Expectations and the Neutrality of Interest Rates

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Challenge

- I'm stuck. Do/how higher interest rates lower inflation?
- Wanted: Simplest basic economic model, minimum *necessary* ingredients.
- Inspiration: Lucas (1972). MV=PY; $\pi_t = E_{t-1}\pi_t + \kappa x_t$. Benchmark: Long run neutrality, rational expectations, proper general equilibrium. One simple friction gives short-run non-neutrality.
- But central banks set interest rates, not money supply.
- Parallel basic model of inflation under interest rate targets?
- The simple textbook NK model is not the answer. What is?
- Back to basics…

Theory of inflation under interest rate targets

Model $x_t = E_t x_{t+1} - \sigma(i_t - \pi_t^e)$

$\pi_t = \pi_t^e + \kappa x_t$

Inflation dynamics $\pi_t = (1+\sigma\kappa)\pi_t^e - \sigma\kappa i_t\,.$

(> 1, < 0)

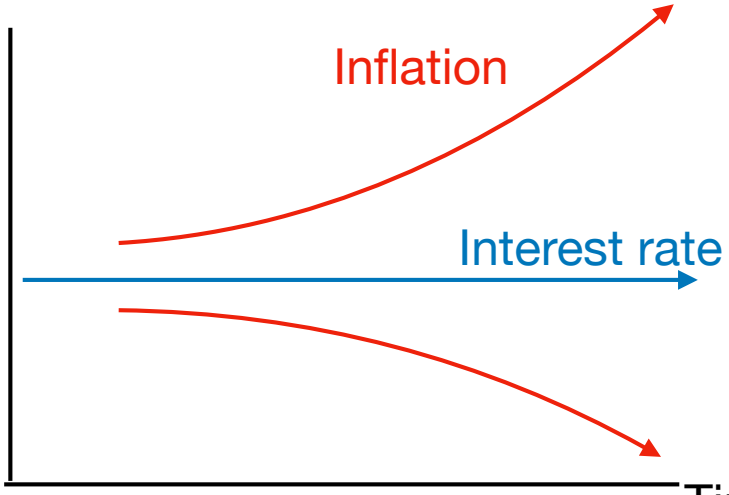
1) Adaptive Expectations $\pi_t^e = \pi_{t-1} \quad \rightarrow \quad \pi_t = (1+\sigma\kappa)\pi_{t-1} - \sigma\kappa i_t\,.$

a) Friedman (1968): i peg is *unstable.* Inflation/deflation spirals. Target M.

b) Taylor rule + adaptive

$$i_t = \phi\pi_t \quad \rightarrow \quad \pi_t = \frac{1+\sigma\kappa}{1+\sigma\kappa\phi}\pi_{t-1}\,.$$

Fed stabilizes inflation with adaptive E.



c) Higher rates lower (future) inflation. Captures common policy/pundit beliefs.

But…

- Adaptive expectations always and everywhere, *necessary, minimal* component?
- Expectations *of* the model ≠ expectations *in* the model?
- There *is no* simple, rational theory for the basic sign and operation of monetary policy?

Theory of inflation under interest rate targets

Model $x_t = E_t x_{t+1} - \sigma(i_t - \pi_t^e)$

$\pi_t = \pi_t^e + \kappa x_t$

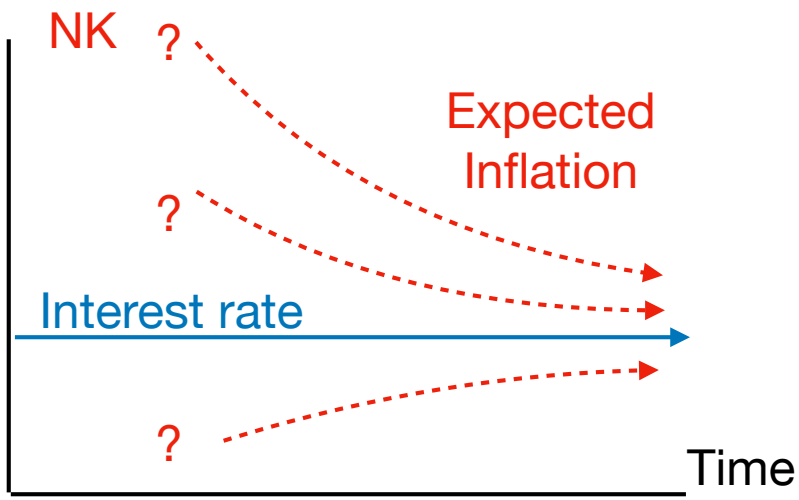
Inflation dynamics $\pi_t = (1+\sigma\kappa)\pi_t^e - \sigma\kappa i_t\,.$

2) Rational expectations $\pi^e = E_t\pi_{t+1} \quad \rightarrow \quad E_t\pi_{t+1} = \dfrac{1}{1+\sigma\kappa}\pi_t + \dfrac{\sigma\kappa}{1+\sigma\kappa} i_t$ (1: < 1; $\sigma\kappa$: > 0)

a) Sargent-Wallace (1975): Inflation is *stable*, but *indeterminate* under a peg. Target M.

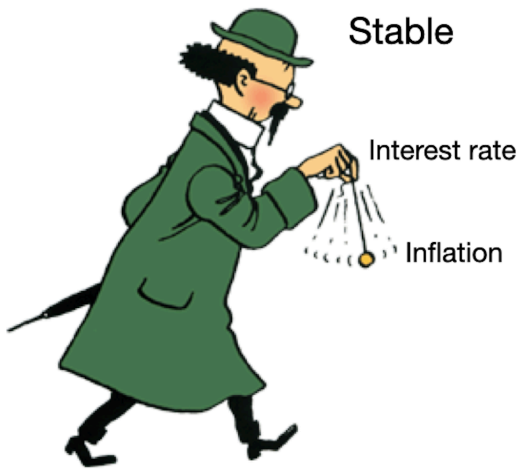
b) New-Keynesian.

$$i_t = \phi\pi_t \;\rightarrow\; E_t\pi_{t+1} = \frac{1+\phi\sigma\kappa}{1+\sigma\kappa}\pi_t$$



- Central bank *destabilizes* inflation to select equilibria. Opposite of adaptive model.
- Central banks don't do that.

c) Higher interest rates *raise* inflation. Unless there is a jump to a different equilibrium. Lower inflation comes from equilibrium selection.



New-Keynesian equilibrium selection

Flex price model for really simple algebra:

$$i_t = E_t \pi_{t+1}$$

$$i_t = \phi \pi_t + u_t$$

Rewrite rule, equivalent to

$$i_t = i_t^* + \phi(\pi_t - \pi_t^*)$$

$$i_t^* = E_t \pi_{t+1}^*;\ u_t = i_t^* - \phi \pi_t^*$$

Equilibrium:

$$E_t(\pi_{t+1} - \pi_{t+1}^*) = \phi(\pi_t - \pi_t^*)$$

$i_t = i_t^*;\ \pi_t = \pi_t^*$ is the unique non-explosive (locally bounded) equilibrium.

- Central bank picks inflation target $\{\pi_t^*\}$. Implement with an *interest rate policy* $i_t^* = E_t \pi_{t+1}^*$ (observed) that sets expected inflation, and a separate *equilibrium selection policy* (unobserved off-equilibrium threats) destabilizing the economy for all but one unexpected inflation.
- The central bank *fully* determines inflation.
- *Central banks don't do this.* Like MV=PY, gold, another beautiful theory that does not apply to current institutions.
- Whether interest raise or lower inflation depends entirely on equilibrium selection.
- "Open mouth" operation. Iid $\{\pi_t^*\}$, i_t is constant, π_t is any desired iid process!

Theory of inflation under interest rate targets

Model $x_t = E_t x_{t+1} - \sigma(i_t - \pi_t^e)$

$\pi_t = \pi_t^e + \kappa x_t$

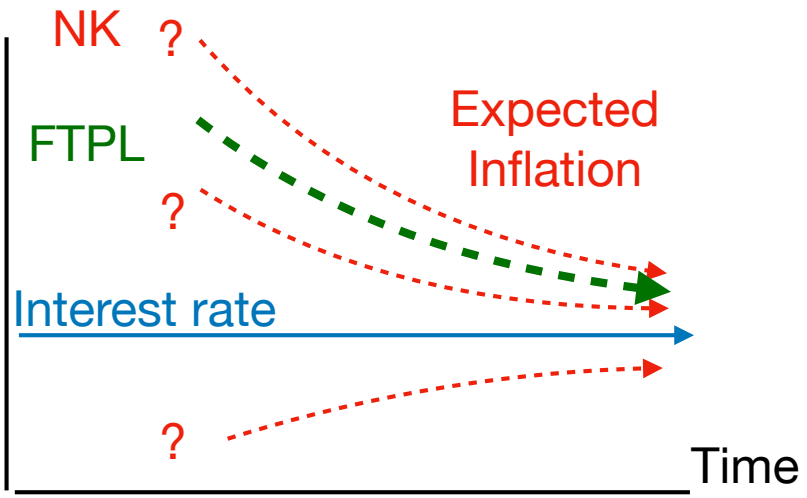
Inflation dynamics $\pi_t = (1 + \sigma\kappa)\pi_t^e - \sigma\kappa i_t\,.$

2) Rational expectations $\pi^e = E_t\pi_{t+1} \quad \rightarrow \quad E_t\pi_{t+1} = \dfrac{1}{1+\sigma\kappa}\pi_t + \dfrac{\sigma\kappa}{1+\sigma\kappa} i_t$ ($1/(1+\sigma\kappa) < 1$; $\sigma\kappa/(1+\sigma\kappa) > 0$)

c) Fiscal theory of the price level

$$\Delta E_{t+1}\pi_{t+1} = \Delta E_{t+1}\sum_{j=0}^{\infty}\rho^j(-\tilde{s}_{t+1+j} + r_{t+1+j}); \quad \Delta E_{t+1} \equiv E_{t+1} - E_t$$

- **Inflation is *stable* and *determinate* (at last); obeys *long-run neutrality*.**
- **A complete economic theory of inflation under an interest rate target, like MV=PY, but consistent with today's institutions.**
- **The only such theory we have! "Test?"**



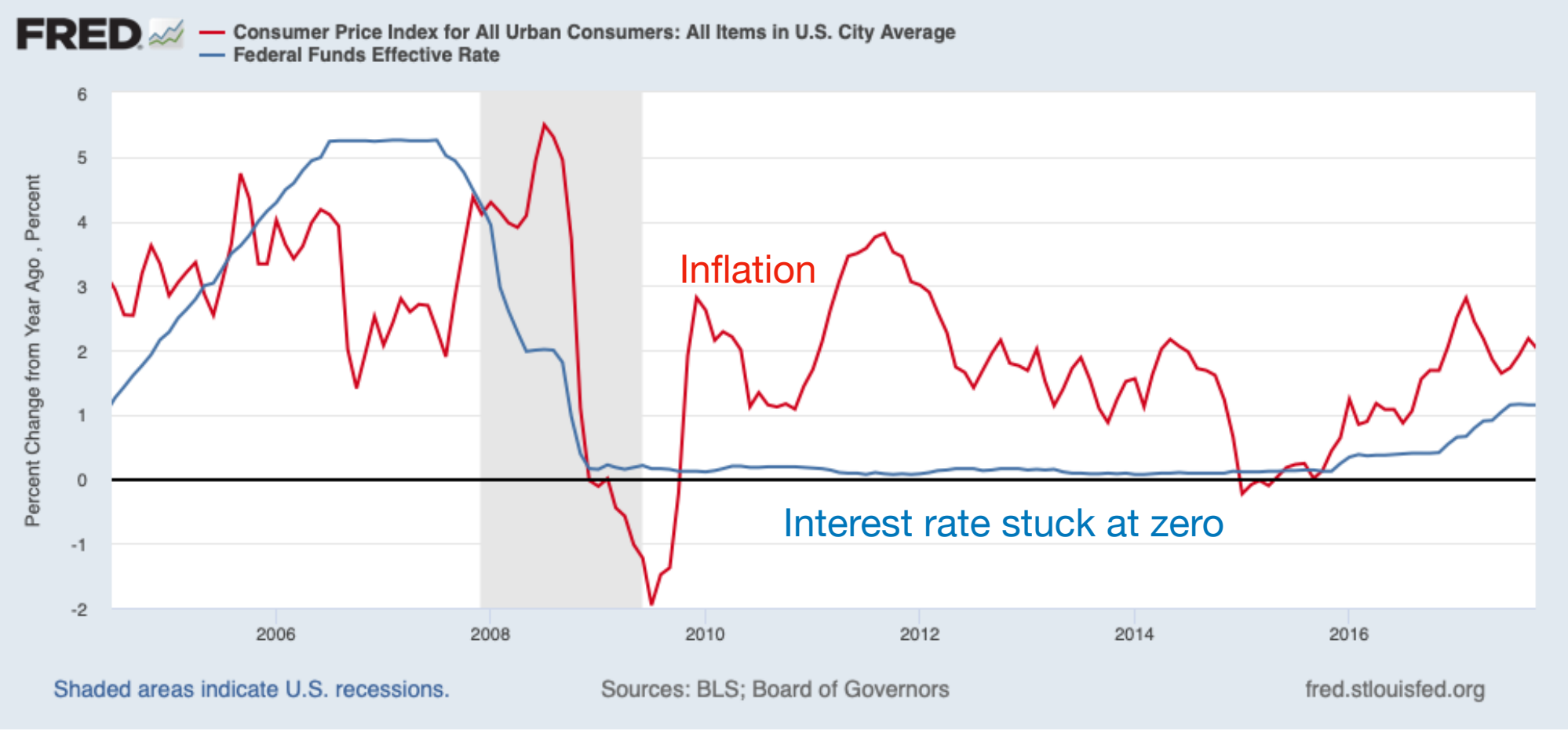
Issues:

- *Is* inflation stable & determinate under a peg?
- Stable + long run neutral: Higher interest rates must (eventually) raise inflation
- Do higher interest rates temporarily lower inflation?

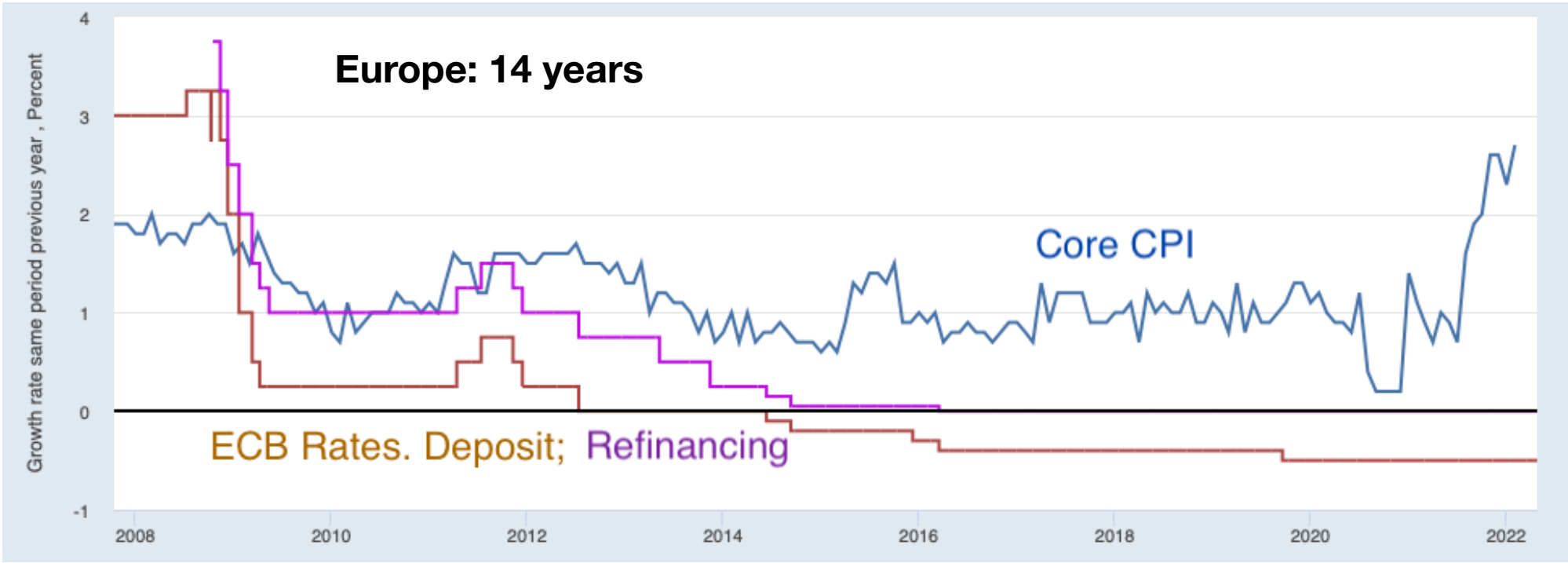
History: Stable quiet inflation at a peg is possible

The long quiet zero bound ($\phi = 0$).

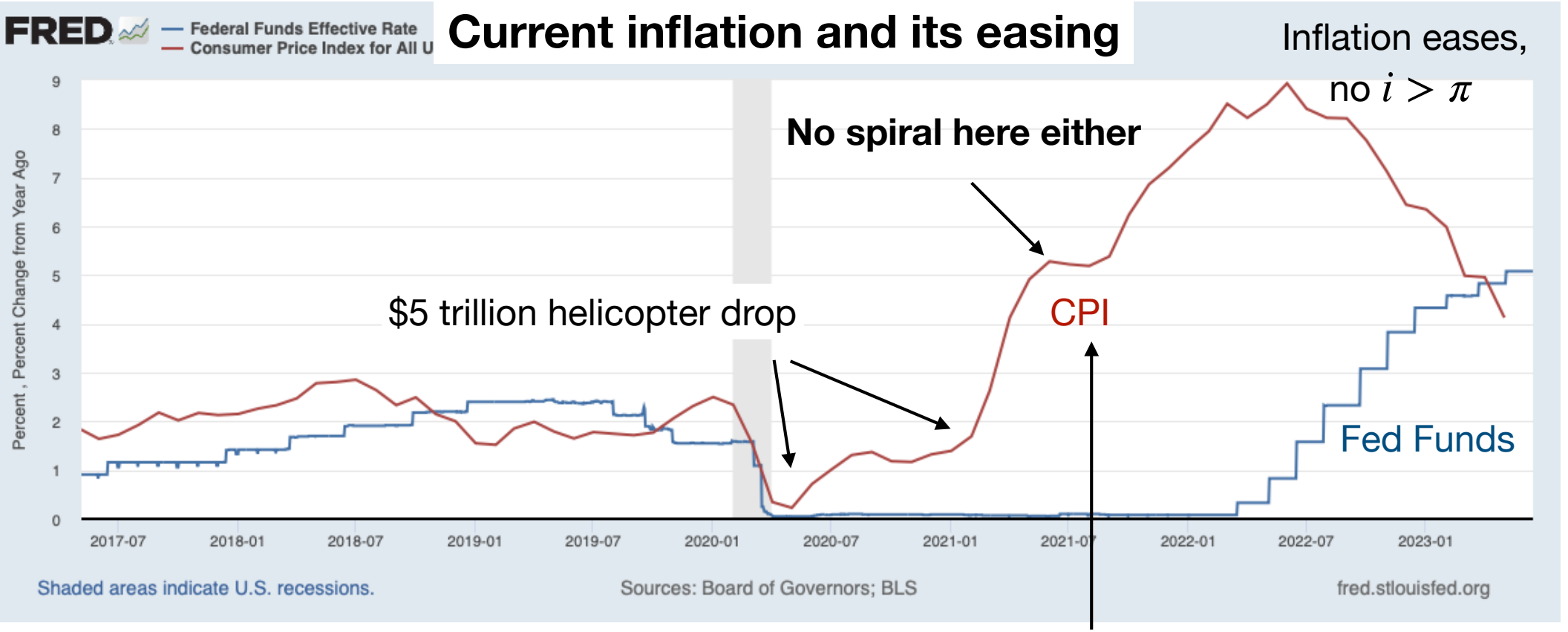
Neither instability (deflation spirals) nor volatility (multiple equilibrium sunspots).

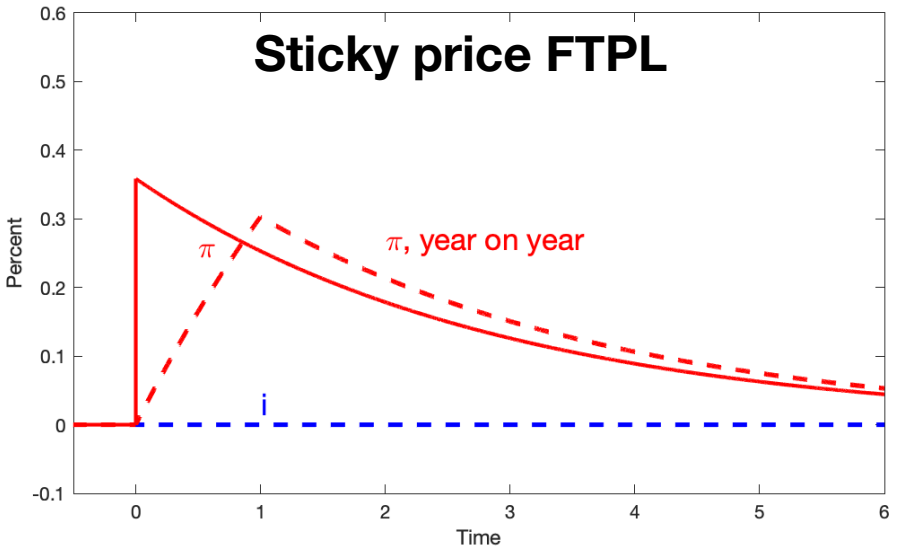


The long quiet stable zero bound



Current inflation and its easing





- Adaptive: Inflation will spiral up until $i > \pi$.
- NK: Central bank can completely control inflation. $\pi_t = \pi_t^*$. There cannot be a fiscal shock; "passive" fiscal policy always changes s_{t+j} so that $B/P_t = EPV(s)$ after CB chooses P_t.
- NK: Inflation broke out early 2021 because the Fed did not announce an equilibrium-selection policy and credibly threaten hyperinflation should inflation exceed its target. Really?

The Fed's Phillips cure

$$\pi_t = \pi_t^e + \kappa x_t$$

$$\pi_t^e = \pi_t^* + \sum \alpha_j \pi_{t-j}$$

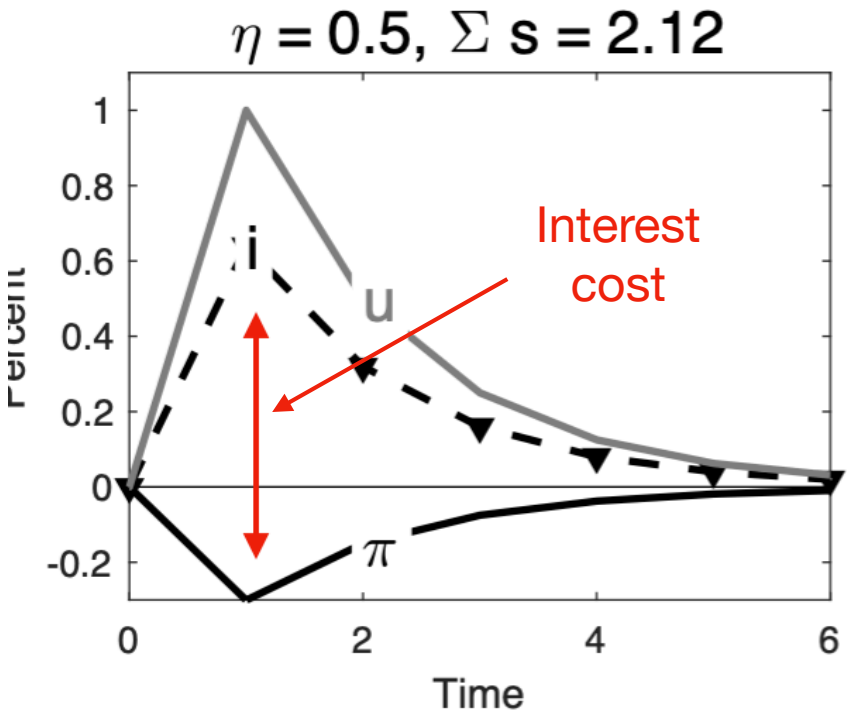
- Inflation = expected inflation + labor slack
- Phillips cure is causal from right to left.
- Expectations are mostly "anchored." That "anchoring" is affected by Fed speeches, forward guidance, etc. Plus, experience with inflation can slowly undermine anchoring.
- Not just "adaptive."
- Key: Expectations are not *reactive*. With rational expectations $E_t \pi_{t+1}$ reacts instantly to i_t.
- The Fed model dynamics are unstable/determinate like the adaptive expectations model.

Can/how do higher rates lower inflation?

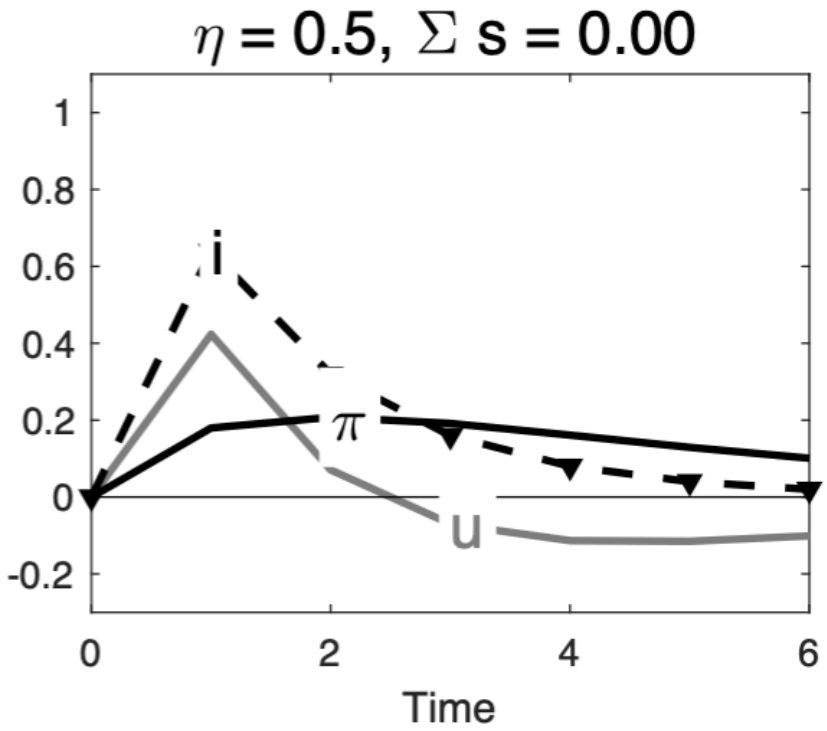
- Can higher interest rates lower inflation? (temporarily?) To FTPL + calibrated NK? Lucas-like *minimal necessary* friction?
- First, What can monetary policy do *without fiscal tightening*?
- Why ask?
  1. Theory: To understand "monetary policy," what can central banks do by themselves?
  2. Policy: Today, monetary policy may not induce fiscal tightening.
- Examples of fiscal effects:
  3. 1% real rate rise = 1% more interest cost = 1% of GDP deficit.
  4. Higher rates →recession→ stabilizers, stimulus, bailout.
  5. Lower inflation = windfall to bondholders.
  6. Higher inflation→ fiscal austerity?
- *Conventional models in which higher interest rates lower inflation include a contemporaneous fiscal tightening to pay the costs. Higher interest rates without fiscal tightening do not lower inflation. No, sticky prices are not enough.*
- (Second, problems even with fiscal tightening to pay interest costs)

Standard new-Keynesian model

$$x_t = E_t x_{t+1} - \sigma(i_t - E_t \pi_{t+1})$$
$$\pi_t = \beta E_t \pi_{t+1} + \kappa x_t$$
$$i_t = \phi \pi_t + u_t;\ \phi > 1$$
$$u_{t+1} = \eta u_t + \varepsilon_{t+1}$$
$$\rho v_{t+1} = v_t + i_t - \pi_{t+1} - \tilde{s}_{t+1}$$ "Passive"

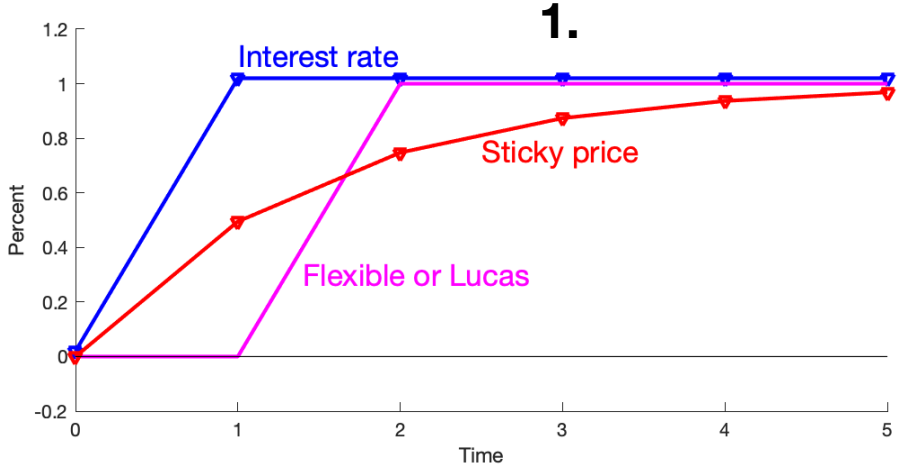


- Transitory AR(1) shock lowers inflation.
- But "passive" fiscal raises taxes to pay interest cost & bondholder windfall.
- Choose $\{u_t\}$(not AR(1)) to give the *same* i path, no fiscal change: *Inflation rises*! (Roughly, $i_t - \pi_{t+1}$ averages zero).
- NK inflation reduction comes from equilibrium selection, with "passive" fiscal tightening! *Despite* higher rates, not *because* of higher rates.
- Without fiscal shock, *higher rates do not lower inflation in the standard NK model!*



Sticky Prices, Short Term Debt, No Change in Surpluses

1.



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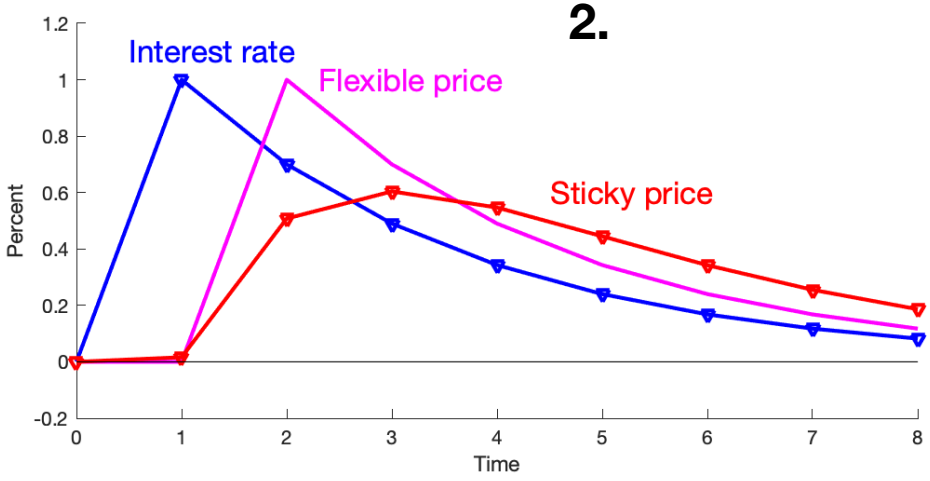
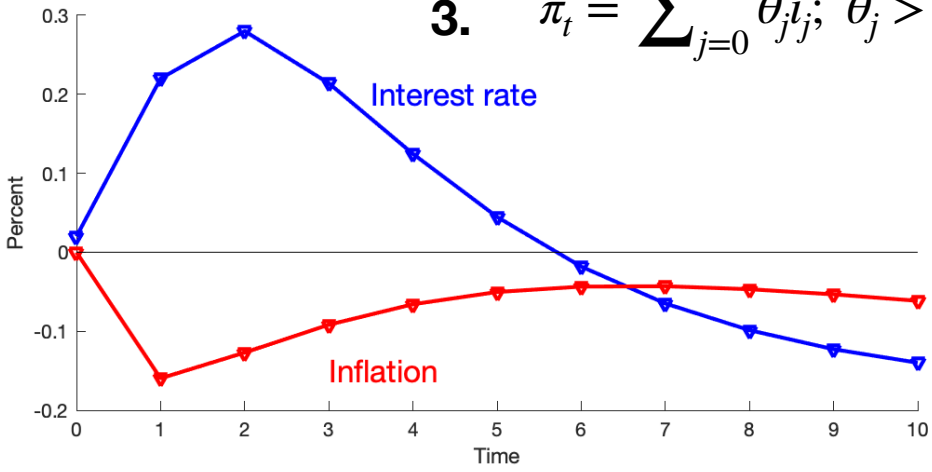


3. $\pi_t = \sum_{j=0}^{\infty} \theta_j i_j;\ \theta_j > 0$



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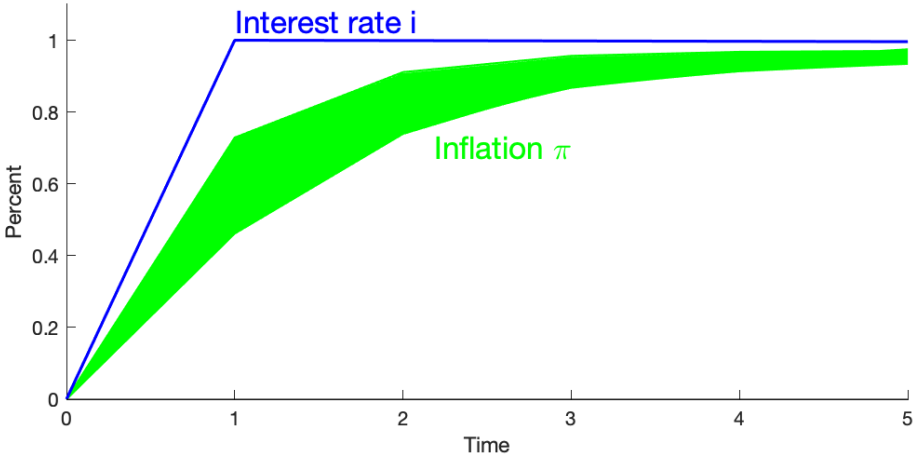


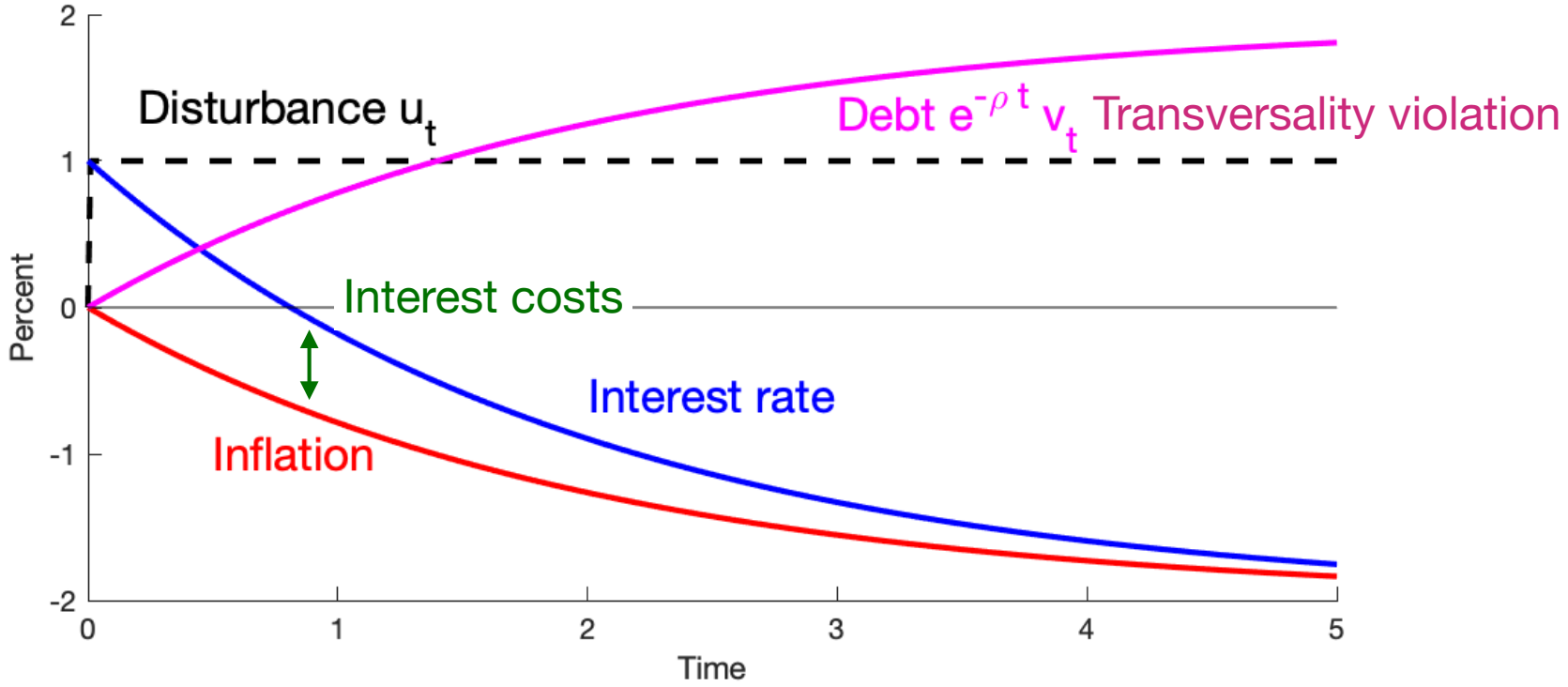
1, 2, 3.

$$x_t = -\sigma(i_t - E_t\pi_{t+1})$$
$$\pi_t = E_t\pi_{t+1} + \kappa x_t$$
$$\rho v_{t+1} = v_t + i_t - \pi_{t+1} - (\tilde{s}_{t+1} = 0)$$

4.

$$x_t = E_t x_{t+1} - \sigma(i_t - E_t\pi_{t+1})$$
$$\pi_t = (1-\alpha)E_t\pi_{t+1} + \alpha\pi_{t-1} + \kappa x_t$$
$$\rho v_{t+1} = v_t + i_t - \pi_{t+1}$$
$$i_{t+1} = \eta i_t + \varepsilon_{i,t+1}\,.$$

Fiscal foundations of adaptive expectations /old Keynesian

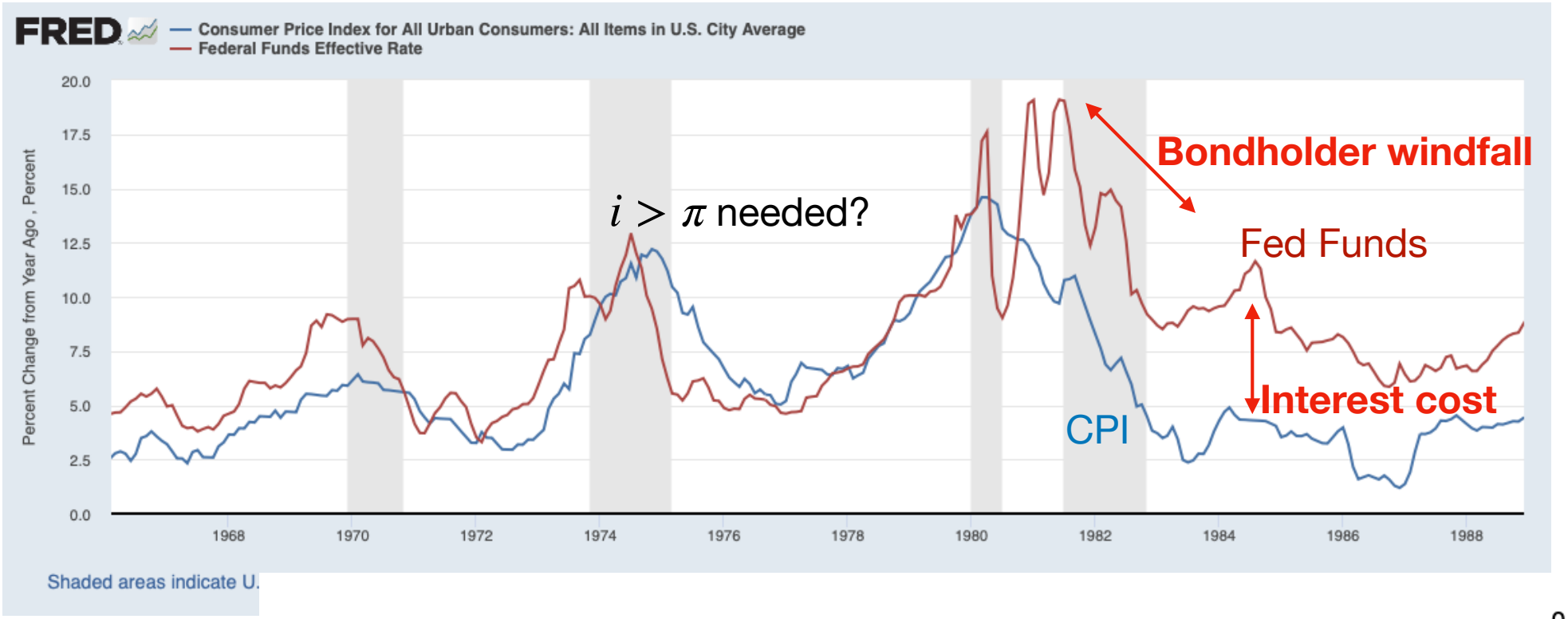


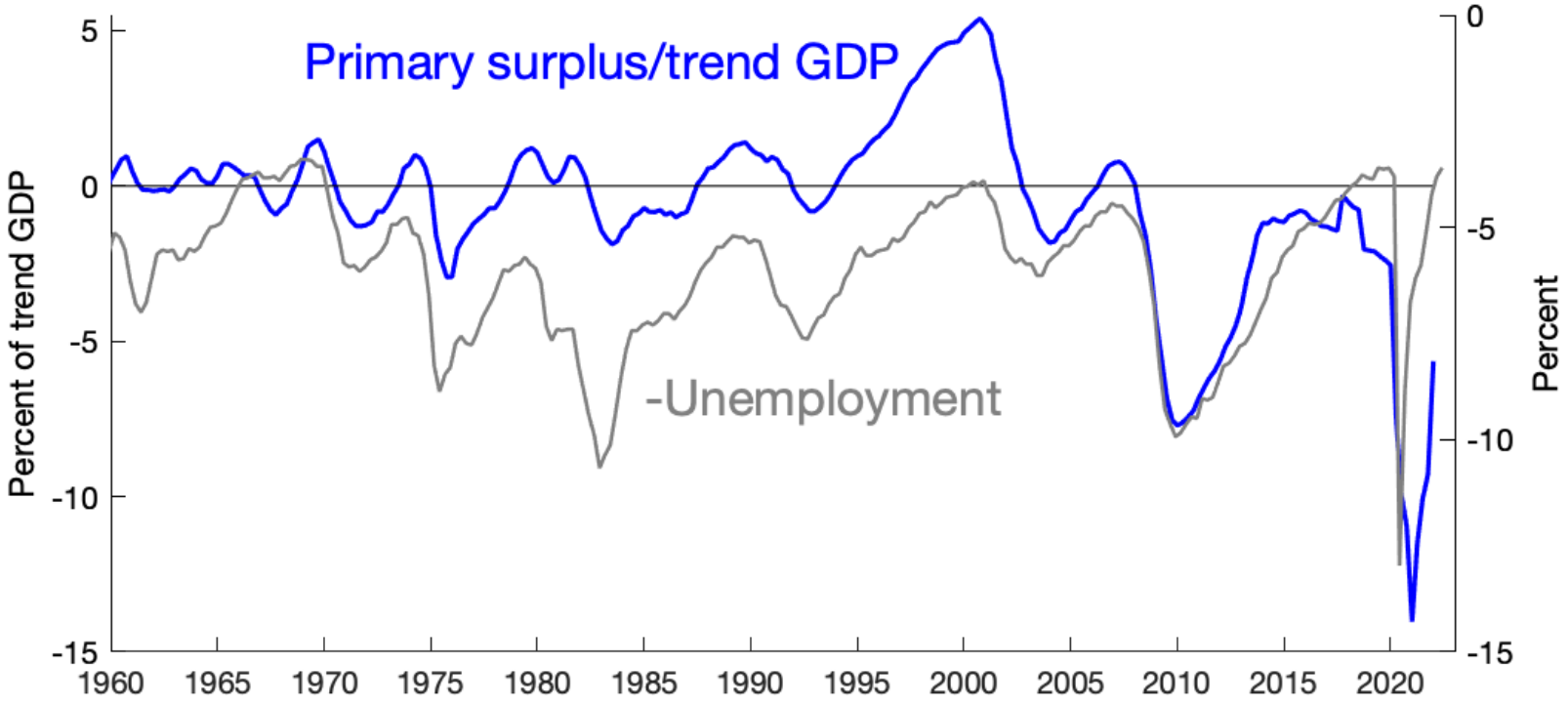
- Disinflation requires fiscal tightening to pay interest costs on debt.
- Paper: Interest rates with no change in fiscal policy *cannot* change long-run inflation. Adaptive expectations doesn't work either!
- Intuition: pv of real interest cost on debt = 0 → average real interest to move inflation = 0.
- $0 = \int_0^\infty e^{-rj} r_j dj;\ \pi_\infty = -\sigma\kappa \int_0^\infty r_j dj\,.$

$$x_t = -\sigma(i_t - \pi_{t-1})$$
$$\pi_t = \pi_{t-1} + \kappa x_t$$
$$\rho v_{t+1} = v_t + i_t - \pi_{t+1}$$
$$i_t = \phi\pi_t + u_t$$
$$\sigma\kappa = 1;\ \phi = 1.5;$$
$$\rho = 0.99$$

(Continuous time)

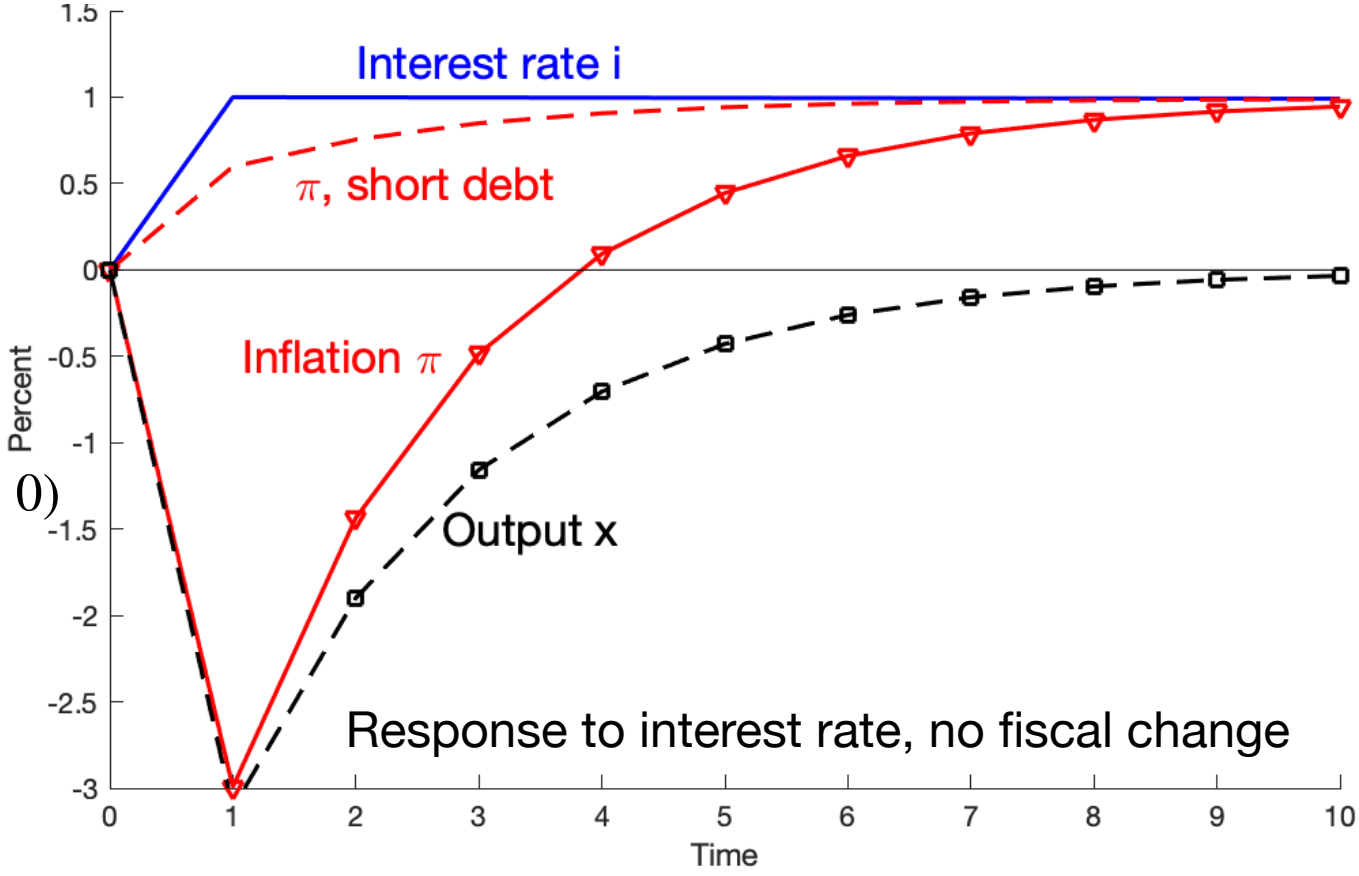
1980s were a joint monetary, fiscal, and microeconomic disinflation





FTPL+NK+long debt. Imperfect best we have so far

$$x_t = E_t x_{t+1} - 0.5(i_t - E_t \pi_{t+1})$$
$$\pi_t = E_t \pi_{t+1} + 0.5 x_t$$
$$i_t = i_{t-1} + \varepsilon_{i,t}$$
$$\rho v_{t+1} = v_t + r^n_{t+1} - \pi_{t+1} - (\tilde{s}_{t+1} = 0)$$
$$E_t r^n_{t+1} = i_t$$
$$r^n_{t+1} = 0.9 q_{t+1} - q_t .$$

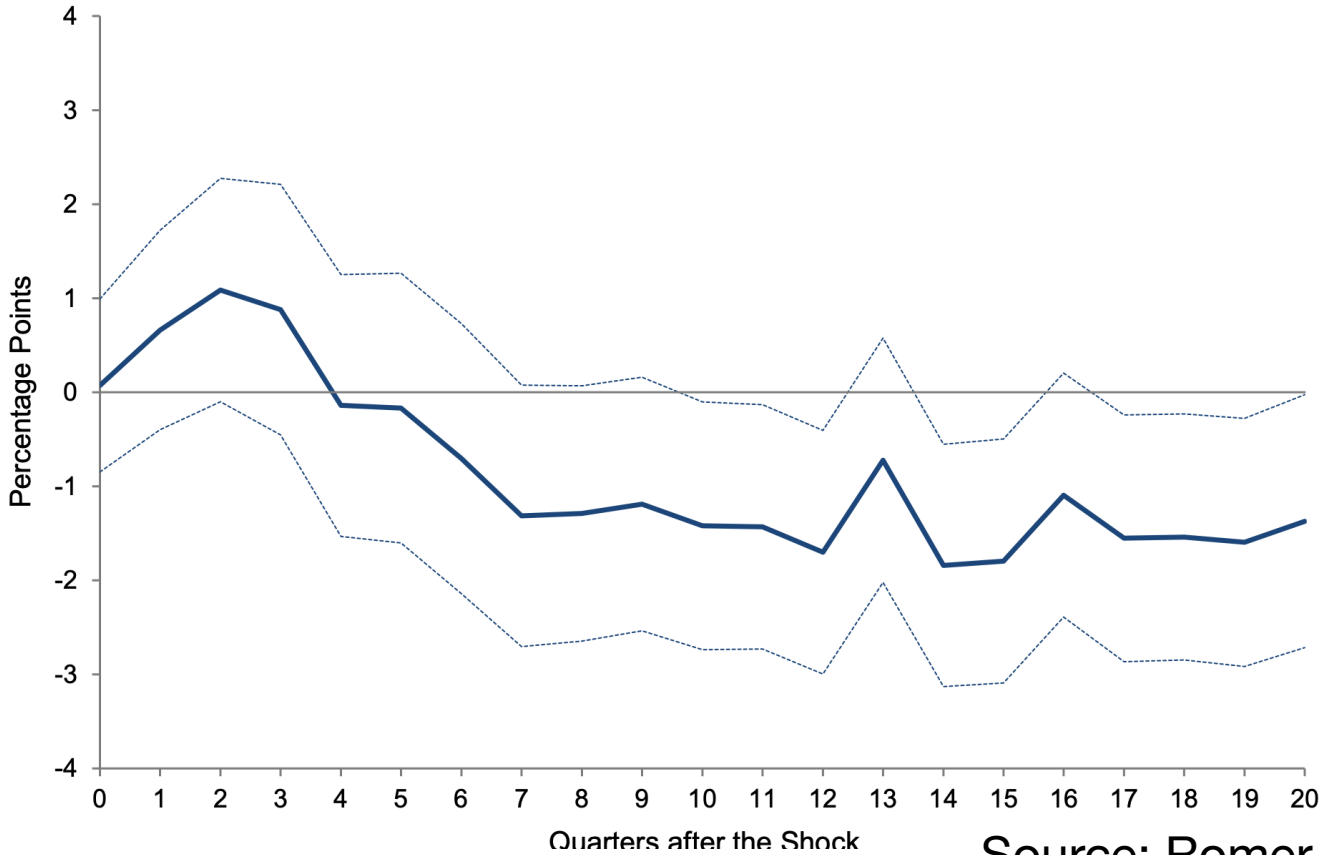


- Mechanism: $\dfrac{B^{(t)}_{t-1} + \sum_{j=1}^{\infty} Q^{(t+j)}_t B^{(t+j)}_{t-1}}{P_t} = EPV(s)$
- ``Unpleasant arithmetic." Only unexpected rate rises; Only with long term debt. Needs long-lasting rate rises. *Less* for more sticky prices.
- *Not* raise real rates, lower AD, Phillips curve. Central bank speech?
- A better model in which higher rates lower inflation? Empirical work for how rates without fiscal help affect inflation? Or, maybe this is right, Fed limited!

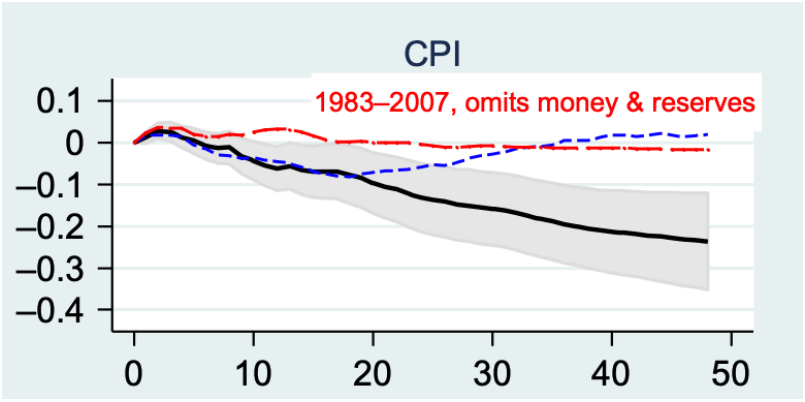
Interest rates and inflation without fiscal constraints

- What is the (is there a) simplest baseline economically respectable model, even ignoring fiscal issues, that replicates standard policy beliefs & VARs?
- Standard beliefs & VARs: Higher rates slowly reduce *future* inflation.
- Standard story: Higher nominal rates → inflation sticky, higher real rates → (lag) lower output, employment → (lag) lower future inflation.

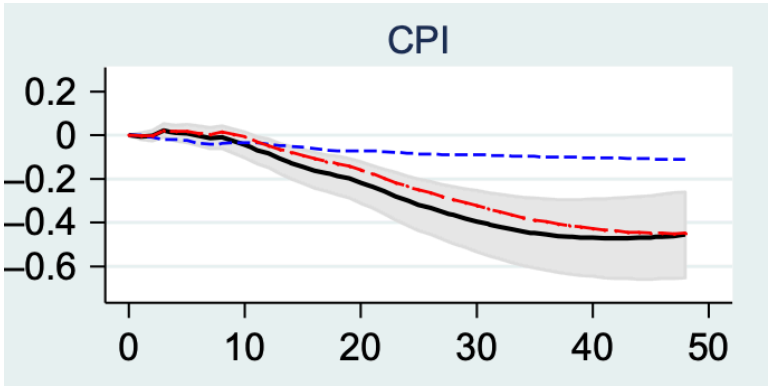
FIGURE 5. RESPONSE OF GDP PRICE INDEX INFLATION TO A MONETARY POLICY SHOCK



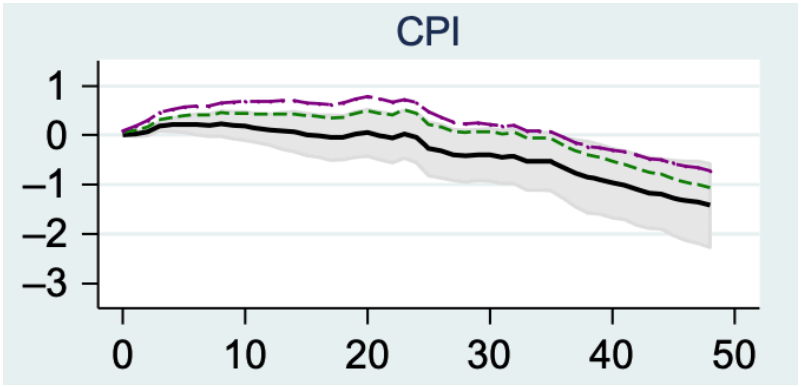
Source: Romer and Romer



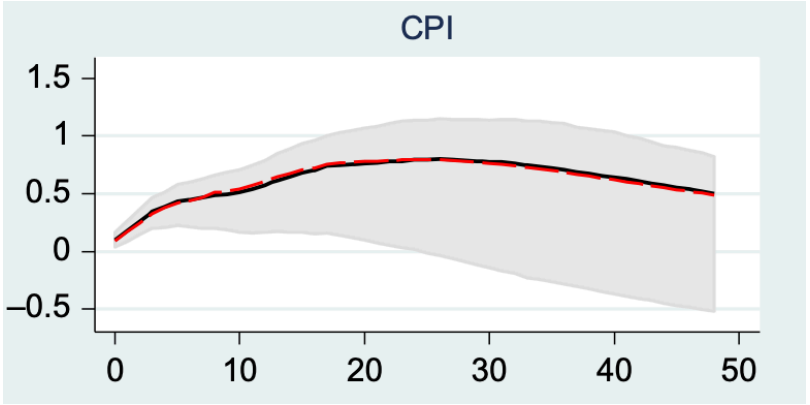
CEE identification



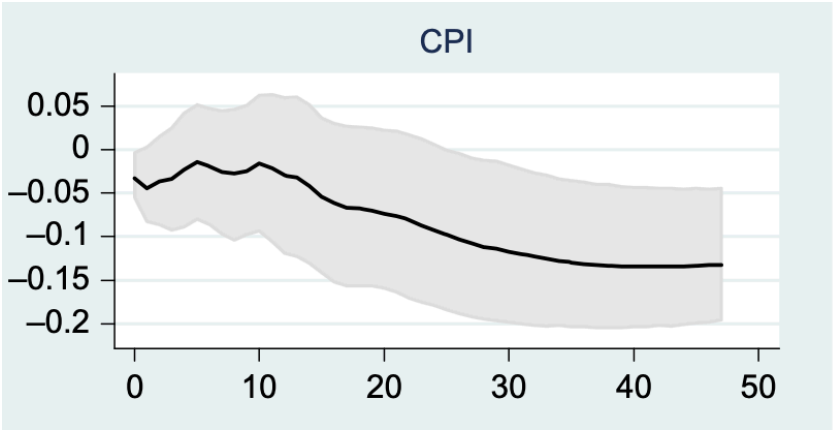
Romer and Romer identification, VAR



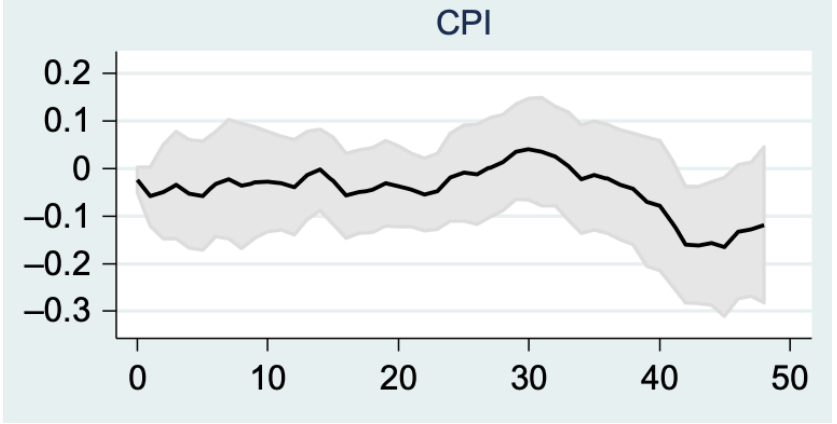
R&R, regression (local projection)



R&R, proxy SVAR



Gertler Karadi VAR



Gertler Karadi, regression

Source: Ramey (2016)

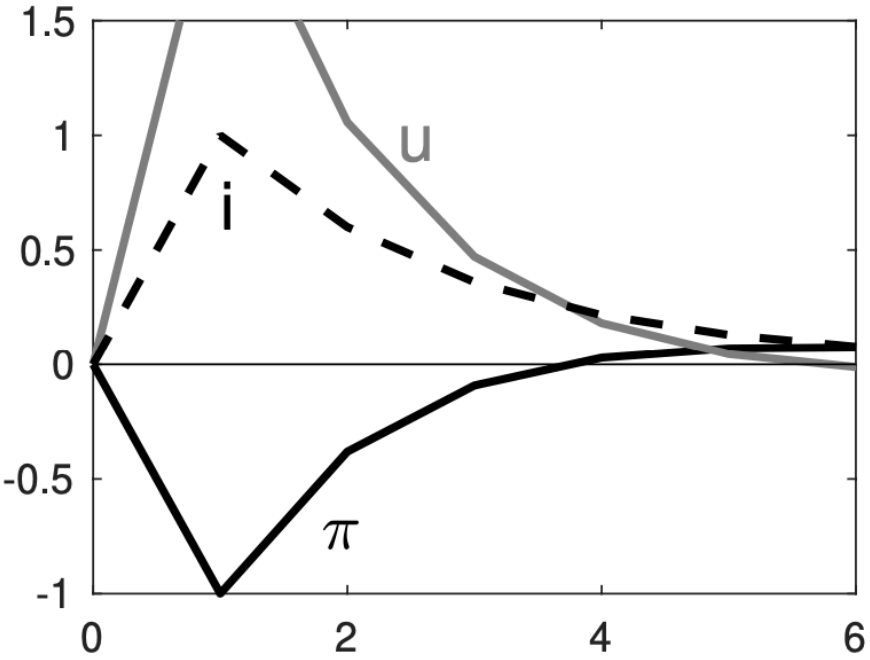
Interest rates and inflation — standard NK model

The standard model does not encode standard belief.

Belief: Higher rates slowly lower *future* inflation

Model: *Current* inflation jumps down, then future inflation *rises*.

Key: $\pi_t = E_t\pi_{t+1} + \kappa x_t$. Lower x means lower π_t, *now, relative to future* $E_t\pi_{t+1}$. "Inflation declines" only from current downward jump.



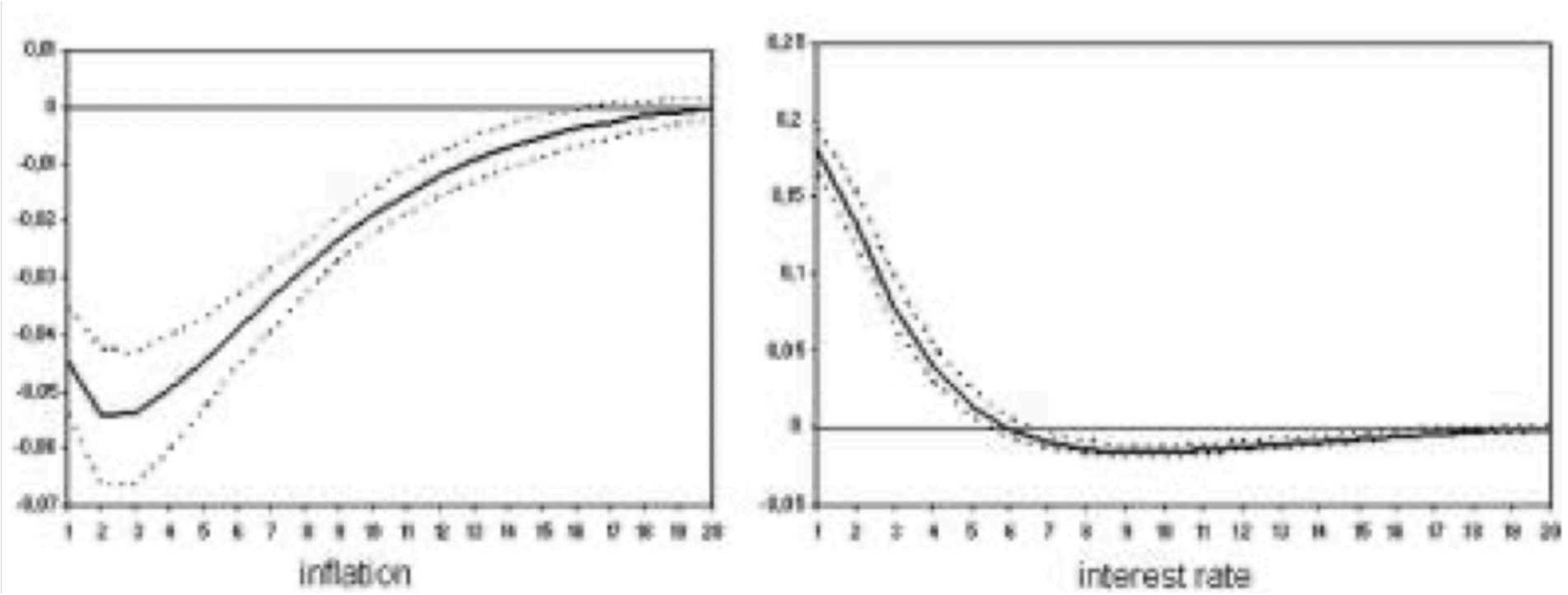
Concepts:

- Ball (1994): high output with rising, not falling inflation.
- Fisherian $i_t = r_t + E_t\pi_{t+1}$ is strong. Hard to make r_t go up by *more* than i_t goes up. Much harder than MV=PY.
- Don't confuse adjustment to current (time 1) equilibrium with the dynamic evolution of observed equilibrium quantities. OK in micro, not in dynamic macro!
- Beliefs want sticky *inflation. Sticky prices do not mean sticky inflation!* Inflation can jump with arbitrarily sticky prices.

Sticky prices vs. sticky inflation

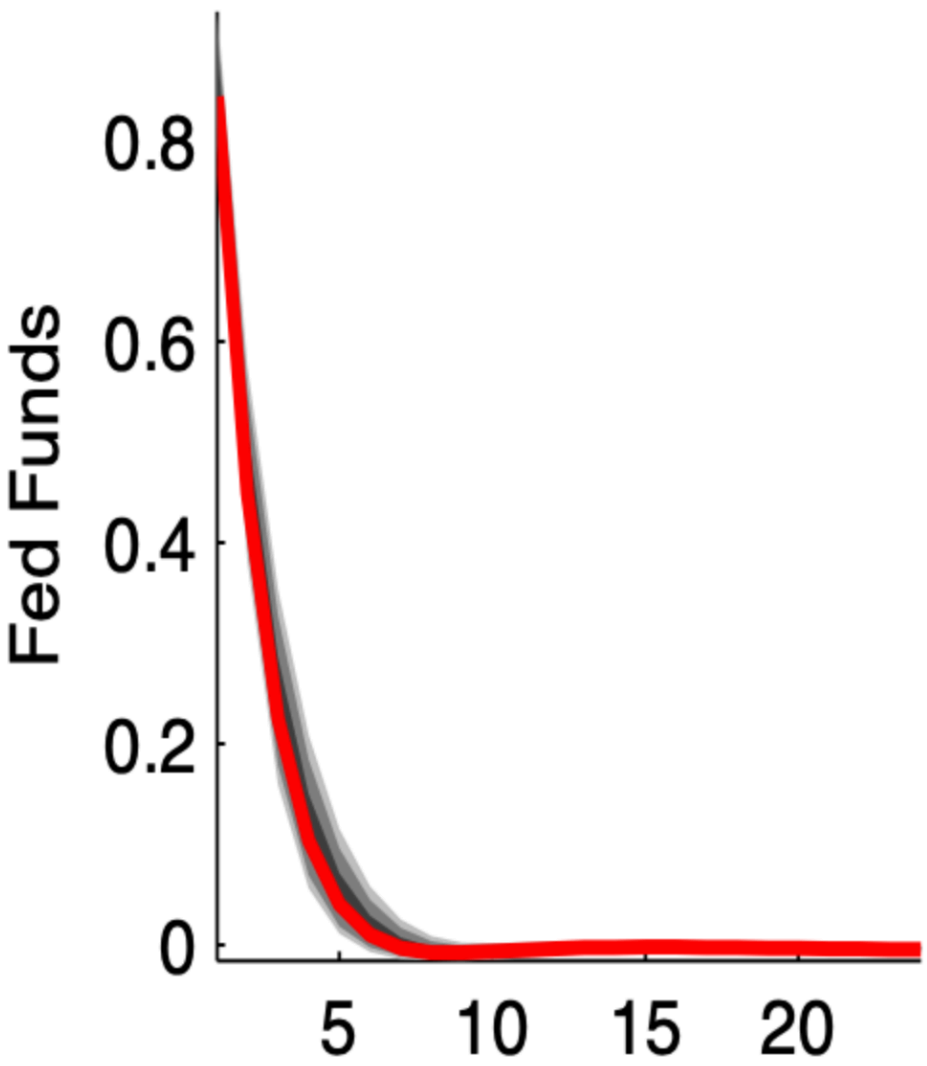
- Beliefs want sticky *inflation. Sticky prices do not mean sticky inflation!* Inflation can jump with arbitrarily sticky prices. Very common confusion.

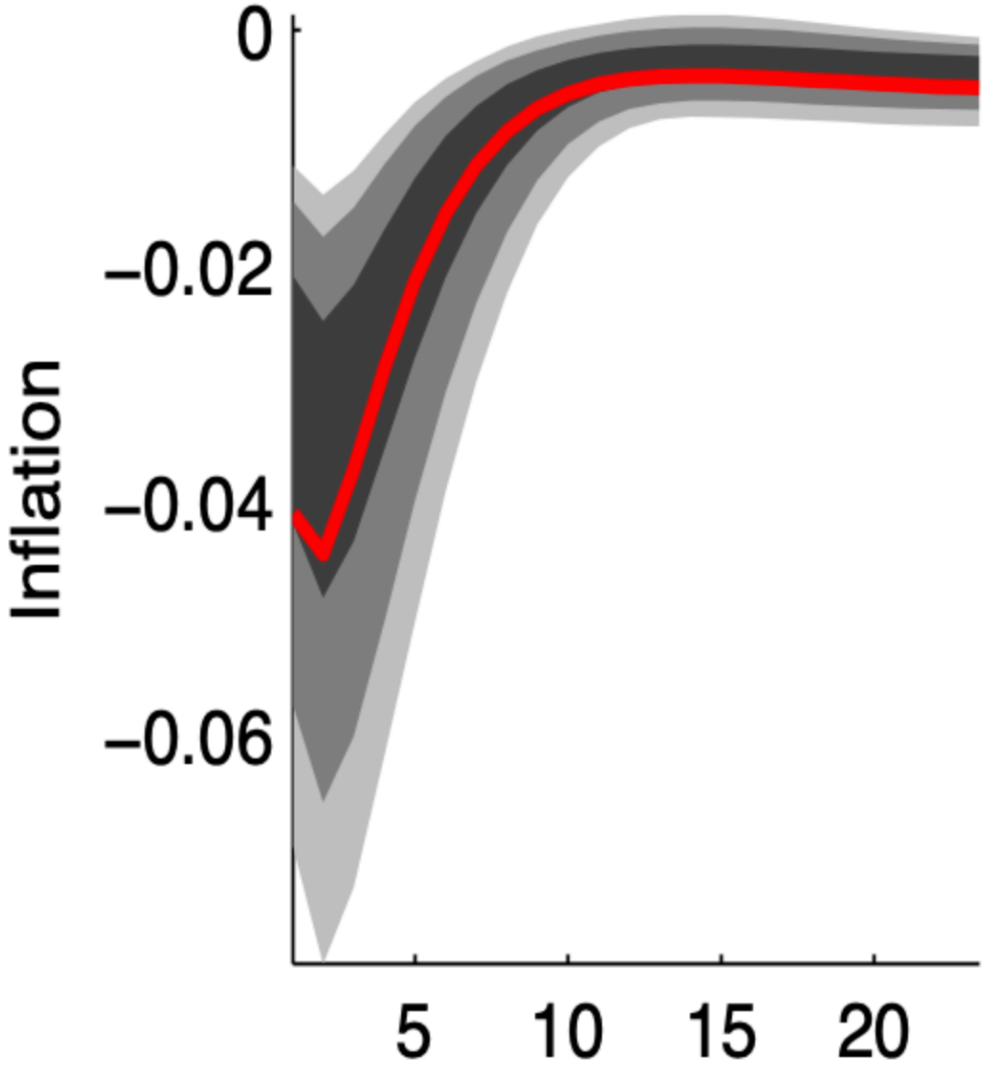
Pervasive: Models say inflation jumps down then rises



Smets and Wouters

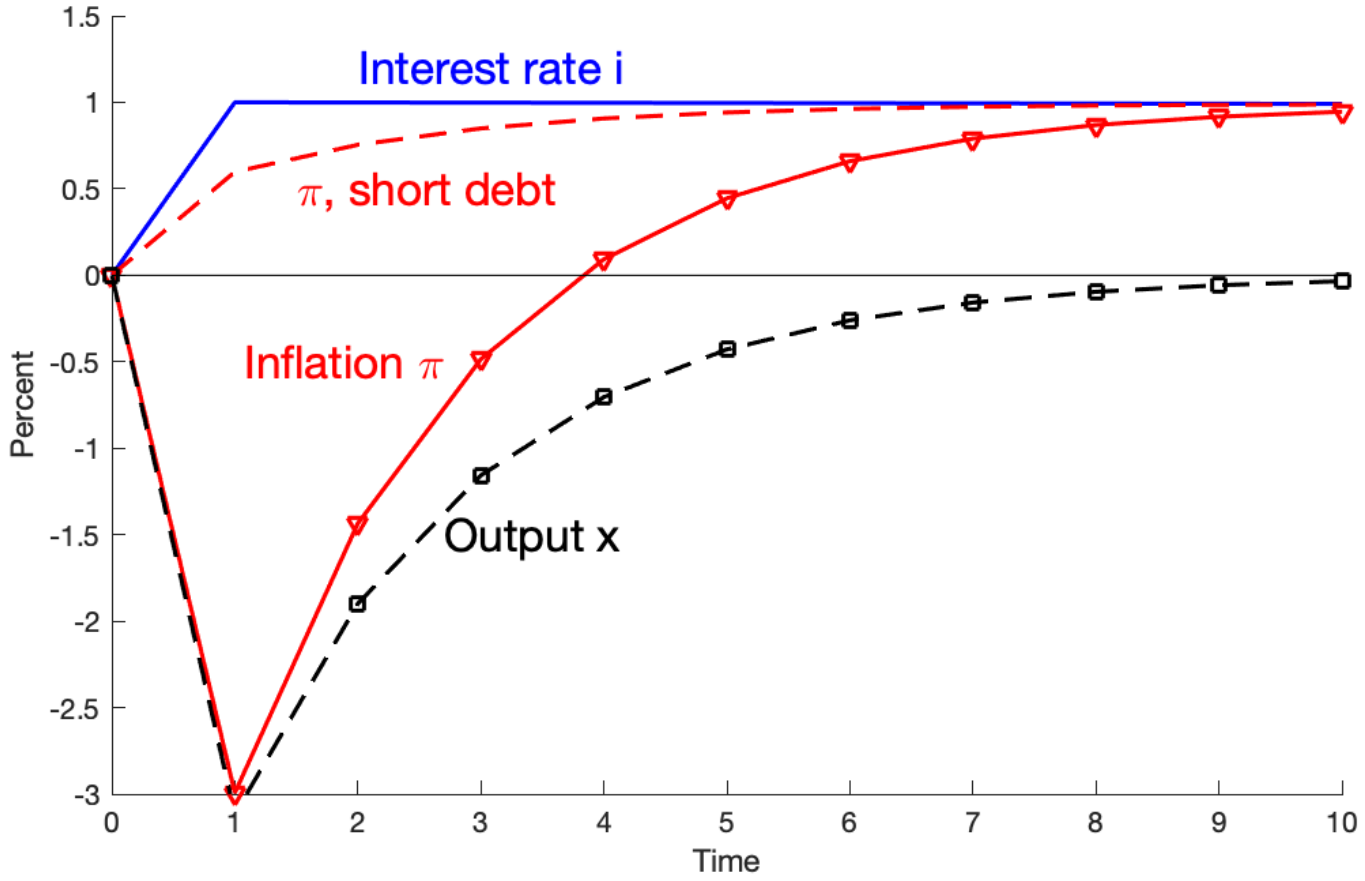
Pervasive: Models say inflation jumps down then rises





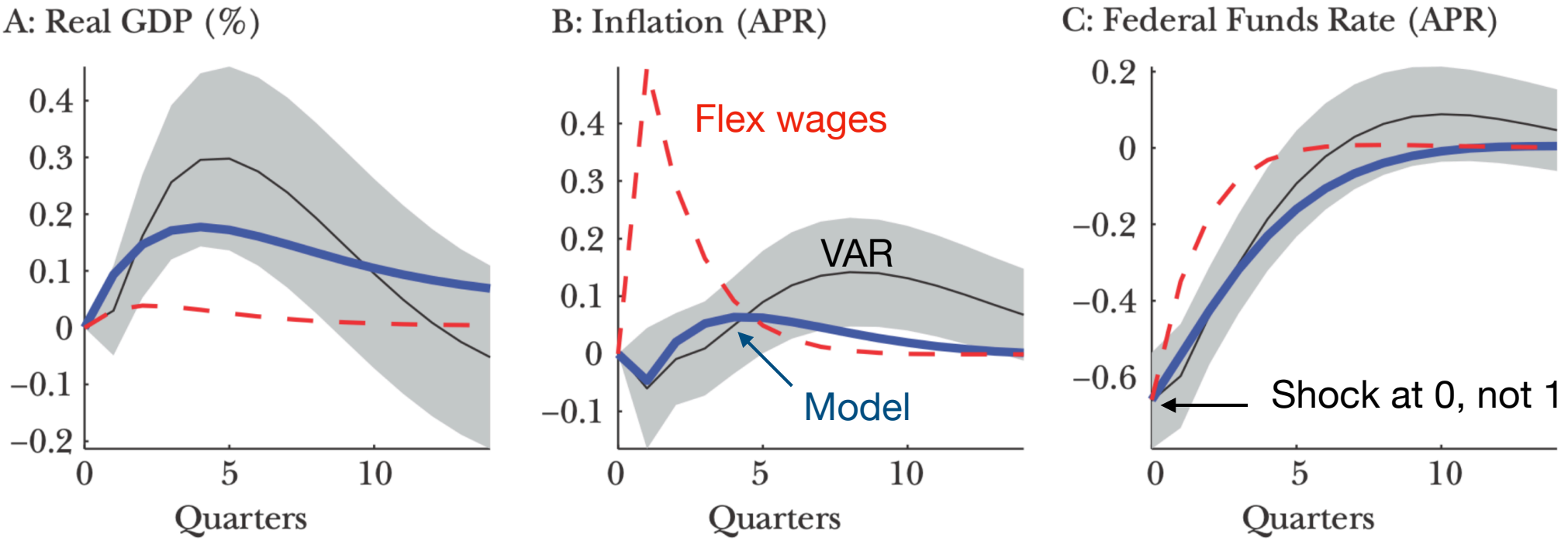
Chung, Kiley, and Laforte FRBY. “Fed model”

Pervasive: Models say inflation jumps down then rises



FTPL with long term debt

Success (sort of) Christiano, Eichenbaum, Evans



- Habits. $\log(c_t - bc_{t-1})$.
- Capital, adjustment costs $[1 - S(i_t/i_{t-1})]i_t$ not $S(i_t/k_t)i_t$.
- Calvo prices, wages; indexation.
- Prices, wages fixed for a quarter (VAR too). π_t not allowed to jump by assumption!
- Variable costly capital utilization $k_t = u_t\bar{k}_t$.
- Firms borrow wage bill 1Q in advance.
- Money, money growth target.

- *Growth rates in place of levels.* Sticky π not p.

$$\pi_t \approx 0.5\pi_{t-1} + 0.5E_t\pi_{t+1} + \text{mc}_t;$$

$$\pi_t - \pi_{t-1} = E_t \sum_{j=0}^{\infty} \beta^j \text{mc}_{t+j}$$

- Rewrites standard micro.
- i raises mc. Interesting. But *raises* inflation.
- mc uncorrelated with output/employment.
- All seem *necessary*! *Far* from standard intuition.
- 25 years ago. Cited but not used. Why is NK macro so uncumulative?

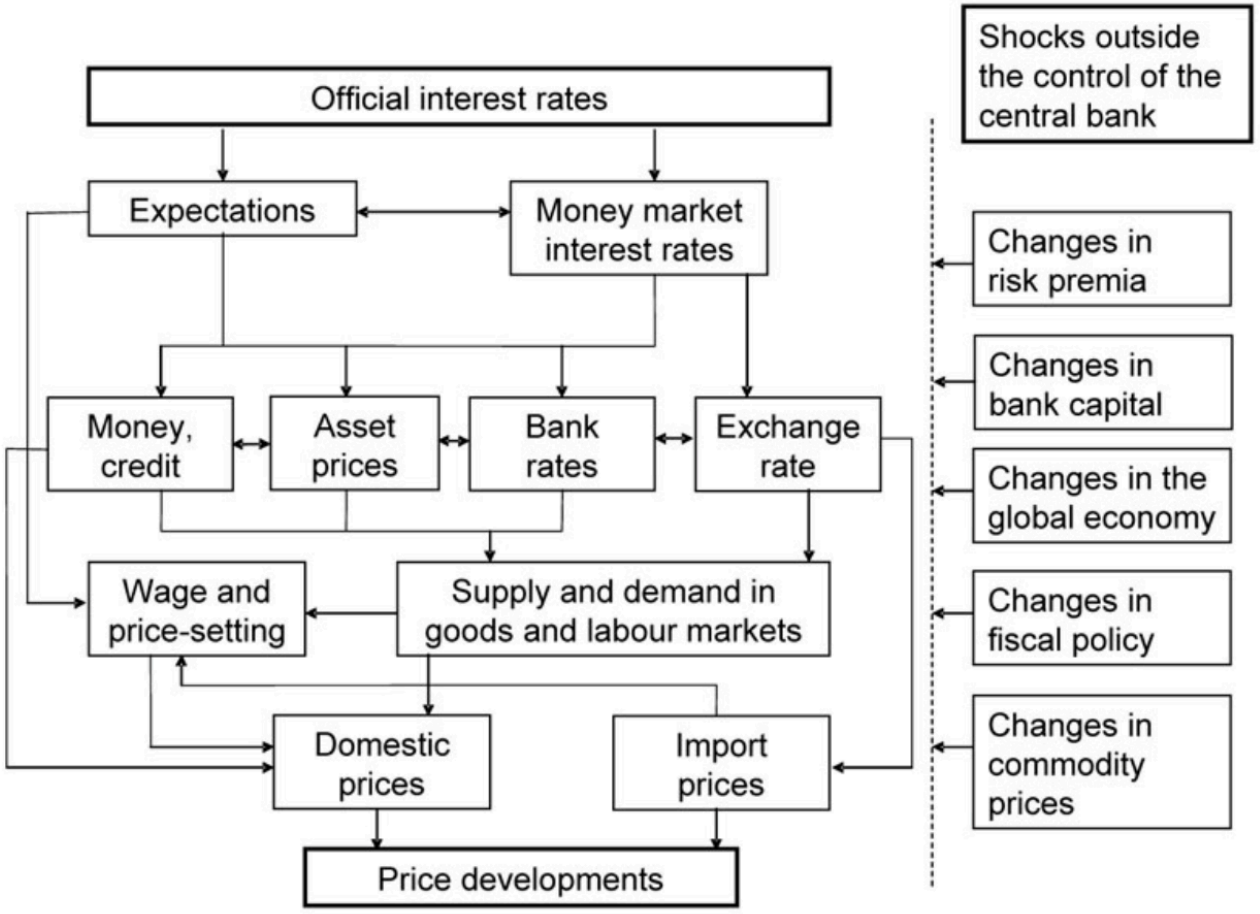
Do (and how) higher interest rates lower inflation? Quest for basic economic model

- Without fiscal help, higher rates don't lower inflation at all (so far).
- Except long term debt mechanism: lower inflation now to raise later.
- Even with fiscal help, we do not have a simple, economic, commonly used model of standard Friedman / Fed "long and variable belief," higher rates slowly reduce future inflation.
- Models (CEE) that replicate VAR do not embody standard intuition.

  higher i $\rightarrow$ (sticky π^e) higher r $\rightarrow$ (lag) lower x,L, $\rightarrow$ (π_t can't move, lag) lower future π_{t+j}.
- Maybe models are right, inflation can jump, belief/VAR wrong?
- Central issue: The ever-troublesome Phillips curve. Sticky price or sticky inflation? Why can't dp/dt jump? Is i$\rightarrow$ lowers x, x $\rightarrow$ future inflation the central causal link of inflation dynamics?
- Amazing that after 40 years such basic questions are unanswered.
- Plenty to do!

What we definitely do not know, courtesy ECB

The chart below provides a schematic illustration of the main transmission channels of monetary policy decisions.

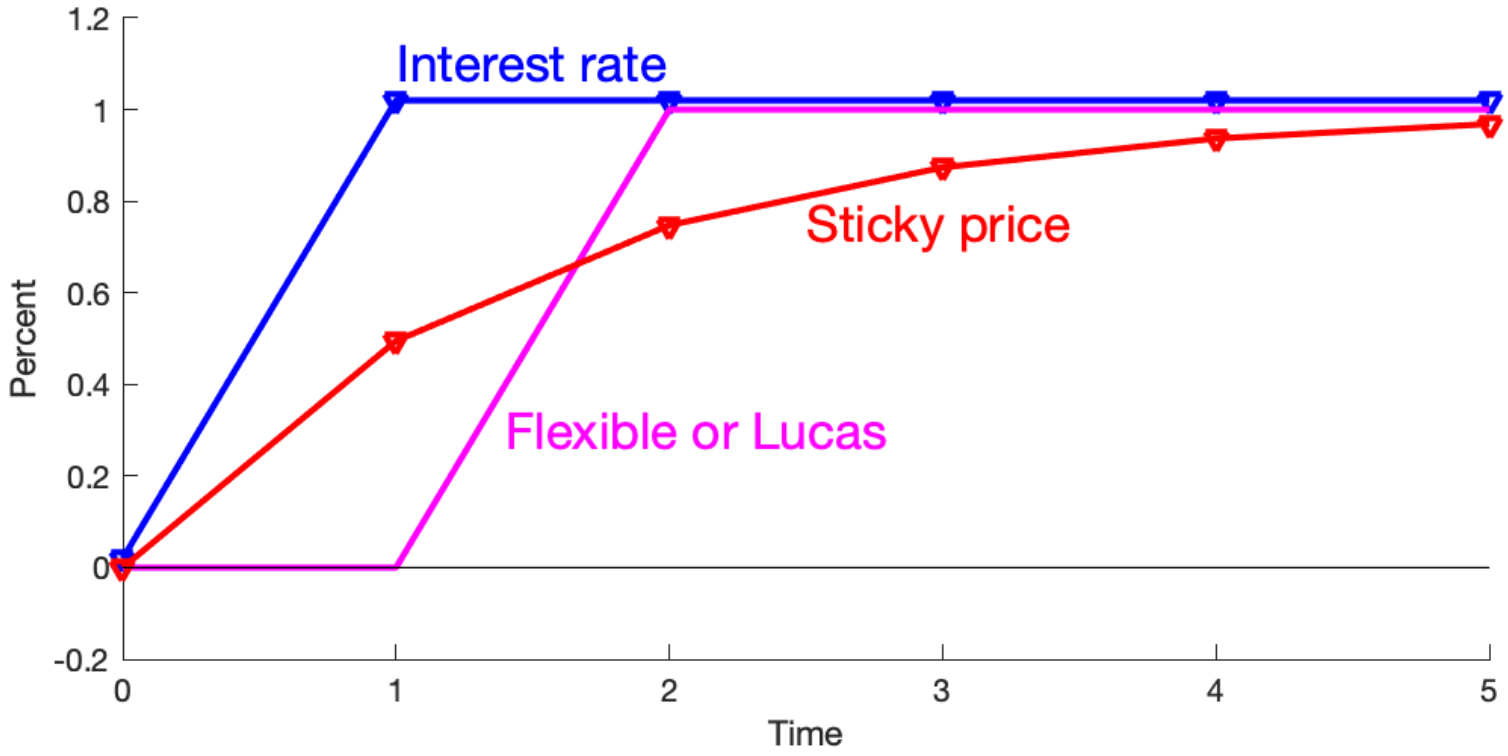


Source: https://www.ecb.europa.eu/mopo/intro/transmission/html/index.en.html

The End

Extra Slides Follow

Sticky price + rational expectations does not give a negative effect



"Flexible or Lucas" plots $E_t\pi_{t+1} = i_t$ and $\Delta E_{t+1}\pi_{t+1} = 0$.

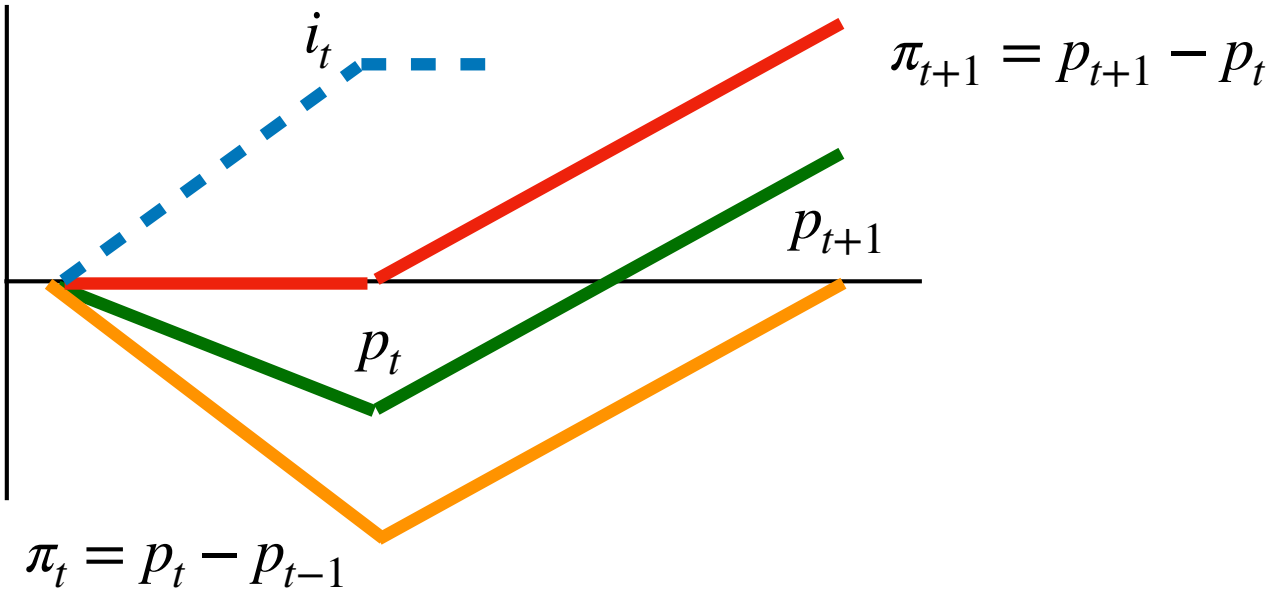
"Sticky Price" plots $E_t\pi_{t+1} = \frac{1}{1+\sigma\kappa}\pi_t + \frac{\sigma\kappa}{1+\sigma\kappa}i_t$ and $\Delta E_{t+1}\pi_{t+1} = \Delta E_{t+1}\sum_{j=0}^{\infty}\rho^j(i_{t+j} - \pi_{t+1+j})$

- Inflation π_1 is *higher*. Interest costs on the debt are paid by devaluing time 0 bonds.
- Yes, non-neutrality and output effects. No, lower inflation.
- This *is* the NK model too.

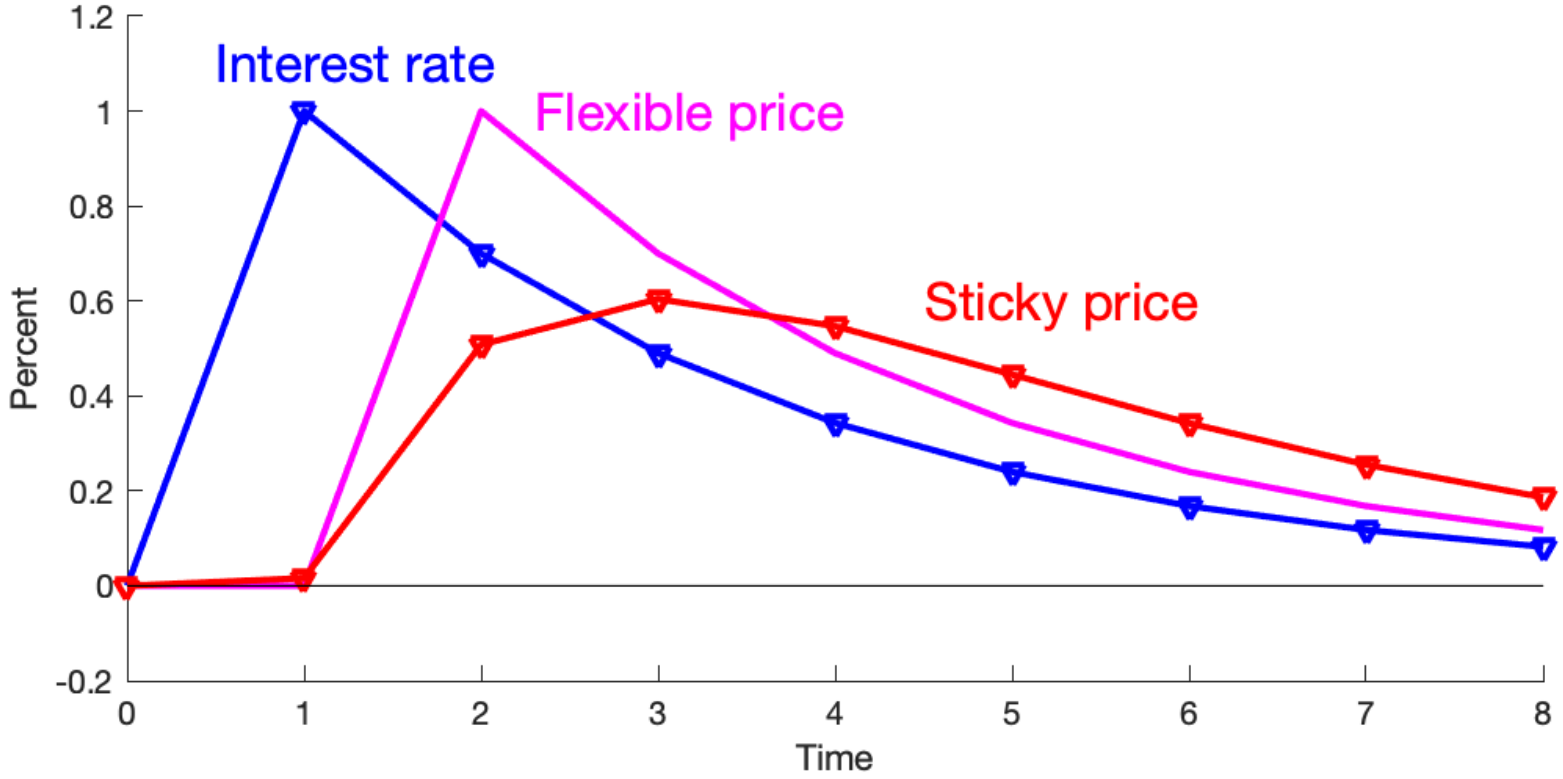
Intuition: Don't higher rates lower demand, inflation?

$$E_t c_{t+1} - c_t = \sigma(i_t - \pi_{t+1})$$

- Higher i_t. Initially p_t, p_{t+1}, π_{t+1} don't change.
- People want more c_{t+1}, less c_t. That pushes p_t down, p_{t+1}, π_{t+1} up. "Intertemporal substitution."
- But is that lower p_t, π_t (current, unexpected) or higher p_{t+1}, π_{t+1}, (future, expected)? "Wealth effect," PV of surpluses.
- Argument confuses p_t, π_t vs. p_{t+1}, π_{t+1}. Proposition is that i_t raises π_{t+1}, intertemporal substitution, natural and hard to overcome.



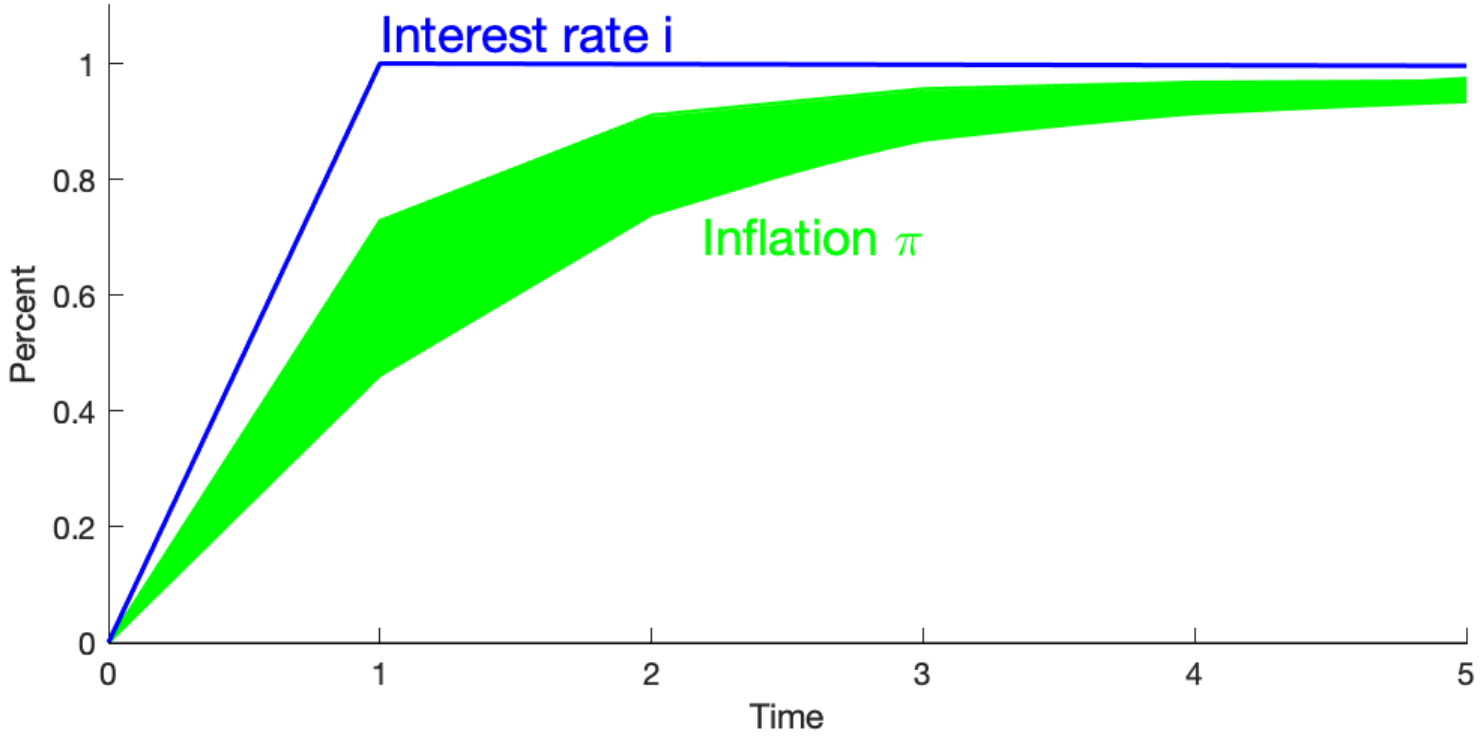
Transitory interest rate path doesn't help.



"Flexible or Lucas" plots $E_t\pi_{t+1} = i_t$ and $\Delta E_{t+1}\pi_{t+1} = 0.$

"Sticky Price" plots $E_t\pi_{t+1} = \frac{1}{1+\sigma\kappa}\pi_t + \frac{\sigma\kappa}{1+\sigma\kappa}i_t$ and $\Delta E_{t+1}\pi_{t+1} = \Delta E_{t+1}\sum_{j=0}^{\infty}\rho^j(i_{t+j} - \pi_{t+1+j})$

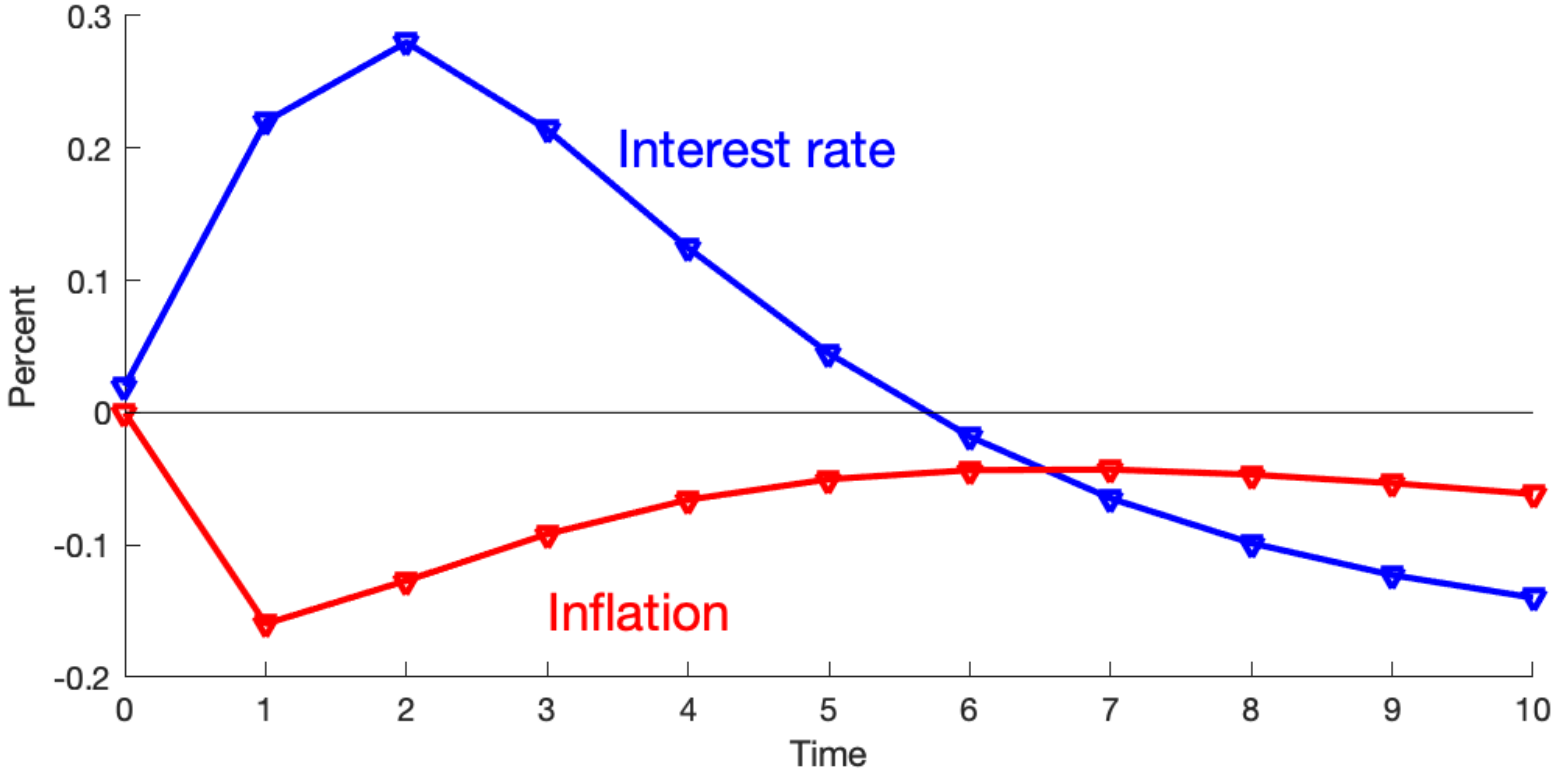
Full model with lagged inflation, all parameters, doesn't help



$$
\begin{aligned}
x_t &= E_t x_{t+1} - \sigma\left(i_t - E_t \pi_{t+1}\right) \\
\pi_t &= (1-\alpha) E_t \pi_{t+1} + \alpha \pi_{t-1} + \kappa x_t \\
\rho v_{t+1} &= v_t + i_t - \pi_{t+1} \\
i_{t+1} &= i_t + \varepsilon_{i,t+1}
\end{aligned}
$$

All parameters σ, κ, α that give real eigenvalues (no zig-zag, sine waves)

Transitory shocks can be misleading

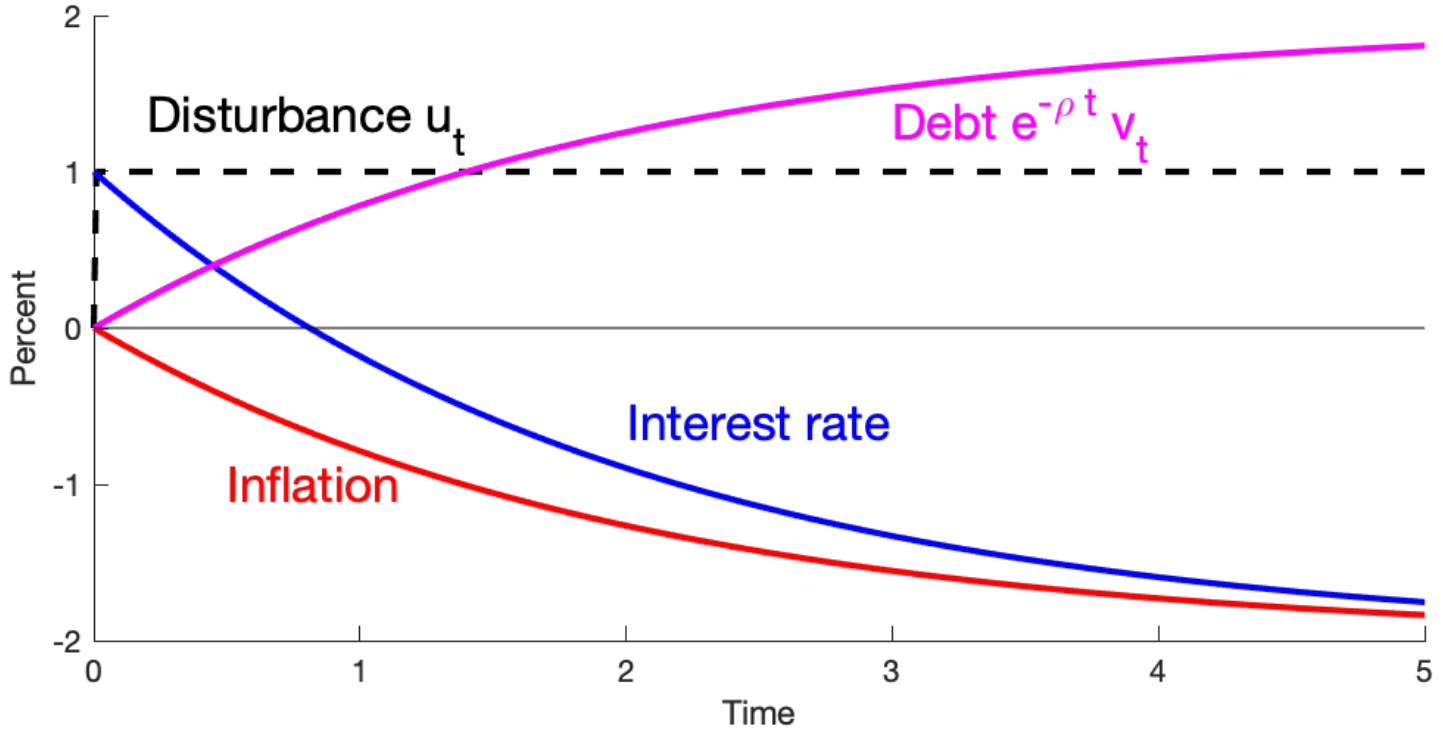


"Inflation" plots $E_t\pi_{t+1} = \dfrac{1}{1+\sigma\kappa}\pi_t + \dfrac{\sigma\kappa}{1+\sigma\kappa}i_t$ and $\Delta E_{t+1}\pi_{t+1} = \Delta E_{t+1}\sum_{j=0}^{\infty}\rho^j(i_{t+j} - \pi_{t+1+j})$.

- Future negative interest rates drag inflation down now; overall interest costs are negative.
- No "high interest rates lower aggregate demand!"
- This could be what we see in VARs!
- Any positive sequence of nominal interest rates uniformly raises inflation.

General: $\pi_1 = \dfrac{1-\rho}{1+\sigma\kappa}\sum_{j=1}^{\infty}\rho^j i_j$. $\pi_{t+1} = \dfrac{1-\rho}{(1+\sigma\kappa)^{t+1}}\sum_{j=1}^{\infty}\rho^j i_j + \dfrac{\sigma\kappa}{1+\sigma\kappa}\sum_{j=1}^{t}\dfrac{1}{(1+\sigma\kappa)^{t-j}}i_j$

Not even adaptive expectations works.

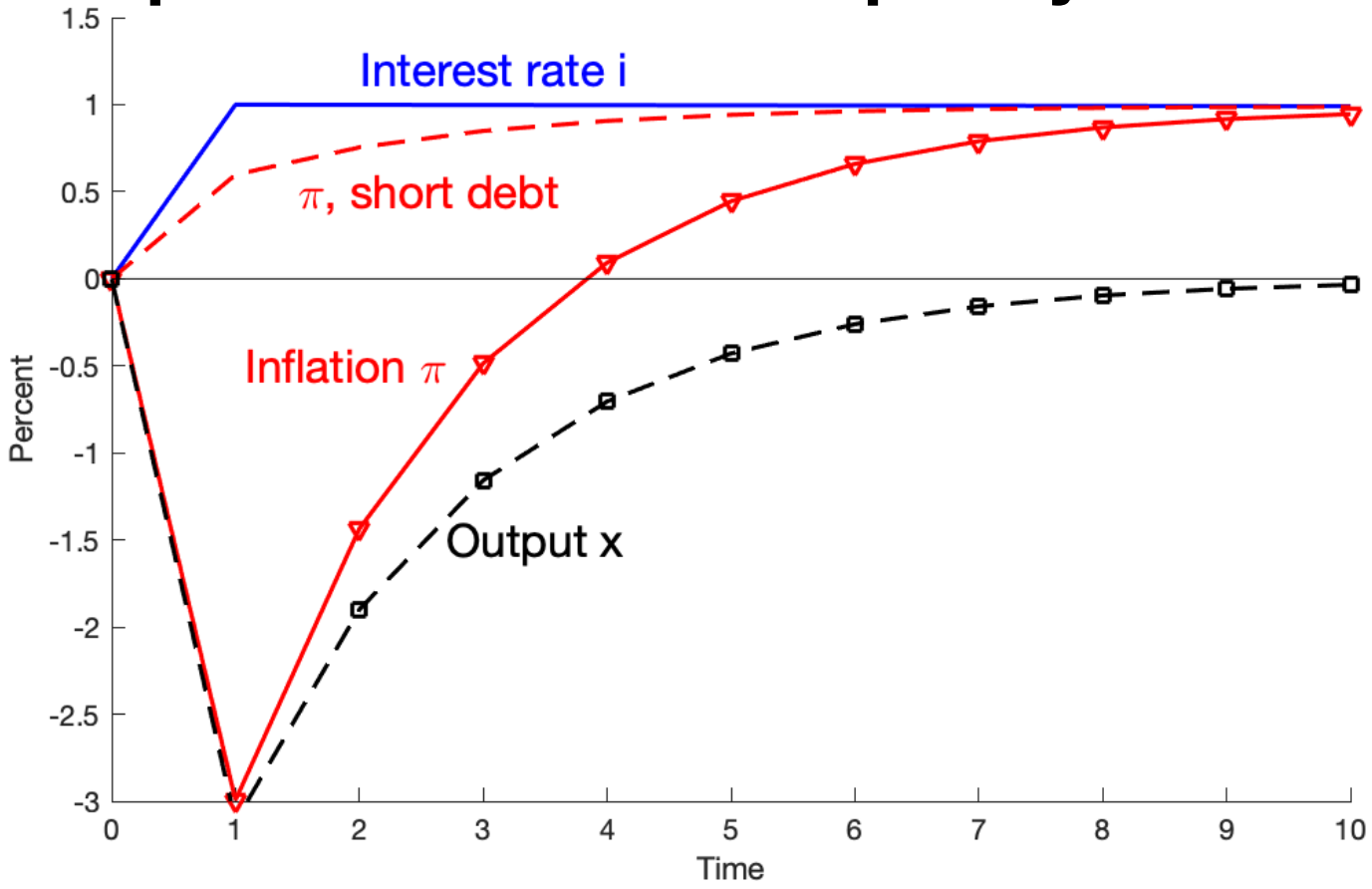


- Disinflation requires interest costs on debt.
- Does not answer our quest, higher interest rates *without* fiscal tightening.
- Paper: for $\rho = 1$ interest rates with no change in fiscal policy *cannot* change long-run inflation. Intuition: average real interest cost on debt = 0 implies average real interest to shove inflation around = 0.

$$x_t = -\sigma(i_t - \pi_{t-1})$$
$$\pi_t = \pi_{t-1} + \kappa x_t$$
$$\rho v_{t+1} = v_t + i_t - \pi_{t+1}$$
$$i_t = \phi \pi_t + u_t$$
$$\sigma\kappa = 1;\ \phi = 1.5\ \rho = 0.99$$

(Continuous time)

An imperfect model of temporary non-neutrality



- Key: long term debt. Lower long-term bond price $Q_t^{(t+j)}$makes short-term debt more valuable

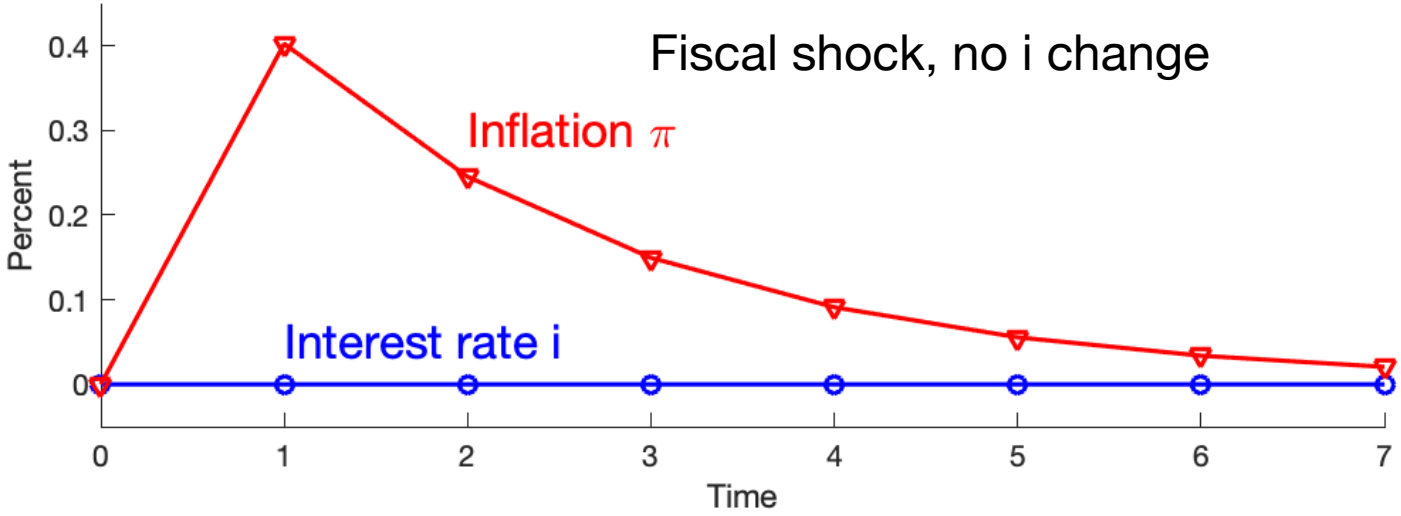
$$\frac{B_{t-1}^{(t)} + \sum_{j=1}^{\infty} Q_t^{(t+j)} B_{t-1}^{(t+j)}}{P_t} = E_t \sum_{j=0}^{\infty} \beta^j s_{t+j} = 0$$

(Calculation includes interest cost/discount rate)

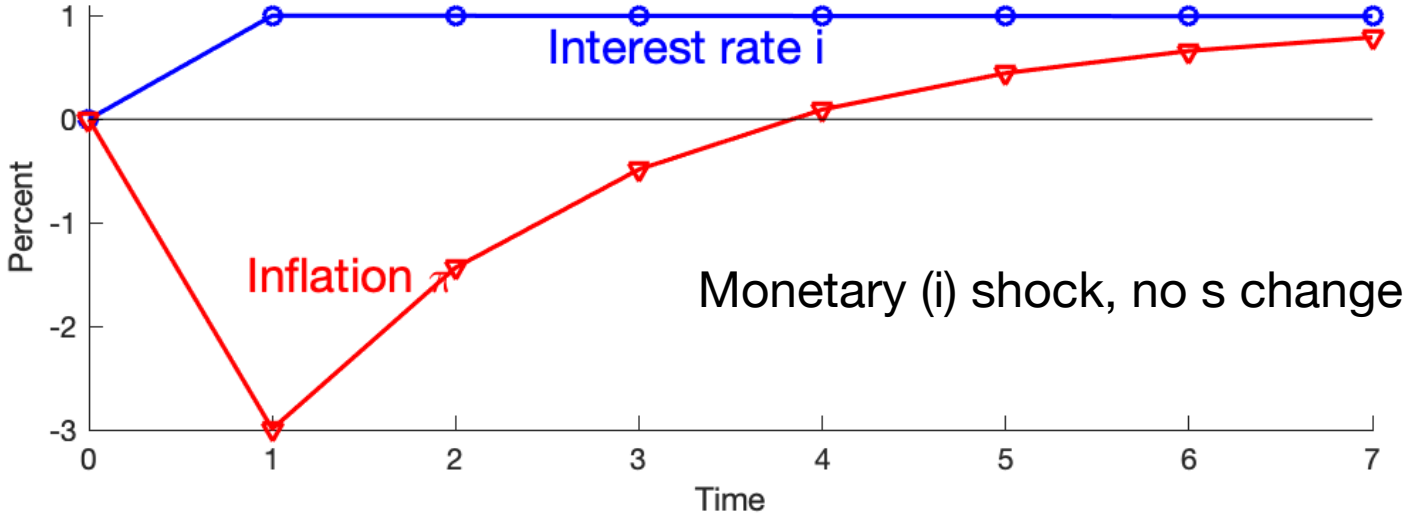
- Stepping on a rake/unpleasant arithmetic.

$$x_t = E_t x_{t+1} - 0.5(i_t - E_t \pi_{t+1})$$
$$\pi_t = E_t \pi_{t+1} + 0.5 x_t$$
$$i_t = i_{t-1} + \varepsilon_{i,t}$$
$$\rho v_{t+1} = v_t + r_{t+1}^n - \pi_{t+1} - \tilde{s}_{t+1}$$
$$E_t r_{t+1}^n = i_t$$
$$r_{t+1}^n = 0.9 q_{t+1} - q_t$$

FTPL digression



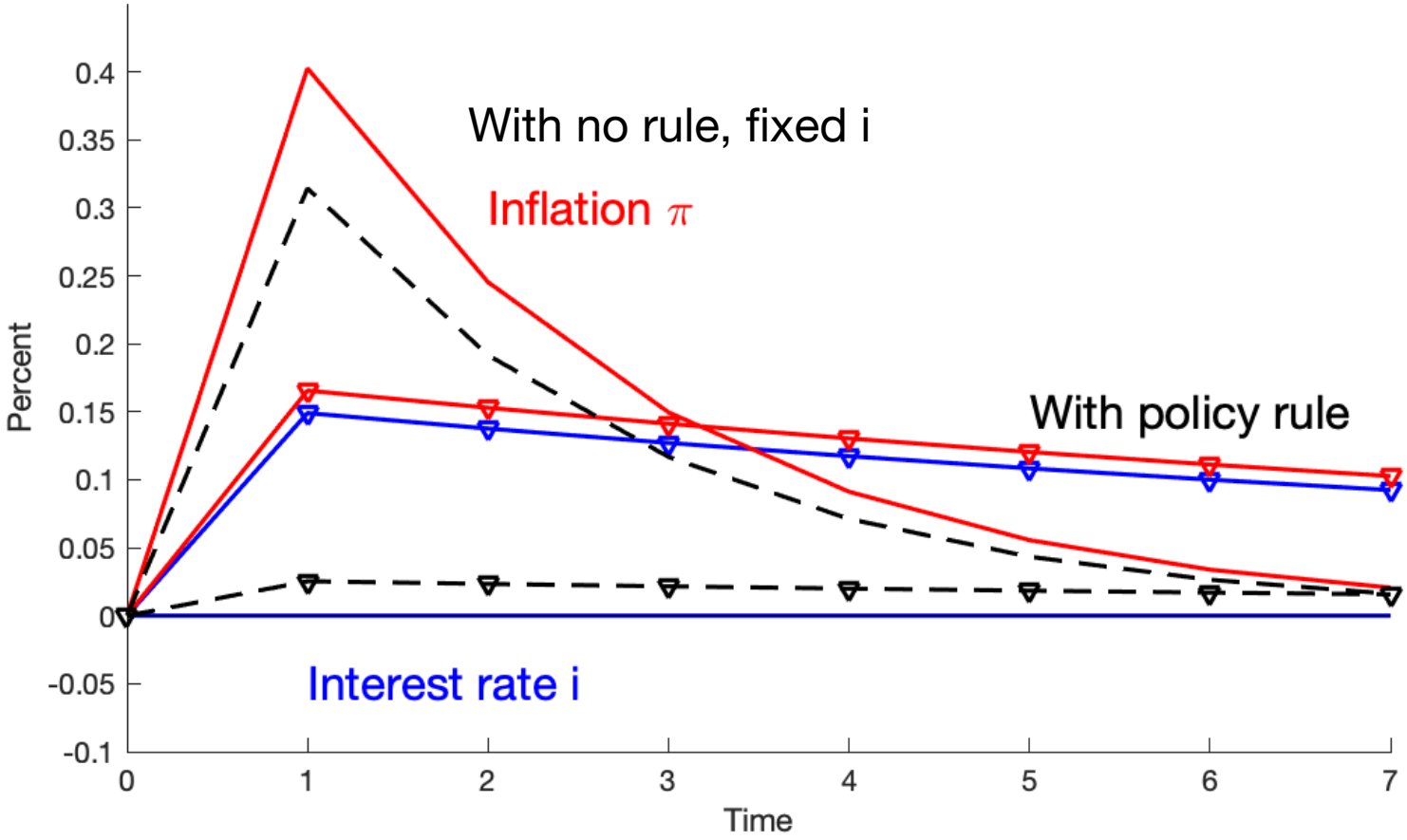
Inflation does fade, if the Fed does nothing. (And no more shocks!) Cumulative low returns drain bondholder value, not price level jump.



Monetary policy can rearrange inflation over time and achieve any long-run expected inflation (once debt rolls over, $i_t = E_t \pi_{t+1}$.)

Now add: What if Fed reacts to a fiscal shock with higher interest rates?

Taylor Rule in FTPL models

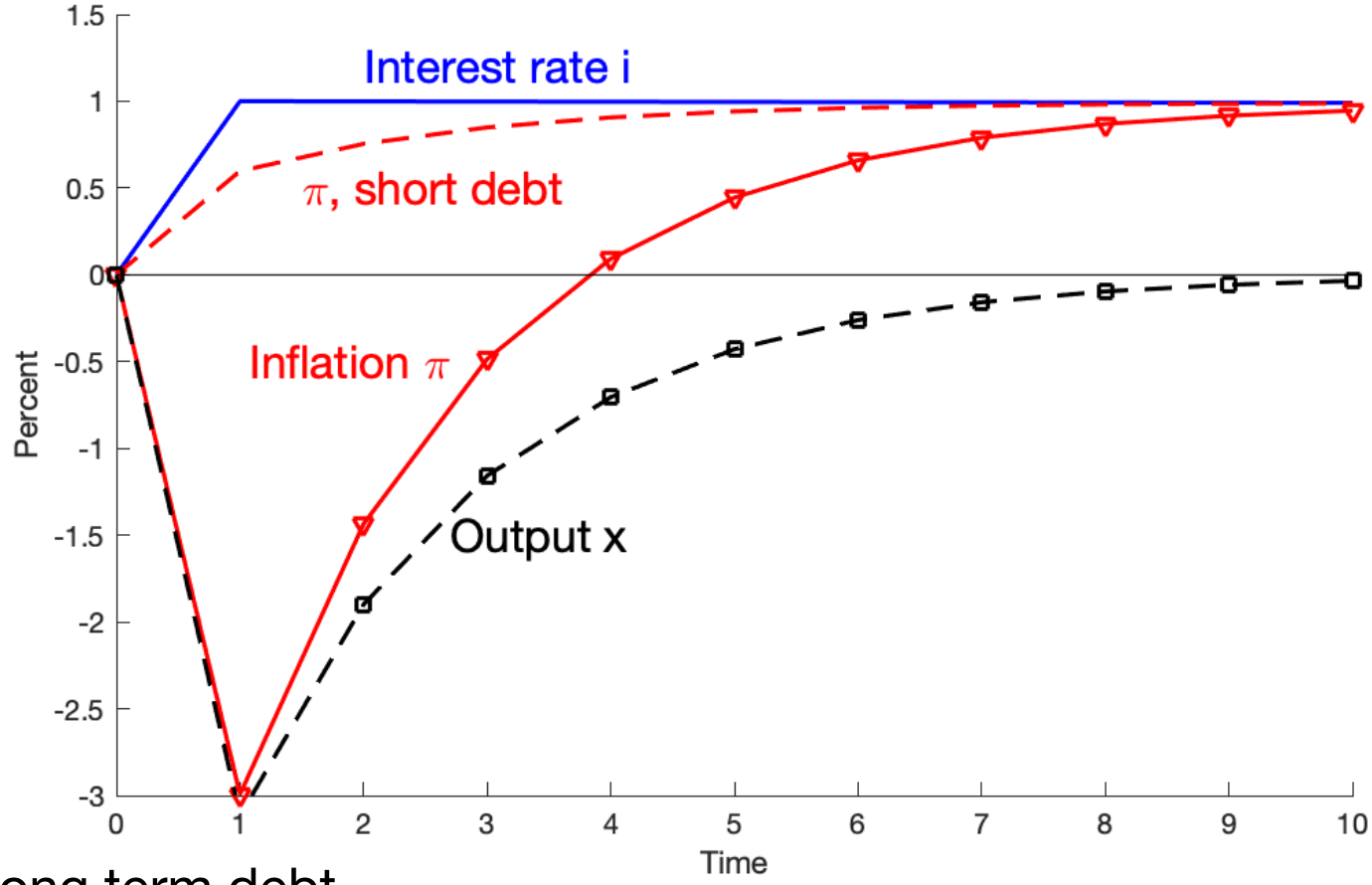


Response to a fiscal shock with a monetary rule, $i_t = \phi \pi_t$

- Adaptive: Taylor rule stabilizes an unstable model
- New Keynesian: Taylor rule brings determinacy to indeterminate model
- FTPL: Taylor rule reduces output and inflation volatility

Current events: Fed will lower inflation, at the cost of prolonging it.

An imperfect model of temporary non-neutrality



But:

- Needs long term debt.
- Stickier prices *reduce* the effect. (Interest costs.)
- Only an unexpected, persistent rate rise, on announcement not when the rates rise.
- Too sudden/strong (relative to VARs).
- Unexpected inflation, not lower expected inflation; not short run adaptive/ long run rational.
- Still a “wealth” effect not “real interest rate” effect.
- Not Lucas holy water on monetarist/ISLM intuition!

$$x_t = E_t x_{t+1} - 0.5(i_t - E_t \pi_{t+1})$$

$$\pi_t = E_t \pi_{t+1} + 0.5 x_t$$

$$i_t = i_{t-1} + \varepsilon_{i,t}$$

$$\rho v_{t+1} = v_t + r^n_{t+1} - \pi_{t+1} - \tilde{s}_{t+1}$$

$$E_t r^n_{t+1} = i_t$$

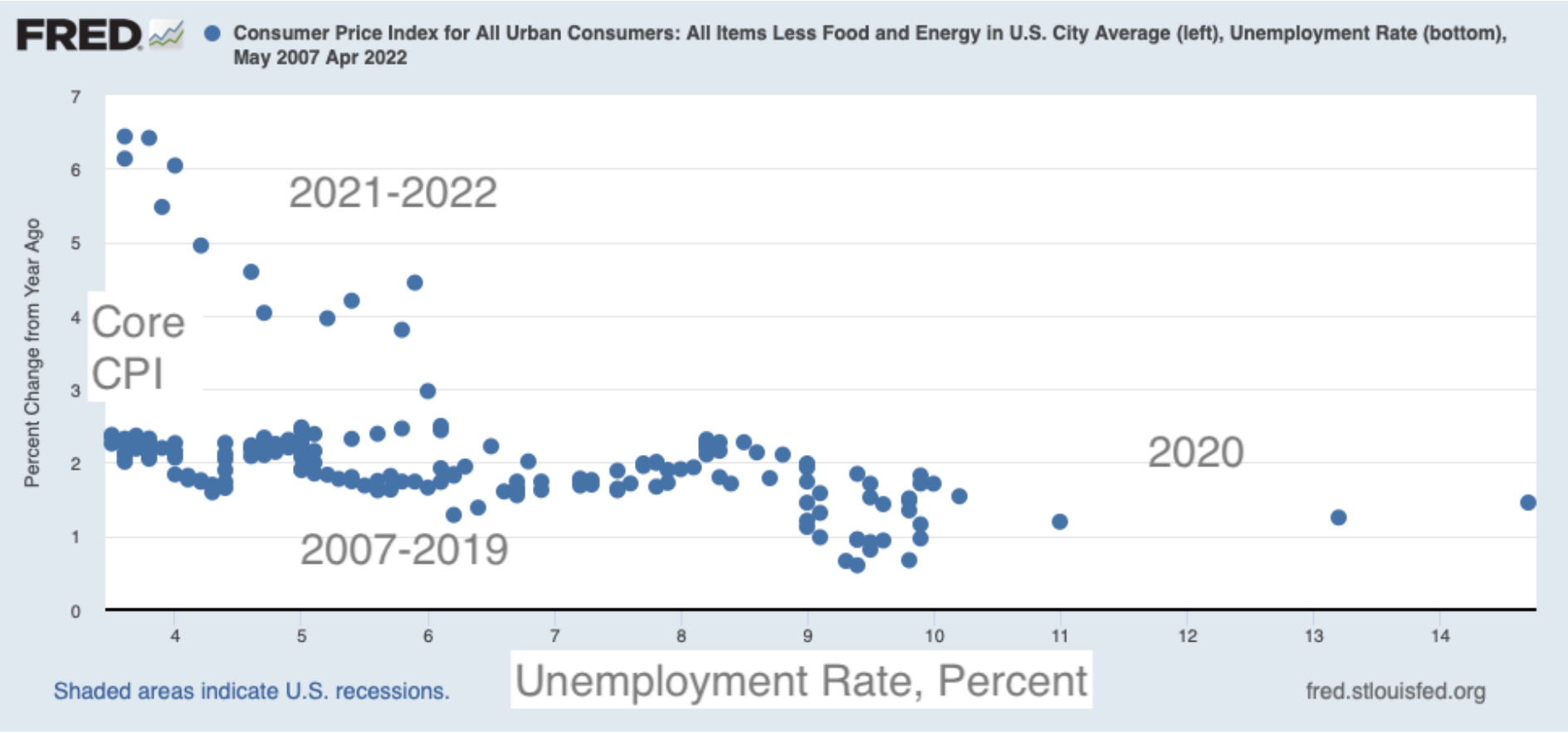
$$r^n_{t+1} = 0.9 q_{t+1} - q_t$$

Needed: Lucas (2022). Expectations and the (temporary non-) neutrality of interest rates

- Irrational / complex / model-inconsistent expectations? As a *necessary* ingredient for the *sign* of monetary policy?
- Stability, determinacy, long run neutrality are deeper and desirable properties.
- Tests are not so easy. Rational can seem adaptive $\pi_t^e = \Sigma a_j \pi_{t-j}$. The rational expectations point is only that parameters $\{a_j\}$ change.
- DSGE smorgasbord? (Investment, credit constraints, financial frictions, heterogeneity, etc. etc.) Yes! But what is the minimal, robust, economically *necessary* set of ingredients/frictions for a negative short run effect? Intuition please? (Yes, please!)

Needed: Lucas (2023). Beyond the Phillips curve?

- Us: How do nominal interest rates affect inflation? (Then output?) We use Phillips curve; $x_t = -\sigma(i_t - E_t\pi_{t+1})$ and $\pi_t = E_t\pi_{t+1} + \kappa x_t$.
- Phillips curves have theory & empirical shortcomings. Relation between all prices, wages and output? (Confuse relative with absolute price level?)
- Sign; inflation rising or falling? $\pi_t = E_t\pi_{t+1} + \kappa x_t$ vs. $\pi_t = \pi_{t-1} + \kappa x_t$

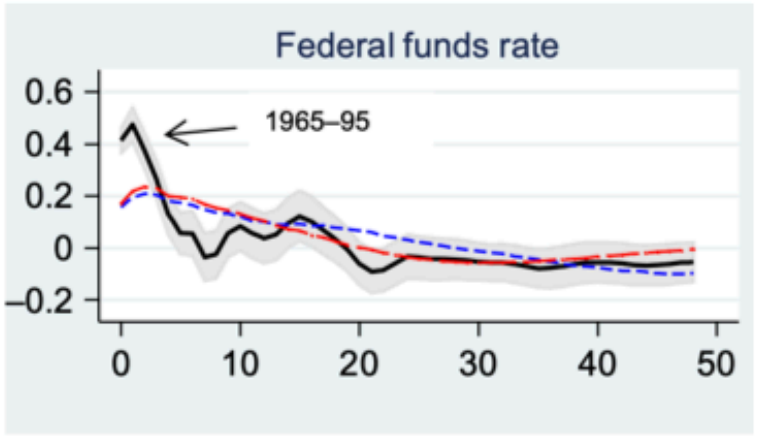


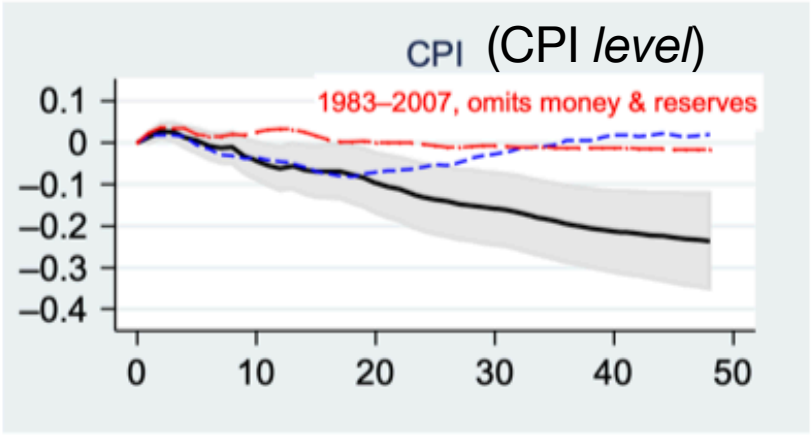
Needed: Lucas (2023). Expectations and the (temporary non-) neutrality of interest rates

- Us: How do nominal interest rates affect inflation? (Then output?) We use Phillips curve; $x_t = -\sigma(i_t - E_t\pi_{t+1})$ and $\pi_t = E_t\pi_{t+1} + \kappa x_t$
- Lucas: How does *inflation* affect *output*? Not how does money affect inflation. Not designed for our purpose.
- Attack $\pi_t = a(L)i_t + \varepsilon_t$ directly? Abandon Phillips curve (for this purpose)? Production network models?
- $i_t = r_t + E_t\pi_{t+1}$ is harder than $m_t + v = p_t + y_t$ because r_t must decline more than 1-1. (If the goal is lower expected inflation).
- Or, maybe, the negative sign (without fiscal policy) isn't true?

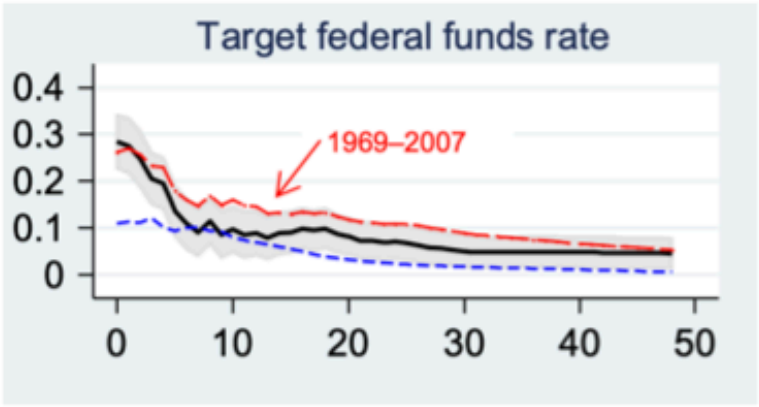
Estimates of the effects of higher interest rates

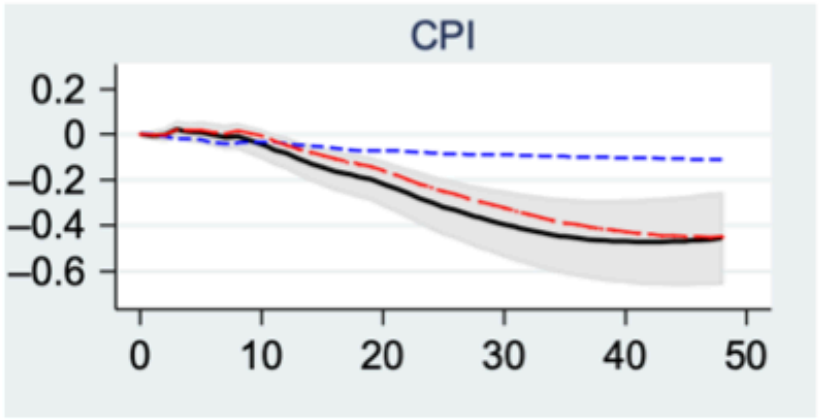
VAR





Romer-Romer





Source: Ramey (2016)

- Slow delayed inflation decline, not AR(1). If at all! *This* is the Fed's big stick?

But

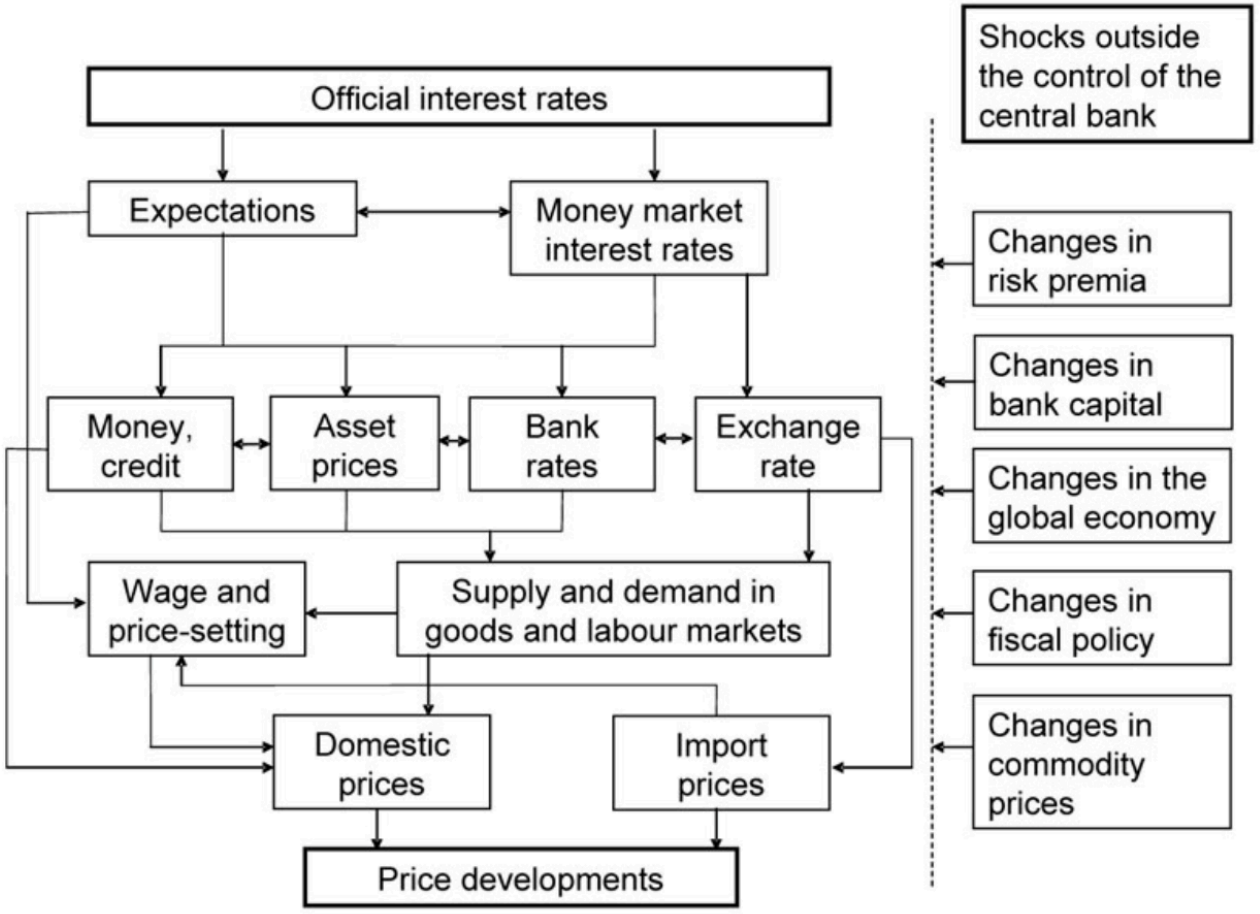
- Only one, average, small, value of funds rate persistence.
- Does not try to hold fiscal policy fixed — at time of shock or in response. It could well be true with contemporary fiscal shocks and responses, but not without them. Estimates that hold fiscal policy constant are low-hanging fruit.
- By design, leaves out changes in regime that change expectations.

Bottom line

- 50 years on. Lots achieved. Lots unknown. Lots to do.
  - We have an economic theory of stable & determinate inflation with an interest rate target. Long run neutrality and frictionless limit. A starting point.
  - Do we believe it? *Is* inflation stable and determinate under an interest rate peg? Is long run neutrality right? K percent rule, long-run positive sign? If not, what is the economic theory of inflation under interest rate targets?
  - Theory need: A better model of the short-run negative effect (without fiscal policy!) if there is one.
  - Empirical need: Is there a short-run negative effect and how?
  - What are fiscal-monetary interactions for Fed, US? Does fiscal policy pay interest costs on the debt? How does Fed affect inflation if fiscal policy responds to a recession with bailout and deficit?
- Policy advice: With basic economic story, stability and sign contentious, a little humility…

The ECB's view of how monetary policy affects inflation

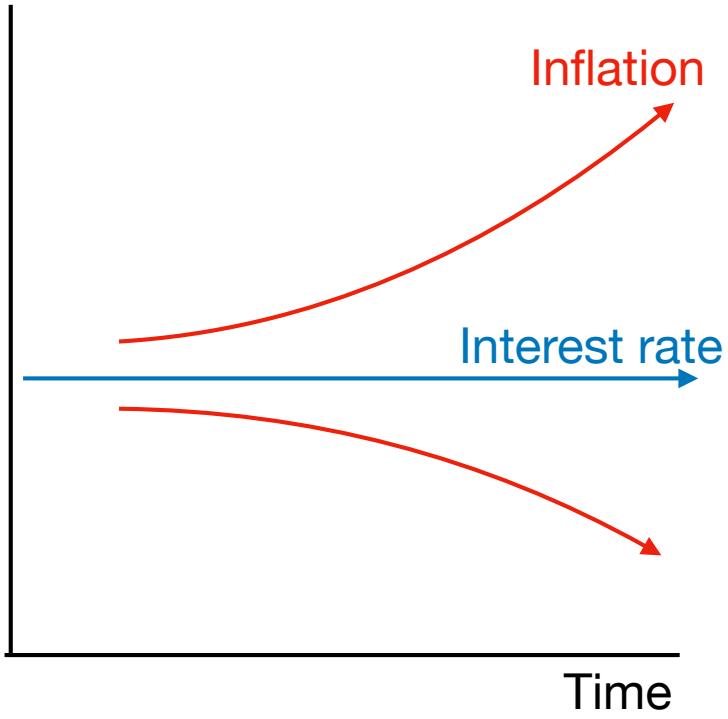
The chart below provides a schematic illustration of the main transmission channels of monetary policy decisions.



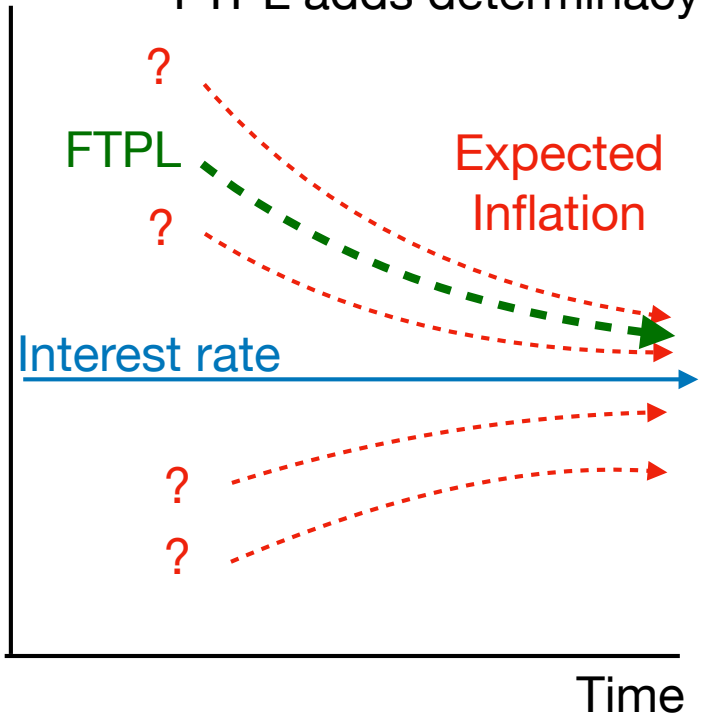
Source: https://www.ecb.europa.eu/mopo/intro/transmission/html/index.en.html

Note somewhere: super rational looks a lot like super adaptive

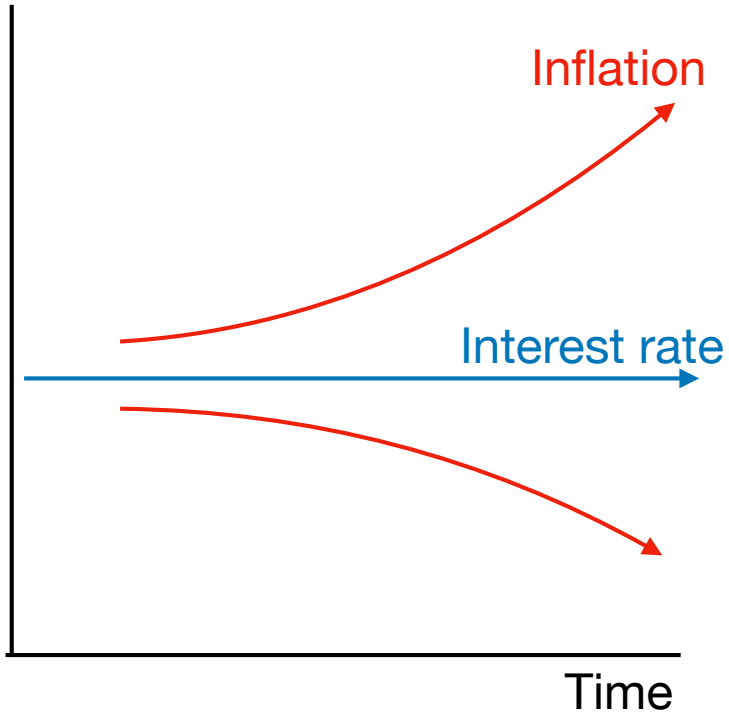
Adaptive expectations.
Unstable (determinate)



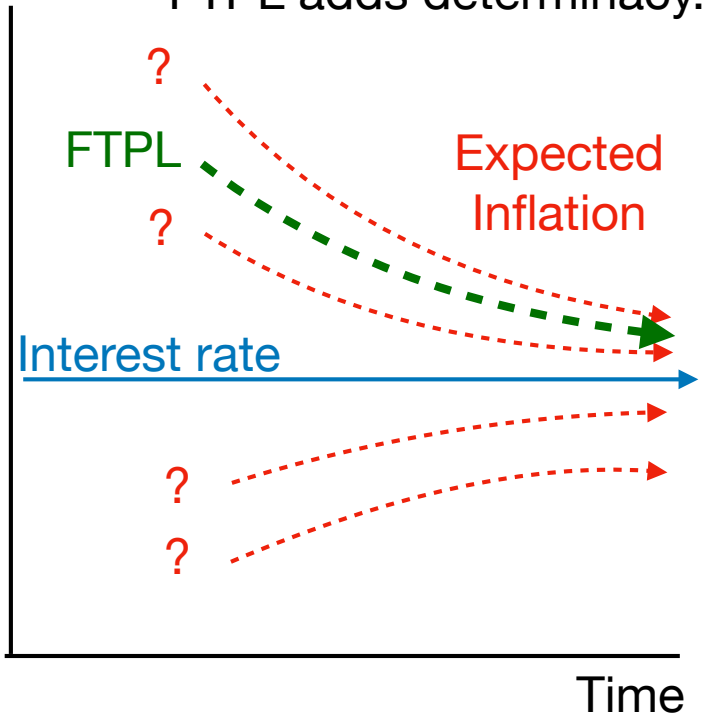
Rational expectations.
Stable, indeterminate
FTPL adds determinacy



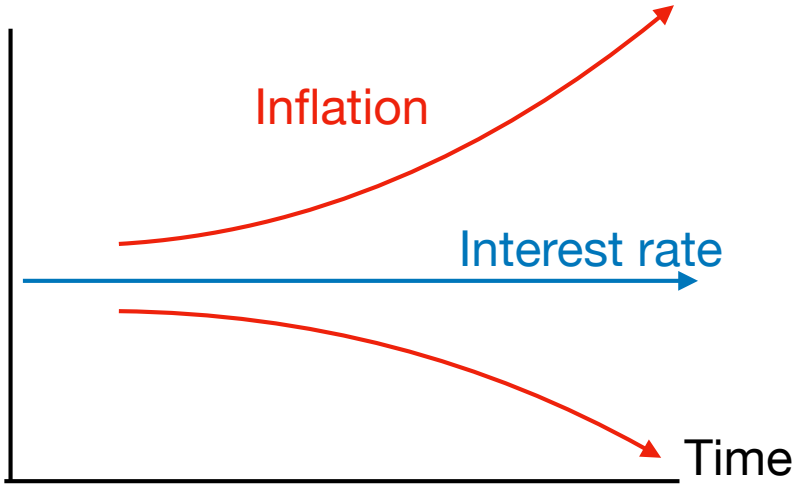
Adaptive expectations.
Unstable (determinate).



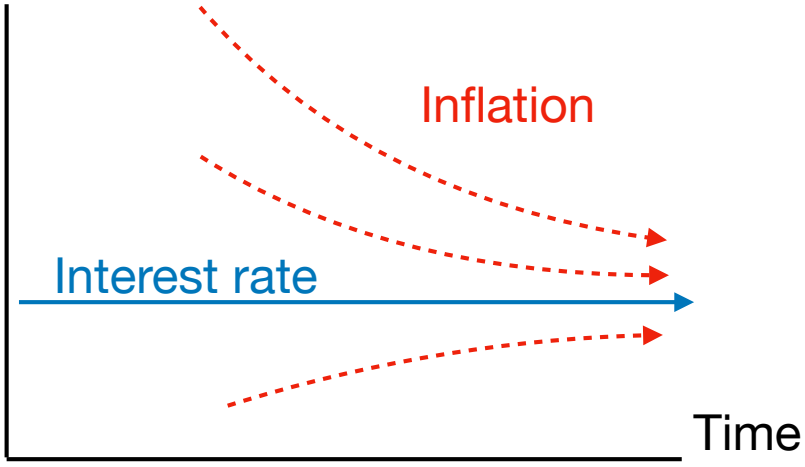
Rational expectations.
Stable, indeterminate;
FTPL adds determinacy.



Unstable (adaptive expectations)



Stable (rational expectations)



Theory of inflation under interest rate targets

Model $x_t = E_t x_{t+1} - \sigma(i_t - \pi_t^e)$ ⟵ In place of $m_t + v = p_t + x_t$

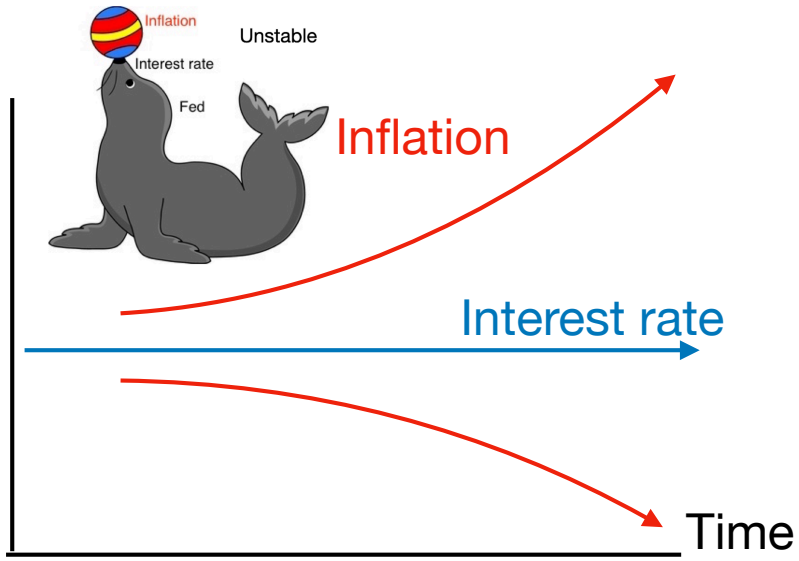
$\pi_t = \pi_t^e + \kappa x_t$

Inflation dynamics $\pi_t = (1 + \sigma\kappa)\pi_t^e - \sigma\kappa i_t\,.$

Adaptive $\pi_t^e = \pi_{t-1}$

$\pi_t = (1 + \sigma\kappa)\pi_{t-1} - \sigma\kappa i_t\,.$

Friedman (1968): i target is *unstable.*



Taylor rule? $i_t = \phi\pi_t$

$$\pi_t = \frac{1 + \sigma\kappa}{1 + \sigma\kappa\phi}\pi_{t-1}\,.$$

Fed stabilizes inflation with adaptive E.

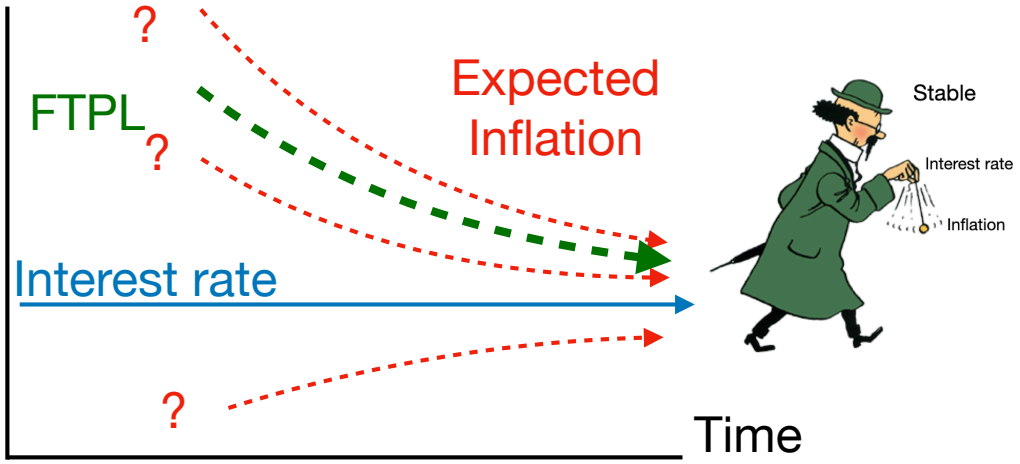
Rational $\pi^e = E_t\pi_{t+1}$

$$E_t\pi_{t+1} = \frac{1}{1 + \sigma\kappa}\pi_t + \frac{\sigma\kappa}{1 + \sigma\kappa}i_t$$

Sargent Wallace (1975): *Stable*, *indeterminate.*

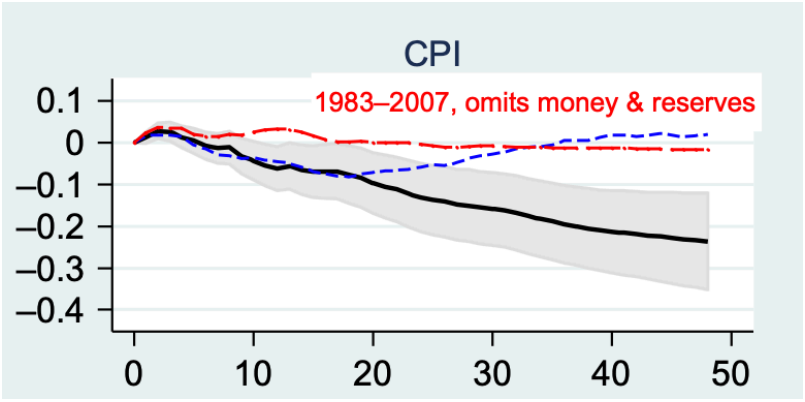
FTPL $\Delta E_{t+1}\pi_{t+1} = \sum_{j=0}^{\infty} \rho^j \Delta E_{t+1}(-\tilde{s}_{t+1+j} + r_{t+1+j})$

Inflation is stable and determinate (at last).

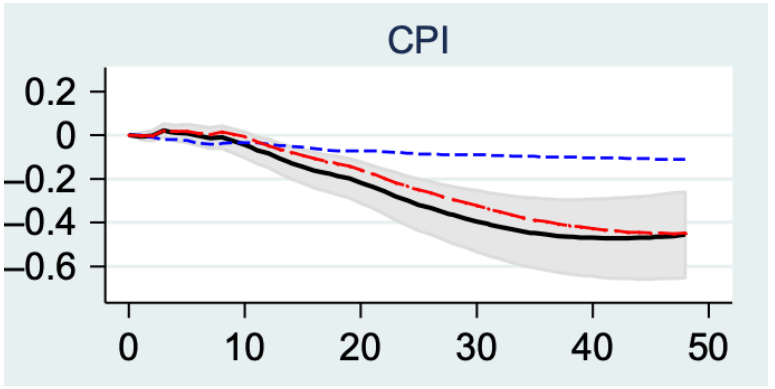


Inflation is not always and everywhere monetary.

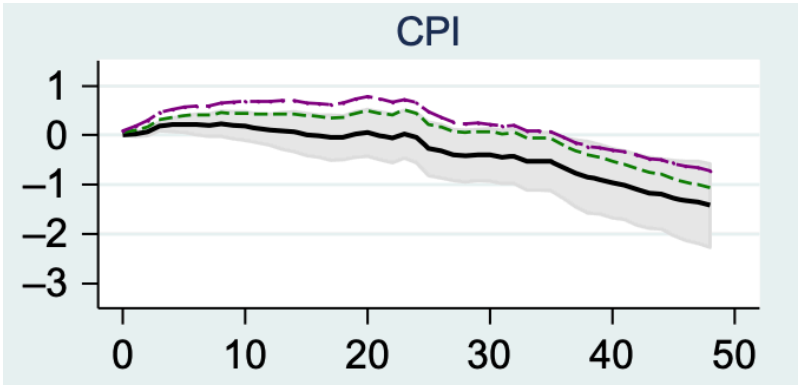
New-Keynesian? $\phi > 1$ Fed destabilizes inflation to select equilibria.



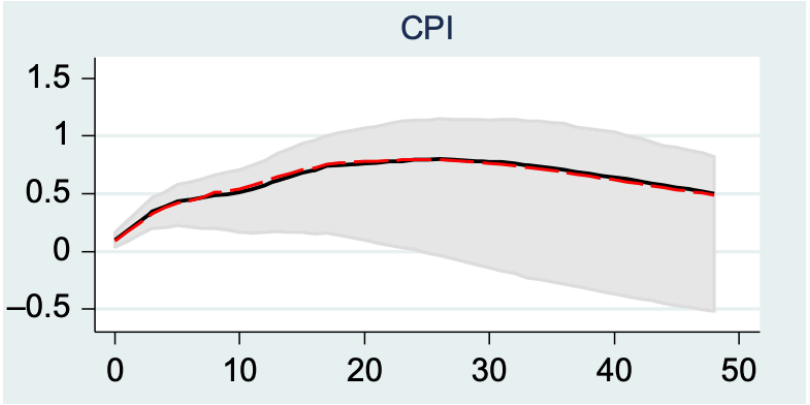
CEE identification



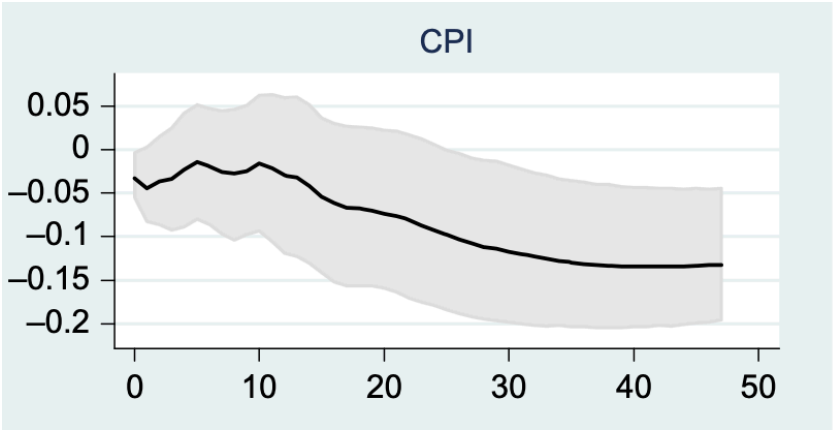
Romer and Romer identification, VAR



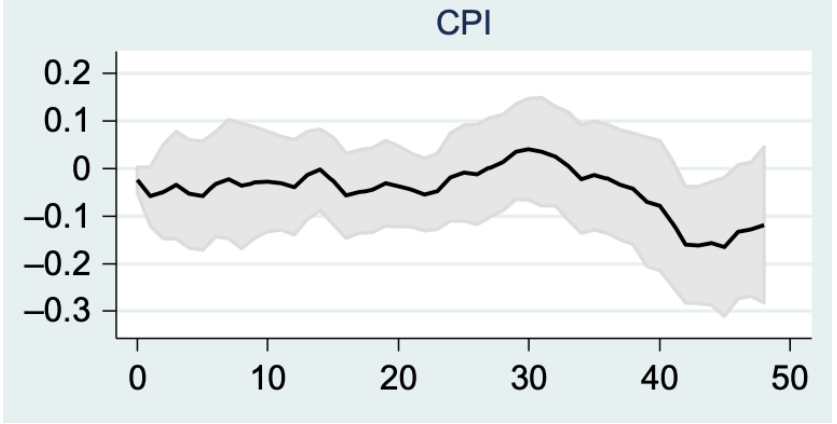
R&R, regression (local projection)



R&R, proxy SVAR



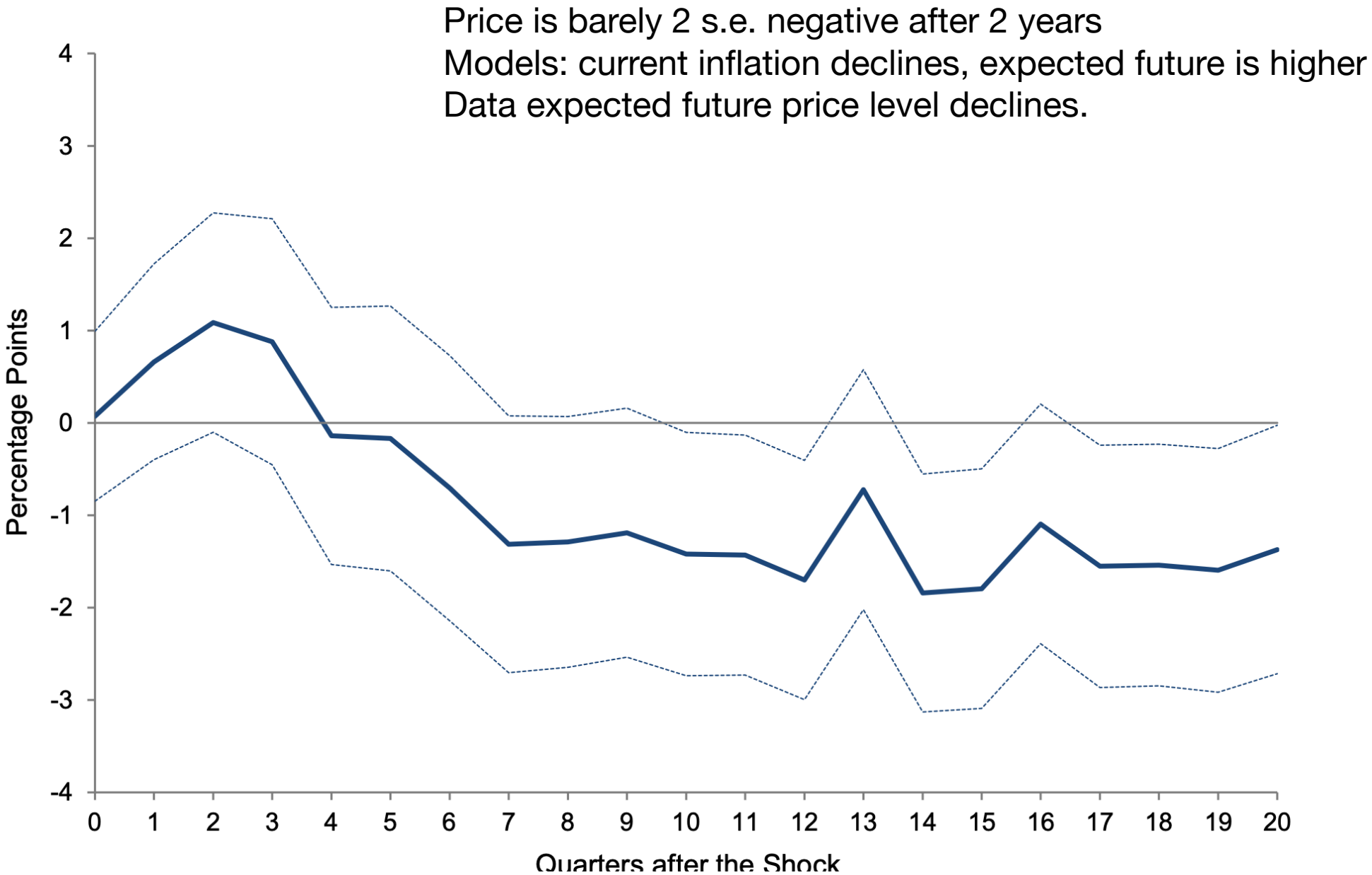
Gertler Karadi VAR



Gertler Karadi, regression

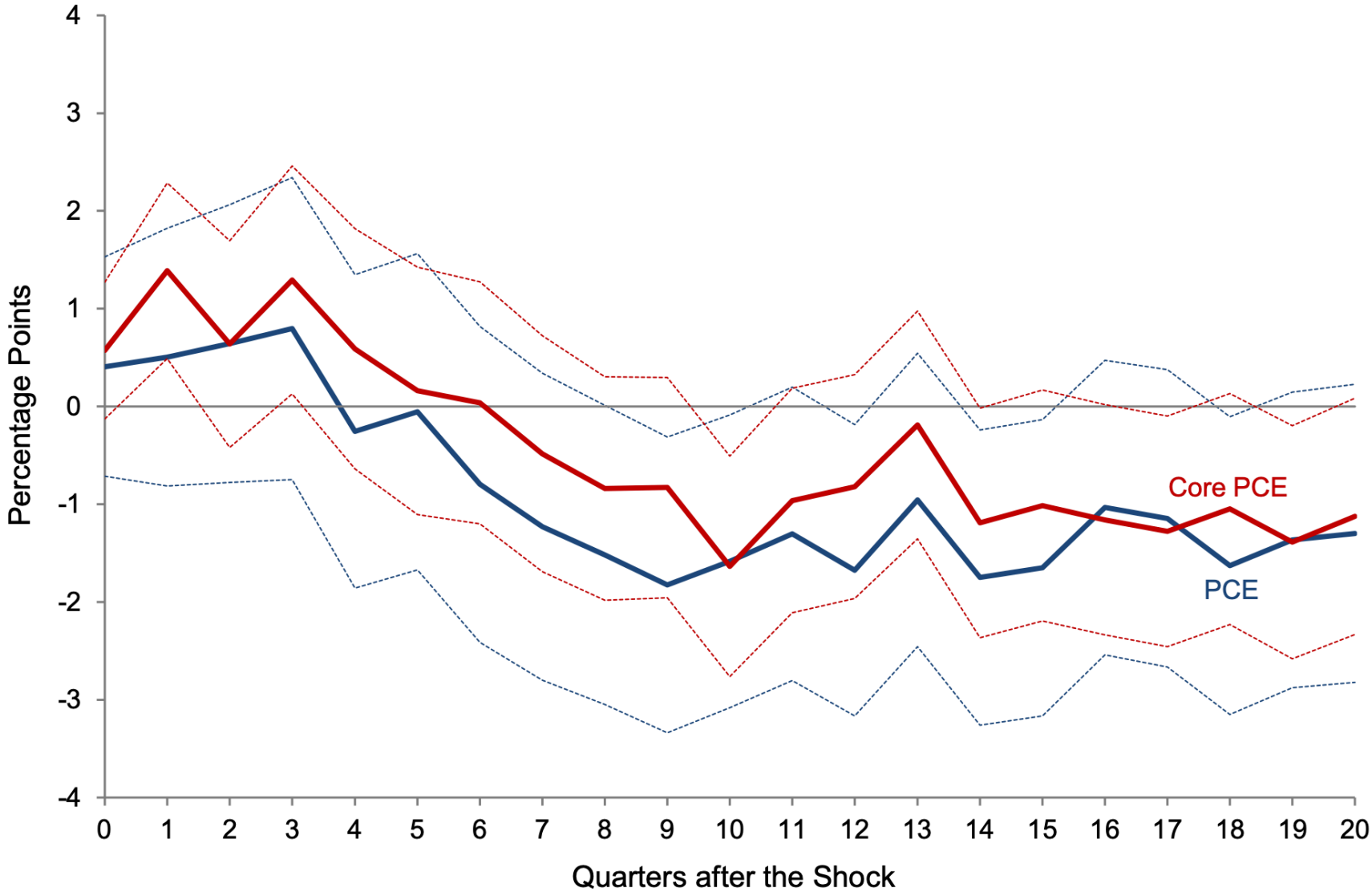
Source: Ramey (2016)

FIGURE 5. RESPONSE OF GDP PRICE INDEX INFLATION TO A MONETARY POLICY SHOCK

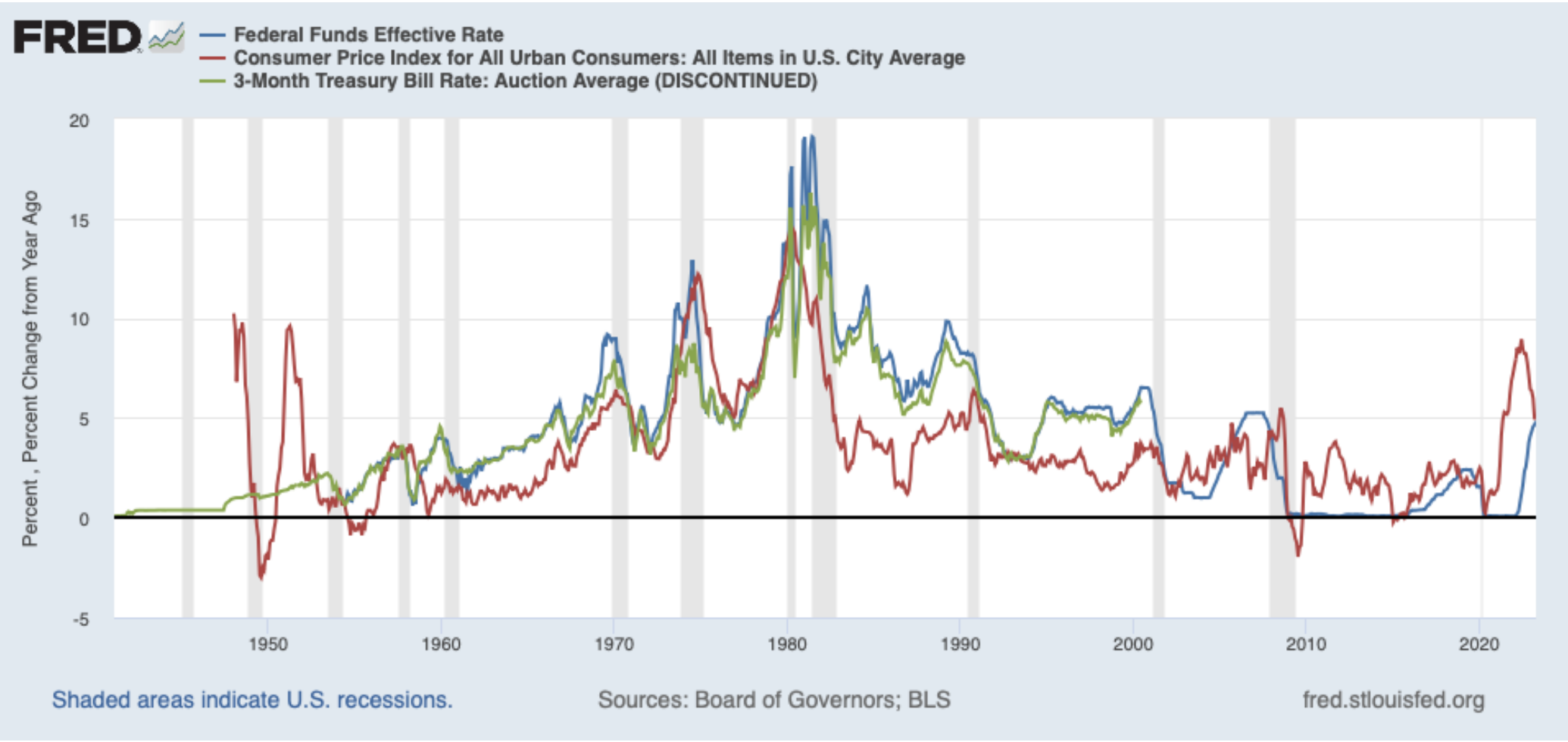


Source: Romer and Romer (2023)

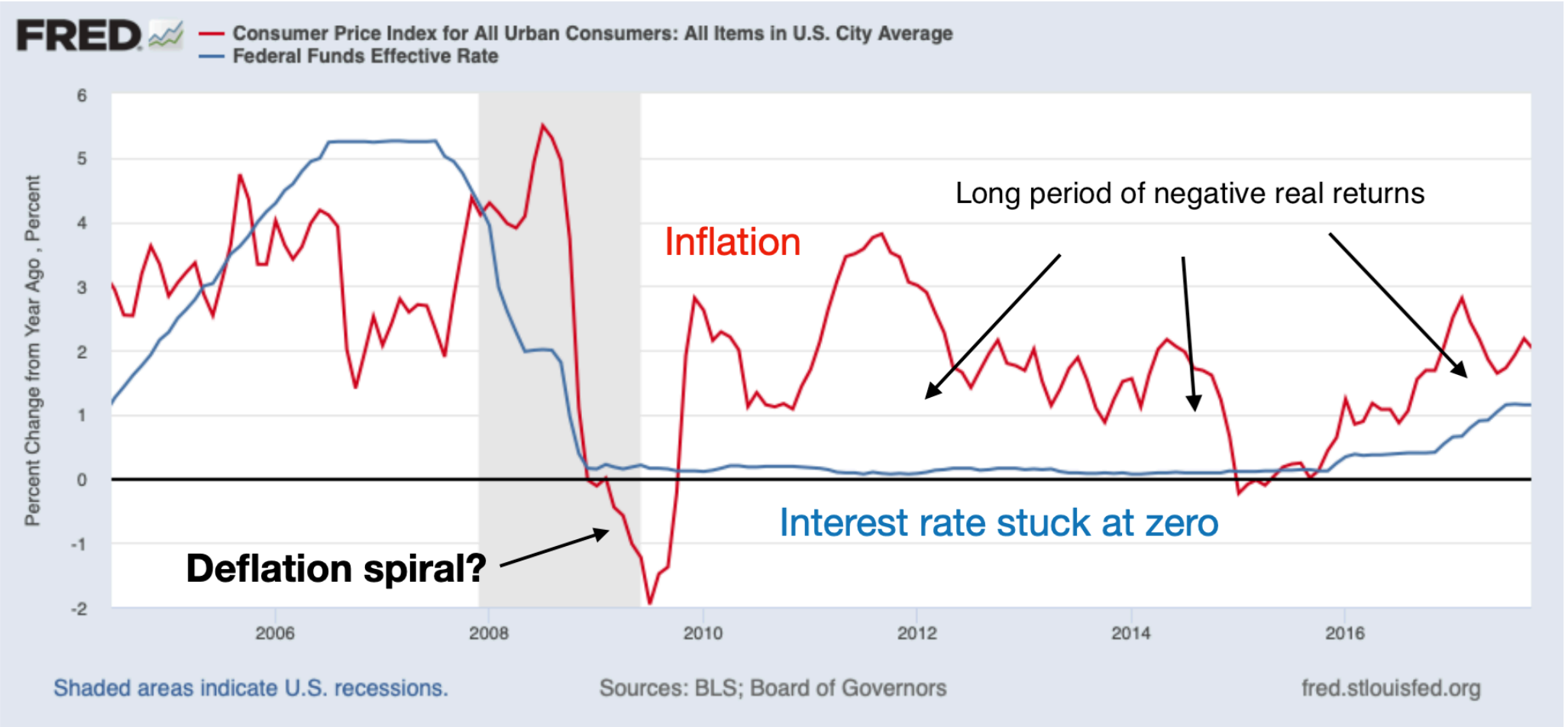
FIGURE 7. RESPONSE OF PCE AND CORE PCE INFLATION TO A MONETARY POLICY SHOCK



Source: Romer and Romer (2023)


FRED
Federal Funds Effective Rate
Consumer Price Index for All Urban Consumers: All Items in U.S. City Average
3-Month Treasury Bill Rate: Auction Average (DISCONTINUED)
Percent , Percent Change from Year Ago
20
15
10
5
0
-5
1950
1960
1970
1980
1990
2000
2010
2020
Shaded areas indicate U.S. recessions.
Sources: Board of Governors; BLS
fred.stlouisfed.org

A test of theories: 2008 and zero bound



- 2008/2009: No big deflation, though widely predicted. Debt/price = EPV(surplus). No deflation because of *fiscal* policy.
- Long zero bound: no spiral, no sunspots, though widely predicted. Only FTPL: inflation *can be* stable, quiet (determinate) at ZLB.
- Immense QE: No monetary hyperinflation, though widely predicted.
- Fiscal? Not great, but no *news*. Unexpectedly low interest rates/costs.