NBER WORKING PAPER SERIES

INFLATION, TAXATION, AND CORPORATE BEHAVIOR

Roger H. Gordon

Working Paper No. 588

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge MA 02138

December 1980

This paper was presented at the NBER's 1980 Summer Institute Program in Taxation. This work, which was also presented at the World Econometrics Congress, in Aix-en-Province, August 29, 1980, was done while the author was at the National Bureau of Economic Research. Any opinions expressed are those of the author and not those of the National Bureau of Economic Research.

NBER Working Paper #588
December 1980

Inflation, Taxation and Corporate Behavior

ABSTRACT

During the past decade, the inflation rate has been very high by historical standards, yet the U.S. tax law has yet to adjust to this fact. The purpose of this paper is to investigate to what degree the lack of indexing of the corporate and personal income taxes by itself ought to have resulted in a change in corporate investment and financial policy, and in capital gains or losses to existing owners of corporate equity. In studying these questions, the paper models corporate financial and real decisions simultaneously, unlike other recent studies.

The principle conclusions of the paper are:
1) the doubling of corporate debt-value rations can easily be rationalized solely by the interaction of inflation and the tax laws, 2) the stock market and the level of investment behaved much less favourably than would have been forecast focusing solely on the increased inflation rate, and 3) more pessimistic expectations, perhaps in combination with increased riskiness, would provide a consistent rationale for observed behaviour.

Professor Roger Hall Gordon
Department of Economics
Princeton University
Princeton, New Jersey 08544

(609) 452-4018

Inflation, Taxation and Corporate Behavior

During the past decade, the inflation rate has been very high by historical standards, yet the U.S. tax law has yet to adjust to this fact. The purpose of this paper is to investigate to what degree the lack of indexing of the corporate and personal income taxes by itself ought to have resulted in a change in corporate investment and financial policy, and in capital gains or losses to existing owners of corporate equity. In particular, the paper investigates the degree to which the unusual experiences of the 1970s, including the collapse of the stock market in real terms, the sharp growth in corporate debt-value ratios, and yet the stable rate of corporate investment can be explained simply by this interaction of inflation with the tax laws. In exploring these questions, we will model simultaneously corporate investment and financial decisions, under uncertainty.

The organization of the paper is as follows: In section I, the equilibrium conditions for corporate behavior are developed given uncertainty and a constant rate of inflation. Section II, explores how the long-run equilibrium changes when there is an unexpected change in the inflation rate. Section III then investigates how the value of existing equity changes due to the unexpected inflation. In section IV, alternative hypotheses for the experiences of the 1970s are investigated.

I Modelling of Corporate Behavior Under Uncertainty

Modelling corporate behavior under uncertainty, in general, is very complicated. In doing so therefore we make two key simplifying assumptions. First, we assue that corporations behave so as to maximize the value of their shares. While often questioned, this assumption is standard and very much simplifies the analysis. (See Auerbach and King(1979) for an example of the difficulties which arise when this assumption is abandoned.)

In addition, we assume that the value of a security to an investor depends only on its effect on the mean and variance of the value of his portfolio 'next period'. Since we allow for varying tax rates across investors, this implies a variant of the capital asset pricing model, developed in detail in Brennan (1970) and Gordon-Bradford (1980).[1] In particular, equilibrium in the securities market in this context implies that the returns on all traded securities satisfy equation (I.1):

$$\text{(I.1)} \qquad \bar{g}_i + \alpha\bar{d}_i + \alpha_b r_i - \alpha_b r_z = \delta_i$$

Here $\bar{g}_i$ represents the component of the expected return on the i'th security taxable at capital gains rates, $\bar{d}_i$ the component taxed as dividends, r_i the component taxed as interest income, r_z the rate of return on an asset whose return is uncorrelated with that or the market portfolio, and γ_i the risk premium required on the i'th asset due to the covariance of its return with that on the market portfolio. All rates of return are in nominal units. The right hand side of the equation measures the risk premium that the market would require in order to absorb the risk from the security while the left hand side measures the market value of the risk premium that investors receive from the security. In equilibrium the two are equal.

The coefficients α and α_b measure the degree to which the market values a dollar of dividends or a dollar of interest income respectively differently from a dollar of capital gains. Income taxes on the investor would be the primary though perhaps not the only reason why each form of return might be valued differently. We will now use this equation to characterize the equilibrium debt-value decision and the equilibrium capial stock of the firm. In doing so, we assume that the firm is sufficiently small that it takes as given the implicit prices embodied in equation I.1 and tries to maximize the

1 In these derivations, only capital gains are assumed to be uncertain.

value of its shares when making its financial and investment decisions.

(A) Debt Value Decision

At the equilibrium debt value ratio for the firm, both the debt and the equity issued by the firm must satisfy the equation (I.1). In addition share values must be unaffected by a marginal repurchase of equity funded by issuing debt.

Let us explore first the effect on share values of a dollar of debt being issued in order to repurchase equity when there is no probability of bankruptcy. Given this assumption, the amount of risk from the firm born by equity holders would not be affected by such an exchange of debt for equity, so the total required risk premium (the right hand side of equation(I.1)) on the equity plus the new debt, should remain unchanged.

The firm will then be indifferent to such an exchange only if the total risk premium received by equity and the new debt holders as valued in the market (the left hand side of equation I.1.), remains unchanged. As a result of the exchange, r additional dollars per period are paid out as interest, which the market values at $\alpha_b r$, relative to capital gains. The corporation can deduct this stream from taxable profits so only $r(i-\tau)$ would be lost to remaining equity holders after the corporation tax of rate τ . Let us assume that p per cent would have been paid out as dividends and (1-p) per cent retained, resulting in capital gains. A dollar of retentions will result in an amount of capital gains which we denote by q, where q is essentially a marginal Tobin's q (Tobin (1969)). The loss to equity holders from the extra stream of interest payments of r per period, is therefore valued at $r(1-\tau)(p\alpha + (1-p)q)$, relative to capital gains. If p is chosen so as to maximize the value of equity, then it must be that, at the chosen value at p (assuming no binding constraint), $q = \alpha$. The total risk premium received by equity holders plus the new debt holders as valued in the market would therefore remain unchanged only if

(I.2) $$\alpha_b r = \alpha r(1-\tau)$$

For any reasonable values of α_b and α, however, α_b would exceed $\alpha(1-\tau)$.[1] Since a given stream of earnings to the firm would be more valuable to debt holders than to equity holders, the firm (and its shareholders) would gain by shifting to debt finance as long as there is no impact on bankruptcy risk . However, bankruptcy risk would in fact rise as the amount of debt rose relative to the amount of capital. The increased risk of bankruptcy, with the implied cost, would to a degree offset the tax advantage of shifting towards debt. The debt-capital ratio would be in equilibrium when the two are exactly offsetting. Let c(D/K) denote the cost per period of the increased risk of bankruptcy arising from a dollar more debt, with a compensating decrease in equity , when the existing debt-capital ratio is D/K. We would normally expect $c_D > 0$ and $c_{DD} > 0$. At the equilibrium debt-equity ratio, it must be that:

(I.3) $$\alpha_b r = \alpha r(1-\tau) + c(D/K)$$

Let us denote the equilibrium debt-capital ratio by γ.

B) Capital Intensity Decision

At the optimal capital stock, it must be that shareholders would be just indifferent to having the firm spend an extra dollar on capital equipment, whether financed by debt or be equity. How would the pre-tax equilibrium marginal real rate of return on capital relate to market parameters? Let us

---

[1] Gordon-Bradford(1979) measure α to be around 1. McCulloch (1975)and Gordon-Malkiel(1979) show that tax free bonds have a return three-quarters of that on taxable bonds, controlling for risk, suggesting that α_b is around .75, assuming that tax free interest is equally as valued as capital gains. With a corporate tax ratio of .46, the right hand side is certainly smaller.

assume that the percent of debt finance γ' used in financing new investment is such as to maintain an optimal debt-capital ratio.

By equation I.1, the marginal unit of capital ought to have an expected return whose value in the market just equals the risk free return (weighted by α_b) plus enough to compensate for the risk created, both through covariance of the return on the new capital with the return on the market portfolio, and any increase in the risk of bankruptcy. Let us denote the required risk premium by δ'. Let s denote the expected earnings resulting from the marginal unit of capital net of corporation taxes, and net of depreciation allowances sufficient so as to maintain the nominal value of the asset. By construction, s is constant in nominal terms over time in order that it be directly comparable with interest income from bonds. One component of this return will be the nominal capital gains resulting solely from inflation. In equilibrium, this value of s must satisfy[1]:

$$\alpha(s-\gamma' r) + \alpha_b \gamma' r = \alpha_b r_z + \delta' \tag{I.4}$$

What does this imply about the pretax real rate of return, ρ, on the marginal unit of capital? In order to simplify the presentation, let us assume that this capital depreciates exponentially, with a proportion d of the remaining capital disappearing each year. Also assume that the tax law allows an exponential depreciation rate of d' (an approximation to a more complicated formula), but does not correct for price changes occuring during the life of the asset.

By construction, s is constant in nominal terms over time. We therefore assume reinvestment just sufficient to maintain a constant nominal capital stock. Since the nominal value of a dollar of capital declines at the rate $(d-\pi)$, where π is the inflation rate, this entails reinvestment of $(d-\pi)$ each

[1] We again assume that a dollar of retentions results in a dollars of capital gains.

period. Without taxes, this gives a net income of $\rho-d+\pi$. Taxes, however, make the problem more complicated. First of all, due to the investment tax credit of rate k, net outlay of a dollar on new capital results in the purchase of $\frac{1}{1-k}$ dollars of new capital. In addition a corporate tax is levied on profits net of tax depreciation and interest payments. Let d_e represent the effective constant nominal depreciation allowance per dollar of capital maintained in place implicit in the tax law. It is straightforward to show that the value of d_e per dollar of initial investment would equal:[1]

$$\text{(I.5)} \qquad d_e = d' \frac{(d-\pi) + r_z(1-\tau)}{d' + r_z(1-\tau)}$$

Given d_e, the corporate tax liability each period is $\frac{\tau(\rho-d_e)}{1-k} - \tau\gamma' r$. Therefore, the relation between ρ and s would be:[2]

$$\text{(I.6)} \qquad s = \frac{\rho-d+\pi}{1-k} - \frac{\tau(\rho-d_e)}{1-k} + \tau\gamma' r$$

$$= \gamma' r + \frac{1}{1-k}[(\rho-d-(1-k)\gamma' r)(1-\tau) + \tau(d_e-d) + \pi]$$

---

1 By definition, d_e is the depreciation deduction, constant over time in nominal terms, equivalent to that allowed in the tax law. The present value of the depreciation deductions in the tax law on an initial dollar of investment is $V=\int_0^\infty d'e^{-d't}e^{-r_z(1-\tau)t}dt = \frac{d'}{d'+r_z(1-\tau)}$.
The reinvestment of $(d-\pi)$ each period will imply additional depreciation deductions whose present value as of that period will be $(d-\pi)V$. The present value of all deductions resulting from maintaining an additional dollar of capital is then $V+\int_0^\infty(d-\pi)Ve^{-r_z(1-\tau)t}dt$. Were there a constant nominal depreciation rate d_e, the present value would be $\int_0^\infty d_e e^{-r_z(1-\tau)t}dt$. Equating the two expressions and solving, we obtain equation (I.5).

2 We ignore in this calculation any effect of inflation on the real value of deductions for expenses. In particular, we implicitly assume that all firms use LIFO accounting. Not knowing why some firms still use FIFO accounting, we do not model their situation separately.

The return available to investors each period is comprised here of the interest payments due to bondholders plus the residual left to share holders. This residual is composed of the real return net of depreciation and interest payments after tax, tax effects from $d_e \neq d$, and inflation induced capital gains.

By substituting equation (I.6) into equation (I.4) and solving for ρ, we can infer what the real marginal rate of return on capital would be when the size of the capital stock is optimal. We find that:

$$\text{(I.7)} \qquad \rho = d + (1-k)(r_z-\pi)\left(\gamma + (1-\gamma)\frac{\alpha_b}{\alpha(1-\tau)}\right) + \frac{\delta'(1-k)}{\alpha(1-\tau)} - (1-k)\gamma(r-r_z)\left(\frac{\alpha_b - \alpha(1-\tau)}{\alpha(1-\tau)}\right)$$

$$- \frac{\tau(d_e-d)}{1-\tau} - \frac{\pi}{\alpha(1-\tau)}\left(\alpha - (\gamma\alpha(1-\tau) + (1-\gamma)\alpha_b)(1-k)\right)$$

Were there no taxes, this formula implies simply that $\rho = d+(r_z-\pi)+\delta$, or the marginal investment must just earn enough to cover depreciation and real interest expenses as well as the risk premium. (Clearly tax factors affect the capital intensity decision in a complicated way. The second term differs from the real interest rate for several reasons. First, the investment tax credit reduces costs by the proportion k . In addition, to the extent $(1-\gamma)$ that equity finance is used, the investment must earn enough to offset the fact that ineffect only $\alpha(1-\tau)$ remains after tax of a dollar going to equity while the taxes reduce the opportunity cost in bonds only by the factor α_b.

The last two terms are the most important for this paper. The first of the two captures the deviation of the effective depreciation allowance in the tax law from the true depreciation allowance. The last term measures the reduction due to inflation in the real after tax required rate of return when the before tax real interest rate remains constant.

Were only debt finance used, inflation lowers the equilibrium ρ since the inflation induced increase in the value of capital is not taxed at the corporate level yet the inflation premium in interest expense is deductible. Were only equity finance used, inflation still lowers the equilibrium ρ since the return on bonds after tax goes up by only $\alpha_b\pi$ while the return on equity goes up by $\alpha\pi$ due to the capital gain on the capital. In general, the effect of inflation is more complicated.

II Impact of unexpected inflation on corporate behavior

Let us now assume that the inflation rate increases unexpectedly by a marginal amount, yet is expected to remain at its new level indefinitely. We explore in this section the effect of this event on the optimal behavior of a corporation, looking in turn at the debt-equity decision and the real investment decision.

The analysis will be explicitly partial equilibrium in character. In order to get explicit results, we therefore have to make some assumption about the effect of a change in the inflation rate on the market prices and interest rates faced by the firm. We assume here that relative prices remain unchanged, and that real interest rates also remain unchanged. The first assumption is natural to the question. The latter assumption is also made by Feldstein (1979), and is supported by the empirical evidence in Feldstein and Eckstein (1970) and Feldstein and Summers (1978).[1]

A. Effect on the equilibrium debt-capital ratio

In section I, we found that the equilibrium debt-value ratio was characterized implicitly by equation (I.3). By differentiating this

[1]Hendershott (1979), in contrast, assumed that the equilibrium ρ remained unchanged, and then solved for the equilibrium interest rate.

equation with respect to the inflation rate, and employing the assumption that the real interest rate is constant, we find that:

$$\text{(II. 1)} \qquad \frac{\delta\gamma}{\delta\pi} = \frac{\alpha_b - \alpha(1-\tau)}{c_\gamma} = \frac{\gamma}{r\varepsilon_c}$$

where ε_c is the elasticity of c in the respect to changes in γ. This is certainly positive, implying that the equilibrium debt-capital ratio rises when the inflation rate rises. The inflation premium in the interest rate is taxed at the rate $1-\alpha_b$ if debt finance is used, but implicitly at the rate of $1-\alpha(1-\tau)$ if equity finance is used. Since the tax rate through equity finance is higher, there is further inducement to shift towards debt finance.

In order to forecast how large the response ought to be, we would need to know the size of ε_c. Unfortunately, there is no empirical evidence on this. The plausible assumptions that $c_{\gamma\gamma}>0$ and $c(0)=0$ imply though that $\varepsilon_c>1$. By assuming $\varepsilon_c=1$, we therefore have an upper bound on $\frac{\delta\gamma}{\gamma\pi}$ of $\frac{\gamma}{r}$.

How consistent are the forecasts from this model with historical experience? Historically, according to the figures in Gordon-Malkiel (1979), the aggregate corporate debt-value ratio has grown from .168 to .325 between 1960 and 1978, while the commercial paper rate has grown from 3.85 to 7.99. If we assume that the debt value-ratio was in equilibrium at both dates, a somewhat heroic assumption, and that $c(\gamma)$ has a constant elasticity form $(c(\gamma)=a\gamma^{\varepsilon_c})$, then we infer a value for ε_c of 1.11, a quite plausible value.[1] We therefore conclude that interactions of inflation and the tax law seem sufficient in themselves to explain the growth in corporate debt-value ratios.

---

[1] This calculation used only two data points. Clearly, it would be better to use all the available data to derive an estimate. However, serious estimation would also require worrying about the dynamics of the process. The author is currently working on this problem.

B. Effect on the equilibrium capital stock

In Section I, we found that equation (I.7) would characterize the equilibrium marginal product of capital. This expression depends in a complicated way on the inflation rate. Let us assume again that a change in the inflation rate will not affect the real interest rate or the risk premium $(r - r_z)$. Then, differentiating the equilibrium ρ with respect to π, we find:

$$\text{(II.2)} \quad \frac{\partial \rho}{\partial \pi} = \frac{-\tau}{1-\tau}\frac{\partial de}{\partial \pi} - \frac{1}{1-\tau} + (1-k)\left[\gamma + (1-\gamma)\frac{\alpha_b}{\alpha(1-\tau)}\right] + \frac{\partial \rho}{\partial \gamma}\cdot\frac{\partial \gamma}{\partial \pi}$$

$$= \frac{\tau(\tau d' + d_e(1-\tau))}{(1-\tau)(d' + r_2(1-\tau))} - \frac{1}{1-\tau} + (1-k)\left[\gamma + (1-\gamma)\frac{\alpha_b}{\alpha(1-\tau)}\right]$$

The second line follows from the first using equation (I.6) and using the fact that at the optimal value of γ, $\frac{\partial \rho}{\partial \gamma} = 0$.[1] In the second line, the first term captures the decline in the value of depreciation allowances as inflation increases, emphasized by Feldstein (1978, 1979). The second term captures the inflation induced capital gain on capital, tax free at the corporate level, while the third term measures the increase in financing costs due to inflation.

In general, this derivative might be either positive or negative. However, for any reasonable parameter values, it turns out to be negative, implying a growth in capital intensity due to a rise in the inflation rate. In order to investigate the importance of this effect, let us calculate its size for the set of plausible parameter values listed in Table I. We assume in addition that $d = .4d'$, or that when there is no inflation, tax lifetimes are forty per cent as long as true lifetimes.[2]

---

[1] Differentiating equation (I.7) with respect to γ and equating to zero implies $r(\alpha_b - \alpha(1-\tau)) = \frac{\partial S'}{\partial \gamma}$, which is just the equilibrium condition in equation (I.3) for the optimal debt-value ratio.

[2] If Bulletin F lifetimes accurately represent expected lifetimes, then the use of the double declining balance formula with that lifetime is essentially equivalent to halving the tax lifetime, while the asset depreciation range lowers lifetimes by a further twenty per cent.

Then for short-lived equipment (d = .2), the derivative equals -.19 while for long-lived equipment (d = .04), the derivative equals -.35 . Thus if the inflation rate were to increase from two to seven per cent, as occurred with the CPI inflation rate between 1965 and 1975, with nothing else changing, the equilibrium real marginal product of capital ought to fall between .01 and .0175, depending on the lifetime of the capital. If the initial marginal product of capital were around .11 (as in Feldstein and Summers (1977)), and if the demand for capital had unit price elasticity, as with a Cobb-Douglas function, then the equilibrium capital stock ought to have increased by nine to sixteen per cent.

However, in spite of this forecast of capital deepening as a result of inflation, no such capital deepening has in fact occurred. If we compare the capital stock of producer durable equipment and structures[1] to the GNP arising from nonfinancial corporate business[2] over time, there is no clear trend. For example, this ratio was 1.33 and 1.31 in 1967 and 1968, while it was 1.33 and 1.30 in 1977 and 1978.

Table I

Chosen Values for Parameters

τ	.46	γ	.3[a]
k	.10	α	1.0[b]
r_z	.06	α_b	.75[c]
π	.05		

Notes: [a] see Gordon-Malkiel (1979,p.57)

[b] see Gordon-Bradford(1979)

[c] see Gordon-Malkiel (1979,app.A)

---

[1]This series was taken from the MPS data bank.

[2]This series was taken from the 1979 Economic Report of the President.

Other factors, discussed below, certainly affected the time pattern of capital intensity besides the tax implications of the change in the inflation rate, so that the poor forecast from the theory focussing just on these tax implications should not be troubling. What we can conclude, however, is that had the tax system been fully indexed, the equilibrium capital stock would have been smaller than it was.

III Effect on the Value of Existing Equity

Not only will an unexpected change in the inflation rate alter the equilibrium behavior of the firm, but it will also cause windfall changes in the value of existing equity. The last decade has seen a dramatic drop in the real value of corporate equity. Can the interaction of inflation with the tax law help explain this drop in stock values?

Under the capital asset pricing model, assets ought to be priced so that equation (I.1) is satisfied for all traded securities. If S represents the expected profits of the firm after taxes and after replacement expenses (set so as to maintain the nominal value of capital prior to the unexpected change, if E is the market value of that equity, and if R is the initial annual debt service requirements, then it must be that:

$$\text{(III.1)} \qquad \alpha(\bar{S}-R) = \alpha_b r_z E + \delta E$$

Here, δ is the market required risk premium per dollar of equity.

How would E change when an unexpected change in the inflation rate is announced? Differentiating equation (III.1) with respect to π gives:[1]

$$\text{(III.2)} \qquad \frac{1}{E}\frac{\partial E}{\partial \pi} = \frac{\alpha\frac{\partial(\bar{S}-R)}{\partial \pi}/K - \alpha_b(1-\gamma)}{(\alpha_b r_z + \delta)(1-\gamma)}$$

We therefore need to calculate the change in $(\bar{S}-R)$ associated with a change in the inflation rate. By analogy with equation (I.6), $(\bar{S}-R)$ initially satisfies:

$$\text{(III.3)} \qquad \bar{S}-R = (\rho(1-\tau) + \pi - d)K - (1-\tau)R + \tau De \; .$$

where D_e is the effective constant depreciation allowance for the entire firm under the tax law. Differentiating with respect to π gives:

$$\text{(III.4)} \qquad \frac{\partial(\bar{S}-R)}{\partial \pi} \doteq K - (1-\tau)\frac{\partial R}{\partial \pi} + \tau\frac{\partial D_e}{\partial \pi}$$

---

[1] If γ and K were optimal initially, then the derivative of E in equation (III.1) with respect to γ or K would equal zero. In exploring the effect of differential changes in π on E, we can therefore ignore the effect on E of implied changes in γ or K.

As a result of the sudden change in inflation, tax depreciation allowances and interest deductions will evolve in a systematic way over time -- due to continuing inflation, depreciation allowances will become smaller in real terms, while interest costs will grow due to the refinance at new interest rates of an increasing fraction of the firms debt. In order to avoid calculating the capital loss after one period resulting from this changing future time pattern of depreciation and interest deductions, we instead calculate new values for De and R, constant over time, which would be equivalent in value to the actual time varying streams for these deductions.

In order to approximate the relation between R and π, we make the following simplifying assumptions: 1) All debt is issued with a 20 year maturity with a fixed coupon rate, 2) the size of new issues grows exponentially over time at the rate g, and 3) all old debt has the same coupon rate r. Given these assumptions, one can show that the new value of R satisfies:[1]

$$R = D\left[r + \frac{g(r_n - r)}{g - r_n(1-\tau)} \cdot \frac{(e^{20(g - r_n(1-\tau))} - 1)}{(e^{20g} - 1)}\right] \qquad \text{(III.5)}$$

where r_n is the firm's new discount rate.

We approximate the value of D_e by making the following assumptions: 1) the real capital stock has been growing at a rate c, and 2) the post inflation rate has been constant at π_p while the future rate will be constant at π_f. Straight forward

1 In order to compute the new value of R, we compute the new present value of debt repayment obligations then find the new consol interest rate on the original debt implying an equal present value of debt repayments. The present value of interest costs after corporate taxes plus principal repayments on a dollar of debt maturing in L years is:

$$V(L) = \int_0^L r(1-\tau)e^{-r_n(1-\tau)t}dt + e^{-r_n(1-\tau)L}$$

Here, r_n is the firms discount rate after the change in the inflation rate. By assumption 2, if D_o dollars of debt were just issued, then $D_o e^{(L-20)g}$ dollars of debt will be maturing in L years. Therefore the present value of all debt obligations is: $D_o\int_0^{20} V(L)e^{(L-20)g}dL$. If the firms original debt were consols then with a coupon interest rate r* the present value of debt repayments would be $(\int_0^{\infty} r^*(1-\tau)e^{-r_n(1-\tau)t}dt)\ (D_o\int_0^{20} e^{(L-20)g}dL)$

At the new value of r*, the two expressions would have equal value. The new value of R is this new r* times the original value of debt outstanding.

calculations then imply that the new constant nominal rate of depreciation D_e equivalent to that allowed in the tax law is:[1]

$$\text{(IV.6)} \quad D_e = \frac{Kd'}{d'+r_n(1-\tau)} \cdot \left(d - \pi_f + \frac{r_n(c+d)(1-\tau)}{c+\pi_\rho+d'}\right)$$

Differentiating R and D_e with respect to π in equations (III.5) and (III.6), given the initial conditions that $r_n = r$ and $\pi_f = \pi_p$ (so that the change is marginal, provides the information needed in equation (III.4). Substituting the resulting value in equation (III.2) then gives an answer for the effect of an unexpected change in the inflation rate on equity prices. In general, the effect can go in either direction. For reasonable parameter values, it seems to be small, however. For example, with the parameter values in Table 1 along with the supplementary parameter values in Table II, the derivative equals .52, implying a 2.6% capital gain on equity resulting from an unexpected five point rise in the inflation rate.

This small effect results, however, from the virtually tax free capital gains on corporate capital being just offset by the increases in future interest payments (as debt is rolled over), by the increase in the required rate of return on equity (due to the rise in interest rates), and by the decline in the value of depreciation allowances. The value of the derivative will be moderately sensitive to the various

---

[1] In order to compute the new value of D_e, we compute the new present value of depreciation deductions then find the new constant depreciation rate on the original capital stock implying an equal present value of depreciation deductions. By assumption 1, investment t years ago, in nominal terms, was:

$I_t = (c + d)e^{-\pi_\rho t} e^{-ct}K$. In T years from now, the depreciation allowance on this investment will be: $D_{tT} = d'I_t e^{-(t+T)d'}$. The present value of future depreciation allowances on all past capital is therefore: $\int_0^\infty \int_0^\infty D_{tT} e^{-r_n(1-\tau)T} dt dT$.

An additional $(d-\pi_f)K$ units of investment will occur in each future year so as to maintain the nominal capital stock. The present value of the resulting depreciation allowances in that year will be: $D = \int_0^\infty d'(d-\pi_f)Ke^{-d't}e^{-r_n(1-\tau)t}dt$. The present value of depreciation allowances on all future investments in therefore: $\int_0^\infty De^{-r_n(1-\tau)t}dt$. Since D_e is constant in nominal terms, its present value is $\int_0^\infty D_e e^{-r_n(1-\tau)t} dt$. Equating this expression with the sum of the expressions for depreciation allowances on both past and future investments and solving for D_e gives equation (III.6).

parameter assumptions. It would be very difficult, though, to claim that the lack of indexing of the tax law contributed in an important way to the dramatic observed drop in real equity prices.

Table 2

Supplementary Parameter Values

δ	.06	c	.02
r	.08	g	.09 [a]
d	.08	d'	.20

[a] According to the figures in von Furstenberg (1977), debt of nonfinancial corporations grew at this rate between 1952 and 1970.

IV. Alternative Explanations

We have found in the previous two sections that while the increase in the inflation rate, given the lack of indexing of the tax system, would be sufficient to rationalize the changes in the debt-equity ratio, it could not rationalize the historic pattern of capital intensity or equity prices. These forecasts assumed, however, that the *only* exogenous chance was in the inflation rate. Everything else was not constant, however.

One parameter which may well have changed during the period is δ, the risk premium, a hypothesis emphasized in Malkiel (1978). This increase in the risk premium demanded on corporate investment might relate to the increase in inflation, however. Whatever caused the higher rate of inflation, in part the success of OPEC, might also simultaneously have caused an increase in risk premiums.

If risk premiums tend to increase when the inflation rate increase, then our forecasts for corporate behavior change. The forecasted value of $\frac{\partial \rho}{\partial \pi}$ would increase implying less of an increase (or even a decrease) in the forecasted capital stock. In addition, in equation (III.3) forecasting the change in equity prices, the numerator would be reduced by $\frac{\partial \delta}{\partial \pi}$, again tending to reconcile the theory with reality.

However, an increase in uncertainty would also cause an upward shift in the marginal bankruptcy cost schedule $c(\gamma)$, resulting in a lower equilibrium value of γ than would otherwise have occurred. In this case our estimate of ε_c would have been biased upwards. Since our estimate was not far above one, however, the bias may not be large.

Alternatively, increases in the inflation rate might have been associated historically with a decline in the expected real rate of return on capital, ρ, for any given capital intensity. This might arise due to expectations of tighter stabilization policy induced by the higher inflation, or might again be caused by the same events, such as OPEC, which caused the inflation. Since capital is not homogenous, however, existing capital would decline in profitability relatively more than new capital, where new designs can be chosen which alleviate the costs of the change, e.g., economize on energy consumption.

If a change in inflation is accompanied by a drop in ρ, the implications for our forecasts are qualitatively similar to those arising from an increase in δ. The key difference, however, is that equity prices ought to be relatively more strongly affected than investment incentives. That in fact equity prices seem to have suffered relatively more than investment incentives lends support to this explanation compared to the hypothesis of a rise in δ, though both undoubtedly have merit.

V. Conclusions

Whatever the relative merit of these two alternative explanations, the fact that the forecasts of the effect of an unexpected increase in inflation per se are inconsistent with observations should not undermine the credibility of the theory, which can easily be reconciled with actual events. We conclude, however, that the lack of indexation in the tax law cannot explain the poor performance of the stock market or the somewhat low level of capital investment during the 1970's. It can, however, explain the growth in debt-capital ratios. Furthermore, attempts now to index the tax law would eliminate the increased investment incentives resulting from inflation, assuming the real interest rate remains unchanged. Given the presumption that there is too little investment, this conclusion ought to somewhat weaken the case for indexing the tax code,[1] unless offsetting changes are made simultaneously.

[1]There are, of course, many advantages to indexation. For example, inflation distorts the composition of capital, as shown above, encouraging long-term investments relatively more than short-term investments. Also, inflation further encourages debt finance, raising bankruptcy costs, which can be very costly.

References

Auerbach, Alan J. and Mervyn A. King, "Corporate Financial Policy, Taxes, and Uncertainty: An Integration," N.B.E.R. Working Paper #324, March, 1979.

Brennan, Michael J., "Taxes, Market Valuation and Corporate Financial Policy," National Tax Journal, 23(1970), pp. 417-427.

Council of Economic Advisors, Annual Report, U.S. Government Printing Office, January, 1979.

Feldstein, Martin S., "Inflation and the Stock Market," American Economic Review, forthcoming.

______________, "Inflation, Tax Rules, and the Stock Market," N.B.E.R. Working Paper #403, November, 1979.

Feldstein, Martin S. and Otto Eckstein, "The Fundamental Determinants of the Interest Rate," Review of Econoimcs and Statistics, 52(Nov., 1970), pp. 363-75.

Feldstein, Martin S. and Lawrence Summers, "Is the Rate of Profit Falling?" Brookings Papers on Economic Activity, 1:1977, pp. 211-227.

______________, "Inflation, Tax Rules and the Long-Term Interest Rate," Brookings Panel on Economic Activity, 1:1978, pp. 61-99.

Gordon, Roger H. and David F. Bradford, "Taxation and the Stock Market Valuation of Capital Gains and Dividends: Theory and Empirical Results," Journal of Public Economics, forthcoming.

Gordon, Roger H. and Burton G. Malkiel, "Taxation and Corporate Finance," Princeton University Financial Research Center Memorandum No. 31, January, 1980.

Hendershott, Patric H., "The Decline in Aggregate Share Values: Inflation and Taxation of the Returns from Equities and Owner-Occupied Housing," N.B.E.R. Working Paper #370, July, 1979.

Malkiel, Burton G., "The Capital Formation Problem in the United States," Journal of Finance, May, 1979.

McCulloch, J. Huston, "The Tax-Adjusted Yield Curve," Journal of Finance, 30(June, 1975), pp. 811-830.

Tobin, James, "A General Equilibrium Approach to Monetary Theory," Journal of Money, Credit, and Banking, 1(February, 1969), pp. 15-29.

von Furstenberg, George M., "Corporate Investment: Does Market Valuation Matter in the Aggregate? Brookings Papers on Economic Activity, 2:1977, pp. 347-397.