

THE COSTS OF INFLATION AND DISINFLATION

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While most economists agree that inflation is “bad,” no consensus exists over how bad it is or what should be done about it. Some believe that inflation is a major, even catastrophic, evil, and argue that monetary policy (or monetary reform) should be geared toward its outright elimination (see, e.g., Gavin and Stockman 1988; Gavin 1990; Howitt 1990a; Selody 1990a, 1990b; and Hoskins 1990: 1992). Many others argue that eliminating inflation would reduce output and employment, and the cost of the lost output and employment would more than offset the gains from establishing price stability (see, e.g., Lucas 1989, 1990; Fortin 1990; Peters 1990; and Scarth 1990). Still others argue that the costs of inflation are small anyway, and could be dealt with by other means (e.g., indexing the fiscal system, as in Aiyagari 1991).

This paper tries to shed some light on these conflicting claims by assessing the available evidence on the costs of inflation and disinflation. My assessment strongly concludes that the costs of inflation are very large and that any costs of disinflation are small in comparison. Furthermore, since many of the costs of inflation identified in the literature cannot be quantified, there is a strong argument that the available evidence understates the “true” costs of inflation—probably by a large amount—so our estimated costs are biased considerably downwards. There is therefore a very strong presumption that the “true” costs of inflation must outweigh any costs of disinflation by an even greater margin than the quantitative estimates suggest. The evidence thus supports the position taken by the zero-inflation school despite fact that the quantitative jury, as it were, is rigged against it.

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The Costs of Inflation

Anticipated Inflation and the Demand for Real Balances

One widely examined cost of inflation is the welfare loss that results when anticipated inflation leads agents to reduce their real money balances. An optimizing agent will demand real balances until the marginal benefit they yield is just equal to their marginal cost. If real balances bear no interest, the opportunity cost of holding them is proportional to the nominal rate of interest. Higher inflation then leads to higher interest, and hence lower real balances, and this reduction in real balances involves a welfare loss because the social cost of producing real balances has remained substantially unaffected. If we think of the benefits that real balances provide as given by the area under the demand curve for them, the loss from inflation can (arguably) be represented by the reduction in that area resulting from an inflation-induced reduction in real balance holdings (see, e.g., Driffil et al. 1990: 1016). We can then derive an expression for the current-period loss L_0 of an increase in anticipated inflation by noting that this loss is equal to the inflation-induced fall in the area under the demand curve for real balances.¹ If inflation rises from π to $\Delta\pi$, and real balances fall as a result from m by an amount Δm , the current-period welfare loss is given by the area $A + B$ in the figure:

The current-period loss is therefore:

$$L_0 = \Delta m \Delta\pi/2 + \pi \Delta m \quad (1)$$

Rearranging, we get:

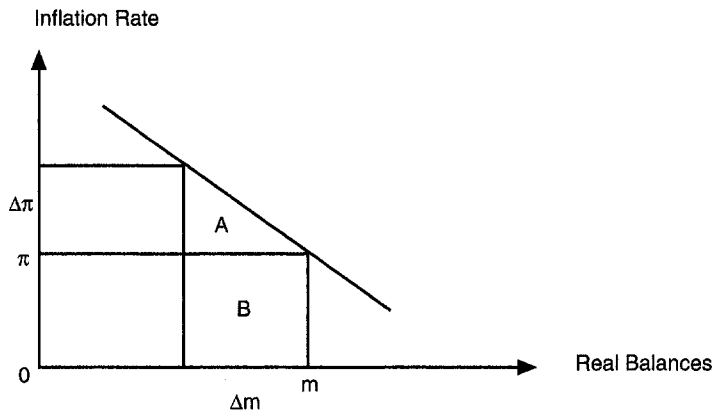
$$L_0 = -m \epsilon_{mi} [\Delta\pi/2 + \pi] \Delta i / i \quad (2)$$

where ϵ_{mi} is the interest elasticity of the demand for real balances and i is the nominal rate of interest. We can then estimate the welfare loss resulting from any given change in the inflation rate using a measure of the monetary aggregate (m), an estimate of the interest

¹Strictly speaking, the welfare loss is the area under the demand curve with the nominal interest rate on the vertical axis. With inflation on the vertical axis, the relevant area is the area under the demand curve plus a rectangle below it which is bounded below by a horizontal line emanating from the point on the vertical axis where the inflation rate equals the negative of the real rate of interest (see, e.g., Tower 1971: 852, and Tatom 1976). The true welfare loss is therefore greater than indicated in the text, and Gillman's (1990) estimates suggest that the difference is actually quite large—he puts it somewhere in the range of 38 to 51 percent of the amount indicated in the text, which in effect means that the expression in the text understates the true cost by a factor of half or close to half. The welfare cost estimates that directly follow are therefore subject to a very considerable downward bias.

FIGURE 1

INFLATION AND THE DEMAND FOR REAL BALANCES



elasticity of the demand for real balances (ϵ_{mi}), and assumptions about the relevant inflation and nominal interest rates.

There are a number of available estimates of this type of loss, and it is perhaps most convenient if we standardize our estimates by focusing on the cost of each percentage inflation point (i.e., we put $\Delta\pi = 1$ percent in (2)) for some given benchmark inflation rate. To give the reader some feel for the size of this cost, it also makes sense to express the cost as a percentage of national income, and I shall refer to the ratio of this cost to national income as the inflation cost ratio. To illustrate what the cost ratio might be, let us therefore take the benchmark inflation rate to be 5 percent², and assume for the sake of argument that the interest elasticity ϵ_{mi} is -0.2 and the nominal interest rate i is π plus 4 percent. Taking m as M1, and taking GDP as national income, both in the last quarter of 1993,³ (2) then gives us a current-period cost ratio of 0.021 percent, or \$1.37 billion.⁴

It is helpful if we compare this figure with those implied by studies published earlier. Most studies quote figures for the cost of all inflation

²The reader who prefers an alternative benchmark inflation rate can easily re-compute the losses for his preferred alternative rate. See also the rest of this paragraph and the next, and footnote 4.

³M1 in November 1993 was \$1,122.4 billion (*Money Stock Revisions*, 1994 [February]: Table 1). Annualized GNP in the last quarter of 1993 was \$6,510.8 billion (*International Financial Statistics*, 1994 [March]: 571). Both series are seasonally adjusted.

⁴For the sake of comparison, we get a cost ratio of 0.0043 percent of national income if we take a benchmark inflation rate of 0 percent, one of 0.026 percent if we take a benchmark inflation rate of 10 percent, and one of 0.029 percent if we assume a benchmark inflation rate of 20 percent. The cost ratio thus rises with the inflation rate.

above 0 percent, rather than a cost ratio for each percentage inflation point, but the different estimates can be made comparable by going back to (2) and reestimating the cost of some given inflation rate relative to zero inflation. Thus Edward Foster (1972) and Michelle Garfinkel (1989) provided estimates of the cost of a fully anticipated inflation rate of 4 percent, which Foster estimated to be less than one-twentieth of 1 percent of GNP, and Garfinkel estimated to be about 0.3 percent of national income. To estimate a comparable figure, one substitutes $\Delta\pi = 0.04$ and $\pi = 0$ for the previous assumptions of $\Delta\pi = 0.01$ and $\pi = 0.05$. Using (2) otherwise as before, one can then estimate the cost of a fully anticipated inflation rate as being about 0.034 percent. My estimate is thus similar to Foster's, but much lower than Garfinkel's. Similarly, Stanley Fischer (1986: 46), Bennett McCallum (1989: 127), and Robert Lucas (1981: 43–44) estimated the cost of a fully anticipated inflation rate of 10 percent, the first two putting it at 0.3 percent of national income, and Lucas putting it at 0.9 percent. If one substitutes $\Delta\pi = 0.1$ and $\pi = 0$, one then estimates the cost of a 10 percent inflation rate as 0.12 percent of national income. My estimate of the cost of a 10 percent inflation rate is thus considerably lower than any of those reported by Fischer, McCallum or Lucas. There is no way to tell which of these figures, if any, is the "right" one, so these comparisons are best interpreted as indicating the relative conservatism of different approaches. My approach and Foster's tend to give relatively low estimates, Garfinkel's, Fischer's, and McCallum's give middling ones, and Lucas' estimate is relatively high. My approach is therefore likely to be conservative and produce cost estimates that are biased downwards, and the reader who prefers to go with the higher estimates should make appropriate upward adjustments to the calculations that follow. If one went with the Fischer-McCallum estimate, for example, then losses would be about two and a half times those I estimated; if one went with the Lucas estimate, they would be about seven-and-a-half times my estimate; and so on.

But whichever estimate one takes, it still only refers to losses borne in the current period and ignores comparable losses in the future. An estimate of the "full cost" must take these future losses into account as well, so we need to estimate the present value of the current and discounted future losses. If we switch to continuous-time for convenience and let L_0 be the instantaneous welfare loss, the present value of the permanent loss from inflation is

$$L = \int_0^{\infty} e^{-rs} ds = L_0/r \quad (3)$$

for the discount rate r and an assumed infinite horizon. The present value loss is thus equal to the instantaneous loss L_0 —which we can

take as estimated by the procedures just discussed—multiplied by $1/r$. If we take r as 5 percent for the sake of illustration, my earlier illustrative current-period cost ratio for a 5 percent benchmark inflation rate would be 0.021 percent of GNP, which would translate into a present-value cost ratio of 0.42 percent of GNP (or \$27.3 billion), and so on.

However, all these estimates involve the “fundamental error” that they ignore the impact of the expected future growth in real balances, and allowing for such growth can drastically increase our estimates of the losses involved (Feldstein 1979: 754; Tatom 1976: 16–17). If future real balances grow at a rate g , it is easy to show that the discount rate in the exercise above needs to be replaced with the “net” discount ($g-r$). The present value of our instantaneous loss then becomes $L_0/(g-r)$ and the resulting estimates can be very much higher. If we take g as 2.5 percent, for example, the net discount rate becomes 5 percent minus 2.5 percent, or 2.5 percent, and the earlier present-value cost ratios would be doubled. The earlier estimate of L_0 as equal to about 0.021 percent of GNP for each percentage inflation point now translates into a present-value cost ratio of 0.84 percent of GNP (or \$54.7 billion) instead of the 0.42 percent it was before. Indeed, as g approaches r , which is far from inconceivable, the numerator term ($g-r$) approaches zero and the (present-value) cost ratio approaches infinity. Ignoring future growth in real balances can thus lead, to put it mildly, to a drastic understatement of the “true” costs of inflation.

There are also other reasons to believe that loss estimates like these are understatements. Traditional approaches were usually based on a transactions theory of the demand for real balances, but the recently developed consumption-smoothing approach of Ayşe İmrohoroğlu (1992) suggests that this approach ignores certain important welfare losses. In her model, individual agents cannot always find work, and they cannot insure themselves completely against the loss of income since work opportunities are idiosyncratic. They therefore carry real balances to allow them to consume when they cannot work. Inflation forces agents to economize on real balances and therefore undermines their ability to smooth consumption over time—an effect on welfare not picked up by the earlier approaches. İmrohoroğlu found that inflation rates of 5 percent and 10 percent produced steady-state welfare losses equal to 0.57 percent, and 1.07 percent of national income respectively. This figure is well above the figures one typically gets in traditional exercises that ignore consumption smoothing. (Recall for example the earlier estimates by Fischer and McCallum.) The difference between the traditional and consumption-smoothing loss estimates arises because the earlier estimates presuppose that

marginal rates of substitution are the same across agents—and therefore that the only loss from inflation is that given by the reduction in the area under the demand curve for real balances. However, under consumption-smoothing, inflation also distorts these marginal rates of substitution across agents—agents face “liquidity” constraints whose shadow values will vary from one agent to another, depending on whether they have work or not—and this distortion creates further losses that must be added to the standard “triangle” losses on which the traditional approach focused. The traditional approach can thus seriously understate the “true” losses in circumstances where consumption-smoothing is an important motive for holding real balances.

Another source of downward bias arises from assumptions about the alternative to holding cash. Many treatments assume that agents have either a costless alternative to holding cash or no alternative at all. However, if agents face a costly alternative, Max Gillman (1992) shows that inflation will also involve costs arising from the greater use of this costly alternative. Taking account of this additional cost, he estimates losses that are nearly four times greater than the losses that arise from traditional approaches that do not allow for costly credit.

Three other studies offer additional reasons to believe that traditional approaches understate “true” losses. John Leach (1983) makes the point that if inflation is a tax on real balances, then it functions in some ways like a general commodity tax which has the effect of reducing the supply of labor and, hence, total output. The costs of this distortion to the labor market must then be added to the earlier real balance “triangle” loss.

Zui Eckstein and Leonardo Leiderman (1992) show that many earlier estimates of the welfare loss depend in an important way on the maintained assumption of a Cagan-style semi-log specification of the demand for real balances. They develop an alternative approach based on a Sidrauski monetary model and provide simulations of the (steady-state) welfare loss by estimating the model on Israeli data. Their results suggest that an inflation rate of 10 percent produces a current-period welfare loss of about 1 percent of national income. These figures are considerably bigger than traditional estimates, and one’s confidence in them is reinforced by the fact that the Eckstein-Leiderman specification produces seigniorage and national income ratios much closer to observed experience than the traditional Cagan specification does.

Finally, Wouter Den Haan (1990), also using a Sidrauski model, estimates that the current-period welfare loss of a 5 percent inflation relative to zero inflation was about 3.12 percent of output, a figure that is also much bigger than figures from traditional exercises. Sidrauski

models thus generate considerably bigger losses than traditional models based on the Cagan specification of the demand for real balances.

Anticipated Inflation, Investment, and the Capital Stock

Another problem with traditional treatments of the welfare cost of inflation is that they ignore the impact of inflation on the capital stock, and there is evidence that these effects are not only quantitatively important, but perhaps much more important than the losses just examined. The theory is set out by Thomas Cooley and Gary Hansen (1989, 1991), and Ronald Benabou (1991). In the basic model agents decide how much to work, consume, and invest, and the real balances to hold, in a cash-in-advance framework that requires them to pay for their purchases of consumption goods each period with prior holdings of currency. Inflation functions as a tax on real balances, and agents respond to this tax by reducing the activities that expose them to it. The higher the steady-state inflation rate, the lower agents' real balances, and, given the cash-in-advance constraint, the lower their consumption. Since inflation indirectly taxes the return on investment, higher inflation leads agents to reduce their investment as well, and the capital stock falls. The falls in consumption and investment imply that agents work less, and the combination of a lower supply of labor and a lower capital stock means that output is lower as well. Cooley and Hansen (1991) and Benabou (1991) proceeded to modify the earlier Cooley and Hansen model by allowing for agents using credit goods along Lucas-Stokey (1983) lines, and the key result that then emerges is that the "true" welfare losses from inflation dwarf traditional estimates, the former being a first-order function of the inflation rate, and the latter being a second-order one (Benabou 1991: 509–10). Benabou's simulations suggest that the traditional estimates are less than a tenth of the "true" welfare loss for a steady-state inflation rate of 10 percent. The traditional estimates improve as inflation rises, but even with an inflation rate of 100 percent they are still well under half the "true" cost (Benabou, 1991: 509). The difference between the two arises primarily because the traditional estimate ignores the consequences of the decline in the capital stock,⁵ and Benabou's

⁵There is thus an "anti-Tobin effect," and *not* a "Tobin effect" as predicted by Tobin (1965). In Tobin's model, inflation leads to a rise in the capital stock because it encourages people to economize on real balances (which serve no useful purpose anyway) and hold capital instead. According to this model, the optimal policy is then to engineer a hyperinflation to reduce real balances to the lowest possible level and thereby maximize the capital stock. A model that can make such a prediction is clearly missing something. In any case, there is as far as I know no empirical evidence to support the prediction that higher inflation leads to a higher capital stock, and (as discussed below) there is considerable evidence to refute it. In my opinion, the emphasis in the theoretical literature on Tobin effects is very misplaced.

results clearly indicate that the capital stock effect on welfare is much more important than the money-holding losses emphasized by traditional studies. If we accept Benabou's results, the traditional estimates of the welfare loss from moderate inflations need to be adjusted upwards by a factor of 10 or more for "moderate" inflations, and our earlier illustrative present-value cost ratio of 0.84 percent becomes something upwards of 8.4 percent.

Inflation can also have additional deleterious effects on investment and the capital stock through its various interactions with the tax system. Following Peter Howitt (1990a: 86), the real after-tax return r on an investment is

$$r = R(1-t) - \pi \quad (4)$$

where R is the pre-tax nominal return, t is the marginal income tax rate, and π as before is the inflation rate. If we take t as 0.3, and assume that R rises *pari passu* with π , then a rise in inflation of one percentage point reduces the real after-tax return r by 0.3 percent. Even relatively "moderate" anticipated inflation can then have dramatic effects. If inflation was zero and the nominal return R was 5 percent, the real after-tax return would be 3.5 percent. If inflation was 5 percent and the nominal return R was 10 percent, r would fall to 2 percent; and if inflation was 10 percent and R was 15 percent, r would fall even further to only 0.5 percent. Elementary simulations thus suggest that even single-digit inflation can wipe out much of the greater part of the real after-tax return. Double-digit inflation would have an even greater impact, and one must also bear in mind that these figures are based on the unrealistic assumption that the nominal return R keeps pace with expected inflation. Since the evidence suggests that R does not in fact keep up with inflation (see, e.g., Pearce 1979 or Summers 1983), the "true" effect on after-tax rates of return is even greater than these illustrative figures suggest.

Writers such as Gary Praetzel (1981: 7) and Martin Feldstein (1982: 827) have presented evidence to suggest that declining real after-tax returns to investment played a major role in the substantial decline in investment since the 1960s. The quantitative significance of the losses involved is hard to assess precisely, but Fischer (1981: 49–50) estimated that the current-period welfare loss of a 10 percent inflation rate was perhaps 0.7 percent of GNP, though he also suggested it could easily be much higher (e.g., 2–3 percent of GNP). Fischer's estimate of 0.7 percent of GNP suggests an average cost ratio—one averaged across inflation rates varying from 0 to 10 percent—of around 0.07 percent of GNP, and crude present-value on the assumptions of a 5 percent discount rate and an infinite horizon suggest a present-

value cost ratio of 20 times 0.07 or 1.4 percent. If the current-period losses were as large as Fischer suggested they might be (i.e., 2–3 percent of GNP), the corresponding average present-value cost ratios would be about 4–6 percent of GNP. These present-value figures make no allowance for growth, however, and making such allowance at the earlier growth rate of 2.5 percent then doubles the present-value cost ratios to 8–12 percent. And if these figures seem high, Howitt (1990b: 108) estimates losses that are much higher still. He suggests a current-period cost ratio of almost 2 percent of GNP. This figure produces a present-value cost ratio of 40 percent if we ignore future investment growth and a cost ratio of 80 percent if we allow for growth at an annual rate of 2.5 percent, as we earlier assumed with real balances. The welfare cost of the reduction in investment induced by inflation appears to be extremely high.⁶

Preliminary Conclusions

It might be helpful to summarize the position at this point. The literature examined so far emphasizes two particular welfare costs of inflation: the costs of reduced holdings of real balances, and the cost of inflation-induced reductions in investment. Using the traditional Bailey approach, I derived an illustrative estimate of the former as a cost ratio of about 0.84 percent of GNP. However, there are a number of reasons to believe that this estimate is very much biased downwards. For a variety of reasons—the fact that my estimates are low relative to others in the literature, the presence of costly credit and liquidity constraints, the possibility of alternative specifications of the demand for real balances, and so forth—this figure is almost certainly a gross underestimate. The second cost, the cost of inflation-induced reductions in investment, is apparently considerably greater. The most conservative estimates were those provided by Fischer, and they suggested cost ratios ranging from 1.4 percent at the lower end, to a range of 8–12 percent at the upper end. Benabou's work indicates that these losses are roughly an order of magnitude greater than the money-holding losses, suggesting perhaps a cost ratio of 8 percent or more, while Howitt's work suggests a loss ratio that was much higher

⁶The existence of an imperfectly indexed fiscal system has thus meant that "monetary policy is far from neutral with respect to economic activity, even in the long run when the induced change is fully anticipated" (Feldstein 1982: 860). Inflation "causes a misallocation of resources in general and a distortion of resources away from plant and equipment in particular," Feldstein continues, and "The traditional idea of 'easy money to encourage investment' that has guided U.S. policy for the past twenty years has backfired and, by raising the rate of inflation, has actually caused a reduction in investment." It is about time economists woke up to these effects and drew the appropriate conclusions from them.

still—in the region of perhaps 40 to 80 percent of GNP. The cost of inflation is consequently extremely high.

It is important to stress that these estimates refer only to two specific types of cost imposed by fully anticipated inflation, and they should not be regarded as reflecting the full cost of inflation, or even the full cost of anticipated inflation. Even if inflation is fully anticipated, prices need to be changed more often, and price-changing is usually costly (see, e.g., Mussa 1977). Anticipated inflation thus involves “menu costs” that also need to be accounted for, but which are not included in either of the two costs quantified earlier. Anticipated inflation also affects relative prices in various ways—it changes relative prices between goods, since price changes tend to be staggered; it increases the intertemporal variability of the relative price of a given good (see, e.g., Danziger 1987); and, by eroding the value of real balances, it increases the effective costs of search and thereby increases the resulting equilibrium dispersion of the price of a given good across different markets—and each of these effects has its costs. Anticipated inflation also causes problems by its interaction with the tax system. It distorts the cost of funds, and thereby distorts relative prices and the allocation of investment,⁷ it distorts reported profits,⁸ it produces artificial capital

⁷If nominal interest rates rise with inflation, and interest payments are tax deductible, a rise in inflation leads to an increase in a borrower's deductible expenses and he pays less tax. The effects can then be very dramatic. To give an example from Feldstein (1983: 10), an American couple with a taxable income of \$30,000 in 1979 faced a marginal federal income tax rate of 37 percent. With an 11.4 percent mortgage rate in the last quarter of 1979, their after-tax cost of funds was 7.2 percent in nominal terms, and given that inflation was 7.8 percent, their real after-tax cost of funds was -0.6 percent. The same calculations for 1964 gave a real after-tax cost of funds of 1.4 percent. Thus, though nominal interest had more than doubled, and the real interest rate had also risen substantially, the real after-tax cost of funds had fallen sharply and become negative. Feldstein suggested that this reduction in the cost of funds had fed into a sharp increase in the demand for residential housing in the United States and led to a significant increase in the relative price of housing. He also argued that it promoted a boom in the demands for consumer credit and consumer durables, as well as substantial declines in saving and the demand for corporate investments.

⁸Feldstein (1983: 3) was of the opinion that the extra tax paid because of the overstatement of profits in the corporate sector was “by far the most substantial effect of inflation on tax burdens.” Inflation leads to an overstatement of reported profits in at least two different ways. First, it leads to an understatement of the cost of maintaining inventories, since inventories have traditionally been valued at historic cost, but it is their replacement cost that is usually relevant to their ‘true’ profit. Second, inflation can overstate firms’ profits by eroding their depreciation allowances because nominal depreciation allowances typically fail to keep pace with inflation. Feldstein and Summers (1979) found that inflation in 1977 had led to an increase of 50 percent in the tax burden paid by nonfinancial corporations. These overstatements of profit were also a major factor behind the finding of Feldstein, Poterba, and Dicks-Mireaux (1981) that the effective tax rate on corporate income in 1979 was 69 percent, a rate that reduced the pre-tax return of 9.0 percent to a post-tax one of just 2.7 percent.

gains,⁹ and it has various other effects, such as distorting firms' capital structure.¹⁰ Since all these effects presumably involve non-negligible welfare costs, our earlier cost ratios must be considered as understatements, perhaps very substantial ones, of the full cost of anticipated inflation.

Then there are of course the effects of inflation being imperfectly predictable. Inflation in practice is always imperfectly predictable, and imperfectly predictable inflation gives rise to many new costs. Agents will generally get their inflation forecasts wrong, and these "mistakes" will generate further costs beyond those we have already discussed. In a world where agents lack perfect information about relative prices, inflation will lead agents to confuse price signals and make production "mistakes" they would otherwise have avoided (see, e.g., Lucas 1972). Inflation will also lead them to confuse temporary and permanent price changes, and thereby distort their decisionmaking over a possibly prolonged period of time (see, e.g., Cukierman 1984). Much deeper, however, are the effects of inflation on social institutions more generally:

Prolonged and intense inflation upsets many habits of economic life, confronting consumers with price increases and price dispersions that send them shopping; making them doubt their ability to maintain their living standards, and downgrade the value of their career jobs and long-term savings; and forcing them to compile more information and to try to predict the future—costly and risky activities that they are poorly qualified to execute and bound to view with anxiety [Okun 1975: 383].¹¹

⁹If nominal values are rising, an agent will make paper capital gains when he sells assets for higher prices than he paid for them, even if the real prices of those assets have remained the same or fallen, and these fictitious gains will expose him to a liability to capital gains tax. Feldstein and Slemrod (1978) estimated that a "permanent inflation rate of 6 percent would effectively quadruple the effective rate of tax on gains compared to the effective tax rate prevailing with zero inflation" (1978: 107, 116–17). Since capital gains are usually taxed only after they have been realized by sale, this exposure to capital gains tax will discourage the sale of assets and produce an inefficient 'lock-in' effect that encourages agents to hold on to assets that would have been better used elsewhere.

¹⁰For example, if interest payments are tax deductible, but capital gains and dividends are not, inflation makes debt a relatively more attractive source of funds, and firms will increase their debt-equity ratios (see, e.g., Tatom and Turley 1978: 7). Many writers have noted how inflation appears to have led to increased debt-equity ratios among U.S. firms (see, e.g., Fischer 1982: 174–76). An inflation-induced increase in the corporate sector's reliance on debt over equity then has all sorts of further repercussions. Individual firms have weaker capital positions, and less liquidity. They become more vulnerable—both financially, and to hostile takeovers—and are more likely to fail. They are more likely to respond to financial distress by shedding labor and closing plants, and so on.

¹¹Okun was (rightly) highly critical of the view espoused by some economists that the public dislike of inflation was merely a product of their irrational "money illusion." As he continues, "The recognition by the consumer that economic institutions are gravely disturbed by

Furthermore, since

Customer markets depend heavily on—and in turn enhance—the usefulness of money as a yardstick and as a store of value; that usefulness is impaired in a world of inflation, as are many aspects of buyer-seller relationships that are “efficient” in a complex world. Thus, the welfare costs usually attributed to inflation . . . should be viewed in a broader context as disturbances to a set of institutions that economize on information, prediction, and transactions costs through continuing buyer-seller relationships. Inflation does fool people But it does so . . . by depriving them of a way of economic life in which they need not depend heavily on the formulation of costly and uncertain point-estimate expectations [Okun 1975: 359].

Unanticipated inflation also produced arbitrary wealth redistributions from some individuals to others. Since the amounts involved can be very large, even for relatively moderate inflation rates,¹² and most people desire security, they naturally regard the possibility of such redistributions as a serious threat to their livelihood. Each of these factors—confusion over price signals, the undermining of social institutions, and the threat of inflationary redistributions of income and wealth—generates its own distinctive welfare losses. If they were estimable, these losses ought to be included in any sensible estimate of the ‘true’ welfare cost of real-world inflation, as opposed to the hypothetical welfare costs that arise in models that assume there is no inflation uncertainty to worry about. But they should not be ignored simply because we do not know how to estimate them, and they are almost certainly much more important than the more estimable costs of anticipated inflation.

Effects of the Inflation Rate on Economic Growth and Output

There is also considerable evidence that inflation has an identifiable negative effect on economic activity. Much of this evidence relates to the effect of the inflation rate on economic or productivity growth. Thus Roger Kormendi and Phillip Meguire’s study of 47 different

inflation is an appreciation of reality—not money illusion. The illusion . . . lies in the models of an economy in which inflation does not matter, offering automatic protection to savers through the interest premium on nominal assets and leaving intact the relative prices of cotton and dacron and the relative wages of janitors and professors” (1975: 383).

¹²To give an illustration, Fischer and Modigliani (1977: 825) pointed out that the total value of nominally-denominated assets in the United States at the end of December 1977 was about \$4.7 trillion, in 1975 dollars. An unanticipated rise of 1 percent in the price level would therefore have reduced the real value of these assets by about \$47 billion—almost 3 percent of GNP—and produced an unanticipated transfer of the same amount to those who had issued the assets. The amounts involved in inflationary redistributions can thus be very large indeed.

countries concluded that the change in the inflation rate had a significantly negative effect on output growth (1985: 147), and José De Gregorio (1992a,b) found that inflation had a significant negative effect on output growth in a sample of 12 Latin American countries. The claim that inflation has a significant negative effect on growth is supported by other studies of Latin America such as those by Nouriel Roubini and Xavier Sala-i-Martin (1991), and by Arthur Grimes (1991) for the industrialized countries.¹³ The effect of inflation on productivity growth was studied by Peter Clark (1982), Peter Jarrett and Jack Selody (1982), Selody (1990b) and Farid Novin (1991), and they all concluded that inflation had a significantly negative effect on productivity growth.

The quantitative implications of these negative effects of inflation on economic or productivity growth are very considerable. Grimes (1991: 641) reported that the coefficient of inflation in his growth equation had a fairly precisely defined value of -0.11 , and a crude present value formula with a discount rate r implies that the present value of the output loss from a 1 percent rise in inflation is $0.11(1+r)^2/r^2$ of current income.¹⁴ Taking r as 5 percent, the cost ratio is therefore $0.11(1.05)^2/0.05^2 = 48.5$ percent. The results of Jarrett and Selody (1982: 363) imply that a permanent 1 percent decrease in inflation would raise productivity growth by 0.23 a year (see also Novin 1991: 1). If we assume that the rise in productivity growth produces the same increase in output growth, this result suggests that the output cost ratio—the present value loss from a permanent 1 percentage point increase in inflation—is just over 101 percent of current national output for a 5 percent discount rate. Jarrett and Selody (1982) went on to extend their bivariate analysis of the inflation-productivity nexus to include hours worked, and this extension produced an estimated 0.32 increase in productivity growth for each 1 percent fall in inflation, a figure that implies a cost ratio of 141 percent at the usual discount rate; and Novin (1991) obtained almost the same estimate in his

¹³These results need to be interpreted cautiously in view of Levine-Renelt (1992), who suggested that cross-country results pertaining to the effects of inflationary factors on growth are generally fragile to relatively minor specification changes. Nonetheless, the fact that most studies reported that inflation has a negative effect on growth and none reported a positive effect, suggests to me that the results reported in this literature might be more robust than Levine and Renelt suggest. Note, too, that the Levine-Renelt critique does not in any case apply to the inflation-productivity literature.

¹⁴Let l_i be the present value output loss from the decrease in growth in the i th period, where $i = 1, 2, 3, \dots$. Then $l_1 = 0.11[1/(1+r) + 1/(1+r)^2 + \dots] = 0.11(1+r)/r$, $l_2 = l_1/(1+r)$, $l_3 = l_2/(1+r)$, etc. The present value loss from a rise in inflation that decreases output growth by 0.11 in all periods is therefore approximately $l_1 + l_2 + l_3 + \dots = 0.11(1+r)^2/r^2$.

extension of the Jarrett-Selody study to cover the 1980s. Selody's (1990b: 11) four variable analysis of the relationship between inflation, productivity growth, hours worked, and labor hoarding suggested that a permanent 1 percent fall in inflation raises productivity growth by 0.23 percent for Canada and 0.11 percent for the United States, figures which (on the continuing assumption that $r = 5$ percent) imply cost ratios of just over 101 percent and 48.5 percent respectively. Even if the higher estimates are dismissed as implausibly high—though on what grounds, one wonders?²—it is striking how the double discounting of lost output growth translates into very large output losses even for low estimates of the effect of inflation on productivity growth. Even if we accept the lowest figure among those reported above—Selody's estimate that inflation reduces U.S. productivity growth by 0.11 percentage points—a rise in inflation of 1 percent would still have an effect on productivity growth equivalent in value to a fall in current output of nearly 50 percent. If we accept one of the larger estimates, the costs of inflation would of course be that much larger still.

There is also evidence that inflation can influence the level of output. Using data for 62 countries over the period 1960–1985, Cozier and Selody (1991) presented evidence from estimates of a neoclassical growth model that imply that inflation has a significantly negative impact on per capita income and productivity. They concluded that a 1 percent reduction in the inflation rate from their sample average of 9 percent would raise income by 6.5 percent in the long run (1991: 24). Cozier and Selody's results suggest however that it would take a very long time for output to adjust—the output adjustment would have a half life of 34 years—and the benefits would come about in the form of an increase in the growth rate of about 0.1 percent in the transition period. As noted already, a figure of 0.1 percent induced growth carried on forever implies a present value output gain (at the usual 5 percent discount rate) of just over 44 percent of current output. This 44 percent figure overstates the gain in the Cozier-Selody model because output growth would eventually taper off, but their half life of 34 years implies that that tapering off would occur so far off in the future that the overstatement from ignoring it would be small anyway. The present value of the output gained by reducing inflation by 1 percent would therefore be of the order of 40 percent of current output.

Effects of Inflation Variability and Uncertainty on Output and Economic Growth

There is also evidence that output and employment can be reduced by inflation variability or inflation uncertainty. In his Nobel lecture,

Friedman (1977) implied that inflation variability has a detrimental effect on economic activity by making agents less willing to enter into long-term relationships and by reducing the effectiveness of market price signals as indicators of relative scarcity. To the extent that agents have not adjusted to it, higher inflation variability should therefore lead to a temporary though perhaps long-lasting reduction of output and employment. However, the Friedman logic applies more naturally to inflation uncertainty than it does to inflation variability,¹⁵ and modified in this way, it suggests that greater inflation uncertainty should lead to lower output and employment and higher unemployment. Extending the Friedman story further, we might also expect inflation variability or uncertainty to reduce the rate of growth of output as well.

There have been a number of attempts to examine these effects empirically. Maurice Levi and John Makin (1980) postulated that inflation uncertainty should be entered as an additional variable in an expectations-augmented Phillips curve. Using the standard deviation of the cross-section dispersion of Livingston inflation expectations as their proxy for inflation uncertainty, they found that inflation uncertainty had a positive and significant effect on U.S. unemployment (1980: 1024). Donald Mullineaux (1980) also used a Phillips-curve approach and a similar measure of inflation uncertainty, and he obtained robust results that suggest that inflation uncertainty has a positive and very significant and long-lasting effect on unemployment (1980: 166–67). Comparable estimates suggest that inflation uncertainty also has a significantly negative impact on industrial production as well (1980: 167). Mullineaux also allowed inflation uncertainty to respond to policy, and his results led him to conclude that “even if . . . it were possible to generate a sustained unanticipated increase in the rate of inflation, within a fairly short period the effect of added uncertainty would more than offset the employment gains from unanticipated inflation” (1980: 166–67). Using postwar U.S. data and a Livingston-type index of inflation uncertainty, Steven Holland (1986: 242) and Lawrence Kantor (1986: 407) found that increased inflation uncertainty raised unemployment, Yakov Ahimud (1981: 785–786) found that it had a significantly negative effect on output and a significantly positive one on unemployment, and Rick Hafer (1986: 367–368) got much the same results as Ahimud using the American Statistical Association–National Bureau of Economic Research measure of the dispersion of one-period ahead inflation forecasts instead of the Living-

¹⁵Inflation variability and inflation uncertainty are not the same, though they are often discussed together. An inflation rate may vary in a fully anticipated, and therefore completely certain way, but uncertainty arises only when the inflation rate is not fully predictable.

ston measure. Richard Froyen and Roger Waud (1987) found that inflation uncertainty (as measured by the variance of one-period-ahead forecasts of the price level) had a negative effect on output for their sample of the UK, U.S., Canada, and West Germany, and Cozier and Selody (1991) found some evidence that output was negatively affected by inflation variability even when allowance was made for the inflation rate itself.

Lastly, Paul Evans (1983: 181–182) presented results suggesting that the short-term variability of the price level did not have much impact on output, but that long-term price variability had a significant negative effect. Evans also presented estimates of the output gains that the United States would have enjoyed had U.S. inflation been eliminated in the last quarter of 1980. His estimates depend on how long it would have taken private-sector expectations to adjust to the change, and the benefits would have been greater the more rapidly these expectations adjusted (which in turn would have depended on the credibility of the policy change). With a 5 percent discount rate, his figures indicate that the present value of the output gains from eliminating inflation would have been equal to 29.4 percent of national output had the private sector taken two years to adjust to the change, and 23.8 percent of national output had they taken five years to adjust (Evans 1983: Table 1). Taking inflation to be 10 percent in late 1980, these figures suggest approximate present-value cost ratios (arising from the effect of price-level instability on output) equal to 2.94 and 2.38 percent of national income. The Friedman story applied to unemployment or output thus receives a considerable amount of empirical support, and Evans' simulations suggest that the costs from ongoing inflation could be quite substantial.¹⁶

¹⁶There is also much evidence that inflation variability or uncertainty has other real effects. There is considerable evidence that inflationary factors have played a large part in reducing the maturity structure of corporate debt. Klein (1975b: 478) noted how "One hundred year railroad bonds were . . . issued around the turn of the century, while it is now quite uncommon to find a maturity of a new corporate issue that is greater than 30 years." The decline in maturity structure is well attested (see also, e.g., Klein 1975a: 146–47 or Fischer 1982: 177), and Klein's empirical work (1975b: 478) relates it to the increased ratio of long-term to short-term price-level variability (which he interpreted as unpredictability). The empirical work of Bordo (1980) suggests that inflation also affects contract length, and Klein (1975b: 479) found that inflation had led to the increased use of escalator clauses in labor contracts in the United States. Similarly, Howitt (1986: 184) documents how the maturity structures of corporate debt and household mortgages in Canada had declined over the previous two decades, effects which he also ascribed to increased price-level uncertainty. These changes appear to have had major real consequences. Inflation has made long-term investment increasingly difficult, and to the extent that households look to investments as inflation hedges, it has also diverted investment into other areas like real estate, works of art, and so on, and thus contributed to speculative booms and busts in those areas. But the overall effect of inflation seems to have been a major deterioration in

A number of others have also found that inflation variability or uncertainty has negative effects on output growth. Kevin Grier and Gordon Tullock's (1989) 113-country study found evidence that the variance of inflation had a significant negative effect on output growth not only in their pooled 24 sample of OECD countries, but also on the pooled sample of their 89 remaining countries (1989: 4, Tables 1 and 2). Similar results have also been found by a variety of time-series studies using postwar U.S. data. Makin (1982) obtained this result using the Livingston measure of inflation forecast dispersion, Kantor (1986: 498–499) obtained it using both the Livingston measure and an alternative measure of inflation uncertainty derived from portfolio theory, Holland (1988) obtained it using both Livingston and University of Michigan dispersion measures, and Viktor Zarnowitz and Louis Lambros (1987: 619) obtained it using a variety of survey-based dispersion measures.¹⁷ There is thus considerable evidence in favor of the Friedman story as it also applies to economic growth as well as the level of output.

The Costs of Reducing Inflation

The Output and Employment Costs of Reducing Inflation

Having discussed some of the costs of inflation, we now consider the possible costs of reducing inflation where inflation has already become entrenched. Perhaps the most commonly cited argument against reducing inflation is the cost of the lost output or employment associated with doing so. If expectations or price or output decisions have some element of stickiness, reducing inflation could lead to lower output and employment as indicated by Phillips-curve analysis. If the disinflation persists, macroeconomic theory suggests that the economy should eventually adjust to the new monetary policy and output and employment should recover. According to the natural rate hypothesis of Friedman (1968) and Phelps (1967), the output and employment

liquidity. By 1983, the Canadian corporate sector was characterized by historically high debt-service ratios, debt-equity ratios, and dependency upon short-term finance. The liquidity problems faced by home-owners and small business firms were a major source of political unrest in Canada *While not all of these liquidity problems can be attributed to inflation, there is little doubt that it was the most important contributing factor* (Howitt 1986: 188; emphasis added).

¹⁷Jansen (1989) however could not find any such effect. He examined whether inflation uncertainty had any impact on output growth by means of a bivariate ARCH model estimated for U.S. data from 1958: 1 to 1988: 2. He found that inflation uncertainty (as proxied by the conditional variance of inflation) had no significant impact on output growth, but he was doubtful about the power of his test because he suspected the variance had been too stable over his sample period.

losses should be entirely transitory, and output and employment would tend to be restored to their former natural levels. We would then be comparing the permanent benefits of lower inflation against the temporary losses resulting from the disinflation needed to achieve it. According to the more recent hysteresis argument (see, e.g., Blanchard and Summers 1986), however, the natural levels of employment and output themselves depend on the past history of those variables. As unemployment rises, workers lose their skills through lack of use, for example, and the natural rate of unemployment itself rises. Unemployment eventually returns to its natural rate, but the natural rate has increased in the meantime. In addition to the temporary losses from output and employment being below their natural levels, there would now also be permanent losses from the shifts in the natural levels themselves.

A recent illustration by William Scarth (1990: 91) suggested that if the sacrifice ratio—the proportion of a year's output that must be foregone to reduce inflation permanently by 1 percent—was, say, 5 percent in the absence of hysteresis, then it would become 8.3 percent in the presence of it. The presence of significant hysteresis effects can therefore add considerably to the estimated sacrifice ratio and hence the estimated cost of disinflation. Pierre Fortin (1990: 141–46) went much further. He argued that the Canadian economy exhibited a very high degree of hysteresis, and on the basis of this claim he proposed a Canadian sacrifice ratio of 313 percent of GDP. However, most other studies argued that there is much less hysteresis than Fortin suggested, and consequently estimated far smaller sacrifice ratios. Fortin's claims were based on the experience of Canada in the 1980s, but his assessment is questionable even for that economy during that period. While he saw the failure of unemployment to fall further after the recession of the early 1980s as evidence of hysteresis, Rose (1988) argued that much of the Canadian unemployment history of the period can be explained by the combination of increasingly generous Unemployment Insurance, regional problems, and female labor force participation behavior. Fortin's claims for 'full' hysteresis have also been challenged by the evidence from other studies. The work of McCallum (1988), Coe (1989), Burns (1990) and Cozier and Wilkinson (1991) suggest that hysteresis, if it exists at all, is relatively weak, and McCallum (1988) for the United States, Gordon (1989) and Dowd and Mizen (1994) get similar results for other countries. The hysteresis story is so far unverified, and the output costs of disinflation are presumably much lower than hysteresis-based estimates would suggest.

Other studies also report much lower estimates of sacrifice ratios. Howitt (1990a: 105) estimated a sacrifice ratio of 4.7 on the basis of Canadian experience in the recession of the early 80s. Cozier and Wilkinson (1991: 13) suggested that Howitt's estimate of the sacrifice ratio was as high as it was only because he failed to control for other relevant variables, and they came up with a considerably lower sacrifice ratio of around 2 percent. Also for Canada, Selody (1990b: 18) obtained an estimate of 2.3, Ford and Rose (1989) an estimate of 2.6 percent, and McCallum (1989) reported an employment sacrifice ratio—the proportion of present employment foregone to obtain a permanent 1 percent reduction in inflation—of 2.1 percent. For the United States, Robert Gordon (1990) and Selody (1990b: 18) estimated output sacrifice ratios of 2.3 percent and 5.1 percent respectively, and McCallum (1988) and Brian Motley (1990) reported employment sacrifice ratios of 2.1 and 2.3 percent.

Fortin's estimated sacrifice ratio can thus be dismissed as a fairly wild outlier, and most studies report sacrifice ratios in the region of 2–4 percent.

Inflation as a Tax?

A second argument against reducing inflation is that the monetary authorities may want to retain the use of monetary policy as a form of taxation. The basic argument was set out explicitly by Phelps (1973) and goes as follows: If the government had access to theoretically ideal lump-sum taxes that could raise the revenues it desired without any efficiency losses, then efficiency considerations dictate that the government should rely only on such taxes. In the real world lump-sum taxes do not exist, so the government needs to rely on taxes that distort economic activity to finance its expenditures. Income taxes distort labor supply decisions, taxes on rates of return distort investment decisions, and so on. If the government has to rely on such taxes, then it ought to do so by minimizing the inefficiencies they create, and it does so when it follows the so-called Ramsey rule and ensures that the marginal efficiency losses from each form of taxation are equal. The creation of inflation can be regarded as a tax because it enables the monetary authority to involuntarily appropriate real resources from the private sector. Given that other taxes also involve welfare losses, the Ramsey rule implies that the monetary authorities should make some use of the inflation tax as well, and so the "optimal" inflation rate in such a world would almost certainly be positive.

There are a number of serious problems with this argument. Even if we accept the basic logic, there is considerable evidence that the efficiency losses from inflation are so high that they render inflation

an inefficient form of taxation even in a world where other taxes are also costly to raise. To give an illustration of the costs involved, Jack Tatom (1976: 19) estimated that the average collection cost of the (relatively small) revenue from a 5 percent inflation rate in 1975 would have been between 80 percent and 120 percent of the amount collected. The average collection costs of the income tax, by contrast, were about 3 percent of the amount collected. These figures admittedly refer to the average costs of collection, and what are relevant here are the marginal costs, but the available marginal cost evidence also suggests that inflation is far less efficient than other forms of taxation. Thus Tatom (1976: 20) estimated that the marginal cost per dollar of the inflation tax was 44 percent of the revenue collected. This estimate was sensitive to the maintained assumption that the interest elasticity of the demand for money was -0.15 , and some might regard this elasticity figure as too close to zero, but if we make the demand for money more elastic and change the elasticity to -0.25 , the marginal collection cost then rises even further to almost 84 percent (Garfinkel 1989: 10, n. 28). We might therefore infer that the marginal collection cost is upwards of 44 percent of the revenues obtained, and quite possibly double that figure.

By contrast, the marginal collection costs of other taxes are much lower. Edgar Browning (1987: 16) for example estimated that the welfare cost of labor taxes varied from 7.5 percent to 28.5 percent of the revenues raised, and even the highest figure in his range is still appreciably higher than the lowest figure in our range for the marginal collection costs of the inflation tax. Fischer (1981) also found that the excess burden of inflation was several times that of labor taxes. Since these studies suggest that the marginal collection cost of inflation exceeds the marginal collection costs of alternative sources of revenue for all positive inflation rates, it follows that inflation is never an optimal tax to collect. As Tatom (1976: 22) put it, having gone through various simulations to try to discover circumstances in which the inflation tax might be justified, "efficient taxation [still] warrants price stability" even "under the most extreme assumptions used . . . to support inflationary finance."

There are also other reasons to question the Phelps argument. As Garfinkel (1989: 10) and Selody (1990a: 18) have pointed out, the Phelps view of inflation as a tax tends to overlook the impact of inflation on the tax collection machinery as a whole. The tax collection system was not designed to operate in an inflationary world, and as already discussed, inflation actually plays havoc with it. Inflation therefore significantly raises the marginal collection costs of other taxes, and the true marginal collection cost of inflation is much higher

than the estimates discussed in the last paragraph might suggest. So, far from the optimal inflation rate being positive from a purely fiscal point of view, there is a good argument that lowering inflation would not only reduce the direct welfare losses from the use of the inflation tax per se, but would also reduce the welfare losses from other forms of taxation as well. It is consequently bizarre, to say the least, to defend inflation on fiscal grounds.

The argument for an inflation tax also runs into other problems. The Phelps result implies a model in which the government only has two sources of financing current expenditures—printing money, and raising taxes. However, Yashiv (1989) has suggested—the argument for an inflation tax no longer holds for models that allow governments the option of issuing bonds to finance their expenditures. Also, the Phelps model simply puts real balances into the utility function and treats them as if they were a good like any other final good. However real balances are not desired for their own sake but for the sake of the convenience they bring, and should therefore be considered as intermediate goods used up in the production of the ‘final’ goods and services the consumption of which is the final end of economic activity. Whether we treat money as a final or an intermediate good often does not matter, but it matters in this case. As Peter Diamond and James Mirrlees (1971a,b) have pointed out, intermediate goods should not be taxed even in a world where nondistorting taxes are not available. The Ramsey rule consequently applies only to final and not to intermediate goods. Applying the Diamond-Mirrlees result to inflation then tells us that inflation is an inefficient form of taxation quite regardless of any of the other problems already discussed (see also Kimbrough 1986, Faig 1988).

Conclusion

There are some fairly obvious conclusions with a clear policy bottom line. First, the available estimates of the costs of inflation suggest that these costs are very high—higher, indeed, than most economists appear to acknowledge. The figures presented here are illustrative, but they are if anything biased on the low side. The reader can of course always alter them by making his own auxiliary assumptions about discount rates, growth rates, and so on, but what impresses me is that changing these assumptions would still not substantially alter the main conclusion that the estimable costs of inflation are very high. Second, even if we accepted these figures as unbiased estimates of the costs they purport to measure, it should be obvious that they represent only a small subset of the total costs of inflation. There are

good reasons to believe that the most important costs of inflation—the effects of inflation on the efficiency of the economy and so forth simply cannot be measured, and it would be a grave mistake to presume that what we cannot measure does not exist or does not matter. Third, the costs of disinflation are not particularly high, and there is no reason to suppose that such estimates as we have are biased downwards. The quantitative rules of evidence are thus rigged, as it were, against those who claim that inflation is costly, and yet the available evidence is so overwhelming that one is still forced to the conclusion that the costs of living with inflation exceed—probably vastly exceed—the costs of getting rid of it.

It follows, then, that monetary policy (and, more fundamentally, the monetary constitution) ought to be geared toward eliminating inflation and establishing price-level stability. But it needs to be emphasized that establishing price-level stability is not the same as the Fed achieving two or three years of low inflation. Establishing price-level stability requires a clear and unambiguous commitment on the part of the Fed—a commitment that almost certainly requires legislative underpinning—and we need to be wary of the siren-song arguments that such a commitment is now redundant because the Fed has somehow got its inflation act together. It has not. A monetary regime with a built-in inflationary bias that happens to be delivering low inflation at the moment is not the same as a monetary regime that delivers price stability over a prolonged period and is committed to do so. An alcoholic without a drink is not a teetotaler. Even if inflation is currently low, people have no reason to expect that this state of affairs will last. If nothing is done soon, past experience suggests that the inflationary roller-coaster will start up again and wreak yet another round of havoc. The time to get off the roller coaster is now, before it gets going again.

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