

Costs and Benefits of Reducing Inflation

By Craig S. Hakkio and Bryon Higgins

The Federal Reserve announced a new program in October 1979 to reduce inflation. By emphasizing control over the supply of bank reserves to achieve objectives for the growth of money and credit, the program contributed substantially to reducing inflation. Progress against inflation, however, was accompanied by a severe recession that pushed rates of unemployment and business failures to post-war highs. Although the economy has recovered sharply from the recession and has been expanding since late 1982, production is still somewhat below the economy's full potential. Clearly, the short-run costs of disinflation have been high.

The high short-run costs of bringing down inflation have led some to question whether further efforts to reduce inflation are worthwhile. Though admitting that inflation causes economic inefficiency, they maintain that the

costs of disinflationary policies are simply too high to justify continued monetary restraint to achieve price stability.

This article argues that the long-run benefits of low inflation exceed the short-run costs of reducing inflation. The first section explains why low inflation improves economic efficiency and leads to economic benefits. The second section shows why reducing inflation is costly in terms of temporary reductions in production and employment. The third section

The costs of inflation are cumulative. They continue as long as inflation remains.

presents empirical estimates consistent with the view that the long-run benefits of low inflation exceed the short-run costs of reducing inflation.

Benefits of price stability

Benefits of price stability reflect the absence of the costs of inflation. Inflation is costly in

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several respects. These costs can be avoided by achieving and maintaining reasonable stability in the aggregate price level.

What constitutes "reasonable price stability" is to some extent subjective. Double-digit inflation like that in the late 1970s clearly does not qualify. But neither does reasonable price stability require zero measured inflation every year. Reasonable price stability is best defined as "a situation in which expectations of generally rising (or falling) prices over a considerable period are not a pervasive influence on economic or financial behavior."¹

The social and political costs of inflation are impossible to measure. It has been claimed that, "Inflation...increases the sense of felt injustice and causes alienation."² For example, inflation—especially if unanticipated—may make social tensions worse by shifting the distribution of income and wealth arbitrarily. Savers are hurt and borrowers helped when inflation unexpectedly reduces the real burden of debt. Similarly, persons with fixed incomes suffer when inflation erodes their purchasing power. In these and other ways, inflation exacerbates social tensions by fostering the perception that the system of economic rewards is unfair. The resulting sense of powerlessness and resentment contributes to political friction. Although a stable price level would alleviate these frictions, the benefits of the alleviation cannot be quantified. For that reason, this analysis focuses on the economic benefits of price stability, which can be estimated in quantitative terms.

The economic benefits of price stability reflect the improvement in economic effi-

ciency when distortions from inflation are removed. The costs of inflation can be measured by the amount of real output lost because of the misallocation of resources or other economic inefficiencies caused by inflation. These costs are cumulative, because they continue as long as inflation remains. Every year that distortions from inflation recur, the average standard of living is reduced. These costs fall into three major categories.³

The first category of costs results from the use of resources by businesses and households to protect themselves against anticipated inflation. For example, both businesses and households devote additional resources to cash man-

Policies to lower inflation cause temporarily higher unemployment and lower economic growth.

agement when inflation is high. Because inflation erodes the purchasing power of money, asset-holders have incentives to keep their holdings of noninterest-bearing cash to a minimum. As a result, individuals make more trips to the bank and firms adopt such techniques as lock boxes and cash concentration accounts when inflation is high. Some of the need for intensive cash management in an inflationary environment results from legal ceilings on deposit interest rates. But, even if deposit ceiling rates were removed, resources would still be used to economize on holdings of currency and reserves. Resources devoted to reducing cash balances are wasted. If not wasted on the socially nonproductive enter-

¹ Paul Volcker, "We Can Survive Prosperity," a speech before a joint meeting of the American Economic Association and the American Finance Association, San Francisco, California (December 28, 1983), p. 5.

² Robert J. Buchanan and Richard E. Wagner, *Democracy in Deficit*, Academic Press, 1977, p. 64.

³ For further discussion of the costs of inflation, see Dean W. Hughes, "The Costs of Inflation: An Analytical Overview," *Economic Review*, Federal Reserve Bank of Kansas City, November 1982, pp. 3-14, and Stanley Fischer, "The Benefits of Price Stability," *Price Stability and Public Policy*, proceedings of an economic symposium sponsored by the Federal Reserve Bank of Kansas City, 1984.

prise of cash management, these resources could be used to produce goods and services that would improve the overall standard of living. Similarly, from society's point of view, resources used in frequent changes in price lists because of an upward trend in the general level of prices serve no useful purpose.

The second category of costs results from distortions caused by the interaction of inflation with the tax system. Because taxes are not indexed for inflation, the real tax burden increases with inflation, whether anticipated or not; and this increased tax burden causes distortions that reduce real output. For example, "bracket creep" pushes individuals into higher tax brackets, reducing the incentive to work and save. Inflation also reduces tax allowances for depreciation to less than would be necessary for firms to replace existing capital, thereby reducing incentives to invest. Moreover, when inflation artificially raises gains in the value of inventories, businesses must pay taxes on illusory inventory profits. As a result, after-tax profits and therefore real investment are depressed. Similarly, inflated gains on assets sold by individuals are taxed, impeding the mobility of capital and distorting the choice of assets. In all of these ways, the interaction of inflation with the tax system impairs incentives to work, save, and invest. For this reason, the tax system increases the costs of inflation. Personal income tax rates will be indexed for inflation beginning this year, reducing somewhat the cost of inflation.

⁴ The recent Treasury Department study of the tax system recommends more extensive indexation of taxes, including indexation of business taxes and capital gains. However, Congressional reaction to the overall plan has been unenthusiastic, suggesting that further indexation may not be implemented in the near future. If it were, the costs of inflation would be lowered.

Many of the costs of inflation discussed in this article are due to what Stanley Fischer has called "institutional nonadaptations" (Stanley Fischer, "Benefits of Price Stability"). Strictly speaking, these costs cannot be attributed solely to inflation but

However, because business taxes and capital gains taxes are unlikely to be indexed for inflation in the near future, the tax system would continue distorting economic decisions in an inflationary environment.⁴

The third category of costs is caused by the increase in uncertainty about prices. Although the reasons are not completely understood, uncertainty about the overall price level and about relative prices tends to increase with inflation. In part, this reflects the tendency for the variability of inflation to increase as the average inflation rate increases. Although higher and more variable inflation is not inherently less predictable, empirical evidence suggests that uncertainty about the price level increases as the overall level and variability of inflation increase.⁵ This is destructive because uncertainty about the price level reduces willingness to invest in financial assets and reduces the willingness to enter into long-term agreements of all kinds. By so doing, inflation interferes with the allocative efficiency of the price system. Uncertainty about relative prices means individuals and firms are less responsive to changes in relative prices. Consequently, production is reduced because resources do not flow to their most productive use.

The sum of the economic costs of inflation can be significant. The important point is that these costs continue as long as inflation continues. They are recurring costs that can be eliminated only by lowering inflation and can

must be attributed to the interaction of inflation with current institutions and laws. Nonetheless, after describing how interest ceilings on deposits and the tax system interact with inflation to produce economic inefficiency, Fischer concludes that "... nominal thinking and nominal institutions are deeply imbedded in the structure of the economy. That is one of the main reasons price stability should be a goal of policy" (p. 38).

⁵ For evidence, see Stanley Fischer, "Benefits of Price Stability," p. 38.

be reduced only by adapting tax laws and other institutions to a permanently high rate of inflation.

The costs of disinflation

In light of the high costs of inflation, the question arises why it has been allowed to persist. The answer is that bringing down inflation is also costly. Policies to lower inflation are likely to cause temporarily higher unemployment and lower economic growth.

Higher unemployment induced by disinflationary policies causes a variety of social and psychological costs. Loss of one's job can lead to frustration, despondency, and family hardships. Like the social costs of inflation, the psychological costs of higher unemployment resulting from disinflationary policies are difficult to measure.

The economic costs of disinflation, however, can be measured by the loss in production and income below levels that would result from accommodating inflation. These costs result from slow adjustment of wages, prices, and expectations to a slowdown in the growth of aggregate spending caused by disinflationary policies. As a consequence of this slow adjustment, disinflationary monetary policies temporarily slow economic growth and impose cumulative losses in output. These losses can be used as a measure of the economic cost of disinflation.

Sources of slow adjustment

Wages adjust slowly to changing economic conditions because of both explicit and implicit labor contracts. Explicit labor contracts are common in unionized industries. Most such contracts establish wage increases for a three-year period. Workers' and firms' expectations of future inflation are built into the wage agreement. That is, expectations of

high inflation over the contract period lead unions to demand commensurately rapid growth in wages and lead firms to agree to the demands. Even in nonunionized industries, implicit contracts between employers and employees can impart inertia to growth in wages. Due to both implicit and explicit labor contracts, a slowing in the rate of inflation may not be reflected immediately in slower growth in wages.⁶

Prices also adjust slowly to changing economic conditions. The initial response of firms to a slowing in sales may be to build up inventories without changing their selling prices. If the slowdown persists, the firms may next reduce output by cutting back on overtime, allowing their work forces to decline through attrition, and in some cases, laying off workers. Firms with considerable market power may consider changing their pricing policies only as a last resort to balance the supply of and demand for their products. As a result, a slowdown in aggregate spending growth is not immediately reflected in slower increases in product prices.

Expectations of future inflation do not adapt quickly to changes in the actual inflation rate. After a prolonged period of high inflation, both workers and firms come to expect high inflation to continue. They have long memories and are not easily convinced that a decline

⁶ The costs of disinflation, like the costs of inflation, result largely from institutional nonadaptations. For example, wage contracts fully indexed to the rate of inflation would make nominal wages more responsive to changes in the inflation rate. As a result, employment and output would not be so affected by disinflationary policies.

⁷ Increased public confidence in the credibility of policymakers' stated intentions to reduce inflation would make expectations, and thus wage-setting and price-setting behavior, more flexible. As a result, improved credibility would reduce the costs of disinflation. For a fuller discussion, see Bennett McCallum, "Credibility of Monetary Policies to Achieve Price Stability," *Price Stability and Public Policy*, 1984.

in inflation for a short period will not be later reversed. As a result, declines in the expected rate of inflation lag behind declines in the actual rate of inflation.⁷

Consequences of slow adjustment

Because of slow adjustment, disinflationary monetary policies can temporarily reduce production and income. The cumulative loss in output that results is the most commonly used measure of the economic cost of disinflation.

An example will help show why disinflation is costly. Assume that inflation has been running at a double-digit rate for a long time before the Federal Reserve announces a program to bring inflation down by reducing growth in money and credit. Some commentators express doubt that the Federal Reserve will persist in its efforts long enough to reduce

Whether disinflationary policies are worthwhile depends on the benefits of price stability relative to the costs of reducing inflation.

inflation. This skepticism contributes to a wait-and-see attitude by firms and workers, many of whom recently signed labor agreements that promised double-digit wage increases to compensate for what was expected to be high inflation over the term of the contract. As money and credit growth slows, growth in total spending declines. Businesses, expecting demand to pick up soon, respond to slackening sales by first accumulating inventories.

As spending growth continues to slow, businesses cut back on production and employment, in part because they cannot raise their prices enough to cover their rapidly rising wage costs. The cutback in production and employment reduces incomes further, leading

to even sharper cutbacks in spending, production, and employment. The economy goes into a recession. As the recession lingers on, inflation comes down gradually. This, together with slack in labor markets, results in new labor contracts requiring more modest wage gains. As a result, businesses post smaller increases in their product prices.

As the economy recovers from recession with a substantially lower inflation rate, concern is again expressed that the Federal Reserve will relent in its efforts to contain inflation during the ensuing economic expansion. Surveys indicate that both businesses and workers still expect relatively high inflation in the next several years and that the public remains skeptical about the resolve of policymakers to consolidate and extend past gains against inflation. In this environment, further efforts to restrain money and credit growth will clearly require another period of subpar economic performance, though probably less severe than the first.

If the scenario seems familiar, it is because of similarities to the experience since the Federal Reserve adopted a disinflationary policy in 1979. Monetary restraint has been accompanied by two recessions, high interest rates, high unemployment, and unprecedented financial strain. Nevertheless, the Federal Reserve has continued its efforts to reduce inflation over time, believing the long-run benefits of lower inflation outweigh the short-run costs of bringing down inflation.⁸

Weighing the costs and benefits

Whether disinflationary policies are worthwhile depends on the benefits of price stability

⁸ The costs of reducing inflation would be more persistent if the temporary reduction in real output lowered investment and reduced the capital stock, thereby reducing future output.

relative to the costs of reducing inflation. Estimating the costs and benefits requires a statistical model of the economy. This section presents results from a model used to estimate the benefits and costs of the reduction in inflation since 1979 and of further reduction that may be made in the next few years.

Three steps were involved in the analysis. First, a simple model of the economy was developed and estimated. Second, the model was simulated to determine the effects of past monetary restraint and to weigh the costs and benefits of the resulting decline in inflation. Finally, the model was simulated to determine the prospective effects of additional monetary restraint and to weigh the costs and benefits of further reduction of inflation.

The empirical estimates from this procedure are not, of course, conclusive. Some economists argue that empirical models of the economy, especially those as simple as the one used here, are unreliable guides to the long-run effects of policy actions. It is true that simulation results from an empirical model are imprecise. Economic models can only capture the average relationship between the variables in the model over some historical time period. Behavior could change in the future, perhaps in response to past or prospective policy changes; or exclusion of some economic variables from a model could bias its forecasts. But policy decisions are typically based on an assessment of the relevant empirical magnitudes. So while the estimates provided in this article are admittedly inexact, they provide some evidence that may be useful to policy-makers in judging whether bringing down inflation is a worthy goal.

The model

A vector autoregression (VAR) model was used in estimating the costs and benefits of lowering inflation. Unlike structural models,

which rely on statistical estimates of numerous behavioral relationships, a VAR model relies only on historical relationships between a few key variables. Because only a few variables are included, a VAR model is preferable in some respects to a structural model and is much easier to use for long-run simulations of the kind needed to study the benefits of low inflation.

The model includes six variables. Since the focus is on the relation between inflation and real output, inclusion of these variables is essential. To make sure that the relationships between the variables of primary interest are captured accurately, other variables also must be included. Money growth was included as the monetary policy variable. The federal government's high employment budget surplus was included as the fiscal policy variable. The relative price of food and energy was included to capture the effect of supply shocks on inflation and real output. And an interest rate was included both to complete the financial market

Past and prospective inflation has been reduced by the monetary restraint program.

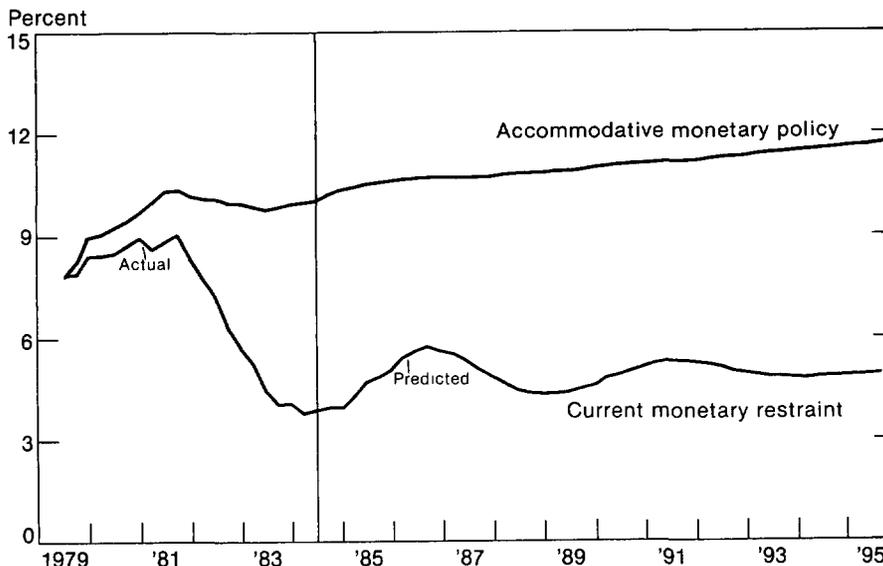
and to capture the effects of inflation expectations. A more detailed explanation of the model is given in the Appendix.

Past disinflationary policies

The model can be used to estimate the effects of the disinflationary monetary policy adopted in October 1979.⁹ Simulation of the model shows how inflation and real output

⁹ The version of the model estimated through the third quarter of 1979 was used for this purpose. This version of the model represents the structure of the economy that prevailed through the 1970s.

CHART 1A
Effects of monetary restraint since 1979
on inflation



would have behaved both with and without monetary restraint.

Effects. The model simulations suggest that past and prospective inflation has been reduced by the monetary restraint program.¹⁰ As shown in Chart 1A, the model predicts that, under the accommodative monetary policy before October 1979, inflation would have accelerated rapidly to double-digit rates by the early 1980s and, if the Federal Reserve had not adopted a policy of monetary restraint in 1979, would have continued to creep upward throughout the simulation period, which ends in 1995.¹¹ In contrast, monetary restraint has

reduced inflation to less than 4 percent currently.

Simulation of the model also shows that the current degree of monetary restraint would allow a modest acceleration of inflation in the future, with inflation averaging about 5 percent for the next 10 years.¹² Despite this acceleration, though, the model simulations indicate that the monetary restraint program adopted in 1979 has cut inflation by more than half.

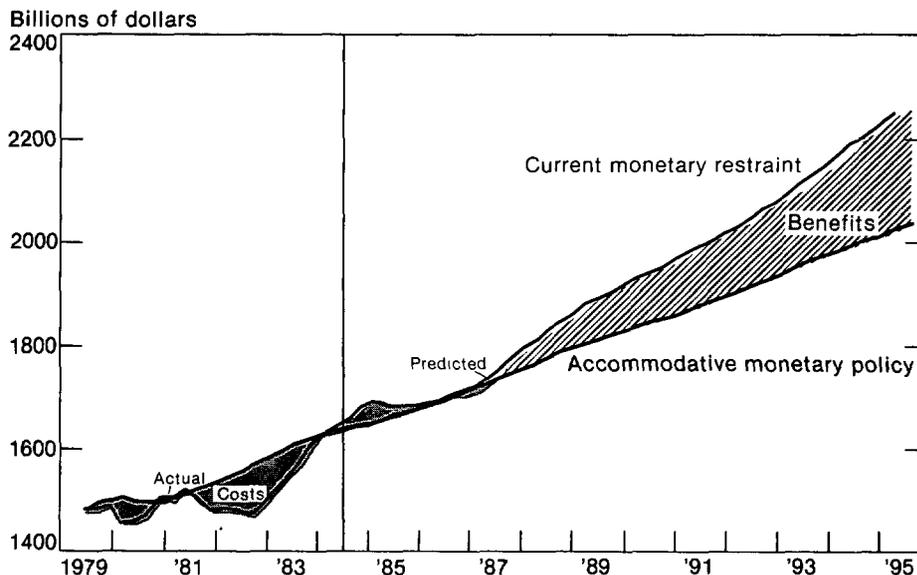
Costs and benefits. The model also indicates that the economic costs of reducing

¹⁰ Strictly speaking, the model cannot attribute the decline in inflation since 1979 solely to monetary restraint. Food and energy prices and other factors may have contributed to lower inflation. However, as shown in the Appendix, the model indicates that money growth is highly correlated with inflation. For expositional purposes, therefore, it is assumed that lower inflation is due primarily to monetary restraint.

¹¹ The values plotted in Charts 1A and 2A are the average growth rates over the preceding two years.

¹² To estimate the benefits of the current degree of monetary restraint, it is necessary to use an updated version of the model. The currently lower inflation could have changed expectations of future inflation and, thus, changed wage-setting and price-setting behavior. To allow for this possibility, the model was reestimated using data through the second quarter of 1984. The details of the reestimated model are given in the Appendix.

CHART 1B
Effects of monetary restraint since 1979
on real output



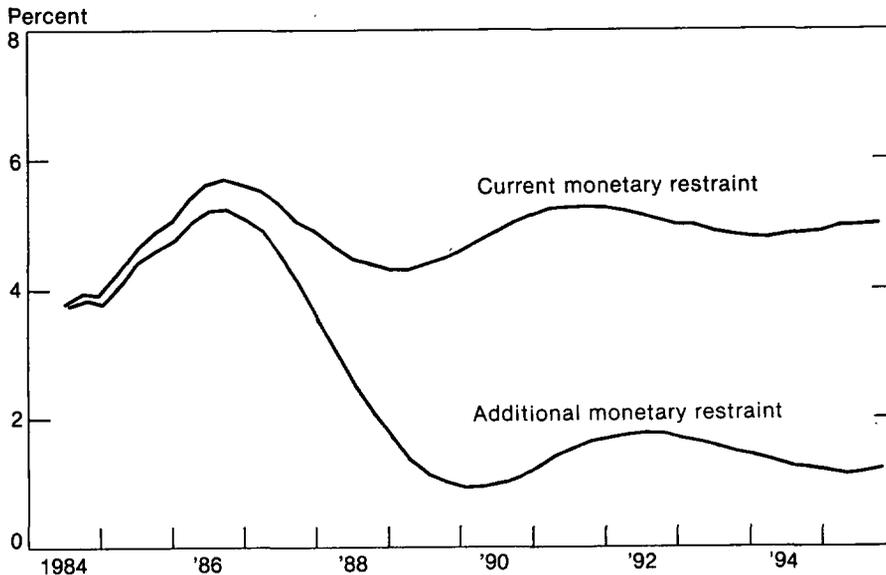
inflation have been high. As shown in Chart 1B, the model suggests that monetary restraint has reduced real output. According to the model, continuation of the accommodative monetary policies in effect before October 1979 would have prevented the recessions of 1980 and 1981-82. The recessions accompanying monetary restraint have kept real output well below the levels that would have been associated with monetary accommodation. Thus, the model simulations suggest that monetary restraint has imposed substantial costs on the economy because of inflexibility in wages, prices, and expectations.

The simulations also indicate, however, that lower inflation will yield economic benefits. As shown in Chart 1B, economic growth will be appreciably higher over the next decade because of improved economic efficiency associated with lower inflation. Consequently, these results indicate that the monetary restraint program adopted in 1979 and the cor-

respondingly lower inflation rate ultimately result in higher output and income than would have accompanied continued monetary accommodation.

The model simulations indicate that the benefits from lowering inflation since 1979 exceed the costs of doing so. Accurate comparison requires considering the costs and benefits of disinflation from the perspective of policymakers when they decided on the monetary restraint program in 1979. The benefits of lower inflation come only after several years in which real output remains below what it would have been if monetary policy had accommodated high inflation. Thus, it is necessary to discount both the costs and benefits of disinflation to arrive at comparable figures in a present-value sense. For this purpose, the difference between real output in the monetary accommodation and monetary restraint simulations, depicted in Charts 1B and 2B, was discounted by a real interest rate of 3 percent. As

CHART 2A
Effects of additional monetary restraint
on inflation



a result of discounting, the present value of both the costs and benefits is somewhat less than is suggested in the charts. Because the benefits occur much later than the costs, the charts overstate the benefits by more than they overstate the costs. The present value of the estimated cost of reducing inflation from the fourth quarter of 1979 through the second quarter of 1984 is \$168 billion of lost output. The benefits of lower inflation after mid-1984, however, total \$688 billion. Thus, the simulations imply that the benefits of lowering inflation to near current levels and keeping it there far exceed the costs of doing so.

Prospective disinflationary policies

Given the favorable estimated outcome from previous reductions in inflation, the question arises whether further lowering inflation would also yield net economic gains. Simulating the model can be used to estimate

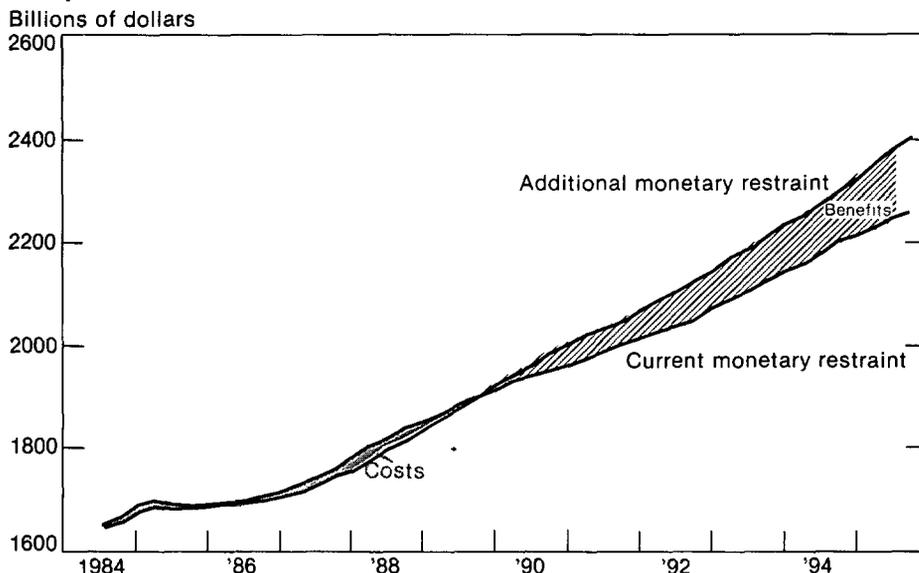
the effects of further reductions in monetary growth and inflation. The model was simulated under two assumptions regarding monetary growth.¹³ The first simulation assumes that the Federal Reserve relents in its program of gradually reducing monetary growth to bring down inflation.¹⁴ The second simulation assumes that the Federal Reserve gradually reduces monetary growth to 1 percent by 1988 and keeps it at that rate thereafter.

Effects. The simulations suggest that further reduction in monetary growth would result in further progress against inflation. As shown in Chart 2A, the model predicts that inflation would accelerate somewhat from current levels if monetary growth were maintained near

¹³ The version of the model estimated through the second quarter of 1984 was used for these simulations.

¹⁴ This simulation is identical to the previous simulation of monetary restraint.

CHART 2B
Effects of additional monetary restraint
on real output



the current rates and would stabilize at about 5 percent in the early 1990s. In contrast, additional monetary restraint that lowered money growth to 1 percent would cause inflation to average less than 1.5 percent in the early 1990s.

The simulations also indicate that lowering money growth would increase economic output. As shown in Chart 2B, the model simulations suggest that additional monetary restraint would result in slightly lower economic growth in the second half of the 1980s. However, the resulting reductions in inflation and consequent improvement in economic efficiency would cause higher economic growth in the early 1990s. According to the model, therefore, further reduction in monetary growth would lead ultimately to higher real output.

Costs and benefits. According to the simulations, the economic benefits of lowering money growth and inflation from current lev-

els exceed the economic costs. The present value of the lower level of economic activity in the next few years resulting from additional monetary restraint is only about \$28 billion. The present value of the higher output through the mid-1990s associated with lower inflation is \$303 billion. Thus, the simulations imply

Estimates suggest that the economic benefits of reducing inflation far outweigh the economic costs.

that the costs of further reducing inflation are much less than the resulting benefits, even after allowing for the fact that the benefits accrue long after the costs are incurred.

Conclusion

Quantitative estimates from the model used in this article suggest that the economic bene-

fits of reducing inflation far outweigh the economic costs. Although different models would undoubtedly yield somewhat different estimates, the analysis in this article provides several important insights.

First, both the costs and the benefits of disinflation must be considered in evaluating alternative monetary policies. Previous studies have estimated the costs of disinflation or the benefits of price stability separately, but none has used a unified framework of analysis to estimate both. As a result, policymakers have had very little empirical evidence to rely on in deciding whether bringing down inflation is worthwhile.

Another important finding is that the economic benefits of lowering inflation are realized long after the associated costs. According to the estimates in this article, the monetary restraint program adopted in 1979 has only recently contributed to better performance of the economy.¹⁵ Moreover, the economic bene-

fits from past and prospective monetary restraint would be realized primarily in the 1990s. In the meantime, real income will remain lower much of the time than it would be with an accommodative monetary policy.

As a result of the long lag between initiating a disinflationary monetary policy and realizing the resulting improvement in economic performance, the Federal Reserve must take a farsighted view of its policies. Focusing only on the short-run effects of monetary restraint would impart an inflationary bias to monetary policy. Such a bias could lead policymakers to a series of decisions not in the long-run best interest of the nation's economic wellbeing.

¹⁵ Strictly speaking, one cannot attribute the current strength of the economy solely to the monetary restraint program adopted in 1979. In particular, the monetary expansion in 1982, the large budget deficits, and the change in tax policy have all contributed to the current strength. However, the improvement in consumer and business confidence resulting from lower inflation has also contributed.

Appendix

This appendix presents a detailed description of the vector autoregression (VAR) used to estimate the costs and benefits of reducing inflation and discusses how robust those estimates are likely to be.

Description of the VAR

A VAR does not rely on a particular economic theory to determine which variables are most important in explaining the behavior of other variables. Instead, all of the variables included in the VAR are assumed to help explain the behavior of each of the other included variables.

The six variables included in the VAR used in this article are listed in Table 1. Only the interest rate variable warrants elaboration. A weighted average of several interest rates was used. The principal components statistical procedure was used to select the weights on the long-term Treasury bond yield, the 6-month commercial paper rate, the Baa corporate bond yield, the dividend-price ratio, the 3-month Treasury bill rate, and the prime rate to construct the interest rate variable. Six lagged values of this variable and the other five variables in the model were included as explanatory variables in each equation of the VAR.

The results of estimating the VAR through the third quarter of 1979 are summarized in the top panel of Table 1. The sum of coefficients on each of the variables in each equation is reported. While this table disregards some useful information, it does provide a convenient summary of the results. For those variables that were significant in explaining another variable, the sum of coefficients is accompanied by an asterisk, *. In addition, those variables that had at least one significant lag coefficient are accompanied by a plus sign, +. Since the focus of this article is the effect of inflation on output growth (Q), the output equation is of primary concern. In the real output equation, lagged inflation has a significant, negative effect on real output growth. A rise in inflation of one percentage point, all else the same, leads to a reduction in output growth of .93 percentage points.

The results of estimating the VAR through the second quarter of 1984 are summarized in the bottom panel of Table 1. The results are similar in most respects to those for the shorter sample period. However, in the income equation, the sum of coefficients on money growth is much smaller than for the earlier version of the model and is statistically insignificant. Although the effect is insignificant, for simulation purposes the "best guess" is that lagged inflation has a negative impact on output growth, consistent with the view that higher inflation reduces output growth. In addition, while there may be some concern about the lack of statistical significance, some economists feel that the issue of statistical significance of coefficients is not relevant for the interpretation of VAR results.¹⁶ Nonetheless, significance of coefficients is indicated in Table 1 for those who think traditional statistical criteria important in evaluating a VAR.

¹⁶ For a discussion of this point, see Christopher A. Sims, "Macroeconomics and Reality," *Econometrica*, January 1980, p. 18.

Robustness of the results

Empirical findings are considered robust to the extent that they are insensitive to the precise specifications of the model used. Robustness can be determined by experimenting to see whether alternative models would yield similar results. Several such experiments were conducted to determine the robustness of the finding that the economic benefits of reducing inflation exceed the costs.

It was initially hoped that simulations from a structural econometric model could be used to supplement the VAR results. Some object to the use of structural models; others, to the use of VAR models.¹⁷ But to simulate a large structural model, it is necessary to specify the values of a large number of "exogenous" variables. Some of the variables taken as exogenous for short-run forecasting are endogenous over a longer run horizon. Thus, changing the path for one exogenous variable, such as monetary growth, can lead to implausible results unless other exogenous variables are also changed in a mutually consistent way. Indeed, there may be no solution for the models when one exogenous variable is changed substantially from the baseline path constructed by the model-builders. Preliminary experiments with two large structural models, the DRI macro model and the MPS macro model, indicated that a large expenditure of manhours and computer time would be necessary to use these models to estimate the costs and benefits of reducing inflation. However, the MPS model was used over its normal five-year forecasting horizon to estimate the costs of reducing inflation. The results were remarkably close to those reported in this article, indicating some degree of robustness for the cost aspect of the cost-benefit comparison.

¹⁷ For a critique of structural models, see Robert Lucas and Thomas Sargent, "After Keynesian Macroeconomics," *Quarterly Review*, Federal Reserve Bank of Minneapolis, Spring 1979.

TABLE 1
Sum of lag coefficients

Equation	Variable						Constant	R ²
	M	Q	P	SURP	PEF	INT		
1955:Q2 to 1979:Q3								
M	1.277*, +	-.194	-.266	-.107	.050	-1.348	.840	.70
Q	.944*	-.288	-.933*	-.256 +	-.070	-3.461	4.092 +	.54
P	.234*, +	.208 +	.741*, +	.036	.154 +	1.864*, +	-.059	.87
SURP	.784	.259 +	-.451 +	.608 +	-.369 +	9.989	-3.347	.49
PEF	.148	.320 +	.148	-.135	.406*, +	1.421 +	-2.209 +	.50
INT	.036 +	.027	-.021	.002	.018 +	.402 +	-.126	.71
1955:Q2 to 1984:Q2								
M	.907*, +	-.111	-.028	.125 +	.036	-1.637 +	1.059	.63
Q	.352 +	.118	-.512	-.216 +	.039	-2.959	3.499 +	.50
P	.208*, +	.056 +	.691*, +	.002	.210*, +	1.183 +	.106	.83
SURP	.063 +	.926*, +	-.000 +	-.687*, +	-.199 +	5.151	-4.699 +	.39
PEF	-.038	.316 +	.204 +	-.028	.448*, +	-.743	-1.601	.44
INT	.047 +	.052 +	-.018 +	-.001 +	.054	.279 +	-.250	.63

Note: A* denotes that the sum of lag coefficients is significant at the 10 percent level.

A + denotes that at least one of the lag coefficients is significant at the 10 percent level.

The variables are:

M = growth rate of M1;

Q = growth rate of real GNP;

P = rate of inflation;

SURP = change in the real value of the high employment budget surplus;

PEF = growth rate in the relative price of energy and food; and

INT = change in the nominal interest rate.

In addition, several different versions of VAR models were used to test the robustness of the results. Various measures of the fiscal policy variable were tried; the 3-month Treasury bill rate was used in place of the weighted average interest rate; several different lag lengths were used; various of the six variables were dropped; and the trade-weighted exchange rate, capacity

utilization, and growth in the monetary base were included in alternative VAR models. None of these alternative specifications changed the conclusion that the long-run benefits of price stability exceed the short-run costs of achieving it, further evidence that the results reported in this article are relatively robust.