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 $\sigma$ 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 $\sigma$ at ZLB
Recent Experience – Japan

![Graph showing recent experience in Japan with Discount Rate, Core CPI, and 10 Year Govt Rate over the years 1992 to 2016. The graph illustrates the trends and changes in these economic indicators over time.](image-url)
Recent Experience – Europe

[Graph showing recent experience in Europe with consumer price index and immediate rates for less than 24 hours, with data from 2000 to 2014. The graph includes a line for Consumer Price Index of All Items in Germany and another for Immediate Rates: Less than 24 Hours: Call Money/Interbank Rate for Germany.]

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Theories

- Classic Monetarist/Keynesian; current policy world. (Adaptive $E$)
  - $i$ peg is unstable, determinate
    \[ \pi_{t+1} = \ldots + (\lambda > 1)\pi_t + \text{struct. shocks.} \]
  - 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 $\delta_{t+1}$.
    \[ E_t\pi_{t+1} = \ldots + (\lambda \leq 1)\pi_t; \quad \pi_{t+1} = E_t\pi_{t+1} + \delta_{t+1} \]
  - Predicts more $\sigma$ at ZLB, we see less.
\[ \Pi_{t+1} = \Phi(\Pi_t) \]

- 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)
▶ Solutions $\pi_t$ 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...
- 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. $F = -GMM/R^2$. 
Agenda: Merge FTPL with NK models

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

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

\[ \frac{B_{t-1}}{P_{t-1}} E_{t-1} \left( \beta \frac{P_{t-1}}{P_t} \right) = \frac{B_{t-1}}{P_{t-1}} \frac{1}{1 + i_{t-1}} = E_{t-1} \sum_{j=0}^{\infty} \beta^{j+1} s_{t+j}. \] \quad (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 inflation.
- 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 $\pi_t$ 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

\[ \Delta E_0 \pi_0 = 0 \rightarrow \text{no big } \pi_t < 0, \text{ small } x_t \text{ effects.} \]

\[ \text{ZLB is not dangerous. } \pi_t > 0 \text{ endogenously solves } r^* < 0, \text{ ZLB.} \]

“Topsy-turvy” policies disappear. If you don’t like GDP, it’s not ZLB.

\[ \text{Frictionless limit } = \text{frictionless limit point, “backwards stable,”} \]
The Neo-Fisherian question

- If a peg is stable, then *raising* rates can (can!) raise inflation.
- Europe/Japan Pedal misapplication? US $\pi$ picking up because $i$ rising?
- Classic view still ok in the short run?
Effects of rate rise – 3 equation model

\[ x_t = E_t x_{t+1} - \sigma (i_t - E_t \pi_{t+1}); \quad \pi_t = \beta E_t \pi_{t+1} + \kappa x_t. \]

- 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 \( \pi_t, x_t \) that accompany it. (Active M)
Multiple equilibrium responses to an unexpected interest rate rise. $\Delta s = \text{xx}$ 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 equilibrium responses to an anticipated interest rate change. “Δs = x.xx” give the percent change in steady state surpluses required to achieve each equilibrium.

- The fiscal / multiple equilibrium shock must be unexpected, on announcement.
Open-mouth policy

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

\[ i_t = i_t^* + \phi \pi (\pi_t - \pi_t^*) \quad i_t^* = 0; \quad \pi_t^* = \delta_0 \lambda_1^{-t}. \]

Equivalently

\[ i_t = \hat{i}_t + \phi \pi \pi_t \quad \hat{i}_t = -\delta_0 \phi \pi \lambda_1^{-t}. \]

▶ If you want lower $\pi$ why raise rates at the same time?
Expected rate rise lowers inflation! But it needs huge $m/c$.

You can get rising $i$ lowers $\pi$ 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 $\pi$?
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 $\pi$. Optimal (huge) quantity of money.
- If i peg is stable, then raising i likely to raise $\pi$. 
Optimal quantity of money/Balance sheet

- Better, now it pays interest and can replace crisis-prone short debt
What should the Fed do?
FTPL Warning

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

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

surplus/debt = \( r - g \)

▶ Why is \( \pi \) so low, with \( B \) so high and bad \( S \)? \( r \) is low!

▶ What if \( r \) rises? Small \( \Delta r \) 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”
THE END
Extra slides follow
Backup slide 1. Interest rate peg stability.

\[ i_t = r_t + \pi_t^e \quad \text{Fisher} \]
\[ y_t = \kappa(\pi_t - \pi_t^e) \quad \text{Friedman-Phillips} \]
\[ y_t = -ar_t \quad \text{IS} \]
\[ \rightarrow i_t = -(\kappa/a)\pi_t + (1 + \kappa/a)\pi_t^e \]

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

\[ \rightarrow i_t = -(\kappa/a)\pi_t + (1 + \kappa/a)\pi_{t-1} \]
\[ \pi_t = -\frac{1}{\kappa/a}i_t + \frac{1 + \kappa/a}{\kappa/a}\pi_{t-1} \]

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

\[ \rightarrow i_t = -(\kappa/a)\pi_t + (1 + \kappa/a)E_t\pi_{t+1} \]
\[ E_t\pi_{t+1} = \frac{1}{1 + \kappa/a}i_t + \frac{\kappa/a}{1 + \kappa/a}\pi_t \]

(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,

\[
(1 + \kappa/a)\pi_{t+1} = i_t + (\kappa/a)\pi_t
\]

\[
\pi_{t+1} = \frac{1}{1 + \kappa/a}i_t + \frac{\kappa/a}{1 + \kappa/a}\pi_t
\]

\[
\pi_{t+1} = \frac{1}{1 + \kappa/a}i_t + \frac{1}{(1 + \kappa/a)^2}i_{t-1} + \frac{\kappa/a}{1 + \kappa/a}\pi_{t-1}
\]

\[
\pi_{t+1} = \frac{1}{1 + \kappa/a}i_t + \frac{1}{(1 + \kappa/a)^2}i_{t-1} + \frac{1}{(1 + \kappa/a)^3}i_{t-2} + \ldots
\]

Model: raising interest rates raises inflation uniformly. True? (More realistic model?)
Effect of rate rise?
3 Equation model – response to m policy shock

New-Keynesian response to monetary tightening — 3 equation model

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