

**COWLES FOUNDATION FOR RESEARCH IN ECONOMICS
AT YALE UNIVERSITY**

**Box 2125, Yale Station
New Haven, Connecticut 06520**

COWLES FOUNDATION DISCUSSION PAPER NO. 849

Note: Cowles Foundation Discussion Papers are preliminary materials circulated to stimulate discussion and critical comment. Requests for single copies of a Paper will be filled by the Cowles Foundation within the limits of the supply. References in publications to Discussion Papers (other than acknowledgment that a writer had access to such unpublished material) should be cleared with the author to protect the tentative character of these papers.

INVENTORIES, INVESTMENT, INFLATION, AND TAXES

James Tobin

September 1987

Inventories, Investment, Inflation, and Taxes
James Tobin

Abstract

Sales today were made possible by inputs of factor services and intermediate goods at various previous dates. Prices change between the input dates and the sale date. Especially in periods of general inflation, these price movements create ambiguities in the reckoning of profits. The accounting definition used in taxing profits can have significant economic effects. Tax accounting is generally not neutral vis-a-vis general inflation. Costing inputs at their historical nominal prices (FIFO) is a real burden and disincentive, greater the higher the inflation rate. It is analogous to depreciating durable capital at historical cost. However, it may be partially, completely, or excessively offset by another non-neutrality, the deductibility of nominal interest from taxable income. This too has analogous effects on after-tax returns from fixed capital.

ISIR

~~ISA~~ Conference
Wesleyan University
June 17, 1987

Inventories, Investment, Inflation, and Taxes

James Tobin
Yale University

This paper is a relic of an earlier period in the United States, the stagflation of the 1970s. Michael Lovell, for some reason, prevailed upon me to exhume it for this conference. In those times, business managers and economists complained loudly about over-taxation of profits by a tax code that was not indexed to inflation. According to Martin Feldstein, who with his colleagues at Harvard produced an impressive volume of research on the effects of taxes on capital formation, the burdens and disincentives of personal and corporate income taxes during inflationary times were a major cause of the "stag" linked to the "flation." He and his associates were concerned with over-taxation both of inventory profits and of returns to fixed capital. [Feldstein, 1983]

Diagnoses with this message were influential in the political arena. The Economic Recovery Tax Act of 1981, a Reagan Administration initiative supported in the Congress by legislators of both parties, made generous concessions in the taxation of business and property income. A major ostensible purpose was to offset the alleged punitive and deterrent effects of the deadly combination of the previous tax code with high inflation rates. Despite this rationale, the legislation did not provide the obvious direct and specific remedy, namely indexation of past costs in reckoning taxable income. Instead, it offered other remedies, notably Accelerated Cost Recovery, which only three years later, when inflation had abated,

appeared extravagant and inefficient to the same Administration and legislators who had enacted ERTA. They hailed the repeal of those concessions as a major reason why the Tax Reform of 1986 was the greatest fiscal legislation in history. Such is American politics.

The 1986 Act did not index costs either, although the initial Treasury proposal of 1984 would have done so. Consequently the concerns of the 1970s may recur if and when serious inflation returns, making my paper relevant once again in this country. And it may be relevant elsewhere too.

There are two Parts of the paper. The first directly concerns inventories. The second concerns fixed investment. I include the second, even in this conference, for two reasons. First, fixed capital can be conceived as an inventory of a kind, its depreciation being analogous to the storage costs of inventories. Like purchases of capital goods, purchases or production of inventories prepare for production of goods for final sale over many future dates. Second, the economic and mathematical arguments in the second part are isomorphic to those of the first part. Indeed, the second part could be applied to inventories if, as many theories would have it, inventories have a gross marginal productivity analogous to that attributed to fixed capital.

In both Parts I consider two non-neutralities arising from the interaction of income taxation and inflation. One arises from the use of historical cost in reckoning profits; inflation raises the tax liability on given real income. The second arises from the deductibility of nominal interest; during inflation, this means that some repayments of principal in real terms are deductible. Interest deductibility lowers the effective tax. The first effect deters, while the second effect encourages, investment in

inventories and fixed capital.

Let me summarize in advance the main point of the algebraic calculations that follow: The historical cost effect, negative for after-tax profits, is a monotonically increasing but bounded function of the inflation rate. Its slope declines with inflation and is asymptotically zero. The reason is obvious. No matter how high inflation is, the most the taxpayer can lose is the full value of the deduction for replacement cost. On the other hand, the value of the interest deduction, positive for after-tax profits, is linear in inflation and unbounded. In Figures 1 and 3, the two effects are super-imposed. At inflation rates below π^* the negative first effect is the larger; at higher rates the positive second effect dominates. Thus the net result depends on the magnitude of the inflation, and on other parameters.

In the debate about the importance of tax-cum-inflation effects in raising effective taxes and handicapping investment, the complainants generally ignored or dismissed the interest effects. They rationalized this neglect by pointing out that interest deducted by businesses is taxable income to individuals, so that the same distortion increases the real borrowing cost facing firms. However, there is no evidence that during the stagflation of the 1970s the real cost of capital to firms increased at all, certainly not to the extent necessary to nullify the advantages to borrowers of full deduction of nominal interest. This point is further discussed at the end.

I. Inventories, FIFO and LIFO

The exaggeration of taxable inventory gains attributed to inflation is, to begin with, mysterious and paradoxical. U.S. tax law allows firms to choose between first-in-first-out (FIFO) and last-in-first-out (LIFO) accounting conventions. Obviously LIFO is virtually equivalent to indexation--not quite, because current sales may exceed current purchases, requiring some inputs to be priced at earlier and lower prices. Nevertheless, most U.S. companies use FIFO. Many did shift to LIFO during the era of inflation, but an amazingly large number did not.

In 1980, the Commerce Department's Inventory Valuation Adjustment reduced the stated profits of nonfinancial corporations by 15 percent. Taxes on those phantom profits lowered after-tax economic income by 13 percent. These were bigger adjustments than the Department's Capital Consumption Adjustment for understatement of depreciation. Lawrence Summers [1981] estimated the effects of FIFO as approximately equivalent to an increase in the corporate tax rate of about $1 \frac{1}{3}$ points for every point of inflation.

It is not clear why firms voluntarily choose, and persist in choosing, an accounting convention that appears to be so avoidable and expensive. It is true that switching to LIFO would reduce reported earnings during inflations, while also entailing revaluations of stocks of materials, products, and work-in-process in nominal balance sheets. There are also a number of technical legal and accounting complications in tax administration and other governmental regulations. It would be a virtually irreversible

decision. On balance, nevertheless, the use of FIFO seems to be based on misconception and inertia. [Foss, 1981, especially Chapter 6]. To count the tax-cum-inflation FIFO distortion as a reason for macroeconomic anti-inflationary policies or for lightening the burdens of taxes on capital income seems very dubious.

It is time to set forth the model.

The firm has sales volume of $S(t)$ at time t . For these sales goods inputs were purchased at various times $t-\theta$, in amounts $c(\theta)$ per unit of sales volume. The total commodity-input cost of sales at time t is

$$(1) \quad C(t) = S(t) \int_0^\infty c(\theta) d\theta = S(t)c$$

where $c = \int_0^\infty c(\theta) d\theta$ is less than or equal to 1. Purchases of goods at time t preparatory for sales at time $t+\theta$ are $S(t+\theta)c(\theta)$. Thus total purchases are

$$(2) \quad P(t) = \int_0^\infty S(t+\theta)c(\theta) d\theta$$

The inventory stock at time t consists of all the goods previously purchased for sales at times after t . For any particular future time $t+r$, this consists of $\int_r^\infty S(t+r)c(\theta) d\theta$. Thus the stock,

$$(3) \quad H(t) = \int_0^\infty S(t+r) \int_r^\infty c(\theta) d\theta dr = \int_t^\infty S(x) \int_{x-t}^\infty c(\theta) d\theta dx$$

From (3) may be derived the change in stock,

$$(4) \quad H'(t) = -S(t)c + \int_t^\infty S(x)c(x-t) dx = -S(t)c + \int_0^\infty S(t+\theta)c(\theta) d\theta$$

$$H'(t) = -S(t)c + P(t)$$

A special case of interest, on which I shall concentrate, is that sales are growing at a steady rate g : $S(t) = S(0)e^{gt}$. Then

$$(5) \quad H(t)/S(t) = \int_0^\infty e^{g\tau} \int_\tau^\infty c(\theta) d\theta d\tau$$

The inventory/sales ratio is a constant, denoted h , larger for higher g .

(If $g = 0$, sales, purchases, and stocks are constant; $P = cS$.) With steady growth, there is some f such that $P(t-f) = cS(t)$. Since $P(t) - cS(t) =$

$gH(t)$, this implies that $P(t-f) = P(t) - gH(t)$

Consider now steady growth at g and steady inflation at π . Suppose that all inventory is financed by short-term debt costing interest at rate $r+\pi$.

The cash flow at time t in dollars is Sales - Purchases + Net Borrowing -

Interest - Taxes:

$$(6) S(t)e^{\pi t} - P(t)e^{\pi t} + (g+\pi)H(t)e^{\pi t} - (r+\pi)H(t)e^{\pi t} - \text{Taxes} = \text{Cash Flow}$$

There are two ways of identifying the tax base:

A. The deductible "cost of goods sold" is specific to the sales at each time t . In this case the constant-dollar cost is $C(t)$, and the only question is whether the price of the goods covered by $C(t)$ is the current price at t -- purest LIFO -- or the actual price paid at various times $t-\theta$ -- FIFO.

B. Goods purchased are not identified with sales. All purchases $P(t)$ are deductible at the current price (LIFO). Or only goods equal in quantity to $C(t)$ are deductible and are assumed to have been purchased at earlier time $t-f$ such that $P(t-f) = C(t)$ (FIFO).

In all cases nominal interest is deductible. The tax rate is T .

A. LIFO. The cash flow is

$$(7) e^{\pi t} \{ [S(t) - P(t) + (g-r)H(t)] + T(r+\pi)H(t) - TS(t)(1-c) \} - e^{\pi t} \{ [S(t)(1-c) - rH(t)](1-T) + T\pi H(t) \}$$

A. FIFO. The cash flow is

$$(8) e^{\pi t} \{ [S(t) - P(t) + (g-r)H(t)] + T(r+\pi)H(t) - T[S(t)(1 - \int_0^\infty c(\theta)e^{-\pi\theta} d\theta)] \} - e^{\pi t} \{ [S(t)(1-c) - rH(t)](1-T) + T\pi H(t) - TS(t)(c - \int_0^\infty c(\theta)e^{-\pi\theta} d\theta) \}$$

According to (7) each point of inflation increases LIFO cash flow by TH . Comparing (8) and (7) gives the loss due to FIFO accounting. It is

$$(9) A.LIFO - A.FIFO = TS(t) \int_0^\infty c(\theta)(1 - e^{-\pi\theta}) d\theta$$

This loss goes from zero at $\pi=0$ to TcS asymptotically as π goes to infinity.

Its derivative with respect to π is $TS(t) \int_0^\infty \theta c(\theta) e^{-\pi\theta} d\theta$, which is positive

but declining with π . However, the real gain due to interest deductibility πH is positive and proportional to π . This gain prevails over the FIFO loss for inflation rates π above π^* , where

$$(9) \quad \pi^* h = c - \int_0^\infty c(\theta) e^{-\pi^* \theta} d\theta \quad (h = H/S, \text{ a constant})$$

These results are shown in Figure 1.

An example may be instructive. Suppose $c(\theta)$ is quadratic, as follows:

$$(10) \quad c(\theta) = a\theta - b\theta^2 \text{ if } \theta < a/b, \quad c(\theta) = 0 \text{ otherwise.}$$

Choose a, b so that $c = \int_0^{a/b} c(\theta) d\theta = 1$, and so that $h = H/S = 1/12$. Then $a = 6^3$, $b = 6^4$, and $a/b = 1/6$. It turns out that in Figure 1 points A and B coincide at the origin -- $\pi^* = 0$; the interest gain is never smaller than the FIFO accounting loss for positive π .

B. LIFO Cash flow is

$$(10) \quad e^{\pi t} \{ [S(t) - P(t) - (r + \pi)H(t)](1 - T) + (g + \pi)H(t) \} - \\ e^{\pi t} \{ [S(t) - P(t) + (g - r)H(t)](1 - T) + T(g + \pi)H(t) \}$$

B. FIFO Cash flow is (recall $P(t-f) = P(t) - gH(t) - cS(t)$)

$$(11) \quad e^{\pi t} \{ [S(t) - P(t) + (g + \pi)H(t) - (r + \pi)H(t)] \} \\ - T \{ S(t)e^{\pi t} - P(t-f)e^{\pi(t-f)} - (r + \pi)H(t)e^{\pi t} \} - \\ e^{\pi t} \{ [S(t) - P(t) + (g - r)H(t)](1 - T) + T\pi H(t) - T(1 - e^{-\pi f})P(t-f) \}$$

In case B, the real loss due to FIFO is

$$(12) \quad B.LIFO - B.FIFO = TgH(t) + TcS(t)(1 - e^{-\pi f})$$

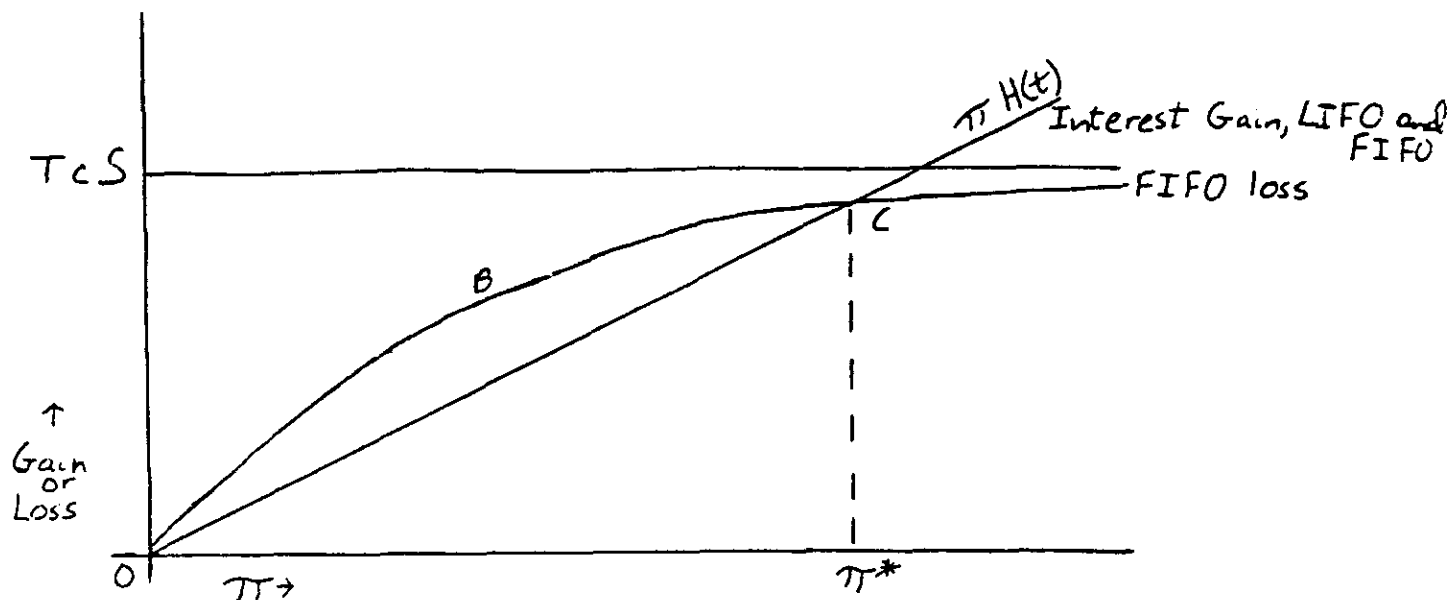


Figure 1. Inflation Effects on Taxation of Inventory Profits: Loss from Use of FIFO and Gain from Nominal Interest Deductibility. Model A.

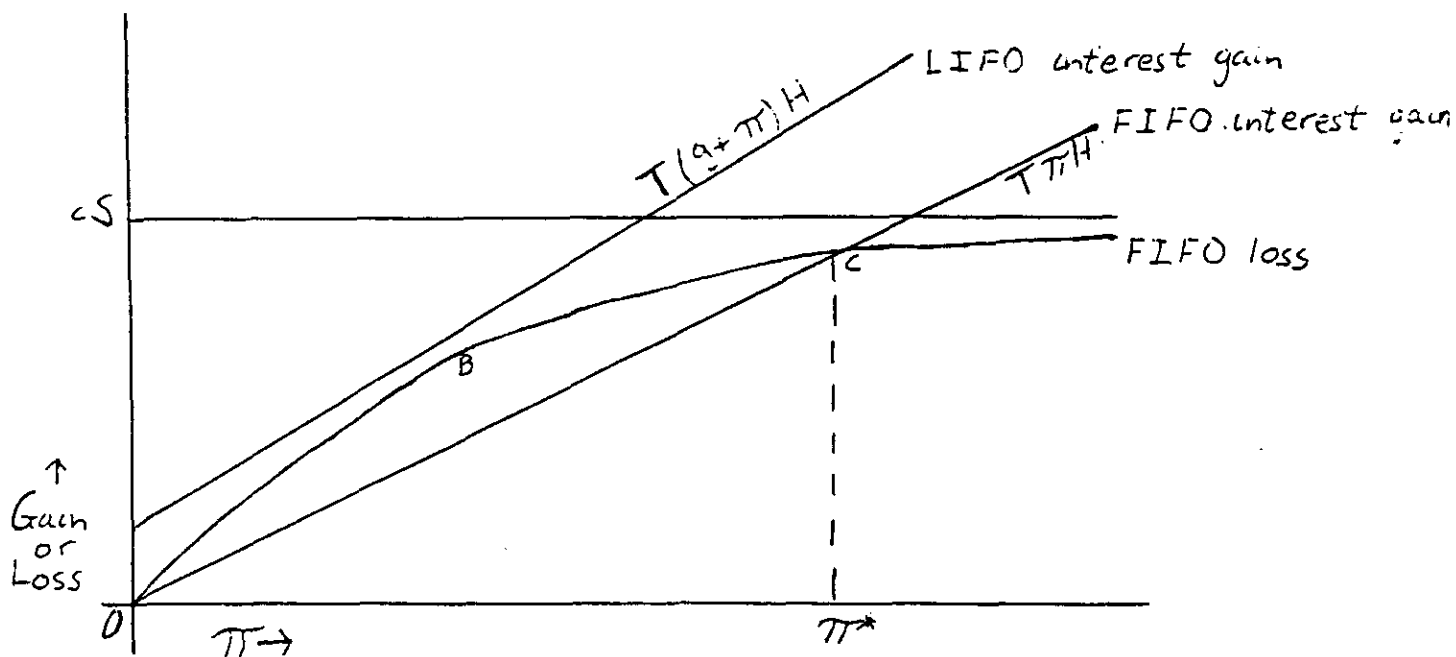


Figure 2. Inflation Effects on Taxation of Inventory Profits: Loss from Use of FIFO and Gain from Nominal Interest Deductibility. (Model B).

The first term is an advantage of B.LIFO independent of inflation. The total real non-neutral tax term for B.FIFO subtracts the second term from the interest gain $T\pi H$: $T\pi H - T(1 - e^{-\pi f})cS$, with derivative $TH - fe^{-\pi f}cS$. The critical inflation rate π^* is given by

$$(13) \quad e^{-\pi^* f} = Th/fc$$

Note that in case B the interest gain for LIFO is $T(g+\pi)H$ and always exceeds that for FIFO.

Figure 2 shows these results for case B.

II. Investment Incentives with Taxes Distorted by Inflation

Here I consider essentially the same two non-neutralities as in Part I. However, the distortion due to historical cost accounting, FIFO above, appears as inadequate allowance for depreciation in reckoning taxable profits. The strength of this distortion relative to the gain from deductibility of nominal interest depends on a number of parameters: the inflation rate, the tax rate, the true economic depreciation rate, the tax allowance for depreciation, the growth rate of the firm, and the debt-equity ratio.

Once again, the method is to compare steady states defined by inflation rates and other parameters. The calculations do not concern transitions from one steady state to another. In particular, the model assumes steady inflation, with actual and expected inflation rates identical. The same inflation rate applies to the firm's outputs and inputs, including purchases of capital goods.

For each steady state, I seek the rate of discount of the future stream

of dollar net receipts that will make their present value equal to the current commodity-price value of the firm's capital stock (q , the ratio of the former to the latter, equal to one.) That discount rate is what the nominal cost of capital to the firm must be to sustain that steady state. The impact of inflation, or of more rather than less inflation, is measured by what happens to that nominal rate. That rate will in equilibrium be the after-tax rate of return required by those who buy or hold, via the stocks and bonds issued by the firm, claims to the earnings of the firm's capital. I am particularly interested in whether the cost of capital has to rise by the same amount as inflation in order to keep the firm's q equal to one, or by more or less.

Consider a corporate firm in a steady state with a real capital stock of 1 at time 0, which is and has been growing at rate g . The real gross yield of capital is R at every point in time. The dollar price of output and of capital goods is 1 at time 0 and is increasing at rate π . Capital evaporates at rate δ . Earnings net of depreciation are taxed at the corporate income tax rate T . Debt is a fraction γ of the nominal value of the capital stock, and bears a nominal interest rate i . The nominal interest outlay is deductible in calculating taxable income. I look for the nominal discount rate ρ that makes the value at time 0 of the stream of dollar cash flow equal to the \$1 value of the capital at this date. Presumably the corporate bond rate i is lower than ρ but is related positively to ρ by a coefficient that depends positively on the debt/equity ratio, here assumed constant over time. The relationship assumed is: $i - \pi = \beta(\rho - \pi)$ with $\beta < 1$. Thus $i = \beta(\rho - \pi) + \pi$.

The basic identity for cash flow in dollars is:

Cash Flow = Gross Earnings - Taxes on Gross Earnings - Gross Investment
+ Tax Savings on Depreciation + Tax Savings on Debt Interest.

Gross Earnings at time t are $Re^{(g+\pi)t}$, and the corresponding tax liability is simply T times that quantity. The tax savings on debt interest are $T\gamma e^{(g+\pi)t}$. (Note that if tax deduction were allowed only on the nominal value of real interest, the saving would be $T\gamma(i-\pi)e^{(g+\pi)t}$)
Gross investment is $(g+\delta)e^{(g+\pi)t}$.

Calculation of tax savings on depreciation is somewhat more complicated. Dollar gross investment at time $u \leq t$ was $(g+\delta)e^{(g+\delta)u}$. The undepreciated amount remaining at time t is $(g+\delta)e^{(g+\delta)u-\delta(t-u)}$. The total tax saving for depreciation is therefore:

$$(14) \quad T\delta(g+\delta)e^{-\delta t} \int_{-\infty}^t e^{(g+\pi+\delta)u} du = [T\delta(g+\delta)e^{(g+\delta)t}] / (g+\delta+\pi)$$

Note that if replacement cost depreciation were allowed the tax saving would simply be $T\delta e^{(g+\pi)t}$. The fraction of this lost is $\pi/(g+\delta+\pi)$.

I now seek the discount rate ρ that makes q , the present value of the cash flow, equal to 1:

$$(15) \quad 1 = (R(1-T) - (g+\delta) + T\delta(g+\delta)/(g+\delta+\pi) + T\gamma\beta(\rho-\pi) + T\gamma\beta\pi) \int_0^{\infty} e^{(g+\pi-\rho)t} dt$$

With the assumption that ρ exceeds $g+\pi$ -- otherwise present value is not finite -- and with some tedious algebra, an explicit expression for ρ can be found:

$$(16) \quad (\rho-\pi)(1-T\gamma\beta) = (R-\delta)(1-T) - T\delta\pi/(g+\delta+\pi) + T\gamma\beta\pi$$

Some special cases will help to elucidate (16). If the two non-neutral features of the tax code were removed, the second and third terms on the right hand side would vanish. If, further, $\gamma\beta = 1$, then the real rate of interest, before and after corporate tax, would simply be the internal return net of depreciation: $\rho-\pi = R-\delta$. This limiting case would apply to a

100 percent debt-financed firm. (Full debt financing was assumed for inventories in Part I.) Inflation would be neutral, and the required nominal discount rate ρ would vary point for point with inflation π . For a pure equity firm ($\gamma\beta = 0$), $\rho - \pi = (R - \delta)(1 - T)$, again independent of inflation. In both these polar cases, the depreciation non-neutrality will make a difference, but debt interest deductibility will not matter for a pure equity firm. Failure to use debt finance, given a tax code that treats it more favorably than equity, is a puzzle of the same nature as FIFO accounting.

From (16) can be calculated the derivative of the required real rate r ($= (\rho - \pi)(1 - T\gamma\beta)$) with respect to π :

$$(17) \quad \partial r / \partial \pi = -T\delta(g + \delta) / (g + \delta + \pi)^2 + T\gamma\beta$$

This derivative is equal to $T\gamma\beta - T\delta/(g + \delta)$ at $\pi = 0$ and increases with π . Consequently, if $\gamma\beta$ exceeds $\delta/(g + \delta)$, the share of depreciation in gross investment, inflation is always expansionary, i.e. the required real discount rate must rise to keep q from exceeding 1. If $\gamma\beta$ is smaller than $\delta/(g + \delta)$, there is a positive finite value of π at which increases in π become expansionary. For example, take $\delta = .075$, $g = .025$, and $\gamma\beta = .04$. These are realistic values; the last one is the ratio of U.S. nonfinancial corporations' net interest payments to the sum of such payments and after-tax profits in 1978. They imply that inflation becomes expansionary beyond a rate of 3.7 percent and that above 8.75 percent inflation the real discount rate r must be at least as high as when inflation is zero. The latter value corresponds to the π^* of Part I. Figure 3 depicts the relationship. Point B represents the 3.7 of the example and point C the 8.75 percent. If the example is realistic, the complaints of

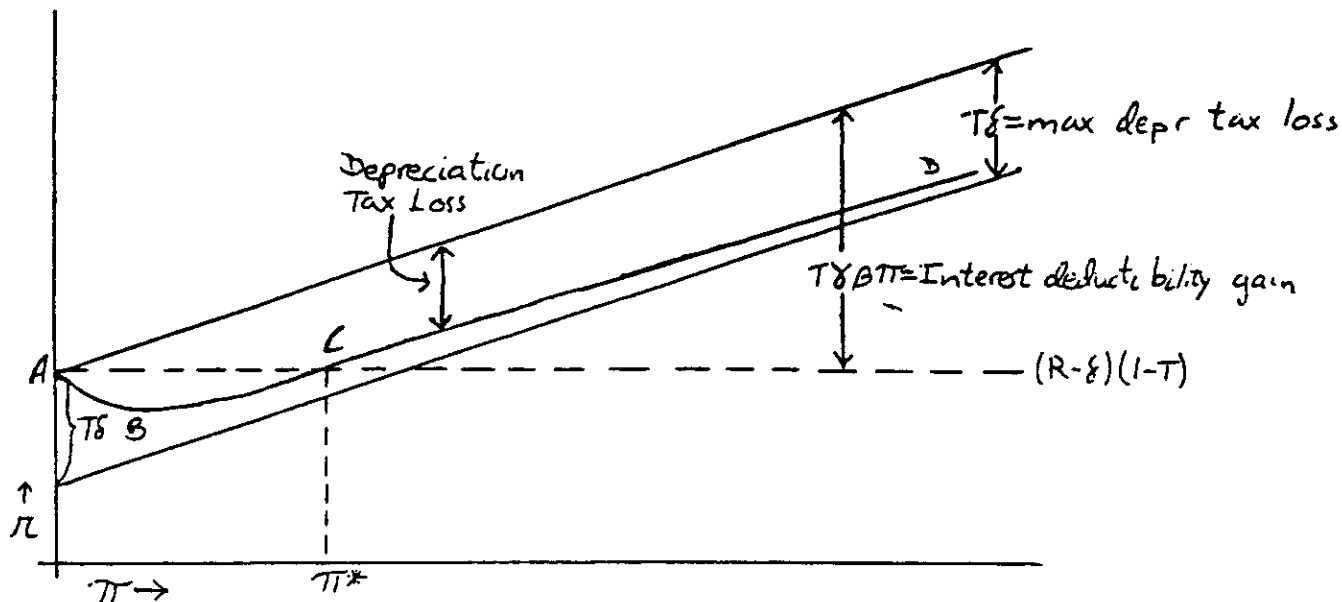


Figure 3. Inflation Effects on After-Tax Return to Business Capital: Decrease due to Historical Cost Depreciation and Increase due to Deductibility of Nominal Interest.

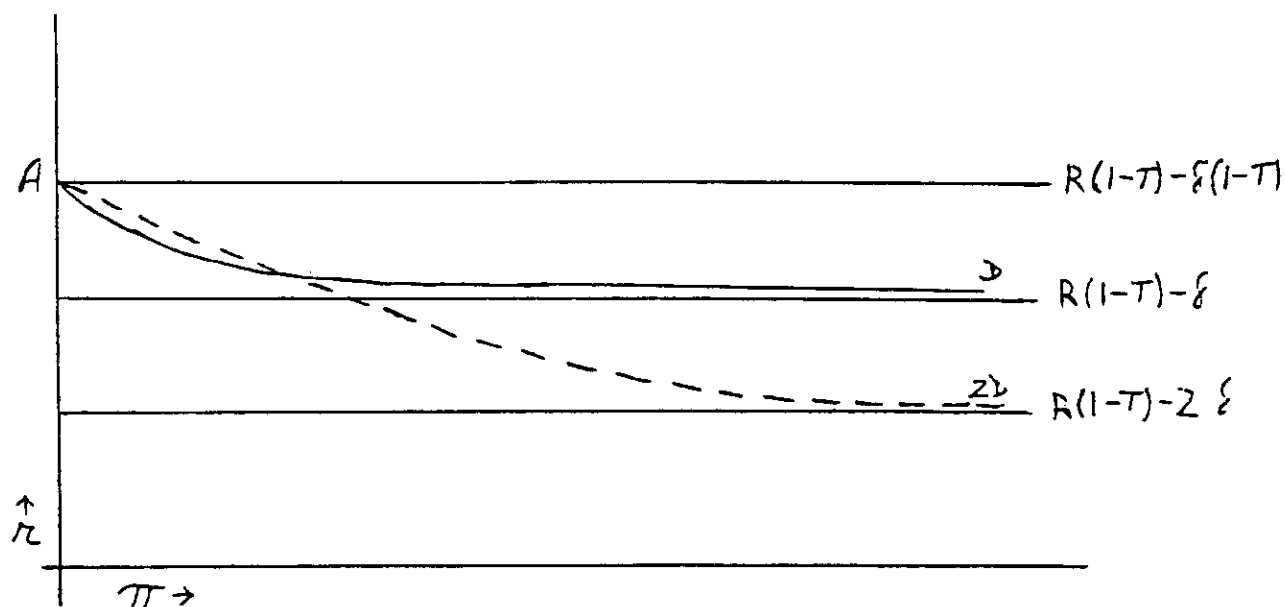


Figure 4. Inflation Effects on After-Tax Return to Business Capital: Decrease due to Historical Cost Depreciation with and without Acceleration.

the 1970s had some merit for the inflation rates prevailing most of the decade.

The reason the interest deduction comes to dominate as the inflation rate rises is that the historical depreciation tax loss is limited to $T\delta$, i.e. to the loss that would occur if no tax saving for depreciation were ever allowed. (A similar limit played the same role in Part I.) In the example, if the corporate tax rate is 40 percent, the maximum possible fall in the real internal rate of return is .03. This non-linearity is shown in Figures 3 and 4. In contrast, the interest deductibility gain is proportional to the inflation rate, as shown in Figure 3, which is analogous to Figure 1 for inventories.

The tax code allowed accelerated depreciation, even before 1981 and ERTA. Assuming the permitted accelerations were more than realistic approximations to true depreciation, they contributed to the after-tax internal rate of return in a way not covered in equation (16). Consequently firms had more to lose during inflation from historical cost accounting.

For illustration, suppose that corporations are allowed to depreciate capital for tax purposes at twice the true rate δ . Then a replication of the calculations above yields, in place of (16),

$$(18) \quad (\rho - \pi)(1 - T\gamma\beta) = (R - \delta)(1 - T) + T\delta(g - \pi)/(g + 2\delta + \pi) + T\gamma\beta\pi$$

It is the second term on the right hand side that is changed from (16). Note that in the absence of inflation the gain from acceleration would be $Tg\delta/(g + 2\delta)$; acceleration is of no advantage to a non-growing firm, for whom deferment of taxes does not alter their present value. Inflation erodes the advantage of acceleration. But in the limit the loss to the internal rate of return cannot exceed $2T\delta(g + \delta)/(g + 2\delta)$. With the numbers assumed in the

previous illustration, this limit is .0343, higher than the .03 without acceleration. The value of π above which $\partial r / \partial \pi$ is positive becomes 1.86 percent, and the value of π at which the real internal rate of return is higher than for zero inflation becomes 3.93 percent. These numbers are lower than without acceleration.

From 1962 to 1986 the tax code allowed an Investment Tax Credit (ITC). Depreciation was allowed on the full historical cost of capital goods, even though part of the cost had been claimed as tax credit. Taking this fact into account and assuming that the debt/equity ratio was not changed by the ITC, the ITC's contribution to the real internal rate of return was not affected by inflation. An ITC of α raises the real internal rate of return by $\alpha(g+\delta)$; for example, an α of 10 percent raises it by 1 percent with $g+\delta$ equal to .10, as assumed in the example above.

In the context of the debate about the alleged stagflationary effects of tax-cum-inflation distortions in the 1970s, my calculations ignore any changes in the tax code made as rough compensation for the inadequacy of historical cost accounting. In fact, the outcry was at least partly responsible for a reduction of 3.2 points in the corporate income tax rate in the ten years prior to 1981. If $R-\delta$ is taken to be 12.5 percent, the rate reduction alone raised the after tax internal rate of return by 0.4 percent. In addition, the ITC was liberalized and supposedly made permanent.

Another question of policy relevance concerns ρ , the pre-tax nominal discount rate applied by the holders of corporate securities to the future yields of corporate capital. As noted at the beginning, this question is also relevant to the possible importance of FIFO accounting in raising

effective tax rates and discouraging business activity, inventory demand, and overall investment. The question considered above was how ρ must change in order to sustain the same steady state, i.e. one with the same path of the capital stock. Must it rise more or less than the inflation rate? The assumption was that if ρ must rise more than π , an increase in π is expansionary, while if it must rise less, an increase in π is contractionary.

However, holding $\rho - \pi$ constant is not neutral for individual owners of corporate securities. Personal income and wealth taxation also contains some non-neutral features. In particular, both interest income and capital gains are taxed on a nominal basis. To a taxpayer with an unchanged marginal tax rate of μ , applied to nominal returns, the after-tax real return is $(1-\mu)\rho - \pi$. If this is to be invariant to inflation, ρ must rise by $1/(1-\mu)$ points for every point of inflation. An increase of this order of magnitude could easily be more than the corporate or business sector could absorb, because $1/(1-\mu)$ surely exceeds $\gamma\beta$.

During the unhappy 1970s a number of steps were taken to reduce μ . These included: reduction by about one-third in the maximum effective tax on capital gains; generous provisions for deferment of taxes on saving for retirement; reduction in maximum marginal personal income tax rates; adjustment of rate brackets in partial compensation for inflation.

There were and still are many ways in which personal income taxpayers escape, reduce, or defer taxes on interest incomes and other asset returns. Eugene Steuerle [1981] estimated that less than one third of property incomes shows up as taxable personal income. The above theoretical greater-than-one elasticity of pre-tax interest rates to inflation certainly is not

supported by evidence.

An estimate of the μ 's relevant in securities markets can be obtained by comparing high grade tax-exempt bond rates with Aaa corporate bond rates. The implicit marginal tax rate was 0.27 in 1964, 0.27 in 1972, and 0.34 in 1979. These are if anything over-estimates of μ , since highly taxed investors are naturally concentrated in the tax-exempt market. The sharp acceleration of inflation increased the tax-exempt nominal rate only by 3.2 points between 1964 and 1979, and only by 1.2 points after 1972. The course of taxable Aaa rates is consistent either with constancy of the pre-tax real rate or with a model in which the after-tax nominal Aaa rate followed the tax-exempt rate and the marginal tax rate effective in the bond market was about 1/2. What the experience seems to contradict very strongly is constancy of the after-tax real rate on corporate securities. That rate declined. Interest rates do not appear to be governed by a constant inter-temporal substitution rate for consumer-savers.

For these reasons, I believe that interest deductibility was a source of gain to business debtors during inflation, not offset by any significant increase in the their real cost of borrowing from personal income taxpayers. The allegation that tax-cum-inflation distortions were crippling the economy in the 1970s were, therefore, exaggerations.

There were plenty of other factors to explain the stagflation. The prices of business inputs rose faster than those of outputs, thanks to oil and energy prices. The risks of cyclical fluctuations in real demand and real earnings increased, thanks to the proclivity of the authorities to counter inflation periodically with restrictive monetary policies, as in 1970, 1974, and 1980, and by price controls in 1971. Excess capacity

inhibits investment. A slowdown in growth of total factor productivity, the sources of which are still not understood, occurred in the mid-1970s. These changes in the environment were reflected in the stock market, where real rates as measured by earnings/price ratios shot up. But it is hard to explain the unhappiness of corporate investors simply by inflationary tax distortions.

A final remark of a theoretical nature: In the article cited above, Lawrence Summers counted the full decline he estimated in the real after-tax internal rate of return to nonfinancial businesses as deterrent to accumulation of fixed capital. Nearly half of the decline was over-taxation of inventory gains due to use of FIFO. This did not seem appropriate to me, because inventory gains cannot be regarded as returns to fixed capital. Goods stocked and work-in-process are the product of all factor inputs, labor and natural resources as well as capital services. Thus overtaxation of inventory gains should reduce the demand for all inputs, not just capital. We need an "Austrian" production function to model inventories, recognizing the time lags, more likely distributed than point-to-point, between inputs and outputs and sales. When I studied introductory economics from Taussig's textbook at Harvard fifty years ago, we learned that labor, for example, is paid its discounted marginal product, discounted over the period of production. A major question of technology is what flexibility and choice, if any, exist in lag structures like the $c(\theta)$ function taken as fixed in Part I, and how they are related to other features of production technology, like capital/labor intensities. Perhaps these are matters on which an amateur like myself will be instructed during this conference.

REFERENCES

- Feldstein, Martin 1983, Inflation, Tax Rules, and Capital Formation, National Bureau of Economic Research Monograph, Chicago: University of Chicago Press.
- Foss, Murray F., Gary Fromm, and Irving Rottenberg 1981, Measurement of Business Inventories, Economic Research Report 3, U.S. Bureau of the Census and National Bureau of Economic Research, Washington: U.S. Government Printing Office.
- Steuerle, C. Eugene 1980, "Is Income from Capital Subject to Individual Income Taxation?" Office of Tax Analysis Paper #42, Washington: U.S. Treasury Department.
- Summers, Lawrence H 1981, "Taxation and Corporate Investment: A q-Theory Approach," Brookings Papers on Economic Activity, No. 1, 67-127.