Rules and Discretion
An Empirical Assessment

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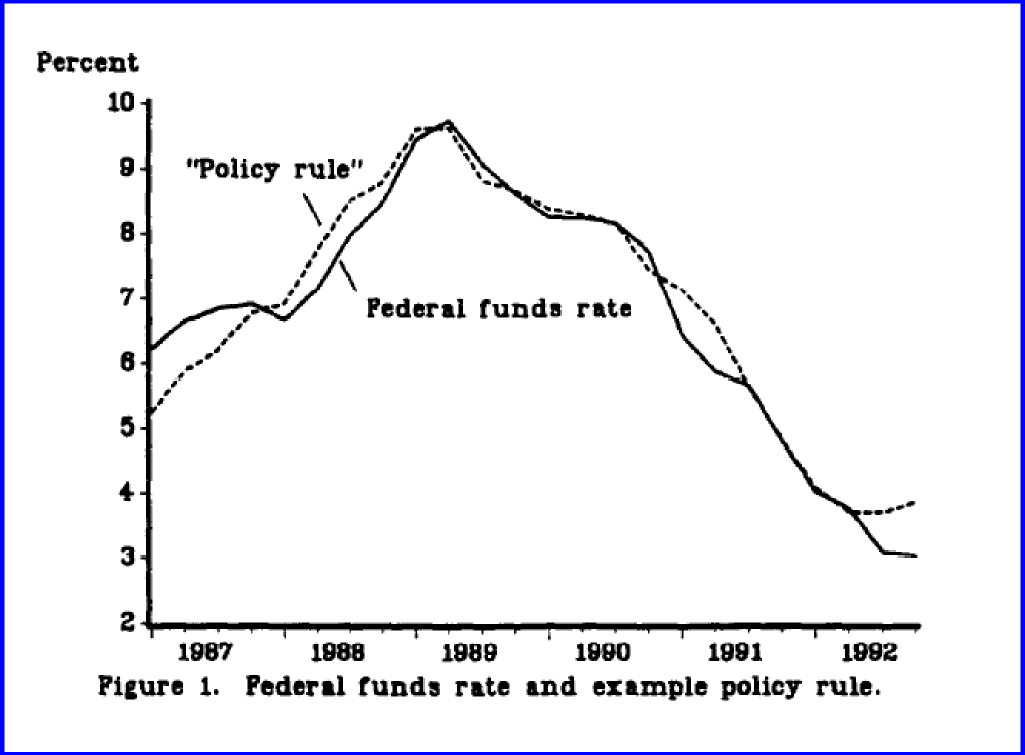
"Are Rules Made to Be Broken?"

Rules rule?

- Taylor 1993

$$r = p + .5y + .5(p - 2) + 2$$

- Simple rule, calibrated, but fit a historical period well:



Some things to note about this canonical rule

$$r = p + .5y + .5(p - 2) + 2$$

- Assumes a fixed equilibrium real interest rate (2)
- Assumes rather than estimates coefficients [1.5, 0.5]
- Assumes simple estimate of potential output in the definition of *y*
- Assumes constant inflation goal of 2%
- Makes policy a function of <u>realizations</u> rather than forecasts
- So what's so bad about a simple rule like that?

Concerns

- Guideline or constraint?
  - Does it hold claim to optimality? Is [1.5, 0.5] best?
- How much do the unobservables in the model matter? How much do they vary? How well can we estimate them?
  - Time-varying real rate, time-varying natural rate, time-varying potential output growth (in some rules), possibly time-varying inflation goal
  - We'll call these "star" variables—r^*, U^*, Δy^*, π^*
- Rule written in realizations, rather than forecasts
  - Most central banks focus on forecasts
- What do deviations from this (or any) rule mean?
  - Mistakes? Discretion?
  - If discretion/mistakes, how much "harm" do they do?

This paper

- Focuses on forecast-based rules
  - Closer to CB practice
  - Incorporates much more information than realization-based rules
- Carefully estimates the time-varying inputs to policy
  - But notes that this enterprise is inherently uncertain
- Uses rules to derive estimates of discretion
  - Caveats apply!
- Estimates the effects of deviations from rules on economy
- Estimates deviations of actual policy from "optimal"

Related Literature

- Forecast-based rules have been estimated before
  - Notable examples include Clarida Gali and Gertler (1999, 2000) and Orphanides (2003, 2004)
  - Previous work takes into account some, but not all, of the time-varying inputs to policy
- There is an extensive literature examining time-variation in the systematic component of policy
  - See, e.g., papers above and Sims and Zha (2006), Boivin (2006), Ireland (2007), Davig and Doh (2009), and Murray, Nikolsko-Rzhevskyy, Papell (2015)
  - Different identification here, with some of the sources of time-variation inferred from the same forecasts used to estimate the rule.
- Optimal monetary policy exercise is performed here using a reduced-form model of Federal Reserve's forecasts
  - More emphasis on approximating a "Fed Model" of the economy.

Key results

- US monetary policy has acted systematically to attain key goals
  - The real funds rate is set relative to its time-varying equilibrium (r^*) to close gaps between forecasts of inflation and its target, and between other goal variables and their time-varying "natural" rates (U^*, Δy^*)
  - Uncertainty around the estimated values of the "stars" (and the average response coefficients) is considerable
- The non-systematic component of policy (discretion?) is small
  - Effects of this component on the macroeconomy are small
- Realized Fed policy not far from estimate of "optimal"
- While quite systematic, this approach to policy differs significantly from simple rule-based responses to realizations of inflation and output

The Forecast-Based Rule

- We estimate the following forecast-based rule at quarterly frequency

$$ff_t = \rho_1 ff_{t-1} + \rho_2 ff_{t-2}$$

$$+(1-\rho_1-\rho_2)[r_t^* + \pi_t^* + \alpha_\pi(\pi_{t,t+4}^{4,f} - \pi_t^*) + \alpha_u(u_{t,t+4}^f - u_t^*) + \alpha_{dY}(\Delta y_{t,t+4}^{4f} - \Delta y_t^*)] + \varepsilon_t^{MP}$$

  - We use realized values for the federal funds rate, ff .
  - We take Federal Reserve Board forecasts as published in the Greenbook or Tealbook more recently (which we refer to as TB forecasts) for inflation, the unemployment rate, and GDP growth. These values in the rule are denoted by $\pi_{t,t+4}^{4,f}$, $u_{t,t+4}^f$, and $\Delta y_{t,t+4}^{4f}$.
  - We need to infer the "star" variables r_t^*, π_t^*, u_t^* , and Δy_t^* .

Estimating *s

- Guiding principles for estimating unobservable "star" variables:
  - Use information in the TB—what estimates are consistent with the forecasts? Exploit multiple forecast horizons in TB.
  - Use simple structures
    - Okun's Law
    - IS curves
    - Error-correction of short-run to long-run (unobserved) attractors
  - Use information in other observables (forward rates, long-term inflation expectations)
  - Use the policy rule—the funds rate as the observable—to infer the values of the equilibrium real rate of interest

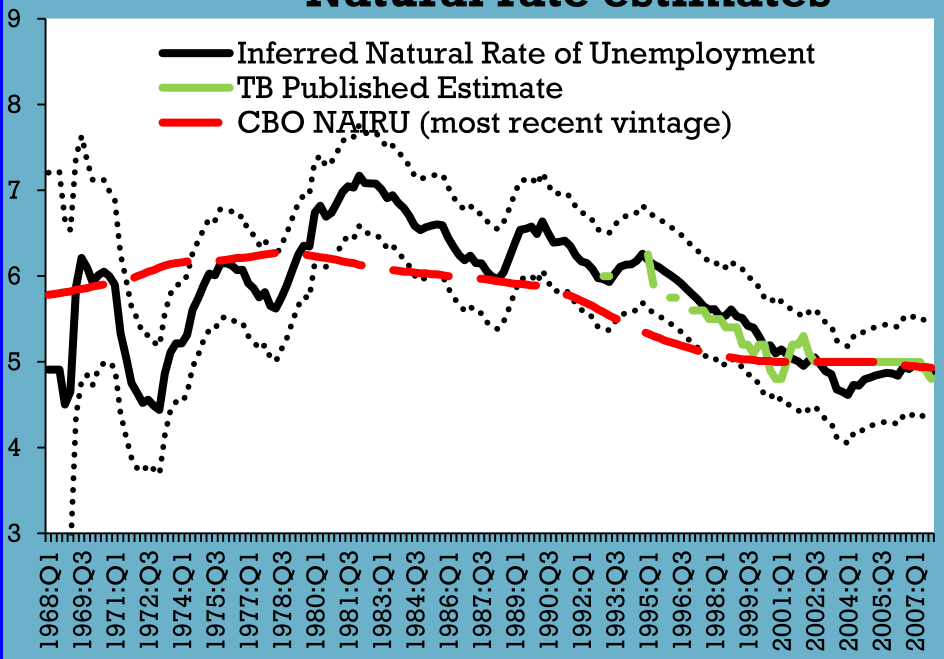
Estimating *s: More specifics

- Inflation target and natural rate
  - Model as following a random walk
  - Assume forecasts revert to targets—error-correction equations at multiple forecast horizons
  - Allow for additional (unobserved) transitory component
- Potential growth
  - Okun's Law in growth rates links changes in unemployment forecasts to deviation of growth forecast from potential growth (multiple forecast horizons)
  - Add information from IS-type curves with transitory component
  - Potential growth follows a random walk

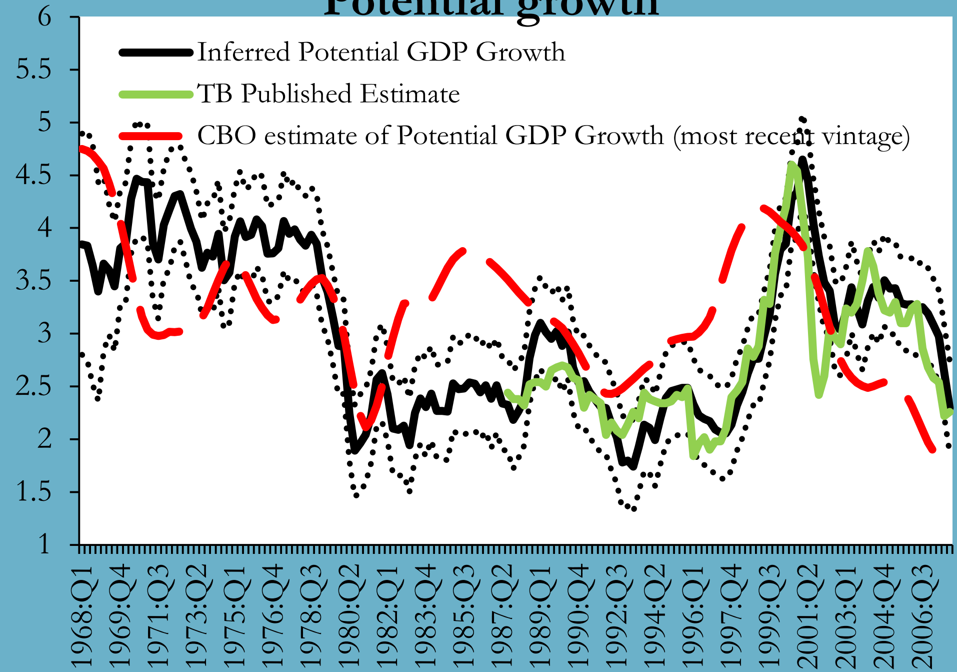
Estimating r*

- There is a bit of work on this already!
  - E.g. Laubach and Williams
- Approach here:
  - Take other "star" variables as given
  - Include r* in a system that has the policy rule as its centerpiece
    - Add "IS" curves as well, which depend on deviations of measured real rate from r*

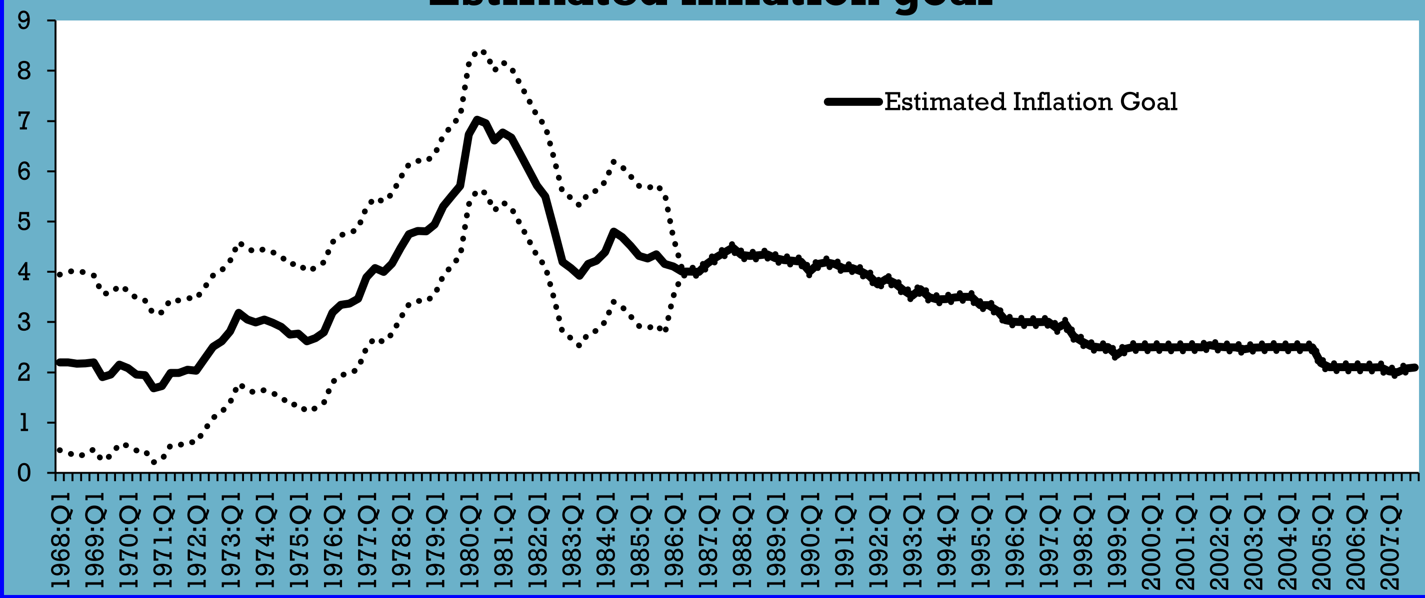
Natural rate estimates



Potential growth

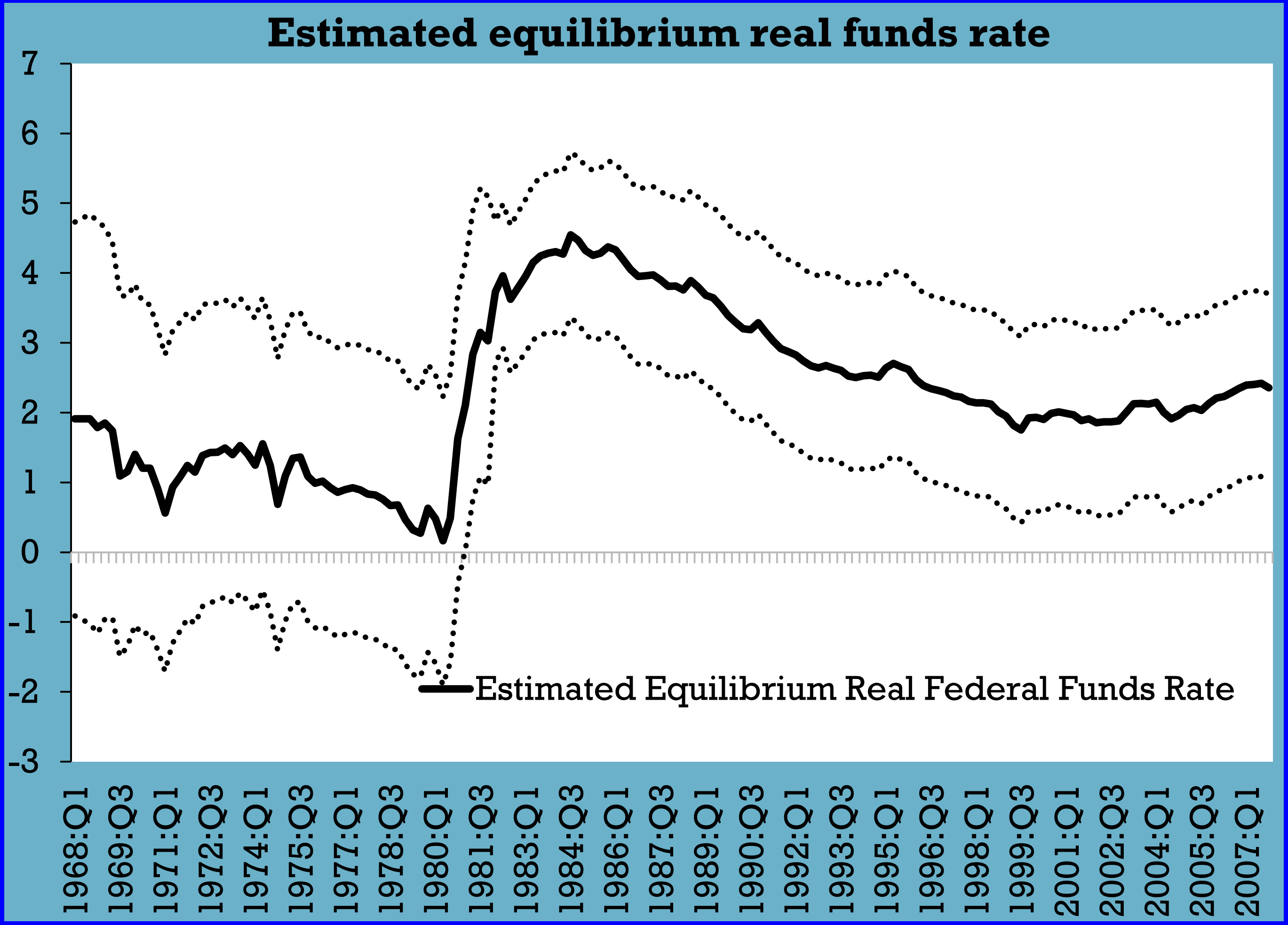


Estimated inflation goal



The much-discussed r*

- Jointly estimated with policy rule (next)



How to estimate the rule

Measurement error and the policy path

- The embedded policy path
  - TB forecasts (projections) embed some kind of assumption for the policy path, which has not always been explicit
- Mis-measured forecasts
  - FOMC does not literally use the TB to make its decisions, it's one (very good) input—how do we control for this?
- Both of these could bias the response coefficients
- Other inputs to policy decision, not captured by forecasts:
  - Realizations, à la original Taylor rule
  - Influence of other data
    - How much of what we attribute to TB forecasts may be better attributed to other information not in the TB, especially second- or fouth-moment considerations, financial instability, etc?

Addressing the potential biases

- Instrument for forecasts
  - Addresses measurement error and purges forecasts of news in future policy assumption
  - Results:

- Highlights:
  - Prominent interest rate smoothing
  - Sizable response coefficients
  - Standard error small

Method 1: System state-space estimates, 1983-2007			
Variable	Coefficient	Standard error (corrected)	p-value
ff_{t-1}	1.14	0.071	0.0000
ff_{t-2}	-0.27	0.080	0.0011
$\pi^{4,f}_{t,t+4} - \pi^*_t$	2.64	1.76	0.135
$u^f_{t,t+4} - u^*_t$	-2.30	1.15	0.0493
$\Delta y^{4,f}_{t,t+4} - \Delta y^*_t$	1.62	1.00	0.109
Standard error: 0.49			
Method 2: GMM, 1969:1-1979:3			
ff_{t-1}	0.59	0.062	0.0000
ff_{t-2}	-0.017	0.048	0.7281
$\pi^{4,f}_{t,t+4} - \pi^*_t$	1.43	0.039	0.0000
$u^f_{t,t+4} - u^*_t$	-2.35	0.15	0.0000
Adjusted R^2: 0.879 J-statistic: 9.77 (p-value = 0.878) Standard error: 0.793			

Fake or real Interest rate smoothing?

- Four possible explanations for fake rate smoothing:
  - Proxies for long moving averages of realizations
  - Proxies for time-variation in the equilibrium level of the funds rate
  - Proxies for serially correlated policy shocks (Rudebusch 2002)
  - Proxies for time-variation in the response coefficients of the policy rule
- But
  - Forecasts build this information in (as appropriate)
  - We estimate this time-variation explicitly
  - Allow serially correlated errors: no evidence of this
  - Test for this: little significant time-variation

Are forecasts really better than lagged data?

- Test for presence of lagged real-time data after controlling for TB forecasts
  - 1983-2007: Not much
  - 1966-1979: A bit more
- Generally speaking, forecasts capture well all the information in lagged data, and more
  - 1970s: Some evidence that both forecasts and lagged data explain federal funds actions

Response to other information

- Some of the response to forecasts is better represented as a response to a wide array of high-frequency information
  - Financial factors reflecting risk, some real/wage-price variables
- Addition of principal components reduces the standard error a bit, but not dramatically (0.44 vs. 0.49)
  - Modestly reduces estimated "discretion" by interpreting as a systematic response to observables not captured in the forecast

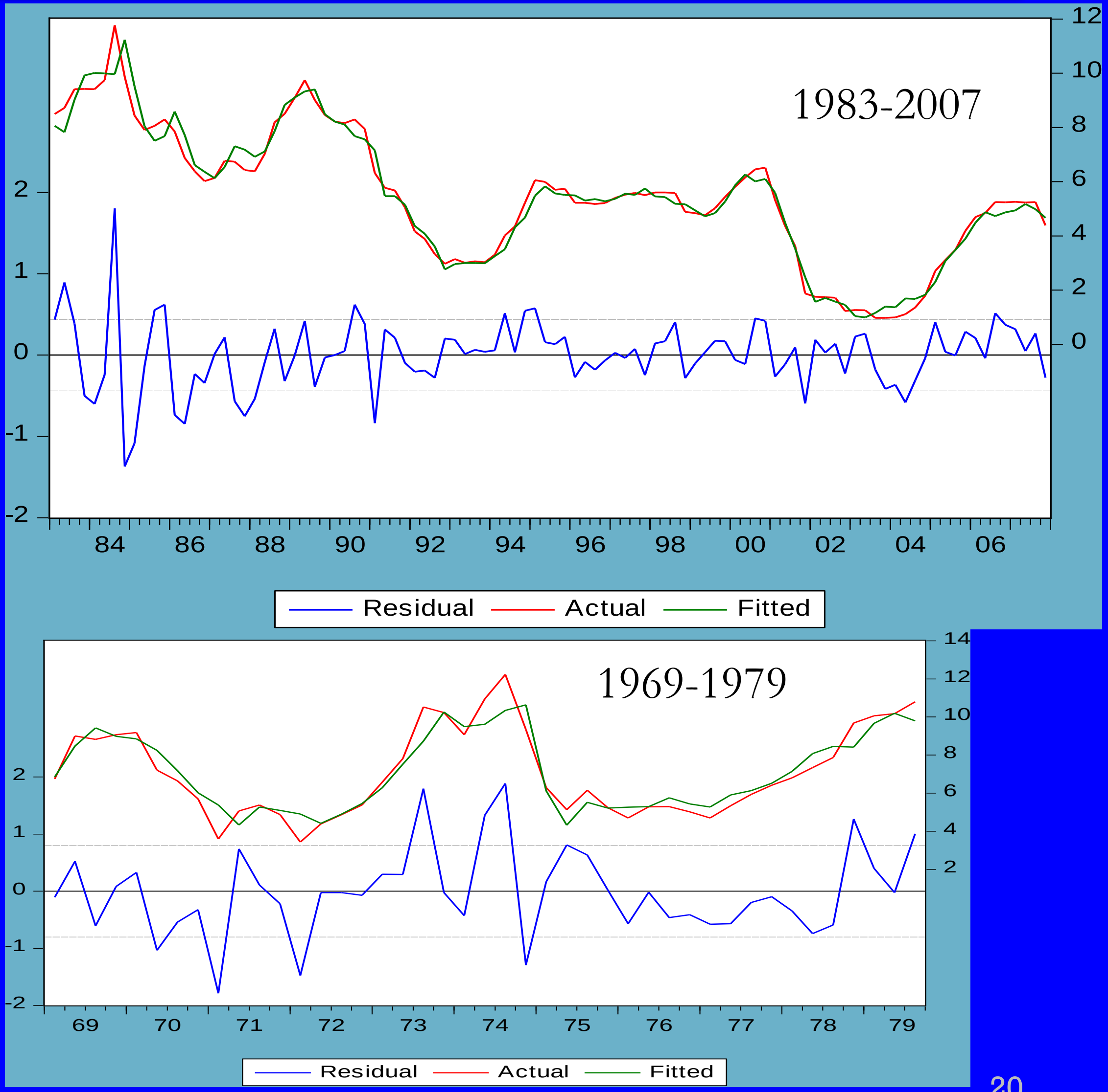
1983:Q1-2007:Q4			
Variable	Coefficient	Standard error	p-value
ff_{t-1}	0.83	0.020	0.0000
$\pi^{4,f}_{t,t+4} - \pi^*_t$	1.77	0.53	0.0013
$u^f_{t,t+4} - u^*_t$	-1.46	0.30	0.0000
$\Delta y^{4,f}_{t,t+4} - \Delta y^*_t$	0.89	0.34	0.0118
1st PC, real variables	0.29	0.052	0.0000
2nd PC, financial "stock" variables	0.27	0.044	0.0000
1st PC, wage and price variables	0.19	0.070	0.0083
Adjusted R-squared: 0.967; S.E. of regression: 0.440; J-statistic (p-value): 17.17 (0.80)			

What do we learn from these rules?

- Time-variation in "stars" matters, but can be estimated
  - Albeit with considerable uncertainty
  - Estimates implied by TB forecasts suggest no gross misunderstanding of the economic environment in real time
- The systematic component of monetary policy is large
  - Conversely, the "shock" or "discretion" component is small
- Responses to inflation and unemployment are of roughly equal magnitude
  - Echoing Bernanke's (2015) "balanced approach," reflecting the FOMC's framework document (Jan. 2012 and as amended)

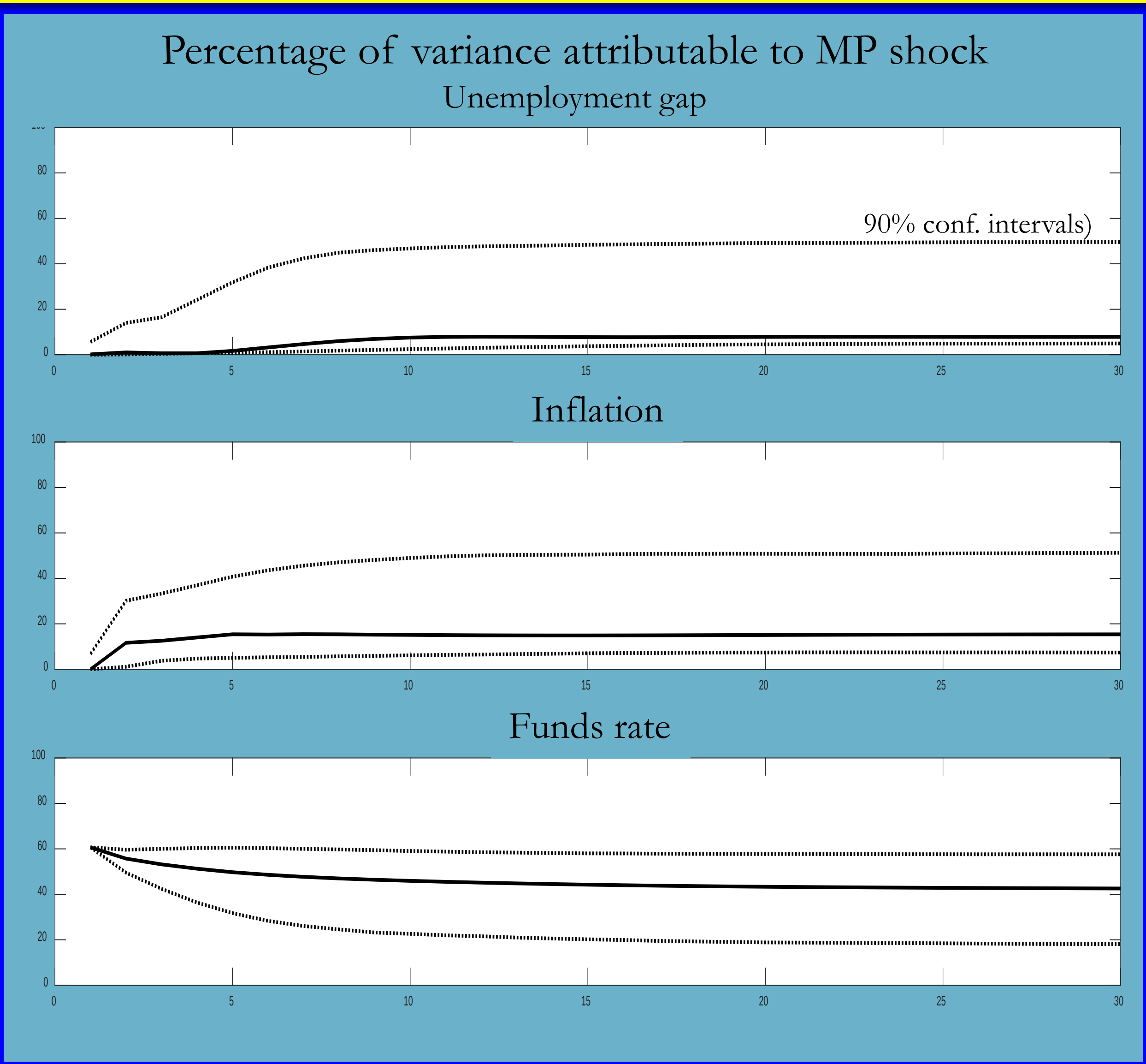
"Discretion" is small, but how much impact on the economy?

- Rules fit well (not surprising given lagged funds rate)
- Shocks are not autocorrelated
- Standard error of a bit less than 0.5 for 1983-2007
  - Larger for 70s



Variance decomposition, method 1
Contribution of identified shocks

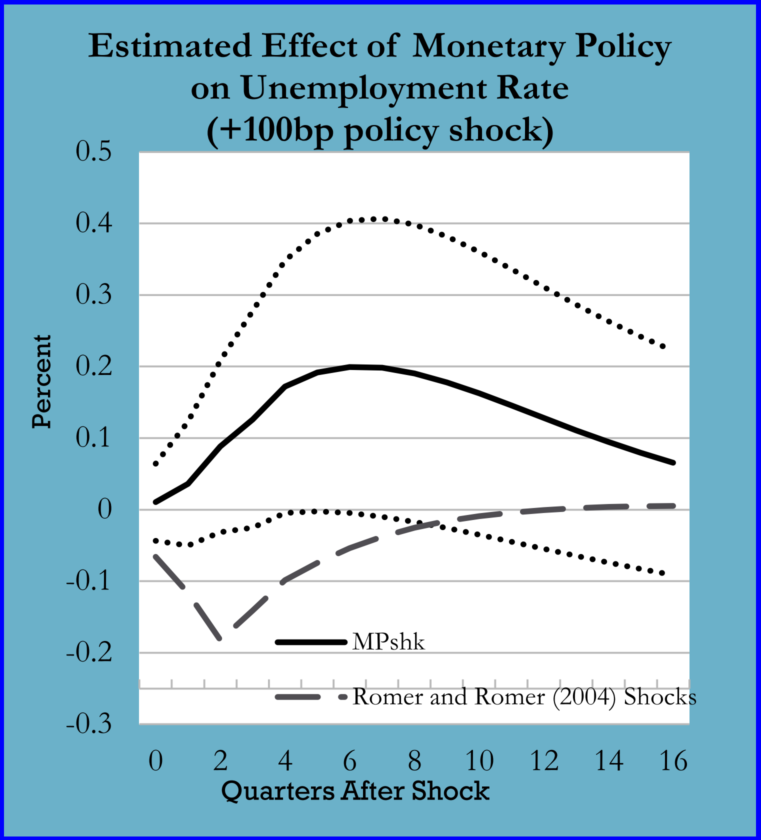
- Contributon to variance is small
  - Standard errors are large
- Standard VAR result

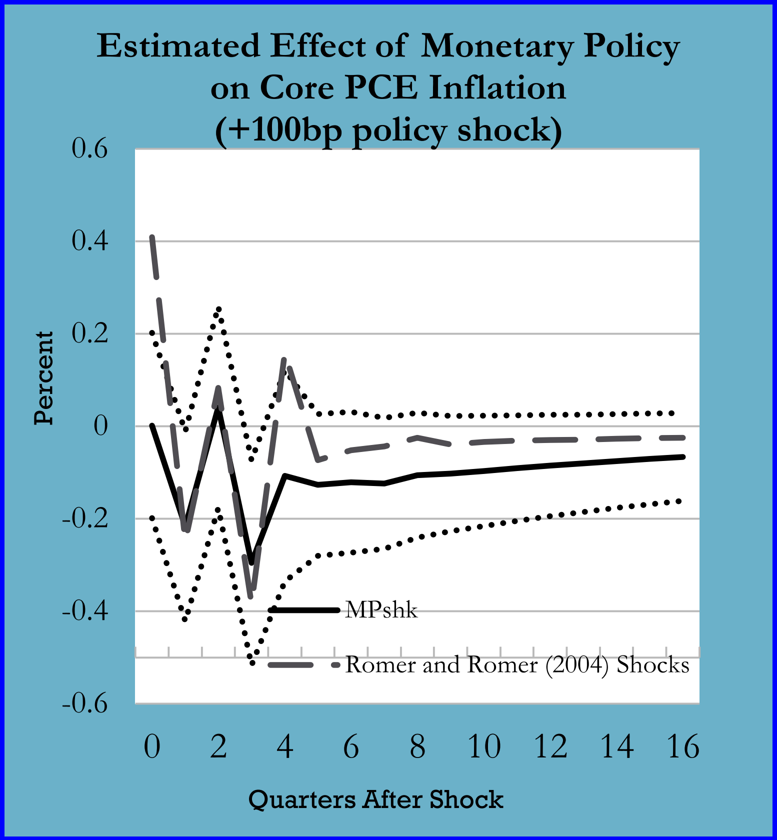


Method 2:
Romer and Romer impulse responses

$$x_t = \sum_{i=1}^{4} b_{ui} MP_{t-i}^{shk} + \sum_{i=1}^{4} \alpha_{xi} x_{t-i} + e_t^u, x_t = [\tilde{u}_t, \pi_t]$$

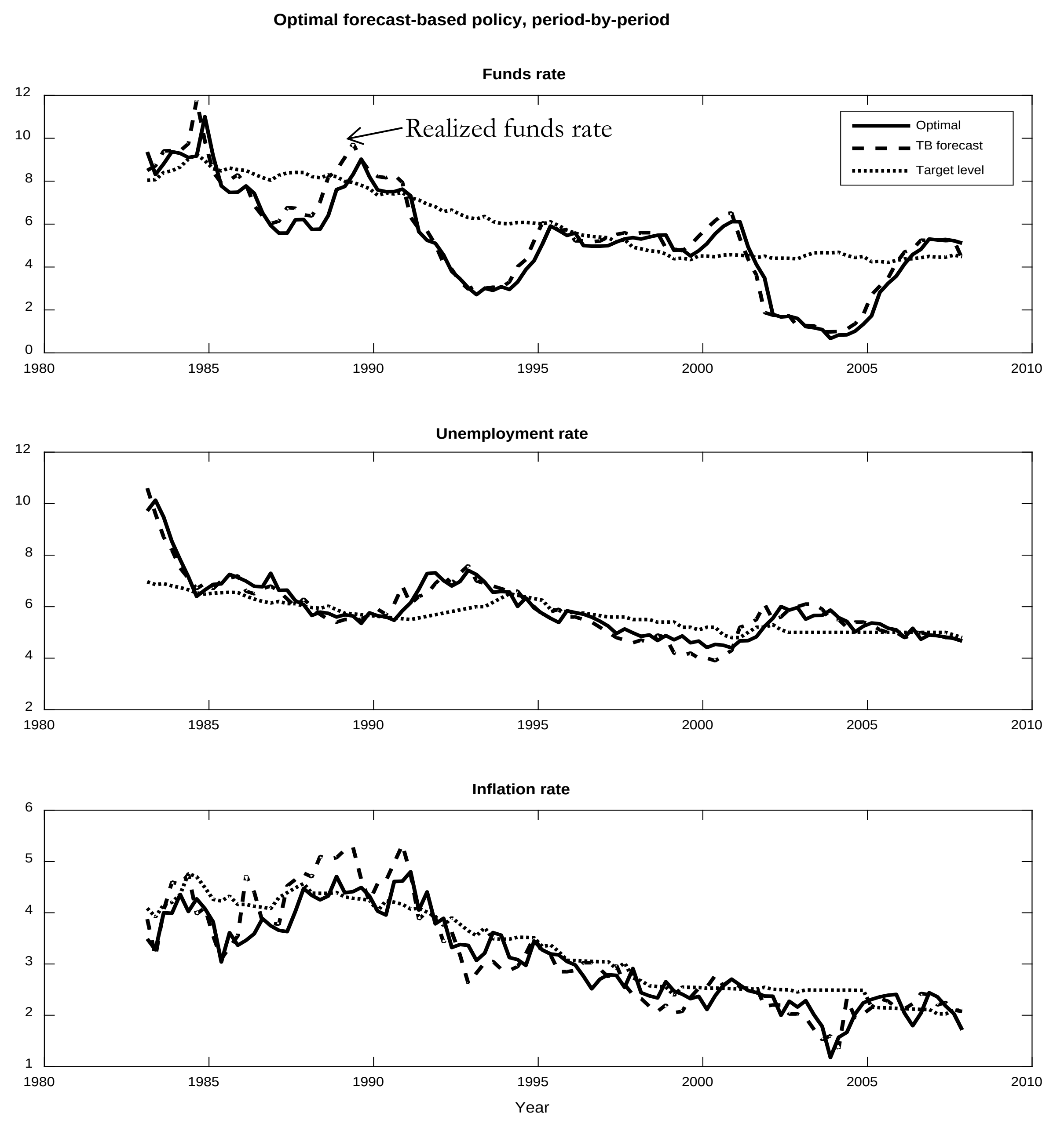
- 100 bp (two-sd) shock produces 0.1-0.2 ppt responses





Optimal versus realized policy

- Minimize standard loss function
- How different are optimal from actual rate settings?
- **Optimal policy looks much like the realized funds rate**

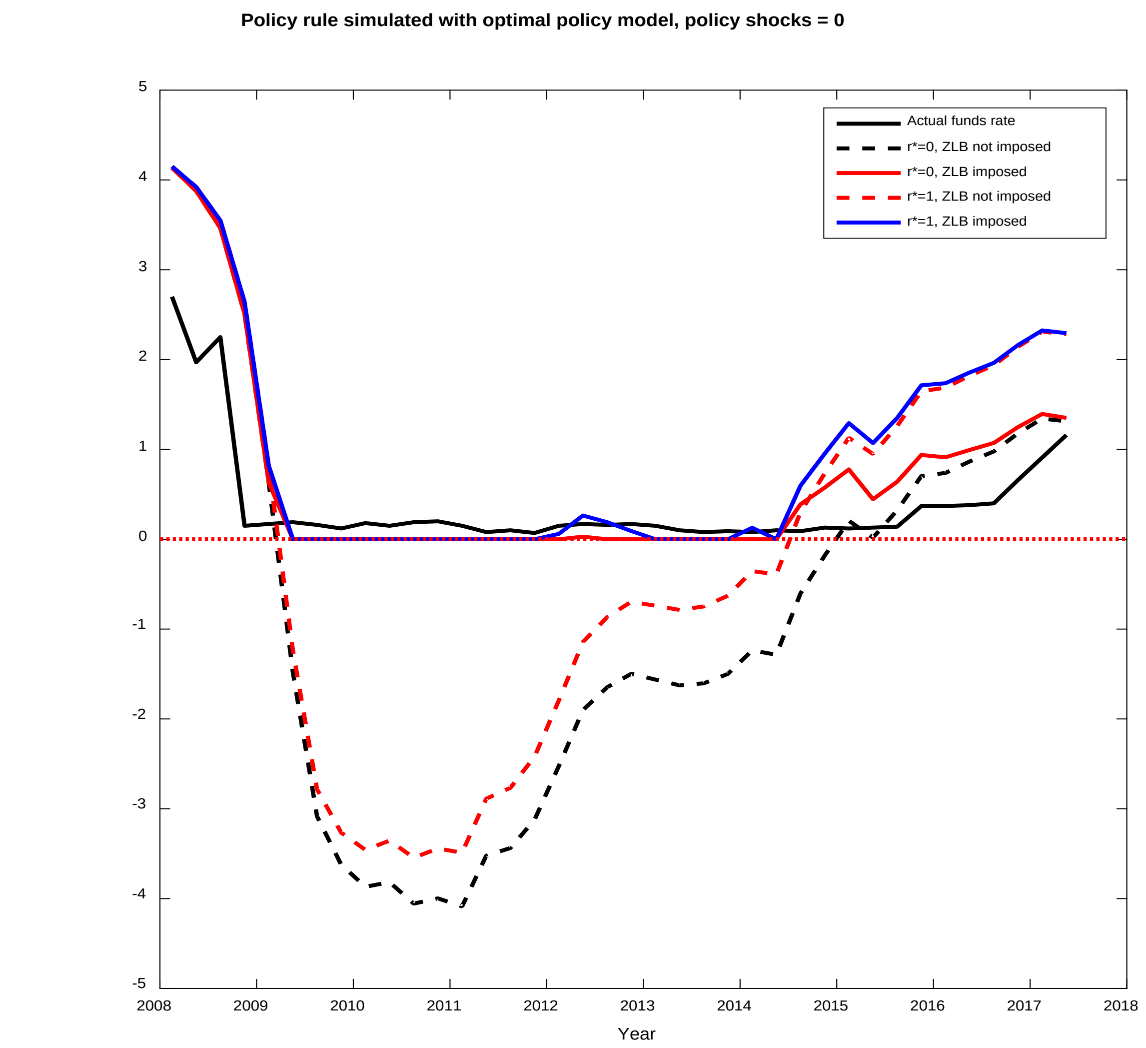


Caveats, concerns

- 1983-2007 a <u>relatively</u> calm period
  - Was policy near-optimal in the 1970s?
- Don't fully believe fixed response coefficients for a period as long as 1983-2007
  - Deviations from the fixed coefficients show up in the estimated policy shocks/discretion
  - Initial estimates of time-varying response coefficients suggest little variation
- We are squeezing a lot out of macro time-series data and forecasts!

The estimated "rule" during the GR

- Depends on r* assumption
- Without ELB:
  - -4% rate prescribed
- With ELB
  - Liftoff a bit earlier than actual
- But overall, a decent description of MP, given low estimated r*

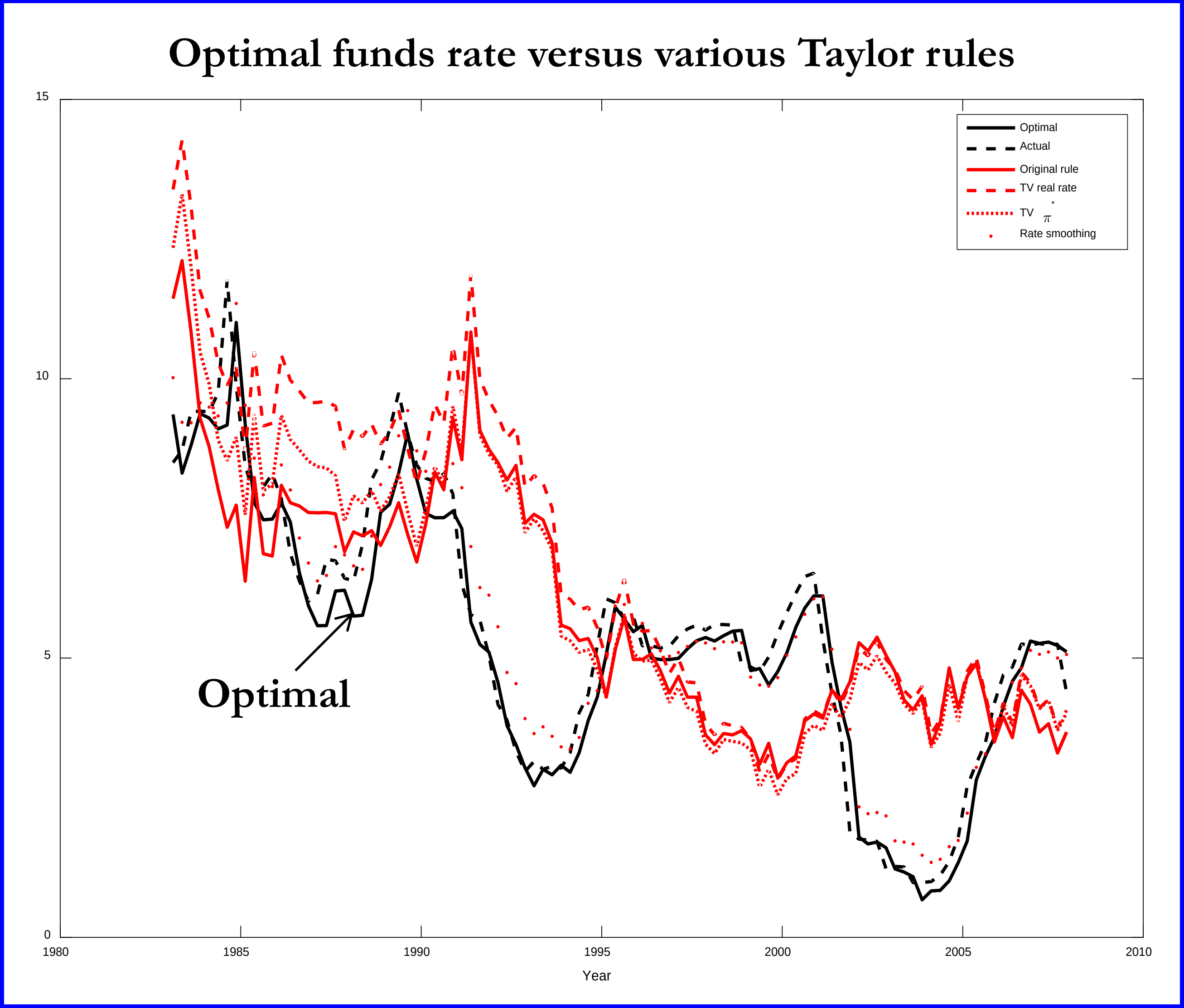


Conclusions

Policy should be systematic, but not rule-bound

- Monetary policy from 1969-2007 has acted systematically to close gaps between forecasts and time-varying desired levels of goal variables
  - This systematic component accounts for most of the variation in the funds rate
  - The non-systematic component is small, and has small effects on the economy
  - Realized policy appears to have been close to "optimal"
- Actual policy differs significantly from the prescriptions from simple realization-based policy rules
  - Existence of a systematic component does not imply binding the Fed to a simple rule—the systematic (optimal) piece requires forecasts, estimates of time-varying equilibrium levels, and desired gap responses, all of which are subject to significant uncertainty
- Consistent with an underlying goal-based policy (Svensson 2003, Walsh 2015):
  - Forecasts and estimates of time-varying "stars" imbed lots of information and may require disciplined judgment
  - The FOMC appears to have quite successfully employed such a systematic approach to closing expected gaps
  - Given inherent uncertainty in key policy inputs, wise to use multiple models/benchmarks to guide monetary policy in achieving its goals

And not as much like earlier Taylor rule predictions



How much is explained by forecasts versus the lagged funds rate?

- Estimate without the lagged funds rate
- Estimated coefficients on inflation, unemployment gap significant (p=0.000)
- Standard error larger (1.5)
- But still captures much variation (R^2=0.61)
- Since 1987, even better (SE = 0.94)