Michelson-Morley, Occam, and the Zero Lower Bound

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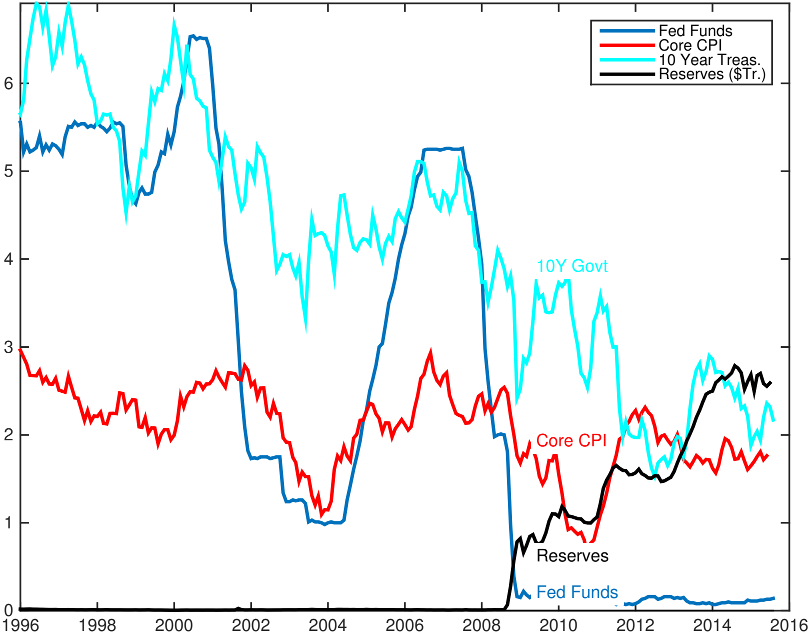
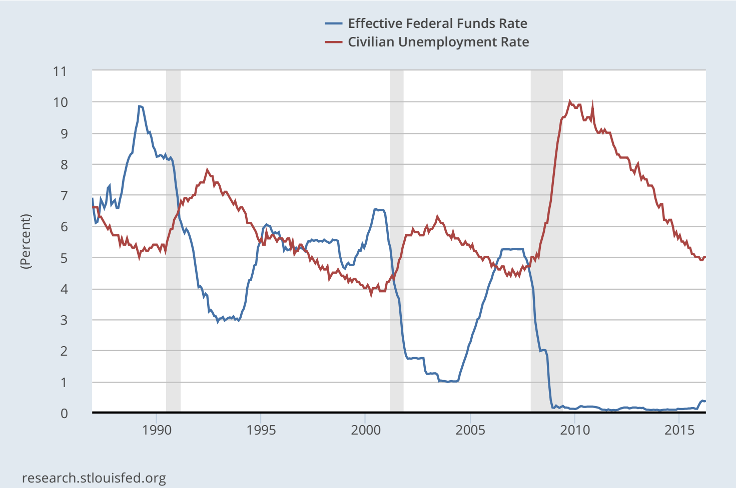
Michelson-Morley

- Hit ZLB, nothing happened.
- Dynamics in and out of the ZLB are identical (or less σ at ZLB!)
- Huge increase in M, nothing happened.
- Lower interest rates are not raising inflation. (Europe/Japan vs. US)

Recent Experience–US

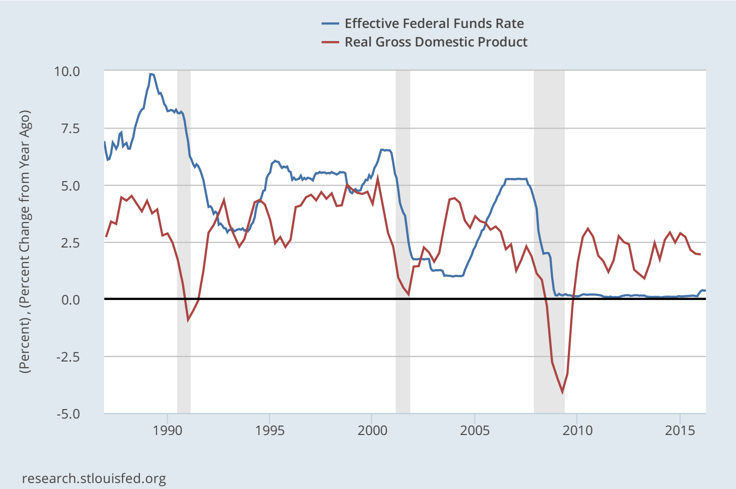


Recent Experience–US unemployment



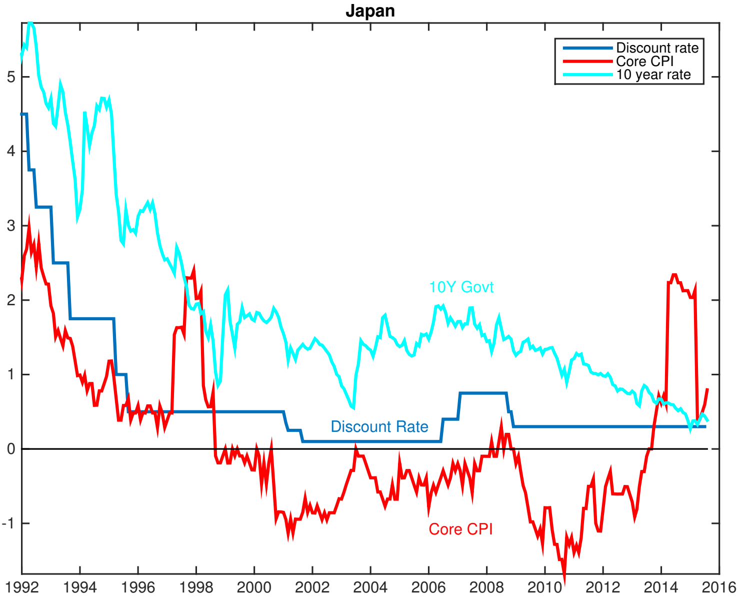
- Occam: Same dynamics. Larger shock.

Recent Experience–US

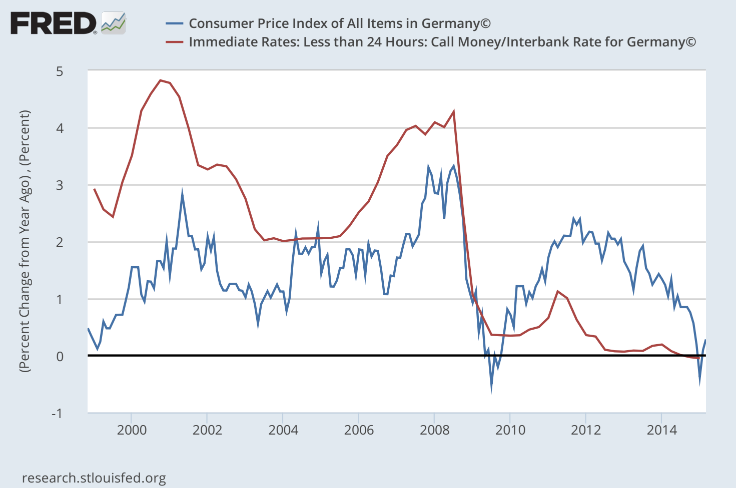


- Growth is “too low” but low σ at ZLB

Recent Experience – Japan



Recent Experience – Europe



Theories

- Classic Monetarist/Keynesian; current policy world. (Adaptive E)
  - i peg is *unstable, determinate*

$$\pi_{t+1} = ... + (\lambda > 1)\pi_t + \text{struct. shocks.}$$

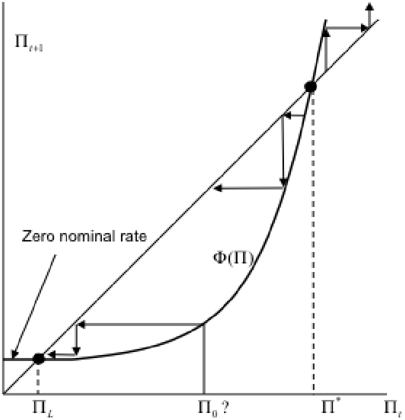
  - Taylor rule $i = r + \phi\pi$; $\phi > 1$ brings *stability* $\lambda < 1$.
  - $\phi = 0$ at ZLB. Predicts deflation spiral. Didn't happen.
- Classic Monetarism; MV=PY, V "stable."
  - Predicts huge inflation. Didn't happen.
- Occam: Knife edge, adverse shocks, headwinds, epicycles, ether drag, or...
  - *An interest rate peg is stable.*
  - *Arbitrary reserves paying market i are not inflationary. We can live the optimal quantity of money.* (&Narrow banking).
- Sargent/Wallace; Woodford; New-Keynesian. (Rational E)
  - i peg, $\phi < 1$ is *stable* (!)
  - But *indeterminate,* multiple equilibria δ_{t+1}.

$$E_t\pi_{t+1} = ... + (\lambda \leq 1)\pi_t;\ \pi_{t+1} = E_t\pi_{t+1} + \delta_{t+1}$$

  - Predicts more σ at ZLB, we see less.

NK ZLB (BSGU)

$$\Pi_{t+1} = \Phi(\Pi_t)$$

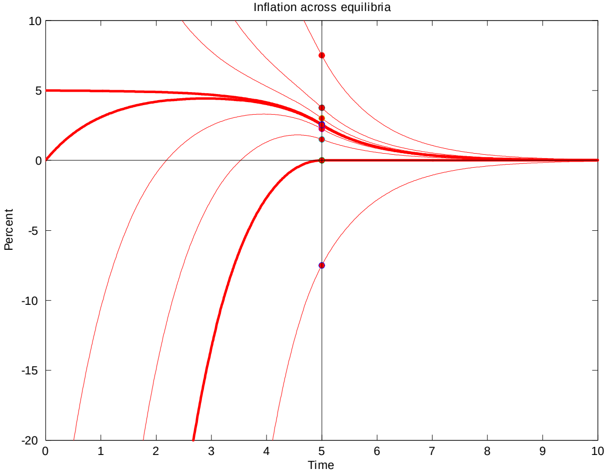


- Multiple stable equilibria at zero bound! Taylor principle can't help.

NK models with exit-based determinacy

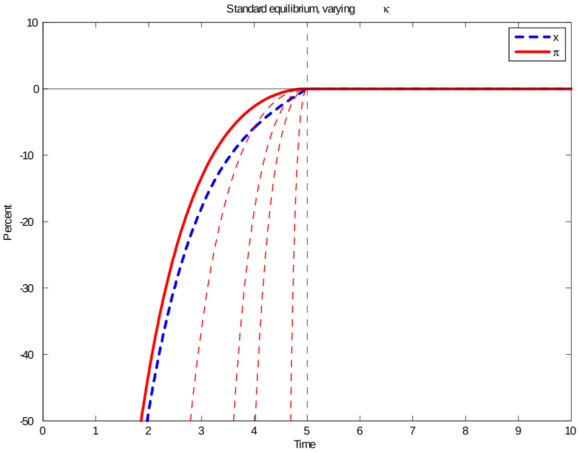
- Add to NK: peg doesn't last forever. Eventually back to $\phi > 1$ range. Work backwards from unique post ZLB equilibrium to unique ZLB equilibrium.
- Many puzzling / amazing / counterfactual predictions
- Example: Werning (2012)

All Solutions of NK model



- Solutions π_t of 3 eq. model. $i = 0, r^* < 0$ to $T = 5$ then exit.
- NK/ZLB lit. picks equilibria by expectations at exit.
- Stable forward = unstable backward. Sensitive to small $\Delta E_t \pi_T$.
- Is ZLB bad? In some equilibria, yes...

NK / ZLB example: Werning 2012



- Big jump deflation / depression, but E growth, deflation decline.
- Limit $\neq$ limit point. Gets *worse* as stickiness better.
- Small changes in far-away E have huge effects today. Talk policy.
- Broken windows are good. Wasted G is good. $F = -GMM/R^2$.

Aganda: Merge FTPL with NK models

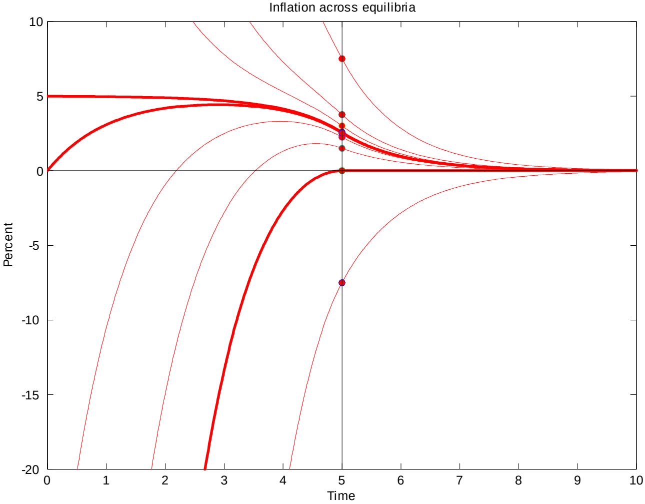
$$\frac{B_{t-1}}{P_t} = E_t \sum_{j=0}^{\infty} \frac{1}{R_{t,t+j}} s_{t+j} = E_t \sum_{j=0}^{\infty} \beta^j s_{t+j}.$$

$$\frac{B_{t-1}}{P_{t-1}} (E_t - E_{t-1}) \left(\frac{P_{t-1}}{P_t} \right) = (E_t - E_{t-1}) \sum_{j=0}^{\infty} \beta^j s_{t+j}. \tag{1}$$

$$\frac{B_{t-1}}{P_{t-1}} E_{t-1} \left(\beta \frac{P_{t-1}}{P_t} \right) = \frac{B_{t-1}}{P_{t-1}} \frac{1}{1+i_{t-1}} = E_{t-1} \sum_{j=0}^{\infty} \beta^{j+1} s_{t+j}. \tag{2}$$

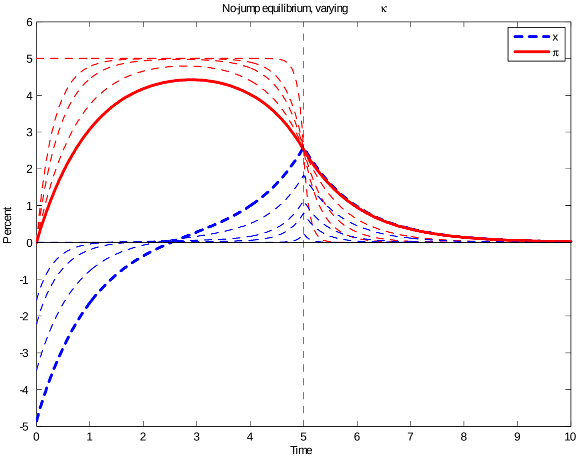
- Solves determinacy. Each equilibrium is indexed by fiscal policy.
- *Monetary policy by IOR (no fiscal policy) can set a nominal interest rate peg* and then expected infation
- Werning deflation jump needs taxes to pay a windfall to bondholders.
- Interest rate target can be *stable* (NK) and (now) *determinate*. (As long as fiscal policy is ok! Past pegs fell apart from fiscal policy.)

Reminder: All Solutions of NK model



- Solutions π_t of 3 eq. model. $i = 0, r^* < 0$ to $T = 5$ then exit.
- If no fiscal news pick no jump $\Delta E_0 \pi_0 = 0$...

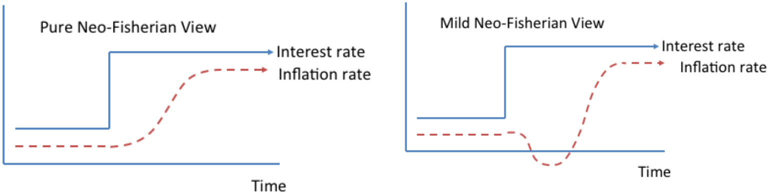
The no-inflation-jump equilibrium



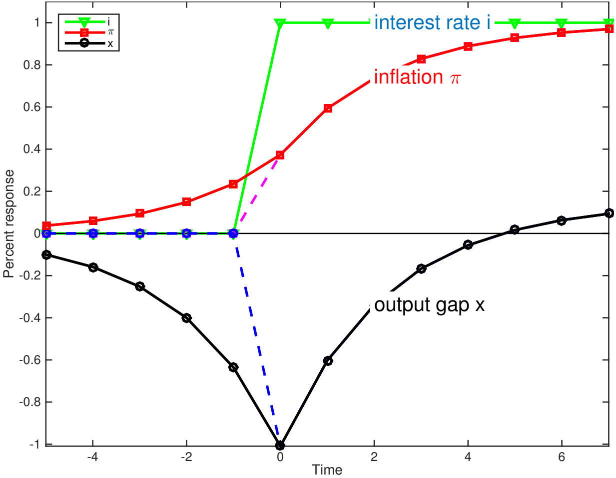
- $\Delta E_0 \pi_0 = 0 \rightarrow$ no big $\pi_t < 0$, small x_t effects.
- ZLB is not dangerous. $\pi_t > 0$ endogenously solves $r^* < 0$, ZLB. "Topsy-turvy" policies disappear. If you don't like GDP, it's not ZLB.
- Frictionless limit = frictionless limit point, "backwards stable,"

The Neo-Fisherian question

- If a peg is stable, then *raising* rates can (can!) raise inflation.
- Europe/Japan Pedal misapplication? US π picking up because i rising?
- Classic view still ok in the short run?

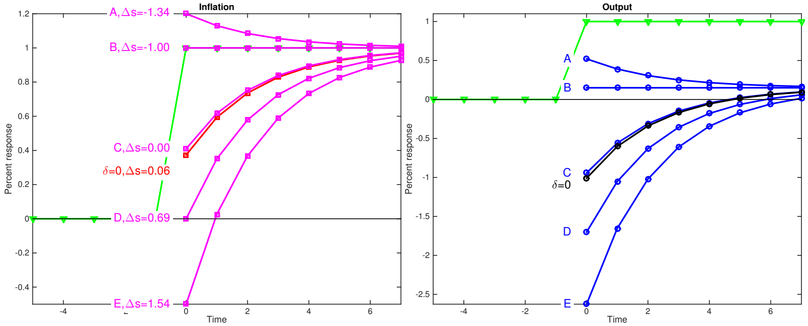


Effects of rate rise – 3 equation model



- $x_t = E_t x_{t+1} - \sigma(i_t - E_t \pi_{t+1})$; $\pi_t = \beta E_t \pi_{t+1} + \kappa x_t$.
- Interpretation 1: Raise i to higher peg, no fiscal change. (Active F)
- Interpretation 2: If $i_t = i_t^* + \phi(\pi_t - \pi_t^*) = \hat{i}_t + \phi \pi_t$ produce this equilibrium observed i_t, this is π_t, x_t that accompany it. (Active M)

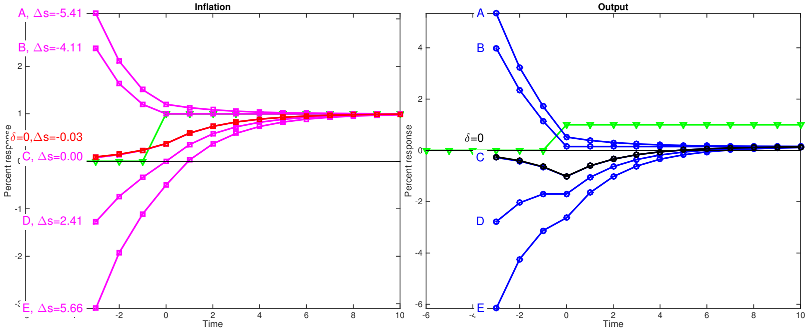
Pair monetary, fiscal shock?



Multiple equilibrium responses to an unexpected interest rate rise. $\Delta s =$ x.xx give the percent change in steady state surpluses required to achieve each equilibrium. The original case is $\delta_0 = 0$.

- Is pairing a rate rise with a negative fiscal shock the answer?

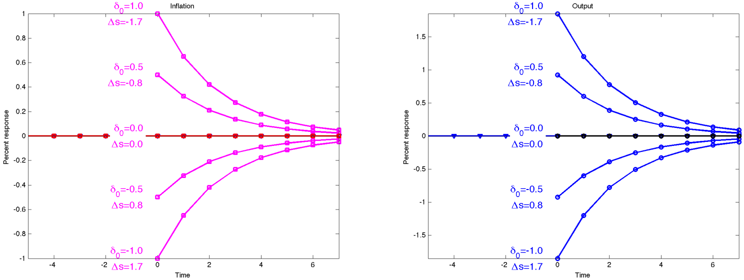
Multiple equilibria – expected rise



Multiple equilibrium responses to an anticipated interest rate change. "$\Delta s =$ x.xx" give the percent change in steady state surpluses required to achieve each equilibrium.

- The fiscal / multiple equilibrium shock must be unexepected, on announcement.

Open-mouth policy



Response of inflation and output to a shift in inflation target with no shift in interest rate target.

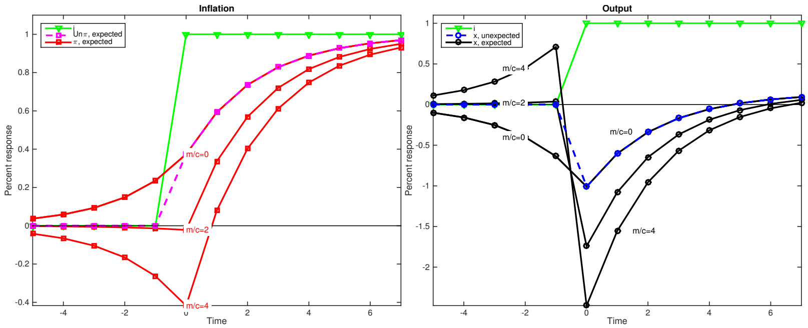
$$i_t = i_t^* + \phi_\pi(\pi_t - \pi_t^*) \; i_t^* = 0; \; \pi_t^* = \delta_0 \lambda_1^{-t}.$$

Equivalently

$$i_t = \hat{i}_t + \phi_\pi \pi_t \;\; \hat{i}_t = -\delta_0 \phi_\pi \lambda_1^{-t}.$$

- If you want lower π why raise rates at the same time?

Impulse-response functions with money



- Expected rate rise lowers inflation! But it needs *huge* m/c.
- You can get rising i lowers π with lots of frictions, DSGE soup to make NK look OK. But then necessary as well as sufficient! The *sign* of M policy depends on soup, not simple economics.
- Work in progress. A few more simple ingredients give short run decline in π?

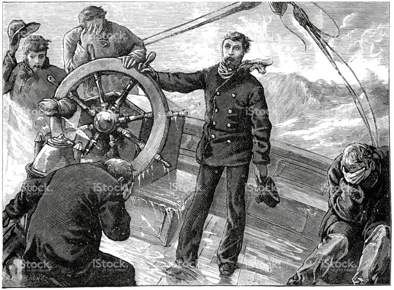
Review, Relax, then Worry.

- Michelson-Morley: ZLB, QE, nothing happened.
- Occam: i peg can be stable, determinate
- Classic adaptive E "spiral" and MV=PY wrong. Rational E NK model is right.
- FTPL (or many other ways to limit $\Delta E_0 \pi_0, \delta_0$) solve weirdness (attraction) of NK with exit-based determinacy.
- If so, r^* was only -2% $= -\pi$. The world is close to optimal NK policy already.
- Then, ZLB not a big problem, magic policy won't work. Look elsewhere for low growth, policy.
- A huge balance sheet paying market interest is great. Don't "normalize."
- The outcomes we want from *monetary* policy are basically perfect. Low i. Low π. Optimal (huge) quantity of money.
- If i peg is stable, then raising i likely to raise π.

Optimal quantity of money/Balance sheet

- Better, now it pays interest and can replace crisis-prone short debt

What should the Fed do?



CAPTAIN LYON AND HIS CREW OFFERING PRAYERS FOR THEIR PRESERVATION.

FTPL Warning

$$\frac{B_t}{P_t} = E_t \int_{j=0}^{\infty} e^{-rj} S_{t+j} dj = E_t \int_{j=0}^{\infty} e^{(g-r)j} dj S_t = \frac{S_t}{r-g}$$

$$\frac{B_t}{P_t S_t} = \frac{1}{r-g}$$

$$\text{surplus/debt} = r - g$$

- Why is π so low, with B so high and bad S? r is low!
- What if r rises? Small Δr has a big effect! (Flow: $r\times$ 100% Debt/GDP is a lot.)
- r and g rise together is not dangerous. But $r = \delta + \gamma g$ says r likely to dominate, Fiscal Phillips curve.
- r alone is dangerous. Sovereign debt/rate spiral.
- "i peg *can* be stable" because it depends on fiscal policy! Historic pegs fell apart from fiscal problems. Ours can too.

Papers

1. "Do Higher Interest Rates Raise or Lower Inflation?"
2. "Monetary Policy with Interest on Reserves"
3. "The New-Keynesian Liquidity Trap"

THE END
Extra slides follow

Backup slide 1. Interest rate peg stability.

$$
\begin{aligned}
i_t &= r_t + \pi_t^e \quad \text{Fisher} \\
y_t &= \kappa(\pi_t - \pi_t^e) \quad \text{Friedman-Phillips} \\
y_t &= -a r_t \quad \text{IS} \\
\rightarrow i_t &= -(\kappa/a)\pi_t + (1+\kappa/a)\,\pi_t^e
\end{aligned}
$$

Classic/policy. Adaptive $\pi_t^e = \pi_{t-1}$. i peg is unstable, determinate:

$$
\begin{aligned}
\rightarrow i_t &= -(\kappa/a)\pi_t + (1+\kappa/a)\,\pi_{t-1} \\
\pi_t &= -\frac{1}{\kappa/a} i_t + \frac{1+\kappa/a}{\kappa/a}\pi_{t-1}
\end{aligned}
$$

NK. $\pi_t^e = E_t\pi_{t+1}$. i peg is stable, indeterminate.

$$
\begin{aligned}
\rightarrow i_t &= -(\kappa/a)\pi_t + (1+\kappa/a)\,E_t\pi_{t+1} \\
E_t\pi_{t+1} &= \frac{1}{1+\kappa/a} i_t + \frac{\kappa/a}{1+\kappa/a}\pi_t
\end{aligned}
$$

(Same with NK IS curve too)

Backup slide 2. Taylor rule in old, new Keynesian models

Old: Taylor rule stabilizes. Add $i_t = \phi\pi_t$; $\phi > 1$,

$$\phi\pi_t = -(\kappa/a)\pi_t + (1 + \kappa/a)\,\pi_{t-1}$$
$$\pi_t = \frac{1 + \kappa/a}{\phi + \kappa/a}\pi_{t-1}$$

$\phi > 1 \leftrightarrow$ stable.
New: Taylor rule destabilizes to get local determinacy

$$\phi\pi_t = -(\kappa/a)\pi_t + (1 + \kappa/a)\,E_t\pi_{t+1}$$
$$E_t\pi_{t+1} = \frac{\phi + \kappa/a}{1 + \kappa/a}\pi_t.$$

$\phi > 1 \leftrightarrow$ inflation is unstable again... *unless* $\pi_t = 0$.

Backup slide. Effect of rate rise in the simplest model.

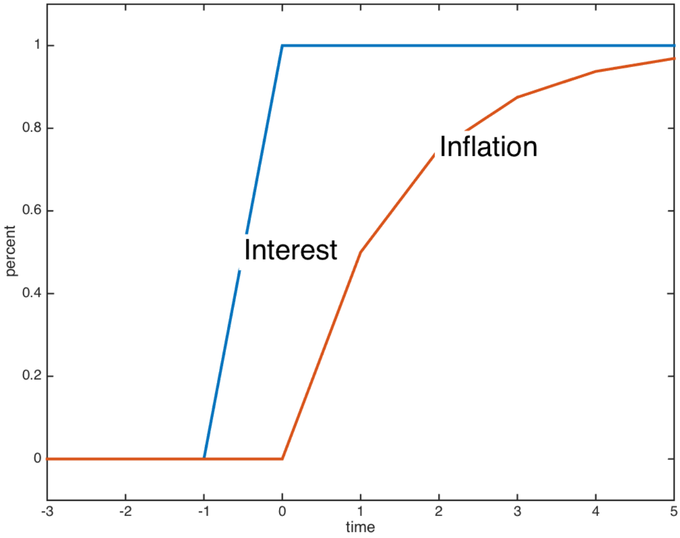
$$i_t = -(\kappa/a)\pi_t + (1+\kappa/a)\, E_t\pi_{t+1}$$

FTPL says, with no fiscal news, $\pi_{t+1} = E_t\pi_{t+1}$. So,

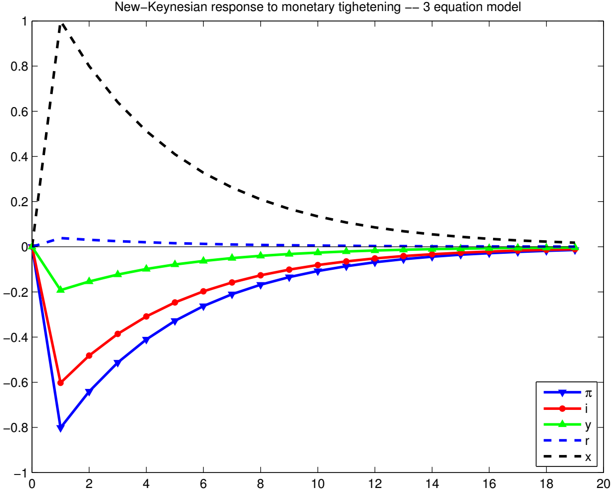
$$\begin{aligned}
(1+\kappa/a)\,\pi_{t+1} &= i_t + (\kappa/a)\pi_t \\
\pi_{t+1} &= \frac{1}{1+\kappa/a} i_t + \frac{\kappa/a}{1+\kappa/a}\pi_t \\
\pi_{t+1} &= \frac{1}{1+\kappa/a} i_t + \frac{1}{(1+\kappa/a)^2} i_{t-1} + \frac{\kappa/a}{1+\kappa/a}\pi_{t-1} \\
\pi_{t+1} &= \frac{1}{1+\kappa/a} i_t + \frac{1}{(1+\kappa/a)^2} i_{t-1} + \frac{1}{(1+\kappa/a)^3} i_{t-2} + \ldots
\end{aligned}$$

Model: raising interest rates *raises* inflation uniformly. True? (More realistic model?)

Effect of rate rise?



3 Equation model – response to m policy shock



- Standard NK model with $i_t = r + \phi\pi_t + v_t;\ \ v_t = \rho v_{t-1} + \epsilon_t^v$.
- Higher v means lower observed i; i and π move in same direction.