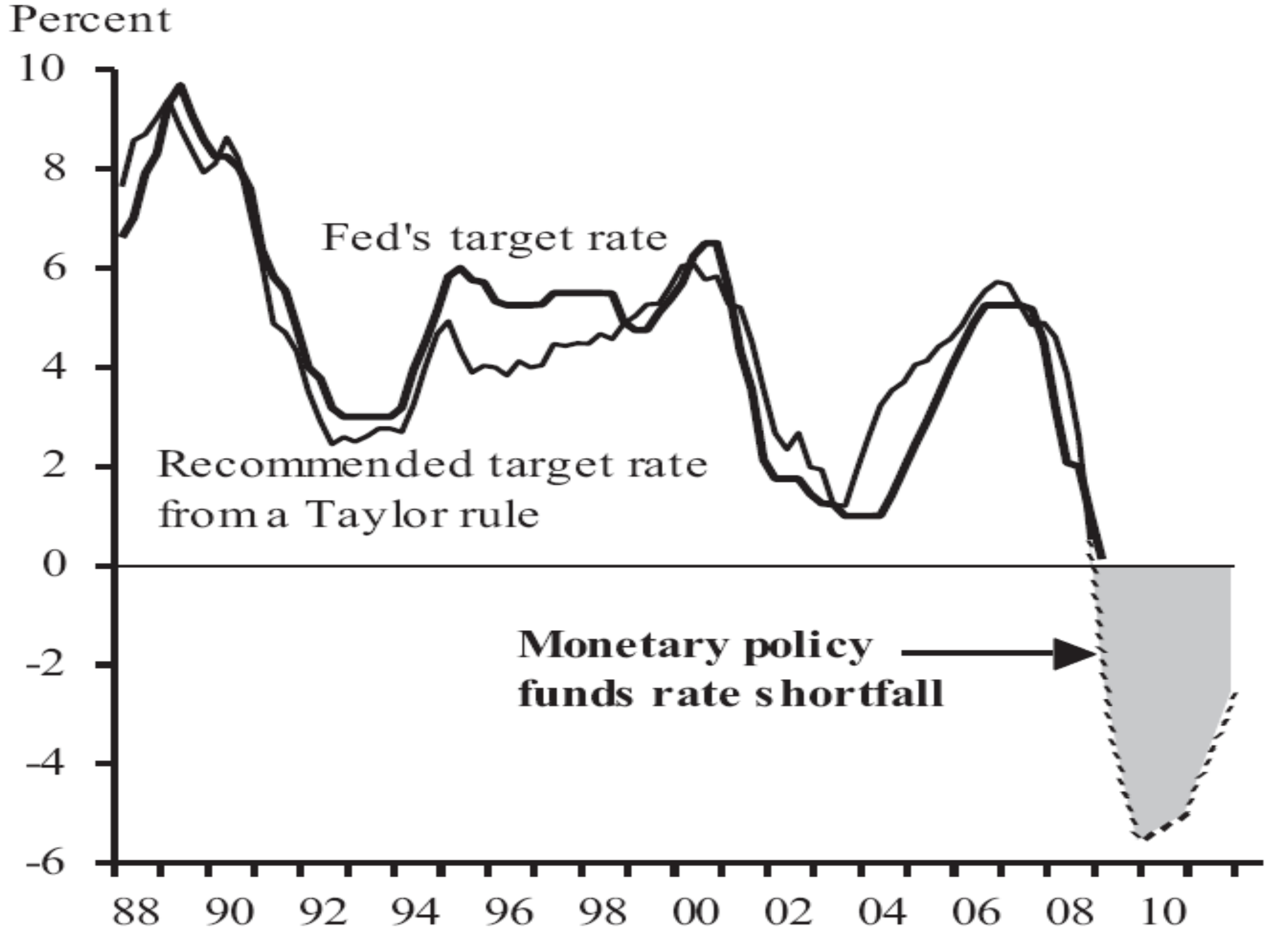




Conclusion

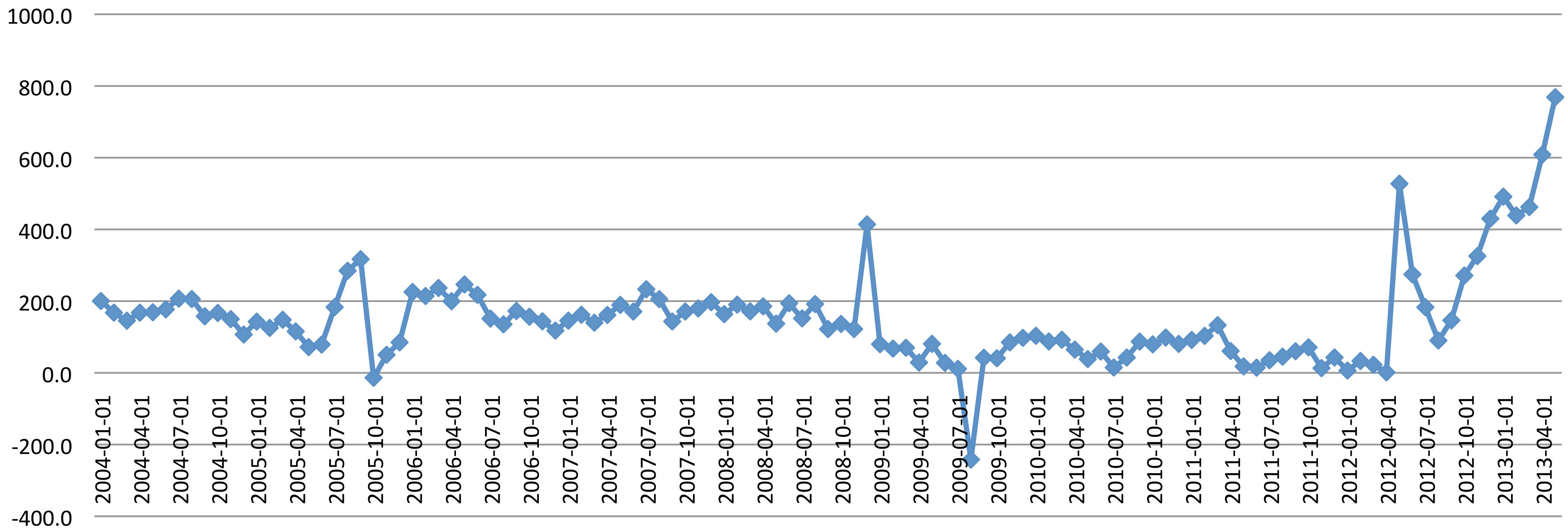
- Increases in G can have large effects when zero bound binds.
- Timing is crucial
  - If most of the spending comes on line when zero bound does not bind multiplier is small.
- To date less than half of the U.S. fiscal stimulus has come on line.

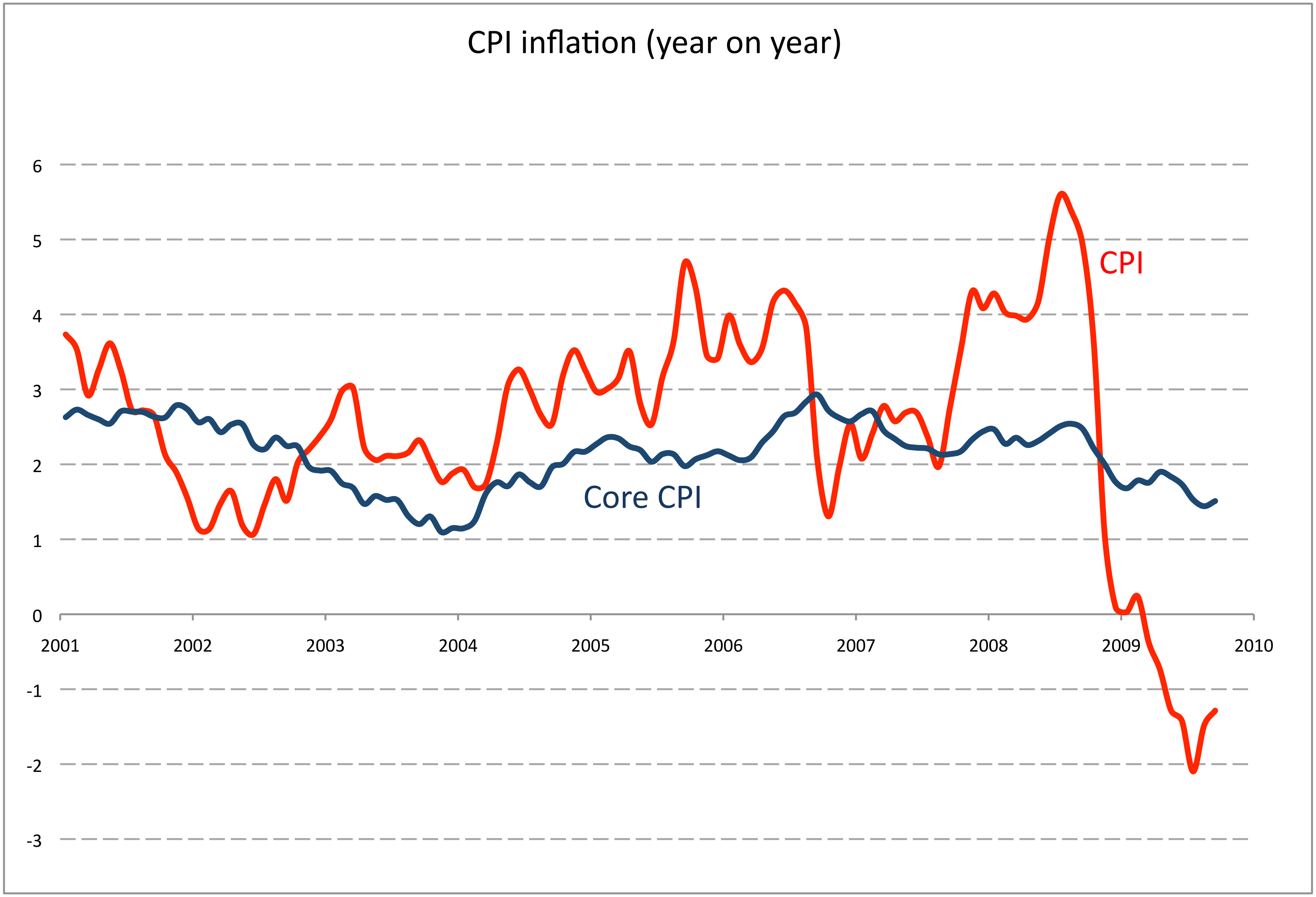
Figure 2
Federal funds rate



Source: Rudebusch

Personal Saving, Billions of $ (SA)





CPI inflation (year on year)
6
5
4
3
2
1
0
-1
-2
-3
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
CPI
Core CPI

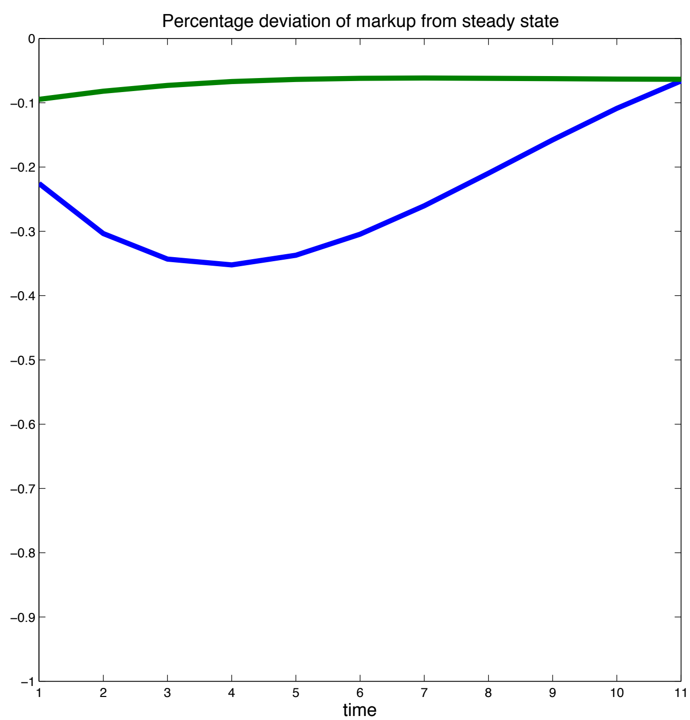
ACEL Benchmark Parameter Values		
Effect of Discount Rate Shock	Zero Bound Doesn’t Bind	Zero Bound Binds
C	-	-
I	+	-
Y	-	-

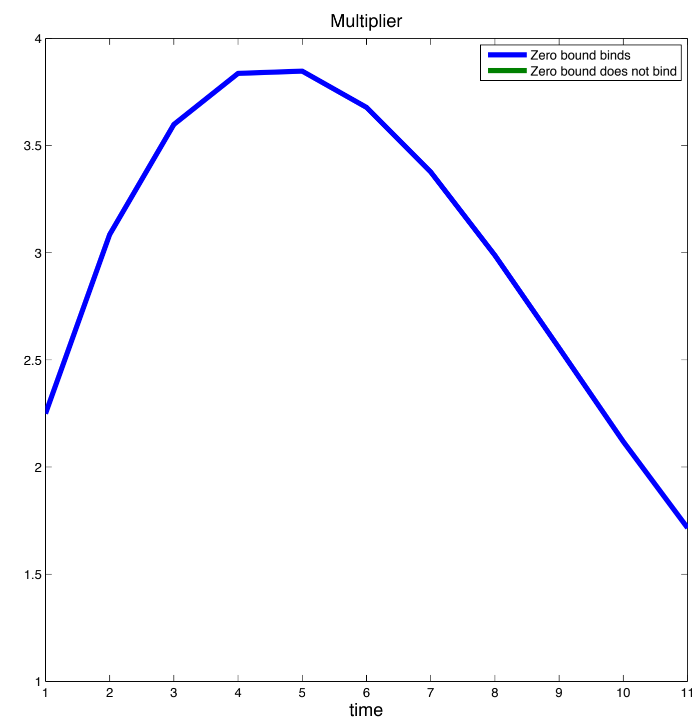
- Why does I go from + to – when the zero bound binds?
- Zero bound is associated with a large fall in inflation and a rise in the real interest rate.
- This rise in r overcomes direct effect on I of shock to discount rate.

ACEL	Benchmark Parameter Values	Flexible Wages
Effect of Discount Rate Shock	Zero Bound Doesn't Bind	Zero Bound Doesn't Bind
C	-	-
I	+	+
Y	-	+

- Why does Y go from – to + when with flexible wages?
- RBC model: discount rate shock implies agents want to save / I more, consume less.
- Drop in consumption leads to an outwards shift in the labor supply.
- This force is a factor which, in and of itself, is expansionary.
- Permits rise in both C and I and therefore in Y.
- Similar reasoning in ACEL – with flexible wages, fall in C leads to outwards shift in labor supply which is expansionary.
- This force can't come into play with sticky wages because labor supply curve is irrelevant.

Markups and multipliers





Rationed Items	Rationing Duration
Tires	January 1942 to December 1945
Cars	February 1942 to October 1945
Bicycles	July 1942 to September 1945
Gasoline	May 1942 to August 1945
Fuel Oil & Kerosene	October 1942 to August 1945
Solid Fuels	September 1943 to August 1945
Stoves	December 1942 to August 1945
Rubber footwear	October 1942 to September 1945
Shoes	February 1943 to October 1945
Sugar	May 1942 to 1947
Coffee	November 1942 to July 1943
Processed foods	March 1943 to August 1945
Meats, canned fish	March 1943 to November 1945
Cheese, canned milk, fats	March 1943 to November 1945
Typewriters	March 1942 to April 1944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TOKEN
OLIVE C
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"Dear Mom: We're __all__ in this one . . ."

Last night the Zeros came again . . . in a nightmare of bombs and shells that shook the earth and crashed and whined above us. All at once I had the strangest feeling. I wasn't a soldier . . . lying in the mud of a slit trench off somewhere . . . half way round the world. I was a little shaver at your knee again . . . repeating *Thy kingdom come* . . . For a blessed instant I felt the peace I used to know—back home with you and Dad and Sis. I wasn't alone anymore . . . or scared of the dark. I knew you were with me—pinching and sacrificing and doing without to send us guns and tanks and planes. So someday soon we'll get an even break—and just not lie here looking up.

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