

Summer 1997

Quarterly Review

S. Rao Aiyagari:
My Student and My Teacher (p. 2)
Neil Wallace

Reprints

Deflating the Case for Zero Inflation (p. 5)
S. Rao Aiyagari

On the Contribution of Technology Shocks
to Business Cycles (p. 15)
S. Rao Aiyagari

Macroeconomics With Frictions (p. 28)
S. Rao Aiyagari

The Published Work of S. Rao Aiyagari (p. 45)

Federal Reserve Bank of Minneapolis

Quarterly Review

Vol. 21, No. 3

ISSN 0271-5287

This publication primarily presents economic research aimed at improving policymaking by the Federal Reserve System and other governmental authorities.

Any views expressed herein are those of the authors and not necessarily those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

Editor: Arthur J. Rolnick

Associate Editors: Edward J. Green, Preston J. Miller,
Warren E. Weber

Economic Advisory Board: Beth Allen, Lawrence J. Christiano,
Edward C. Prescott, James A. Schmitz, Jr.,
Neil Wallace

Managing Editor: Kathleen S. Rolfe

Article Editors: Kathleen A. Mack, Kathleen S. Rolfe,
Jenni C. Schoppers, Martha L. Starr

Designer: Phil Swenson

Typesetters: Mary E. Anomalay, Jody Fahland,
Correan M. Hanover

Circulation Assistant: Elaine R. Reed

The *Quarterly Review* is published by the Research Department of the Federal Reserve Bank of Minneapolis. Subscriptions are available free of charge.

Quarterly Review articles that are reprints or revisions of papers published elsewhere may not be reprinted without the written permission of the original publisher. All other *Quarterly Review* articles may be reprinted without charge. If you reprint an article, please fully credit the source—the Minneapolis Federal Reserve Bank as well as the *Quarterly Review*—and include with the reprint a version of the standard Federal Reserve disclaimer (italicized above). Also, please send one copy of any publication that includes a reprint to the Minneapolis Fed Research Department.

A list of past *Quarterly Review* articles and electronic files of many of them are available through the Minneapolis Fed's home page on the World Wide Web: <http://woodrow.mpls.frb.fed.us>.

Comments and questions about the *Quarterly Review* may be sent to

Quarterly Review
Research Department
Federal Reserve Bank of Minneapolis
P.O. Box 291
Minneapolis, Minnesota 55480-0291
(612-340-2341 / FAX 612-340-2366).

Subscription requests may also be sent to the circulation assistant at err@res.mpls.frb.fed.us; editorial comments and questions, to the managing editor at ksr@res.mpls.frb.fed.us.

Reprint This article originally appeared in the summer 1990 issue of the *Federal Reserve Bank of Minneapolis Quarterly Review* (pp. 2–11).

Deflating the Case for Zero Inflation*

S. Rao Aiyagari
Research Officer
Research Department
Federal Reserve Bank of Minneapolis

Early in the last decade, the annual U.S. inflation rate plunged from extremely high, double-digit levels to an apparently more acceptable level, around 5 percent. That's where it's hovered ever since, to the great relief of many. Lately, though, some people have begun to see even 5 percent as quite high. Just last year, in fact, the U.S. Congress began to consider legislation instructing the Federal Reserve to lower the inflation rate to zero in the next five years.¹

Would eliminating inflation be a reasonable policy to adopt? Some say, yes: Moving the inflation rate from 5 percent to zero would likely have some temporary costs, as the rate of change in the general price level gradually slowed and the economy adjusted; but in the long run, the policy's benefits would outweigh its costs. Others say, no: The move's costs could easily outweigh its benefits. This conclusion comes primarily from a consideration of policy options besides zero inflation that could produce most of its benefits with fewer costs.

I side with the naysayers. My review of the available relevant economic theory and evidence demonstrates that the case for a shift to the proposed policy of zero inflation is, at best, weak.

An Economic Measure of Welfare

Before I explain that in detail, let me explain how economists measure the costs and benefits of moving to zero inflation—or any other policy option.

In general, our goal when analyzing a governmental policy is to try to determine the policy's overall effect on

the welfare of society as a whole. We think of society's welfare in quite a natural way—as the satisfaction, or happiness, of its individual members. But how do you measure the satisfaction of even one person, much less that of millions? Economists think of individual satisfaction as resulting from time spent in leisure activities and from the consumption of goods and services. Therefore, for us, a natural measure of a person's satisfaction is the income required to support whatever amounts of leisure and consumption the person is enjoying. What we're interested in when analyzing a policy change is how it would change this income measure of satisfaction. We try to judge that effect for an individual, then magnify the measure and express the resulting likely change in total individual satisfaction as a percentage of total income in the economy. That is, we determine and measure the total welfare effects of a proposed governmental policy—its likely costs and benefits—and translate them into percentages of the gross national product (GNP).

Policies that are meant to change inflation are rather difficult to analyze. A proper analysis of such a policy would start with a formal theoretical model that simultaneously captures all the ways changes in an economy's

*This is a revised and expanded version of the author's unpublished paper, "The Costs of Reaching Zero Inflation," co-authored with David K. Backus.

¹The bill was H.J. Res. 409, introduced by Representative Stephen L. Neal of North Carolina (101st Cong., 1st sess., September 25, 1989). See also U.S. Congress 1990.

money supply—and thus its general price level—affect the welfare of the economy's participants. However, money and inflation influence the welfare of people in many complex ways, so economists haven't developed that type of comprehensive model yet. All we've done so far is identify a few of its essential features. Changes in each of these features due to policy-induced changes in inflation are what we have studied and tried to measure and translate into a percentage of GNP. These changes can be thought of as the policy's welfare costs and benefits.

A Critical Cost/Benefit Analysis

Studies of the welfare effects of the proposed zero inflation policy suggest that, from a narrow perspective, its benefits would outweigh its costs. But a broader view, one that takes other policy options into account, concludes just the opposite.

The Benefits of Zero Inflation? . . .

The benefits of a zero inflation policy have been identified as coming from three separate sources (the features of the hypothetical money model mentioned above): a reduction in the costs of making transactions, a reduction in the capital income tax, and a reduction in uncertainty. Studies have estimated the sizes of most of these benefits, and supporters of zero inflation seem to consider their total fairly large. I disagree. When the analysis expands to include alternative policy options, the first two of the three estimated benefits clearly are too high. The third seems to be mistakenly classified as a benefit; that classification is not supported by economic theory and evidence. After my analysis, therefore, the total benefits of a zero inflation policy shrink to practically nothing—and may, in fact, be negative.

□ *Reducing Transaction Costs*

An often-mentioned benefit of eliminating inflation is a reduction in the efforts people would make to decrease the amount of cash they hold available for spending. I think this *transaction cost* benefit would actually be very small.

The idea here is that inflation encourages the waste of resources each time people convert interest-earning assets into money, so eliminating inflation would save those resources for productive uses. Resources are wasted with inflation because it raises market interest rates, and people naturally want to earn as much interest as they can. They can't earn much with some forms of money used in transactions: currency and demand deposits.² So, with inflation raising market interest rates, people try to decrease their balances of

currency and demand deposits and increase their assets that earn market rates of interest. When people want to spend, this involves some costly juggling—frequent trips to the bank or the cash machine, for example, to get cash or move funds between accounts. (These costs are also known as *shoe-leather costs*.) Lowering inflation to zero is expected to reduce these costs by lowering market interest rates and so people's incentive to juggle funds between accounts.

Studies have come up with several quantitative estimates of the welfare benefit from reducing transaction costs. These estimates vary in size across studies and across the definitions of money used to calculate the benefit. One study (Fischer 1981a) says that a ten percentage point reduction in inflation would produce a transaction cost benefit of about 0.30 percent of GNP if the monetary base (currency plus financial institution reserves) is used in the calculation. For the same inflation reduction, but using the Fed's slightly broader definition of money, M1 (currency plus checkable deposits plus travelers checks), another study (Lucas 1981) puts the transaction cost benefit higher, at about 0.45 percent of GNP. Yet another study (Cooley and Hansen 1989) gets lower estimates for this inflation reduction: 0.08 percent of GNP for the base and 0.30 percent of GNP for M1.

Based on these studies, eliminating inflation as the proposed policy suggests could reasonably be expected to produce at least a small transaction cost benefit. Inflation has been roughly 5 percent lately, so lowering inflation to zero would mean reducing it about five percentage points, half the amount the studies assumed. If we halve the studies' lowest and highest estimated benefits, we get a reasonable range for the proposed policy's transaction cost benefit: from 0.04 percent to 0.22 percent of GNP.³

However, this benefit would likely be even smaller than the lower end of that range. For these numbers do not take into account several significant factors.

²In the United States today, most of the demand deposits that earn no interest are held by large businesses. These businesses are not allowed to hold interest-bearing checking accounts.

³One more-recent study (Imrohorglu 1989) argues that the estimates of the older studies (Fischer 1981a and Lucas 1981) may be too low. This study uses a model in which money smooths consumption when income fluctuates randomly and those fluctuations cannot be insured against. The model estimates the welfare benefit of a ten percentage point inflation reduction as about 1 percent of GNP.

However, in this model, money is the only asset available to smooth consumption. If the model included other assets, its estimate of the welfare benefit would be much smaller. In the United States, after all, currency is only about 4.5 percent of total liquid assets (according to December 1987 data).

One is alternative policy options to eliminating inflation. If the benefits of reducing transaction costs are desired, most of them can be achieved in simpler, more direct ways than manipulating the inflation rate. Some obvious ways are to just allow more forms of money that are used in transactions to earn market rates of interest. If that were done, less effort would be necessary to decrease the balances of forms that don't. Specifically, all demand deposits that are now not allowed to earn market rates of interest could be deregulated. At the same time, policymakers could pay interest on reserves held by financial institutions as backing for those and other deposits. This sort of deregulation could be done with all forms of money except perhaps the most basic: currency in the hands of the public.⁴

If these policy changes were made, the remaining transaction cost benefit possible from a zero inflation policy wouldn't be much. Circulating currency is a very small part of the total amount of money used in transactions: In 1989, it was only about a quarter of M1. For that small amount, reducing transaction costs by eliminating inflation would likely result in a welfare benefit toward the lower end of the estimated range: 0.04 percent of GNP, or less.

Even that calculation is likely too big, though, because it mistakenly assumes something about the way taxes would be affected if inflation were eliminated.

Taxes are affected by a zero inflation policy because inflation itself is a type of tax. Inflation occurs when the government increases the amount of money in the economy, so that more dollars are chasing the available goods and services. The government increases inflation essentially by printing more money and spending it. Officially, the government could issue more Treasury bills, increase its debt; but actually, when the Fed buys the T-bills, the government is simply borrowing from itself—effectively printing more money to spend. This extra money and spending in the economy transfers resources from the public to the government; it's a way to raise government revenue, a form of taxation. If inflation were eliminated, therefore, the government would likely replace it with another revenue-raising tax.

The estimated benefit from transaction cost reductions implicitly assumes that the replacement tax would not itself reduce welfare, and that's highly unlikely. The only taxes that don't reduce welfare, by distorting the economic decisions people would have made otherwise, are *lump-sum*, or head, taxes. These are fixed amounts paid by groups of people selected for some

characteristic irrelevant to their economic behavior (something other than income or wealth, for example). Lump-sum taxes are simply not used in the United States or most other countries because they are viewed as inequitable, or unrelated to individuals' ability to pay. Therefore, the only tax available to replace inflation is one that distorts economic behavior and so reduces welfare. The estimated benefit from transaction cost reductions thus must be reduced further by some unknown amount.⁵

Whatever remains of the studies' estimated benefit could disappear—or even turn negative—when one last factor is taken into account: the fact that most U.S. currency is not held by law-abiding U.S. residents.

This perhaps surprising fact affects the studies' estimates in two ways. One is directly. The estimates implicitly assume that more or less all U.S. currency is held by adult U.S. residents; these are the people they assume would benefit from inflation's elimination. According to a Federal Reserve study, however, adult U.S. residents instead hold only about 12–14 percent of it (Avery et al. 1987).⁶ Thus, the estimates of a transaction cost benefit from a zero inflation policy must be reduced accordingly.

But these estimates must also be reduced because of an indirect welfare effect, one that comes from inflation's effect on those who do hold most of the U.S. currency. For the Fed study also implies that over 80 percent of it is held by people who are residents of other countries and people who are engaged in illegal activities (in the *underground economy*). These are people for whom U.S. policymakers may not want to eliminate the inflation tax.

If the inflation tax were eliminated, resources would implicitly be transferred from U.S. citizens, who don't

⁴Policymakers could go even further and remove the prohibition against financial institutions issuing small-denomination bearer notes. This might effectively take the government out of the business of providing currency. (See Wallace 1983 for a theory of the demand for fiat money based on such legal restrictions.) The merits, or lack thereof, of such an extreme policy do not necessarily have any bearing on the merits of the other policy options. Another extreme policy—paying interest on bank reserves while increasing reserve requirements to 100 percent—would effectively turn banks into money warehouses (Friedman 1960). However, such a proposal may be ignoring an essential liquidity-creating role of banks (Diamond and Dybvig 1983).

⁵In the United States, the amount of revenue raised by the inflation tax is actually quite small: currently, it is about 0.3 percent of GNP. Therefore, if the inflation rate were brought down to zero, replacing the lost revenue by other taxes should be fairly easy. One study (Fischer 1981a) suggests that, with the inflation rate at 9 percent, there is a clear welfare benefit to reducing that rate to zero and replacing the lost inflation tax revenue by taxing wage income.

⁶This proportion has apparently remained fairly stable. It matches, roughly, the proportions found by studies in 1944 and 1974.

use U.S. currency much, to citizens of other countries, who do. This clearly implies some welfare loss to U.S. citizens.

More will be lost, too, because of the drop in the inflation tax on the activities of people in the underground economy, who also use currency a lot. These activities have harmful side effects on people in the legitimate economy (*aboveground*). Illegal activities generally in some way reduce the happiness, or satisfaction, or economic welfare of individuals who obey the laws. Prostitution and drug-dealing, for example, may profit the people involved, but at the least, they lower the property values of others in the neighborhood. (Economists call these harmful side effects *negative externalities*.) Eliminating inflation may also encourage cash transactions designed to evade taxes. So policymakers likely would be concerned about these activities but almost surely unable to tax them in any way other than inflation. After all, by definition, illegal activities escape explicit forms of taxation. Thus, eliminating inflation would reduce total economic welfare by eliminating a beneficial tax.⁷ Taking account of this missed effect of zero inflation would likely reduce the remaining transaction cost benefit quite a bit. The remaining benefit was, at most, only 0.04 percent of GNP. Much of a reduction in a benefit of that size would drop it below zero—or turn it into a cost.

□ Reducing the Capital Income Tax

Another often-mentioned benefit of eliminating inflation is a reduction in the capital income tax. I think that, if other ways to reduce the capital income tax are considered, estimates of this benefit, like those for the transaction cost benefit, are much too high. In fact, the benefit that zero inflation could provide through the tax system drops to zero.

Eliminating inflation reduces the capital income tax because inflation effectively increases this tax. Inflation raises market prices, in particular, what businesses have to pay to replace worn-out capital stock, but the federal tax code doesn't take that into account. When calculating the tax on their income, businesses are allowed to subtract the depreciation of their capital stock, but they must value it at historical rather than current market prices. With inflation, therefore, the capital income tax must be figured on a larger amount than it would be otherwise, and the effective tax rate is higher. Without inflation, there is no distinction between historical and current prices, so the effective tax rate on capital income is lower.

Studies have estimated quite large welfare benefits

from this sort of tax reduction. A theoretical model suggests, for a start, that a five percentage point change in inflation is equivalent, roughly, to a ten percentage point change in the effective tax rate on real corporate profits (Kydland and Prescott 1980). Studies of actual changes in U.S. inflation and taxes generally agree with that rough estimate (Feldstein and Summers 1979, Feldstein and Poterba 1980). The theoretical model also estimates that such changes in inflation and the effective capital income tax rate would, in the long run, increase the capital stock about 20 percent and total production about 5 percent (Kydland and Prescott 1980).

That wouldn't be the size of the welfare benefit, of course. To determine the effect on individual welfare, the production increase must be translated into a welfare measure. A quantitative study has provided something to go on (Lucas 1990). It says that adopting the optimal policy for an economy (eliminating the capital income tax and replacing it with a wage tax)⁸ would, in the long run, increase the capital stock about 33 percent and personal consumption of goods and services between 4 percent and 7 percent. In the long run, the study suggests, the optimal policy would produce an overall welfare benefit of between 5.5

⁷In fact, the correct inflation tax rate to be levied on the underground economy may well be higher than that implied by the current inflation rate of around 5 percent.

Some quick calculations will suggest this. Suppose, for simplicity, that the amount of currency held by the underground economy is a constant proportion k of GUP (by which I mean *gross underground product*). If GUP is some fraction x times GNP and the currency held in the underground economy is some fraction y times the total currency held, then $k = (y/x)$ (total currency/GNP) = $0.04(y/x)$, according to 1989 data. If the money growth rate is 7 percent (which implies an inflation rate of 5 percent after 2 percent is subtracted for real GNP growth), then the effective tax rate on GUP is given by $k(0.07/1.07) = (0.04) \times (0.07) y / (1.07x) = 0.0026(y/x)$. Two studies provide some estimates of x (the size of GUP relative to GNP) and y (the proportion of all outstanding currency that is held underground). They say x is probably not less than 10 percent (Gutmann 1977, Feige 1979) and y is about 6 percent (Avery et al. 1987). The effective income tax rate on the underground economy is, then, 0.156 percent. That is, a 5 percent inflation rate is equivalent to a 0.156 percent income tax rate on activities in the underground economy. Even if x were as low as 2 percent and y as high as 20 percent, the effective income tax rate on the underground economy works out to only 2.6 percent.

That's obviously far below the income tax rate faced by those aboveground. This suggests that a 5 percent inflation rate is likely to imply too low, rather than too high, a tax rate.

Eliminating inflation may therefore turn a transaction cost welfare gain into a loss. In this context, the idea of deregulating interest rates on all demand deposits and paying interest on reserves is even more attractive. For doing these things would lower the cost of the inflation tax on the aboveground economy without lowering it on the underground economy.

⁸For a theoretical argument that the optimal long-run tax rate on capital income is zero, see Chamley 1985, 1986. The *optimal long-run tax rate* is the appropriate tax rate to be levied in the very distant future.

percent and 7 percent of consumption.⁹ But the change to this policy would also have some short-run costs; to increase the capital stock, consumption would have to be temporarily decreased and saving temporarily increased. Therefore, the total welfare benefit from this policy would be smaller. According to this study, for example, subtracting short-run costs may shrink a long-run benefit of 6.7 percent of consumption to 0.4–0.7 percent—a smaller, but still significant benefit.

That, again, would be the result of an optimal policy change. Using it and the other studies as a guide, though, we can estimate the likely capital income tax benefit of the proposed zero inflation policy change. This change, again, would mean reducing the inflation rate five percentage points, which the studies say would reduce the capital income tax rate about ten percentage points. If the effective rate is assumed to start out at 36 percent, then based on the studies, this welfare benefit should be about 0.10–0.20 percent of consumption.¹⁰ Since personal consumption is about 60 percent of GNP, the overall benefit from this source can be estimated at about 0.06–0.12 percent of GNP.

Still, none of this benefit should be attributed to the zero inflation policy: all of it could be achieved in other, more direct ways.

The simplest way to get a welfare benefit from a reduction in the capital income tax is, obviously, to just lower that tax. Indexing depreciation allowances to inflation would lower the tax rate and produce the same welfare benefit without any potential costs that might come from reducing inflation.

A slightly more complicated change might work better than that. Some have argued that depreciation allowances shouldn't be indexed to inflation (Judd 1989). They say that a zero tax rate on capital income is optimal, but only on average. In an economy with uncertainty, the optimal policy is to vary the capital income tax rate with government spending.¹¹ That happens naturally when the tax is not indexed to inflation (since inflation tends to vary with government spending), but it wouldn't happen with indexing. This objection doesn't eliminate indexing as an option, however. It just suggests that depreciation allowances might be better indexed to expected inflation (or some long-run average rate of inflation) instead of to the actual inflation rate. If this were done, then the actual tax rate could still vary with actual inflation, as is thought to be optimal.

A more difficult, but still simple way to get a welfare benefit from a reduction in the capital income tax would be to index the whole federal tax code to infla-

tion. This massive change would likely be difficult to enact, but it would surely wipe out all inflation's effects on tax rates, which seems to be desirable. And like the other, easier policy options, such a change would produce at least the same tax benefits as would the proposed zero inflation policy, without any of its costs.

These options obviously leave no capital income tax benefits left to attribute to zero inflation.

□ *Reducing Uncertainty*

Perhaps the most often-mentioned benefit of eliminating inflation is through a reduction in uncertainty about why prices of goods and services are changing—is it due to a real change in the economy (which changes the prices of some goods relative to those of others, or *relative prices*) or merely to a change in the money supply (which changes all prices, the general price level, inflation)? (See, for example, Friedman 1977 and U.S. Congress 1990.) Studies have not yet managed to quantify this uncertainty benefit, but that's appropriate: according to the available evidence, it may not be much of a benefit.

The benefit is thought to come from letting the price system operate properly. In a market economy, changes in prices of particular goods and services are supposed to signal to market participants when the demand for or supply of those goods and services has changed. If that can happen, then the economy's available resources will flow where society wants them, to produce the goods and services wanted in the amounts wanted. Inflation disrupts this system, making the price signals hard to read. Especially when inflation is high and variable, people see changes in prices for particular goods and services, but they don't know what's causing them—a general inflation due to money changes or real changes in what consumers want or what producers can supply. As a result, economic decision-making is harder, and the decisions made are not likely to be those that would have been made otherwise. Sometimes, output will change in response to changes in the money supply even though real demand and supply conditions have not changed. With inflation high and variable, that is, the economy's available resources are likely to be misallocated. Eliminating inflation is thought to elimi-

⁹These numbers are based on a particular, but reasonable specification of the parameters for the economy.

¹⁰According to Lucas' (1990) calculation for the United States, total taxes attributable to capital income were about 36 percent of total capital income in 1985.

¹¹The models of Chamley (1985, 1986) and Lucas (1990) have no uncertainty.

nate the misperceptions and let only changes in real demand and supply conditions direct the allocation of resources, as people want.

Despite the popularity of this argument, economic studies do not strongly support it as a source of any potential benefit from a zero inflation policy.

True, some economic theory does support this idea. One theoretical study (Lucas 1972) has shown that changes in the money supply can change economic decisions. In a model with some relevant elements—changes in money (and thus inflation), real changes (in demand and supply forces), uncertainty, and imperfect information—this study finds a positive correlation between inflation and output. This suggests that movements in output and in relative prices of goods and services can be caused by money expansion and not just by real demand and supply forces. The changes in money involved here, though, must be unexpected. In this model, expected money changes do not make relative prices more variable or change output.

Two empirical studies also find some relationship between changes in inflation and relative prices. One (Vining and Elwertowski 1976) finds a simple positive relationship between these changes. The other study (Parks 1978) finds just what theory predicts: a strong positive relationship between unexpected changes in the inflation rate and changes in relative prices, but not between changes in the general inflation rate (the trend rate) and in relative prices.

However, other studies looking for evidence for this theory don't find it. One (Fischer 1981b) looks at data for the U.S. economy during 1956–80. It finds that what was primarily responsible for the relationship between inflation and relative prices in this period was not money changes but *real supply shocks*, large surprise movements in food and energy prices in the 1970s. Another study (Hercowitz 1982) agrees. It looks at U.S. data for a slightly different period, 1948–76. Taking the effects of the real supply shocks into account, it concludes that changes in money (inflation)—expected or unexpected—did not significantly affect changes in relative prices.

Studies that could provide some indirect evidence for this theory don't—or, at best, they find only weak evidence. Two (Barro 1977, 1978) support the theory: they find a strong relationship between unexpected changes in money and changes in output and unemployment. One study (Barro and Hercowitz 1980) doesn't find any such relationship, however. And another (Boschen and Grossman 1982) finds just the opposite of what the theory predicts: no relationship between unex-

pected changes in money and changes in output, but a small relationship between actual changes.

The theory is questionable in several other ways, as well. Little or no evidence exists for the theory's prediction that unexpected movements in the price level are significantly related to changes in output or employment (Sargent 1976, Fair 1979). Also, very hard to believe is the theory's suggestion that imperfect information is an important link in the chain between money and output: The U.S. public are barraged daily with data on the money supply and other economic indicators. And finally, a closer look at the data suggests a different interpretation for the relationship between money and output. The Fed's broader measures of the money supply seem to be more closely correlated with output than are its narrower measures. The broader measures include large components (like liabilities of banks and other financial institutions) that are affected by changes in general economic activity. This strongly suggests that any positive correlation between money and output noted by empirical studies is due to money responding to output rather than vice versa.¹²

Even if the theory were right, though, reducing the average rate of inflation to zero may not have any effect on welfare. People who favor the zero inflation policy suggest that lowering inflation on average would necessarily make inflation less variable. Simple U.S. data support that idea. According to the data for the 1960s and the 1970s, the higher inflation is on average, the more it varies. But these data may be misleading. A study of them (Taylor 1981) finds that the observed relationship between level and variability is due merely to monetary policy responses to supply shocks that had lifted the inflation rate. Government attempts to decrease fluctuations in output increased fluctuations in inflation. Thus, intentionally reducing the average money growth rate (to reduce inflation's level) wouldn't automatically reduce inflation's variability. All of this may be only marginally relevant for economic welfare, anyway. What matters for welfare is not the variability of inflation, but the variability of personal consumption of goods and services, and that is already pretty low. Two studies (Fischer 1981b, Lucas 1985) say that, per

¹²See Plosser 1989, Abstract, for the view that "the empirical evidence for a monetary theory of the [business] cycle is weak. Not only do variations in nominal money explain very little of subsequent movements in real activity, but what explanatory power exists arises from variations in endogenous components of money." See also Barro 1989 for a short, useful summary of the empirical deficiencies of the theory as well as many pertinent references.

person, consumption in the United States doesn't vary much. Thus, reducing the variability of consumption won't improve welfare much.

... *Small or Negative*

This analysis of the zero inflation policy has more or less eliminated the potential benefits from reducing uncertainty and reducing the capital income tax. All that's left as a potential benefit of zero inflation is that from reducing transaction costs. As we have seen, that benefit—and so total benefits from this policy—would likely be very small: much less than 0.04 percent of GNP, the low end of the transaction cost estimate, and possibly less than zero.

The Costs of Zero Inflation? ...

With economic welfare benefits so small, the zero inflation policy couldn't reasonably be considered advisable unless its costs were, at most, insignificant. That's not likely.

□ *Sticky Money Contracts*

Economists have identified one way that policies intended to reduce inflation would also reduce output and increase unemployment: through rigidity in contracts specified in money amounts (*money contracts*). These effects are usually presumed to also reduce society's welfare, or have a cost.¹³

The general idea is that decisions to enter into money contracts are made with an expectation of continued inflation, and these decisions likely would not have been made as they were without that expectation. Reducing inflation thus will likely reduce economic welfare, at least temporarily—as long as people are stuck with their binding agreements. When inflation drops, money's purchasing power, or *real value*, rises, but the money amounts in the contracts do not change to fully compensate people for the price level change. They would if these amounts were fully indexed to price level changes. Otherwise, though, the unexpected changes in real values will necessarily change people's behavior and so economic welfare until the contracts run out and new ones can be negotiated.

These general costs apply to any money contracts that are not fully indexed to inflation, but economists have extensively studied only one type: the labor contract. The welfare costs that an inflation-reducing policy would produce through labor contracts parallel the general description above. What sticks with labor contracts are money wages. These wages are agreed on with an expectation about inflation on both sides of the

contract: the employers and the workers. If inflation were to drop unexpectedly, money wages wouldn't change, but real wages would increase. That would mean employers would effectively be paying more than they expected to for labor (as well as anything else under contract). They would respond by cutting back production and laying off workers or simply not hiring some they would have otherwise. This disruption in economic activity would affect overall economic welfare, at least temporarily. The economy's total production would decrease, unemployment would increase, and individuals' consumption—and, presumably, their satisfaction—would decrease. These effects would continue until the labor contracts expired and new money wages could be negotiated, taking the new expected inflation rate into account.¹⁴

□ *The Importance of Being Credible*

Estimating the size of this cost of a zero inflation policy is difficult because economists disagree on how best to analyze it. They do seem to agree, though, that the cost will be much smaller if the policy is taken seriously by the public.

The starting point for these analyses is the inverse relationship between changes in money wages (inflation) and the unemployment rate. This relationship was noted in 1958 by economist A. W. Phillips and was later named the *Phillips curve*. Economists quickly interpreted this relationship as a trade-off that policymakers could exploit: for each percentage point they managed to decrease the inflation rate, they had to accept an increase in unemployment, which means a decrease in output. The size of the output decrease became known as the *sacrifice ratio*.

The likely size of this ratio—and thus the estimated welfare cost of any inflation policy—seems to vary with

¹³This presumption is by no means well established.

¹⁴The inflation-reducing effects on another type of money contract have only recently begun to be studied by economists: those on the loan contract. No quantitative estimates of these effects are available, but their analysis is quite similar to that for wage contracts.

In general, the idea here is that unexpectedly reducing inflation could lead to costly defaults and bankruptcies of debtors who have long-term, nominally denominated, unindexed loans outstanding. Like wage contracts, loan contracts may have been entered into with the expectation that the current monetary expansion would continue. An unexpected change in monetary policy to lower the inflation rate would increase the real value of the existing debt burden. Therefore, the net worth of potential borrowers and entrepreneurs could be adversely affected. This could decrease or eliminate new loans to them and thereby reduce profitable investments that might otherwise have been made. (See Fisher 1933 and Bernanke and Gertler 1989.)

As with wage contracts, though, the loan contract effects would only be temporary. New loan contracts would be tailored to reflect the new, lower inflation rate.

the views economists have about the way the public see inflation policy in general.

One view—that of *Keynesian* economists—seems to be that inflation policy is never credible. This is an interpretation based on the way Keynesians treat expectations. When these economists analyze inflation policy, they seem to implicitly assume that the inflation rate people expect when they make wage contracts is unrelated to the actual inflation rate, or, especially, to monetary policy. In Keynesian models, expectations are independent of these things. This assumption could be seen as an assumption that people are stupid or irrational—they ignore obviously relevant things when forming expectations about inflation—but this is hard to believe. If that were true, for example, why would so much media attention be focused on what the Fed is doing now and what it's likely to do next? A more reasonable way to interpret the Keynesian assumption is that people simply don't believe what the government says about its current or future inflation policy, so they form expectations independent of that.

Economists with this view estimate the cost of eliminating inflation as quite large. Two studies (Okun 1978, Fischer 1984) put the sacrifice ratio, on average, at 10 percent of a year's GNP. A more recent study (Blinder 1989) puts it somewhat lower, at 6 percent of a year's GNP. An average of the two most recent studies' estimates thus puts the ratio at 8 percent of a year's GNP. With a sacrifice ratio that large, the lost output from the proposed five-year zero inflation policy is huge: 40 percent of a year's GNP, or about 2 trillion current dollars.

Not all economists think inflation policy always is incredible, however. Some—*rational expectations* economists—take the view that this type of policy could be credible or not and which it is will determine the policy's cost. When these economists analyze inflation policy, they explicitly assume that policy credibility is reflected in people's expectations for inflation; that is, expectations take into account people's evaluations of inflation experience and the course of monetary policy, and those evaluations are correct.

Under this view, the cost of reducing inflation could be the same as that which the Keynesians expect. If the public do not believe the government's policy announcements, then the sacrifice ratio for reductions in inflation will be large.

This view allows for the possibility of a much smaller cost, though. If the public are convinced that the government is really shifting to an announced new lower-inflation policy and will stick to it, then the

sacrifice ratio could be close to zero. People who believe the government will quickly reduce their expectations of inflation and, as old labor contracts expire, lower their wage demands. As a result, output will not be affected much by the inflation reduction. An abrupt, surprise change in policy could cost some output. But a gradual, credible reduction in inflation could cost very little. At the start of such a policy, some output could be lost due to confusion about whether the observed slow money growth rates are planned or accidental. Still, those losses would soon stop, and the total output lost would be much smaller than the Keynesian estimates.

The economic literature includes many studies supporting the rational expectations view of this cost. Several are worthy of special note. Two related studies (Taylor 1980, 1983) show theoretically that if policy is credible, inflation can be lowered quickly with no cost in output. The model in these studies has rational expectations and staggered (overlapping) wage contracts, and as contracts expire and new ones are negotiated, their wage increases are reduced. In a version of the model with three-year contracts, for example, inflation can be lowered seven percentage points in four years with no loss in output.¹⁵

A striking historical study (Sargent 1982) shows more or less the same thing. This study examines the economic experience in four European countries (Austria, Germany, Hungary, and Poland) in the period between the two world wars. During this time, the governments in these countries ran enormous budget deficits, which led to enormous inflations, known as *hyperinflations*. In each country, the government adopted a highly credible inflation-reduction policy, consisting of binding international agreements as well as fiscal and monetary reforms. Then, in each country, the price level that had been rising very rapidly stabilized abruptly with relatively little cost in output.

... Probably Significant

Despite the possibilities provided by the rational expectations view, the total cost of the zero inflation policy is not likely to be insignificant. As we have seen, for the cost to be very small, the policy has to be credible. Policy credibility requires coordination between monetary and fiscal authorities—something that hasn't been seen lately in the United States.

The need for this coordination is well established in the literature. We saw it, for example, in the interwar

¹⁵However, according to this model, a faster decrease in the inflation rate is only possible at some cost in terms of output.

hyperinflation study (Sargent 1982). It is demonstrated theoretically in another prominent study (Sargent and Wallace 1981). This study shows that the Fed simply can't keep to a tight money (low or zero money growth) policy if the fiscal authorities continue to run large budget deficits. Budget policy determines how much money the government is spending and where it's getting money to spend, through taxing or borrowing. If the fiscal authorities insist on deficit spending despite an attempted zero inflation policy, the Fed's policy will be in trouble. As we have seen, more government debt—if bought by the Fed—means more money in the economy and more inflation. But if both the public and the Fed were to refuse to buy the extra government debt, the government would be insolvent. The Fed will thus have little choice but to give in. The public, therefore, are not likely to take the Fed's commitment to a zero inflation policy seriously if Congress and the administration don't at the same time get the federal budget under control.

How likely is that? Anyone paying even occasional attention to the media knows that the federal government has shown few signs of getting its budget under control. This has likely given the public quite large, persistent doubts about the Fed's ability to stick to a zero inflation policy (regardless of its good intentions). Such large doubts mean that the costs of the proposed zero inflation policy could also be large.

Conclusion

This cost/benefit analysis has essentially deflated the case for the proposed policy of achieving zero inflation in five years: on balance, the policy does not appear to be advisable. Zero inflation would have both costs and benefits, but the costs likely would not be small, and the benefits likely would be; they might even be negative. That judgment comes from a consideration of other, more direct policies than the one proposed. Specifically, instead of trying to manipulate the inflation rate, U.S. policymakers should seriously consider allowing all demand deposits to earn market interest rates, paying interest on reserves held by financial institutions as backing for these and other deposits, lowering the federal tax rate on capital income, and indexing the federal tax code to inflation. These changes could achieve most of the desired benefits of zero inflation without the possibly significant costs.

References

- Avery, Robert B.; Elliehausen, Gregory E.; Kennickell, Arthur B.; and Spindt, Paul A. 1987. Changes in the use of transaction accounts and cash from 1984 to 1986. *Federal Reserve Bulletin* 73 (March): 179–96.
- Barro, Robert J. 1977. Unanticipated money growth and unemployment in the United States. *American Economic Review* 67 (March): 101–15.
- . 1978. Unanticipated money, output, and the price level in the United States. *Journal of Political Economy* 86 (August): 549–80.
- . 1989. Introduction. In *Modern business cycle theory*, ed. Robert J. Barro, pp. 1–15. Cambridge, Mass.: Harvard University Press.
- Barro, Robert J., and Hercowitz, Zvi. 1980. Money stock revisions and unanticipated money growth. *Journal of Monetary Economics* 6 (April): 257–67.
- Bermanke, Ben, and Gertler, Mark. 1989. Agency costs, net worth and business fluctuations. *American Economic Review* 79 (March): 14–31.
- Blinder, Alan S. 1989. The economic myths that the 1980s exploded. *Business Week* (November 27): 22.
- Boschen, John F., and Grossman, Herschel I. 1982. Tests of equilibrium macroeconomics using contemporaneous monetary data. *Journal of Monetary Economics* 10 (November): 309–34.
- Chamley, Christophe. 1985. Efficient taxation in a stylized model of intertemporal general equilibrium. *International Economic Review* 26 (June): 451–68.
- . 1986. Optimal taxation of capital income in general equilibrium with infinite lives. *Econometrica* 54 (May): 607–22.
- Cooley, Thomas F., and Hansen, Gary D. 1989. The inflation tax in a real business cycle model. *American Economic Review* 79 (September): 733–48.
- Diamond, Douglas W., and Dybvig, Philip H. 1983. Bank runs, deposit insurance, and liquidity. *Journal of Political Economy* 91 (June): 401–19.
- Fair, Ray C. 1979. An analysis of the accuracy of four macroeconomic models. *Journal of Political Economy* 87 (August): 701–18.
- Feige, Edgar L. 1979. The irregular economy: Its size and macroeconomic implications. Working Paper 7916. Social Systems Research Institute, University of Wisconsin, Madison.
- Feldstein, Martin S., and Summers, Lawrence H. 1979. Inflation and the taxation of capital income in the corporate sector. *National Tax Journal* 32 (December): 445–70.
- Feldstein, Martin, and Poterba, James. 1980. State and local taxes and the rate of return on nonfinancial corporate capital. Working Paper 508. National Bureau of Economic Research.
- Fischer, Stanley. 1981a. Towards an understanding of the costs of inflation: II. In *The costs and consequences of inflation*, ed. Karl Brunner and Allan H. Meltzer. Carnegie-Rochester Conference Series on Public Policy 15 (Autumn): 5–41. Amsterdam: North-Holland.
- . 1981b. Relative shocks, relative price variability, and inflation. In *Brookings Papers on Economic Activity*, ed. William C. Brainard and George L. Perry, vol. 2, pp. 381–431. Washington, D.C.: Brookings Institution.
- . 1984. Contracts, credibility, and disinflation. Working Paper 1339. National Bureau of Economic Research.
- Fisher, Irving. 1933. The debt-deflation theory of great depressions. *Econometrica* 1 (October): 337–57.
- Friedman, Milton. 1960. *A program for monetary stability*. New York: Fordham University Press.
- . 1977. Nobel lecture: Inflation and unemployment. *Journal of Political Economy* 85 (June): 451–72.
- Gutmann, P. M. 1977. The subterranean economy. *Financial Analysts Journal* 33 (November/December): 26–27.
- Hercowitz, Zvi. 1982. Money and price dispersion in the United States. *Journal of Monetary Economics* 10 (July): 25–37.
- Imrohorglu, Ayse. 1989. The welfare cost of inflation under imperfect insurance. Working Paper. Department of Finance and Business Economics, University of Southern California.
- Judd, Kenneth L. 1989. Optimal taxation in dynamic stochastic economies: Theory and evidence. Manuscript. Hoover Institution, Stanford University.
- Kydland, Finn, and Prescott, Edward C. 1980. A competitive theory of fluctuations and the feasibility and desirability of stabilization policy. In *Rational expectations and economic policy*, ed. Stanley Fischer, pp. 169–98. A Conference Report, National Bureau of Economic Research. Chicago: University of Chicago Press.
- Lucas, Robert E., Jr. 1972. Expectations and the neutrality of money. *Journal of Economic Theory* 4 (April): 103–24.
- . 1981. Discussion of the Fischer paper. In *The costs and consequences of inflation*, ed. Karl Brunner and Allan H. Meltzer. Carnegie-Rochester Conference Series on Public Policy 15 (Autumn): 43–52. Amsterdam: North-Holland.
- . 1985. Models of business cycles. Manuscript. Yrjo Jahnsson Lecture, May. Helsinki, Finland.
- . 1990. Supply-side economics: An analytical review. *Oxford Economic Papers* 42 (April): 293–316.
- Okun, Arthur M. 1978. Efficient disinflationary policies. *American Economic Review* 68 (May): 348–52.
- Parks, Richard W. 1978. Inflation and relative price variability. *Journal of Political Economy* 86 (February): 79–95.
- Plosser, Charles I. 1989. Money and business cycles: A real business cycle interpretation. Working Paper 210. William E. Simon Graduate School of Business Administration, University of Rochester.
- Sargent, Thomas J. 1976. A classical macroeconomic model for the United States. *Journal of Political Economy* 84 (April): 207–37.
- . 1982. The ends of four big inflations. In *Inflation: Causes and effects*, ed. Robert E. Hall, pp. 41–97. Chicago: University of Chicago Press.
- Sargent, Thomas J., and Wallace, Neil. 1981. Some unpleasant monetarist arithmetic. *Federal Reserve Bank of Minneapolis Quarterly Review* 5 (Fall): 1–17.
- Taylor, John B. 1980. Aggregate dynamics and staggered contracts. *Journal of Political Economy* 88 (February): 1–23.
- . 1981. On the relation between the variability of inflation and the average inflation rate. In *The costs and consequences of inflation*, ed. Karl Brunner and Allan H. Meltzer. Carnegie-Rochester Conference Series on Public Policy 15 (Autumn): 57–85. Amsterdam: North-Holland.
- . 1983. Union wage settlements during a disinflation. *American Economic Review* 73 (December): 981–93.
- U.S. Congress. 1990. House. Committee on Banking, Finance and Urban Affairs. Subcommittee on Domestic Monetary Policy. Hearing on H.J. Res. 409: Zero Inflation. 101st Cong., 2nd sess., Part 2, February 6. Serial 101-71.
- Vining, Daniel R., Jr., and Elwertowski, Thomas C. 1976. The relationship between relative prices and the general price level. *American Economic Review* 66 (September): 699–708.
- Wallace, Neil. 1983. A legal restrictions theory of the demand for “money” and the role of monetary policy. *Federal Reserve Bank of Minneapolis Quarterly Review* 7 (Winter): 1–7.