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Federal Reserve Bank of Cleveland

On the Cost of Inflation

by Paul Gomme

So far this year, the Federal Open Market Committee (FOMC) has lowered the targeted federal funds rate by 275 basis points. Twice, it has reduced the target by 50 basis points following unscheduled meetings. Some commentators have questioned why it took the Committee so long to take these decisive steps. After all, real output growth clearly slowed in the second half of 2000, and inflation measures had apparently ceased the upward trajectory that characterized 1998 and 1999. As late as November of last year, the FOMC had maintained the perspective that the balance of risks in the U.S. economy were weighted in the direction of heightened inflationary pressures, and its public assessment of risks did not shift toward economic weakness until the December meeting.

There are several potential explanations for the FOMC's behavior. One is that business cycles are characterized by sharp ups and downs in economic activity. Consequently, a fair amount of evidence must accumulate before one can be fairly certain that the economy is entering a period of sustained real-side weakness. (Remember that the so-called softening in the second half of 2000 came on the heels of a remarkably robust first half.)

The Committee must also strike a balance between its—at times—mutually inconsistent goals. While the FOMC is charged with ensuring sustainable economic growth, it is also responsible for maintaining a low-inflation environment. While overall CPI inflation leveled off in 2000–2001, "core" measures of inflation—those that attempt to identify the underlying trend in price growth—have been rising, suggesting that inflationary pressures may be building once again.

There are, perhaps, important reasons why central bankers only reluctantly shift their focus from inflation to economic growth. It is a widely held belief that, in the long run, the primary channel through which monetary authorities can promote economic growth is by maintaining the purchasing power of the nation's currency. Granted, monetary policy can have positive short-run effects on real economic activity, but such gains would represent a pyrrhic victory if they were purchased at the price of accelerating inflation.

The economy has likely entered a phase during which attention will, with some justification, shift to concerns over the immediate course of real economic activity. It is also an opportune time to remind ourselves of the costs of inflation—the avoidance of which remains the ultimate long-run goal of monetary policy.

Measuring the Costs of Inflation

In any product market, the socially efficient quantity of output is determined by the quantity at which the marginal costs of production equal the marginal social benefit of an additional unit of output. In general, we can think of the latter as the price of the product in question. In the case of money, the relevant "price" is a nominal interest rate since it tells us the return that must be foregone to hold dollars instead of some other asset that yields the market interest rate.

The FOMC has two objectives: maximizing sustainable economic growth, and maintaining price stability. At times—like the past year—these goals appear to be in conflict. This *Economic Commentary* outlines some economic theory that suggests that in the long run the FOMC can achieve its two objectives by focusing primarily on its price stability target.

What is the marginal cost of producing money? In the United States, the Federal Reserve is the sole supplier of central bank money (currency and bank reserves—the accounts that commercial banks hold with the Fed). The marginal cost of producing central bank money is, effectively, zero. Applying the principle that the most desirable level of production requires setting the price equal to marginal cost, the socially efficient quantity of money would be that amount at which the nominal interest rate (the "price" of money) equals zero. An implication of this analysis is that an optimal monetary policy would result in nominal interest rates equal to zero—a proposition widely known as the Friedman rule.[1]

If optimal monetary policy implies a zero nominal interest rate, what should the inflation rate be? A relationship known as the Fisher equation tells us that the nominal interest rate is (approximately) equal to the inflation rate plus the real rate of interest. Consequently, the optimal inflation rate is the negative of the real interest rate. For example, if the real interest rate is 3 percent, then the

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optimal rate of inflation is –3 percent. By similar reasoning, the value of the nominal interest rate tells us how much the inflation rate exceeds its socially optimal level.

Clearly, the zero nominal interest rate implied by the Friedman rule typically is not observed in practice. How large are the implied costs of deviations from the socially optimal rate of inflation? In extreme cases, these costs can be substantial. Using evidence for seven European hyperinflations between 1920 and 1946, Martin Bailey found that the largest welfare cost was on the order of half of income, while a "typical" cost was around a third of income.[2]

What "real-world" phenomena do these welfare cost calculations capture? Bailey describes them as the costs associated with changes in habits and payment procedures. For example, during hyperinflations, it is common to see people eschew the use of currency in favor of less efficient barter transactions. (Barter is less efficient than using money because barter requires a double coincidence of wants, while money only requires a single coincidence since everyone will accept money.) As inflation becomes more severe, workers demand to be paid more frequently. Having received their wage payments, households rush to purchase consumers goods or assets like foreign currencies. All of these activities are costly and disruptive to an economy.

What about more modest inflation experiences? Stanley Fischer, using money demand estimates for the United States, calculated that lowering the inflation rate from 10 percent to 0 percent would generate a welfare gain of between 0.3 and 0.8 percent of output.[3] While this figure may seem fairly modest, when applied to U.S. GDP for 1999, it implies a deadweight loss of between $28 billion and $74 billion. The magnitude of this welfare cost is comparable to that associated with other distortionary taxes. Furthermore, this welfare gain can be achieved each and every year—it is not a once-off gain.

A More Sophisticated Approach

In obtaining their estimates of the costs of inflation, Bailey and Fischer use the simple supply and demand analysis familiar to any student of elementary economics. More recent estimates of these costs have been obtained using more sophisticated models that are an outgrowth of *real business cycle theory,* which arose in the 1980s. The key feature of the real business cycle program is the adoption of a methodology in which economic phenomena are modeled by explicitly specifying the features of the basic microeconomic structure, such as preferences and technologies.

To explore the costs of inflation within a real business cycle model, we first need to specify *why* economic agents hold money. One way to do this is to adopt the *cash-in-advance constraint*, which states that individuals must have cash balances in their pocket at the start of the period in order to purchase goods. That is to say, these goods cannot be purchased on credit. Somewhat more flexible formulations allow money balances to help conserve on either shopping time or the pecuniary costs of making transactions. For the present purposes, these details are of secondary importance. It is sufficient that there is a well-defined "demand" for cash balances.

A feature that this class of models shares with some simpler frameworks is that increases in inflation can arise only through increases in the growth rate of money. When the rate of inflation rises, its proximate effect in these models is to distort the household's choice of how much to work. Owing to the cash-in-advance constraint, $1 earned today cannot be spent until tomorrow, when the price of goods will have risen. Consequently, the $1 earned today will garner fewer goods than it could purchase today. From the household's perspective, an increase in inflation acts in much the same way as an increase in the tax on its labor earnings; both serve to reduce the real wage received by the household. In the face of a fall in its real wage, we expect that the household will reduce the quantity of labor it is willing to supply. As a result of less labor, real production in the economy will fall.

A secondary channel through which inflation affects real activity operates via capital accumulation. Since households supply less labor, a given unit of capital is less productive in the sense that it produces less output (given the quantity of labor now being supplied). Since the return on capital has fallen, firms will curtail their investment activity in order to bring the return on capital in line with the long-run real interest rate, which is determined by the household's rate of time preference. (The "rate of time preference" is related to the real interest rate and refers to the idea that people prefer a unit of consumption received today over a unit received in the future.) To summarize, the long-run response to higher inflation is lower employment, capital, and output.

Suppose that in the model just described, the rate of inflation increases from 0 percent to 10 percent. To evaluate the costs of inflation, we ask the following hypothetical question: How much consumption would the representative household be willing to forego in order to avoid living in the 10 percent inflation world? The answer gives us the welfare cost of 10 percent inflation relative to 0 percent inflation; this figure is typically expressed as a percentage of output.

Thomas Cooley and Gary Hansen were among the first to try to quantitatively assess the costs of inflation in an environment like the one outlined above.[4] Relative to an optimal inflation rate (–4 percent per annum in their model), they found that an inflation rate of 10 percent resulted in a welfare cost of 0.4 percent of income. This figure is fairly typical of the estimates other researchers have subsequently obtained.

A slightly different way of casting the Cooley and Hansen result is to say that a reduction in the inflation rate from 10 percent to –4 percent would result in a 0.4 percent welfare *gain*. As with the simple supply and demand case, remember that this is a gain which can be enjoyed each and every year into the future.

The Costs of Fighting Inflation

The analysis thus far suggests that there is a "free lunch" to be had by reducing the rate of inflation. Yet the U.S. experience in the early 1980s shows that reductions in inflation are often bought at considerable short-term costs in terms of lower output and higher unemployment. These costs are absent from the calculation in the previous section because they are derived by assuming that the relevant comparison is between two distinct economies that differ only with regard to their rates of inflation and the economic effects that these differences imply.

Policymakers often use the "sacrifice ratio" to try to get a handle on these short-term costs. In brief, the sacrifice ratio gives the cumulative loss in output (over some time horizon) associated with a 1 percentage point reduction in the inflation rate.

FIGURE 1 OUTPUT LOSS AFTER DISINFLATION: SACRIFICE RATIO APPROACH

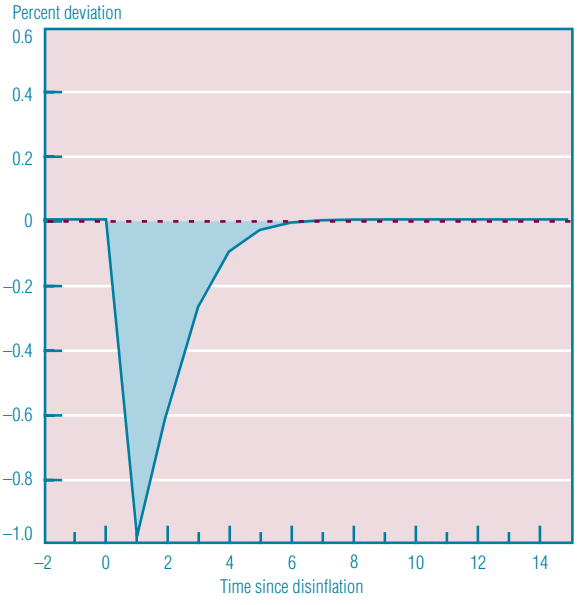
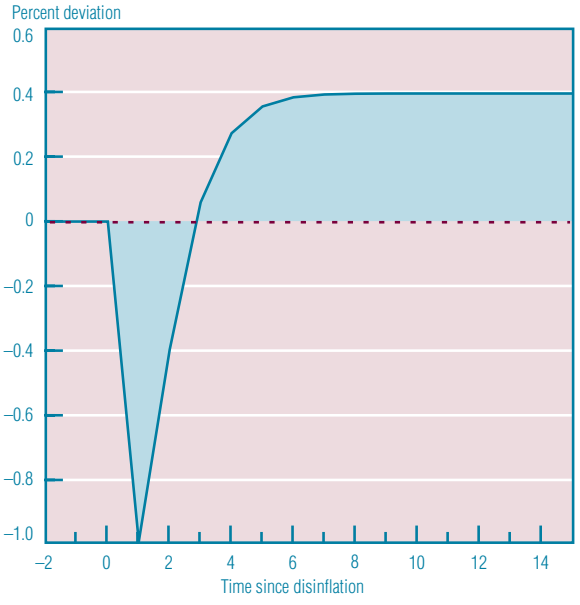


FIGURE 2 ONGOING GAINS AFTER DISINFLATION: ECONOMIC APPROACH



A typical exercise is the following: Estimate a simple relationship between real growth and inflation.[5] Next, generate an artificial time series while imposing a reduction in the inflation rate. Finally, add up the shortfall in output (the deviation of output from the path that it would have taken) and divide by the resulting fall in inflation (in order to express the lost output relative to a 1 percentage point fall in inflation). A stylized example of such an exercise is presented in figure 1.

There are at least two problems with the sacrifice ratio approach. First, the statistical techniques used typically provide no room for subsequent benefits of lower inflation. More specifically, in the long run, this statistical exercise produces an output growth rate equal to that in the data sample used to estimate that relationship.

Roughly speaking, common practice would involve adding up the shaded area in figure 1. If inflation is costly, we would expect to observe either an increase in the level of output, an increase in its growth rate, or both. Thus, following a disinflation, we might expect output to follow a path like that given in figure 2, in which the short-term losses in output are offset by medium- and long-term gains. Of course, one could argue that ignoring the growth effects of lower inflation is appropriate since the long-run benefits of a disinflation are so far off in the future that they can safely be ignored. One would hope that policymakers are not so short sighted.

Second, and more importantly, the sacrifice ratio gives the loss in output, not the loss in utility (or its output equivalent). This is an important distinction since the well-being of the typical American depends only in part on his or her material consumption. A different way to see this point is to realize that while we could all have more goodies to enjoy if everyone would work 60-hour weeks, we are unlikely to be happier since we would have much less leisure time in which we could enjoy these goodies.

That is not to suggest, however, that the transition costs from higher to lower long-run inflation rates are, or should be, of no concern. An important agenda for economists working within the methodology of general equilibrium macroeconomic models is to design models in which the long-run rate of inflation periodically changes. Doing so would allow a more complete assessment of the welfare benefits of a disinflation, incorporating the short-run losses in utility along with the long-term gains.[6]

Summary

There can be little doubt that the disinflation of the early 1980s was costly. The United States suffered the worst recession since the Great Depression, and the unemployment rate reached its highest level in post–World War II history. However, those short-term costs have hopefully been paid for by the subsequent strong economic performance of the U.S. economy, including the longest expansion in U.S. history. This is not to suggest that *all* of the positive economic performance since the early 1980s can be attributed to judicious monetary policy. However, it is probably fair to say that good monetary policy was a necessary precondition for this unprecedented performance.

In the 1979–80 period, the annual rate of inflation averaged over $12^{1}/_{2}$ percent; by 1982, it was under 4 percent. The quantitative literature on the costs of inflation suggests that sustained differences of this magnitude have substantial welfare consequences for the economy. Maintaining the gains from lower inflation is not, however, automatic. It is useful to recall that prior to the last recession, inflation was accelerating rapidly, rising from just over 1 percent in mid-1986 to over 6 percent by mid-1990. Had this trend continued, the gains of the 1990s would have very much been at risk. As the short-run risks to the U.S. economy shift, for now, in the direction of economic weakness, it is important to remember why the central bank's focus can never stray too far from its primary role in delivering the gains made possible by maintaining the purchasing power of the nation's currency.

Footnotes

1. See Milton Friedman, "The Optimum Quantity of Money," in *The Optimum Quantity of Money and Other Essays*, Chicago: Aldine, 1969, pp.1–50.

2. Martin J. Bailey, "The Welfare Costs of Inflationary Finance," *Journal of Political Economy,* vol. 64, no. 2 (April 1956), pp. 93–110.

3. Stanley Fischer, "Towards an Understanding of the Costs of Inflation: II," *Carnegie–Rochester Conference Series on Public Policy*, vol. 15 (Autumn 1981), pp. 5–142.

4. Thomas F. Cooley and Gary D. Hansen, "The Inflation Tax in a Real Business Cycle Model," *American Economic Review*, vol. 79, no. 4 (1989), pp. 733–48.

5. This simple relationship is often estimated using a vector autoregression (VAR). The VAR gives a reduced-form or unstructured estimate of the relationship between inflation and growth.

6. One attempt to incorporate such monetary policy regime-switching is found in David Andolfatto and Paul Gomme, "Monetary Policy Regimes and Beliefs," Federal Reserve Bank of Cleveland, Working Paper no. 99–05.

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