

MONETARY POLICY RULES AND MACROECONOMIC STABILITY: EVIDENCE AND SOME THEORY

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Outline

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- II. The Federal Reserve's Policy Reaction Function: A Forward-Looking Model
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- IV. Interest Rate Rules And Economic Fluctuations
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I. Introduction

- Explore the role of monetary policy
 - Monetary policy in the US has been relatively well managed during the time of Paul Volcker
- Identify how monetary policy differed before and after Volcker came to office
 - By estimating policy rules for each era

#	Chairman ^{[7][8]}	Years in office	President(s) with whom they served ^[9]
9	 William McChesney Martin, Jr.	April 2, 1951 – January 31, 1970	Harry S. Truman Dwight D. Eisenhower John F. Kennedy Lyndon B. Johnson Richard M. Nixon
10	 Arthur F. Burns	February 1, 1970 – January 31, 1978	Richard M. Nixon Gerald R. Ford Jimmy Carter
11	 G. William Miller	March 8, 1978 – August 6, 1979	Jimmy Carter
12	 Paul A. Volcker	August 6, 1979 – August 11, 1987	Jimmy Carter Ronald W. Reagan
13	 Alan Greenspan	August 11, 1987 – January 31, 2006 ^[11]	Ronald Reagan George H.W. Bush Bill Clinton George W. Bush

Pre-Volcker

Volcker-
Greenspan

Pre-Volcker V.S. Volcker-Greenspan

- The Federal Reserves was highly “accommodative” in the pre-Volcker years
 - It let short-term interest rates decline as anticipated inflation rose.
 - While it raised nominal rates by less than the increase in expected inflation.
- During the Volcker-Greenspan era
 - The Federal Reserve adopted a proactive stance toward controlling inflation.
 - It systematically raised real as well as nominal short-term interest rates in response to higher expected inflation.

Pre-Volcker V.S. Volcker-Greenspan

- The estimated rule for the pre-Volcker period permits greater macroeconomic instability than does the Volcker-Greenspan rule.
 - The pre-Volcker rule leaves open the possibility of bursts of inflation and output that result from self-fulfilling changes in expectation.
 - These sunspot fluctuations may arise under this rule because individuals (correctly) anticipate that the Federal Reserve will accommodate a rise in expected inflation by letting short-term real interest rates decline (which in turn stimulates the rise in aggregate demand and inflation).

Pre-Volcker V.S. Volcker-Greenspan

- Self-fulfilling fluctuations cannot occur under the estimated rule for the Volcker-Greenspan era.
 - The Federal Reserve adjusts interest rates sufficiently to stabilize any changes in expected inflation.
- The pre-Volcker rule is less effective than the Volcker-Greenspan rule at mitigating the impact of fundamental shocks to the economy.
 - The economy exhibits greater stability under the post-1979 rule than under a rule that closely approximates monetary policy pre-1979.

II. The Federal Reserve's Policy Reaction Function: A Forward-Looking Model

A. A Simple Forward-Looking Rule

- Baseline policy rule

$$(1) \quad r_t^* = r^* + \beta (E\{\pi_{t,k}|\Omega_t\} - \pi^*) + \gamma E\{x_{t,q}|\Omega_t\},$$

r_t^* = the **target rate** for the **nominal Federal Funds** rate in period t

$\pi_{t,k}$ = the percent change in the **price level** between periods t and $t + k$

π^* = the **target for inflation**

$x_{t,q}$ = a measure of the average **output gap** between period t and $t + q$

E = the expectation operator

Ω_t = the **information set** at the time the interest rate is set

r^* = the **desired nominal rate** when both inflation and output are at their target levels.

II. The Federal Reserve's Policy Reaction Function: A Forward-Looking Model

- Benefits of this model:
 - It provides reasonably good descriptions of the way major central banks around the world behave.
 - The forward-looking specification allows the central bank to consider a broad array of information to form beliefs about the future condition of the economy.

II. The Federal Reserve's Policy Reaction Function: A Forward-Looking Model

- B. Implied Real Rate Rule

$$(2) \quad rr_t^* = rr^* + (\beta - 1) (E\{\pi_{t,k} | \Omega_t\} - \pi^*) + \gamma E\{x_{t,q} | \Omega_t\},$$

where $rr_t^* \equiv r_t - E\{\pi_{t,k} | \Omega_t\}$ and where $rr^* \equiv r^* - \pi^*$ is the long-run equilibrium real rate.

The sign of the response of the real rate target to changes in expected inflation and the output gap depends on whether β is greater or less than one and on the sign of γ .

We use $\beta = 1$ and $\gamma = 0$ as benchmarks.

$\beta > 1$ and $\gamma > 0$; stabilizing

$\beta \leq 1$ and $\gamma \leq 0$; destabilizing, accommodative of shocks to the economy.

II. The Federal Reserve's Policy Reaction Function: A Forward-Looking Model

- C. Interest Rate Smoothing and Exogenous Shocks
 - Modified from the first equation (1), mainly because (1) ignores the Federal Reserve's tendency to smooth changes in interest rates.

$$(3) \quad r_t = \rho(L) r_{t-1} + (1 - \rho) r_t^*$$

where $\rho(L) = \rho_1 + \rho_2 L + \dots + \rho_n L^{n-1}$, and where $\rho \equiv \rho(1)$. v_t is a zero mean exogenous interest rate shock, and the Funds rate target r_t^* is given by (1).

- Equation (3) postulates partial adjustment of the Funds rate to the target r_t^*
- ρ = an indicator of the degree of smoothing of interest rate changes

II. The Federal Reserve's Policy Reaction Function: A Forward-Looking Model

$$(1) \quad r_t^* = r^* + \beta (E\{\pi_{t,k}|\Omega_t\} - \pi^*) + \gamma E\{x_{t,q}|\Omega_t\},$$

$$(3) \quad r_t = \rho(L) r_{t-1} + (1 - \rho) r_t^*,$$

- Combining the partial adjustment equation (3) with the target model (1) yields the policy reaction function.

$$(4) \quad r_t = (1 - \rho) \{r^* - (\beta - 1)\pi^* + \beta \pi_{t,k} + \gamma x_{t,q}\} + \rho(L) r_{t-1} + \varepsilon_t,$$

where $\varepsilon_t \equiv -(1 - \rho) [\beta (\pi_{t,k} - E\{\pi_{t,k}|\Omega_t\}) + \gamma (x_{t,q} - E\{x_{t,q}|\Omega_t\})]$.

III. The Federal Reserve's Policy Reaction Function: The Evidence

- The **baseline inflation measure** is the (annualized rate of change of the **GDP deflator** (GDPP) between two subsequent quarters.
- The **baseline “output gap” measure** is the series constructed by the **Congressional Budget Office** (CBO).
- The instrument set includes lags of the Funds rate, inflation, and the output gap.

III. The Federal Reserve's Policy Reaction Function: The Evidence

- We divide the sample into two main subperiods; (60:1-79:2) and (79:3 – 96:4).

TABLE I
AGGREGATE VOLATILITY INDICATORS

	<i>Standard Deviation of:</i>			
	Inflation		Output	
	<i>Level</i>	<i>hp</i>	<i>Gap</i>	<i>hp</i>
Pre-Volcker	2.77	1.48	2.71	1.83
Volcker-Greenspan	2.18	0.96	2.36	1.49
<i>post-82</i>	1.00	0.79	2.06	1.34

- Table I reports the standard deviation of inflation and output, for the two subperiod.
- The decline is more dramatic when we begin the second subperiod in 82:4, after Volcker disinflation, as the bottom row of the table indicates.

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Pre-Volcker

Volcker-
Greenspan

III. The Federal Reserve's Policy Reaction Function: The Evidence

TABLE II
BASELINE ESTIMATES

	π^*	β	γ	ρ	p
Pre-Volcker	4.24 (1.09)	0.83 (0.07)	0.27 (0.08)	0.68 (0.05)	0.834
Volcker-Greenspan	3.58 (0.50)	2.15 (0.40)	0.93 (0.42)	0.79 (0.04)	0.316

Standard errors are reported in parentheses. The set of instruments includes four lags of inflation: output gap, the federal funds rate, the short-long spread, and commodity price inflation.

$$(1) \quad r_t^* = r^* + \beta (E\{\pi_{t,k}|\Omega_t\} - \pi^*) + \gamma E\{x_{t,q}|\Omega_t\},$$

$$(3) \quad r_t = \rho(L) r_{t-1} + (1 - \rho) r_t^*,$$

- Table II reports the estimations on each parameters using the CBO output gap and GDP deflator inflation.
- As both p values are > 0.05 , the model is not rejected at conventional significance levels for any of the specifications.

$$(1) \quad r_t^* = r^* + \beta (E\{\pi_{t,k}|\Omega_t\} - \pi^*) + \gamma E\{x_{t,q}|\Omega_t\},$$

$$(3) \quad r_t = \rho(L) r_{t-1} + (1 - \rho) r_t^*,$$

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Standard errors are reported in parentheses. The set of instruments includes four lags of inflation: output gap, the federal funds rate, the short-long spread, and commodity price inflation.

- The estimates of β , the coefficient associated with expected inflation, is significantly below unity for the pre-Volcker period (0.83) and far greater than one for the Volcker-Greenspan period (2.15).
- The estimates of γ , the coefficient measuring the sensitivity to the cyclical variable—are also significant in both period.
- The estimates of π^* , the difference is not significant.
- The estimates of the smoothing parameter ρ , are high in all cases. This implies that the Fed smooths adjustments in the interest rate.

Alternative Measures

- We reestimate the reaction function using different measures of the output gap and inflation.
- We consider two alternative measures of the output gap: (a) the deviation of (log) GDP and (b) the deviation of the unemployment rate.
- We consider one alternative measure of inflation: the rate of change of the consumer price index (CPI).

TABLE III
ALTERNATIVE VARIABLES

	π^*	β	γ	ρ	p
Detrended output					
<i>Pre-Volcker</i>	4.17 (0.68)	0.75 (0.07)	0.29 (0.08)	0.67 (0.05)	0.801
<i>Volcker-Greenspan</i>	4.52 (0.58)	1.97 (0.32)	0.55 (0.30)	0.76 (0.05)	0.289
Unemployment rate					
<i>Pre-Volcker</i>	3.80 (0.87)	0.84 (0.05)	0.60 (0.11)	0.63 (0.04)	0.635
<i>Volcker-Greenspan</i>	4.42 (0.44)	2.01 (0.28)	0.56 (0.41)	0.73 (0.05)	0.308
CPI					
<i>Pre-Volcker</i>	4.56 (0.53)	0.68 (0.06)	0.28 (0.08)	0.65 (0.05)	0.431
<i>Volcker-Greenspan</i>	3.47 (0.79)	2.14 (0.52)	1.49 (0.87)	0.88 (0.03)	0.138

Standard errors are reported in parentheses. The set of instruments includes four lags of inflation, output gap, the federal funds rate, the short-long spread, and commodity price inflation.

- Both the signs and magnitudes of the estimated parameters remain largely unchanged.

Alternative Horizons

TABLE IV
ALTERNATIVE HORIZONS

	π^*	β	γ	ρ	p
$k = 4, q = 1$					
<i>Pre-Volcker</i>	3.58 (1.42)	0.86 (0.05)	0.34 (0.08)	0.73 (0.04)	0.835
<i>Volcker-Greenspan</i>	3.25 (0.23)	2.62 (0.31)	0.83 (0.28)	0.78 (0.03)	0.876
$k = 4, q = 2$					
<i>Pre-Volcker</i>	3.32 (1.80)	0.88 (0.06)	0.34 (0.09)	0.73 (0.04)	0.833
<i>Volcker-Greenspan</i>	3.21 (0.21)	2.73 (0.34)	0.92 (0.31)	0.78 (0.03)	0.886

Standard errors are reported in parentheses. The set of instruments includes four lags of inflation, output gap, the federal funds rate, the short-long spread, and commodity price inflation.

- The Fed looks ahead one quarter for both inflation and the output gap.
- In either case, the results are qualitatively very similar to those reported in Table II.

Subsample Stability

- Explore the stability of parameters within each subsample
- 1. Miller (78:1-79:3)
- 2. Burns (70:1-78:1)
- 3. Martin (60:1-69:4)
- 4. Burns and Miller (79:3-87:2)
- 5. Greenspan (87:3-96:4)

SUBSAMPLE STABILITY

	π^*	β	γ	ρ	p
Martin					
(1,1)	5.16 (1.72)	0.86 (0.08)	0.14 (0.16)	0.77 (0.06)	0.524
(4,1)	7.15 (5.55)	0.92 (0.08)	0.06 (0.07)	0.72 (0.05)	0.719
Burns-Miller					
(1,1)	5.16 (1.72)	0.86 (0.08)	0.78 (0.18)	0.69 (0.04)	0.524
(4,1)	7.15 (5.55)	0.92 (0.08)	1.24 (0.39)	0.80 (0.05)	0.719
Volcker					
(1,1)	3.75 (0.28)	2.02 (0.23)	-0.02 (0.15)	0.63 (0.04)	0.612
(4,1)	2.45 (0.47)	2.38 (0.35)	0.68 (0.30)	0.74 (0.04)	0.804
Greenspan					
(1,1)	3.75 (0.28)	2.02 (0.23)	0.99 (0.18)	0.63 (0.04)	0.612
(4,1)	2.45 (0.47)	2.38 (0.35)	0.68 (0.30)	0.91 (0.02)	0.804
Post-82					
(1,1)	3.43 (1.24)	1.58 (0.72)	0.14 (0.42)	0.91 (0.03)	0.416
(4,1)	3.16 (0.10)	3.13 (0.33)	0.09 (0.15)	0.82 (0.02)	0.894

Standard errors are reported in parentheses. The set of instruments includes two lags of inflation, output gap, the federal funds rate, the short-long spread, and commodity price inflation, as well as the same variables

Table V

- Consider first the pre-Volcker period.
 - The estimated value for inflation coefficient β is below unity and is in line with the baseline estimates.
 - The estimates π^* and β are stable across chairmen.

Backward-looking estimates

TABLE VI
BACKWARD-LOOKING ESTIMATES

	π^*	β	γ	ρ	p
Pre-Volcker	5.95 (1.92)	0.86 (0.07)	0.39 (0.08)	0.68 (0.05)	0.590
Volcker-Greenspan	4.08 (0.56)	1.72 (0.28)	0.34 (0.19)	0.71 (0.05)	0.307
Post-82	2.96 (0.27)	2.55 (0.56)	-0.15 (0.28)	0.89 (0.03)	0.486

Standard errors are reported in parentheses. The set of instruments includes four lags of inflation, output gap, the federal funds rate, the short-long spread, and commodity price inflation.

- While we view the forward-looking specification as more plausible a priori, our key insights also obtain from the backward-looking specification.

Discussion of the Empirical Results

- During the pre-Volcker period, in response to forecastable inflationary pressures, the Fed tended to let real interest rates decline or, at best, did not try to raise them.
- According to our results, the persistent and volatile behavior of inflation in the pre-Volcker era may be partly due to the monetary rule in place.

Discussion of the Empirical Results

- Under the Volcker-Greenspan regime, the Fed has substantially raised target real rates in the wake of an anticipated increase in inflation.
- To the extent that a rise in the real rate slows down the level of economic activity and relieves inflationary pressures, the interest rate policy in the Volcker-Greenspan era provides a natural explanation for the stability of inflation experienced by the U.S. economy in recent years.

Oil Shocks versus Monetary Policy

- The two major oil shocks that occurred in 1973 and in 1979.
- Oil shocks alone could account for the shift in macroeconomic volatility?
- Bernanke, Gertler, and Watson; it would be difficult for these shocks to generate the kind of persistent inflation that arose in this era in the absence of an accommodating monetary policy.
- Note: There is a steady rise in inflation over a three-year period prior to 1979's shock.

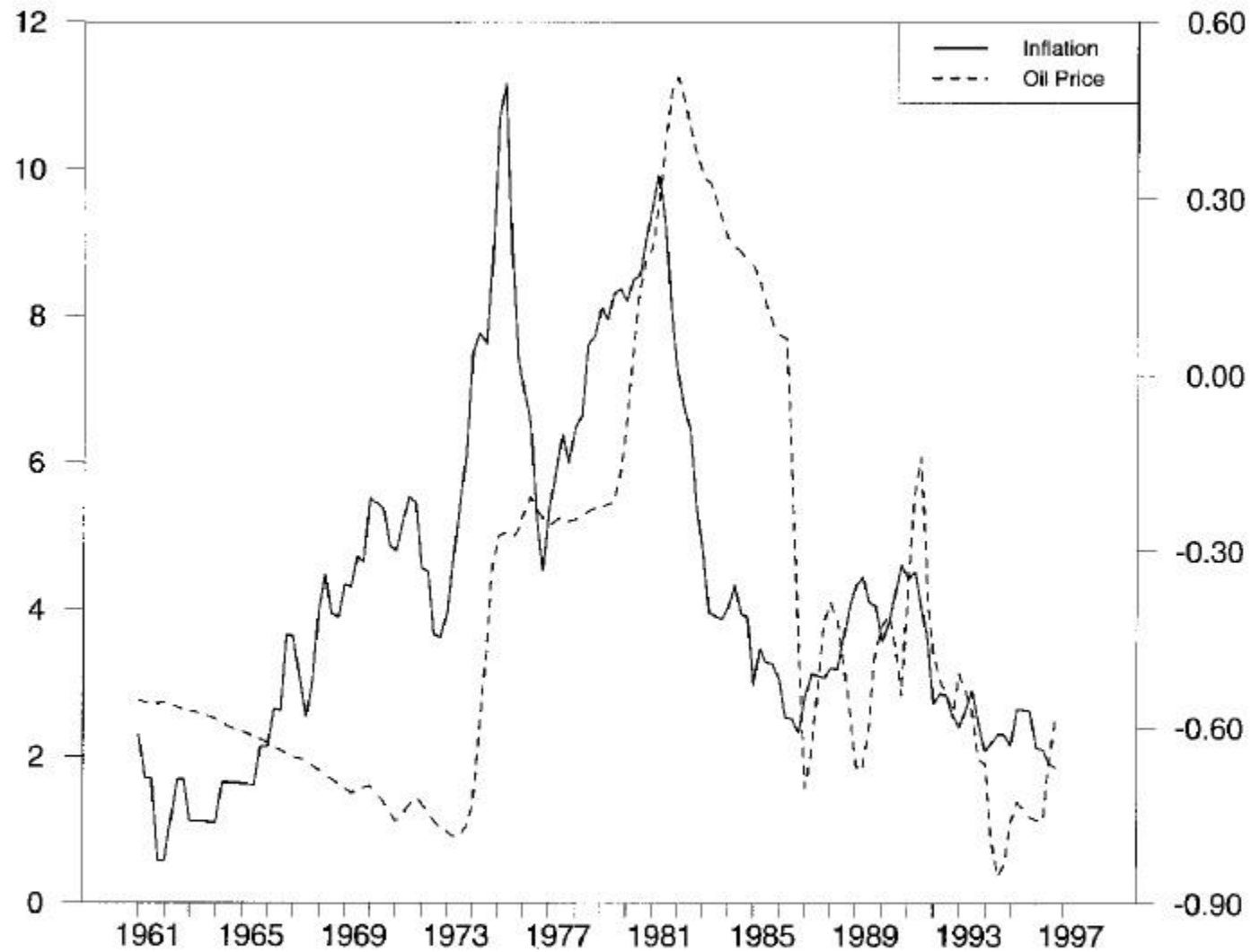


FIGURE III
Real Oil Price and Inflation

The Real Interest Rate and Inflation

- Pre-1979: the real rate steadily declines as inflation rises.
- Conversely, the real rate rises sharply in late 1979, leading the subsequent decline in inflation.
- *Switch in monetary policy from accommodating to combating inflation.

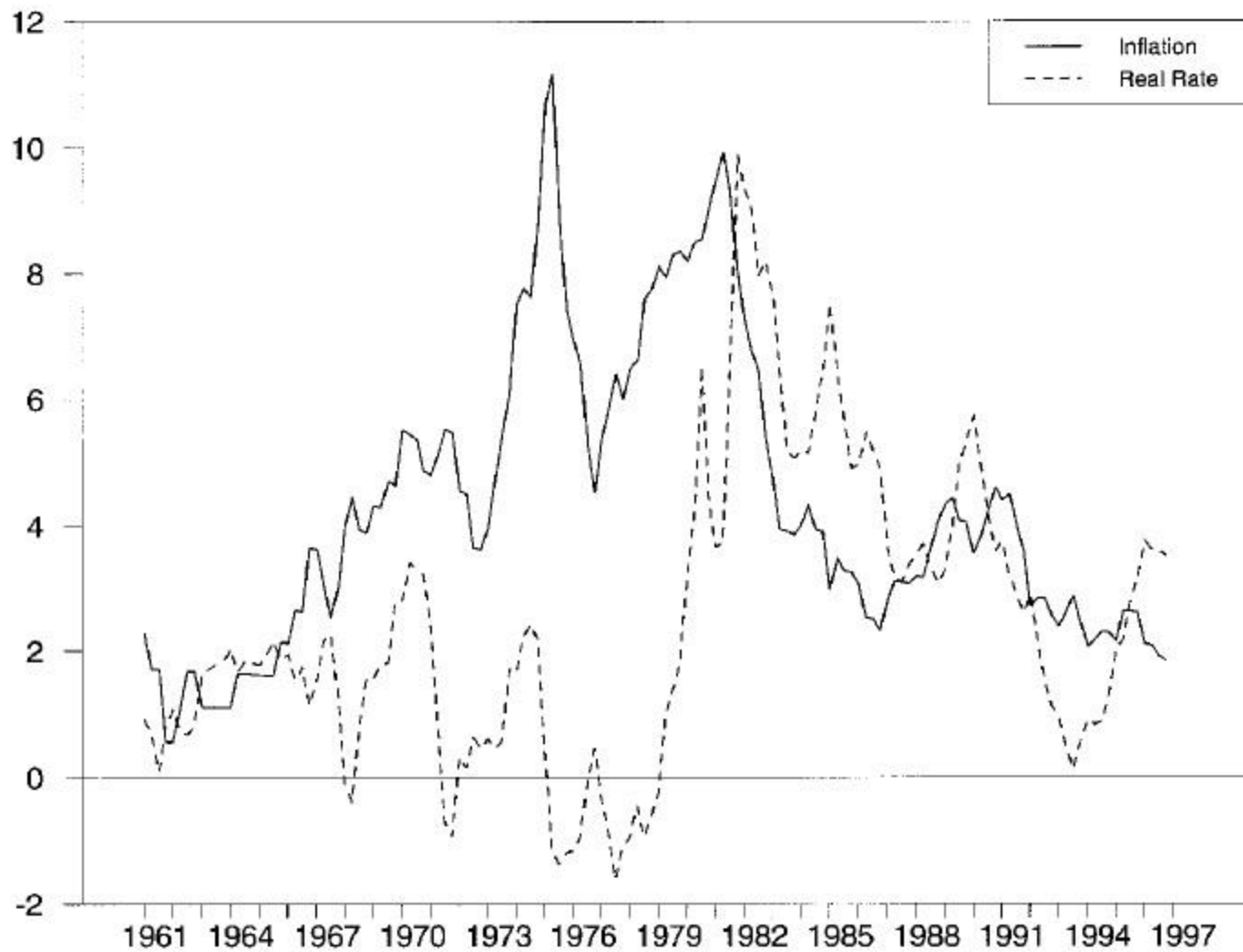
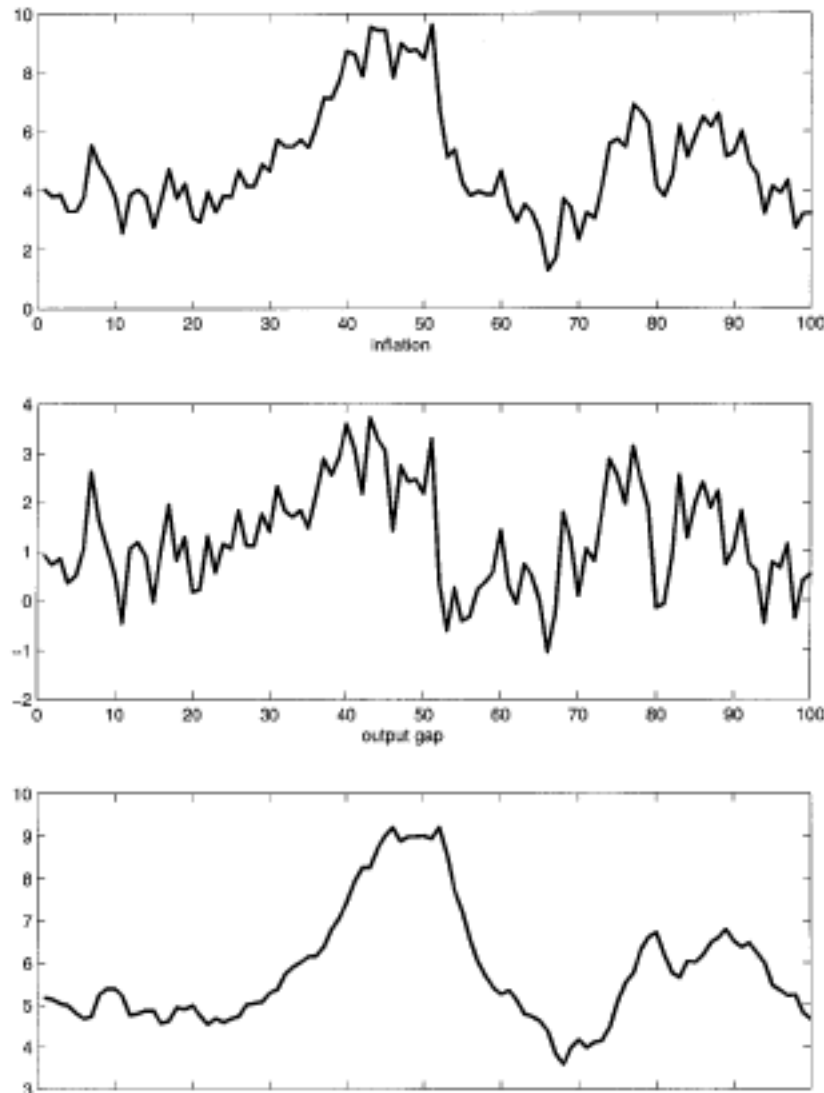


FIGURE IV
The Real Interest Rate and Inflation

IV. Interest Rate Rules And Economic Fluctuations

- The change in the systematic component of monetary policy across the pre-Volcker and the Volcker-Greenspan eras many explain some of the differences in the degree of macroeconomic instability.
- When $\beta < 1$, it raises the possibility of fluctuations in output and inflation.
- Since the estimate of β is consistently less than unity for the pre-Volcker era, self-fulfilling fluctuations are possible in this regime. (refer to Figure V)

Figure V: Cyclical behavior of output, inflation, and the nominal interest rate



- By way of contrast, self-fulfilling fluctuations cannot arise under the estimated interest rate for the Volcker-Greenspan period.
- Because β is well above unity in this regime, short-term real rates cannot adjust to accommodate shifts in inflationary expectations, as they instead do under the estimated pre-Volcker policy.

V. Summary And Concluding Remarks

- In the pre-Volcker years the Fed typically raised nominal rates by less than any increase in expected inflation, thus letting real short-term rates decline as anticipated inflation rose.
- During the Volcker-Greenspan era the Fed raised real as well as nominal short-term interest rates in response to higher expected inflation.
- Thus, the anti-inflationary stance of the Fed has been stronger in the past two decades.