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Taxes, Inflation and Corporate Financial Policy

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ABSTRACT

This paper examines inflation-induced distortions in personal and corporate income taxes and discusses the implications for corporate dividend and financial structure policies and for shareholder unanimity. The tax effects relating to capital gains and debt interest cause changes in aggregate corporate borrowing and lead to equilibrium tax relationships which differ from the zero-inflation tax relationships.

SOME OF THE IMPORTANT consequences of inflation arise from inflation-induced changes in the real tax rates on business and personal income. The real tax rate on business income can increase because the historical cost rather than the replacement cost of inventories and of plant and equipment are used in computing taxable income (e.g., see Nelson [15], and Hong [8]). Inflation can increase real personal taxes through the taxation of shareholder capital gains that are nominal but not real (see Feldstein [6]). Hamada [7] points out that corporate capital structures may be affected by inflation because part of nominal debt interest payments are tax-deductible even though they are actually repayments of principal.

This paper analyzes certain inflation-induced tax distortions and discusses the consequences for corporate policy. The major findings include: (1) Real taxes associated with capital gains and losses are greater the higher the inflation rate unless inflation causes offsetting changes in statutory tax rates, pretax rates of return on assets, or asset holding periods. (2) Real capital gains tax rates can exceed real dividend tax rates, but, even in this case, shareholders generally lose if the firm reduces capital gains by paying larger dividends financed by new share sales. (3) A shareholder's ranking of alternative firm policies can change as a result of a purely neutral inflation, in which case a policy which does not maximize share price will be preferred under some inflation rates. (4) The lender's real tax rate on debt interest income and the borrower's real tax shelter per dollar of real interest expense depend on the inflation rate and on the nominal interest rate even if statutory tax rates are fixed. (5) If the dividend tax rate differs from the capital gains tax rate for some or all investors, the Miller [13] equilibrium tax relationship does not generally hold with inflation, and the effect of inflation on aggregate debt and equity in the economy depends on personal and corporate tax rates. Section I examines the impact of inflation on the taxation of capital gains and losses and of dividends, and discusses the implications for dividend policy and for shareholder preferences concerning firm policies. Section II examines the

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taxation of debt. Section III uses the results of Sections I and II to analyze the effects of inflation on equilibrium corporate financial structure. Section IV is a summary.

I. Inflation, the Taxation of Equities, and Firm Policy

The term "nominal" will mean in terms of current (time t) dollars and, unless otherwise noted, "real" will mean in terms of time 0 dollars (although constant dollars of any time period could be used). An asterisk superscript signifies real quantities. The inflation rate is signified as p and is assumed to be constant over time. Subscript t indicates calendar time; variables without a t subscript are assumed to be fixed over time. Thus, for example, $d_t^* = d_t(1 + p)^{-t}$, where d_t^* and d_t are an investor's real and nominal dividend income at time t, respectively. The frequently used symbols are:

d_t = nominal dividend income of the investor
e = statutory dividend exclusion ($100 under 1983 U.S. tax law)
v_t = nominal market price of a share
i = nominal interest rate on riskless debt
τ_{gt} = fraction of taxable capital gain paid in taxes = (nominal capital gains tax)/(nominal capital gain)[1]
τ_{gt}^* = fraction of real capital gain paid in taxes = (real capital gains tax)/(real capital gain)
τ_{dt} = fraction of taxable dividend income ($d_t - e$) paid in taxes = (nominal dividend tax)/(taxable part of nominal dividend)
τ_{dt}^* = fraction of real dividend income paid in taxes = (real dividend tax)/(real dividend)
τ_b = fraction of taxable interest income paid in taxes = (nominal tax on interest income)/(nominal interest income)
τ_b^* = fraction of real interest income paid in taxes = (real tax on interest income)/(real interest income)
τ_c = corporate tax rate = (nominal tax savings from interest expense)/(nominal interest expense)
τ_c^* = (real tax savings from interest expense)/(real interest expense)

The remaining symbols will be defined when used. In this section and in Sections II and III, we only consider the cases of no general price level change over time ($p = 0$) and of inflation ($p > 0$); the same method of analysis is applicable with deflation ($p < 0$).

A. Inflation and the Personal Taxation of Equities

This section analyzes the relationship between the fraction of *real* equity income paid in personal income taxes (i.e., the "real tax rate" on equity income)

[1] For short-term gains, τ_{gt} is the taxpayer's tax rate on marginal ordinary income in the amount of the gain. For long-term gains, 40% of the gain is included in ordinary taxable income and 60% is untaxed.

and the statutory tax rates applicable to that income. We first examine capital gains and losses and then consider dividends. We assume that an investor's dividend and capital gains tax rates can change over time and therefore the tax rates have a time subscript. We also assume that investors can differ in their tax rates.

In examining capital gain and loss taxation we consider common stock, although the same principles apply to gains and losses on other types of assets.[2] Assume that an investor purchased a share at time 0 for price v_0 and sold the share at time t for price v_t, implying a nominal return of $(v_t - v_0)$ and a real return of $(v_t^* - v_0)$ on the share, where $v_t^* = v_t(1 + p)^{-t}$. The nominal tax and real tax are $\tau_{gt}(v_t - v_0)$ and $\tau_{gt}(v_t - v_0)(1 + p)^{-t} = \tau_{gt}[v_t^* - v_0(1 + p)^{-t}]$, respectively, where τ_{gt} is the investor's statutory tax rate on capital gains. The investor's real capital gains tax rate on the share, τ_{gt}^*, is given by:[3]

$$\tau_{gt}^* = \frac{\text{real tax}}{\text{real gain}} = \frac{\tau_{gt}[v_t^* - v_0(1 + p)^{-t}]}{v_t^* - v_0} \tag{1a}$$

$$= \tau_{gt} + \tau_{gt}\left[\frac{1}{(1 + r)^t - 1}\right][1 - (1 + p)^{-t}] \tag{1b}$$

where r = the average per period rate of growth of the share's real price = $(v_t^*/v_0)^{1/t} - 1$. It follows from Equation (1b) that real capital gains tax rate τ_{gt}^* is an increasing function of inflation rate p and, for any positive p, is a decreasing function of real growth rate r and holding period t.[4]

Equations (1a) and (1b) reveal that τ_{gt}^* is highly sensitive to inflation rate p. For example, with $\tau_{gt} = 20\%$, $t = 1$, and $r = 5\%$, τ_{gt}^* rises from 20% when $p = 0$ to 86.7% when $p = 20\%$. Real tax rate τ_{gt}^* in Equations (1a) and (1b) depends on p, r, and t because nominal rather than real gains and losses are used in tax computations. If the share's tax basis were $[v_0(1 + p)^t]$ rather than v_0 (i.e., if the cost basis were restated in time t dollars), real rather than nominal gains and losses would be used in computing taxes and $\tau_{gt}^* = \tau_{gt}$ for all p, r, and t.[5] The

[2] The tax distortion discussed below applies both to capital assets owned by individuals and to assets owned by businesses (plant and equipment, marketable securities, etc.). Inflation can therefore raise real personal taxes associated with gains and losses (as discussed below) and, simultaneously, raise real business taxes on business asset dispositions.

[3] If there is a tax loss on the share (i.e., if $(v_t - v_0) < 0$), τ_{gt}^* in Equations (1a) and (1b) is the real tax benefit from the tax loss divided by the real loss. With $(v_t - v_0) < 0$, the real loss is $(v_0 - v_t^*)$ and the nominal and real tax loss benefits are $\tau_{gt}(v_0 - v_t)$ and $\tau_{gt}(v_0 - v_t)(1 + p)^{-t} = \tau_{gt}[v_0(1 + p)^{-t} - v_t^*]$, respectively, where τ_{gt} is the tax rate on the taxable income being offset by the loss. If there is a nominal taxable gain but a real loss on the share (i.e., if $(v_t - v_0) > 0$ but $(v_t^* - v_0) < 0$), then $\tau_{gt}^* < 0$ in (1a)–(1b); in this case, a more useful expression than (1a)–(1b) is [(real tax)/(real loss)] = $\tau_{gt}[v_t^* - v_0(1 + p)^{-t}]/[v_0 - v_t^*] = |\tau_{gt}^*|$.

[4] This follows by *partially* differentiating (1b) with respect to p, r, and t, given that $r > 0$. Therefore, we are not considering the interrelationships between τ_{gt}, p, r, and t. Similar analysis applies if $r < 0$ (real loss). If $r = 0$, τ_{gt}^* is undefined.

[5] With $v_0(1 + p)^t$ as the tax basis, a taxable gain and tax loss are $[v_t - v_0(1 + p)^t]$ and $[v_0(1 + p)^t - v_t]$, respectively; these terms also equal the real gain and real loss restated in time t dollars. Thus, for a gain, τ_{gt}^* = (real tax)/(real gain) = $\tau_{gt}[v_t - v_0(1 + p)^t](1 + p)^{-t}/[v_t^* - v_0] = \tau_{gt}$; for a loss, τ_{gt}^* = (real tax benefit)/(real loss) = $\tau_{gt}[v_0(1 + p)^t - v_t](1 + p)^{-t}/[v_0 - v_t^*] = \tau_{gt}$.

distortions introduced by employing historical cost v_0 as the tax basis are *not* eliminated by tax bracket indexing.[6]

To examine the effect of inflation on dividend taxes, let d_t signify an investor's nominal dividend income and let e signify the dividend exclusion, where $e \geq 0$. The investor's real dividend income d_t^* equals $d_t(1+p)^{-t}$. If dividend income d_t does not exceed exclusion e, the tax on d_t is zero. If d_t exceeds e, the nominal dividend tax is $\tau_{dt}(d_t - e)$ and the real dividend tax is $\tau_{dt}(d_t - e)(1+p)^{-t}$, where τ_{dt} is the investor's statutory dividend tax rate. In this case, the investor's real dividend tax rate, τ_{dt}^*, is given by (noting that $d_t = d_t^*(1+p)^t$):

$$\tau_{dt}^* = \frac{\text{real dividend tax}}{\text{real dividend income}}$$

$$= \frac{\tau_{dt}(d_t - e)(1+p)^{-t}}{d_t(1+p)^{-t}} = \tau_{dt}\left[1 - \frac{e}{d_t^*(1+p)^t}\right] \tag{2}$$

If exclusion e is positive in (2), then $\tau_{dt}^* < \tau_{dt}$, τ_{dt}^* is an increasing function of inflation rate p (for any given τ_{dt} and d_t^*), and $\tau_{dt}^* \to \tau_{dt}$ as $p \to \infty$ (for any given d_t^*). Thus, an increase in p raises the real tax rate on any given real dividend. τ_{dt}^* increases with p because a rise in p raises d_t relative to e and thereby raises the proportion of d_t being taxed (at rate τ_{dt}). If e is large relative to d_t, τ_{dt}^* varies considerably with p for any given d_t^* and τ_{dt}. Under current U.S. tax law, however, e is relatively small.[7] The dependence of τ_{dt}^* on p (for any given d_t^*) would disappear if the exclusion were indexed to the price level (i.e., if exclusion $= e(1+p)^t$, with e fixed).[8]

We have found that, for any given statutory tax rates on nominal capital gains and dividends, the real tax rates on capital gains and dividends increase with the inflation rate. This implies that, for any particular structure of statutory tax rates, the implied real tax rates are higher the greater the inflation rate. In practice, dividend exclusion e is small and the capital gains tax inflation effect is far more important than the dividend tax inflation effect.

An issue relating to dividend and capital gains taxes that we will mention here briefly is how such taxes affect shareholder preferences for dividends that are financed by new share sales. For any given after-tax earnings, investment policy, and financial structure for the firm, dividends can be increased and capital gains reduced by the *same* dollar amount (ignoring transaction costs) if the firm sells shares and distributes the proceeds as dividends. In Appendix A, it is shown that the preference for added dividends financed by new shares depends on the inflation rate and on current *and future* statutory tax rates. We find that

[6] With tax bracket indexing, a given real *taxable income* implies a given real income tax; however, for any *given* real pretax gains and losses, an increase in p raises real taxable income and real taxes if v_0 rather than $v_0(1+p)^t$ is used as the tax basis (see footnote 5).

[7] In 1978, the dividend exclusion was \$100, taxable dividends received by U.S. individual taxpayers was over \$31 billion, and the total dividend exclusion used was less than \$1.5 billion (see [18]).

[8] Another dividend tax distortion arises because contributed capital is not stated in current dollars. Roughly stated, dividends paid out of contributed capital are treated as a return of capital and are not taxed. Contributed capital has a smaller real magnitude and provides a smaller tax shelter the greater the inflation since the capital was contributed by shareholders.

stockholders will usually prefer that the firm *not* sell shares to pay dividends, and this is so even if real capital gains tax rate τ^*_{gt} exceeds real dividend tax rate τ^*_{dt}. Appendix A applies only to dividends that are financed by new shares. Therefore, even if investors do not prefer dividends that are funded by issuing stock, they may want the firm to pay dividends from other sources (e.g., cash from operations) if the firm has poor investment opportunities.

B. Capital Gains Taxation and the Firm's Objective

It has been shown elsewhere that, under certain conditions, shareholders unanimously prefer the firm policy which maximizes share price, but that the presence of capital gains taxes can cause unanimity to fail.[9] Below we examine the impact of capital gains taxes assuming that markets are competitive and transactions costless and that the markets satisfy conditions sufficient for unanimous shareholder preference for share value maximization:

(1) With realization-based capital gains taxes (the capital gains tax is paid when the asset is sold), at time t a shareholder's ranking of alternative time t firm policies may depend on past (i.e., before time t) levels of inflation rate p and rankings may differ among shareholders (unanimity may fail); these results hold even if the time t real share price associated with each policy is independent of past p (i.e., even if the inflation is "neutral").

(2) With accrual-based capital gains taxes (the capital gains tax is paid when the gain accrues) and marginal capital gains tax rates below 100%, at time t shareholders unanimously prefer the time t policy which maximizes time t share price (nominal and real) and policy ranking is independent of a neutral inflation before time t.

(1) states that introducing realization-based capital gains taxes can cause a shareholder's preferences to depend on inflation rate p and can cause unanimity to fail. (1) follows because: (a) a shareholder's preference ranking of firm policies depends on what is provided by a share under each policy in terms of future income on the share and in terms of other income streams obtainable by selling the share and using the *after-tax* proceeds to make purchases in the market; and (b) as explained in Section I *A*, inflation can alter the real capital gains tax rate (τ^*_{gt}) and thereby alter the real after-tax proceeds received from selling shares. Because of (b), a change in inflation can affect the relative attractiveness of the policies being compared on the basis of (a).

To illustrate (1) using a highly simplified example, assume that, at time t, a firm can adopt share value maximizing policy M or alternative policy A. Y_M and Y_A are the uncertain per share dividend streams with policies M and A, respectively. Consider a shareholder who bought the firm's stock at time 0 for \$100 per share; let this shareholder's tax rate on capital gains be $\tau_{gt} = 20\%$. Table I shows the time t market price and after-tax sales proceeds per share if the inflation rate

[9] On conditions sufficient for unanimity, see DeAngelo [3] and Makowski [12] and the references contained therein. On capital gains taxes and unanimity, see Schall [17].

Table I

Share Values and Sales Proceeds with Policy M and Policy A

	If $p = 0$		If $(1 + p)^t = 2$	
Policy	Time t Share Price[a] (1)	After-Tax Proceeds[b] (2)	Time t Share Price[a] (3)	After-Tax Proceeds[b] (4)
M	\$200	\$180	\$400	\$340
A	\$175	\$160	\$350	\$300

[a] Equal to the price of identical income streams in the market.

[b] After-tax proceeds = share price − τ_{gt}[share price − \$100], where the \$100 is the price the shareholder paid for the share at time 0.

from time 0 to time t has been zero ($p = 0$) and if prices have doubled ($(1 + p)^t = 2$). The capital gains tax paid at time t equals the time t capital gains tax rate (20%) times the taxable capital gain; the taxable capital gain equals the time t share price minus the \$100 paid for the share at time 0. Assume that the shareholder prefers Y_A to Y_M because Y_A is better than Y_M as part of his or her total portfolio of assets.[10] Nevertheless, with zero inflation, the shareholder prefers policy M to policy A because, with M, the shareholder can sell a share and net \$180, buy a substitute for Y_A in the market for \$175, and have \$5 left over; this is preferable to the firm's adopting policy A. Now assume that prices have doubled; with policy M the shareholder can net only \$340 from selling a share, which is less than the \$350 price of a substitute for preferred stream Y_A. Since the \$340 is insufficient to buy stream Y_A, the shareholder prefers that the firm adopt policy A. Thus, policy M is preferred with no inflation but policy A is preferred if prices have doubled.[11] The reason is that the real capital gains tax rate, τ_{gt}^*, is greater with a doubling of prices than with no inflation.[12] As shown in the prior section, τ_{gt}^* is higher with inflation because nominal rather than real gains are used in tax computations. It is easily shown that, with realization-based capital gains taxes, investors may prefer different firm policies (unanimity may

[10] Neither complete markets nor a riskless asset is required for unanimity. With incomplete markets or no riskless asset, investors may hold different portfolios and have different asset preferences. Thus, w might prefer Y_A and Y_M because Y_A is negatively correlated, and Y_M is positively correlated, with the returns from w's other assets. The point made in (1) is that realization-based capital gains taxes combined with inflation (even if neutral) can produce policy ranking changes and unanimity failure in some cases in which, without realization-based capital gains taxes, shareholders would unanimously prefer share value maximization.

[11] Several assumptions are made here. First, we assume that future capital gains taxes do not make w prefer policy M at time t if $(1 + p)^t = 2$; future capital gains taxes could make policy M preferable (depending on future share price with A and M, the discount rate, etc.). Second, we assume that, with $(1 + p)^t = 2$, no stream in the market with a price of \$340 or less is preferred by w to Y_A. Third, we assume no differences between market bid and ask prices (differences can result from capital gains taxes); (1) fully holds with such differences.

[12] If $p = 0$, $\tau_{gt}^* = 20\%$; if $(1 + p)^t = 2$, $\tau_{gt}^* = 30\%$ with M and $\tau_{gt}^* = 33\frac{1}{3}\%$ with A. Note that, with transaction costless, competitive capital markets, if A were adopted but were reversible, then if $p = 0$ an arbitrager would pay up to \$200 per share (and w would sell for \$200) and have the firm switch to policy M; if $(1 + p)^t = 2$, an arbitrager would pay up to \$400 per share but w would prefer not to sell for \$400 per share (given that the firm adopts policy A).

fail) because the investors differ in their capital gains tax rates or in the prices they originally paid for the firm's shares.[13]

(2) states that introducing accrual-based capital gains taxes will not cause unanimity to fail. (2) follows because, with accrual taxation, value maximizing policy M provides the shareholder with more than the resources required to duplicate the shareholder's position under any alternative policy A.[14] Consequently, policy M will be unanimously preferred by shareholders regardless of p.

II. Inflation and the Taxation of Debt

It is well-known that, with inflation, part of nominal debt interest is actually a repayment of principal. However, all of the nominal interest is taxable income of the creditor and a tax-deductible expense of the debtor. In this section, we examine how this tax provision affects the tax on interest income and the tax savings from deducting interest expense. We focus only on this tax provision and do not consider debt financing relative to equity financing and financial structure equilibrium until Section III.

Let i be the nominal interest rate and let τ_c be the borrower's marginal tax rate. In the present context, the borrower is a corporation and τ_c is the corporation's marginal tax rate. The lender's marginal tax rate on interest income is τ_b. In this section and in Section III, we assume for simplicity that debt is single-period and riskless and that τ_c and τ_b are independent of inflation and are constant over time (the results below do not require these assumptions). Assume that at time 0 the corporation is considering an increase in debt of amount ΔB_0 and that any such debt will be repaid at time 1. The time 1 interest plus principal payment will be $(1 + i)\Delta B_0$, the tax on interest income will be $\tau_b i \Delta B_0$ and the corporation's tax savings from interest expense will be $\tau_c i \Delta B_0$. Thus, in computing time 1 taxes, ΔB_0 and $i\Delta B_0$ are treated as principal and interest, respectively.

[13] For example, assume investor q, who also owns the firm's shares and prefers income stream Y_A to income stream Y_M. Investor q will prefer policy M both with $p = 0$ *and* with $(1 + p)^t = 2$ if q's capital gains tax rate $\tau_{gt}^q = 5\%$ and q paid \$100 per share for the firm's stock, or if $\tau_{gt}^q = 20\%$ and q paid \$300 for the stock. Thus, although q and the investor in Table I both prefer policy M with $p = 0$, they can have different policy preferences with $(1 + p)^t$ if they have different tax rates or different tax bases for the shares.

[14] To establish (2), let v_t', $v_t(M)$, and $v_t(A)$ be the time t share price if neither M nor A is adopted, with M and with A, respectively; and let $v_t(M) > v_t(A) \geq v_t'$. Whether or not a shareholder sells shares at time t, with accrual taxation the shareholder will, at time t, pay any accrued capital gains taxes on nominal gains. If A is adopted, the shareholder has a share worth $v_t(A)$ and pays tax $\tau_{gt}(A)[v_t(A) - v_t']$. If M is adopted, the shareholder pays tax $\tau_{gt}(M)[v_t(M) - v_t']$, but can sell a share for $v_t(M)$ and, for $v_t(A)$, buy a share in the market equivalent to the firm's share with Policy A. This provides the shareholder with a share worth $v_t(A)$, plus cash flow $\{v_t(M) - v_t(A) - \tau_{gt}(M)[v_t(M) - v_t']\} = v_t(M) - v_t(A) - \hat{\tau}_{gt}[v_t(M) - v_t(A)] - \tau_{gt}(A)[v_t(A) - v_t'] > - \tau_{gt}(A)\,[v_t(A) - v_t']$ = shareholder's cash flow if policy A had been adopted, where $\hat{\tau}_{gt}$ is the marginal tax rate ($\hat{\tau}_{gt} < 1.0$) on added gain $[v_t(M) - v_t(A)]$. Thus, the shareholder can duplicate the situation with A and have added cash amount $[1 - \hat{\tau}_{gt}][v_t(M) - v_t(A)]$. Policy M is therefore preferred to policy A, and this is true for all shareholders (unanimity). Note that (2) does not require the existence of a market for the exchange of tax liabilities.

However, the amount in time 1 dollars with the same purchasing power that ΔB_0 had at time 0 is $(1 + p)\Delta B_0$; therefore, the part of total debt payment $(1 + i)\Delta B_0$ that is a return of real principal is $(1 + p)\Delta B_0$ and the part that is real interest (*measured in time 1 dollars*) is $(i - p)\Delta B_0$. Amount $p\Delta B_0$ is the portion of real time 1 principal which is treated as interest for tax purposes.

Define τ_b^* as the proportion of real interest income $(i - p)\Delta B_0$ paid by the lender in time 1 taxes. Let τ_c^* signify the borrowing corporation's time 1 tax savings from interest expense per dollar of real interest expense $(i - p)\Delta B_0$; τ_c^* is the proportion of $(i - p)\Delta B_0$ which would be paid in corporate taxes (the real tax rate on $(i - p)\Delta B_0$) if $i\Delta B_0$ were not paid out as debt interest but were included as corporate taxable income (i.e., if the firm were not to borrow ΔB_0). We find below that, because nominal rather than real interest is used in tax computations, τ_b^* and τ_c^* depend on the inflation rate p.

Let ρ signify the *real* pretax interest rate (rate of return) on loan ΔB_0, where:

$$\rho = \frac{(1 + i)\Delta B_0(1 + p)^{-1} - \Delta B_0}{\Delta B_0} = \frac{i - p}{1 + p} \tag{3}$$

Using (3) and the definitions of τ_b^* and τ_c^* stated above, and assuming that nominal interest $i\Delta B_0$ is interest for tax purposes, if $i > p$ then:[15]

$$\tau_b^* = \frac{\tau_b i\Delta B_0}{(i - p)\Delta B_0} = \left[\frac{1}{1 - (p/i)}\right]\tau_b \tag{4a}$$

$$= \left[1 + \frac{p}{(1 + p)\rho}\right]\tau_b \tag{4b}$$

and

$$\tau_c^* = \frac{\tau_c i\Delta B_0}{(i - p)\Delta B} = \left[\frac{1}{1 - (p/i)}\right]\tau_c \tag{5a}$$

$$= \left[1 + \frac{p}{(1 + p)\rho}\right]\tau_c \tag{5b}$$

The terms in large brackets in (4a)–(5b) equal the proportion of real interest $(i - p)\Delta B_0$ which is treated as interest for tax purposes. It follows from (4a)–(5b) that: $\tau_b^* > \tau_b$ and $\tau_c^* > \tau_c$ if $\rho > 0$ and $p > 0$; τ_b^* and τ_c^* and increasing functions of (p/i); and τ_b^* and τ_c^* are increasing functions of p (given any $\rho > 0$) and decreasing functions of ρ (given any $p > 0$). If real interest $(i - p)\Delta B_0$ rather than nominal interest $i\Delta B_0$ were interest for tax purposes, (4a)–(5b) would not hold and, instead, we would have $\tau_b^* = \tau_b$ and $\tau_c^* = \tau_c$ for all i and p.[16]

The relative magnitudes of real tax rates τ_b^* and τ_c^* in (4a)–(5b) depend on statutory tax rates τ_b and τ_c. Theoretical arguments have been used to show that

[15] If $i = p$, real interest is zero and τ_b^* and τ_c^* are undefined. If $i < p$ then, using τ_b^* and τ_c^* in (4a)–(5b), $|\tau_b^*|$ is the tax on the lender per dollar of real loss for the lender on the loan, and $|\tau_c^*|$ is the tax savings of the borrower per dollar of real gain for the borrower on the loan.

[16] With $(i - p)\Delta B_0$ as interest for tax purposes, $\tau_b^* = [\tau_b(i - p)\Delta B_0]/[(i - p)\Delta B_0] = \tau_b$ and $\tau_c^* = [\tau_c(i - p)\Delta B_0]/[(i - p)\Delta B_0] = \tau_c$.

the statutory tax rates of lenders can equal, exceed, or be less than the statutory tax rates of corporate borrowers, and therefore the relationship between these rates is an empirical issue.[17] In the next section, we consider the effects of inflation on equilibrium tax relationships.

We have shown in this section that inflation rate p affects the real tax rates of borrowers and lenders. In Section III, we will find that inflation can, by altering real tax rates, cause a change in the equilibrium levels of debt and equity in the economy.

III. Inflation and Firm Financial Structure

In Section I *A*, we showed that inflation increases real taxes on equities by increasing taxes on capital gains and on dividends. The taxation of debt is not directly affected by the dividend exclusion and is affected only to a limited extent by capital gains taxes.[18] In Section II, it was found that inflation alters the real tax rate on debt interest income and the real tax savings from deducting interest expense. The tax distortions described in Sections I *A* and II arise because nominal rather than real quantities are used in tax computations, i.e., they would disappear if real quantities were used. In this section, we examine the effects of inflation on relative tax rates and on equilibrium financial structure. For convenience, we will use the term "Gain and Loss Effect" (GLE) to refer to the impact on real shareholder taxes of using nominal rather than real capital gains and losses in tax computations (see Section I *A* for details); and we will use the term "Interest Effect" (IE) to refer to the effect on borrower and lender taxes of using nominal rather than real interest in computing taxes (see Section II).

Intuitively, it would seem that the tax distortions introduced by using nominal rather than real dollar amounts in determining taxes might affect debt and equity levels in the economy. Specifically, it would seem that an inflation-induced increase in the real tax rate on equity income (due to GLE) would tend to decrease equity financing and would encourage a shift from equities to debt. Similarly, the presence of a tax effect (IE) which makes real taxes associated with debt interest depend on inflation might cause the equilibrium levels of debt and equity in the economy to depend on the inflation rate (although the direction of the effect is not immediately apparent). This intuitively plausible result is what emerges from the analysis below. We will begin with a highly simplified analysis which makes assumptions that are far less general than those of Sections I and II. We demonstrate that certain important properties of a zero-inflation

[17] That either τ_b or τ_c may be larger, see DeAngelo and Masulis [4]. It has been argued that companies may limit their borrowing (even if $\tau_b < \tau_c$) in order to avoid financial distress costs (for example, see Robichek and Myers [16], Kraus and Litzenberger [11], Kim [10], and DeAngelo and Masulis [4]), agency costs (see Jensen and Meckling [9] and Myers [14]), or the loss of the interest tax shelter (see Brennan and Schwartz [2]).

[18] Most debt other than bonds generates no capital gains or losses. Taxable gains and losses on bonds are on average smaller than those on equities because bond prices generally fluctuate less than equity prices, and because original issue bond discounts and premiums are usually amortized by the bondholder and reflected in the bondholder's ordinary taxable income (i.e., not reflected as a capital gain or loss).

system do not characterize a system with inflation (whether moderate or rapid). Our purpose below is not to develop a general equilibrium model which explains financial structure in any full sense; rather, it is to illustrate the basic aspects of the relationship between financial structure equilibrium and the two major tax distortions examined in this paper, GLE and IE. Later, we consider the limitations of the simplified analysis and indicate the implications of that analysis and of the Section I and Section II results for corporate financial structure in general. In the discussion we will relate the present findings to those of Miller [13] and DeAngelo and Masulis [5].

Assume transaction costless, competitive capital markets and certainty. X_t is nominal firm pretax operating cash flow (revenues minus expenses), where real pretax operating cash flow is constant over time and equal to X^* (i.e., $X_t(1 + p)^{-t} = X^* > 0$, for all t). B_t is time t nominal firm debt; borrowing is on a single-period basis and is constant over time in real terms ($B_t(1 + p)^{-t} = B_0$, for all t). All firms have constant, perpetual operating cash flows, single-period debt, and fixed real debt over time; however, firms may differ in size by a scale factor and may also differ in their debt-equity ratios. The analysis can be generalized to incorporate uncertainty and real growth, with no changes in the major conclusions.[19] V_0 and S_0 are current firm value and firm equity value, respectively ($V_0 = S_0 + B_0$). Nominal interest rate i may depend on p, but for any given p over time there is a given i over time. Capital outlays are zero (we assume the absence of profitable firm investment opportunities); there are no corporate tax shelters other than debt interest, and capital gains taxes are paid by shareholders at the end of each time period.[20] Dividend paying firms distribute dividends at the end of each period; dividends are paid because firms have no profitable investment opportunities. Companies issue no new shares. It is assumed that firms make no treasury stock purchases or that payments for treasury stock are treated, for tax purposes, as dividends; this assumption is roughly consistent with a provision in current U.S. tax law that is designed to prevent shareholders from avoiding dividend taxes through the use of stock redemptions.[21]

Let the statutory tax rates of investor z on interest income, dividends, and capital gains be signified as τ_b^z, τ_d^z, and τ_g^z, respectively, where we will assume that $0 \leq \tau_b^z < 1$, $0 \leq \tau_d^z < 1$, and $0 \leq \tau_g^z < 1$. Tax rates vary among investors but

[19] With uncertainty, a similar analysis applies except using debt and equity time-state securities. With real growth, (10) includes a term for the growth rate and (6a)–(9b) include an additional capital gains term.

[20] For gains taxes to be payable each period, it is sufficient that either (a) the time period is defined as the investor's holding period and all investors have the same fixed holding periods, or (b) the time period is defined as the tax period and the gains tax is paid whether or not the stock is sold (accrual taxation). Note that GLE exists with accrual-based as well as realization-based capital gains taxation as long as the nominal cost of the asset is used as the asset's tax basis (as is assumed here).

[21] Section 302 of the Internal Revenue Code of 1954 as Amended (see especially Section 302(b)(2)) specifies highly restrictive conditions that must be met for payments for treasury stock to be subject to capital gain rather than dividend treatment. In practice, dividends significantly exceed stock redemptions in dollar amount. It should be emphasized that the analysis of this section is *not* a solution to the multiperiod financing and dividend policy optimization problems since we are assuming no new share sales, no tax-favored treasury stock purchases, and a fixed firm capital structure over time. The objective here is only to illustrate the basic properties of GLE and IE.

are fixed over time and are independent of the inflation rate p. We assume that no firm or investor is significant enough to affect the structure of prices in the market (markets are "competitive"). It is shown in Appendix B that (a), (b), and (c) below hold *at equilibrium*:

(a) For any investor z, the real rates of return on debt and equity securities are:

$$\text{real rate of return on debt} \equiv k_b^z = (1 - \tau_b^{z*})\rho \tag{6a}$$

$$\text{real rate of return on equity} \equiv k_s^z = (1 - \tau_d^z)(1 - \tau_c^*)\rho - \tau_g^z\left[\frac{p}{1 + p}\right] \tag{6b}$$

where ρ, τ_b^{z*}, and τ_c^* are defined by (3), (4a), and (5a). Rate ρ is the *real* market interest rate. Tax rate τ_b^{z*} is the fraction of ρ paid in taxes by bondholder z, and τ_c^* is the fraction of ρ paid in corporate taxes if ρ is not paid out as debt interest (i.e., if ρ is equity income). The last term in (6b), $[\tau_g^z p/(1 + p)]$, is due to GLE. The nominal capital gain per dollar of equity investment equals p; $\tau_g^z p$ is the nominal capital gains tax on the gain; and $[\tau_g^z p/(1 + p)]$ is the real capital gains tax per dollar of equity investment.

(b) Let j signify any investor who invests in bonds but not in stock, m signify any investor who is indifferent between bonds and stock (a "marginal investor"), and w signify any investor who invests in stock but not in bonds. Using (6a) and (6b), for investors j, m, and w the following relationships hold:

Investors j (bondholders):

$$(1 - \tau_b^j) > (1 - \tau_d^j)(1 - \tau_c) + (p/i)(\tau_d^j - \tau_g^j) \tag{7a}$$

$$k_b^j > k_s^j \tag{7b}$$

Investors m (marginal investors):

$$(1 - \tau_b^m) = (1 - \tau_d^m)(1 - \tau_c) + (p/i)(\tau_d^m - \tau_g^m) \tag{8a}$$

$$k_b^m = k_s^m \tag{8b}$$

Investors w (stockholders):

$$(1 - \tau_b^w) < (1 - \tau_d^w)(1 - \tau_c) + (p/i)(\tau_d^w - \tau_g^w) \tag{9a}$$

$$k_b^w < k_s^w \tag{9b}$$

(c) The value of the firm equals[22]

$$V_0 = S_0 + B_0 = \frac{(1 - \tau_d^m)\{(1 - \tau_c)X^*(1 + p) - [(1 - \tau_c)i - p]B_0\}}{(1 - \tau_b^m)i - (1 - \tau_g^m)p} + B_0 \tag{10}$$

[22] We assume that the system is stable which, under the present assumptions, implies that $(1 - \tau_c)i - p > 0$ in (10). Using (B.3b) in Appendix B, this implies that equity price P_S is positive, from which it follows that, using (B.14), $(1 - \tau_b^m)i - (1 - \tau_g^m)p > 0$ in (10).

where[23]

$$dV_0/dB_0 = 0 \tag{11}$$

A given investor z will necessarily fall into one, but only one, of catgories j, m, or w. Each of categories j, m, and w can contain investors with differing tax rates. For example, category j includes any investor with completely tax sheltered income ($\tau_b^j = \tau_d^j = \tau_g^j = 0$, which implies (7a) for that investor if $\tau_c > 0$) or with any set of positive tax rates satisfying (7a). And investors m, who are indifferent between debt and equity, include those with any combination of personal tax rates satisfying (8a). Thus, some marginal investors m may satisfy (8a) with a nonzero $(p/i)(\tau_d^m - \tau_g^m)$ term and other marginal investors m may satisfy (8a) with $(p/i)(\tau_d^m - \tau_g^m) = 0$ (which would hold if the investor's equities were tax sheltered and $\tau_d^m = \tau_g^m$). Similar arguments apply to investors in category w.

Notice that, with no inflation ($p = 0$) *or* with no difference in dividend and capital gains tax rates for *all* investors ($\tau_d^z = \tau_g^z$ for all investors z), relations (7a), (8a), and (9a) become the equilibrium tax relationships of Miller [13] and DeAngelo and Masulis [5]. However, with both a positive inflation rate ($p > 0$) *and* a difference between the dividend and capital gains tax rates ($\tau_d^z \neq \tau_g^z$) for one or more investors in each of categories j, m, and w, the tax relationships defining bondholders, marginal investors, and stockholders ((7a), (8a), and (9a)) must each include a $(p/i)(\tau_d - \tau_g)$ term. The $(p/i)(\tau_d - \tau_g)$ term can be relatively significant even with a very moderate inflation rate (e.g., $p = 2\%$).

It is easily shown that, in (7a), (8a), and (9a), term $[(p/i)\tau_g]$ is due to GLE and term $[(p/i)\tau_d]$ is due to IE; that is, if real capital gains and real interest were used in tax computations, the zero inflation tax relationships would also hold with inflation.[24] Without IE, the real and nominal tax rates are equal both for lenders and for corporate borrowers, i.e., $\tau_b^{z*} = \tau_b^z$ in (6a) and $\tau_c^* = \tau_c$ in (6b). Without GLE, the $\tau_g^z[p/(1 + p)]$ term in (6b) disappears (since, in this illustration, all capital gains are nominal). Therefore, with neither GLE nor IE, (6a) becomes $k_b^z = (1 - \tau_b^z)\rho$, (6b) becomes $k_s^z = (1 - \tau_d^z)(1 - \tau_c)\rho$, and the $(p/i)(\tau_d - \tau_g)$ term does not appear in (7a), (8a), or (9a).

The existence of term $(p/i)(\tau_d - \tau_g)$ in Equations (7a), (8a), and (9a) (i.e., the failure of the zero-inflation relationship to hold) under present tax law should not be surprising. If real tax rates were independent of inflation (i.e., if real quantities were used in tax computations and therefore if GLE and IE were absent), we would expect (correctly) the Miller zero-inflation equilibrium tax relationship to hold even with inflation. But we should also expect that a different tax relationship will apply if real tax rates are not independent of inflation, which is the situation if nominal quantities are used in computing taxes and conse-

[23] For (11), substitute $(1 - \tau_b^m)$ of (8a) into (10) and differentiate (10) with respect to B_0. Also, see the Appendix B discussion in the paragraph following Equation (B.14).

[24] With tax basis indexing and no GLE (see footnote 5), the capital gains term in (B.6) of Appendix B (term $\tau_g^z(S_1 - S_0)/S_0$) becomes $\tau_g^z[S_1 - (1 + p)S_0]/S_0 = \tau_g^z(S_1 - S_1)/S_0 = 0$ (using (B.4)), and $(p/i)\tau_g$ terms do not appear in (7a), (8a), and (9a). Using real interest rate $(i - p)$ rather than nominal interest rate i to compute taxable income in (B.1), (B.2b), and (B.5): IE disappears (see footnote 16); $(p/i)\tau_d$ terms do not appear in (7a), (8a), and (9a); and the $(p/i)\tau_g$ terms in (7a), (8a), and (9a) become $[p/(i - p)]\tau_g$ (thus, for example, (8a) becomes $(1 - \tau_b^m) = (1 - \tau_d^m)(1 - \tau_c) - [p/(i - p)]\tau_g^m$).

quently GLE and IE are present; this different tax relationship is the one shown in Equations (7a), (8a), and (9a).

Equation (11) states that firm value is independent of the firm's debt-equity ratio regardless of p. Thus, simply introducing inflation does not make financial structure a determinant of firm value. However, although each firm's value is independent of its financial structure, (6a)–(11) imply that, because of GLE and IE, inflation can affect the aggregate levels of debt and equity in the economy. To predict the effect of inflation on aggregate debt and equity, assumptions must be made about investor tax rates and about the dollar amounts invested by the j, m, and w investors with and without inflation. From (7a), (8a), and (9a) notice that, if investor z's dividend and capital gains tax rates are equal ($\tau_d^z = \tau_g^z$), then $(p/i)(\tau_d^z - \tau_g^z) = 0$ and a $(p/i)(\tau_d - \tau_g)$ term will not appear in (7a), (8a), or (9a) for investor z. In this case, the level of (p/i) does not determine whether z prefers bonds (is in category j of (7a)), is indifferent between bonds and stock (is in category m of (8a)), or prefers stock (is in category w of (9a)). It follows that inflation can affect an investor's preference for bonds and stocks only if the investor's dividend and capital gains tax rates are not equal. We will assume below that, in (6a)–(11), each investor's dividend tax rate equals or exceeds the investor's capital gains tax rate, and that the dividend tax rate exceeds the capital gains tax rate for at least some investors. This tax rate assumption would be consistent with the existence of some investors who utilize tax shelters (e.g., IRAs, Keogh Plans, and other pension plans) under which dividend and capital gains tax rates are equal, and other, unsheltered investors for whom dividends are more heavily taxed than are capital gains. It follows from (7a), (8a), and (9a) that:

(a) For any investor with equal dividend and capital gains tax rates ($\tau_d^z = \tau_g^z$), the preference for stock and bonds will be unaffected by inflation rate p (see above discussion).

(b) For any investor with a dividend tax rate that exceeds the capital gains tax rate ($\tau_d^z > \tau_g^z$):[25]
- —Investors who are in category j (prefer debt), if $p = 0$, will either continue to prefer debt, will be indifferent between debt and stock, or will prefer stock if $p > 0$; the number of these investors preferring stock increases as (p/i) increases;
- —Investors who are in category m (are indifferent between debt and equity), if $p = 0$, will prefer stock for all $p > 0$; and
- —Investors who are in category w (prefer stock), if $p = 0$, will also prefer stock for all $p > 0$.

The above results hold that changes in p or i will not affect the preference for stock and bonds of any investor whose dividend and capital gains tax rates are

[25] Note that, for investors with $(\tau_d^z - \tau_g^z) > 0$, a rise in (p/i) will cause the right-hand side of (7a), (8a), and (9a) to increase. Therefore, tax rates satisfying (7a) when $(p/i) = \gamma$ (any γ) may not satisfy (7a) when $(p/i) > \gamma$; that is, some or all investors who are in category j (i.e., prefer debt) when $(p/i) = \gamma$ may be in category m (be indifferent) or in category w (prefer stock) when $(p/i) > \gamma$. Similarly, any tax rates satisfying (8a) when $(p/i) = \gamma$ will satisfy (9a) when $(p/i) > \gamma$; and any tax rates satisfying (9a) when $(p/i) = \gamma$ will also satisfy (9a) for all $(p/i) > \gamma$.

equal ($\tau_d^z = \tau_g^z$); but the preferences of investors with $\tau_d^z > \tau_g^z$ may be affected, with some or all such investors shifting from debt to equity—and none shifting from equity to debt—as (p/i) increases. A rise in (p/i) (e.g., due to an increase in p from $p = 0$ to $p > 0$) will consequently cause an increase in equity relative to debt in the economy unless the rise in (p/i) causes a sufficiently large increase in the average amount invested by those who are debt-holders at the new higher (p/i) relative to the average amount invested by those who are equity-holders at the new (p/i). Changes in the amount invested by a particular investor (bondholder or shareholder) due to variations in (p/i) will in part depend on the investor's reaction to any associated changes in the real after-tax rates of return on debt and equities. Of course, if the savings rates of debt-holders and equity-holders are, on average, similarly related to (p/i), aggregate equity will increase relative to aggregate debt as (p/i) increases.

The above conclusions can also be derived by examining the effect of changes in (p/i) on the real rates of return earned by investors on debt and equity securities. Using real debt rate k_b^z of (6a) and real equity rate k_s^z of (6b), it is easily shown that a rise in (p/i) causes some or all bondholders and all marginal investors to prefer stock (because the rise in (p/i) reduces (k_b^z/k_s^z) to below unity) and causes no investors to switch from stock to bonds.[26]

A similar analysis applies if we relax the assumption that the dividend tax rate equals or exceeds the capital gains tax rate for every investor. Depending on the tax rate assumptions made, it can be shown that an increase in (p/i) will cause, for the economy as a whole, an increase in the number of stockholders relative to the number of bondholders (the case examined above), an increase in the number of bondholders relative to the number of stockholders, or no predictable effect (without further information) on the relative numbers of debt and equity investors.[27]

The results presented above follow from the analysis in Appendix B. With sufficiently differing tax rates among investors (specifically, with investors satisfying each of (7a), (8a), and (9a)), equilibrium requires the existence of both debt and equity securities in the economy. For any particular i and p equilibrium

[26] Using (6a) and (6b) and the definitions of τ_b^{z*}, τ_c^*, and ρ in (3), (4a) and (5a):

$$\frac{k_b^z}{k_s^z} = \frac{(1 - \tau_b^z) - (p/i)}{(1 - \tau_d^z)(1 - \tau_c) + (\tau_d^z - \tau_g^z)(p/i) - (p/i)} \tag{a}$$

where $(k_b^z/k_s^z) > 1$ for those who prefer bonds (category j), $(k_b^z/k_s^z) = 1$ for those who are indifferent between debt and equity (category m), and $(k_b^z/k_s^z) < 1$ for those who prefer stock (category w). For investors with $\tau_d^z = \tau_g^z$, using (a), $(k_b^z/k_s^z) \gtreqless 1$ as $(1 - \tau_b^z) \gtreqless (1 - \tau_d^z)(1 - \tau_c)$, and (p/i) does not affect the investor's preference for stocks and bonds. For investors with $\tau_d^z > \tau_g^z$, a rise in (p/i) lowers (k_b^z/k_s^z) for all investors in category j who are close to the margin (these investors therefore enter category m or category w), all investors in category m (these investors shift to category w), and all investors in category w (these investors remain in category w). This is the same as the result in footnote 25.

[27] If the capital gains tax rate exceeds the dividend tax rate for all investors, the $(p/i)(\tau_d - \tau_g)$ terms in (7a), (8a), and (9a) are negative. Using arguments similar to those in footnote 25, a rise in (p/i) lowers the right-hand sides of (7a), (8a), and (9a), causing some investors to shift, from stock to bonds and none from bonds to stock. If, however, we assume that $\tau_d > \tau_g$ for some investors but $\tau_d < \tau_g$ for other investors, a rise in (p/i) may encourage some investors to shift from debt to stock and encourage other investors to shift from stock to debt, with no predictable net effect (without further information) on the economy as a whole.

implies a particular price for equity streams (P_S of Appendix B, Equation (B.11)), and implies, for each investor, the real debt rate of return k_b^z of Equation (6a) and the real equity rate of return k_s^z of Equation (6b). A movement from one equilibrium to another which involves a change in (p/i) will also involve changes in k_b^z and k_s^z for any investor z for whom $\tau_d^z \neq \tau_g^z$. The consequences for investor z's equilibrium holdings of debt and equity securities were described above.

As noted earlier, the assumptions made in the above equilibrium analysis were very restrictive and only the most basic issues were addressed. The important implications were that, even in the simplest case, there are significant differences between the zero-inflation and inflationary equilibria, and that GLE and IE are major determinants of those differences. The analysis could be extended to incorporate many additional factors including: asset holding periods that differ among investors; investor strategies other than lending and buying and selling stock, for example, buying stock and borrowing against the stock or utilizing complex personal tax shelters; corporate noninterest tax shelters, such as depreciation and the investment tax credit; noninterest borrowing costs (e.g., financial distress costs and agency costs); inflation-induced changes in corporate dividend and investment policies and in the real returns earned on business assets; and inflation-induced changes in government policies. Introducing these factors using an uncertainty model would undoubtedly produce additional, and empirically relevant, insights.

It should be pointed out that GLE and IE and all the other findings of Sections I and II were derived under highly general assumptions and should apply in a context involving the complicating factors just noted above. Sections I and II and even the simplified analysis of this section have implications for corporate capital structure and equilibrium tax relationships in general. The inflationary equilibrium tax relationships of any realistic model of financial market equilibrium will almost certainly include terms reflecting GLE and IE. The actual magnitudes of capital gains and debt interest suggest that GLE and IE are empirically significant.[28] Notice from (1b), however, that for any particular τ_{gt} the sign of the change in τ_{gt}^* due to an increase in p also depends on simultaneous changes in r and t. The effects of inflation on capital gains taxes are therefore likely to be more complex than as shown in (6a)–(11). Furthermore, in general, IE may promote higher or lower average debt-equity ratios depending on the changes in p and i and on the relative magnitudes of borrower and lender tax rates.

IV. Summary

There is a common element among virtually all inflation-induced tax distortions; dollar quantities which are used in computing period t taxable income are not stated in time t dollars. Each of these quantities takes the form of: (i) a tax deduction, (ii) taxable income, or (iii) both a tax deduction and taxable income. Examples of (i) are the dividend exclusion, tax bases of assets, depreciation, costs

[28] In 1978, personal taxable income in the United States included over $61 billion in interest and over $26 billion in capital gains (see [18]).

of inventories, and contributed equity capital used to determine the nontaxable portion of a dividend. There are no significant examples of (ii) under U.S. tax law. The primary example of (iii) is debt principal payments. Principal is not restated in current dollars and consequently part of the repayment of *real* principal is taxable to the lender as interest income and is deductible for the borrower as interest expense. An increase in the inflation rate produces, for taxpayers in the aggregate, greater real taxes through type (i) items (since the real value of the tax deductions falls), reduced real taxes through type (ii) items, and a net increase or a net decrease in real taxes through type (iii) items (the net effect depending on the relative tax rates of those for whom the type (iii) items are tax deductions and those for whom the items are taxable income). The present paper examined two type (i) items and one type (iii) item—the tax bases of assets used in computing taxable gains and losses, the dividend exclusion, and debt principal payments.

In Section I, it was found that, because nominal and not real capital gains are used in tax computations, the real capital gains tax rate (percentage of real gains paid in taxes) depends on inflation rate p, the investor's holding period, and the real pretax rate of return on the asset, as well as on the statutory capital gains tax rate. *Ceteris paribus*, an increase in p raises real taxes on capital gains and reduces real tax benefits from capital losses. Similarly, with a fixed nominal dividend exclusion, a greater p implies a greater real dividend tax rate on any given real dividend stream. Even if the real capital gains tax rate exceeds the real dividend tax rate, shareholders ordinarily lose if the firm reduces capital gains by paying added dividends financed by new shares. With capital gains taxation on a realization basis, shareholder unanimity may be absent and any particular shareholder's ranking of alternative firm policies may depend on p even if the real share price associated with each policy is independent of p (i.e., even if the inflation is "neutral"); with accrual-based capital gains taxation, shareholders unanimously prefer the policy that maximizes current share price, and policy rankings are independent of a neutral inflation.

In Section II, we found that the use of nominal rather than real principal and interest in tax computations causes the real tax rate on interest income and the real interest tax savings of the borrower to depend both on the nominal interest rate and the inflation rate. In Section III, we used the terms "Gain and Loss Effect" (GLE) and "Interest Effect" (IE) to refer to the tax distortions introduced by using nominal rather than real gains and losses and by using nominal rather than real interest in tax computations. Because of GLE and IE, equilibrium tax relationships with inflation differ from those which obtain when inflation is absent. Under simplifying assumptions, IE will encourage less borrowing in the economy and will dominate GLE (which motivates more borrowing by increasing equity taxes), the net impact being an inflation-induced tax incentive to decrease debt relative to equity. However, in general (i.e., assuming no constraints on tax rates, on changes in real pretax returns on assets caused by inflation, on noninterest debt costs, etc.), the effects of GLE and IE are more complex and their net impact may be to increase or decrease the average level of corporate debt-equity ratios.

Appendix A

Dividends and New Share Sales

Assuming transaction costless and competitive capital markets with homogeneous expectations, we will derive and briefly discuss necessary conditions for a particular shareholder to perceive a benefit from additional time 0 dividends *that are financed by new share sales.*

Assume that investor w bought shares at time c, $c < 0$, for total amount Q_c. At time 0 the firm will pay to w total dividends of d_0 on those shares. Consider two alternatives: (i) at time 0 the firm sells new shares and pays out the proceeds as dividends, producing *added* dividends to w of Δd_0; (ii) instead of (i), at time 0 w sells shares worth Δd_0, where the original time c cost of *those* shares was Q'_c (a part of Q_c). (i) and (ii) equally reduce w's ownership interest. For w to perceive a gain from the firm's adopting (i), w must prefer (i) to (ii) (since w can elect to do (ii)). Note that

$$\frac{\Delta d_0}{Q'_c} = \frac{v_0}{v_c} \tag{A.1}$$

where v_0 is the time 0 price per share under (ii) and v_c is the time c price per share. Investor w's statutory tax rates on all marginal dividends and capital gains considered in the analysis are τ_{dt} and τ_{gt}, respectively. The time 0 after-tax cash flows to w under (i) and (ii) are:[29]

$$\text{time 0 cash flow under (i)} = (1 - \tau_{d0})(d_0 + \Delta d_0) \tag{A.2a}$$

$$\text{time 0 cash flow under (ii)} = (1 - \tau_{d0})d_0 + \Delta d_0 - \tau_{g0}(\Delta d_0 - Q'_c) \tag{A.2b}$$

Assume that, at time $h > 0$, w will sell all shares remaining after (i) or (ii).[30] The sale proceeds will be the same with (i) and (ii) since they both imply the same remaining fractional ownership of the firm's equity. Thus, using $E[\ ]$ to signify the expected value operator,

$$\begin{matrix}\text{expected time } h \text{ cash} \\ \text{flow under (i)}\end{matrix} = E[\text{proceeds} - \tau_{gh}(\text{proceeds} - Q_c)] \tag{A.3a}$$

$$\begin{matrix}\text{expected time } h \text{ cash} \\ \text{flow under (ii)}\end{matrix} = E[\text{proceeds} - \tau_{gh}(\text{proceeds} - [Q_c - Q'_c])] \tag{A.3b}$$

(i) is preferred to (ii) if (A.2a) plus the present value of (A.3a) exceeds (A.2b) plus the present value of (A.3b); that is, if

$$-\tau_{d0}\Delta d_0 + \tau_{g0}\Delta d_0 - \tau_{g0}Q'_c + \frac{E[\tau_{gh}]Q'_c}{(1 + k)^h} > 0 \tag{A.4}$$

[29] If $(v_0 < v_c)$, then τ_{g0} in the equations below is the time 0 dollar tax savings per dollar of realized loss on any shares w sells at time 0.

[30] We assume that h is known, but τ_{gh} is unknown at time 0. With unknown h, a more complex relationship holds, but with similar policy implications.

where k is the nominal discount rate. Dividing (A.4) by Q'_c, using (A.1) and rearranging terms, it follows that

$$E[\tau_{gh}] > (1 + k)^h\{1 + [(\tau_{d0}/\tau_{g0}) - 1][v_0/v_c]\}\tau_{g0} \tag{A.5}$$

(A.5) is a necessary condition for w to perceive a benefit from dividends financed by new shares. (A.5) does *not* apply if dividends are financed from sources other than new share proceeds. Thus, even if (A.5) were violated, w might prefer that the firm pay dividends if the firm has poor investment opportunities and is not issuing new shares.[31]

(A.5) is defined in terms of statutory rather than real tax rates because an increase in dividends financed by new shares involves marginal changes in taxes at times 0 and h which directly depend on the statutory tax rates at times 0 and h. (A.5) can fail even if $\tau^*_{dt} < \tau^*_{gt}$.[32] (A.5) is unlikely to hold since, in most cases, $\tau_{d0} \geq \tau_{g0}$ for marginal dividends and $(v_0/v_c) > 1$, implying that $\{1 + [(\tau_{d0}/\tau_{g0}) - 1][v_0/v_c]\} \geq 1$ in (A.5); under these conditions, (A.5) holds only if τ_{gt} is growing over time at a rate exceeding k. Whether (A.5) is satisfied will depend on inflation since inflation affects k, h, and the tax terms in (A.5). It is easily shown that, under plausible assumptions, if $\tau_{g0} \leq \tau_{d0}$, there exists an inflation rate p' such that, for all $p > p'$, (A.5) is violated.[33] Opposite arguments hold if $\tau_{g0} > \tau_{d0}$.[34]

Appendix B

Derivation of Text Relations (6a)–(11)

The assumptions and terms described at the beginning of Section III are used below. Time t nominal firm dividends equal

$$\begin{aligned} D_t &= X_t - \tau_c(X_t - iB_{t-1}) - (1 + i)B_{t-1} + B_t \\ &= (1 + p)^t\{(1 - \tau_c)X^* - [(1 - \tau_c)i - p][1 + p]^{-1}B_0\} \equiv (1 + p)^t D^* \end{aligned} \tag{B.1}$$

[31] Another (i.e., in addition to (A.5)) necessary condition for (i) to produce benefits follows from comparing (i) with a time 0 share sale by w which provides w with the same after-tax time 0 cash flow as does (i). The resulting condition is, like (A.5), not generally satisfied.

[32] For example, let $p = 20\%$, $r = 5\%$ (real rate of share price increase per period), $k = 25\%$, $\tau_{g0} = E[\tau_{gh}] = 20\%$, $\tau_{dt} = \tau^*_{dt} = 50\%$ for all t, and $c = -1$ (shares were purchased by w one period ago). Under these assumptions, $(v_0/v_c) = 1.26$ and (A.5) is violated. Using (1b) in the text, $\tau^*_{g0} = 0.867$ and $\tau^*_{g1} = 0.796$, both of which exceed τ^*_{dt}, where τ^*_{g0} is the real capital gains tax rate if w sells shares at time 0 ($t = 1$ in (1b)) and τ^*_{g1} is the real capital gains tax rate if w sells shares at time 1 ($t = 2$ in (1b)).

[33] We assume that statutory capital gain tax rates cannot exceed 100% (therefore, $E[\tau_{gh}] \leq 1.0$) and that there exists a sufficiently high inflation rate p' such that nominal market interest rate k satisfies $(1 + k)^h > [1/\tau_{g0}]$ for all $p > p'$. Let $[(\tau_{d0}/\tau_{g0}) - 1] \equiv \alpha$; the right-hand side of relation (A.5) becomes $(1 + k)^h\tau_{g0} + (1 + k)^h\alpha(v_0/v_c)\tau_{g0}$. If $\tau_{g0} \leq \tau_{d0}$, then $\alpha \geq 0$, and given the assumptions it follows that, for all $p > p'$, the right-hand side of (A.5) $= (1 + k)^h\tau_{g0} + (1 + k)^h\alpha(v_0/v_c)\tau_{g0} > 1 + (1 + k)^h\alpha(v_0/v_c)\tau_{g0} \geq 1 \geq E[\tau_{gh}]$ = the left-hand side of (A.5); this violates (A.5).

[34] If $\tau_{g0} > \tau_{d0}$ and there is a p' such that $(v_0/v_c) > |\alpha|^{-1}$ for all $p > p'$, where $[(\tau_{d0}/\tau_{g0}) - 1] \equiv \alpha$, then relation (A.5) is satisfied for all $p > p'$; this follows using arguments similar to those in footnote 33.

D^* is the number of real dollars of firm dividends per period. Define P_S as the time 0 market price of a dividend stream of one real dollar per period, and define V_0, S_0, and B_0 as the time 0 market values of the firm, of the firm's stock, and of the firm's bonds, respectively. Using D^* of (B.1)

$$V_0 = S_0 + B_0 = P_S D^* + B_0 \tag{B.2a}$$

$$= P_S\{(1 - \tau_c)X^* - [(1 - \tau_c)i - p][1 + p]^{-1}B_0\} + B_0 \tag{B.2b}$$

At time 0, the firm will set B_0 so as to maximize V_0, i.e., such that $(\partial V_0/\partial B_0) = 0$.[35] Using (B.2b), $(\partial V_0/\partial B_0) = 1 - P_S[(1 - \tau_c)i - p][1 + p]^{-1}$; therefore, $(\partial V_0/\partial B_0) \gtreqless 0$ as $(1 + p) \gtreqless P_S[(1 - \tau_c)i - p]$. Since the firm will be all debt, all equity, or indifferent between debt and equity as $(\partial V_0/\partial B_0)$ exceeds, is less than, or is equal to zero, it follows that:[36]

Firm is all debt if	$(1 + p) > P_S[(1 - \tau_c)i - p]$	(B.3a)
Firm is indifferent between debt and equity if	$(1 + p) = P_S[(1 - \tau_c)i - p]$	(B.3b)
Firm is all equity if	$(1 + p) < P_S[(1 - \tau_c)i - p]$	(B.3c)

Since all firms have level operating flows, single-period debt, etc., (B.3a)–(B.3c) apply to all firms. Given the assumption that the economy (i.e., i, tax structure, etc.) is static and that firm X^* and capital structure are fixed over time, $S_t = (1 + p)^t S_0$. Using $S_0 = P_S D^*$ in (B.2a),

$$S_1 = (1 + p)S_0 = (1 + p)P_S D^* \tag{B.4}$$

A dollar invested in a bond at time 0 provides a time 1 real after-tax return to investor z of (expressed as a number of time 0 dollars)

$$\text{real bond return to } z = (1 + i - i\tau_b^z)(1 + p)^{-1} \tag{B.5}$$

A dollar invested in the firm's stock at time 0 provides z with a fraction $(1/S_0)$ $(= 1/(P_S D^*)$ by (B.2a)) of the firm's time 1 dividends and time 1 share value (net of capital gains taxes); using (B.4) and $D_1 = (1 + p)D^*$ from (B.1), the real after-tax time 1 return to z per dollar of stock investment equals:

$$\text{real stock return to } z = \frac{(1 - \tau_d^z)(D_1/S_0) + (S_1/S_0) - \tau_g^z[(S_1 - S_0)/S_0]}{1 + p}$$

$$= \frac{(1 + p)(1 - \tau_d^z) + (1 + p)P_S - p\tau_g^z P_S}{(1 + p)P_S} \tag{B.6}$$

It follows that:

[35] In the present analysis, various alternative assumptions are sufficient for the firm to adopt, at time 0, the financial structure that maximizes V_0. For example, assuming (a) or (b) of footnote 20 and that firms are established at time 0 and their financial structures set at time 0, the V_0 maximizing financial structure will maximize shareholder wealth and will be unanimously preferred by shareholders at time 0.

[36] See footnote 37 on the corporate tax assumptions made here.

z demands only debt if	(B.5) > (B.6)	(B.7a)
z is indifferent between debt and equity if	(B.5) = (B.6)	(B.7b)
z demands only equity if	(B.5) < (B.6)	(B.7c)

Assume investors of types j, m, and w who have tax rates satisfying:

$$(1-\tau_b^j) > (1-\tau_c)(1-\tau_d^j) + (p/i)(\tau_d^j - \tau_g^j) \quad \text{(B.8a)}$$

$$(1-\tau_b^m) = (1-\tau_c)(1-\tau_d^m) + (p/i)(\tau_d^m - \tau_g^m) \quad \text{(B.8b)}$$

$$(1-\tau_b^w) < (1-\tau_c)(1-\tau_d^w) + (p/i)(\tau_d^w - \tau_g^w) \quad \text{(B.8c)}$$

To show that (B.3b) holds at equilibrium, assume (B.3a). (B.3a) implies $\{[(1+p)/P_S] + p\}/i > (1-\tau_c)$; using (B.8c), it follows that

$$(1-\tau_b^w) < \left[\frac{[(1+p)/P_S] + p}{i}\right](1-\tau_d^w) + (p/i)(\tau_d^w - \tau_g^w) \quad \text{(B.9)}$$

Multiply (B.9) by i; add 1 to both sides of (B.9); divide through by $(1+p)$; on the right-hand side of (B.9), multiply terms by (P_S/P_S) or $(1+p)/(1+p)$ so that the right-hand side of (B.9) is an expression with denominator $P_S(1+p)$. (B.9) becomes:

$$\frac{1+i-i\tau_b^w}{1+p} < \frac{(1+p)(1-\tau_d^w) + (1+p)P_S - p\tau_g^w P_S}{(1+p)P_S} \quad \text{(B.10)}$$

Using (B.5) and (B.6), (B.10) implies that (B.5) < (B.6) for $z = w$, which by (B.7c) implies that w would pay a premium above the market price P_S for shares; but, (B.3a), which was assumed, means that firms issue only debt. Thus, (B.3a) implies disequilibrium. By similar arguments (using (B.8b)), given (B.3a), investors m are also willing to pay more than P_S for equities even though no equities are supplied, which implies disequilibrium. Now assume (B.3c). Only equities are supplied even though investors j and m demand debt and would pay a premium above the market price for debt; this implies disequilibrium. Equilibrium requires (B.3b); with (B.3b) firms supply both debt and equity. Since (B.3b) holds at equilibrium, equilibrium implies that:

$$P_S = \frac{1+p}{(1-\tau_c)i - p} \quad \text{(B.11)}$$

We now show that:

(i) Categorizing investors as j, m, and w using (B.8a)–(B.8c) (or, equivalently, using text relations (7a), (8a), and (9a)), at equilibrium investors j hold only bonds, investors m are indifferent between bonds and stock, and investors w hold only stock; and, therefore, using equilibrium rates k_b^z and k_s^z (of Equations (6a) and (6b)), $k_b^j > k_s^j$, $k_b^m = k_s^m$, and $k_b^w < k_s^w$.
(ii) At equilibrium, firm value V_0 satisfies Equation (10).
(iii) At equilibrium, V_0 is independent of B_0 (Equation (11)).

For (i), assume equilibrium, which implies (B.11). Eliminate P_S in (B.6) using (B.11). It follows that, for j (i.e., using (B.8a)), (B.7a) holds and j owns only bonds; for m (using (B.8b)), (B.7b) holds and m is indifferent between bonds and stock; and for w (using (B.8c)), (B.7c) holds and w owns only stock. Now note that k_b^z and k_s^z (of (6a) and (6b)) are investor z's equilibrium real rates of return on bonds and stock since, using ρ, τ_b^{j*}, and τ_c^* of Equations (3)–(5b),

$$k_b^z = \frac{(\text{B.5}) - 1}{1} = \frac{(1 - \tau_b^z)i - p}{1 + p} \tag{B.12a}$$

$$= (1 - \tau_b^{z*})\rho \tag{B.12b}$$

and, first eliminating P_S in (B.6) using equilibrium relationship (B.11) and then substituting the resulting (B.6) into the equation below,

$$k_s^z = \frac{(\text{B.6}) - 1}{1} = \frac{(1 - \tau_d^z)(1 - \tau_c)i + p\tau_d^z - p\tau_g^z - p}{1 + p} \tag{B.13a}$$

$$= (1 - \tau_d^z)(1 - \tau_c^*)\rho - \left[\frac{p}{1 + p}\right]\tau_g^z \tag{B.13b}$$

Using (B.12a) and (B.13a), it follows that: given (B.8a) of j, $k_b^j > k_s^j$; given (B.8b) of m, $k_b^m = k_s^m$, and given (B.8c) of w, $k_b^w < k_s^w$.

For (ii), solve (B.8b) for $(1 - \tau_c)$ and substitute into (B.11):

$$P_S = \frac{(1 - \tau_d^m)(1 + p)}{(1 - \tau_b^m)i - (1 - \tau_g^m)p} \tag{B.14}$$

Substitute (B.14) into (B.2b) and Equation (10) follows.

For (iii), note that, with transaction costless, competitive markets, changes in a firm's B_0 are too small to affect i, p, P_S, or any tax term in (B.2b), (B.3b), (B.11), or (B.14); thus, with a given X^*, differentiating (B.2b), $(dV_0/dB_0) = -P_S[(1 - \tau_c)i - p][1 + p]^{-1} + 1 = 0$, where P_S is in (B.11).[37]

[37] The analysis in this appendix has made the following assumption. (a) Negative period t taxable income ($[X_t - iB_{t-1}] < 0$) results in an inflow to the firm of $\tau_c[X_t - iB_{t-1}]$ in the form of a government tax rebate or proceeds from selling the tax-loss in the market. Let $[(1 + p)X^*/i] \equiv B'_0$, where $B_0 = B'_0$ if taxable income $[X_t - iB_{t-1}] = 0$ for all t (since $X_t = X^*(1 + p)^t$ and $B_{t-1} = B_0(1 + p)^{t-1}$). It is easily shown that (B.3b) holds at equilibrium if assumption (a) is dropped and instead we assume the following. (b) There are no tax-loss sales, and the corporate tax is $\tau_c[X_t - iB_{t-1}]$ if $[X_t - iB_{t-1}] > 0$ and is zero if $[X_t - iB_{t-1}] \leq 0$. (c) If $B_0 = B'_0$ held for every firm (where B'_0 for a particular firm will depend on the firm's X^*), the supply of stock in the market would be so small that investors w (investors satisfying (B.8c)) would pay, for stock, a price P_S which makes $\{1 - P_S[(1 - \tau_c)i - p](1 + p)^{-1}\} \equiv \alpha \leq 0$, where, given assumption (b), $(\partial V_0/\partial B_0) = \alpha$ if $B_0 < B'_0$ and $(\partial V_0/\partial B_0) = \{1 - P_S(i - p)(1 + p)^{-1}\} \equiv \beta$ if $B_0 \geq B'_0 (\alpha \geq \beta$ as $\tau_c \geq 0)$. With assumptions (b) and (c), at equilibrium, $\alpha = 0$ (implying (B.3b)) and $B_0 \leq B'_0$ for each firm, with the value of a firm the same for any B_0 in the range $0 \leq B_0 \leq B'_0$. Since $\alpha = 0$, $\beta \leq 0$ ($\beta < 0$ if $\tau_c > 0$). $\alpha > 0$ is inconsistent with equilibrium because, with $\alpha > 0$, every firm will attempt to set its debt at least at its B'_0, making $\alpha \leq 0$ (by assumption (c)). $\alpha < 0$ is inconsistent with equilibrium by the arguments in the discussion following (B.8c).

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