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WHAT DETERMINES THE SACRIFICE RATIO?

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ABSTRACT

This paper investigates the determinants of the "sacrifice ratio" for disinflation: the ratio of the loss in output to the fall in trend inflation. I develop a method for estimating the sacrifice ratio in individual disinflation episodes, and apply it to 65 episodes in moderate-inflation OECD countries. In this sample, the sacrifice ratio is decreasing in the speed of disinflation: cold turkey is less costly than gradualism. The ratio is also decreasing in the flexibility of wage-setting institutions. The openness of the economy has no effect on the ratio, and the effects of incomes policies and the initial level of inflation are unclear.

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I. INTRODUCTION

Disinflations are a major cause of recessions in modern economies -- perhaps the dominant cause. In the United States, for example, recessions occurred in the early 1970s, mid-1970s, and early 1980s. Each of these downturns coincided with falling inflation caused by tight monetary policy (Romer and Romer, 1989).

Is there an iron law that disinflation produces large output losses? Or can favorable circumstances and wise policies reduce or even eliminate these costs? Economists have suggested a wide range of answers to this question. One traditional view is that disinflation is less expensive if it occurs slowly, so that wages and prices have time to adjust to tighter policy. An opposing view (Sargent, 1983) is that quick disinflation can be inexpensive, because expectations adjust sharply. Some economists argue that disinflation is less costly if tight monetary policy is accompanied by incomes policies or other efforts to coordinate wage and price adjustment. Finally, a number of authors suggest features of the economic environment that affect the output-inflation tradeoff, such as the initial level of inflation (Ball, Mankiw, and Romer, 1988), the openness of the economy (Romer, 1991), and the nature of labor contracts (Gordon, 1982).

Despite this debate, there has been little systematic empirical work on these issues. The speed of disinflation, the nature of incomes policies, and so on differ considerably across countries and disinflation episodes, but we do not know whether these differences produce important differences in output behavior. Many studies examine individual disinflation experiences, but few compare sizable numbers of episodes. Those that do consider multiple episodes focus on establishing that the output losses are generally large (e.g. Gordon, 1982; Romer and Romer, 1989). This paper measures the variation in the costs of disinflation across a sample of episodes, and asks whether this variation can be explained.[1]

I examine disinflations from 1960 to the present in moderate-inflation OECD countries. The sample contains all episodes in which trend inflation (defined as a moving average of actual inflation) falls substantially (usually more than two percentage points). Using quarterly data, I identify 28 episodes in nine countries; with annual data, I identify 65 episodes in 19 countries. I then develop a simple method for estimating the "sacrifice ratio" for each episode: the ratio of the total output loss to the change in trend inflation. This method is based on a new approach to measuring full-employment output during disinflation. Finally, I examine the relation between the sacrifice ratio and variables that influence it in various theories.

There are two main results. First, the sacrifice ratio is decreasing in the speed of disinflation (the ratio of the change in trend inflation to the length of the episode). That is, as suggested by Sargent, gradualism makes disinflation more expensive. Second, the ratio is lower in countries with more flexible labor contracts. The most important feature of contracts is their duration.

I also examine the effects of initial inflation, incomes policies, and the openness of the economy. For these variables, the results range from negative to inconclusive.

II. CONSTRUCTING SACRIFICE RATIOS

This section develops a method for identifying disinflation episodes and calculating the associated sacrifice ratios. This approach might prove useful for future studies of disinflation, as well as for the empirical work below.

A. Motivation

Many previous authors estimate sacrifice ratios, but their techniques are not appropriate for the current study. The most common approach is to derive the ratio from an estimated Phillips curve -- from the relation between output and inflation in a long time series (Okun, 1978; Gordon and King, 1982). A limitation of this approach is that it constrains the output-inflation tradeoff to be the same during disinflations as during increases in trend inflation or temporary fluctuations in demand. This restriction is false if the sacrifice ratio is influenced by factors specific to disinflations, such as incomes policies or credibility-induced shifts in expectations. Most important, the Phillips curve approach constrains the sacrifice ratio to be the same for all disinflations within a time series. This paper estimates separate ratios for each episode to see whether the ratio varies systematically, both within the experience of a country and across countries.

A number of authors compute sacrifice ratios for particular episodes based on ad hoc estimates of the change in inflation and output losses. Blinder (1987), for example, considers the Volcker disinflation, which he dates from 1980 through 1984. He assumes that trend inflation fell by six percentage points, and that the natural rate of unemployment was constant at 5.8%. Along with the actual path of unemployment, these assumptions yield a sacrifice ratio of 2.1 points of unemployment per point of inflation. If one multiplies by an Okun's Law coefficient of 2.5, the output sacrifice ratio is 5.3.

My estimates of sacrifice ratios are in the spirit of previous episode-specific estimates, but are more systematic. Previous estimates rely on judgement about the dating of episodes and the natural levels of unemployment or output. Applying such judgement on a case-by-case basis is cumbersome, and raises the possibility that different episodes are treated inconsistently. I seek an algorithm for calculating sacrifice ratios that generally comes close to conventional estimates but can be applied mechanically to many episodes.

B. Selecting Episodes

The first step in my procedure is to identify disinflations -- episodes in which trend inflation falls substantially. Trend inflation is defined as a centered, nine-quarter moving average of actual inflation: trend inflation in quarter t is the average of inflation from t-4 through t+4. This definition captures the intuition that trend inflation is a smoothed version of actual inflation. I doubt that other reasonable definitions would produce substantially different results.

To identify disinflations in a given country, I first identify "peaks" and "troughs" in trend inflation. A peak is a quarter in which trend inflation is higher than in the previous four quarters and the following four quarters; a trough is defined by an analogous comparison to four quarters on each side. A disinflation episode is any period that starts at an inflation peak and ends at a trough with an annual rate at least two points lower than the peak. These definitions assure that an episode is not ended by a brief increase in inflation in the midst of a longer-term decrease. Figure 1 illustrates the procedure by identifying disinflations in the United States, Germany, the United Kingdom, and Japan.

This procedure is meant to separate significant, policy-induced shifts in inflation from smaller fluctuations arising from shocks. It appears quite successful. I have checked the historical record for each of the 28 disinflations in my quarterly data set (mainly by reading the OECD Economic Outlook and OECD studies of individual countries). In every one of the cases, there is a significant tightening of monetary policy near the start of disinflation. In most cases, the motivation for tight policy is either to reduce inflation or to support the domestic currency. Declines in inflation arising primarily from favorable supply shocks, such as the 1986 decline in oil prices, are too small or too transitory to meet my criteria for disinflation. Intentional demand contractions are essentially the only source of two-point declines in trend inflation.

Indeed, a significant tightening of monetary policy is not only necessary for disinflation but also, it appears, close to sufficient. For the United States and Japan, I have compared my disinflations to the lists of monetary contractions developed by Romer and Romer (1989) and Fernandez (1992). In the U.S., policy was tightened in 1968, 1974, 1978, and 1979; if the last two are treated as one episode, there is a close correspondence to the disinflations starting in 1969, 1974, and 1980. Similarly, there is a close correspondence between the six Japanese disinflations and Fernandez's dates.

C. The Sacrifice Ratio

The denominator of the sacrifice ratio is the change in trend inflation over an episode -- the difference between inflation at the peak and at the trough. The numerator is the sum of output losses -- the deviations between actual output and its "full employment" or trend level. The most delicate issue is the measurement of trend output, because small differences in fitted trends can make large differences for deviations.

Standard approaches to measuring trend output do not yield appealing results in this application. This point is illustrated by Figure 2, which shows trend output in the U.S. and Germany calculated using a log-linear trend split in 1973 and using the Hodrick-Prescott filter. Since these methods minimize deviations from trend, they appear to understate or even eliminate recessions. In the U.S., for example, output does not fall below trend during the 1980 recession. In Germany, total deviations from trend during the 1980-86 disinflation are close to zero, whereas traditional accounts of this period include a deep recession without an offsetting boom.[2]

My goal is a definition of trend output that is consistent with conventional views about the costs of various disinflations. After experimentation, I arrive at a definition based on three assumptions. First, output is at its trend or natural level at the start of a disinflation episode -- at the inflation peak. This assumption is reasonable because the change in inflation is zero at a peak. The natural level of output is often defined as the level consistent with stable inflation.

Second, I assume that output is again at its trend level four quarters after the end of an episode, i.e. four quarters after an inflation trough. The logic behind the first assumption suggests that output returns to trend at the trough, where inflation is again stable. In practice, however, the effects of disinflation are persistent: output appears to return to trend with a lag of about a year. The return to trend is indicated by above-average growth rates in years after troughs. In the United States, for example, average growth in the four quarters after an inflation trough is 5.7%.[3]

My final assumption is that trend output grows log-linearly between the two points when actual and trend output are equal. In graphical terms, trend output is determined by connecting the two points on the log output series. The numerator of the sacrifice ratio is the sum of deviations between this fitted line and log output.

Figure 3 plots log output and the fitted trends for the U.S., the U.K., Germany, and Japan. The trends are usually close to the lines one would draw by hand if doing ad hoc calculations of the sacrifice ratio.

I interpret the sacrifice ratio as the cost of reducing inflation one point through an aggregate demand contraction. This interpretation relies on two assumptions. First, shifts in demand are the only source of changes in inflation: there are no supply shocks. As discussed above, demand contractions do appear to be the main cause of the disinflations in my sample. Nonetheless, it is likely that supply as well as demand shifts occur during some episodes, and that supply shocks affect the sizes of the output losses and changes in inflation. Thus the sacrifice ratio for a given disinflation is a noisy measure of the effects of the demand contraction. This need not create a problem for my analysis, however. When I regress the sacrifice ratio on explanatory variables, the noise in the ratio can be interpreted as part of the error term.

A second assumption behind my sacrifice ratios is that trend output is unaffected by disinflation: there is no hysteresis. Recent research suggests that demand shifts can reduce output permanently (Romer, 1989); that is, contractionary policy reduces trend output as well as causing temporary deviations from trend. In this case, the true undiscounted sacrifice ratio is infinite. With discounting, however, one can calculate a finite ratio with the present value of output losses as the numerator. Moreover, it is plausible that this sacrifice ratio is well-proxied by the ratio computed here. My variable measures the deviation from trend output and ignores the change in the trend, but it is likely that these components of the output loss move together: a larger recession leads to a larger permanent loss. In this case, my procedure understates the sacrifice ratio in all disinflations, but accurately identifies the relative costs of different episodes. Thus I can compare episodes without taking a stand on whether disinflation has permanent effects.[4]

D. Annual Data

For some countries, output data are available only annually. Thus I also use a version of my procedure in which a year is the basic time unit. I define trend inflation for a year as an eight-quarter moving average centered at the year -- an average over the four quarters of the year and the two quarters on each side. (Quarterly inflation data are available for all countries.) Year t is an inflation peak (trough) if trend inflation at t is higher (lower) than trend inflation at t-1 or t+1. That is, peaks and troughs are defined with reference to a year on each side rather than four quarters. Trend output is determined by connecting output at the inflation peak to output one year after the trough. Finally, a disinflation occurs when trend inflation falls at least 1.5 percentage points, rather than two points as before. For a given country, this cutoff yields roughly the same number of episodes as I identify with quarterly data. The use of annual data dampens movements in inflation, and the resulting loss of episodes offsets the gain from the lower cutoff.

III. A SAMPLE OF SACRIFICE RATIOS

The data on inflation and output are from the IMF's International Financial Statistics. I examine all OECD countries for which reliable data are available and trend inflation has stayed below 20% since 1960. I consider disinflations that begin in 1960 or later and end by 1991. Inflation is measured by the change in the consumer price index, and output is measured by real GNP or real GDP (whichever is available).

For most countries, my procedure identifies two to five disinflation episodes. The quarterly data yield 28 episodes from nine countries: the U.S., the U.K., France, Germany, Italy, Switzerland, Canada, Japan, and Australia. The annual data yield 65 episodes in 19 countries. 25 episodes appear in both the quarterly and annual data sets. Tables I and II list all the episodes and their sacrifice ratios.

The average ratio across all episodes is 5.8% for quarterly data and 3.1% for annual data. For the 25 episodes in both samples, the averages are 6.0% and 4.6%. It appears that the annual data understate output losses because time aggregation smooths the output series. Nonetheless, the two data sets yield similar pictures of the relative costs of different disinflations; for the 25 common observations, the correlation between the two ratios is .81.

For the quarterly data, the sacrifice ratios for individual episodes range from 0.0% to 14.2%. The ratio exceeds 2% in 25 of 28 cases, suggesting that disinflation almost always has significant costs. There are large differences in average ratios across countries, as shown in Table III. Countries fall into three groups: the U.S. and Germany, with averages near 10%; Italy, Switzerland, and Canada between 6% and 7%; and the U.K., France, Japan, and Australia between 3% and 4%. A regression of the ratio on country dummies yields an $\bar{R}^2$ of .47.

There is greater variation in the ratio with annual data, and a number of negative ratios. These results probably reflect greater measurement error arising from cruder data. The $\bar{R}^2$ from a regression on country dummies is only .18. Similarly, the $\bar{R}^2$ is lower for annual than for quarterly data in most of the regressions below.

For the United States, the average sacrifice ratio is 9.6% with quarterly data and 9.2% with annual data. These figures are higher than most estimates of sacrifice ratios based on Phillips curves; for example, Gordon and King's (1982) final estimate is 5.8%. My estimated ratios for the Volcker disinflation are

7.3% and 7.7%, which are moderately higher than the 5.3% derived from Blinder. It is not clear whether these results reflect random variation or a systematic difference between my approach and previous ones.

IV. THE SPEED OF DISINFLATION

The next three sections ask whether variation in the sacrifice ratio can be explained. This section shows that the ratio is lower if disinflation is quick.

A. Background

The optimal speed of disinflation -- the choice between "gradualism" and "cold turkey" -- is a central issue for macroeconomic policy. One view is that gradualism is less costly because wages and prices possess inertia, and thus need time to adjust to a monetary tightening. This view has been formalized by Taylor (1983), who presents a model of staggered wage adjustment in which quick disinflation reduces output but slow disinflation does not.[5]

A contrary view is that disinflation is less costly if it is quick. Sargent (1983) argues that a sharp regime shift produces credibility, and hence a shift in expectations that makes disinflation costless. Gradualism, by contrast, "invites speculation about future reversals," so that expectations do not adjust. Another argument for quick disinflation appears to follow from "menu cost" models of price adjustment. In these models, large shocks trigger greater price adjustment than small shocks; thus a large, one-time shift in monetary policy may be close to neutral, whereas a series of smaller tightenings reduces output substantially. (This idea has not been formalized, however.)

There is currently little evidence on these issues. The two sides make their cases by appealing to historical examples, but the interpretation of individual episodes is controversial. (See, for example, the debate over

Sargent's account of the Poincare disinflation.) This study compares the sacrifice ratio and the speed of disinflation across my sizable sample of episodes.

My basic measure of the speed of disinflation is the change in trend inflation per quarter -- the total change from peak to trough divided by the length of the episode. It is not clear, however, that this variable is the right summary statistic; in particular, the numerator and denominator of speed could influence the sacrifice ratio in different ways. In models of staggered price adjustment, the ratio depends only on the length of disinflation relative to the frequency of price adjustment. A larger change in inflation over a given period increases the numerator and denominator of the ratio by the same proportion (Ball, 1992). By contrast, Sargent's view suggests that the change in inflation matters: a larger change is more likely to be perceived as a regime shift, and thus produce a shift in expectations. In my empirical work, I test for separate effects of the inflation change and the episode length.

B. Basic Results

Table IV presents my basic results about the sacrifice ratio and the speed of disinflation. Columns (1) and (2) report simple regressions of the ratio on speed for the quarterly and annual data sets. In both cases, speed has a significantly negative coefficient: faster disinflations are less expensive. To interpret the coefficients, consider the difference between the fitted sacrifice ratio when speed equals one and when speed equals one half. These speeds correspond to a ten point disinflation carried out over ten or twenty quarters (or a five point disinflation over five or ten quarters). For the quarterly data set, the sacrifice ratio is 2.6% when speed is one and 5.7% when speed is one half. The results for annual data are similar. Thus faster disinflation produces substantially lower output losses.

Columns (3) and (4) of the Table enter the change in inflation ($\Delta\pi$) and the episode length as separate variables. The $\Delta\pi$ coefficient is significantly negative, and the length coefficient is significantly positive. That is, greater speed reduces the sacrifice ratio regardless of whether it results from a larger inflation change over a given period or from a faster completion of a given change. The $\bar{R}^2$'s for this specification are considerably higher than when $\Delta\pi$ and length enter only through their ratio.

I have also estimated the equations in columns (1)-(4) with the addition of dummy variables for countries. These regressions isolate the within-country comovement of the sacrifice ratio and speed. The results are similar to Table IV, although somewhat weaker. The coefficient in the simple regression on speed is -.037 (t=1.9) for quarterly data and -.048 (t=1.8) for annual data. In the multiple regression, both coefficients are significant for the quarterly sample ($t>2$), and the length coefficient is significant for the annual sample.[6]

C. A Potential Bias

As discussed above, the effects of supply shocks on the sacrifice ratio can be interpreted as measurement error. Measurement error in the dependent variable does not generally cause econometric problems, but it does in this application. The problem is that $\Delta\pi$ is both the denominator of the sacrifice ratio and the numerator of the independent variable speed (or, in columns (3) and (4), a separate regressor). For a given demand contraction, a favorable supply shock that increases $\Delta\pi$ will reduce the estimated sacrifice ratio and increase speed, creating a spurious negative relation between the two. I now check whether this problem has an important effect on my results.

I take two approaches. First, Table V regresses the sacrifice ratio on speed for disinflations ending by 1972 and disinflations ending after 1972. Aggregate supply was less stable in the second period, and so the negative bias arising from supply shocks should be larger. With quarterly data, however, the speed coefficients for both subsamples are close to the coefficient for the whole sample. With annual data, the coefficient is more negative in the first period than in the second, the opposite of what we expect if supply shocks create bias. These results suggest that my basic findings are not driven by supply shocks. Similar results arise if speed is replaced by $\Delta\pi$ and length, or if the sample is split at 1984 (before the 1986 oil price decline).

As a second approach to the supply-shock problem, I estimate the effect of speed using instrumental variables, with length as an instrument. Length is clearly correlated with speed = $\Delta\pi$/length. And length is plausibly uncorrelated with the errors arising from supply shocks. For a given path of aggregate demand, a beneficial supply shock is likely to increase $\Delta\pi$, but not to reduce length: the shock does not cause disinflation to end sooner. Thus increases in speed resulting from decreases in length should not be negatively correlated with the errors in the sacrifice ratio. (Indeed, beneficial supply shocks near the end of an episode may <u>increase</u> its length by extending the inflation decline beyond the end of tight policy. Note that a number of episodes end in the beneficial-shock year of 1986. In this case, the IV coefficient on speed has a positive rather than negative bias.)[7]

Table VI presents instrumental variables estimates, with the inverse of length as the instrument. (1/length is more highly correlated with speed than is length.) For the quarterly sample, the coefficient on speed is close to the OLS coefficient. For the annual sample, the coefficient is larger in absolute value, but the difference is not statistically significant. Once again, there is no evidence of negative bias in my basic results.

V. NOMINAL WAGE RIGIDITY

A. Background

Comparisons of macroeconomic performance in different countries often emphasize differences in nominal wage rigidity (e.g., Bruno and Sachs, 1985). These differences are attributed to wage-setting institutions such as the frequency of adjustment, the degree of indexation, and the synchronizion of adjustment across sectors. Many authors argue, for example, that three-year staggered contracts make U.S. wages rigid, whereas one-year synchronized contracts make Japanese wages flexible. These differences are used to explain cross-country variation in the costs of disinflation, such as the high costs in the U.S. and the lower costs in Japan (e.g., Gordon, 1982).

In contrast to this tradition, recent "New Keynesian" research has deemphasized wage-setting institutions. New Keynesians argue that monetary non-neutrality arises largely from rigidities in output prices rather than wages (e.g., Mankiw, 1990). To the extent that price rigidity determines the cost of disinflation, wage-setting institutions are unimportant.

Once again, the relevant empirical evidence consists mainly of informal comparisons of a few episodes. I now investigate whether wage rigidity helps explain the variation in the sacrifice ratio in my sample.[8]

B. Basic Results

My basic measure of wage rigidity is Bruno and Sach's index of "nominal wage responsiveness." For a given country, Bruno and Sachs assign a value of zero, one, or two to each of three variables: the duration of wage agreements, the degree of indexation, and the degree of synchronization. Higher values mean greater flexibility (i.e. shorter, more indexed, and more synchronized agreements). The wage responsiveness index is the sum of the three values, and thus runs from zero to six. I regress the sacrifice ratio on the index, and also experiment with the three components.

The results for quarterly and annual data are presented in Tables VIIA and VIIB. In both cases, I report simple regressions on the responsiveness index and regressions that include $\Delta\pi$ and disinflation length. I also use the duration of agreements in place of the total index. Duration is the only component of the index that is significant by itself.[9]

The results are quite similar across specifications. The coefficients on responsiveness or duration are negative, implying that greater flexibility reduces the sacrifice ratio. The statistical significance of these results is borderline: t-statistics range from 1.8 to 2.1 for annual data and from 1.6 to 1.9 for quarterly data. The point estimates imply large effects of flexibility. In column (1) of the annual results, for example, the fitted value of the sacrifice ratio is 5.5% for a responsiveness of zero and 1.8% for the maximum responsiveness of six. (Switzerland has a rating of zero, and Australia, Denmark, and New Zealand have ratings of six.) The results for duration show that it is the most important component of the index. In column (3) of the annual results, raising duration from zero to two reduces the fitted ratio from 5.1% to 2.2%. (Zero means wage agreements of three years, and two means agreements of a year or less.)

C. A Variation

As an alternative explanatory variable, I use the index of nominal wage rigidity in Grubb, Jackman, and Layard (1983). This variable is quite different from the Bruno-Sachs index: it is constructed from a time series regression of wages on prices and unemployment. An advantage of the Grubb index is that it flexibly measures the overall rigidity of wages -- it does not rely on arbitrary assumptions about the importance of particular contract provisions. An obvious disadvantage is that the Grubb variable is endogenous. Factors that directly influence the sacrifice ratio, such as the initial level of inflation or the prevalence of incomes policies, are likely to influence the speed of wage adjustment that Grubb measures. To address this problem, I estimate the effects of the Grubb index using instrumental variables, with Bruno and Sach's variables as instruments. This approach isolates the effects of rigidity arising from wage-setting institutions.

Table VIII reports results for both quarterly and annual data. Columns (1) and (2) present OLS regressions of the sacrifice ratio on the Grubb index, $\Delta\pi$, and disinflation length. For both data sets, the Grubb variable has a significantly positive coefficient. Columns (3) and (4) report instrumental variables estimates; the instruments are the three components of the wage-responsiveness variable and another Bruno-Sachs index measuring "corporatism" (the extent of unionization, the centralization of bargaining, and so on). The instrumental variables estimates are close to the OLS estimates, although the statistical significance becomes borderline. The results are reasonably stable when various subsets of the instruments are used. Overall, the results confirm the finding that wage rigidity is an important determinant of the sacrifice ratio.

VI. OTHER RESULTS

This section reports additional results that are either negative or inconclusive. Future research should explore these issues further.

A. Initial Inflation

Ball, Mankiw, and Romer (1988) show that trend inflation influences the output-inflation tradeoff in New Keynesian models. Higher inflation reduces the extent of nominal rigidity, and thus steepens the short run Phillips curve. Ball, Mankiw, and Romer show that cross-country evidence strongly supports this prediction. A special case of the prediction is that the sacrifice ratio during disinflation is decreasing in the initial level of trend inflation. I now test this idea with my sample of disinflations. For both quarterly and annual data, Table IX reports regressions of the ratio on initial inflation, π_0. I present simple regressions and regressions that include length, $\Delta\pi$, and contract duration (the best-fitting set of variables from the previous section).

The results for the two data sets are rather different. With quarterly data, the simple regression shows a negative effect of π_0, as predicted by theory. The t-statistic is 1.9. The coefficient in the multiple regression is similar in size, but statistically insignificant (t=1.0). This weaker result reflects collinearity between π_0 and $\Delta\pi$: inflation tends to fall more in episodes when it is initially high. (Note that the coefficient on $\Delta\pi$ also becomes insignificant.) Overall, it is difficult to identify separate effects of π_0 and $\Delta\pi$, but the data are at least suggestive that π_0 has a negative effect.

The annual data, by contrast, provide no support for this hypothesis. In both specifications, the coefficient is not only insignificant, but has the wrong sign (positive).

The differences between the quarterly and annual results arise from differences in the samples of countries. When the annual sample is restricted to the countries for which quarterly data exist, the results are similar to the quarterly results. It is not clear why the choice of countries is so important.

It is also not clear why the effect of π_0 is weaker than the effect of trend inflation on the Phillips curve found by Ball-Mankiw-Romer.

B. Incomes Policies

If inflation possesses inertia, there may be a role for governments to intervene directly in wage- and price-setting during disinflation. By mandating a slowdown in the growth of prices, governments can reduce inertia and thus reduce the sacrifice ratio. This logic has led to wage-price controls or other incomes policies during many disinflations.

To investigate the effects of incomes policies, I must first measure them. For each of the 28 episodes in the quarterly data set, I consult the historical record to see whether incomes policies were employed. My main sources are the OECD Economic Outlook and surveys of incomes policies (Ulman and Flanagan, 1971; Flanagan, Soskice and Ulman, 1983). I create two dummy variables. The first, INCM, equals one if mandatory incomes policies were employed at any time during the episode. A mandatory policy is defined as one in which legal restrictions are placed on the majority of wages or the majority of output prices. According to my survey, such policies were imposed in six of the 28 episodes (U.S. 69-71, Canada 74-76, France 74-76, France 81-86, U.K. 65-66, and U.K. 75-78). The second variable, INCV, equals one if voluntary incomes policies were introduced. These policies are defined broadly to include voluntary guideposts, jawboning, and negotiated settlements with business and labor. Voluntary policies occurred in another twelve of the episodes.

Table X regresses the sacrifice ratio on INCM and INCV, both with and without additional controls. When both dummies are included, the results are disappointing: INCV has a positive coefficient and INCM has a negative coefficient, and both are insignificant. When INCV is excluded, however, the

INCM coefficient is almost significant in the regression with additional controls (t=1.8). The coefficient implies that a mandatory policy reduces the sacrifice ratio by 2.4 percentage points.

One interpretation of these results is that voluntary policies are ineffective but mandatory policies do reduce the sacrifice ratio. This finding is not very robust, however. The results could be checked by extending the measures of incomes policies to the larger annual sample.

C. Openness

As stressed by Romer (1991), basic macroeconomics suggests a relation between the output-inflation tradeoff and the openness of the economy -- the share of imports in total spending. In a more open economy, the exchange rate appreciation arising from a monetary contraction has a larger direct effect on the price level. Consequently, inflation falls more for a given policy shift: the sacrifice ratio is smaller.

This idea receives no support from my data. Table XI reports regressions of the sacrifice ratio on the imports/GNP ratio (taken from Romer). The effects of imports/GNP is very insignificant for both quarterly and annual data. These results cast doubt on Romer's argument that openness influences average inflation by changing the output-inflation tradeoff.

VII. CONCLUSION

This paper constructs sacrifice ratios for a sample of disinflations and asks whether variation in the ratio can be explained. I find that the ratio is lower when disinflation is quick, and when wage-setting is more flexible. Openness has no effect on the ratio, and the effects of initial inflation and incomes policies are unclear.

My analysis uses a new measure of the sacrifice ratio based on several assumptions about the behavior of trend output. Future research should check the robustness of the results to variations in my assumptions. Some evidence of robustness is provided by Schelde-Andersen (1992), whose study was carried out independently of mine. Schelde-Andersen estimates sacrifice ratios using a substantially different approach. For example, he measures the ratio using a fixed period for every country (1979-1988), and he examines unemployment as well as output losses. His ranking of sacrifice ratios across countries differs considerably from my Table III. Nonetheless, Schelde-Andersen and I reach similar conclusions about the determinants of the ratio. In particular, he confirms my findings about both the speed of disinflation and nominal wage rigidity.

Do my results about speed imply that cold-turkey disinflation is preferable to gradualism? This conclusion is warranted only if the cost of disinflation is measured by the total output loss. The welfare loss in a given quarter might be a convex function of the output loss, as macro theorists usually assume. In this case, gradualism has the advantage of spreading the losses over a longer period. Since we do not know the shape of the social loss function, it is difficult to determine the optimal speed of disinflation. At a minimum, however, my results refute the view that gradualism makes disinflation costless.

A clearer policy implication is that governments should regulate wage-setting, especially by limiting the length of labor contracts. Such a policy is suggested by Bosworth (1981) and others, and is justified in principle by the negative externalities from long contracts (Ball, 1987). My results suggest that the welfare gains from shorter contracts are large: the recessions arising from disinflation are dampened considerably.

Footnotes

1. A recent paper by Schelde-Andersen (1992) also attempts to explain variation in the costs of disinflation. As discussed in the conclusion, the findings are broadly similar to mine.

2. Indeed, the HP filter almost always keeps average output over five years or so close to trend. In the U.S., average output is close to trend over 1973-78 and 1978-84, which again conflicts with the usual view that these were recessionary periods.

3. Both my first and second assumptions can be derived from the following model. Assume $y = a(\pi-\pi_{-1}) + by_{-1}$, where y is the deviation of output from trend. This equation is a Lucas supply function with lagged inflation proxying for expected inflation. Assume that inflation is stable before the inflation peak and after the trough. Finally, assume that b^4 is approximately zero. These assumptions imply that $y=0$ at the inflation peak and four quarters after the trough, and that $y<0$ between these points.

4. In the model of footnote three, hysteresis can be introduced by assuming $y^* = y_{-1}^* + cy$, where y^* is trend output and y is the deviation from trend. Under this assumption, a larger deviation implies a larger change in the trend, as suggested in the text.

5. This result can be criticized on grounds of theoretical robustness, as well as on the empirical grounds discussed below. See Ball (1992).

6. I have also experimented with a "random effects" specification, in which the error term contains a component common to episodes from the same country. GLS estimates of this model are very close to the OLS results reported in the text.

7. My approach assumes that the demand contraction during disinflation is

exogenous. If policy responds to supply shocks, there are scenarios in which the negative bias in OLS extends to IV. This is the case, for example, if a favorable supply shock causes policymakers to shorten disinflation because an inflation target is met more quickly. In such a case, the identification problem appears insuperable.

8. Bruno-Sachs and others report extensive cross-country comparisons of wage rigidity and the effects of supply shocks. To my knowledge, however, this study and Schelde-Andersen (1992) are the only papers that compare rigidity and sacrifice ratios.

9. For these regressions, the annual data set is reduced from 65 to 58 observations, because the Bruno-Sachs index is missing for several countries.

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Table I

Disinflations - Quarterly Data

Episode	Length in Quarters	Initial Inflation	Change in Inflation	Sacrifice Ratio
AUSTRALIA				
74:2-78:1	15	14.60	6.57	0.0289
82:1-84:1	8	10.50	4.98	0.0511
CANADA				
74:2-76:4	10	10.60	3.14	0.0251
81:2-85:2	16	11.60	7.83	0.0949
FRANCE				
74:2-76:4	10	11.90	2.98	0.0363
81:1-86:4	23	13.00	10.42	0.0240
GERMANY				
65:4-67:3	7	3.67	2.43	0.1024
73:1-77:3	18	6.92	4.23	0.1054
80:1-86:3	26	5.86	5.95	0.1423
ITALY				
63:3-67:4	17	6.79	5.74	0.1062
77:1-78:2	5	16.50	4.30	0.0391
80:1-87:2	29	19.10	14.56	0.0640
JAPAN				
62:3-63:1	2	8.11	3.00	0.0212
65:1-67:2	9	5.99	2.20	0.0663
70:3-71:2	3	7.53	2.09	0.0508
74:1-78:3	18	17.10	13.21	0.0243
80:2-83:4	14	6.68	5.07	0.0007
84:2-87:1	11	2.29	2.11	0.0592
SWITZERLAND				
73:4-77:4	16	9.42	8.28	0.0740
81:3-83:4	9	6.15	3.86	0.0515

UNITED KINGDOM

61:2-63:3	9	4.24	2.10	0.0764
65:2-66:3	5	4.91	2.69	-0.0003
75:1-78:2	13	19.70	9.71	0.0347
80:2-83:3	13	15.40	11.12	0.0117
84:2-86:3	9	6.19	3.03	0.0347

UNITED STATES

69:4-71:4	8	5.67	2.14	0.1175
74:1-76:4	11	9.70	4.00	0.0957
80:1-83:4	15	12.10	8.83	0.0733

Table II

Disinflations - Annual Data

Episode	Length in Years	Initial Inflation	Change in Inflation	Sacrifice Ratio
AUSTRALIA				
61-62	1	1.27	1.52	-0.0016
74-78	4	13.10	6.38	0.0187
82-84	2	9.48	5.46	0.0303
86-88	2	7.80	1.88	0.0033
AUSTRIA				
65-66	1	2.18	2.21	-0.0201
74-78	4	8.05	5.16	0.0433
80-83	3	5.93	1.90	0.0614
84-86	2	4.55	3.56	-0.0089
BELGIUM				
65-67	2	3.60	1.69	0.0295
74-78	4	10.80	7.23	0.0198
82-87	5	7.57	6.54	0.0686
CANADA				
69-70	1	3.74	1.54	0.0395
74-76	2	9.08	2.57	0.0153
81-85	4	10.00	6.56	0.0890
DENMARK				
68-69	1	6.13	2.94	-0.0278
74-76	2	11.40	3.95	0.0230
77-78	1	9.52	1.74	0.0231
80-85	5	10.60	7.89	0.0705
FINLAND				
64-65	1	7.27	3.92	-0.0143
67-69	2	7.03	5.22	0.0378
74-78	4	14.70	8.33	0.0663
80-86	6	9.92	6.95	0.0259
FRANCE				
62-66	4	5.31	3.63	-0.0271
74-76	2	11.00	3.19	0.0432
81-86	5	11.30	9.05	0.0101

GERMANY				
65-67	2	3.28	1.78	0.0625
73-78	5	6.31	3.91	0.1567
80-86	6	4.96	5.11	0.0830
IRELAND				
64-66	2	5.41	3.37	0.0365
74-78	4	15.90	8.52	0.0326
80-87	7	15.60	13.52	0.0172
ITALY				
63-67	4	5.95	4.76	0.0914
76-78	2	14.90	4.30	0.0204
80-87	7	17.60	13.40	0.0658
JAPAN				
62-64	2	7.55	3.78	-0.0250
74-78	4	15.20	12.51	0.0185
80-82	2	5.44	3.72	-0.0063
83-86	3	1.84	1.99	-0.0245
LUXEMBURG				
75-78	3	8.79	6.03	0.0212
NETHERLANDS				
65-67	2	5.44	2.55	0.0511
75-78	3	8.33	4.89	-0.0342
81-83	2	5.92	3.11	0.0559
84-86	2	2.85	3.35	-0.0230
NEW ZEALAND				
71-72	1	8.39	2.42	0.0216
75-78	3	13.20	3.73	0.0516
80-83	3	13.50	8.19	0.0070
86-88	2	12.30	7.62	0.0041
SPAIN				
62-63	1	7.37	2.13	-0.0225
64-69	5	9.95	7.28	-0.0086
77-87	10	18.40	13.86	0.1394

SWEDEN				
65-68	3	5.59	3.74	0.0445
77-78	1	9.53	2.85	0.0143
80-82	2	11.80	4.35	0.0348
83-86	3	7.61	4.21	-0.0214
SWITZERLAND				
66-68	2	3.58	1.55	0.0642
74-76	2	7.90	6.87	0.0538
81-83	2	4.75	2.12	0.0505
84-86	2	3.22	2.12	-0.0317
UNITED KINGDOM				
61-63	2	3.32	2.27	0.0709
75-78	3	16.70	9.71	-0.0027
80-83	3	13.10	9.78	0.0215
84-86	2	4.51	1.84	0.0193
UNITED STATES				
69-71	2	4.76	1.53	0.1347
74-76	2	8.91	3.63	0.0642
79-83	4	10.40	7.63	0.0774

Table III

Average Sacrifice Ratios by Country

Country	Quarterly Data	Annual Data
Australia	4.0%	1.3%
Austria		1.9%
Belgium		3.9%
Canada	6.0%	4.8%
Denmark		2.2%
Finland		2.9%
France	3.0%	0.9%
Germany	11.7%	10.1%
Ireland		2.9%
Italy	7.0%	5.9%
Japan	3.7%	-0.9%
Luxembourg		2.1%
Netherlands		1.2%
New Zealand		2.1%
Spain		3.6%
Sweden		1.8%
Switzerland	6.3%	3.4%
United Kingdom	3.1%	2.7%
United States	9.6%	9.2%

Table IV

The Sacrifice Ratio and the Speed of Disinflation

Dependent Variable: Sacrifice Ratio

Data Set	(1) Quarterly	(2) Annual	(3) Quarterly	(4) Annual
Constant	.0878 (.0131)	.0605 (.0123)	.0418 (.0130)	.0052 (.0093)
Speed - $\Delta\pi$/Length	-.0618 (.0235)	-.0672 (.0256)		
$\Delta\pi$			-.0079 (.0024)	-.0049 (.0023)
Length			.0048 (.0013)	.0042 (.0010)
$\bar{R}^2$	.180	.085	.301	.209
Sample Size	28	65	28	65

Table V

The Speed of Disinflation - Subsamples

Dependent Variable: Sacrifice Ratio

Data Set	(1) Quarterly Through 1972	(2) Quarterly After 1972	(3) Annual Through 1972	(4) Annual After 1972
Constant	.0992 (.0207)	.0864 (.0197)	.0773 (.0197)	.0515 (.0155)
Speed - $\Delta\pi$/Length	-.0607 (.0315)	-.0687 (.0381)	-.1208 (.0424)	-.0416 (.0316)
$\bar{R}^2$	.279	.106	.271	.017
Sample Size	8	20	20	45

Standard errors are in parentheses.

Table VI

The Speed of Disinflation - Instrumental Variables
(Instrument = 1/Length)

Data Set	(1) Quarterly	(2) Annual
Constant	.0831	.1453
	(.0182)	(.0528)
Speed = $\Delta\pi$/Length	-.0521	-.2592
	(.0347)	(.1184)
Sample Size	28	65

Standard errors are in parentheses.

Table VIIA
The Sacrifice Ratio and Wage Rididity
(Quarterly Results)

	(1)	(2)	(3)	(4)
Constant	.0827 (.0160)	.0637 (.0178)	.0736 (.0121)	.0617 (.0163)
Wage Respons.	-.0072 (.0041)	-.0060 (.0035)		
Contract Duration			-.0125 (.0078)	-.0122 (.0065)
$\Delta\pi$		-.0076 (.0013)		-.0082 (.0023)
Length		.0046 (.0013)		.0046 (.0013)
$\bar{R}^2$	.069	.352	.056	.366
Sample Size	28	28	28	28

Table VIIB
The Sacrifice Ratio and Wage Rigidity
(Annual Results)

	(1)	(2)	(3)	(4)
Constant	.0547 (.0130)	.0263 (.0155)	.0512 (.0108)	.0260 (.0142)
Wage Respons.	-.0061 (.0031)	-.0052 (.0029)		
Contract Duration			-.0144 (.0067)	-.0132 (.0062)
$\Delta\pi$		-.0038 (.0023)		-.0044 (.0023)
Length		.0039 (.0012)		.0040 (.0011)
$\bar{R}^2$	.050	.191	.059	.208
Sample Size	58	58	58	58

Standard errors are in parentheses.

Table VIII

The Sacrifice Ratio and Wage Rigidity - Grubb Measure

	(1)	(2)	(3)	(4)
Data Set	Quarterly	Annual	Quarterly	Annual
Procedure	OLS	OLS	IV	IV
Constant	.0292 (.0130)	-.0062 (.0107)	.0283 (.0143)	-.0069 (.0121)
Wage Rigidity	.0151 (.0062)	.0231 (.0067)	.0162 (.0096)	.0245 (.0128)
$\Delta\pi$	-.0080 (.0022)	-.0045 (.0022)	-.0080 (.0022)	-.0045 (.0022)
Length	.0050 (.0012)	.0041 (.0011)	.0050 (.0012)	.0041 (.0011)
Sample Size	28	58	28	58

Table IX

The Sacrifice Ratio and Initial Inflation

Dependent Variable: Sacrifice Ratio

Data Set	(1) Quarterly	(2) Quarterly	(3) Annual	(4) Annual
Constant	.0837 (.0154)	.0754 (.0213)	.0264 (.0123)	.0192 (.0165)
π_0	-.0027 (.0014)	-.0022 (.0022)	.0005 (.0014)	.0016 (.0020)
$\Delta\pi$		-.0050 (.0040)		-.0065 (.0035)
Length		.0039 (.0015)		.0042 (.0012)
Duration		-.0133 (.0066)		-.0128 (.0062)
$\bar{R}^2$	.086	.365	-.015	.203
Sample Size	28	28	58	58

Standard errors are in parentheses.

Table X

The Sacrifice Ratio and Incomes Policies
(Quarterly Data)

Dependent Variable: Sacrifice Ratio

	(1)	(2)	(3)	(4)
Constant	.0534	.0625	.0616	.0699
	(.0116)	(.0078)	(.0170)	(.0162)
INCM	-.0139	-.0229	-.0140	-.0237
	(.0189)	(.0169)	(.0146)	(.0131)
INCV	.0166		.0179	
	(.0156)		(.0129)	
$\Delta\pi$			-.0089	-.0082
			(.0022)	(.0022)
Length			.0045	.0045
			(.0012)	(.0012)
Duration			-.0114	-.0132
			(.0062)	(.0062)
$\bar{R}^2$	.035	.030	.443	.421
Sample Size	28	28	28	28

Standard errors are in parentheses.

Table XI

The Sacrifice Ratio and Openness

Data Set	(1) Quarterly	(2) Annual	(3) Quarterly	(4) Annual
Constant	.0545 (.0214)	.0331 (.0121)	.0646 (.0221)	.0188 (.0161)
Imports/GNP	.0144 (.0966)	-.0038 (.0386)	-.0157 (.0782)	-.0109 (.0344)
$\Delta\pi$			-.0082 (.0024)	-.0049 (.0023)
Length			.0046 (.0013)	.0041 (.0010)
Duration			-.0122 (.0066)	-.0066 (.0056)
$\bar{R}^2$	-.038	-.017	.340	.218
Sample Size	28	61	28	61

Figure 1

Trend Inflation and Disinflation Episodes

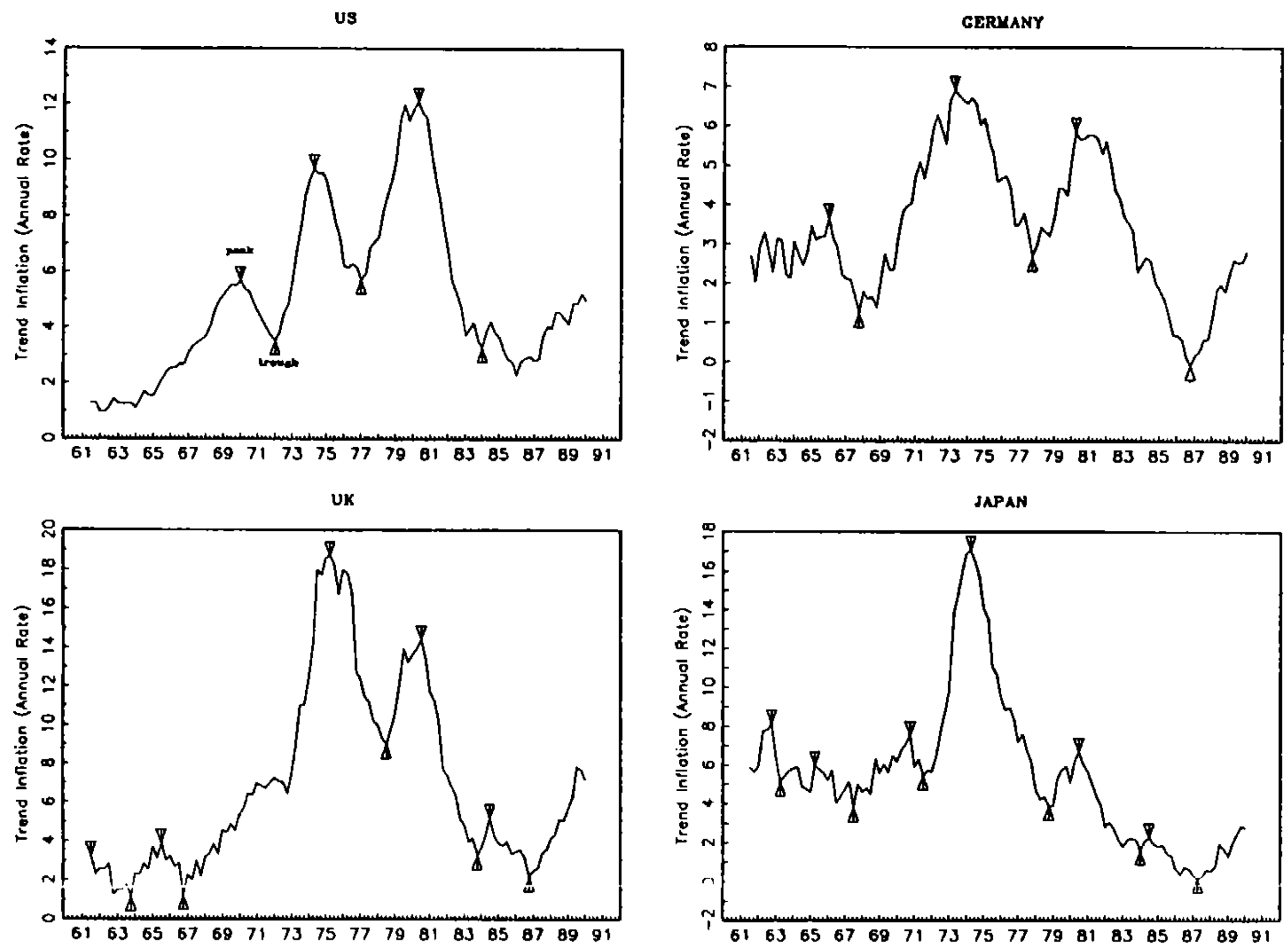

Figure 2

Trend Output - Standard Methods

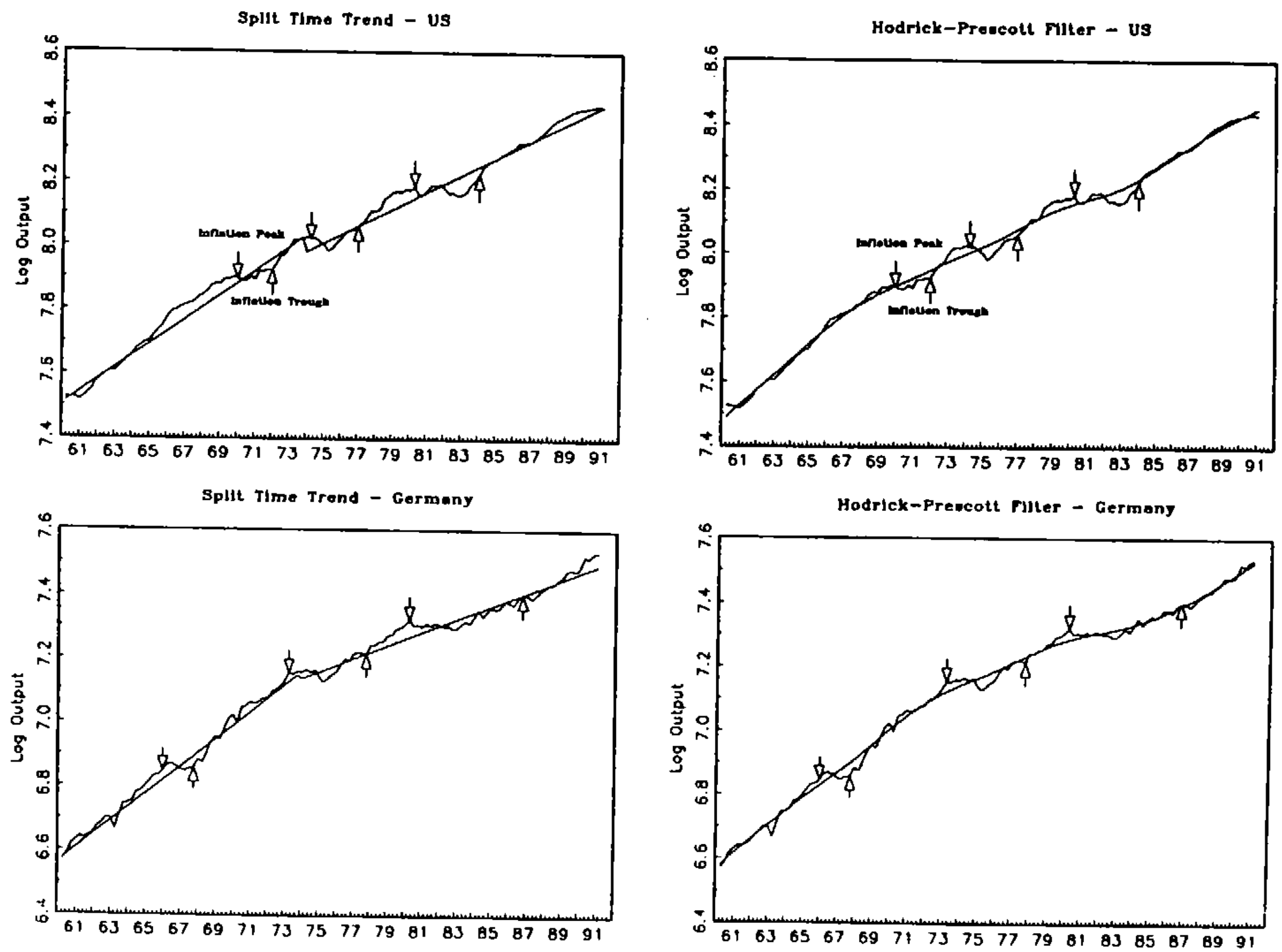

Figure 3

Trend Output During Disinflations