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The Output-Inflation Trade-off in the United States: Has It Changed Since the Late 1970s?

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In recent years, the Federal Reserve has become more explicit in stating a goal of gradually reducing inflation to near zero rates. An important consideration in seeking lower inflation is the transition cost (lost output and employment) incurred in the process. In this paper we ask whether the output-inflation trade-off in the U.S. is any more favorable now than it was in the high-inflation environment of the late 1970s and early 1980s. Our empirical estimates suggest that this trade-off is about the same as it was in the earlier period. In light of these results, we consider ways in which policies might be designed to reduce the amount of lost output associated with further disinflation.

Since late 1979, the Federal Reserve has pursued disinflationary monetary policies that can be characterized as occurring in two stages. First, in 1979–1981 the Fed successfully reduced inflation from double-digit to moderate rates of around 3½ percent in 1983–1985. Beginning in 1988, the Fed began explicitly stating that it intended to achieve a second period of disinflation, gradually moving the inflation rate from a moderate level of about 4 percent at that time to very low levels ("near" price stability) over a number of years. In 1992, CPI inflation was 3 percent, before dropping to about 2½ percent in the first ten months of 1993, indicating modest progress toward this goal.

An important consideration in seeking lower inflation is how to design policies that minimize the size of the transition costs that will be incurred in the process. These costs depend importantly on the credibility of the disinflation policy, i.e., on whether the public believes that the central bank actually will adhere to that policy. Thus a more (less) credible disinflation policy will translate more (less) quickly into lower inflation expectations, and therefore will have smaller (larger) effects on economic output.[1]

The costs associated with the policy of the early 1980s appeared to have been large, since the U.S. economy experienced the deepest recession of the post-World War II period in those years. This is not surprising. Over the prior decade the inflation rate had reached serious proportions, and thus the public may have needed to see some results before it began to believe in the Fed's resolve.

In this paper, we ask whether the transition costs have been any smaller in the recent disinflationary period than they were during the episode of the early 1980s. If so, it may be because the Fed's policies gained some credibility from its earlier disinflationary success, which reduced the

1. For an extensive review of the literature on monetary policy and policy credibility, see Blackburn and Christensen (1989). In their introduction, they note that ". . . the argument that figures prominently in contemporary discussions of deflationary management—namely that greater credibility of an anti-inflationary policy reduces the costs of disinflation—is persuasive" (p.2). Two approaches to designing an anti-inflation policy are discussed—gradualism, which implies a steady, predictable reduction in inflation, and immediacy, which aims at a more radical policy of cutting inflation more quickly. In this paper, we focus on the gradualist approach favored by the Fed.

size of the transition costs. If the costs were not smaller, then it may be because while the public believed that the Fed would not let inflation get out of control as in the late 1970s, the public was not convinced that it would reduce inflation from the moderate rates of the mid- to late-1980s to near zero.

We address this empirical issue by estimating the size of the short-run trade-off between output and inflation in the U.S. Our results suggest that this trade-off is about the same now as it was in the early 1980s. In addition, we point out that surveys of long-term inflation expectations suggest that the public expects inflation to rise a bit from present levels rather than decline according to the Fed's stated goal.

In light of these results, we consider ways in which policies could be designed to enhance credibility and thereby reduce the amount of lost output associated with a given amount of disinflation. First, and foremost, credibility is established through results: i.e., actually reducing the rate of inflation (Beebe 1991). However, it is possible that within the context of achieving a measure of success, lost output could be limited during disinflation if the Fed were more explicit about its disinflation goals. Thus having an explicit year-by-year inflation goal or range might help.

Going a step further, we also discuss the potential enhancements to credibility of finding an intermediate policy target to supplant the monetary aggregates, which have become less useful in recent years due to well-known instabilities. Consistently employing an intermediate target that is linked directly to the longer-term goal of reducing inflation might contribute to an expeditious enhancement of the credibility of that goal. Thus we suggest a class of intermediate-targeting approaches that might prove useful.

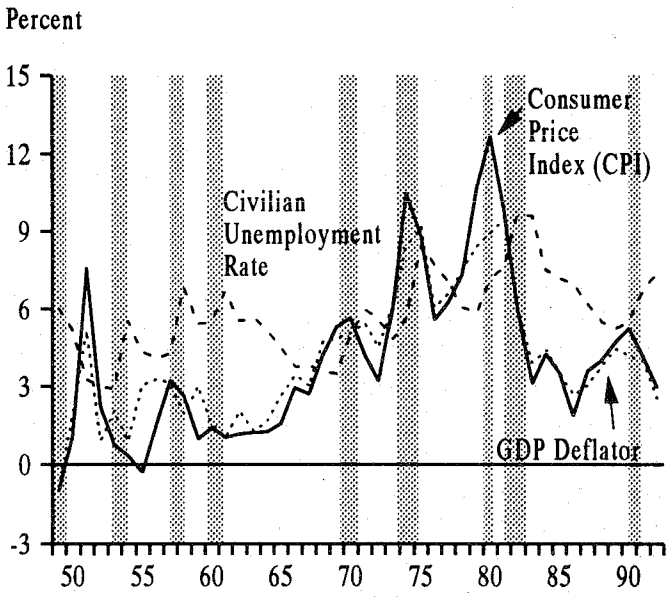
This paper follows with four sections. Section I is a brief discussion of Fed disinflationary policy since 1979. Section II provides evidence on the output-inflation trade-off. Section III provides evidence on long-term inflation expectations. Section IV offers suggestions on how credibility might be enhanced.

I. The Evolution of the Federal Reserve's Disinflationary Monetary Policy

By the time Paul Volcker became Federal Reserve Chairman in mid-1979, the expansionary monetary and fiscal policies of the late-1960s and 1970s had allowed consumer inflation to rise well into double digits (see Figure 1). These rates of inflation were very high by post-World War II standards and disrupted U.S. and world financial markets. U.S. long-term interest rates (for example, as measured by 20-year Treasury bond yields) rose from 4¼ percent in 1964 to 10¼ percent in late-1979, the dollar depreciated by nearly 25 percent between 1970–1979, and the price of gold rose to an historic high of over $800 an ounce in 1979 before settling back to over $400.

FIGURE 1

U.S. Inflation and Unemployment



Shaded areas represent recessions as defined by the NBER.
Inflation rates determined by a year/year calculation.

In response to these problems, the Fed dropped its practice of targeting the federal funds rate and instituted a new operating procedure under which it manipulated the quantity of reserves supplied to banks in an attempt to hit pre-announced ranges for several monetary aggregates. The main aggregate used was the narrow measure, M1, which includes currency in the hands of the public and fully checkable deposits. The new disinflationary policy consisted of attempting to achieve annual target ranges for M1, which would be gradually lowered over time.

The policy was successful in achieving its main goal: Between 1980 and 1983, CPI inflation fell from 12.7 to 3.1 percent (annual averages over the prior year). The cost was the most severe recession in post-World War II history, in which the civilian unemployment rate peaked at 10.8 percent in late-1982 and averaged over 9½ percent in both 1982 and 1983 (Figure 1).

By 1983 the operating procedures of monetary policy had shifted. First, the Fed de-emphasized M1 in favor

of a broader aggregate, M2. Problems with M1 appear to have stemmed from both financial innovation and deregulation. Such new instruments as repurchase agreements and money market mutual funds were close substitutes for the deposits in M1, and therefore led to instability in its velocity. The availability of these new instruments was a major impetus behind the removal of deposit interest rate ceilings, mainly from 1978 to 1983. However, deregulation also created problems by blurring the distinction between transactions and savings balances held at depository institutions. The rationale for emphasizing M2 was that it was broad enough to internalize much of the portfolio substitution that had disrupted M1.

Second, in day-to-day operations, the Fed began to focus on the quantity of reserves borrowed from Reserve Banks as its operating instrument, which is similar to using the federal funds rate as the instrument of policy (Wallich 1984). Moreover, the degree of precision in monetary targeting was reduced, and money once again became one among a number of important indicators for policy, including data on developments in the real economy and prices, as well as in the domestic and international financial markets (Heller 1988).

The explicitness of a "price stability" goal did not appear until late in the 1983-90 expansion. Early in the expansion, official statements of Chairman Volcker generally were vague as to an inflation goal. For example, the February 6, 1984 *Monetary Report to Congress* stated that, "The (monetary) ranges for 1984 are intended to be consistent with the basic objective of achieving long lasting economic expansion in a context of continuing control of inflationary pressures."

However, after becoming Chairman in 1987, Mr. Greenspan stated explicitly in his monetary reports to Congress that the Fed's long-term goal was price stability, although neither a time frame nor specific annual goals for inflation were established. In his testimony of February 23, 1988, accompanying his first monetary report to Congress, Chairman Greenspan stated, "Progress toward price stability is the foundation on which the longest peacetime expansion in our nation's history has been built, and continued efforts along this line will be the framework for future economic advances." The February 20, 1990 *Monetary Report to Congress* stated that, "The Federal Open Market Committee is committed to the achievement, over time, of price stability." Moreover, Chairman Greenspan and a number of Reserve Bank Presidents supported a bill introduced by Congressman Neal requiring the Fed to achieve price stability within five years. Given the focus of the Greenspan Fed on price stability, it may be instructive to think of two disinflationary sub-periods since 1979: the early 1980s in which inflation was reduced to around 3½ percent, and the period since the late-1980s in which a further reduction has been sought.

Over the 1983–1990 expansion, little or no progress was made in reducing inflation below the 4 percent rate that had been established by 1984. In fact, following temporarily low inflation in 1986, caused by a sharp drop in the oil price, inflation began rising somewhat again, reaching over 5 percent on a consumer price basis by 1990 (although the latter rate was boosted by a temporary surge in the oil price.)

By mid-1989, the U.S. economy had slowed substantially, growing at less than a 2 percent rate, until it fell into recession in mid-1990. The recession, which was relatively mild and lasted three quarters, was followed by a long period of slow, but positive, growth in 1991 through mid-1993. In response to the overall pattern of slow economic growth since 1989, inflation has shown signs of a downward trend, averaging about 3 percent in 1992 and 2½ percent over the first ten months of 1993.

Since the onset of the 1990–1991 recession, Fed policy has focused on boosting economic growth moderately, although it has retained its long-run goal of gradually reducing inflation to very low levels. M2 growth has remained extremely weak. Especially in 1991 and 1992, M2 came in near the bottom of, or below, its annual range. However, low M2 growth has not been considered a reliable measure of monetary tightness, since M2's relationship to other economic variables appears to have shifted significantly. Like the earlier problem with M1, the problem with M2 seems to have arisen primarily from financial deregulation and innovation (Judd and Trehan 1992).

For these reasons, M2 has been de-emphasized in policy decisions by the Fed in recent years. In essence, the Fed has not had any monetary aggregate considered reliable enough to use as a primary guide to monetary policy. Instead, in recent years, it has relied on purely discretionary adjustments to the federal funds rate to find a delicately balanced policy geared toward promoting moderate economic growth, while making further progress in reducing inflation.

II. Empirical Evidence on the Output-Inflation Trade-off

In this section, we assess whether the output-inflation trade-off has shifted downward since the late 1970s, when the Fed increased its emphasis in public statements and actions on the goal of reducing inflation. To do so, we analyze an equation commonly used to estimate the trade-off, and we review movements in inflation expectations as measured by surveys.

To estimate the trade-off, we use:

$$(1)\ \Delta p_t = \alpha + \lambda \Delta x_t + \beta \Delta p_{t-1} + \gamma(y_{t-1} - \bar{y}_{t-1})$$

where, $x_t \equiv p_t + y_t$; x = log of nominal GDP; p = log of aggregate price level; y = log of real GDP; and $\bar{y}$ = log of trend real GDP.

This equation has been used to estimate the trade-off by authors with such diverse views about the structure of the economy as Lucas (1973), Gordon (1983), Gordon and King (1982), Schultze (1984), and Ball, Mankiw, and Romer (1988).[2] Thus equation (1) appears to be consistent with both "new" and "old" Keynesian theory as well as demand-oriented, or monetarist, equilibrium business cycle theory. Correlations of the type expressed by the equation should be evident in both (1) an economy in which expectations are adaptive, so that an expectations-augmented Phillips-curve would apply, and (2) an economy in which expectations are rational, so that the "trade-off" represents only an observed short-run correlation that is not exploitable by policymakers. Thus Lucas (1973) derives a relationship like equation (1) from a monetary-misperceptions model with rational, optimizing agents, and Gordon (1983) shows how equation (1) can be viewed as a rearranged version of an adaptive-expectations Phillips curve.[3]

The key assumption underlying the equation is that growth in nominal GDP is exogenous with respect to inflation. As such, it would capture the effects of aggregate demand on inflation, and would be independent of aggregate supply shocks. (The viability of this assumption is assessed below.) Then, for a given lagged inflation rate and state of the business cycle, the coefficient λ measures the proportion of the change in aggregate demand that affects prices in the short-run as opposed to output. The output-inflation trade-off is calculated as $\tau = (1-\lambda)/\lambda$. It measures the percentage point change in output per percentage point of change in inflation resulting from a given change in aggregate demand. If the Fed's disinflation policy has gained credibility over the 1980s, then λ should have risen and τ should have declined over this period. Other coefficients in the equation also might have changed. However, following the earlier literature, we will focus exclusively on λ and its implications for τ.

Estimating the Trade-off

Table 1 presents the results of estimating various forms of equation (1) using annual data over 1949 to 1992. The simplest estimated equation is shown in column 1. In this column, the cyclical variable $(y-\bar{y})$ is formed by linearly de-trending real GDP. (An alternative de-trending method is discussed below.) All of the explanatory variables have the expected signs, are highly significant, and together account for about 82 percent of the variation in annual inflation. This regression suggests that τ averaged about 1.7 (.63/.37) in the U.S. in the post-World War II period.[4]

However, in order to feel comfortable with the assumption that x is exogenous with respect to p, it is necessary to investigate the issue of whether supply shocks are likely to be biasing estimates of λ. A supply shock causes p and y to move in opposite directions. If these variables do *not* move by equal (proportional) amounts, then there will be a resulting movement in nominal GDP, which will produce a correlation between nominal GDP and inflation that would be misinterpreted by the equation as reflecting the trade-off. In other words, supply shocks will bias estimates of λ unless the aggregate demand function has a (negative) unitary elasticity.

Columns 2 through 6 represent attempts to see if supply shocks present a problem in estimating λ. First, we introduce supply shock variables to see if the estimate of λ is altered substantially. Second, we use two-stage least squares estimation to eliminate possible reverse causation, and again observe whether this affects the estimate of λ. In column 2, we add a dummy variable that attempts to capture the effects of major oil shocks, by taking on the value of 1 in 1974 and 1979 and -1 in 1986. This variable is significant in the equation and has the expected sign, but does not significantly alter the estimate of λ. Column 3 shows two-stage-least squares estimates of the same equation that was estimated with OLS in column 2. Again, the estimate of λ is not materially affected. Column 4 introduces changes in the relative price of oil (from the Producer Price Index), and has no effect on λ. In column 5, we test

2. Other papers dealing with this issue are Ball (1991, 1993), Friedman (1984, 1988), and Okun (1978).

3. In Judd and Beebe (1993, pp. 306 and 317), we tested for the stability of an inflation-augmented Phillips curve, which expressed wage inflation as a function of slack in the labor market (as measured by the unemployment rate relative to its estimated full employment level), and expected wage inflation (as measured by past wage inflation). These tests can be considered an alternative way of testing for the stability of the inflation-unemployment trade-off. Similar to the results discussed below for equation 1, we failed to reject stability of the wage inflation Phillips curve.

4. Using monte carlo methods, we calculated the t statistic for the test of whether this estimate of τ is different from zero, based upon the estimate of λ and its standard error in column 1. The t statistic for τ was estimated to be 4.33, suggesting that τ is different from zero with a high level of confidence.

TABLE 1

OUTPUT-INFLATION TRADE-OFF EQUATIONS: ALTERNATIVE SPECIFICATIONS
1949–1992

	(1)	(2)	(3)[1]	(4)	(5)[2]	(6)[3]
Constant	−1.07**	−0.96**	−0.95**	−0.91**	−0.99**	−0.015**
Δx_t	0.37**	0.36**	0.37**	0.36**	0.37**	0.42**
Δp_{t-1}	0.44**	0.41**	0.42**	0.40**	0.41**	0.66**
y_{t-1}	0.15**	0.13**	0.13**	0.12**	0.14**	—
T_t	−0.0041**	−0.0036**	−0.0036**	−0.0034**	−0.0037**	—
$y_{t-1} - \bar{y}_{t-1}$	—	—	—	—	—	0.41**
$D0$	—	0.013*	0.012*	—	0.011*	—
$\Delta poil_t$	—	—	—	0.030*	—	—
$\Delta forex_t$	—	—	—	—	0.00013	—
$\bar{R}^2$	0.82	0.84	0.84	0.85	0.83	0.83
SEE	0.010	0.0099	0.0099	0.0096	0.010	0.010
Q(11)	8.08	7.39	7.59	8.52	8.32	6.61

NOTE: Marginal significance levels: * = .05; ** = .01.

1. This equation was estimated with a two-stage least squares procedure. Instrumental variables used for Δx_t include Δx_{t-1}, Δb_{t-1}, ΔDEF_t, Δp_{t-1}, y_{t-1}, T_t, $D0$.

2. This equation was estimated with a two-stage least squares procedure. Instrumental variables used for Δx_t and $\Delta forex_t$ include Δx_{t-1}, Δb_{t-1}, ΔDEF_t, Δp_{t-1}, y_{t-1}, T_t, $D0$ and $\Delta forex_{t-1}$.

3. $\bar{y}$ was estimated as the permanent component of y from a VAR for y and the six-month commercial paper rate as in Judd-Trehan (1990). Because of well-known problems associated with using generated regressors (Pagan 1984), the t statistic on $\bar{y}_{t-1}$ in column 6 is biased upward.

Definition of variables:

x = log of nominal GDP $\equiv p + y$
p = log of GDP deflator
y = log of real GDP
$\bar{y}$ = log of trend real GDP
T = time
$poil$ = log of relative price of energy, producer price index
$forex$ = real trade-weighted exchange rate beginning in 1969, zero from 1949 to 1968

$$D0 = \begin{cases} 1 \text{ in } 1974, 1979 \\ -1 \text{ in } 1986 \\ 0 \text{ elsewhere} \end{cases}$$

b = log of monetary base (FRB St. Louis)
DEF = log of nominal federal defense expenditures

for possible effects of changes in the real trade-weighted value of the dollar. Using two-stage-least squares methods, we again find no significant effect on the estimated size of λ. We conclude from these exercises that the basic equation does not appear to be distorted by the effects of supply shocks.

A second issue in estimating λ has to do with how to de-trend real GDP to form the business cycle variable (see Rudebusch 1993). In the estimated equations discussed above, we used a linear time trend to represent equilibrium real GDP. In a second somewhat more complex approach, we used the method of Blanchard-Quah (1989) to extract the trend component. This method involves estimating a structural VAR with the identifying restriction that there are two types of shocks—a permanent and a transitory shock.[5] The permanent shock is associated with trend real output, while the transitory shock is associated with the business cycle. Thus, we introduced the transitory component of real GDP, as estimated by this method, into the equation in column 6 in place of y_{t-1} and T in column 1. Based upon the estimates of λ in columns 1 and 6, this substitution reduced the estimate of τ by 19 percent ((1.70 − 1.38)/1.70). In the discussion below, we test for possible shifts in λ using both methods of de-trending y, to be sure that this factor does not affect our results.

Tests for Shifts in the Trade-off

In Table 2, we present tests for shifts in λ. First, we take columns 2 and 6 in Table 1 and introduce a dummy variable times the growth in nominal GDP, which yields columns 7 and 9. These latter columns provide a test for a decline in λ over 1980–1992 compared with 1949–1979. Column 7 (like column 2) uses linearly de-trended real GDP while column 9 (like column 6) uses the Blanchard-Quah method of de-trending. In both equations, the estimated λ rises somewhat (from .36 in 2 to .42 in 7 and from .42 in 6 to .46 in 9), but neither change is statistically significant even at the 10 percent level.

Using monte carlo methods, we calculated the t statistics for a change in τ in 1980–1992 based upon the estimates of λ and their standard errors in columns 7 and 9. The results were the same qualitatively as those for λ: We were not able to reject stability even at the 10 percent level.

One potential problem with the tests in columns 7 and 9 is that the period from 1949 to 1979 encompasses years in which inflation was low (1949–1965), as well as years in which inflation increased (1965–1979). The tests in column 7 and 9 ask whether λ was different in 1980–1992 from the *average* ratio in the *entire* prior period, whereas we are more interested in seeing if it rose in 1980–1992 compared with the period in which inflation rose (1965–1979). Columns 8 and 10 attempt to address this question by including slope dummy variables (on Δx) for 1965–1992 and for 1980–1992. Although column 8 shows a decrease in λ beginning in 1965, neither column 8 nor 10 suggests a significant shift since the late 1970s.[6]

As a final check, we consider the possibility that λ may have changed gradually following the late 1970s as the public learned of the Fed's increased resolve to reduce inflation. In Table 3 (p. 32) we test for a shift in λ in blocks stretching from *each year* in 1980–1992 to the end of the sample. Again, we do not find any single dividing point in which there is a significant change in λ, even at the 10 percent level of significance.

In summary, despite a considerable search for a shift in λ after the late 1970s, we have found none. It appears that the Fed faces about the same output-inflation trade-off today in attempting to reduce inflation from its present moderate level that it faced at the height of the inflation and financial instability in 1979.

III. INFLATION EXPECTATIONS

Our conclusion that the output-inflation trade-off has not shifted seems consistent with the evidence from surveys of inflation expectations, which have been slow to adjust to disinflationary results. As shown in Figure 2 (p. 32), expectations in 1980 through 1982 of average inflation over the next ten years were well above subsequent actual ten-year average inflation rates for the ten-year-ahead period. Even by 1982, average inflation expected over the next 10 years was 6¾ percent, while the *ex post* realized average turned out to be only 4 percent.

A decade later, long-run inflation expectations remain well above the 1992 inflation rate of around 3 percent. Financial decisionmakers, as represented by the

5. Following Judd-Trehan (1990), we estimated a two-variable VAR for log changes in real GDP and the change in the commercial paper rate, using six lags of each variable. This system yielded impulse response functions similar to those commonly found in the literature. Thus, for example, positive transitory (demand) shocks cause output to rise temporarily before returning to trend, while positive permanent (supply) shocks cause output to rise permanently.

6. Ball, Mankiw, and Romer (1988) argue that the sacrifice ratio should rise (fall) as inflation falls (rises) because of menu costs, and they present cross-sectional evidence from a number of different countries that such a relationship exits. However, using time-series data, Ball (1993) fails to find this effect. We tested for this effect by including both Δx and Δx^2 in regressions 7 and 9, Table 2. The combination of these two variables means that the sacrifice ratio can vary with the growth rate of nominal demand. Like Ball, we failed to find a significant effect in our time-series data.

TABLE 2

TESTING FOR CHANGES IN THE OUTPUT-INFLATION TRADE-OFF BEGINNING IN 1965 AND 1980

	(7)	(8)	(9)	(10)
Constant	−1.08**	−1.56**	−0.015**	−0.014**
Δx_t	0.35**	0.48**	0.43**	0.41**
$\Delta xD65_t$	—	−0.22**	—	0.02
$\Delta xD80_t$	0.073	0.075	0.026	0.022
Δp_{t-1}	0.41**	0.49**	0.65**	0.65**
y_{t-1}	0.15**	0.21**	—	—
T_t	−0.0043*	−0.0059**	—	—
$y_{t-1} - \bar{y}_{t-1}$	—	—	0.43**	0.42*
$D0$	0.014*	0.013*	—	—
$\bar{R}^2$	0.84	0.86	0.81	0.81
SEE	0.001	0.009	0.010	0.010
Q(11)	9.09	6.79	6.03	6.90

NOTE: Marginal significance levels: * = .05; ** = .01.

Definition of variables:

$$D65 = \begin{cases} 1 & 1965\text{–}1992 \\ 0 & \text{elsewhere} \end{cases}$$

$$D80 = \begin{cases} 1 & 1980\text{–}1992 \\ 0 & \text{elsewhere} \end{cases}$$

Other variables are defined in Table 1.

Hoey/Philadelphia Fed survey, expect inflation to average 3¾ percent over the next ten years (survey of 1993.Q2), while the Michigan survey suggests that households expect a 5¼ percent average inflation rate over the same period (average of January through May 1993 surveys). It appears that the public remains unconvinced that the Fed will achieve inflation much below 4 percent, despite the stated goal of price stability.

IV. WHAT CAN BE DONE TO MAKE DISINFLATION LESS COSTLY?

Apparently, the Fed faces the same output-inflation trade-off now that it faced in the early 1980s as it sought to bring inflation down from double-digit rates. Of course, one reason for this may be that it has yet to produce clear results in reducing inflation significantly below the level established in the mid-1980s. Although it seems unlikely that the public fears another outbreak of double-digit inflation, evidence has not yet been observed supporting the view that inflation will move to a level much below those that have prevailed since the mid-1980s.

Doubts about lower inflation may be magnified by large actual and projected federal budget deficits since the early 1980s. There may be concern that in the long run, persistently large deficits will lead to higher inflation, even though the Fed generally is credited with not having succumbed to pressure to monetize the federal debt to date.

In addition, the current design of monetary policy may not make it easy for the public to discern how much emphasis is being placed on inflation reduction. Although the Fed has stated for a number of years that its main objective is to eliminate inflation, it also has paid attention to output stabilization. The expressed intent of mitigating

TABLE 3

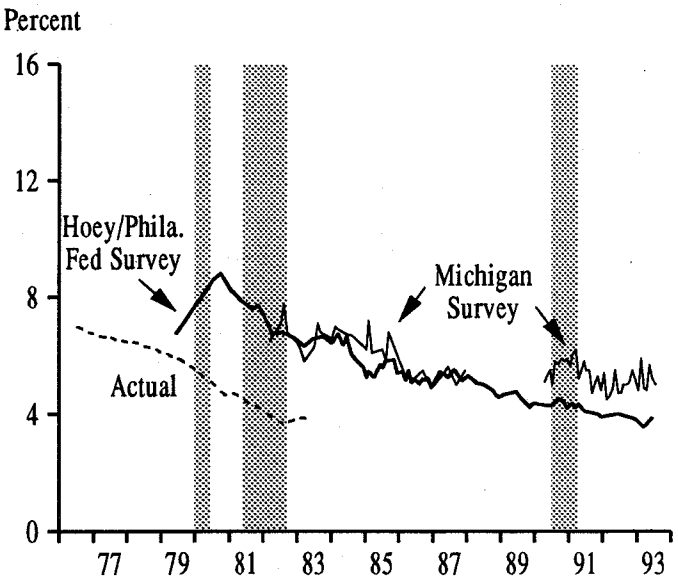
TESTING FOR CHANGES IN THE OUTPUT-INFLATION TRADE-OFF IN 1980 THROUGH 1992

	CHANGE IN COEFFICIENT ON Δx	
PERIOD TESTED	(8)	(10)
1980–92	.076 (0.25)	.022 (0.68)
1981–92	.021 (0.76)	−.006 (0.91)
1982–92	−.121 (0.18)	−.049 (0.47)
1983–92	−.117 (0.20)	−.048 (0.47)
1984–92	−.071 (0.43)	−.041 (0.55)
1985–92	−.101 (0.34)	−.043 (0.59)
1986–92	−.038 (0.73)	−.017 (0.84)
1987–92	−.048 (0.64)	−.002 (0.98)
1988–92	−.022 (0.84)	−.025 (0.80)
1989–92	.006 (0.96)	−.024 (0.84)
1990–92	.019 (0.91)	.009 (0.96)
1991–92	.052 (0.81)	.011 (0.96)
1992	−.067 (0.76)	−.014 (0.55)

NOTE: Marginal significance levels shown in parentheses. For example, a marginal significance level of 0.10 would suggest that stability could be rejected with the probability of 10 percent that the equation is stable. The power of these tests declines as the dividing point in the sample moves toward the end of the sample.

FIGURE 2

EXPECTED AND ACTUAL CPI INFLATION FOR TEN YEARS AHEAD



Shaded areas represent recessions as defined by the NBER. Expected and actual data are for averages over the next 10 years, not for the 10th year out.

cyclical downturns inevitably raises the issue of whether this goal will take precedence over disinflation at any particular time. Given the discretionary approach followed by the Fed, in which it resolves conflicts between the two goals on a case-by-case basis, it may be difficult for the public to be sure that the Fed's resolve to reduce inflation has not flagged.

One approach that might help convince the public that the Fed is serious about disinflation would be to announce specific inflation targets, or at least target ranges, for the years ahead.[7] By showing a willingness to commit itself to a particular path of disinflation, and thereafter, to a particular range for inflation, the Fed might be making its resolve more credible. Moreover, it would be providing the market with a benchmark for judging progress in meeting that goal.

A related issue concerns intermediate targets for monetary policy. As discussed above, although the Fed establishes target ranges for the monetary aggregates, it often does not take actions to achieve those targets, since rapid financial change has made it inadvisable to adhere to rigid targets for these variables. As a consequence, however, the market has received ambiguous and confusing signals about what the Fed is doing to achieve its long-run disinflation goal. If the Fed had been able to pursue its monetary target variables more aggressively, it might have enhanced the credibility of its disinflation goal by providing the market with timely feedback on whether it was acting in the short run in a way that would achieve its long-run inflation goal (Cukierman-Meltzer 1986).

Given the problems with the monetary aggregates, it seems worthwhile to evaluate the usefulness of alternative intermediate target variables and targeting procedures. Recent research outlined briefly in the accompanying box suggests that nominal GDP possibly could be used effectively as an intermediate target in a context in which the Fed retains its use of a nominal interest rate as its instrument of policy (Judd and Motley 1992 and elsewhere in this *Review*). Essentially, the approach involves raising (lowering) a short-term nominal interest rate whenever growth in last period's nominal GDP exceeds (falls short of) a preestablished target for nominal GDP growth. The targeted growth rate for nominal GDP would be chosen to be consistent with a goal for inflation and made explicit *ex ante*.

A monetary policy rule such as this offers several potential advantages. First, nominal GDP would not be disrupted by shifts in the velocity of money. Second, to construct such a rule, the Federal Reserve would first have to specify an inflation goal. Moreover, by linking specific

7. In this discussion, we confine ourselves to ways of improving the credibility of gradualist disinflation policies. For a discussion of the merits of "cold-turkey" approaches, see Ball (1993) and Sargent (1983).

LINKING AN INFLATION GOAL TO AN INTERMEDIATE TARGET AND OPERATING PROCEDURE

The following rule is used to illustrate an approach to policy that might have advantages from the point of view of expeditiously establishing credibility. The feedback rule links movements in a short-term interest rate to nominal GDP:

$$\Delta R_t = \delta[\Delta x_{t-1} - \Delta x^*_{t-1}].$$

The variable R denotes the policy instrument, which in this case is a short-term nominal interest rate such as the federal funds rate that is under the direct *short-run* control of the monetary authority. The variable x represents the intermediate target variable of policy, which in this case is (the log of) nominal GDP. The rule specifies that the change in the interest rate each quarter is a function of last quarter's deviation between the growth rate of nominal GDP (Δx) and its target growth rate (Δx^*).

The targeted growth rate of nominal GDP would be set according to:

$$\Delta x^*_t = \Delta p^*_t + \Delta \bar{y}_t,$$

where Δp^* is the central bank's inflation target and $\Delta \bar{y}$ is the estimated trend growth rate of real GDP. The strength of the monetary authority's response to deviations between Δx and Δx^* is defined by δ, and can be selected by the central bank. Based upon stochastic simulations of two small macroeconomic models, this rule appears to be capable of holding long-run inflation to within fairly narrow bounds, without substantially increasing volatilities in real GDP or interest rates above those observed in the post-war period (Judd-Motley 1992 and this issue.)

policy actions (i.e., changes in a short-term interest rate) to an intermediate target that is simply and clearly linked to the inflation goal, the public would have a simple way to monitor the Fed's resolve to achieve and maintain that inflation goal. Finally, the rule *either* could be followed explicitly by the Fed or be used to guide and assess a discretionary policy, should the Fed wish to diverge from the policy prescribed by the rule. While a full assessment of such an approach would involve issues other than credibility, it appears that an approach of this type, whether used as a rule or as a baseline for discretion, might reduce the cost of disinflation.

In conclusion, the empirical tests in this paper suggest strongly that the output cost of reducing inflation is about the same as it was at the height of the inflationary period from the late 1970s to the early 1980s. It is possible, however, that this cost might be reduced if the Fed were to make a public commitment to an explicit inflation target and perhaps if it also were to commit itself to an intermediate target and operating procedure linked explicitly to the inflation target.

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