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CAPITAL ASSET REPLACEMENT UNDER CONDITIONS OF CHANGING PRICES

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Michael W. Maher
Assistant Professor of Accounting
The University of Michigan

Timothy J. Nantell
Associate Professor of Finance
The University of Michigan

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ABSTRACT

Ongoing levels of double-digit inflation have prompted concerns about the ability of firms to replace capital assets. One concern in that current tax laws, based on historical cost depreciation, "understate" the depreciation deduction and "overstate" taxable income. A proposed method for dealing with this problem is to index depreciation to reflect changes in the prices of assets.

This paper (1) demonstrates conditions and assumptions under which the depreciation indexing argument holds, and (2) demonstrates that the introduction of debt financing has a major impact on the argument. Because the "premium" paid to lenders to maintain the purchasing power of the principal loaned is treated as interest under current tax laws, depreciation indexing compensates for the effect of inflation only if the corporate tax rate equals the lenders' tax rate. If the corporate tax rate exceeds the tax rate of lenders, then depreciation indexing <u>over</u>compensates for the effects of inflation.

INTRODUCTION TO DEPRECIATION INDEXING

Problems of dealing with inflation have received extensive attention in the literature and by policy makers. Ongoing levels of double digit inflation have prompted concerns about the ability of firms to generate sufficient funds to replace their existing capacity, as exemplified in the following statement by Harold Williams:

> The economic reality of an inflationary environment is that much of American business is not generating and retaining sufficient funds to replace existing capacity and to maintain the present level of operations--let alone expand and invest in improved productivity (Williams [1979], p. 14).

Although these concerns have been expressed both in the context of accounting policies[1] and cost-based reimbursement policies[2], the essentials of the argument can best be seen by examining the tax treatment of depreciation. Essentially, the argument is that with tax laws based on original cost depreciation, "understated" depreciation deductions result in "overstated" taxable income:

> Since depreciation expenses allowable for tax purposes are tied to a historical cost valuation of capital assets, the real value of such tax deductions is continually eroded in an inflationary economy. The process is cumulative, so that over time the original cost depreciation base of an asset is worth progressively less in terms of purchasing power. As the revenues of corporations rise with the upward march in the general level of prices, depreciation deductions fixed in historical dollars provide an ever less effective shield against the bite of the corporate income tax (Corcoran [1979], p. 162).[3]

One remedy to "overstating" taxable income because depreciation is "understated" is to "index" or to adjust depreciation to reflect current costs. Hong (1977) presents evidence of a reduction in the value of firms in an inflationary environment due to tax effects of historical cost depreciation, while Nelson's (1976) establishment of an inverse relationship between inflation and capital investment is derived from the fact that depreciation for tax purposes is not indexed to inflation: ". . . after-tax present values are not neutral with respect to different rates of inflation because depreciation charges are based on historical costs . . .(p. 923). One of the strongest arguments for indexing of accounting costs would be the elimination of such distortions" (p. 931). In addition, Revsine and Weygandt (1974) provide an argument for retroactive indexing: "If replacement prices have continuously been increasing, then past replacement cost depreciation has not shielded sufficient inflows from possible dividend distribution to allow eventual replacement of the asset with a new asset at its current higher price" (p. 77).

In short, these arguments maintain that depreciation indexing is needed to assure that firms have the capacity to maintain (i.e. replace) their capital. The purpose of this paper is to address this issue by demonstrating that the issue is more complex than implied by these arguments. We begin by showing that, under certain conditions, indexing depreciation for tax purposes compensates for inflation and provides sufficient cash flows for capital asset replacement. However, we find that when assets are at least partially debt financed, and the Fisher hypothesis is used to consider the full impact of lenders' personal taxes, depreciation indexing does not necessarily remedy the situation. Further, under certain conditions, indexing the depreciation tax shield overcompensates for the effect of changing prices.

Before proceeding with the analysis, we should point out that this paper emphasizes the cash flow effects of indexing the depreciation tax shield. There are, of course, implications of our analysis for accounting policy, particularly for those who argue that users are misled when financial statements do not signal the replacement cost of assets, that managers have tendencies to "overpay" dividends, that inflationary wage demands are made when accounting income is "overstated,"[4] or that inflated accounting income unduly attracts the attention of regulators, media and the public. Similarly, there are implications of our analysis for depreciation reimbursement policy in cost-based reimbursement programs such as Medicaid and defense contracting. We emphasize that we do not address these tax, accounting and cost-reimbursement policy issues directly. Nor do we argue for or against the social or private desirability of depreciation indexing. Our objective is only to demonstrate the effect this procedure has on cash flows in the context of the tax law; we leave it to our readers to draw their own conclusions for the other policy issues.

THE ARGUMENT FOR DEPRECIATION INDEXING

In this section, we demonstrate the conditions and assumptions of the argument that failure to index depreciation results in "understatement" of depreciation and "overstatement" of taxable net income. Thus, according to the argument for depreciation indexing, insufficient funds are retained in the firm to replace assets and maintain operating capacity.

To demonstrate the argument in support of depreciation indexing, we compare the inflation to the no-inflation case, assuming assets are totally equity financed. To keep the numerical analysis from becoming unduly complex, we assume a simple firm in which a depreciable asset with a one year life and no salvage value had been acquired for cash at the beginning of the year, and to maintain operating capacity, the same asset is replaced at the end of the year. All cash flows occur at the end of the year and are either paid in operating expenses and taxes, are retained to replace the asset, or are paid to the firm's owners. Sales and wage contracts are formed such that all cash transactions take place at year-end in end-of-year dollars. As we proceed through the analysis, it will be readily seen that these assumptions, however restrictive they appear, do not affect the underlying concept; we employ them only to simplify the exposition.

Basic Case.

The first step in formulating the model is to define the after-corporate-tax cash flows available to the owners of the firm in the no-debt, no-inflation case as follows:

(1) $NCF = X(1 - t_c) + t_c C - C,$

where NCF = net cash flows available to owners, in the no-inflation case.[5]

X = before-tax cash operating flows. These are the net result of all before-tax, before-interest operating transactions, except depreciation. These are assumed to be taxable.

t_c = corporate tax rate.

C = cost of the asset at the beginning of the period. This entire cost is depreciated for tax purposes. The cash flow in equation (1) occurs at year-end when the asset is replaced.

Basic Case with Inflation.

To demonstrate the argument for depreciation indexing, we first examine the effect of inflation on the basic model without depreciation indexing, as follows:

(2) $NCF_p = X(1 + p)(1 - t_c) + t_cC - (1 + p)C,$

where p = the rate of all price changes.[6] The subscript p on NCF denotes cash flows under inflation without depreciation indexing. The other terms are as defined for equation (1).

As shown in equation (2), after-tax operating cash flows $[X(1 - t_c)]$ and asset replacement costs (C) reflect changes in market prices automatically as goods and services are exchanged; however, the depreciation tax shield (t_cC) does not. Those who maintain that the "understated" depreciation deduction for tax purposes results in "overstated" taxable income argue that if an equivalent amount of purchasing power is paid to owners under inflation as would be paid under no inflation, then insufficient funds would be available to replace the asset. According to the depreciation indexing argument, price-level changes must be reflected for all cash flow variables, as shown in equation (3), to maintain the purchasing-power-equivalent payment to owners under inflation as under no inflation.

(3) $$\begin{aligned} NCF_{pd} &= [X(1 - t_c) + t_cC - C]\,(1 + p) \\ &= X(1 - t_c)(1 + p) + t_cC(1 + p) - C(1 + p) \\ &= NCF(1 + p) \end{aligned}$$

where NCF_{pd} = net cash flow available to owners under inflation and depreciation indexing.

Example. This argument is demonstrated by the presentation in Table 1, in which X = \$20,000, t_c = 0.40, C = \$10,000 and the rate of inflation, p, is either zero or six percent. For ease of analysis, assume t_c is constant, C is the original asset purchase price at the beginning of the year and (1 + p)C is required to replace it at the end of the year. A comparison of the cash flows for the no-inflation, inflation-without-indexing and inflation-with-indexing cases is shown in Table 1.

A comparison of columns (1) and (2) of Table 1 demonstrates the argument that if operating capacity is maintained through replacement of depreciated assets, then insufficient funds are available to maintain the purchasing power of payments to owners. Under the no-inflation case, the payment to owners is $6,000. Under inflation without depreciation indexing, the payment to owners goes up to $6,120; however, when adjusted for inflation, the purchasing-power-equivalent payment to owners is only $5,774.[7] Depreciation indexing increases the tax shield by pt_cC, or $240, to reflect the higher price required at the end of the year to replace the asset. Thus, as shown in column (3) of Table 1, if depreciation is indexed, the cash available to owners provides the same purchasing power as in the no-inflation case.

This is consistent with Nelson's (1976) establishment of an inverse relationship between inflation and capital investment because depreciation for tax purposes is not indexed to inflation. In a similar vein, Kim (1979) makes reference to decreasing investment under inflation due to historical depreciation charges (p. 941). However, as we demonstrate in the next section, the effects of inflation are more complex when we introduce debt financing. Indexing depreciation for tax purposes will rarely have the impact on net cash flow that was demonstrated in the no-debt case.

IMPACT OF DEBT FINANCING ON THE DEPRECIATION INDEXING ARGUMENT

The No-Inflation-With-Debt Case.

If the asset is partially financed by debt which is borrowed at the beginning of the year under a contract calling for principal repayment and interest payment at the end of the year, equation (1) (i.e. the no-inflation basic case) becomes:

$$(4) \quad NCF^* = X(1 - t_c) + t_cC - rbC(1 - t_c) - bC - (1 - b)C$$

where NCF* = net cash flows available to owners in the no-inflation-with-debt case, without depreciation indexing;

r = rate of interest on debt in the no-inflation case;

b = percent of the cost financed with debt (thus bC is the principal repaid and (1 - b)C is the cost to replace that portion of the asset not financed with debt);

and the other terms are as defined for equation (1).

The Inflation-With-Debt-Financing Case.

In a similar fashion, equation (2) (i.e. the basic case with inflation) becomes:

$$(5) \quad NCF^*_p = X(1 + p)(1 - t_c) + t_cC - ibC(1 - t_c) - bC - (1 - b)C\ (1 + p)$$

with the terms defined as before, except that the level of interest in equation (5), i, is higher than r in equation (4) if lenders expect positive inflation rates. Next we specify the interest variable more completely.

Specifying required interest rates. The level of interest required by lenders is assumed to be set by the market as a function of risk and personal tax rates of lenders as follows:

(6) $r = \dfrac{r'}{(1 - t_\ell)}$

where r = the interest rate on debt;

r' = the lenders' risk-adjusted required after-personal-tax rate;

t_ℓ = the lenders' personal tax rate.

According to equation (6), if the lenders are to receive an after-personal-tax rate commensurate with the risk they are facing, and if that rate is r', then they must charge the borrower at the rate r.

To completely specify equation (4) under the no-inflation assumption, we substitute equation (6) for r in equation (4):

(7) $NCF^* = X(1 - t_c) + t_cC - \left[\dfrac{r'}{(1 - t_\ell)}\right]bC(1 - t_c) - bC - (1 - b)C.$

The level of r as specified in equation (6) ignores expected inflation.[8] If the real rate of interest is unaffected by anticipated inflation,[9] then according to the Fisher hypothesis:

(8) $1 + i' = (1 + r')(1 + p)$

or

(8a) $i' = r' + r'p + p$

where i' = the lenders' required after-personal-tax interest rate, taking expected inflation into account. The other terms are as previously defined.

To provide lenders with the required rate i', the required before-personal-tax rate is:

(9) $i = \dfrac{r'}{(1 - t_\ell)} + \dfrac{r'p}{(1 - t_\ell)} + \dfrac{p}{(1 - t_\ell)}$

$= \dfrac{r'\ (1 + p) + p}{(1 - t_\ell)},$

where i = the lenders' required before-personal-tax interest rate, taking expected inflation into account.

The term $\left[\frac{r'(1 + p)}{(1 - t_\ell)}\right]$ from equation (9), when multiplied by the principal bC, reflects the lenders' requirement that they be paid a purchasing power equivalent interest payment with expected inflation as they would be paid under no inflation. In addition, lenders require payment to maintain the purchasing power of the principal loaned, or pbC. Because that payment is taxable to lenders as "interest," they require a before-personal-tax rate of $\frac{p}{(1 - t_\ell)}$, not p, if they are to maintain the after-tax purchasing power of their principal.[10]

Summary. To summarize, we substitute the results from the before-personal-tax version of the Fisher hypothesis shown in equation (9) for i in equation (5) to derive net cash flows under inflation with debt financing:

$$(10)\quad NCF^*_p = X(1 + p)(1 - t_c) + t_cC - \left[\frac{r'\ (1 + p) + p}{(1 - t_\ell)}\right]bC(1 - t_c)$$
$$- bC - (1 - b)C(1 + p).$$

Impact on Net Cash Flows.

As in the case with no debt, we compare the inflation to the no-inflation case to determine the validity of the argument that depreciation indexing for tax purposes shields sufficient cash flows to replace assets.

Example. The argument is demonstrated by the presentation in Table 2, in which X = \$20,000, $t_c = 0.40$, C = \$10,000, p is either zero or six percent, bC = \$3,000, r' = 0.04 and $t_\ell = 0.20$. To demonstrate the net cash flows in the no-inflation case, we refer to equation (7):

$$(7)\quad NCF^* = X(1 - t_c) + t_cC - \left[\frac{r'}{(1 - t_\ell)}\right]bC(1 - t_c) - bC - (1 - b)C$$

= \$5,910 available for payment to owners. This case is detailed in column (1) of Table 2.

In the inflation case, we let p = .06, and retain the other assumptions of our ongoing example. Referring to equation (10), we have the following results without depreciation indexing:

$$(10)\quad NCF^*_p = X(1 + p)(1 - t_c) + t_cC - \left[\frac{r'\ (1 + p) + p}{(1 - t_\ell)}\right] bC(1 - t_c)$$

$$- bC - (1 - b)C(1 + p)$$

$= \$6,069.60$ available to owners. As shown in column (2) of Table 2, while the net cash available to owners is higher than in the no-inflation case, the purchasing-power-equivalent of that cash is lower. As we saw in the no-debt case, if the purchasing-power-equivalent of the payment to owners is maintained, insufficient cash is left to replace the asset.

If depreciation indexing is allowed for tax purposes, the index pt_cC is introduced into equation (10) to provide a tax shield of $(1 + p)t_cC$:

$$(11)\quad NCF^*_{pd} = X(1 + p)(1 - t_c) + (1 + p)t_cC$$

$$- \left[\frac{r'(1 + p) + p}{(1 - t_\ell)}\right] bC(1 - t_c) - bC - (1 - b)C(1 + p).$$

Continuing the previous example, but introducing depreciation indexing, we have

$$NCF^*_{pd} = \$6,309.60$$

available to owners. As shown in column (3) of Table 2, depreciation indexing results in <u>over</u>compensation for the effect of inflation, in this case, because the purchasing-power-equivalent of cash available to owners is greater under depreciation indexing with inflation than it is in the no-inflation case.

Source of the Problem.

Although depreciation-indexing resulted in compensation for the effect of inflation in the no-debt case, financial leverage makes the situation more complex. This is because the payment to lenders to maintain the purchasing power of their principal (the principal "premium") is not a tax free transfer of funds under current tax laws. If it was, as shown in column (4) of Table 2, depreciation indexing would compensate for the effects of inflation, just as it did in the no-debt case.

Under conventional loan contracts, however, the principal "premium" is treated as interest which is deductible to the firm and taxable to the lender. Thus, instead of paying a "premium" of pbC to lenders, firms pay $\left[\frac{p}{(1 - t_\ell)}\right] bC(1 - t_c)$ and the difference (D) is:

$$(12) \quad D = pbC - \left\{\left[\frac{p}{(1 - t_\ell)}\right] bC(1-t_c)\right\}.$$

Example. The dollar impact of (12) on our continuing example is:

$$(12) \quad D = pbC - \left\{\left[\frac{p}{(1 - t_\ell)}\right] bC(1 - t_c)\right\}$$

$$= (.06)(.3)(\$10,000) - \left[\frac{.06}{.8}\right] (.3)(\$10,000)(.6)$$

$$= \$180 - \$135$$

$$= \$45.$$

Under current tax laws, the firm pays \$135 after corporate taxes to lenders for the principal "premium," instead of \$180 which would be paid if the "premium" was a tax free transfer of funds from the firm to the lender. When adjusted to purchasing-power-equivalence, this difference of \$45 is \$42.45, which is the overcompensation shown in column (3) of Table 2.

The above illustration of our analysis demonstrates a case in which depreciation indexing overcompensates for the effects of inflation on cash flows, because the lenders' personal tax rate was assumed to be less than the corporate tax rate. It is apparent from equation (12) that when $t_c = t_\ell$, $D = 0$ and depreciation indexing neutralizes the effects of inflation as it did in the no-debt case. When $t_c < t_\ell$, $D < 0$ and depreciation indexing undercompensates for the effects of inflation. An example of each of the overcompensation, neutral, and undercompensation cases is presented in Table 3.

An Extension.

To this point, the analysis has assumed that lenders predict inflation accurately; that is, expected and actual inflation were assumed to be equivalent. In the interests of generalizing the results, this section examines the impact of removing this assumption.[11]

Because lenders establish the interest rate at the beginning of the period, that rate is a function of expected, not actual, inflation. In other words, equation (9) should read

$$(13) \quad i = \frac{r'(1 + \overline{p}) + \overline{p}}{(1 - t_{\ell})}$$

where $\overline{p}$ is the one period expected rate of inflation. Using this version of the Fisher hypothesis to develop the formulation of cash flows under inflation with depreciation indexing results in the following:

$$(14) \quad NCF^{*}_{pd} = X(1 + p)(1 - t_c) + (1 + p)t_cC - \left[\frac{r'(1 + \overline{p}) + \overline{p}}{(1 - t_{\ell})}\right]bC(1 - t_c) - bC - (1 - b)C(1 + p).$$

This is equivalent to equation (11), except that $\overline{p}$ has replaced p in those terms associated with the interest payments.

In order to compare cash flows under inflation and with indexing (NCF^{*}_{pd}) to those from the no-inflation case (NCF*), it is helpful to express actual inflation as the sum of expected and unexpected inflation; that is, $p = \overline{p} + \mu$. Rewriting this as $\overline{p} = p - \mu$, substituting the result into equation (14), and simplifying we get

$$(15) \quad NCF^{*}_{pd} = NCF^{*}(1 + p) + pbC - \left[\frac{p}{1 - t_{\ell}}\right]bC(1 - t_c) + \mu\left[bC(1 - t_c)\right]\left[\frac{1 + r'}{1 - t_{\ell}}\right]$$

The second and third terms on the right hand side of this equation comprise the difference term (D) of equation (12). As we concluded above, cash flow increases by more than or less than the rate of inflation depending on the relationship between t_c and t_ℓ. However, the final term of equation (15) accounts for an additional effect on cash flow whenever inflation has not been correctly anticipated by the lenders (i.e. whenever $\mu \neq 0$). If lenders haven't fully reflected inflation in their interest charges (i.e. if $\mu > 0$), then cash flow to shareholders are incremented by the additional amount represented by the last term in equation (15). This term represents the well-known inflation-induced wealth transfer from lenders to borrowers that occurs whenever lenders underestimate inflation rates. Of course, if inflation is overestimated and interest rates are set too high, then $\mu < 0$ and the direction of the additional wealth transfer is from the borrowers to the lenders.

When $\mu \neq 0$, the resulting wealth transfer will not affect our basic argument about the effects of depreciation indexing under inflation when firms' depreciable assets are at least partially debt-financed. The interaction of this wealth transfer with debt-financing does affect the dollar impact of depreciation indexing. These points are demonstrated in Table 4, where μ is assumed to be $\pm$ .04 and the cash flow effect on owners is $\pm$ \$93.60.

Summary.

When debt financing of the depreciable asset is considered, the depreciation indexing argument becomes more complex than it did in the no-debt case, even if the actual rate of inflation equals the expected rate. Because the principal "premium" is treated as interest under current tax laws, it is deductible to the corporation (borrower) and taxable to the lender. Thus, depreciation indexing compensates for the effect of inflation only if the corporate tax rate equals the lenders' tax rate. If the corporate tax rate, t_c, is greater than the lenders' tax rate, t_ℓ, depreciation indexing overcompensates for the effects of inflation. When $t_c < t_\ell$, it undercompensates. Allowing actual inflation rates to deviate from expected levels does not alter this basic conclusion regarding the impact of depreciation indexing on cash flows; rather, generalizing the assumptions to allow for deviations between actual and expected inflation results in an additional term which captures the well-known potential wealth transfer between lenders and borrowers under inflation.

CONCLUSIONS

We have demonstrated that the depreciation-indexing argument holds when no debt financing is used. However, with debt financing, the issue is more complex and depends upon the relation between corporate and lender tax rates. We emphasize that these results are not normative, we have not addressed the propriety of depreciation indexing for tax or any other purpose. However, we have shown that with debt financing, changing the tax law to provide depreciation indexing would not necessarily neutralize the effect of inflation on net cash flow.

Of course, managers have incentives to call for indexing depreciation for tax purposes if they believe the net benefits[12] of a change in the tax law would have a positive net present value. Our results indicate that with debt financing, depreciation indexing rarely neutralizes and may overcompensate for the effects of inflation.

Current tax laws, which tax the principal "premium" to lenders while allowing it as a deduction to corporations, create incentives for debt financing if the corporate tax rate is greater than the lenders' rate. This is one possible explanation for debt financing under inflation. If the lenders' tax rate exceeds the corporate rate, there are incentives to reduce the level of debt financing.

Table 1

Comparative Analysis of Net Cash Flows: No-Debt Case

Assumptions

X = \$20,000 C = \$10,000

t_c = .40   Asset life: One year

p = .00 or .06

	(1) No Inflation (p = 00)	(2) With Inflation (p = .06), Without Depreciation Indexing	(3) With Inflation (p = .06) and Depreciation Indexing
After-tax operating cash flows:			
$[X(1 - t_c)]$	\$12,000		
$[X(1 + p)(1 - t_c)]$		\$12,720	\$12,720
Depreciation tax shield:			
$[t_c C]$	4,000	4,000	
$[(1 + p)t_c C]$			4,240
Cash required to replace asset:			
$[C]$	(10,000)		
$[(1 + p)C]$		(10,600)	(10,600)
Net cash flow available for payment to owners	\$ 6,000	\$ 6,120	\$ 6,360
Purchasing-power-equivalent (of net cash flow) to the no-inflation case	\$ 6,000	\$ 5,774	\$ 6,000

Table 2

Comparative Analysis of Net Cash Flows
with Debt Financing

Assumptions

$X = \$20{,}000$ $\quad p = .00$ or $.06$ $\quad b = .30$ $\quad t_\ell = .20$

$t_c = .40$ $\quad C = \$10{,}000$ $\quad r' = .04$ $\quad$ Asset life: One year

	(1) No Inflation (p = .00)	(2) With Inflation (p = .06), Without Depreciation Indexing	(3) With Inflation (p = .06) and Depreciation Indexing	(4) With Inflation (p = .06), Depreciation Indexing and Premium Payment as Part of Principal
After-tax operating cash flows:				
$[X(1 - t_c)]$	$12,000			
$[X(1 - t_c)(1 + p)]$ . . .		$12,720	$12,720	$12,720
Depreciation tax shield:				
$[t_c C]$	4,000	4,000		
$[(1 + p)t_c C]$			4,240	4,240
Interest payment:				
$\left[\left\{\frac{r'}{(1 - t_\ell)}\right\} bC(1 - t_c)\right]$	(90)			
$\left[\left\{\frac{r'(1 + p) + p}{(1 - t_\ell)}\right\} bC(1 - t_c)\right]$		(230.40)	(230.40)	
$\left[\left\{\frac{r'(1 + p)}{(1 - t_\ell)}\right\} bC(1 - t_c)\right]$				(95.40)
Principal repayment:				
$[bC]$	(3,000)	(3,000)	(3,000)	
$[bC(1 + p)]$				(3,180)
Cash required to replace portion of asset not financed with debt:				
$[(1 - b)C]$	(7,000)			
$[(1 - b)C\ (1 + p)]$ . .		(7,420)	(7,420)	(7,420)
Net cash flow available for payment to owners	$5,910	$6,069.60	$6,309.60	$6,264.60
Purchasing-power-equivalent (of net cash flow) to the no-inflation case	$5,910	$5,726.04	$5,952.45	$5,910
Over(under)compensation, in equivalent purchasing power .	$ -0-	$(183.96)	$ 42.45	$ -0-

Table 3

Effects of the Relation Between Corporate and Lender Tax Rates on Compensation for Inflation with Debt Financing

Assumptions

$X = \$20{,}000$	$b = 30$
$t_c = .40$	$r' = .04$
$p = .06$	$t_\ell = .20, .40,$ or $.60$
$C = \$10{,}000$	Asset life: One year

	Overcompensation Case ($t_c = .40$, $t_\ell = .20$)		Neutral Case ($t_c = .40$, $t_\ell = .40$)		Undercompensation Case ($t_c = .40$, $t_\ell = .60$)	
	(1) Without Inflation*	(2) With Inflation*	(3) Without Inflation	(4) With Inflation	(5) Without Inflation	(6) With Inflation
After-tax operating cash flows:						
$[X(1 - t_c)]$	$12,000		$12,000		$12,000	
$[X(1 + p)(1 - t_c)]$.		$12,720		$12,720		$12,720
Depreciation tax shield:						
$[t_c C]$	4,000		4,000		4,000	
$[(1 + p)t_c C]$.		4,240		4,240		4,240
Interest payment:						
$\left[\left\{\frac{r'}{(1 - t_\ell)}\right\} bC(1 - t_c)\right]$ . . .	(90)		(120)		(180)	
$\left[\left\{\frac{r'(1 + p) + p}{(1 - t_\ell)}\right\} bC(1 - t_c)\right]$.		(230.40)		(307.20)		(460.80)
Principal repayment:						
$[bC]$.	(3,000)	(3,000)	(3,000)	(3,000)	(3,000)	(3,000)
Cash required to replace portion of asset not financed with debt:						
$[(1 - b)C]$	(7,000)		(7,000)		(7,000)	
$[(1 - b)C(1 + p)]$		(7,420)		(7,420)		(7,420)
Net cash flow available for payment to owners	$5,910	$6,309.60	$5,880	$6,232.80	$5,820	$6,079.20
Purchasing-power-equivalent (of net cash flow) to the no-inflation case	$5,910	$5,952.45	$5,880	$5,880	$5,820	$5,735.09
Over(under)compensation in equivalent purchasing power . .		$ 42.45		$ -0-		$ (84.91)

* Column (1) corresponds to column (1) of Table 2, column (2) corresponds to column (3) of Table 2.

Table 4

Effect of Differences Between Expected and Actual Inflation on Depreciation Indexing Under Inflation

Assumptions

$X = \$20,000$	$p = .06$	$r' = .04$
$t_c = .40$	$\overline{p} = .02,\ .06$ or $.10$	$t_\ell = .20$
$C = \$10,000$	$b = .30$	Asset life: One year

	(1) Expected Inflation Less Than Actual Inflation ($p = .02$, $p = .06$)	(2) Expected Inflation Equals Actual Inflation ($p = p = .06$)*	(3) Expected Inflation Greater Than Actual Inflation ($p = .10$, $p = .06$)
After-tax operating cash flows $[X(1 - t_c)(1 + p)]$.	\$12,720	\$12,720	\$12,720
Depreciation tax shield $[(1 + p)t_cC]$. .	4,240	4,240	4,240
Interest payment $\left[\left\{\dfrac{r'(1 + \overline{p}) + \overline{p}}{(1 - t_\ell)}\right\} bC(1 - t_c)\right]$	(136.80)	(230.40)	(324)
Principal repayment [bC]	(3,000)	(3,000)	(3,000)
Asset replacement $[(1 - b)C(1 + p)]$ . . .	(7,420)	(7,420)	(7,420)
Net cash flow available for payment to owners	\$ 6,403.20	\$6,309.60	\$ 6,216
Payment to lenders (interest and principal)	\$ 3,136.80	\$3,230.40	\$ 3,324
Total payment to owners and lenders . . .	\$ 9,540	\$9,540	\$ 9,540

* Column (2) corresponds to column (3) of Table 2.

FOOTNOTES

[1]See Gynther (1970) for an extensive discussion of the arguments for capital maintenance under changing prices. Hicks (1939) provides an early analysis of "value" which is the foundation for much of the work on current value accounting. Davidson and Weil (1975a, 1975b, 1978) show effects on calculated income when various methods of accounting for changing prices are used. Watts and Zimmerman (1979) report the historical influence of tax law on accounting policy. Bach (1973) argues: "In a world of inflation, depreciation charges should be reckoned in terms that will replace the depreciating assets at current prices, not at their misleading historical costs" (p. 76). However, Alberts (1973) argues that orthodox accounting is consistent with the needs of managerial and investor decision models, while Hakansson (1969) demonstrates conditions under which price-level accounting is irrelevant both to the individual investor-consumer and to the firm's management.

[2]Inflationary accounting has received extensive attention by the Cost Accounting Standards Board. See Cost Accounting Standards Board Regulations, Subchapter G, Part 409; and Cost Accounting Standards Board (1974) (1975). Abel and McClenon (1977) provide an extensive review of the issues and reasoning of the Board in adopting historical cost based depreciation. An analysis of cost-based reimbursement policy for Medicaid patients in long-term health care facilities is provided by Maher, Winn and McCaffree (1975).

[3]Also see Wallich (1975) and Tatom and Turley (1979), who support this position, arguing that corporate liquidity is being drained by the tax system in such a way that companies cannot make their annual investment in assets to maintain their scale of operations.

[4]For example, Davidson (1979) argues that ". . . the exaggeration of profits rationalizes and encourages inflationary wage demands and lends credibility to the notion that business profiteering is a major cause of the rising cost of living" (p. 12).

[5]Conventional financial statements would report after-tax net income (NI) as:

$$\begin{aligned} NI &= (X - C)(1 - t_c) \\ &= X(1 - t_c) - C + t_c C \\ &= NCF \end{aligned}$$

in equation (1).

[6]In order to concentrate on the issue of depreciation indexing, we have assumed that all inflows and outflows inflate at the same rate, p. In other words, we are examining the impact of inflation on the cash flows of

the "average" firm in the economy. Of course, a particular firm's experience with inflation will also be influenced by the differential effects of inflation on its cash inflows and outflows.

[7]In this case, the "government" benefits at the expense of the owners. As shown below, the government's tax receipts increase to offset the decreased purchasing power equivalent payment to owners under inflation without depreciation indexing.

	No Inflation	With Inflation (p = .06), Without Depreciation Indexing: Cash Flow	With Inflation (p = .06), Without Depreciation Indexing: Purchasing Power-equivalent
Payments to:			
Owners	\$ 6,000	\$ 6,120	\$ 5,774
Government	4,000	4,480	4,226
Total	\$10,000	\$10,600	\$10,000

[8]To simplify the exposition, we initially assume that the expected rate of inflation equals the actual rate of inflation. At the end of this section we extend the analysis to include a more general assumption regarding expected and actual inflation rates.

[9]To demonstrate our results we, like Nelson (1976) and Kim (1979), are willing to assume that <u>real</u> rates are unaffected by expected inflation. For an excellent discussion of the possible effect of <u>uncertain</u> inflation on the <u>real</u> rate, see Levi and Makin (1979).

[10]See Feldstein (1976) for a more detailed presentation which supports our position.

[11]Kaplan (1977) also addresses the effects of price changes on firms with debt. He demonstrates that much of the apparent purchasing power gain on debt may be due to a reduction in the market value of debt because of changes in the expected inflation rate.

[12]Not all of the apparent benefit may be captured by the firm because it may share in subsidizing the loss to the treasury either directly or indirectly. We refer to "net benefits" as the excess of a company's benefits over its share of the subsidy.

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