1 Toward an Understanding of the Real Effects and Costs of Inflation

(with Franco Modigliani)

There is no convincing account of the economic costs of inflation that justifies the typical belief—of the economist and the layman—that inflation poses a serious economic problem relative to unemployment. In this paper we present a systematic account of the real effects of inflation that we hope will contribute to understanding of and continuing research on the costs of inflation.

It will become clear that the effects of inflation can vary enormously depending on two major factors: first, the institutional structure of the economy; and second the extent to which inflation is or is not fully anticipated. Because the institutional structure of the economy adapts to ongoing inflation, the real effects (and costs) of inflation can be expected to vary, not only among different economies but also in the same economy at different periods.

The organization of the paper is simple. We start by examining the real effects of anticipated inflation in an economy that has fully adapted to inflation. In particular, in this economy (1) public institutions are fully attuned to inflation (or inflation proof), (2) the same is true of private institutions, (3) current and future inflation is fully reflected in inherited contracts, and (4) future inflation is fully reflected in contracts for the future. After we have discussed the effects of anticipated inflation in this environment, we examine the real effects of inflation that arise as the assumptions (1) to (4) are dropped one after the other. The effects cumulate in the sense that those present in the economy that has fully adapted to inflation are also present in economies with noninflation proof institutions, and so on.

The organization of the paper enables us to provide a coherent listing of the major real effects of inflation.[1] The list is long, and surprisingly pervasive, and is contained in its essentials in table 1.1. The remainder of the

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Table 1.1
The real effects of inflation

	Nature of effect	
Source of effect	Direct	Indirect (general equilibrium)
Fully indexed economy		
No interest paid on currency, a government (outside) liability	1. Increase in government revenue (inflation tax) 2. Economizing on currency 3. Reduction in private net wealth	G1 Reduction in other taxes or increases in government spending G2 Diversion of resources to transactions (shoe-leather costs)
Need to change prices more frequently	4. Resource costs of price change ("menu costs")	G3 Offsetting increase in capital stock, lowering real interest rate
Real effects of nominal government institutions		
Progressive taxation of nominal income	5. Increased real income tax bill	G5 See G1
Nominal tax base 1. Taxation of nominal interest income received by persons 2. Deductibility of nominal interest paid by persons	6. Reduction of net of tax real return on lending relative to pretax real rate	G6–10 Potential effects on cost of capital to corporations and individuals, with resultant effects on capital accumulation; changes in patterns of financing G9 See also G1
3. Deductibility of nominal interest paid by corporations	7. Reduction of net real cost of borrowing relative to pretax real rate 8. Return to equity holders in levered corporations rises given constant debt-equity ratios, constant real pretax interest rate on bonds, and constant marginal product of capital 9. Changes in government tax receipts; net effect depends on induced changes in pretax real interest rate on bonds, differences in tax rates between debtors (including corporations) and creditors	

4. Depreciation at original cost Cost of goods sold measured at original cost	10. Return to equity holders declines 11. Tax revenue increases	**G10–11 See also G1 Combined effects vary among firms, depending on nature of assets; likely shift away from use of long-lived assets; shift in inventory accounting methods from FIFO to LIFO**
5. Taxation of nominal capital gains	12. Post-tax return to equity owners on realized gains declines if pre-tax return remains constant 13. Lock in effects	
Nominal accounting methods used by government	14. Distortions in interpretations of economic situation, e.g., nominal interest share in GNP rises, savings rate misinterpreted since both income and savings measured incorrectly; overstatement of government deficit	
Real effects of nominal private institutions and habits		
Continued reliance on nominal annuity contracts, mortgages	15. Declining real repayment streams relative to nominal streams	G15 Possible effects on real interest rates, and therefore investment
Nominal accounting methods	16. Distortion of reports of profits; other money illusions based on confusion between real and nominal interest rates possible	G16 Effects on stock market valuation of firms; investment decisions
Real effects of unanticipated inflation through existing nominal contracts		
Existing contracts for goods or services fixed in money terms or otherwise sticky	17. Redistribution between buyer and seller if quantity of services fixed by contract 18. Effects on quantity of services provided 19. Distortions of relative prices fixed at different times	G17–19 Effects on level of economic activity (Phillips curve) Short-run functional income redistributions by income size
Existing debt contracts fixed in nominal terms	20. Redistribution from private to public sector 21. Redistributions between private debtors and creditors	G19 Misallocations of resources arising particularly from need to search for relative price information G20 Ultimately intergenerational transfers

Table 1.1 (continued)

Source of effect	Nature of effect: Direct	Nature of effect: Indirect (general equilibrium)
Real effects of uncertainty of future inflation		
Need to make decisions without knowledge of future prices	22. Reluctance to make future commitments without knowledge of prices; absence of safe asset	G22 Changes in patterns of asset accumulation
	23. Shortening of nominal contracts	G23 Increased transaction costs of making frequent contracts, and loss of planning ability
Real effects of government endeavors to suppress symptoms of inflation		
Public dissatisfaction over inflation, and government reactions	24. Wage and price controls	G24 Shortages, possibly pervasive; misallocations of resources
Government concern over potential bankruptcies and other financial losses resulting from a rise in interest rates	25. Control of interest rates, intervention in bond markets	G25 Instability of financial flows, with possible effects on direction and level of investment activity

Note: The real effects cumulate. For instance, the effects described in section 1.1 are present also under the assumptions of section 1.2.

paper may be regarded as a commentary on table 1.1, which will also be useful as a guide to the subsequent discussion. We should note that the space devoted in this paper to the items on the list is not necessarily a judgment on their relative importance but in part reflects what is known about the particular effect. For instance, we have much to say about the wealth redistributions associated with unanticipated inflation but relatively little about the misallocations that result from increased uncertainty that typically accompanies inflation. The latter effect may well be extremely important, but very little systematic is known about it.

We have one other disclaimer to enter before we begin the substantive part of the paper. Although the measurement of the social and private costs of inflation is one eventual goal of research in this area, we do not attempt here to cost systematically individual effects of inflation and hence to provide a quantitative appraisal of the overall cost of inflation.[2] Any measures would be almost totally speculative at this stage; our listing of the real effects of inflation will show that considerable detailed work is necessary before it will be possible to provide serious answers to the key question of the real costs (and benefits) of those effects. We do, however, provide numerical estimates of the magnitudes of some of the important effects, and in any event we believe that the systematic listing and discussion of the real effects or inflation that is provided in this paper is a necessary step toward estimating the costs of inflation.

1.1 The Indexed Economy

The starting point for analysis is a fully indexed economy. All debt instruments are indexed, except currency, on which no interest is paid (because there is no convenient way to do so); wage and salary contracts are indexed; the exchange rate is freely flexible; tax brackets, fines, and other payments fixed by law are indexed; real rather than nominal returns on assets are taxed; there are no nominal interest rate ceilings; and so on. Demand side disturbances in this economy, arising, for example, from a change in the nominal stock of high-powered money, would have temporary real effects, depending on the frequency with which index adjustments are made. Similarly changes in the general price level might be the result of real supply side disturbances, such as a change in the terms of trade. In discussing the effects of inflation in such an economy, we abstract from the frictional real effects of demand disturbances and from the effects of real disturbances other than those on the general price level.

In this section we discuss the effects of anticipated inflation, noting in

passing, however, that in a fully indexed economy unanticipated inflation has very minor real effects, consisting essentially of a redistribution between the private and public sectors. Such redistributions are discussed in more detail in section 1.4.

The real effects and costs of anticipated inflation in a fully indexed economy would result from the absence of interest payments on currency, and from the "menu costs" of changing prices and wages. First, we examine the effects arising from the nonpayment of interest on currency, assumed initially to be a government liability, which is outside wealth for the private sector. Anticipated inflation represents a tax on real currency holding, since it reduces the real return earned by currency holders. The other side of the tax analysis is that the government obtains tax receipts through the issue of new currency, if the inflation is caused by the growth of high-powered money.

There are two potential routes for the anticipated inflation to affect real variables. First, the demand for real currency should be expected to fall as a result of the increased cost of holding it, producing the well-known shoe-leather costs of inflation, the welfare cost of which is measured by the size of the triangle under the demand for currency function.[3] As the optimal inflation tax literature has emphasized, the optimal rate of inflation is not necessarily either zero or negative.[4] The costs of inflation have to be calculated relative to that rate of inflation that, as part of the overall pattern of taxation, minimizes the social costs of raising government revenue. From this viewpoint there are welfare costs from inflation that is below the optimum rate, as well as from inflation above the optimum rate.

The costs of inflation arising from the reduced demand for currency have the distinction of being the only costs that have been carefully measured. An estimate for the United States can be constructed based on an assumed stock of currency of about $100 billion and a very generous estimate of the interest elasticity of demand for currency of one-half. The annual cost of an increase of the inflation rate from, say 5 percent to 6 percent, would then be under $0.5 billion—and this is a relatively high estimate because the elasticity assumption is upward biased.[5]

The second potential route through which fully anticipated inflation could have real effects in the fully indexed economy is through the relationships among inflation, saving, and capital accumulation. Capital accumulation, through life cycle savings effects, results from the reduction in outside wealth caused by the reduced value of high-powered money. Further, capital accumulation may be encouraged as a result of the fall in the anticipated rate of return on an asset alternative to capital, namely

currency. Calculation will show that the reduction in wealth caused by the anticipated inflation is small; given that fact and also the fact that currency holdings are very small relative to those of capital, the effects of the induced changes on the capital stock would probably also be small. Nonetheless, such changes would tend to offset the reduction in welfare caused by the loss of liquidity.[6]

So far we have been considering the costs of a perfectly anticipated inflation in an indexed economy where high-powered money is an outside asset. If currency were inside money, then an increase in the inflation rate would still produce a deadweight loss as the anticipated inflation reduced real currency holding. However, with the right to issue currency now being assigned to the banking system, an increased real bank revenue due to inflation would increase the value of bank stocks and thus wealth, perhaps leading to a decline in capital accumulation; the effects of a reduced return on currency on the demand for capital would tend to work in the opposite direction.

The other source of the effects of inflation in a fully indexed economy is the "menu costs" of changing prices. In principle, most prices in the indexed economy could be quoted in the unit of account, the cost of a commodity basket. In that case the costs of changing nominal prices would be largely the costs of calculating the nominal amount to be handed over in each transaction, based on the stated indexed price of goods. There would be no need to change marked prices in an indexed economy more often than in a noninflationary environment.

At low rates of inflation it would probably be most convenient (cheapest) to fix prices for many commodities in nominal terms. We have to distinguish here between auction markets where prices are set to clear markets more or less continually, and where the costs of changing prices would not be affected by the rate of inflation, and "custom" markets where prices are set and usually held for some time.[7] The menu costs of inflation arise in the custom markets, which include those for labor, manufactures, much of wholesale and retail trade, transportation, and such obvious examples as pay telephones, vending machines, and parking meters.

If we assume nominal pricing would be used at some low rates of inflation, and that there is a fixed cost of changing a given nominal price in the custom sector, then we should expect the frequency of price changes to increase with the rate of inflation, though we should of course recall that relative prices change even in the absence of inflation. However, as the inflation rate rose, prices would probably be adjusted *relatively* less frequently, so that the variability of relative prices might increase as the fre-

quency of absolute price changes increased.[8] If the system continued using nominal pricing, the menu costs of inflation could become dramatic at high rates of inflation. Before such costs were incurred, however, the system would probably switch over to the use of indexed pricing. Tokens would be used for telephones and other vending machines, and parking cards could be used in place of parking meters. The new real monies would compete with the depreciating money, be a nuisance to carry, and likely reduce the government's seignorage. The transitional costs of moving to such a system would also be large.

Thus we should expect menu costs to rise with the (anticipated) inflation rate up to some fairly high rate of inflation, at which time the system would start switching over to another unit of account, and for some purposes, to stores of value that substitute for currency. The costs of changing nominal prices thereafter would be largely the costs of calculating nominal prices from stated real prices.

Overall, the nonpayment of interest on currency and the menu costs of changing prices do not generate substantial real effects of moderate rates of inflation.[9] Additional real effects of inflation come into play when we recognize the existence of nominal government institutions, to be discussed next in section 1.2.

1.2 Real Effects of Nominal Government Institutions

The way in which anticipated inflation interacts with nominal government institutions to produce real effects on the economy depends on the particular institutional structure of the economy. Our discussion in this section relates primarily to the United States; while similar conclusions may apply in other economies, the details are surely not identical.

The major source of the real effects of inflation that occur as a result of "nominal" government institutions is the tax system. The tax system in the United States was clearly intended for noninflationary times, but it has been little amended in response to the inflation of the last ten years. It is significant that although indexation, particularly in regard to taxation of capital gains, was discussed in the debates over the tax "reforms" to be introduced in 1979, such measures were not included in the bill finally passed.

Perhaps the best known tax effect occurs as a result of the nonindexation of tax brackets in progressive income tax schedules. As nominal incomes rise, and nominal tax brackets are not adjusted, the proportion of income that is taken by the personal income tax rises. However, this effect is quite

small: Sunley and Pechman (1976) estimate an elasticity of real income taxes with respect to the price level of 1/2. In 1977 personal taxes were of the order of $150 billion; a 1 percent increase in the price level would increase taxes by about $0.75 billion. Even this small effect could be removed by the simple step of indexation of brackets, a change that has been introduced in Canada and other countries. It is also emphasized in Aaron (1976) that in fact the Congress has made discretionary income tax changes that have kept average personal income tax rates at about the same levels as in the fifties, despite the intervening inflation.

The effects of taxes on corporations and asset holders are potentially more important than those arising from nonindexation of brackets. Taxes are levied on the total nominal interest income received by individuals. Thus, if the pretax real rate of return on an asset remains constant as the inflation rate increases, the aftertax real rate to the asset holder will fall. The magnitude of this effect at the individual level is quite dramatic. Consider an individual for whom the tax rate is 25 percent, and who is earning pretax and preinflation, 5 percent nominal and real on his bonds. His aftertax real return is 3.75 percent. Now let the inflation rate rise to 5 percent, and the interest rate to 10 percent. Then the nominal aftertax interest rate is 7.5 percent, and the aftertax real rate received by the asset holder is 2.5 percent. The 5 percent inflation reduces the net of tax real return by one third.

The other side of this coin, from the viewpoint of the individual, is that nominal interest *paid* on personal debts is deductible from income on which taxes are levied. Thus insofar as nominal rates adjust fully so as to leave the real rate unchanged, preventing a redistribution from creditors to debtors in pretax income, there would still be a redistribution of aftertax income between creditors and debtors. This redistribution in taxes may have further social implications which will be examined later in connection with redistribution of wealth effects. In addition there would tend to be overall effects for net government tax take. Since the household sector is, on balance, a creditor, net taxes should tend to rise, but this effect could be more or less fully offset by the fact that debtors appear to be on the average richer, and hence in higher tax brackets, than creditors.

Corporations too are allowed to deduct nominal interest from their profits before the corporate tax liability is calculated. As of a given debt-equity ratio, and given a constant real interest rate and marginal product of capital, the real return to stockholders would tend to increase. Whether the owners of the firm, including bondholders, would have a greater or smaller real aftertax return, depends on the relation between the corporate and

individual income tax rates. If we start with the strong and unrealistic assumption that the tax rate paid by all individuals is the same, and also assume the pretax real interest rate on bonds and marginal product of capital constant, the firm's owners could have exactly the same real return independent of the rate of inflation if corporations and individuals paid the same tax rates. If the corporate tax rate is higher than the individual rate, an increase in the inflation rate would reduce total taxes paid by the firm's owners and government tax collection, and vice versa.

As long as we consider only the treatment of interest by the tax system, the effects of inflation on total post-tax real returns of the owners of corporate firms appear likely to be small, and aftertax real returns would not necessarily be adversely affected by inflation. Subsidiary effects would arise if there were changes in the relative post-tax real returns of bond and equity holders, which induced a change in the debt-equity ratio and perhaps a change in the cost of capital.

The next two elements in table 1.1 that relate to the nominal tax system tend to increase the taxes paid by corporations as the inflation rate rises. First, depreciation is charged off at historical cost; the present discounted value of the depreciation deduction from taxes falls as the inflation rate rises, given any particular depreciation schedule. This unambiguously raises the cost of capital to a corporation, as of given real interest rates. The second element—the measurement of the cost of goods sold at original cost, and the consequent overstatement of profits—is not required by the tax laws. Firms have the choice of using LIFO rather than FIFO inventory accounting methods, and the former will prevent the overstatement of profits that FIFO produces in an inflationary environment. Firms did growingly switch to LIFO as the inflation rate increased in the 1970s.

The more general effects of original cost depreciation depend on the nature of firms' assets. There is, in general, a rise in the cost of capital as the inflation rate rises, with the effect being greatest for firms using the longest-lived capital. There would presumably be both a fall in the rate of investment, and a shift to shorter-lived capital, as the inflation rate increased. It should be noted that the effects of inflation that work through the tax treatment of depreciation are not present in countries that allow 100 percent write-off of investment expenses in the first year.

The presumption from the various effects of inflation on tax revenues that we have discussed so far is that government revenue would rise with inflation, mainly through a fall in the real value of the depreciation deductions. Davidson and Weil (1976) find an elasticity of about three for the corporate income tax with respect to inflation, based on a sample of large

firms, and omitting capital gains on outstanding debt. With corporate income taxes of about $40 billion in 1976, the effect of a 1 percent increase in the price level is to increase corporate income taxes by $1.2 billion. Allowing for tax exemption of interest payments, the inflation premium included in interest is likely to offset this effect to a very large extent,[10] but there remains a net effect through higher taxes on personal interest received. Any increases in government revenue would make it possible to reduce other taxes or increase government spending, given the deficit.[11]

The taxation of nominal capital gains results in the aftertax real return to equity and other asset holders being reduced by inflation, if the pretax real return remains constant. It leads also to lock-in effects, given the principle of taxation only on realization of the gains. The first effect tends to reduce the return to equity holders and would therefore likely lead to an increase in the cost of capital for firms and reduced investment. The allocative effects of lock-ins are difficult to establish a priori; there is a general case to be made that they inhibit the efficient operation of the capital markets by encouraging some asset holders not to register their expectations in the marketplace by buying and selling assets.

The tax effects reviewed are clearly complicated and many. The net directions of those effects are not all obvious, and the overall impact of the tax system on the sensitivity of the post-tax rates of return received by asset holders and the cost of capital to the rate of inflation is uncertain.[12] But it appears that on balance increases in the inflation rate will tend to increase the cost of capital and reduce the aftertax real rate of return to wealthholders, given the marginal product of capital and the pre-tax real interest rate.

Finally, in our consideration of nominal governmental institutions, we turn to the inflation illusion that is present in economic statistics. It is clear, first, that inflation increases the reported share of interest in GNP, since interest is reported as nominal and not real. It would be preferable to present real interest earnings by deducting the capital losses on outstanding bonds from interest and adding them to profits or whatever other category they should enter.

In particular, insofar as net interest is paid by the government, the inflation premium portion should be treated as a repayment of principal to the debt holders and thus deducted from government expenditure. Failure to do so leads to an overstatement of the current government deficit which can be quite large when inflation is significant. Thus a recomputation of the deficit to reflect the fall in the real value of government liabilities—or repayment of real debt through the inflation premium—would involve a

major change in the perspective on the last few years deficits in the United States; for instance, in 1978 government liabilities to the public will fall in real value by about $45 billion, or approximately the size of the deficit.

Similarly the nominal treatment of private and government interest payments leads to an overstatement of both personal and disposable income as well as saving, since it treats as income and saving, respectively, what should be correctly treated as a return of capital and the reinvestment thereof. It might be argued that with respect to the government, the nominal deficit is still the relevant measure since it is the amount that needs to be financed with resulting crowding-out effects. But in reality that portion of interest payments that represents a repayment of principal should give rise to matching "saving" available for reimbursement by the public. To be sure, to the extent that the public is fooled into treating as income what is not, there may be some net reduction in real saving with final effects analogous to crowding out. But there is clearly no reason why these effects would be captured by using a wrong measure of interest earned and paid.

The accounting errors referred to in the previous two paragraphs are not widely recognized and may even influence policy. Thus the overstatement of the government deficit creates at least the potential for errors in fiscal management. At any rate it is hard to believe that intelligent policymaking is systematically aided by the use of inappropriate measurement.

1.3 Real Effects of Nominal Private Institutions

The private sector as well as the government has continued to use nominal institutions and practices in the face of ongoing inflation. At the same time there have been financial innovations in the past decade that mitigate the effects of inflation on the private sector—one important illustration is the introduction of floating rate debt instruments. In this section we concentrate on the effects arising from the continued use of nominal annuity contracts and mortgages, and from the reliance on nominal accounting methods, while still maintaining the assumption that inflation is *anticipated.*

Reliance on the level payment nominal mortgage as the major vehicle for financing residential housing means that the time pattern of real repayments on a mortgage is tilted by inflation. Since the nominal payment is the same in each month on a level payment mortgage, the real value of the payment falls over time if there is inflation; the tilt is greater the higher the inflation rate. If the real interest rate remains constant, initial real repayments, for a mortgage of given real value at the time of purchase, will rise

with the inflation rate. Similar statements can be made in the case of nominal annuities purchased by constant nominal payment streams: the real value of the payments by the purchaser of the annuity will fall over time; then after the annuity starts paying out to the purchaser, the real value of the receipts fall over time.[13]

The consequences of the tilting of the repayment stream on mortgages are thoroughly explored in Modigliani and Lessard (1975). The use of nominal mortgages means that inflation substantially increases the real burden of financing in the early years of home ownership and on those grounds reduces the demand for housing (of course the demand for housing may rise because it is an inflation hedge).

The continued use of constant nominal repayment mortgages poses problems also for the financial intermediaries that issue them. We discuss these difficulties in section 1.6, though they fit in also in section 1.4.

The continued use of nominal accounting methods in the private sector leads to distortions of reported profits and other accounting magnitudes. Evidence by Shoven and Bulow (1975, 1976) and Davidson and Weil (1976) indicates that these distortions are substantial as between firms in a given period. Such distortions create potential misallocations of resources, partly because internal firm data may be misinterpreted and partly because markets may incorrectly assess the relative desirability of investment by different firms and provide capital at an inappropriate cost. It is possible to argue that such errors would ultimately be self-eliminating, but we find it difficult to know how the stock market and the capital markets in general are to divine "true" profits of corporations if the firms themselves do not know the profits.[14]

Accounting reforms have been proposed by committees in a number of countries but have not been adopted. The failure to change accounting methods stems both from the inertia arising from the need to convince and educate the accounting profession and from the intellectual difficulties of problems such as the appropriate treatment of inflation-induced gains to firms from the reduction in the real value of their outstanding debt. Nor is it clear that firms whose accounting profits would change with the reform would be uniformly enthusiastic about changes in accounting systems.

The use of nominal accounting methods is one example of the type of money illusion that may remain in the economic system despite continuing inflation; this illusion results from the convenience of using money as a unit of account, rather than the medium of exchange function. On a priori grounds we are reluctant to believe such illusions can remain in the system over long periods, but there does appear to be some evidence of their

continued existence. They are familiar in everyday discussion; it also appears that even the supposedly sophisticated capital markets may be using nominal interest rates to capitalize real profits (Modigliani and Cohn 1979). All such illusions must ultimately be self-destructive, but the surprise is that they still persist.

1.4 Real Effects of Unanticipated Inflation through Existing Nominal Contracts

We now consider the real effects of unanticipated inflation that occur through the existence of nominal contracts for goods and services, and for debts. The primary effects that have received major attention are the redistributions of income and wealth associated with unanticipated inflation; there are in addition possible changes in the level of economic activity and misallocations arising from ignorance about relative prices.

We will start with the income and wealth redistributions. The direction of the income redistribution associated with unanticipated inflation will depend on the details of the contract structure of the economy. It has typically been believed that wages lag behind in inflation, and that inflation therefore implies a shift away from wage-earners and toward profits. It is presumably on the same grounds that the claim is often made that inflation hurts the poor relatively more than the rich.

There seems to be no way a priori of predicting the direction of the income redistributions, by function (wage, rent, etc.) or size, associated with unanticipated inflation; the direction may well depend on the source of the unanticipated inflation. For instance, an exogenous wage push would have different implications for the redistribution of income associated with the induced inflation than would a change in the price of oil. Empirical evidence for the postwar U.S. economy is that inflation has, if anything, redistributed income to the lower quintiles of the income distribution (Blinder and Esaki 1978) and toward labor income (Bach and Stephenson 1974). However, examination of the cited empirical results will show that the effects are indeed very small; inflation does not appear to have major effects on the functional or size distributions of income.[15]

The wealth redistributions arising from unanticipated inflation are more substantial. The redistribution is obviously from nominal creditors to nominal debtors. The emphasis in discussing these redistributions is usually along sectoral lines, an approach we shall follow for expositional purposes. From the viewpoint of the private sector as a whole, the unanticipated change in the price level reduces the real value of their outstanding claims

on the government. But that is not the end of the story. The reduction in the real value of the debt reduces the real value of future tax payments required to service or retire the debt.

The increased disposable income of the younger generation, whose taxes have been reduced, leads them to save more, thus increasing the capital stock while the corresponding reduction in consumption comes from the retired, whose real wealth has been reduced. There is thus a redistribution from the older generation to younger and future generations. The transfer should be thought of as chiefly intergenerational within the household sector rather than between the private and public sectors; its extent is reduced insofar as retired consumption is financed through indexed social security.

Within the private sector the shift between the corporate and household sectors is frequently singled out for special discussion as an effect of an unanticipated increase in the price level. The unanticipated increase in the price level reduces the real value of outstanding corporate debt, apparently benefiting corporations at the expense of households. The redistribution is ultimately, however, between different households; the reduction in the value of the outstanding debt should be reflected in an increase in the value of corporate equity, leaving the net wealth of the private sector unaffected. The redistribution is fundamentally from the more risk averse to the less risk averse—this perhaps corresponding to the popular notions of suckers and sharpies.

However, the assumption that the value of corporate equity rises with unanticipated inflation is not borne out by U.S. data (Bodie 1976, Nelson 1976). Part of the explanation for this consistent empirical finding may be the increased real tax burden caused by an increase in the price level. Other explanations for this characteristic of the U.S. capital market are examined in Lintner (1975) and Modigliani and Cohn (1979).

The extent of the wealth redistributions associated with unanticipated inflation is examined in some detail in Modigliani and Papademos (1978) and will be only summarized here. It is shown to depend on the maturity structure of existing debt and on the path of unanticipated inflation over the life of the assets. Specifically, for an asset of a given (remaining) maturity the redistribution is roughly proportional to the unanticipated change in the price level over the life of the asset (or the cumulated unanticipated rate of inflation). It follows in particular that a 1 percent unanticipated inflation in the current period followed by no unanticipated inflation in later periods would produce a transfer of 1 percent of the value of outstanding debt.

Table 1.2
Outstanding volume of nominal assets in U.S. economy, December 31, 1975 (billion $)

Demand deposits and currency		290.3
Time and saving accounts		884.6
Life insurance and pension reserves, plus interbank claims		591.8
Credit market instruments		2,626.7
Federal government	558.1	
State and local government	230.5	
Corporate and foreign bonds	317.2	
Mortages	803.3	
Other	717.6	
Trade credit		308.9
		4,702.3

Source: Flow of Funds Accounts (1976, p. 90).

Now how large are the wealth redistributions associated with unanticipated inflation in the United States? The total value of nominal assets in the U.S. economy on December 31, 1975, was about $4.7 trillion, composed of the assets shown in table 1.2. This does not mean that an unanticipated change in the price level of 1 percent redistributes $47 billion of wealth, since individuals and institutions hold both nominal assets and nominal liabilities, and since there is some pyramiding of the asset structure.

It is more relevant to the question of redistributions to look at the household sector's balance sheet for nominal assets and liabilities.[16] Table 1.3 shows that the household sector had in 1975 about $1.8 trillion in nominal assets, and just under $800 billion in nominal liabilities. The net outstanding value of nominal assets held by the private sector was over $1 trillion, so that an unanticipated change in the price level by 1 percent would have reduced the real value of household sector net holdings of nominal assets by about $10 billion. However, this $10 billion figure probably understates the total real losses of those who on balance lost from inflation since the balance sheets of different individuals no doubt differ in proportions from those of the sector as a whole. Assuming no major changes in asset positions since 1975, a number like $15 billion would be in the ball park as a measure of the loss of real wealth suffered on nominal asset account by all those in the private sector who on balance lose on nominal asset account from the inflation.

Of course $15 billion does not reflect the total effects of the inflation on distribution, since it does not adjust for the effects of a change in the price level on the real value on nonnominal assets and liabilities, particularly

Table 1.3
Balance sheet for nominal assets and liabilities held by household sector in the United States, December 31, 1975 (billion $)

Assets			**Liabilities**		
Demand deposits and currency		165.6	Credit market instruments		753.5
Time and savings accounts		776.2	Mortgages	508.2	
Credit market instruments		346.8	Consumer credit	197.3	
Federal government	123.4		Other	46.0	
State and local government	74.2		Other		29.3
Corporate and foreign bonds	65.9		Total liabilities		782.8
Mortgages	72.7		Net		1,039.8
Other	10.5				
Life insurance reserves		164.6			
Pension fund reserves		368.6			
Total assets		1,821.8			

Source: Flow of Funds Accounts (1976, p. 100).

equity and housing. For equity, existing evidence is that an increase in the price level reduces real value; for housing there is little evidence, but a belief that the real value of housing rises with inflation.[17] We must therefore acknowledge a great deal of uncertainty as to the net effect of inflation on the real value of real assets in the United States.

One very important aspect of wealth redistribution is from the young to the old, but unfortunately the relevant evidence is skimpy. The only systematic information we have is taken from Bach and Stephenson (1974). (Table 1.4 reproduces part of the relevant table from Bach and Stephenson.) Using a 1969 survey,[18] they find that the ratio of net nominal to real assets rises with the age of the head of household and, in particular, that it is only after the age of 55 that households become net creditors in nominal terms. If this evidence stands up, then the indication is that the redistributions that occur when the price level rises chiefly reduce the real wealth of the old, while increasing the real wealth of the young. As noted before, such redistributions tend to be mitigated by the existence of indexed social security in the United States.

We can also use table 1.4 to look at the net nominal creditor position by income class. It turns out that those with very high and very low incomes are net nominal creditors, whereas the middle of the income distribution is occupied by nominal debtors. Thus we can think of the redistribution as being from those with high and low current incomes to those with intermediate incomes, but we should emphasize that such statements cannot be made meaningful without standardizing for the stage of the life cycle, something we are not able to do with the data we have.

We have so far been discussing the extent of redistribution caused by an unanticipated 1 percent change in the price level. We noted, however, that the redistribution caused by a change in the inflation rate depends on the maturity of the outstanding stock of nominal obligations. Of the assets and liabilities of the households shown in table 1.3, about $900 billion of assets and over $500 billion of liabilities are of a term longer than one year. On the assets side, life insurance and pension fund reserves are of long maturity, as are mortgages on the liability side. The effects of a change in the inflation rate might roughly cancel out for these classes of assets and liabilities. That still leaves over $400 billion of other longer-term nominal assets. The maturity of these assets is not known, though that of federal obligations is close to three years.[19] Accordingly, a 1 percent change in the inflation rate would reduce the current value of these assets by substantially more than $4 billion.

It is clear that the wealth redistributions arising from unanticipated

Table 1.4
Assets and debts of households, early 1969

	Percent of all households (1)	Total assets (billion $) (2)	Percent of total assets			(2)/(1)
			Monetary assets	Variable price assets	Debts	
Age of head of household						
18–24	10	27	14	86	49	2.7
25–34	21	189	8	92	48	9.0
35–44	18	335	9	91	37	18.6
45–54	17	366	13	87	22	21.5
55–64	15	301	21	79	9	20.1
65–	19	404	23	77	3	21.2
By 1968 money income before taxes ($)						
Under 3,000	17	92	20	80	8	5.4
3,000–4,999	14	119	20	80	15	8.5
5,000–9,999	33	350	18	82	23	10.6
10,000–14,999	24	420	14	86	29	17.5
15,000–24,999	9	359	12	88	21	39.9
25,000–49,999	2	177	14	86	18	88.5
50,000 and over	0.4	105	18	82	10	262.5

Source: Bach and Stephenson (1974, p. 6), based on data from Survey of Consumer Finances (1969).

inflation are large, of the order of 1 percent of GNP per 1 percent unanticipated increase in the price level. Although these effects are large, it is difficult to attach a social cost to them. For every loser there is a gainer; to calculate the social costs of the redistributions it would be necessary to have a Bergsonian social welfare function that appropriately weights the welfare of every individual. Unfortunately there are no data on individual redistributions, and we do not have an accepted welfare function at hand.

We have devoted considerable attention to the wealth redistributions associated with unanticipated inflation. This is partly because the redistributions have received a good deal of attention in the literature and partly because there are some relevant data, but it is also because the extent of the redistributions is substantial.

We turn next to the other real effects that occur through the use of nominal contracts. The fixity of some prices might give unanticipated inflation real effects on the level of economic activity. One of the main theories underlying the Phillips curve (Lucas 1973) argues that unanticipated inflation increases labor supply and therefore output, and Keynesian sticky wage theories would also suggest that unanticipated inflation increases output.

The fixity of nominal prices may also lead to misallocations of resources in the face of unanticipated inflation, as relative prices change—because of the differential costs of changing prices in different markets and because of imperfect information about relative prices among consumers. It is reasonably well established that relative price variability increases with the inflation rate (Jaffee and Kleiman 1977, Vining and Elwertowski 1976); such increased variability leads to misallocations of resources, and to the absorption of resources in search and information gathering activities.

1.5 Real Effects of Uncertainty of Future Inflation

Practical men tend to emphasize that inflation makes it difficult to plan in the absence of knowledge of future prices. This argument clearly implies that uncertainty about future price levels is increased at high inflation rates. We know that in principle there is no necessary link between the rate of inflation and the variability of the inflation rate. In fact it appears that the variability of the rate of inflation (which is not quite the same as uncertainty about the rate) increases with the level of inflation. Flemming (1976) suggests the reason may be that governments typically announce unrealistic stabilization programs as the inflation rate rises, thus increasing uncertainty about what the actual path of prices will be.

If we accept the link between the level of inflation and uncertainty about future price levels, we can ascribe to inflation the effects that arise from the need to make decisions with decreased certainty of future price levels. The first effect is a change in the pattern of asset accumulation. If there is no indexed asset, increased uncertainty about future prices reduces the safety of nominal assets and increases the relative attractiveness of real assets as inflation hedges. Residential structures occupy a prominent position among such assets, especially when the performance of the equity values is as disappointing as it has been in the recent inflation all over the world. Other assets the public may turn to include nonreproducible tangible wealth such as land, gold, or art work. Given the fixity of the supply, the prices of such assets will tend to be bid up faster than the general price level. It is entirely conceivable that the resulting "capital gains" increase in real wealth will result in a decline in saving and, finally, in physical investment.

A second effect of uncertainty about the rate of inflation is the shortening of contracts. Uncertainty about the real value of the quid for which the quo is being exchanged is likely to reduce the use of long-term contracts. Uncertainty about the rate of inflation should lead also toward the use of indexed contracts. There seems to be some evidence of this in labor markets but very little in capital markets, except through the use of floating rate notes which are equivalent to shortening the effective maturity of the contracts. This reduces uncertainty about the real value of the payments over the lifetime of the note but also implies sacrificing the possibility of hedging against future movements of the real rate.

Both the changes discussed in the previous two paragraphs—shifts in the demand for assets, toward inflation hedges, and the shortening, of contracts—would tend to reduce the rate of investment by firms, and lead to investment in shorter lived assets.

1.6 Real Effects of Government Attempts to Suppress Symptoms of Inflation

Governments frequently attempt to suppress inflation using wage and price controls. Such controls are likely to produce serious distortions and inequities, particularly when they are introduced at times of excess demand. Measures of the extent of the distortions for particular cases have apparently not been undertaken, though anecdotal evidence on shortages induced by wage and price controls abound.

Governments also intervene in attempts to control rising interest rates, or the consequences of potential increases in interest rates. Attempts to

keep interest rates from rising in inflationary situations may result from the desire of the government to avoid the imposition of capital losses on bond holders, in part under the fear that large capital losses would tend to destroy the capital markets. Attempts to keep interest rates low by monetary policy are ultimately destabilizing; attempts to keep them low through controls lead also to credit rationing and to disintermediation and misallocation of funds.

In the United States Regulation Q, which controls the interest rates paid by financial intermediaries, has been responsible for episodes of disintermediation in credit crunches in 1966, 1970, and 1974. The disintermediation resulted in sharp reductions in construction activity. However, the control over interest rates imposed by Regulation Q may well have been desired by the financial intermediaries, since competitive rises in interest rates would have led to large losses for them, as the rates they would have had to pay on their liabilities would have exceeded receipts from their assets (Modigliani and Lessard 1975). The ultimate cause of Regulation Q and the credit crunches may be thought of as the extreme imbalance in the maturity structure of the balance sheets of financial intermediaries—borrowing very short, lending very long—rather than government concern with interest rates as such. The effects we attribute here to government intervention are certainly partly to be ascribed also to the existence of nominal institutions in the private sector. It is worth noting that the financial intermediaries in the United States have innovated significantly in recent years, both by introducing new debt instruments (roll over mortgages, variable rate mortgages, etc.) and by inventing new liabilities (generally of longer term, some with variable interest rates, tied to the treasury bill rate).

It should be recognized that the cost of government intervention must be set against the possible reduction in cost that may arise from success in suppressing some symptoms or concomitants of inflation. For instance, if it succeeded in keeping the price level permanently lower, then it might avoid the cost of redistribution. On the other hand, artificially holding down long-term interest rates reduces the cost to the initial holders of long-term debt, but it increases the cost to those investing in money fixed assets, thereby perpetuating the transfer from creditors to debtors. A full cost-benefit analysis of government intervention is actually a complex task. The prevailing conviction among economists today seems to be that the costs resulting from attempts to suppress or reduce inflation through government interferences with the market mechanism—some of which costs were outlined here—are likely on balance to outweigh the benefits even when, if initially, they may appear to produce small gains. Though this

view could no doubt stand some closer scrutiny, particularly in terms of redistribution effects, the task is clearly beyond the scope of this survey.

1.7 Concluding Comments

Perhaps the only surprising feature of this paper is the length of the list of the real effects of inflation. Conventional analysis of the welfare costs of inflation emphasizes the area under the demand curve for money as the cost of anticipated inflation and redistributions as the cost of unanticipated inflation. However, in economies that have not fully adapted to inflation—and that means all economies—potential real effects are far more pervasive. Some of these real effects are very hard to pin down—for instance, the extent of misallocations caused by variability of relative prices and uncertainty of future price levels—but they may well be as important as the costs that are conventionally emphasized.

We should also repeat that measurement of these costs of the real effects that we have listed is obviously a task of importance. Our hope is that systemization of the list of real effects will assist in organizing attempts to measure the costs (and benefits) of inflation.

Notes

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1. The listing is probably incomplete, and the emphasis possibly not to everyone's liking. We have been struck by reactions to this paper of the nature: "Of course, you omitted (or failed to emphasize) the most important item *X*," where *X* varies widely. Such reactions of course reflect the lack of quantitative knowledge of the effects of inflation.

2. Surveys of the costs of inflation are contained in Phelps (1972), Foster (1972), Laidler and Parkin (1975), and Flemming (1976). Laidler (1975), Okun (1975), and Solow (1975) contain useful non-survey discussions of the costs of inflation. The present paper has benefited considerably from the stimulus of a paper by Tobin (1976).

3. This cost has the dimension of a flow, \$/time. For some purposes one may be interested in the capital value of this flow, through suitable discounting. A recent paper by Martin Feldstein (1979) raises some difficulties about the discounting procedure.

4. See, for instance, Phelps (1973).

5. Even if we assumed the inflation tax applied to M_1, the annual welfare cost of the tax would be under $2 billion. But in the fully indexed economy, demand deposits would pay interest at least equal to the rate of inflation.

6. The effects of anticipated inflation on capital accumulation have been at the center of a long controversy. Such effects do arise in the context of life cycle utility-maximizing individuals or families with finite horizons, but in some models they do not occur in steady state if the family effectively has an infinite horizon (Sidrauski 1967, Fischer 1979).

7. The distinction is Okun's (1975); it is related to some Hicksian distinctions.

8. The "might" is included since the variability of relative prices would depend on both the correlation of the timing of price changes and the frequency of such changes.

9. Increased variability of relative prices might absorb resources as individuals search for information on prices; this point is taken up in more detail in section 1.4.

10. This conclusion is suggested by a comparison of the magnitude of the overstatement of equity returns due to inventory and nominal depreciation with the magnitude of the understatement due to real capital gains or debt. See, for example the study of Shoven and Bulow (1975, 1976) and Davidson and Weil (1976).

11. It is estimated by Fellner et al. (1975) that taxes in 1974 were $17 billion higher than they would have been had the tax system been indexed. The inflation rate in that year was about 10 percent and tax receipts $265 billion.

12. The effects discussed in this section have been studied recently by Feldstein and others; see, for example, Feldstein and Summers (1978).

13. In principle, the tilting of the payments stream could be offset by anyone with access to the capital markets, by borrowing to make the early payments. Loans for such smoothing purposes do not appear to be readily available.

14. Preliminary evidence by Modigliani and Cohn (1979) seems to show that the capital markets do, at least in aggregate, correctly adjust for inappropriate inventory and depreciation accounting but do not adjust for capital gains accruing to equity owners as inflation reduces the real value of outstanding debt.

15. Preliminary empirical work shows that the results of Blinder and Esaki and Bach and Stephenson are not fundamentally changed when the effects of anticipated and unanticipated inflation on the income distribution are distinguished.

16. The household sector in these tables is actually "Households, Personal Trusts, and Nonprofit Organizations."

17. Budd and Seiders (1971) in their study of the effects of inflation on distribution argue that real estate maintains but does not increase its real value in the face of inflation. They do claim that real equity values rise with inflation.

18. The Michigan Survey Research Center stopped its surveys of consumer finances after 1970; they are in the process of being reinstated in 1978.

19. *Economic Report of the President* (1977, table 77).

References

Aaron, Henry J. (ed.). *Inflation and the Income Tax.* The Brookings Institution, Studies of Government Finance, Series 2, Washington, D.C., 1976.

Bach, G. L., and James B. Stephenson. "Inflation and the Redistribution of Wealth." *The Review of Economics and Statistics,* Vol. 56, Cambridge, Mass., 1974, pp. 1–13.

Blinder, Alan S., and Howard Y. Esaki. "Macroeconomic Activity and Income Distribution in the Postwar United States." *The Review of Economics and Statistics,* Vol. 60, Cambridge, Mass., 1978, pp. 604–609.

Bodie, Zvi. "Common Stocks as a Hedge against Inflation." *The Journal of Finance,* Vol. 31, New York, N.Y., 1976, pp. 459–470.

Budd, Edward C., and David F. Seiders. "The Impact of Inflation on the Distribution of Income and Wealth." *The American Economic Review,* Vol. 61, Menasha, Wisc., 1971, *Papers and Proceeding,* pp. 128–138.

Davidson, Sidney, and Roman L. Weil. "Inflation Accounting: Implications of the FASB Proposal." In Henry J. Aaron (ed.), *Inflation and the Income Tax.* The Brookings Institution, Studies of Government Finance, Series 2, Washington, D.C., 1976, pp. 81–120.

The Economic Report of the President to the Congress, 1977. Washington, D.C.

Feldstein, Martin. "The Welfare Cost of Permanent Inflation and Optimal Short-Run Economic Policy." *Journal of Political Economy,* Vol. 87 (4), 1979, pp. 749–768.

Feldstein, Martin, and Laurence Summers. "Inflation, Tax Rules, and the Long-Term Interest Rate." *Brookings Papers on Economic Activity,* Washington, D.C., 1978, pp. 61–99.

Fellner, William, Kenneth W. Clarkson and John H. Moore (eds.). *Correcting Taxes for Inflation.* American Enterprise Institute for Public Policy Research, Domestic Affairs Study, 34, Washington, D.C., 1975.

Fischer, Stanley. "Capital Accumulation on the Transition Path a Monetary Optimizing Mode." *Econometrica.* Vol. 47(6), 1979 pp. 1433–1440.

Flemming, J. S., *Inflation.* London, 1976.

Flow of Funds Accounts, *1946–1975.* Board of Governors of the Federal Reserve System, Washington, D.C., 1976.

Foster, Edward. *Costs and Benefits of Inflation.* Federal Reserve Bank of Minneapolis, Studies in Monetary Economics, I, Minneapolis, 1972.

Jaffee, Dwight M., and Ephraim Kleiman. "The Welfare Implications of Uneven Inflation." In Erik Lundberg (ed.), *Inflation Theory and Anti-Inflation Policy,* Macmillan, 1977.

Laidler, David E. W. *On the Costs of Anticipated Inflation.* University of Western Ontario, London, Ont., 1975, unpubl.

Laidler, David E. W., and Michael Parkin. "Inflation: A Survey." *The Economic Journal,* Vol. 85, Cambridge, 1975, pp. 741–809.

Lintner, John, "Inflation and Security Returns." *The Journal of Finance,* Vol. 30, New York, N.Y., 1975, pp. 259–280.

Lucas, Jr., Robert E. "Some International Evidence on Output-Inflation Tradeoffs." *The American Economic Review,* Vol. 63, Menasha, Wise., 1973, pp. 326–334.

Modigliani, Franco, and Richard Cohn. "Inflation, Rational Valuation, and the Market." *Financial Analysis Journal,* March/April 1979, pp. 3–23.

Modigiani, Franco, and Donald Lessard. *New Mortgage Designs for Stable Housing in an Inflationary Environment.* Federal Reserve Bank of Boston, Conference Series, No. 14, Boston, Mass., 1975.

Modigliani, Franco, and Lucas Papademos. "Optimal Demand Policies against Stagflation." *Weltwirtschaftliches Archiv,* Vol. 114, 1978, pp. 736–782.

Nelson, Charles R. "Inflation and Rates of Return on Common Stocks." *The Journal of Finance,* Vol. 31, New York, N.Y., 1976, pp. 471–482.

Okun, Arthur M. "Inflation: Its Mechanics and Welfare Costs." *Brookings Papers on Economic Activity.* Washington, D.C., 1975, pp. 351–390.

Phelps, Edmund S., *Inflation Policy and Unemployment Theory. The Cost-Benefit Approach to Monetary Planning,* New York, 1972.

Phelps, Edmund S. "Inflation in the Theory of Public Finance." *The Swedish Journal of Economics,* Vol. 75, Stockholm, 1973, pp. 67–82.

Shoven, John B., and Jeremy I. Bulow. "Inflation Accounting and Nonfinancial Corporate Profits: Physical Assets." *Brookings Papers on Economic Activity.* Washington, D.C., 1975, pp. 557–598.

Shoven, John B., and Jeremy I. Bulow. "Inflation Accounting and Nonfinancial Corporate Profits: Financial Assets and Liabilities." *Brookings Papers on Economic Activity*, Washington, D.C., 1976, pp. 15–57.

Sidrauski, Miguel. "Rational Choice and Patterns of Growth in a Monetary Economy." *The American Economic Review*, Vol. 57, Menasha, Wisc., 1967, *Papers and Proceedings*, pp. 534–544.

Solow, Robert M. "The Intelligent Citizen's Guide to Inflation." *The Public Interest*, New York, N.Y., 1975, No. 38, pp. 30–66.

Sunley, Jr., Emil M., and Joseph A. Pechman. "Inflation Adjustment for the Individual Income Tax." In Henry J. Aaron (ed.), *Inflation and the Income Tax*. The Brookings Institution, Studies of Government Finance, Series 2, Washington, D.C., 1976, pp. 153–171.

Survey of Consumer Finances, 1969. The University of Michigan, Institute for Social Research, Ann Arbor.

Tobin, James. *Inflation Control as Social Priority*. Yale University, New Haven, Conn., 1976, unpubl.

Vining, Jr., Daniel R., and Thomas C. Elwertowski. "The Relationship between Relative Prices and the General Price Level." *The American Economic Review*, Vol. 66, Menasha, Wisc., 1976, pp. 698–708.